Final Report

DEVELOPMENT OF A STATEWIDE MODEL FOR HEAVY TRUCK FREIGHT MOVEMENT ON EXTERNAL ROAD NETWORKS CONNECTING WITH FLORIDA PORTS, PHASE II

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16. Abstract

Investigation of several Florida Ports has provided critical information for generating heavy truck trips based on computer models developed by applying Artificial Neural Networks (ANN) and utilizing vessel freight cargo data. 1026 days of truck counts from the field were collected to calibrate and validate the developed computer models. Over nine years of vessel data were analyzed. The computer models developed have the ability to accurately produce truck volumes for the identified port access roads. The models perform with a range of 88% to 95% accuracy, depending on the port model. The ports with available historical vessel records provided adequate data for building forecasting models using the time series approach. These forecasting models predicted vessel freight cargo data that was used as input into the developed ANN port truck trip generation models. These models subsequently output corresponding truck volumes for years 2001 through 2005. With 2000 as the base year, by the year 2005, the Port of Palm Beach was forecasted to have an 86% average increase in daily heavy trucks, the Port of Everglades was forecasted to have a 31% average increase in daily heavy trucks, and the Port of Tampa was forecasted to have a slight 3% decrease in average daily truck traffic.

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DISCLAIMER

The opinions, findings and conclusions in this publication are those of the authors and not necessarily those of the Florida Department of Transportation of the US Department of Transportation. This report does not constitute a standard specification, or regulation. This report is prepared in cooperation with the State of Florida Department of Transportation.

EXECUTIVE SUMMARY

Ports are special generators of trucks and therefore are an important part of planning the infrastructure of the area around the ports to accommodate the high percentage of trucks generated by the need to move freight in and out of these ports. Any urban planning model must consider this special generator for application of the model to be precise and the results acceptable. The percentage of trucks is usually a minimum of 5 to 10 percent higher on the roads surrounding the port area that can be directly attributed to the operations of the port.

In order to accurately identify the number of trucks on the roads entering and leaving the port area, some independent variables must be identified to use as measurement tools. Previous studies of port activity use the measure of the freight imported and exported at the port. This measure is by the units of commodity type. The measurements most commonly used are tonnage (tons or short tons (ST)), barrels (BBL), measured board feet (MBFT, MBF) and each (for containers or individual units like automobiles). After examination of the available vessel data, the independent variables were chosen primarily to be the units of measure for the commodities. The commodities were classified by tons, barrels, or each. The other independent variables were found to be day of the week. Sample truck counts indicated a difference between weekdays and weekends.

The choice of models was considered carefully because of the dynamic nature and inherent variability of freight transportation by independent carriers. It was desired to have a model that would be flexible with the freight and would recognize variations in the patterns of the freight movements. For these reasons, Artificial Neural Networks (ANN) was chosen as the most appropriate approach. ANN models are more precise

than ordinary regression models because of multiple combinations of calculations. Unlike ordinary regression models, ANN models will continuously process the sample input data until the desired results are achieved. ANN models are more intelligent because they learn by using sample input data to determine the most appropriate parameters necessary for the desired model structure. This modeling also accommodates for variability in the data that would otherwise be unrecognizable by conventional modeling techniques. Sample data collected at the ports was used to train the model and test the results of the model using the parameters concluded to be most appropriate based on consecutive runs completed until satisfactory results were obtained.

The ANN model developed for modeling the truck movements in and out of the port provided accurate results at the 95% confidence level. This modeling process has been applied to several ports in the state of Florida including the Ports of Palm Beach, Everglades, Tampa, and Jacksonville. The computer models developed have the ability to accurately produce truck volumes for the identified port access roads with a range of 88% to 95% accuracy, depending on the port model. The vessel data provided the necessary input to the model for determining the number of truck in and out of the port on a daily basis. This model was used to forecast the increase or decrease in movements around the port using forecasted import and export freight totals at the ports.

Time series was applied to the historical vessel data provided by the port authorities of Palm Beach, Everglades, and Tampa. Forecasting models for each of these ports were developed to predict future values of the vessel data. These predicted records were used as input into the developed ANN truck trip generation models to produce output values. These output values were estimations of future truck volumes on the access roads to each of the ports. These models subsequently output corresponding truck volumes for years 2001 through 2005. With 2000 as the base year, by the year 2005, the Port of Palm Beach was forecasted to have an 86% average increase in daily heavy trucks, the Port of Everglades was forecasted to have a 31% average increase in daily heavy trucks, and the Port of Tampa was forecasted to have a slight 3% decrease in average daily truck traffic.

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CHAPTER 1

INTRODUCTION

Freight transportation plays a critical role in the health and vibrancy of the US economy. As the economy grows more, more freight is transported all over the country. This puts a demand on the services provided for efficient movement of freight by different modes. Throughout this report emphasis will be on freight movement by truck and rail in the state of Florida.

According to Commodity Flow Survey in 1993(1), freight weighing 346 million tons valued $ 172 billion originated from the state of Florida and was transported all over United States. Excluding shipments carried by multiple modes and some unknown modes, truck carried 77.3 % and rail 2.9 % of freight. Over the years, freight transportation industry in Florida has evolved to serve a changing and growing economy.

In the year 1997, the Commodity Flow Survey (2) measured 397 million tons of freight transported from the state of Florida. The freight hauled was estimated to cost about $ 214 billion. Among the various modes truck still carried major portion of freight. According to Commodity Flow Survey done in 1997, Truck carried 71% of freight originating from Florida. This high percentage of transportation share to trucks can be attributed to its complete door-to-door service. Trucks have been most successful in attracting shipments of high values and low bulk commodities.

Florida stands at fifth position in the maximum tonnage handled through out the year in 1999 (3). Figure 1.1 shows the tonnage for the top five states.

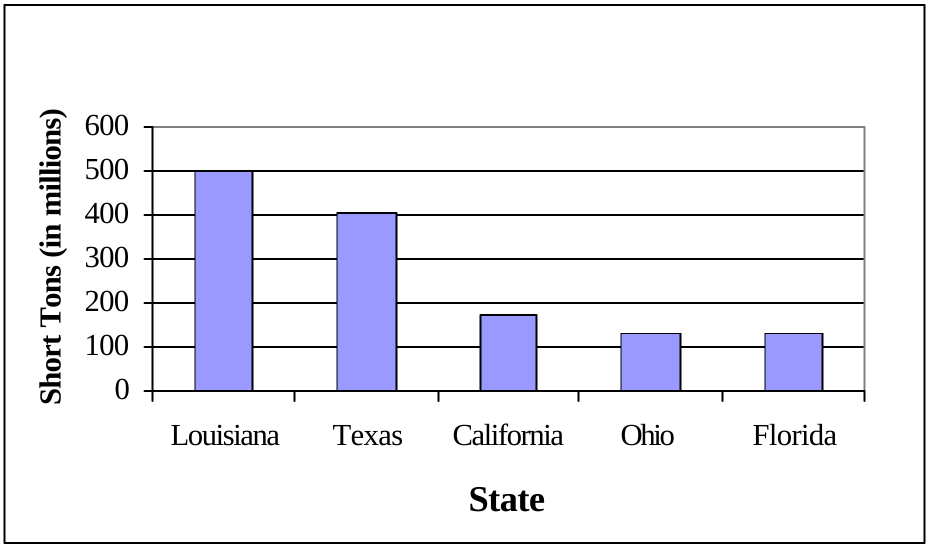


Figure 1.1: U.S. Waterborne Traffic by States in 1999
(Source: http://www.wrsc.usace.army.mil/ndc/fcstate.htm (3))

Economic projections indicate that the trading activity in Florida will continue to accelerate and require expansion and more efficiency of the port's operations. Forecasts in the near future indicate an increase in the total trade performance for the state of Florida. Fig 1.2 shows 1997 compared to the forecast for the year 2005.

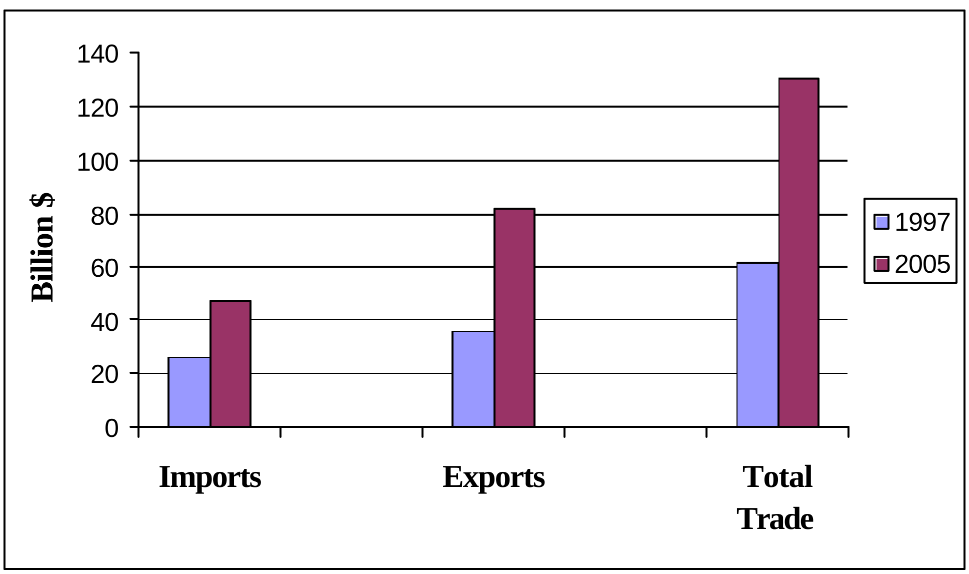


Figure 1.2 Forecasts of Florida's Trade Performance
(Source: Florida Trade Data Center- Washington Economics Group (4))

Seaports have been playing a significant role in generating truck and rail traffic. With the projected growth at almost all the ports, there are concerns if the present transportation infrastructure is sufficient for accommodating this growth in traffic.

There has been a considerable amount of increase in vehicle-miles traveled for each mode over the past several years. Figure 1.3 indicates a steady increase in truck activity over the last 30 years.

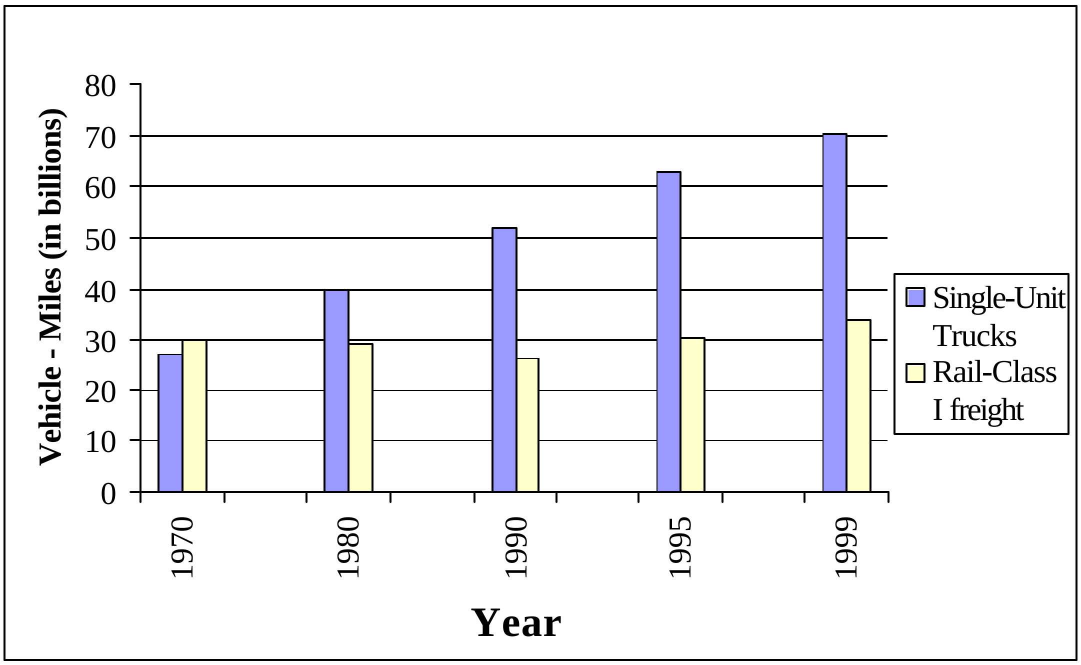


Figure 1.3: Vehicle-Miles for Truck and Rail
(Source: Pocket guide to transportation, Bureau of Transportation Statistics. (5))

In 1998, the Florida Department of Transportation sponsored the University of Central Florida's Transportation Systems Institute (UCF-TSI) to examine freight traffic at the State's major seaports. The Port of Miami was selected for the first phase of this sponsored research.

Port of Miami is the largest container port in Florida and among the top 10 in the United States. The port witnessed cargo movements of 7.8 million tons with 3.3 million exported tons and 4.4 million imported tons in fiscal year 2000. The number of TEU's (Twenty Equivalent Units, used for containerized cargo measurement) was 868,178, a 12% increase from the fiscal year 1999. Figure 1.4 shows the increase in cargo tonnage over the last 10 years (6).

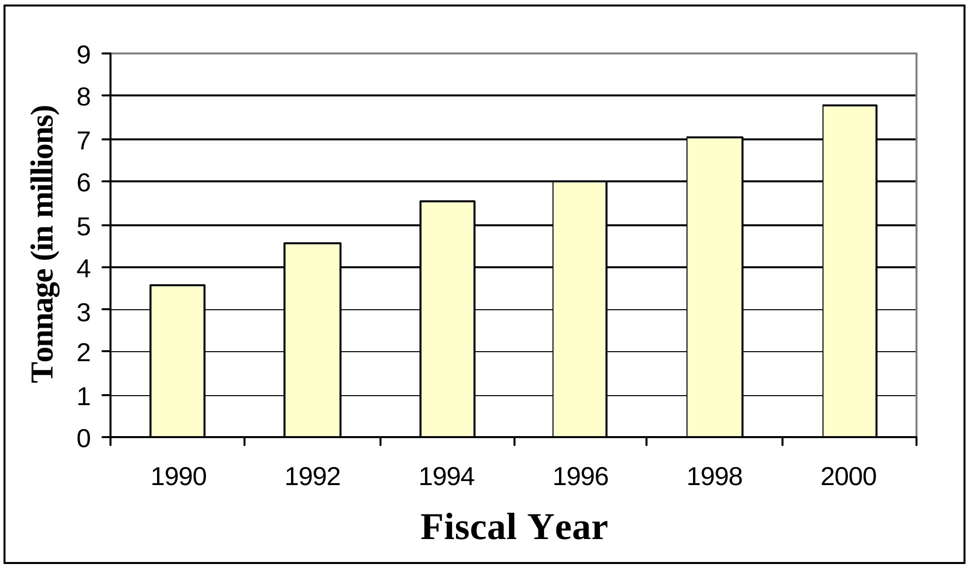


Figure 1.4: Cargo Tonnage at the Port of Miami
(Source: Port of Miami official Web-site. (6))

In Phase one, the objective of the project was to develop heavy truck trip generation models for both inbound and outbound directions (7). The research focused on internal port activity, rather than the traditional land use approach utilizing demographic and economic data. Also, the UCF-TSI team related the volume models to the gross tonnage of the truck movement. The following data sources were collected at the port:

- Daily Dock Reports: *provided the details of cargo vessel departures/arrivals with their berths.*

- Gate Pass Records: *provided details of truck trips including day and time of exit/entry.*

- *Trailer/Container Reports:* provided the number of freight units moved on and off of cargo vessel for each vessel berthing on every activity day

- *Monthly Performance Reports:* provided records of consolidated monthly totals from the Trailer/Container Report, which further facilitated in long term analysis.

Regression analysis was used to calibrate and validate the model. The model produced inbound and outbound truck volumes as its output. The independent variables required for the regression model were imported and exported number of containers. In order to forecast truck volumes in the near future, time series analysis was used to forecast the independent variables (imported and exported containers). Since the phase I study was completed in 1998, a five-year forecast was prepared as part of that study. A time series model forecasted independent variables for 2003, which were later used for estimating inbound and outbound trucks. Truck volumes were predicted for the entire year of 2003. The phase I study was followed by phase II where four other Florida Ports with significant freight transportation similar to the Port of Miami were investigated for determining which other ports should be selected. This report documents the methodology, data collection, and findings of phase II.

CHAPTER 2

LITERATURE REVIEW

2.1 FREIGHT GENERATION

The term freight demand or freight generation means the aggregate amount of freight generated by the economy or facility. State freight demand estimation is closely linked to forecasting future state and regional economic activity. Hence, it is essential to have a general understating and awareness of the relationship between transport demand and a state's industrial production and consumption by major commodity groupings and geographic locations, trade relationships with industries in other states and countries, and long-term changes in industrial location, technology, and economics. This section presents recent applications of some of the foregoing methods to freight demand estimation at several levels.

In 1994, List and Turnquist presented a method for estimating multi-class truck trip matrices from partial and fragmentary observations. The data sets included link volumes, classification counts, cordon counts of trucks entering and exiting the study area, and partial observations of the OD flows themselves. The method is linked to a geographic information system environment for data management and display of the results. A case study focusing on the Bronx in New York City was presented. Trip matrices are estimated for three truck classes: vans, medium and heavy trucks. One of their conclusions is that the nature of truck flow changes is likely to be related to commodities being carried as well as the physical characteristics of the trucks (8).

Also, in 1994, Tadi and Balbach presented a truck trip generation model as truck trip rates for several land use categories of various sizes as well as levels of activities. The equations were developed for weekday trip ends for two- and three-axle trucks, four-, five-, and six-plus-axle trucks, and all trucks, using floor area of buildings and total area in acres as independent variables (9).

In 1995, a traffic circulation study to determine truck drivers most heavily used routes was conducted by The Corradino Group (TCG) at the Port of Miami as a part of a larger countywide study. This local study also involved brief interviews of truck drivers at the Port's security entrance gate to determine which connector roads and routes were most commonly used by the drivers to access the nearby main highway routes (i.e., Interstates 95, 395, State Routes 836, 968, U.S. Routes 1, 41, etc.). The next phase in this project is to conduct in-depth analysis of the data, and examine how freight considerations can be included in the Dade County travel model (10).

In 1998, The Tampa Bay Regional Freight Movement study was conducted. This study provides an understanding of the magnitude, characteristics and special needs of freight movement in the Tampa Bay Area. The study has three primary objectives, to develop a database describing the characteristics and patterns of freight movement in the Tampa Bay region, to identify both current problems and emerging future needs facing goods movement in the Tampa Bay Region, and to develop a recommended set of priorities, improvements and other actions to address those problems and needs to enhance safety, efficiency, and effectiveness of freight movement in the Tampa Bay area (11).

In 1999, Gorys et al in a study for defining a strategic freight network for the Greater Toronto Area concluded that four distinct and specific land users were identified as being strong indicators of freight movement origin and destinations. They are manufacturing and assembly facilities; warehouses; intermodal terminals; and trucking support facilities, including yards, terminals, parking, and service locations. The geographic concentration of trucking companies, their clients, and their servers in freight centers or activity modes, coupled with higher truck volume linkage, lent itself to the creation of a series of demand overlays for freight movement trips and the identification of candidate elements of a strategic freight network (12).

2.2 FREIGHT MODAL SPLIT MODELS

Large number of investigations attempted to identify the variables that affect the freight transportation modal selection process. The purpose of mode selection models is to allocate freight demand among competing modes. Given the amount of freight, X, to be transported from an origin i, to a destination j, for a specific time period, the mode share T_{ijk}, becomes the amount of freight transported from origin i to destination j by mode k. The general form of the freight modal selection model is:

$$T_{ijk} = P_k (X_{ij}) \cdot X_{ij}$$

and

$$P_k(X_{ij}) = f\,(C, T, S, M)$$

In which

T_{ijk} = tonnage of freight shipped by mode k from origin i to destination j;

$P_k(X_{ij})$ = percentage of freight shipped by mode k from origin i to destination j;

X_{ij} = total amount of freight shipped from origin i to destination j within a specified time period;

C = commodity related attributes;

T = transport level of service attributes;

S = shipper attributes; and

M = market attributes.

A large number of mode split models were examined. Each model is discussed in terms of its type, general formulation, application, data requirements, and evaluation for use in statewide transportation systems planning applications.

The freight transportation modeling research and investigation goes back in time as far as the 50's. In 1959, Meyer, et al used the analysis of comparative cost approach. This approach essentially states that if the costs for moving a certain class of freight are less for railroads than for motor carriers, then from the standpoint of economic efficiency this traffic should be carried by railroads. The argument concluded that in the absence of rate regulation such traffic would be carried by rail. Their model selected the lowest cost mode of transportation by length of haul. Mode choice attributes were limited to two variables, which are, the freight rate charged, and inventory costs based on average commodity value, transit time, and shipment size differences between modes (13).

In 1963, United research recognized the importance of including total transport costs as an explanatory variable in the selection of mode of transport. They stated: "The preferred method of shipment and the intensity of this preference will be roughly proportional to the saving in Total cost" (14). Also, in 1963, Milne advanced the concept that quality of service measures play an integral role in the mode selection decision-making process. He concluded that service quality could be measured by three general attributes, which are, safety, reliability, and transit time. Transit time is broken up into accessibility time, line haul time, and frequency of service time (15).

In 1967, further research was conducted by Church to determine the extent to which distribution of freight traffic among modes can be explained by elements of commodity, size of shipment, plant size, and distance between origin and destination. The data were drawn from the 1963 Commodity Transportation Survey. He concluded that when the distance factor is measured in terms of mileage blocks (rather than a simple average distance), there is a highly significant relationship between highway participation and distance. It was also concluded that size and distance factors account for most of the variability in the highway share of freight transportation, and there is a substantial inverse correlation between the highway-carrier share of total tons originated by manufacturing establishments and plant size. Employment was used as the measure of the size of the firm. His results indicated that long-term estimates of total highway traffic are not merely a function of total output, but that size-distance-commodity factors should be taken into consideration (16).

In 1969, Dueker mentioned that for the purpose of freight modal split, it appears that contacting shippers should be investigated in greater detail in order to collect data on commodities flowing between nodes by the different modes under study, and for different commodities desired. He described an ideal motor carrier commodity flow data set. The analysis attempted to relate the flow data set to the data requirements for a freight modal split model. The following elements of the ideal data set were identified as essential to the mode selection process. These elements included location of shippers and receivers, commodity type, completeness of service, transit time, weight of shipment, rate, and actual routings (17).

In 1969, Herendeen used the regression analysis for freight modal split model. He stated that the model must be compatible with the freight demand model whose output becomes input for the modal split model. The output of a freight demand model (freight generation and freight distribution model) will be the amount of commodity *i* that will be shipped from node *g* to node *h*, X_{igh}. The form of the regression model is as follows:

$$P_k (X_{igh}) = \alpha_0 \; R_k^{\alpha 1} \; C_k^{\alpha 2} \; T_k^{\alpha 3} \; F_k^{\alpha 4}$$

Where:

$P_k (X_{igh})$ = Percent of X_{igh} that will be shipped by mode k

R_k = Reliability of mode k

C_k = Relative cost by mode k = (lowest rate by all modes)/(rate by mode k)

T_k = Relative transit time by mode k

= (lowest time by all modes)/(time by mode k)

F_k = Relative frequency of service

= (frequency of service by mode k)/(best frequency of service)

$\alpha_{0,1,2,3,4}$ = Coefficients to be determined by the regression analysis

He originally stated that there are eight variables particularly connect to the freight modal split task, these variables include transportation cost, weight of shipment, distance, transit time, reliability of service, frequency of service, commodity type, and size of firm. Later, because transport cost is highly interrelated with weight and distance, these two factors could be replaced by the single measure, transport cost. Also, firm size as a variable was found to be statistically questionable in estimating mode shares, consequently it was not included in his modeling effort.

Since it will be very difficult to quantify reliability of each mode, and also, having the sufficient data for the frequency of service. And since the regression output did not recommend these variables to be included in the model, he finally concluded that only transportation cost and transit time will effect the freight modal split model (18).

In 1971, Wallace focused again on the economical attributes. He suggested that mode selection decisions are determined on a basis of minimizing the total cost of transportation, where transport cost consists of four component parts: handling cost (described as functions of size of shipment, number of parcels per consignment, and access or egress distance/time), terminal cost (depends on consignment size, number of parcels and type of mode that is used), line-haul cost (that portion of the shipper's costs assignable to the carriage of goods between terminals but excluding terminal charges), and cost of ownership (includes insurance, depreciation, packing cost, and a value of investment that is a function of transit time). It was found that mode of transport, vehicle weight and capacity, shipping and handling requirements, and density or weight of consignment affects Line-haul charges (19).

In 1972 Surti and Ibrahimi stated that the size of shipment, distance of shipment, and shipper groups are sufficiently independent and can explain variations in highway-rail distribution. Three types of regression models were presented, the first was curvilinear regression model with distance of shipment and shipper group as the independent variables. The second model was curvilinear regression model with size of shipment and shipper group as the independent variables. The third was linear regression model with size of shipment, distance of shipment, and shipper group as the independent variables. The dependent variable was the percent highway share of total highway and rail. It was verified from the data by: P = TH/(TH+TR) x100

Where:

P = percent highway share of total highway and rail;

TH = tons of commodities transported on highways;

TR = tons of commodities transported on railways

They concluded that of the three models developed, the third type (linear regression model) fit the data best and was significantly better than the other two type models. The values of coefficients of determination ranged from a low of 0.82 to a high of 0.98 (20).

In 1973, Kullman estimated a binary logit model with aggregate data to predict market share for rail and truck for specific city pairs and commodity groups.

Logit analysis is a statistical technique used extensively in the field of disaggregate passenger travel demand modeling. The multinomial logit model has two important and essential characteristics. The first is that the estimated probability of mode choice always lies within the range of 0 to 1, eliminating the unbounded probability problem inherent in using linear probability functions. The second logit characteristic is that the sum of the probabilities of the choice of each of the mode alternatives is equal to 1.

This logit form for disaggregate modeling was chosen because of its demonstrated reasonable explanatory powers to predict the probability that the shipper will select a specified means of transportation from a set of alternative modes. Freight mode choice models of the logit form have been used to predict the truck-rail modal split as a function of modal and commodity characteristics using either aggregate data or disaggregate data.

The logit model, in its multinomial form, can be written as :

$$P_k (X) = \frac{e^{U(X)}}{1 + e^{U(X)}}$$

In which,

Pk (X) = the probability of a shipper choosing mode k out of the full set of mode alternatives available to him.

$U(X)$ = $x_0 + x_1 X_1 + \ldots + x_n X_n$

X_1, X_n = independent variables, expressed as differences; and

X_n = coefficients of X_n.

therefore, if P_k (X) is the probability of choosing mode k, the probability of not choosing mode k is 1 - P_k (X), in which

$$1 - P_k (X) = 1 / [1 + e^{U(X)}]$$

The logit transformation of the linear probability function is written as:

$$Log_e (P_k (X) / [1 - P_k (X)]) = x_0 + x_1 X_1 + \ldots + x_n X_n$$

In which the left-side term is called the logit.

The logit model was tested under a variety of aggregations (both commodity and geographical) and a number of different variable combinations to determine which combination would produce the best model results. Kullman estimated two sets of models, the first set included those variables not under carriers' control (internal variables) such as value per ton of commodity, annual tonnage, and mileage. The second set included those variables under carriers' control (external variables) such as travel time, freight rates and reliability, along with the internal variables. Of all the estimated models, the best regressions were obtained with a modified data sample using 3-digit Standard Transportation Commodity Codes (STCC), and using commodity value, mileage and annual tonnage as independent variables in the first set. The second set used rail cars per year, differences in freight rates and average transit time. The estimated models were of the following form:

ln (rail share / truck share) =

-13.13 - .0941 ln ($/ton / 1000) + 0.888 ln (tons / 10,000) + 1.52 ln (miles / 100)

Having R2 = 0.337

ln (rail share / truck share) =

1.25 + 0.769 ln (cars) - 1.13 ln ($/ton / 1000) - 0.0203 ln (RDIFF) - 0.320 ln (TDF15)

Having R2 = 0.2603

Where RDIFF is the difference in freight rates and TDF15 is the average transit time.

All coefficients were significant at the 95 percent confidence level. The addition of external variables (transit time and rate) to the model did not improve the accuracy of the prediction achieved. This can be explained, in part, by the fact that using an internal variable (such as distance) approximated an external variable (such as shipping rate).

Is summation, Kullman concluded that the accuracy of disaggregate models is limited due to the high sampling variability of the existing data. He also concluded that the aggregation of data could lower the variation among observations of certain variables, such as travel time reliability, to a point where its inclusion in the model is insignificant (21).

In 1974, Hartwig and Linton used probit analysis to model the individual shipper's mode choice between truck trailer load and rail carload shipments. Their analysis was limited to observations from a single shipper for a particular group of consumer durable household manufactured goods.

Preliminary testing of the model was limited to four variable factors, expressed principally as differences. The variables used were: (i) the difference in truck and rail freight charges, (ii) the difference in truck and rail transit times, (iii) the difference in truck and rail reliability, and (iv) the value of commodity. The formulation was designed to determine the probability of making a truck shipment.

Tests used to assess the statistical validity of the model were: (i) the t-test to determine the significance of the coefficients, (ii) the likelihood ratio test to determine the significance of the probit function, and (iii) the pseudo-R^2 measure for comparing the effectiveness of the model with other modeling techniques tested.

In an attempt to develop the best model formulation, three behavioral hypotheses were tested. In the first, only time and cost were included as independent variables of mode choice; in the second, the reliability measure was added; the third included not only all the previous external factors but also the shipper controlled measure, the value of commodity. Their initial belief was that the function with the most number of modal choice variables (the final formulation) would also be the most statistically explanatory and the most accurate estimator of mode choice. The model was based on a data base comprised of 619 shipment observations (134 truck and 485 rail shipments). The probit model was able to predict the correct mode for shipment approximately 90 percent of the time when adopted to classifying individual observations by an arbitrary cutoff value. Hartwig and Linton concluded that the probit analysis form is applicable to disaggregate freight mode choice modeling. Their analysis showed that binary mode choice (truck or rail) is more sensitive to changes in freight rates than either changes in transit time or reliability. In fact, time in the model used was statistically insignificant.

The study by Hartwig and Linton clearly demonstrated that probit analysis can be applied to freight modal split analysis. However, their model would require expansion if it is to be applied as a micro-level policy tool. Shipper attributes and commodity attributes should be added to make the model more useful to analyze a wider range of commodities. Probit analysis is ideally suited for relating observed shipper behavior to factors for determining mode choice between two means of transportation. Besides the problem of data availability, the probit analysis has several major drawbacks. First, probit analysis requires a more time-consuming calibration procedure than most other models. Second, commodity type is not considered. Third, the model is binary; that is, only two modes can be analyzed (22).

In 1981, Hashemian primarily concluded that the variables that affect a firm's choice among available transport modes were described in terms of four groups of attributes: commodity attributes, level of service attributes, user's attributes, and market attributes. His final conclusion was that shipper's mode choice decisions between air and truck can be predicted with 87 percent accuracy using modal rates, times, and value of commodity (23).

In 1987, Murthy and Ashtakala introduced three new variables that might affect the modal-split analysis in addition to average shipment size and type of commodity. The first new variable was loads (full or less than full). They claim that trucks are expected to be used for transporting lower average shipment size as less than full loads, and rail is expected to be used for transporting higher average shipment size as full load. It was found in the study that the truck mode captures almost 100% of the less-than-full-load market, and the rail mode shares a very small percentage (<15%) of the full-load market. The second variable was hire (private or for hire). Private carriers are used mostly to carry less-than-full-loads over short distances. For-hire carriers carry commodities for larger distances and carry much greater capacities of freight as full-load. Finally, the last variables were control (yes or no). The survey contained a question asking the shipper or consignee if they decided by which mode the product is to be transported. They indicated their type of control by marking "yes" or "no" on the survey forms. They assumed that the control factor gives an insight into the decision process of shipper/consignee as to the selection of a mode (24).

In 1989, Sullivan used transportation time and tariffs as the factors that affect truck-rail modal split. He concluded that transportation time and tariffs may be considered to be the only variables within the control of the transport operators (truckers and railroad companies) (25).

In 1990, Ogwude concluded that freight charges have a significant influence on model choice. He also concluded that the transport service (transit time and reliability) variables are also very important determinants of modal choice, although their significance varies considerably between groups of industrial freight and transport modes. On the whole, he concluded that it would seem that service competition would lead to greater modal split shifts than price competition, except in the case of capital goods, dominated by the iron and steel products, where it would seem that the public freight transportation modes, including the railways, can attract substantial amount of traffic by offering relatively lower charges (26).

In 1996, Smadi and Maze examined freight demand analysis using employment data and inpput-output factors. Their analysis focused on major commodity groups and was applied to a case study in Iowa using two major manufacturing sectors and available data sets. They concluded that the major efforts of developing freight transportation model lies in assembling a reliable data set of freight data. The paper showed that modal analysis could be simplified by reducing data requirements and the difficulty of applications. Many commodities can be classified as captured for one more. For example, coal shipments are almost entirely carried by rail, while trucks usually carry meat products. However, Modal preference relationships must focus on commodities with transportation needs that enable them to use more than one mode (that is, not captured) (27).

In 1997, Nam concluded that transit time exerts the greatest influence on the shippers' mode choice for all commodity groups for both modes (truck and trail); rate and accessibility have some influence on rail and truck users, respectively, while service frequency has less of an influence for both modes (28).

All previous researches focused primarily on the identification of the various factors that affect freight mode choice decisions. In summary, these variables fall into four main categories, which are, commodity attributes, transport system attributes, shipper attributes, and market attributes. Table 2.1 summarizes these attributes. Researchers are trying to investigate which of these attributes affect the most on freight mode choice decisions. Commodity attributes refer to the physical characteristics of the commodity being shipped, as well as information on its handling and use. Transport system attributes (or transport level of service attributes) pertain to mode, commodity, and shipment size. Shipper attributes pertain to plant location, supplier, and operating policy strategic decisions that underlie long-term shipper behavior. Market attributes pertain for the demand for the commodity being produced.

Commodity Attributes	**Transport System Attributes**
1. Type of commodity shipped	1. Waiting time for shipment to begin
2. Unit value of the commodity	2. Travel time between origin and destination
3. Commodity density (original and packaged for shipment)	3. Time reliability
4. Shelf life or number of days to spoilage	4. Incidence of loss and damage
5. Fragility or susceptibility to damage	5. Transport tariff charged by the carrier
6. Volatility or likelihood to change	6. Distance shipped
7. Seasonality	7. Frequency of service
8. Product use (weather in manufacturing or for final consumption)	8. Routing availability and restrictions
9. Inventory control System (single or multiple item)	9. Completeness of service
10. Adaptability to liquid transport	10. Special services (e.g., refrigerating)

Shipper Attributes	**Market Attributes**
1. Annual production volume	1. Amount sold to consuming industries
2. Number of establishments	2. Characteristics of consuming industries
3. Location of establishments and modal	3. Ownership of freight

access	
4. Ownership of the freight	4. Pricing structure
5. Pricing structure	
6. Size of establishment (No. of employees)	
7. Shipper's awareness of alternative modes	
8. Ownership to specific means of transport	

Source: Freight data requirements for statewide transportation systems planning, TRB 1977

Table 2.1 Freight Modal Selection Attributes

CHAPTER 3

METHODOLOGY

3.1 METHODOLOGY

The methodology of developing truck trip generation models for the Ports of Palm Beach, Everglades, Tampa, and Jacksonville consisted of the following steps:

1. Examine the Florida Port operations and determine which ports would be the most appropriate to include as significant generators of truck traffic.
2. Ports were selected based on observed truck traffic and significance of freight commodity types and volumes imported and exported.
3. After selection of the ports was completed, detailed observations were conducted around the ports to determine the locations where the trucks enter and leave the port terminals when transporting freight for import and export by the vessels.
4. Investigation of the best equipment to classify vehicles at these locations was completed and several technologies were tested for data collection accuracy. Pilot studies were done to ensure accuracy of the data. From these, the equipment most diverse, accurate and useful was selected.
5. Daily traffic volumes (24 hour period) were collected including vehicle types (vehicle classification and number of axles), which provided the daily truck volumes. This was done at the individual locations at each of the ports.

6. Port personnel were interviewed to investigate data sources for acquiring necessary freight data. This included acquisition of vessel data for determining the freight imports and exports on a daily basis for comparison to the collected daily truck volumes from the field. Representatives from private companies were also interviewed to gain their input and perspective on the movement of freight and trucks around the ports.
7. Analysis of the collected and acquired data was completed and entered in a manageable database to determine the important variables for use in the modeling. The analysis also provided the details for the organization of the data.
8. Investigation of the best modeling approach was done to ensure that the model would be able to generate accurate output results for both the present and future. Some initial analyses were done with Regression and Artificial Neural Networks.
9. Determination of the independent variables was done using preliminary Artificial Neural Network models. Each of the initially developed models was tested to determine a base model for application to the ports.
10. Development of the truck trip generation models for the four selected Florida Ports. Determine the applicability of the initially developed model to each of the four ports.
11. Specific identification of the independent variables was completed for each port. Each of the four ports was determined to have site-specific variables, which concludes that one comprehensive model was not applicable for all ports.
12. Calibration of the developed models for each port was conducted using a selection of actual field data for the independent and dependent variables. Adjustments to the parameters of the independent variables were done to improve the models.

13. Validation of the models was accomplished by using a selection of actual field data for the independent variables and comparing the truck volumes output to the actual field collected truck volumes corresponding to the independent variables input.
14. Time series analysis was done to examine future trends in freight movements. Historical vessel data from each port was obtained to use in forecasting future vessel freight unit volumes.
15. Forecasted future vessel freight unit volumes for each port were used as input to the developed truck trip generation models to produce estimated future truck volumes at each port.
16. Interpretation of the results to establish conclusions and make recommendations for future research.

3.2 BACKGROUND OF STUDY SITES

Florida Ports handle enormous amounts of freight traffic. Florida is ranked fifth in the nation for waterborne traffic by state (3). In 1999, Florida Ports handled 128.6 million short tons of commerce. The following four ports have been investigated and chosen for modeling in this project:

- Port of Palm Beach
- Port Everglades
- Port of Tampa
- Port of Jacksonville

All of these ports are in the top 100 leading U.S. Ports in 1999 in waterborne commerce short tons (29).

3.2.1 Port of Palm Beach

The Port of Palm Beach is one of the smaller ports in Florida but is significant for certain commodities and has been experiencing continuous growth over the last few years. Due to its prospective growth and importance it was one of the five ports studied. This is one of the important ports for sugar and molasses exports. It also has a significant amount of containerized cargo movements. A list of the site-specific information for this port is:

- Sugar, Molasses are significant commodity exports in terms of tonnage
- Cement is a significant bulk commodity import in terms of tonnage (also brought in by rail from Tampa)
- Sugar and Molasses are transported to the port only by truck
- Cement is transported out of the port only by truck
- There is significant container import/export traffic
- Rail activity present
- One access road (Martin Luther King Jr Blvd.)

The Port of Palm Beach acts as a distribution center for cargo shipped through the larger ports as transshipments to small ports in the Caribbean and Central America. The port handled 3.6 million tons in the fiscal year 2000 and has projected an increase in future years. The port handles General Cargo (containerized cargo and break bulk), Bulk (Cement, Molasses, Sugar, Fuel Oil) and Dry Cargo (other unclassifiable bulk products).

Figure 3.1 shows the commodity tonnage at the port in the fiscal year 2000 (30). Water is mainly for replenishment of on-board vessel consumption.

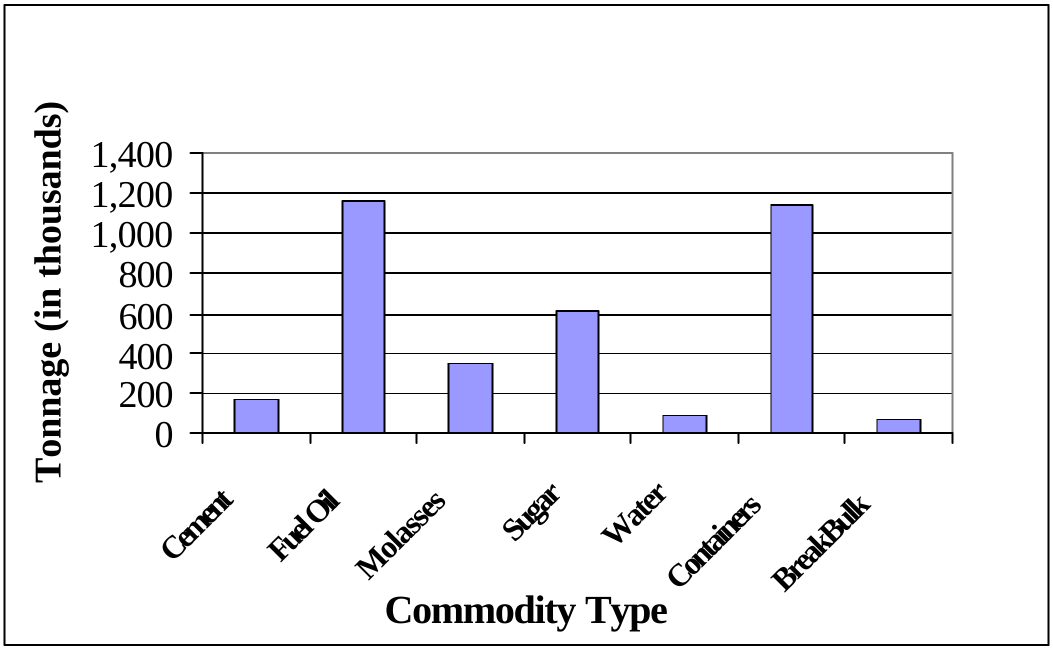


Figure 3.1: Total Tonnage at Port of Palm Beach (10)

Among the various means of moving freight, trucks haul the maximum amount of freight but there is also rail activity present. Pipelines carry Molasses from just outside the port warehouses to the vessels docked.

3.2.2 Port of Everglades

Described as "The World's Best Cruise Port", (31) the Port of Everglades has a continually growing containerized cargo business that has established itself among the nation's top seaports. Port of Everglades was ranked 31st out of the top 100 leading U.S. Ports in 1999 handling 22.1 million short tons (29). It is one of the South Florida's strongest economic engines with annual operating revenues of more than $66 million in total waterborne commerce in liquid, bulk and containerized cargo (31). A list of the site-specific information for this port is:

- Imported petroleum is a very significant commodity in terms of overall volume
- Exported petroleum is insignificant, there is virtually no exports at all
- No rail activity, virtually all traffic is by truck or vessel
- High containerized cargo activity is present here. This port continues to grow from containerized cargo and development around the port is planned due in part to this growth.
- Three main access roads (Eller Dr., Spangler Blvd., Eisenhower Blvd.)

Figure 3.2 shows the growth at the Port of Everglades over four years. The growth in tonnage handled has been steady from 19.5 million tons in 1995 to 21.8 million tons in 1998. It is projected that the port would handle 28.3 million tons of cargo in the year 2000 (32).

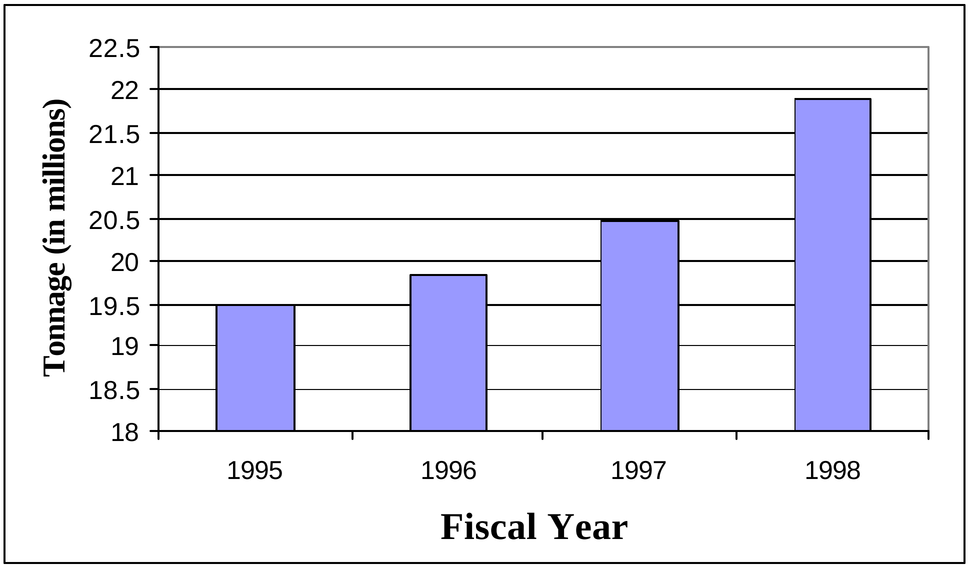


Figure 3.2: Total Tonnage at the Port of Everglades

The port handles different types of cargo, bulk (i.e. petroleum, cement, gypsum, scrap metal); break bulk (i.e. building materials, steel, lumber, secondary fiber) and containerized cargo (i.e. tile, leather goods, coffee, paper products, auto parts, furniture). The nation's second largest non-refinery petroleum storage tank farm is located at the Port of Everglades. The port has been recently approved as a designated point of entry for coffees to be traded in the future market of the Coffee, Sugar and Cocoa Exchange. Port Everglades is now one of the top U.S. ports for coffee imports, bringing in the highest quality product to supply the nation's leading roasters.

3.2.3 Port of Tampa

The Port of Tampa is ranked at 12th in the top 100 U.S. Ports for the year 1999 handling 32.5 million short tons, the largest port in Florida by tonnage (29). Figure 3.3 shows the port’s annual tonnage from year 1990 to 1999 (33).

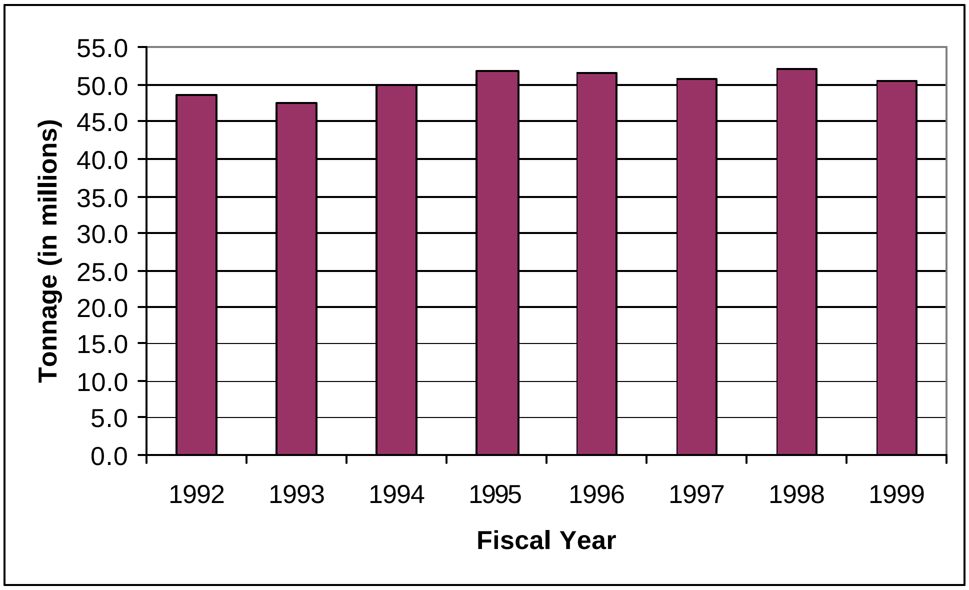


Figure 3.3: Total Tonnage at the Port of Tampa

Port of Tampa handles various products: - general cargo (includes citrus, melons, cars, steel coils, etc) and bulk cargo (includes phosphate rock, fertilizer products, petroleum, cement, citrus pellets and aggregate). Port of Tampa moves 25 million tons of phosphate and related products annually, more than any other port in the world. The port adopts many means to transport freight, including the majority by truck, rail, and pipeline. It is also a major cruise port in Florida. A list of the site-specific information for this port is:

- Three main port locations/Five main access roads
    - Hookers Point (20th Street, 22nd Street, Causeway Blvd.)
    - Port Sutton (Port Sutton Rd)
    - Pendola Point (Pendola Point Rd)
- Rail activity present
- There was significant petroleum imports in terms of volume

- Insignificant containerized imports/exports in terms of volume. The activity is minimal especially compared to the bulk imports/exports.
- Significant bulk exports, including phosphate products and citrus pellets which are very frequent and in high volumes.

3.2.4 Port of Jacksonville

This seaport on the North–East Coast of Florida is dominated by the container traffic. The Port of Jacksonville was 14th largest containerized shipping port in the United States (34). It ranked 36th in the top 100 U.S. Ports for the year 1999 handling 19.3 million short tons in waterborne commerce (29). Figure 3.4 shows the top 10 commodities handled during the fiscal year 2001 and Figure 3.5 displays the annual total tonnage for years 1996 through 2000.

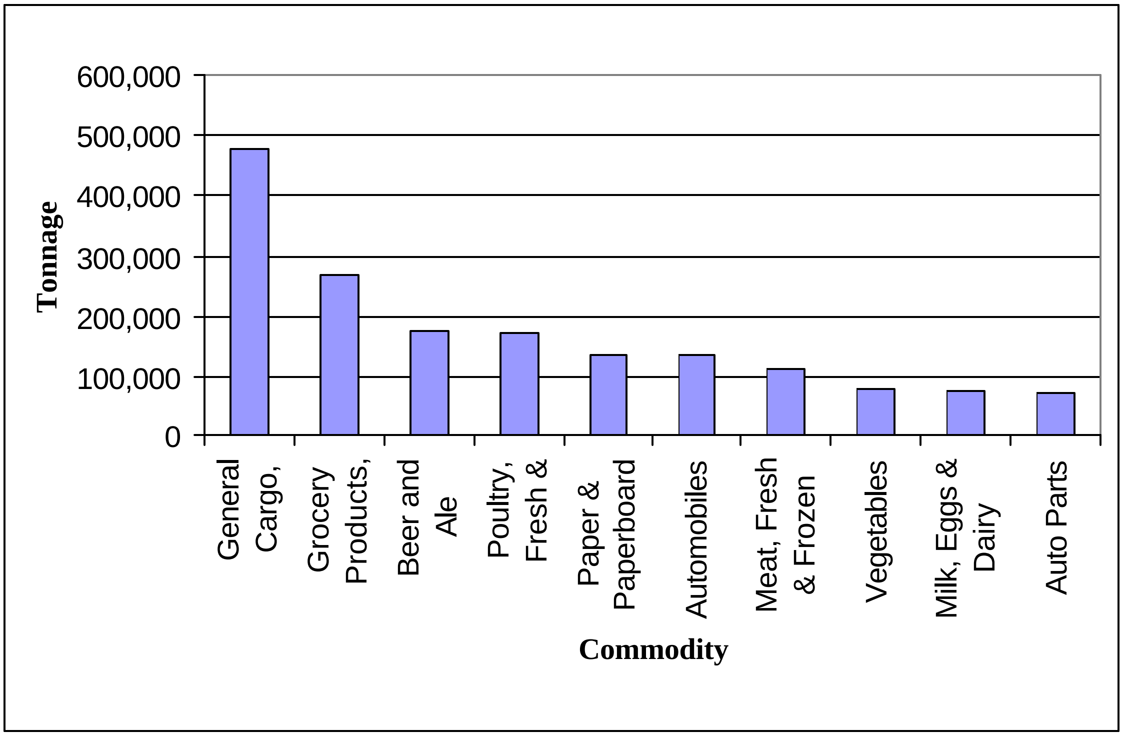


Figure 3.4 Top 10 Commodities at Jacksonville in FY 2001(35)

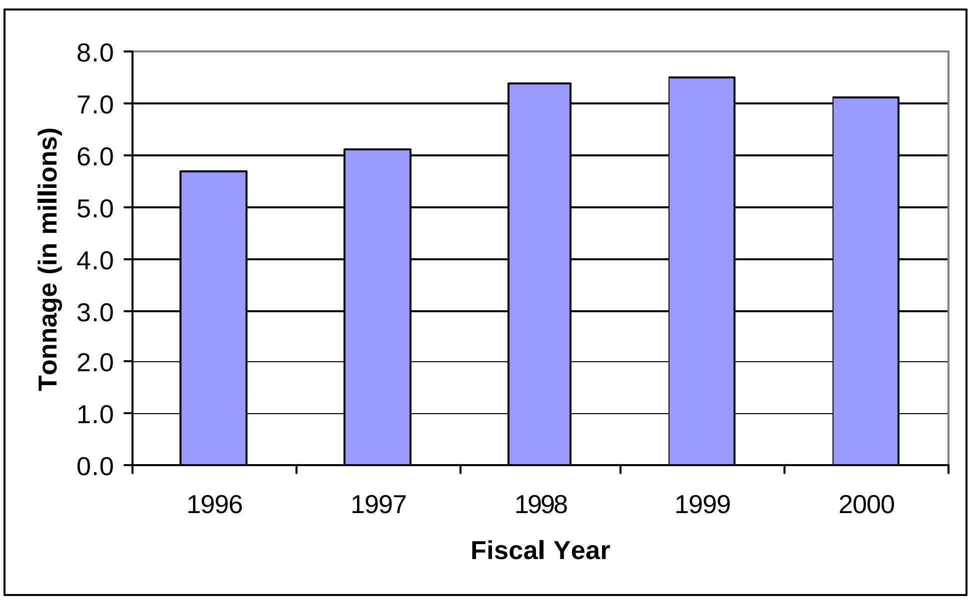


Figure 3.5 Five year Commodity Tonnage at Jacksonville (35)

Trucks dominate the freight movement followed by rail operations by CSX Transportation, Norfolk Southern (NS) and Florida East Coast (FEC) Railway. Vessel activity is distributed at three terminals, Blount Island Terminal, Talleyrand Terminal and the Ed Austin Terminal on Dames Point. The main commodities handled by the first two terminals are automobiles, containers and bulk, whereas the Ed Austin terminal primarily handles dry bulk which are basically for transshipments. Currently Martin Marietta is the only tenant at the Ed Austin Terminal and primarily import aggregate products. A list of the site-specific information for this port is:

- Two significantly different major terminals (Talleyrand and Blount Island)
- Three main access roads
    - Talleyrand (8th street and 21st street)
    - Blount Island (Blount Island Rd.)
- Significant container activity in terms of volume
- Significant new automobile imports. This commodity type is significant in terms of volume imported
- Virtually no petroleum products imported or exported.
- The variation in shipment volumes and frequency of the bulk cargo shipments were irregular.
- Rail activity present

CHAPTER 4

DATA COLLECTION AND ANALYSIS

4.1 TRUCK COUNTS

A number of data collection technologies were investigated before deciding to test the conventional traffic road tubes. Before purchasing and installing any units on-site, two units were tested. The traffic road tube counts were compared to actual (field observations) counts. A pilot study was conducted for two days at the Port of Jacksonville on 8th Street leading to the Talleyrand Terminal in both the eastbound and westbound directions. This was one of the locations later determined to be an entrance to the Port of Jacksonville where truck counts would be collected. Figure 4.8 in Section 4.1.4 illustrates a map with the location of the pilot study (Location 3).

On 8th Street, traffic was manually counted for two days (Tuesday 8/10/99, and Tuesday 8/17/1999). The corresponding truck traffic volume maintained by the traffic counting tubes for the selected days were counted to ensure the reliability of traffic counting tubes as a substitute data source for manual traffic counting. One of the important reasons for manual counting was to have a visual record of some observed traffic. Another reason was to compare the observations from the manual counting with traffic volumes obtained from tube counts.

Two different statistical tests (Wilcoxon Rank Sum Test and T-Test) were performed to statistically demonstrate reasonable reliability of the traffic counting tubes data. Appendix A illustrates the equation and the hypothesis used for the Wilcoxon Rank Sum test. Both the

Wilcoxon Rank Sum Test and T-Test revealed that there is no significant difference, at the 95% confidence level ($Z<1.96$ and $P>0.05$), between the actual traffic volumes and volumes obtained from the traffic counting tubes. Figure B-1 and Table B-1 in Appendix B show the analysis results for truck traffic on Tuesday 8/10/99. Figure B-2 and Table B-2 show the analysis results for truck traffic on Tuesday 8/17/99.

Following a thorough investigation of technologies for counting heavy truck volumes at ports, the FDOT and the UCF-TSI reached a major decision on the possibility of a more appropriate data collection technology for most of the ports' sites under study. The decision was to go with the fiber optics sensors developed by a Florida based company. The FDOT approved a supplement agreement to the present contract to fund the purchase of this technology. Following is a detailed description of this technology and the short pilot study conducted prior to making this decision.

The fiber optic sensors are flat, gray strips consisting of a flexible rubber type material which have optic fiber loops running through them. Each sensor has one optic fiber loop for each lane (i.e. 2-lane sensor has two loops). These sensors are laid in the road similar to how road tubes are laid. The sensors are inserted into asphalt pocket tape and then adhered to the road. Once this has been done, the sensors are connected to the interface box. The interface box converts the optic readings to piezo readings so the classifier can file the data records. The interface box is connected to the piezo input on the classifier.

A pilot study using fiber optic sensors and Diamond/Phoenix Classification equipment was conducted on November 30th, 1999 in Palm Bay to evaluate the accuracy of this equipment for classifying motor vehicles. One pair of two-lane sensors was installed with 16ft between them. This was the setting in the Diamond/Phoenix vehicle classification unit. The installation of the sensor strips was quick (basically about as long as it takes to walk across the road). Attachment of the sensors to the hardware was very easy as well, thus making the total installation process very simple.

The sensors and classifier were observed to have some good points. The speed is not a factor as it is with the tube counters. A vehicle traveling at 10 mph was logged. Classification was viewed and confirmed for vehicle classes 2, 3, 4, 5, and 6. Class 1 was motorcycles. The following table 4.1 illustrates the counts observed for the specific classes and a description of the classes.

Vehicle Class	2 axle counts	3 axle counts
Class 2	85	1
Class 3	23	1
Class 4	4	0
Class 5	2	0
Class 6	0	3

note: time period of observation-1 hour

Table 4.1 Fiber Optic Pilot Study Observations, Nov. 30th 1999

- Class 2: small motor vehicle (passenger car)
- Class 3: small-medium motor vehicle (van, large pickup truck)
- Class 4: light duty truck (small cargo truck)
- Class 5: medium duty truck (large cargo truck)
- Class 6: heavy duty truck (cement truck)

No heavy vehicles (4 axles or more) were observed at the site during the experiment. Also, when a vehicle travels in the wrong direction across the sensors, an error message is recorded. No duplicate readings were viewed for the parallel lane recordings. The fiber optic sensors were sensitive to car following in that two vehicles following close were recorded as two vehicles instead of one 4-axle vehicle which has been known to occur using the traditional road tubes. The classification was sensitive to the type of vehicle regardless of the number of axles. For example, a small motor vehicle pulling a one-axle trailer was classified as Class 2, 3-axle but a cement truck with 3 axles was classified as Class 6. The resolution of the pilot study was that this technology was more accurate and easier to install than the conventional road tubes.

Once the traffic classification equipment was received, inspected and installed at the Port of Everglades and Port of Tampa, some problems were realized. Fiber optic sensors are more fragile than air tubes. Because of this and the issue of security, steel cages were designed and constructed, see Figure 4.1. These steel cages were made to house one Diamond Phoenix Vehicle Classifier and fiber optic interface box. The cage is constructed of steel rebar and is removable from the wooden base. The interface box is secured to the wooden base for immobility. This is important because if the box moves around too much, the fiber optic connectors may be bent and subsequently broken. A three-section security bar connects the base to the cage and is secured by an ordinary hardened steel key lock.

Besides security, limitations to the durability of the fiber optic sensors in some unusual traffic conditions were also realized. Though the fiber optic sensors can withstand fairly heavy impacts while on a smooth flat surface, they can be easily broken when bent because they are basically strands of glass. The road surfaces at most of the port locations showed heavy wear and had many imperfections in the pavement which causes damage to the sensors when impacted by the vehicles. Temperature was also a factor in the durability of the sensors. Initial testing of the fiber optic sensors was completed in October of 1999 and March of 2000. The Florida temperature was not as severe as it is during the summer months. It has been discovered that with high traffic volumes during periods of extremely high temperatures, the fiber optic sensors had a short operational span. This was due in part to the rapid deterioration of the asphalt pocket tape on the road heating up and thus wears much faster than expected. Optical Sensor Systems,Inc. the company that produces the fiber optics replaced those sensors identified to have been damaged due to this problem. New pocket tape with an extra layer of asphalt substance was experimented with but the endurance of the sensors was not improved much.

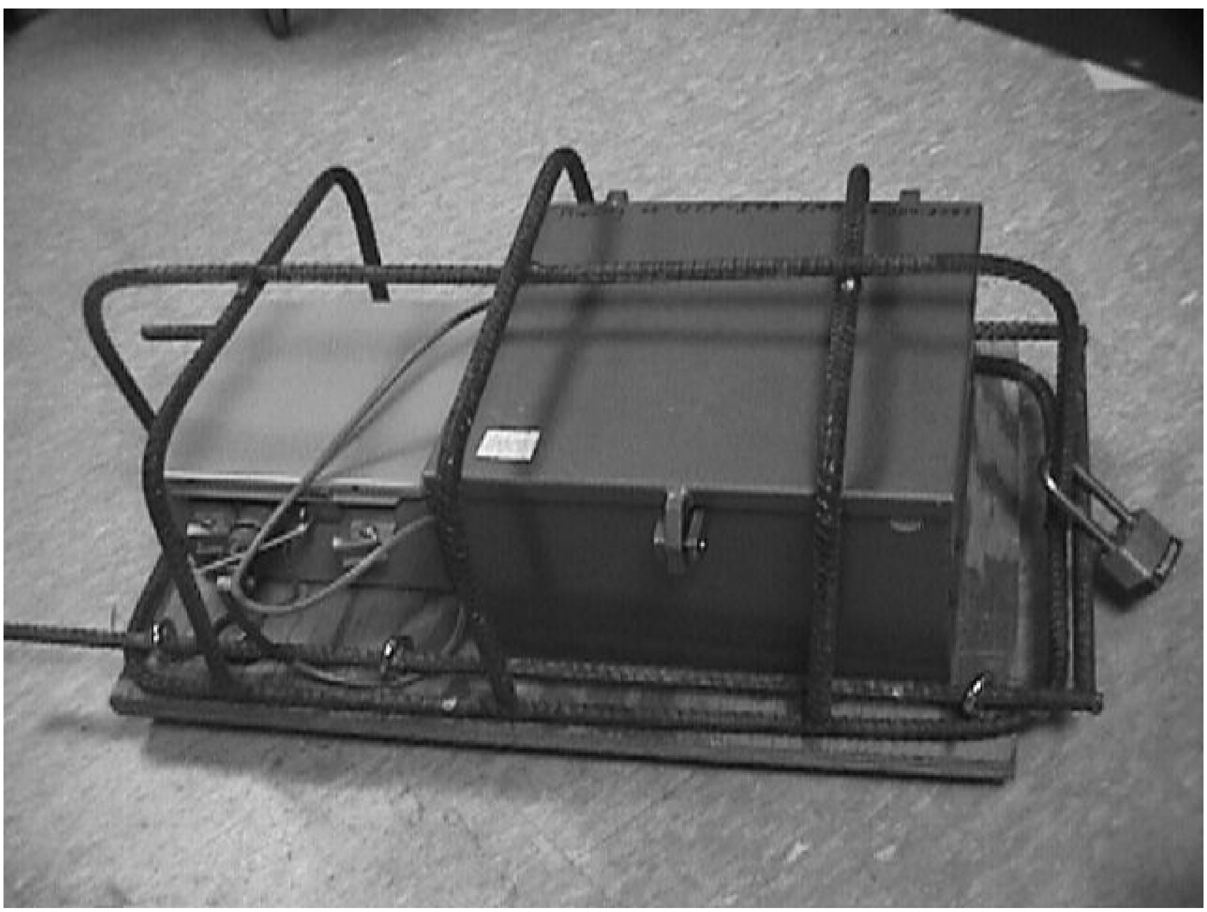


Figure 4.1 Classifier Unit and Steel Cage

Initial conclusions show that the variability of vehicle types at the port may be much higher than other highway locations. Construction and maintenance vehicles that are not normal highway travel vehicles have tires with large indentations that can damage the fibers. These are quite common around the port area but are uncommon for normal highway travel. The replacement sensors were damaged only two days after installation. This was probably due to an unusual vehicle type because the air tubes in operation near the sensor location were also damaged. This indicates that fiber optic sensors should not be used in areas where abnormal vehicle types are in operation, like construction zones. Figure 4.2 shows a picture of one of these heavy equipment vehicles.

Figure 4.2 Abnormal Heavy Vehicle

The frequent damage to the sensors created high maintenance costs due to the high cost associated with a fiber optic sensor as compared to a road tube. Therefore, air tubes were installed using asphalt pocket tape at the data collection locations. Though the air tubes are also frequently damaged, the replacement cost is much lower (Road tubes $0.37/ft, one 2-lane sensor $250). Also, it has been determined through previous experiments that the asphalt pocket tape is more durable and easier to use than road nails or screws. The air tubes were connected to the existing Diamond Phoenix Vehicle Classifiers. At the beginning of the data collection endeavor, each location displayed difficulties with classifier operations. Sometimes the tubes were damaged, sometimes the equipment failed and other times it was a combination of factors including location choice. It was concluded that the Metrocount Vehicle Classifiers were more dependable than the Diamond Phoenix Vehicle Classifiers. The only hardware failures that occurred with the Metrocount Classifiers were due to water intrusion from heavy rains. The Metrocount Company replaced all the damaged units with new units that have an updated design to reduce the possibility of water intrusion and a longer battery life as well. The Diamond Phoenix Classifiers failed due to battery failures and other unidentified internal hardware problems possibly related to a damaged chipset board. The units with hardware failures were returned for maintenance. Upon receiving them back and then reinstalling them back in the field, two of the six repaired units still had hardware failures and another four units experienced similar hardware failures.

Weekly trips were conducted to maintain the equipment, download data and reset the memory and to recharge the classifiers and the interface boxes when they were in use. These trips were necessary no matter which type of technology would have been used. Traffic was monitored on several occasions to determine solutions for resolving the frequent damage. Noticeably heavy traffic including high truck traffic was the most probable cause of this frequent damage.

Data was transferred electronically to text files then to Microsoft Excel format and compiled for each location. Data has been filtered to ensure reliable analysis. Inaccurate readings have been excluded from the analyses. Inaccurate readings consist of incorrect vehicle classifications recognized by daily data comparisons where some days display unusually high or low counts. Some corrupted files also have been noticed and excluded from the inventory of data. The following Table 4.2 describes the default categories for vehicle classification that were used in both the Metrocount and Diamond Vehicle Classifiers. These are referred to as Scheme F by the Federal Highway Administration.

Code	Category Name	Axle Range
Cycle	Motorcycles	2
Cars	Passenger car (w/wo trailer)	2 - 4
2A-4T	Other two axle, 4 tire vehicles (w/wo trailer)	2 - 5
Buses	Buses	2 - 3
2A-SU	two axle, six tire, single trailer trucks	2 - 5
3A-SU	Three axle, single unit trucks	3
4A-SU	Four axle, single unit trucks	4
4A-ST	Four or less axle, single trailer trucks	3 - 4
5A-ST	Five axle, single trailer trucks	5
6A-ST	Six or more axle, single trailer trucks	6 - 10
5A-MT	Five axle, multi trailer trucks	5
6A-MT	Six axle, multi trailer trucks	6
Other	All other vehicles	7 - 13

Table 4.2 Vehicle Classifications

Trucks having three or more axles have been considered as those that would transport freight. Trucks that are classified as two axle, six tire, or single trailer trucks have been excluded from the truck counts as they are light duty and most likely will not transport freight imported or exported at the port.

An inventory of the total number of days during which truck counts were successfully collected is shown in Table 4.3. There were a number of reasons for the days of unsuccessful data collection. At first, the fiber optic sensors were failing frequently. Then, though the road tubes were more durable, they still were frequently damaged, but not as often as the fiber optic sensors. Also, the classifiers would fail due to a hardware malfunction as previously mentioned. Sometimes it was prohibitive to make trips frequent enough to capture the data before the memory in the classifiers was full. Inclimate weather during the summer also added to the unsuccessful collection of data. There were some holidays or special events that would skew the truck volumes to and from the ports that were not included as well. Each port is described in detail for their data collection efforts because of the unique characteristics of each port selected.

Port of Palm Beach

Direction	Martin Luther King Blvd.
Inbound	76
Outbound	103

Port of Everglades

Direction	Eisenhower Blvd.	Spangler Dr.	Eller Dr.
Inbound	117	137	152
Outbound	108	123	131

Port of Tampa

Direction	22nd St.	20th St.	Causeway Blvd.	Port Sutton Rd.	Pendola Point Rd.
Inbound	142	142	140	143	153
Outbound	106	151	116	143	153

Port of Jacksonville

Direction	Blount Island Rd.	8th St.	21st St.
Inbound	41	129	127
Outbound	41	129	128

Table 4.3 Truck Count Inventory (Successful Days)

4.1.1 Port of Palm Beach

Data collection of truck counts at the Port of Palm Beach commenced on January 31st, 2000 and was completed by June 1, 2000. A total of 123 days of data were collected. There was only one location for data collection at this port (Shown in Figure 4.3), which is one of its distinguishing characteristics from the other ports selected.

Location 1: West of Broadway Avenue on 8th Street.

Both inbound and outbound truck traffic was collected on Martin Luther King Jr. Blvd (8th St), which was a four-lane bi-directional road with no median. See Figure 4.3 for a map of the surrounding port road network. This road serves as the main access point for the port. Road tubes were used to collect the truck counts. Table 4.3 displays the total number of days data was successfully collected for at the port. Out of this data, 75 days were used for the model calibration and validation process. Not all the successful days were utilized due to some inaccuracies in the vessel data for some weekdays such as extremely low vessel freight volumes compared to the rest of the weekdays.

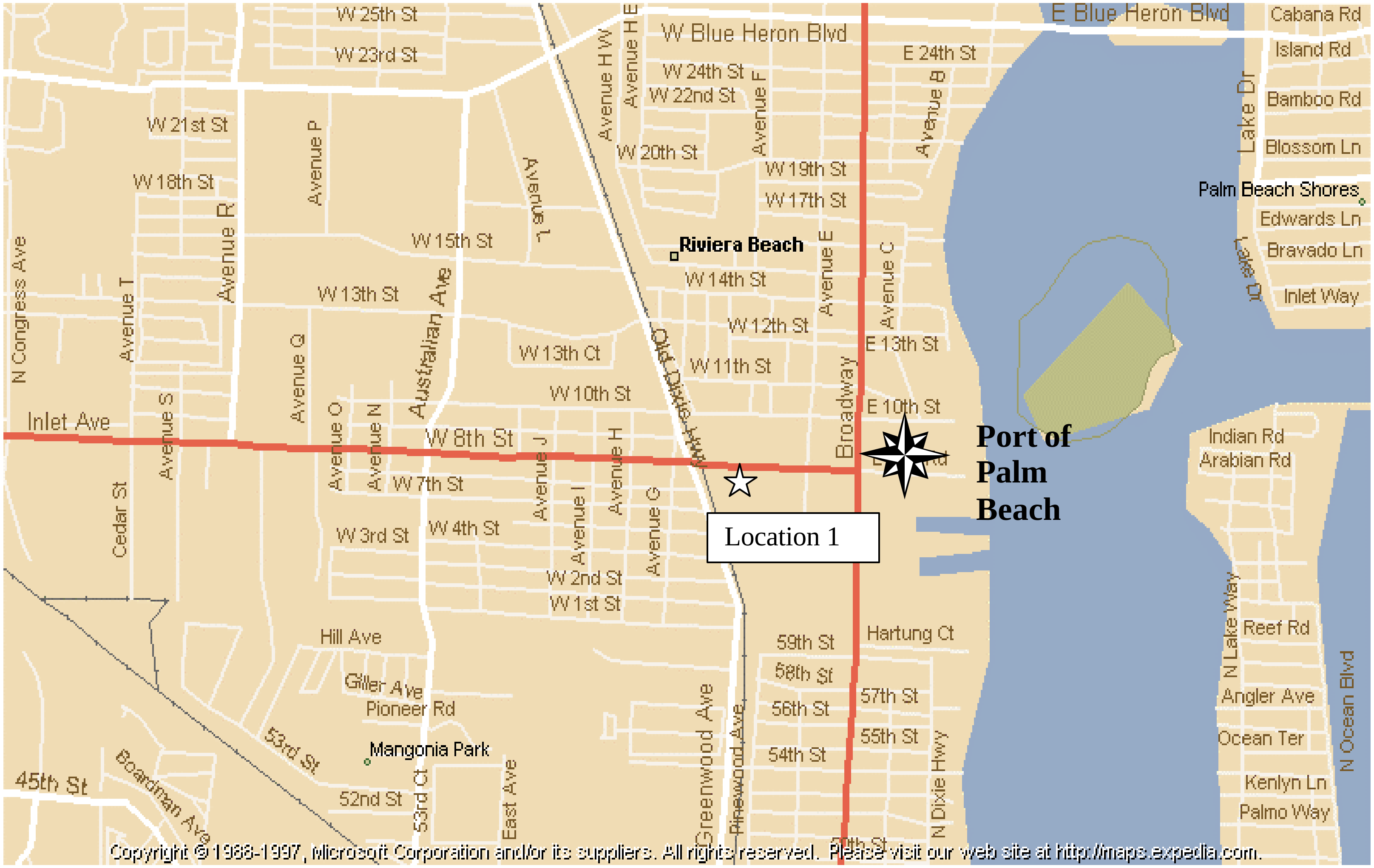


Figure 4.3 Port Entrance at the Port of Balm Beach

4.1.2 Port of Everglades

Data collection at the Port of Everglades commenced on May 3rd, 2000 and was completed on December 23, 2000. Data was collected for 235 days. Fiber optic sensors were initially installed at all locations but due to the frequent damage, the fiber optic sensors were replaced with road tubes at all locations. Three locations were chosen to collect truck traffic counts (shown in Figure 4.4), which is a distinguishing characteristic for this port compared to the other ports selected. The locations include:

Location 1: Intersection between S.E. 17th St. and Eisenhower Blvd. on Eisenhower Blvd.

Location 2: Intersection between SR 84 and Miami Rd. on Spangler Blvd.

Location 3: At the end of I-595 and the beginning of Eller Drive. Split into two data collection sites: One between Macintosh Rd. and 14th St and the other on 14th St. just north of the Eller Dr. and 14th St. intersection.

Location 1, Eisenhower Blvd., is a four-lane bi-directional road with a raised median. One classification unit for each direction was installed in the median. Location 2, Spangler Blvd., is also a four-lane bi-directional road with a raised median. One classification unit for each direction was installed in the median. Location 3 was initially located east of the Eller Dr. and 14th St. intersection (smaller “star” in Figure 4.4). But, because of the close proximity to the eastbound traffic light, the equipment was incurring frequent damage from the heavy trucks. Therefore, the location was moved and split into two separate sites (identified by the two larger “stars” in Figure 4.4 at Location 3). The additional site was required in order to capture the trucks that were using 14th St. as an alternate route to Eller Drive. 14th St. is a two-lane bi-directional road and only one counter was required here. Eller Dr. is a four-lane bi-directional road with no median and required one classification unit in each direction. Eller drive is an exit/entrance to I-595, I-95 and US-1 that not only adds to the traffic volumes but also has high average travel speeds. When the traffic lights are in the green phase, speeds have been recorded over 55 mph. This location is by far the one with the highest percentage of truck volumes. Table 4.3 displays the total number of days data was successfully collected for at the port. Out of this data, 61days for inbound and 73 days for outbound were used for the model calibration and validation process. Not all successful days were utilized due to not having comprehensive data for all locations on a particular day.

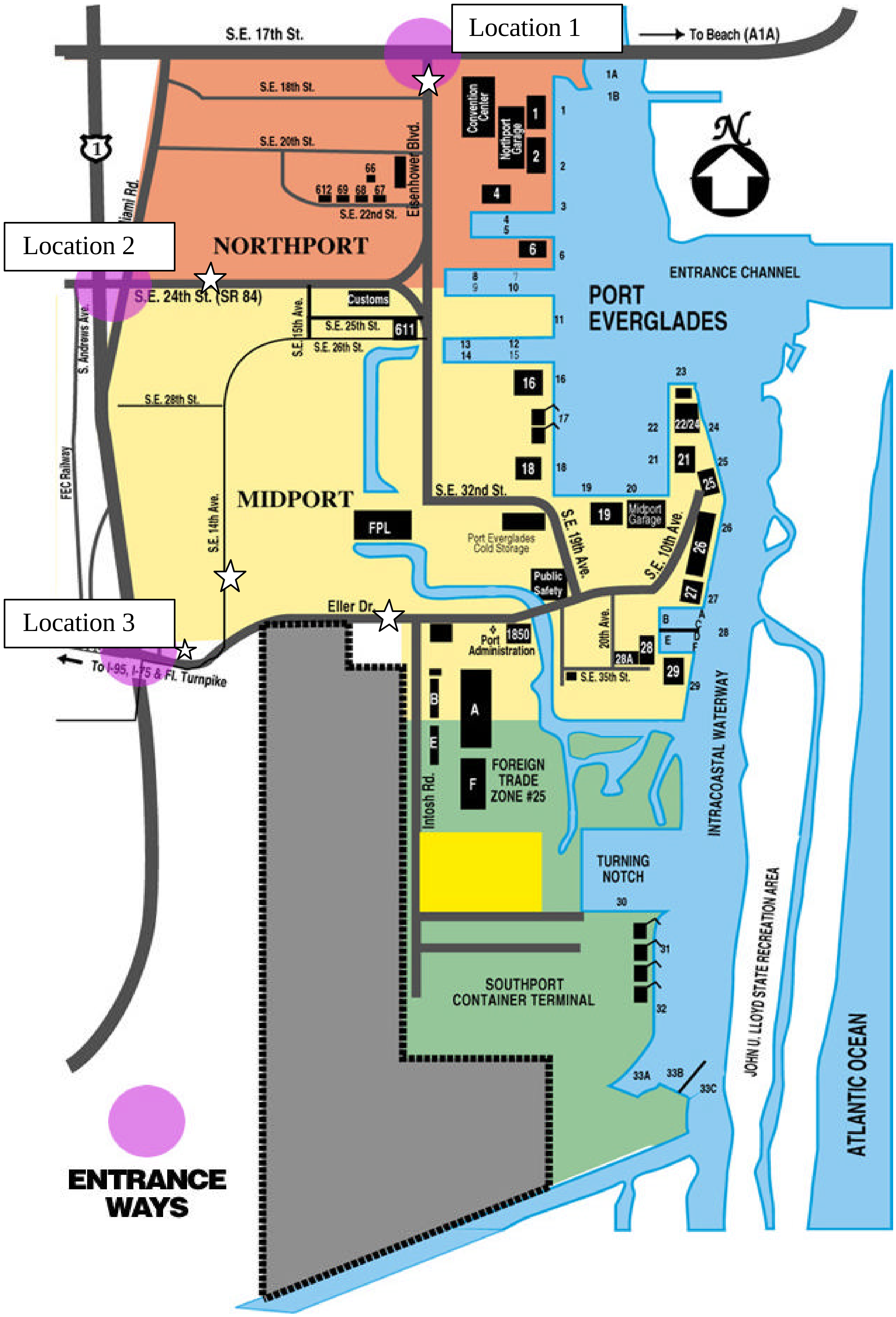


Figure 4.4 Port Entrance at the Port of Everglades

4.1.3 Port of Tampa

Data collection at the Port of Tampa commenced on May 9, 2000 and was completed on December 16, 2000. Data was collected for 221 days. Fiber optic sensors were initially installed at all locations but due to the frequent damage, the fiber optic sensors were replaced with road tubes at all locations. Successful data collection was not actually achieved until June 1, 2000 due to the difficulties with the fiber optic road sensors. Five locations at three separate port facilities were chosen to collect truck traffic counts (shown in Figures 4.5 and 4.6), which is a distinguishing characteristic for this port compared to the other ports selected. The locations include:

Location 1: South of the Crosstown Expressway on 22nd Street.

Location 2: South of the Crosstown Expressway on 20th Street.

Location 3: West of 50th Street on Causeway Boulevard.

Location 4: West of 50th Street on Port Sutton Road.

Location 5: West of 50th Street on Pendola Point Road.

This port was the most difficult for obtaining comprehensive counts at. Because there were five separate locations, it was difficult to obtain a high number of days when all the units were functioning at the same time. Many times, there would be at least one location with a damaged road tube, thus making the counts not useful for modeling because a total daily volume for all five locations was required. This was one reason for having separate classification units for each direction at the higher volume locations (Locations 1, 2, and 3). These locations not only had high truck volumes, but the non-truck volumes were extremely high as well. Having separate units for each direction would provide higher probability of obtaining comprehensive counts for inbound or outbound. The model development did not require matching inbound and outbound truck volumes. The directions are modeled separately, see Section 5.3.3 for more details.

Location 1 (22nd Street, see Figure 4.5) is a two-lane bi-directional road with a center turn lane (suicide lane). Because of the short distances between traffic signals, two separate classification units were required. During one of the visits to investigate the traffic situation before installation, it was observed that traffic would queue past the location of each unit in one direction at times. Therefore in order to have good count accuracy, one unit for each direction was used. Location 2 (20th Street, see Figure 4.5) is a two-lane bi-directional road with no median. However, the lane widths are such that two vehicles could travel adjacent in one direction and there were times this was observed during the field observations. Because of the frequency of damage and the large lane widths, two separate classification devices were used, one for each direction. Location 3 (Causeway Boulevard, see Figure 4.6) is a four-lane bi-directional road with a center turn lane (suicide lane). This location has the highest truck volumes of the five locations. One classification unit was used for each direction. Location 4 (Port Sutton Road, see Figure 4.6) is a two-lane bi-directional road with no median. One classification unit was used for both directions. The fiber optic sensors that were installed here remained operational longer than any of the other locations. This is attributed to the low traffic volumes and higher speeds of the vehicles. They were operational until damaged by road maintenance. The damaged sensors were then replaced with road tubes. Location 5 (Pendola Point Road, see Figure 4.6) is a two-lane bi-directional road with no median. One classification unit was used for both directions. This location is by far the one with the highest percentage of truck volumes. Table 4.3 displays the total number of days data was successfully collected for at the port. Out of this data, 68 days for inbound and 73 days for outbound data were used for the model calibration and validation process. Not all successful days were utilized due to not having comprehensive data for all locations on a particular day.

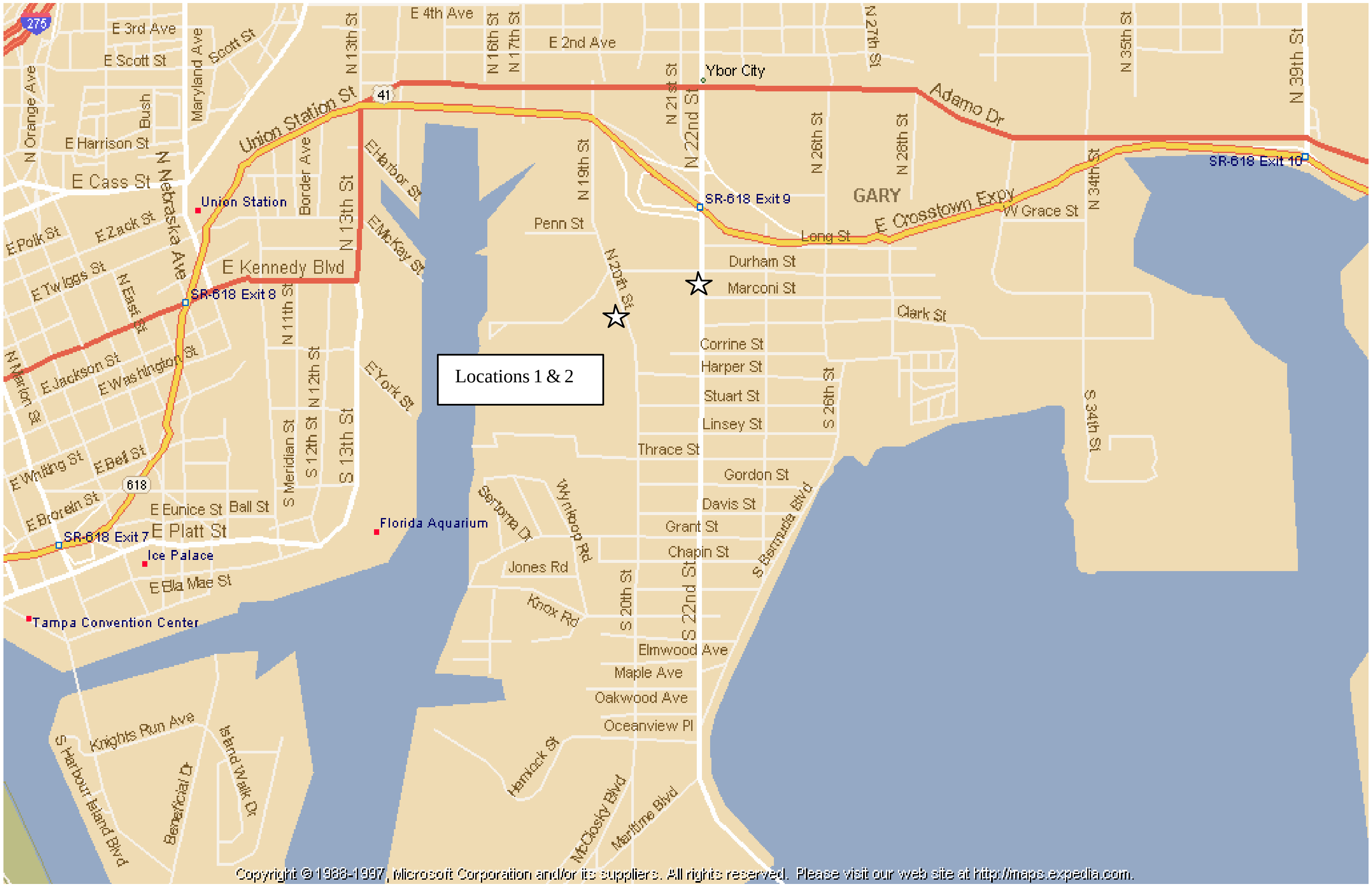


Figure 4.5 Port Entrance at the Port of Tampa (Locations 1 and 2)

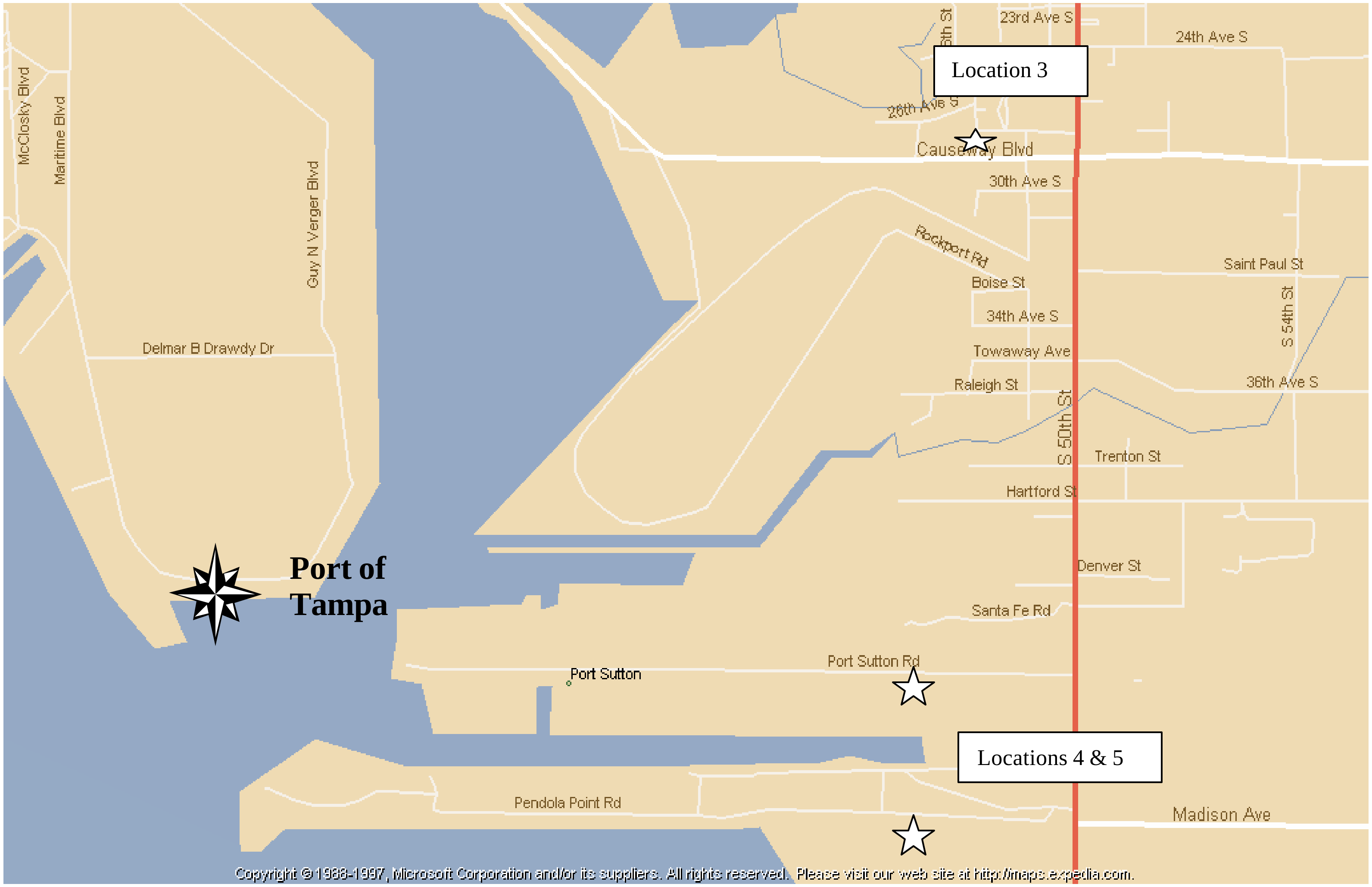


Figure 4.6 Port Entrance at the Port of Tampa (Locations 3, 4 and 5)

4.1.4 Port of Jacksonville

Data collection at the Port of Jacksonville commenced on September 20, 1999 and was completed on December 11, 1999. Data was collected for a total of 162 days in 1999 and 2001. There were difficulties collecting data at Location 1 (see Figure 4.7) so a second data collection endeavor was conducted from February 9, 2001 to April 28, 2001. Fiber optic sensors were not installed at any of these locations because data collection was initiated before this technology was investigated and proposed for use and in 2001 it was already concluded that the air tubes were more cost efficient. Three locations at two separate terminals were chosen to collect truck volume counts (shown in Figures 4.7 and 4.8), which is a distinguishing characteristic for this port compared to the other ports selected. The locations include:

Location 1: Southeast of Hecksher Drive on Blount Island Road

Location 2: West of Talleyrand Avenue on E. 21st Street.

Location 3: West of Talleyrand Avenue on 8th Street.

Location 1 (Blount Island Road, see Figure 4.7) is a four-lane bi-directional road with a wide raised unpaved median. This location was difficult to collect data at because the road tubes were frequently damaged by vehicular traffic and vandalism. Data collection at this location was not successful until the early part of 2001. Two classification units, one for each direction were installed. Location 2 (21st Street, see Figure 4.8) is a four-lane bi-directional road. Two classification units, one for each direction were installed. Location 3 (8th Street, see Figure 4.8) is a four-lane bi-directional road. Two classification units, one for each direction were installed. Data was collected for a total 162 days in 1999 and 2001. Table 4.3 displays the total number of days data was successfully collected for both terminals at the port. Out of this data, 69 days for Talleyrand and 41 days for Blount Island terminal were used for the model calibration and validation process. Not all successful days were utilized due to not having comprehensive data for both locations at Talleyrand on a particular day or inaccuracies in the vessel data for days truck counts were available like significantly low or high volumes for a particular commodity type compared to most other days in the month.

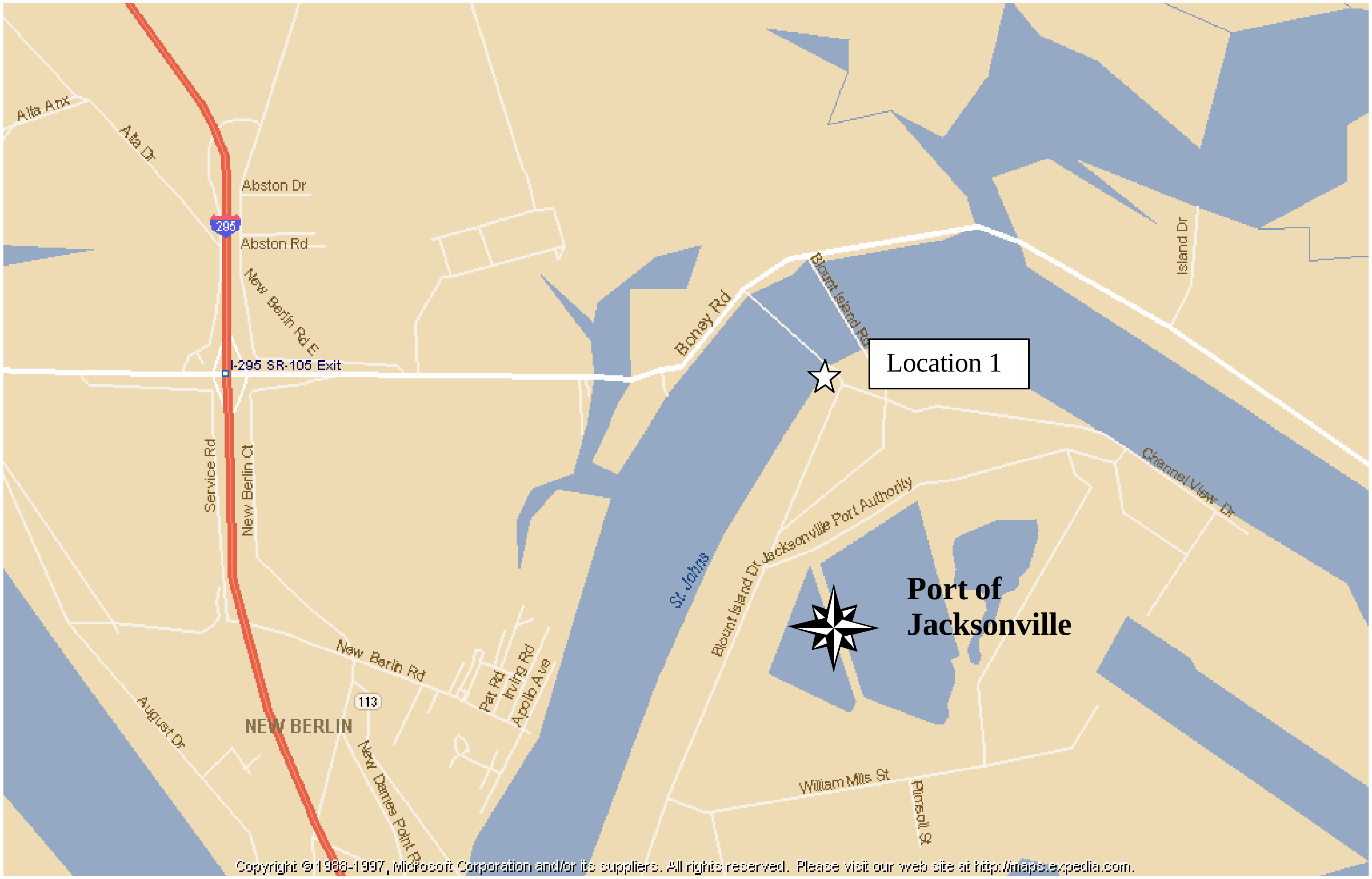


Figure 4.7 Port Entrance at Blount Island Terminal (Port of Jacksonville)

Figure 4.8: Port Entrances at Talleyrand Terminal (Port of Jacksonville)

4.2 RAIL COUNTS

The Port of Palm Beach, Port of Tampa and Port of Jacksonville have rail activity. The Port of Everglades is the only port of the four chosen in this phase to have shown insignificant rail activity. Because the rail companies are private transportation companies and competitors with the trucking companies, it was difficult to obtain any useful data. The data that would be useful for determining modal split and commodity flow by rail may be considered too detailed for operational purposes related to economics of the rail companies and very proprietary. The rail data obtained was not comprehensive enough to be useful for modeling purposes. It was necessary to know the specific tonnage and type of each rail car moving in and out of the port daily in order to provide enough information in the model development process for the desired accuracy.

The Port of Palm Beach provided rail data that included the type and quantity of rail cars. The types of rail cars transporting cargo for import or export by vessel are:

- Hopper Car (cement) (H)
- Flat Car (F)
- Box Car (refrigerated) (B)
- Box Car (non-refrigerated) (B)
- Tank Car (chemicals) (T)
- 2-section Spline Car (2)
- 2-section Spline Car (2)
- 3-section Spline Car (3)
- 4-section Spline Car (4)
- 5-section Spline Car (5)

The daily rail car counts provided by the port were coded by a letter or number designation for type of car. These are indicated above. The daily rail car counts inbound and outbound corresponding to the time period data was collected and analyzed for the Port of Palm Beach are shown in Appendix C. Tables C.1.and C.2. The Port of Palm Beach provided the only rail data with enough information to calculate any modal split. With this data and commodity information related to the cargo transported by truck and rail from the port authority and private transport companies, a modal split was calculated. Figure 4.9 shows the modal split for exported cargo.

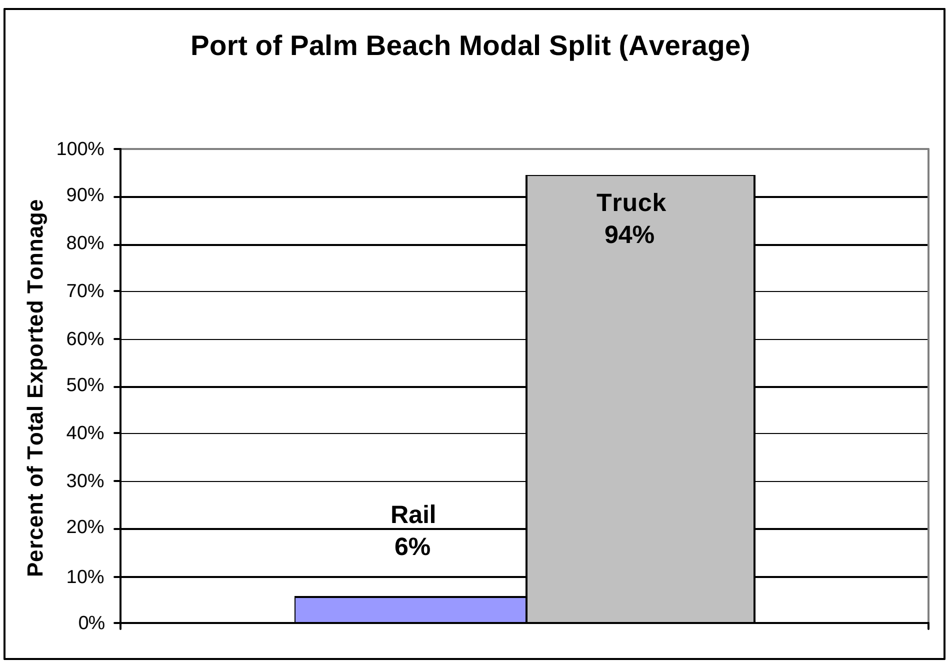


Figure 4.9 Port of Palm Beach Modal Split (Inbound Rail and Trucks)

The port authority does not record data on the number of inbound and outbound rail cars empty or loaded and FEC could not disclose this information. Exported tonnage could be calculated because the port authority provided the information that almost 100% of the inbound rail cars to the port are loaded. The number of outbound rail cars loaded however varies greatly. The commodity information related to what the rail cars transport was tonnage and TEUs (twenty equivalent units). This was:

- One Spline Car section (2 TEUs)
- Flat Car (2 TEUs)
- Box Car (2 TEUs)
- Hopper Car (140 tons of cement)
- Tanker Car (113 tons of bulk)

There were a number of steps in the procedure for determining the modal split. It was assumed that the daily rail cars transported cargo that was exported the following day. Therefore, the daily vessel records for exported cargo were related to the previous day's rail car counts. Sundays had no vessel or rail car activity so Monday's exports were related to Saturday's rail car counts. The TEUs are equivalent to one twenty-foot container. All non-bulk cargo was considered containerized cargo. Using the daily tonnage and number of TEUs for this containerized cargo, a daily tons per TEU value was calculated and used to determine the daily tonnage carried by all rail cars that transport cargo in TEUs. The Hopper Cars were excluded from the calculations of exported tonnage because they only transport cement products that are not an exported commodity. This is brought to the port from Tampa and transported from the port by truck. The port authority also stated that the Tanker Cars are normally empty inbound and loaded outbound so these were also excluded. With the total tonnage per TEUs for rail calculated, the remaining tonnage was assumed to be transported by truck.

For the Port of Everglades, Florida East Coast Rail (FEC) has provided information about rail activity indicating that it is insignificant and therefore was not considered in the analysis for the port. From January through June of 2000, only 123 cars were recorded inbound loaded. For the entire year of 1999, only 301 cars were recorded inbound loaded. No outbound rail commodity transport activity was recorded. Also, the rail activity was said to be only for supplying port tenants with materials for daily operations. None of the Port of Everglades rail activity is attributed to imported or exported cargo.

Rail data for the Port of Tampa was not obtained for the exception of a few sparse data records. CSX indicated an average of 540 cars/day for transportation of fertilizer and the total rail car movements per day were estimated at 1200 cars/day. The port authority provided records for the two tenants that are billed for rail car movements. These are displayed in Table 4.4. These tenants are at the Hooker's Point Terminal. It is known that there is more rail activity than this for the same commodity types as well as other cargo imported and exported. Because this data is not available, no modal split can be determined.

	Trademark Metals	**GATX Petroleum**
Month	tons	# of Barrels
March	10,309	6,007
April	10,232	6,861
May	10,890	9,482
June	1,808	4,138
July	193	6,888
August	2,943	8,240
September	2,650	5,706
October	677	5,503
November	0	5,474
December	0	5,487

note: railcar movements (outbound only)

Table 4.4 Port of Tampa Rail Car Tonnage

Jacksonville rail data was the least informative. Only the number of rail cars for the Talleyrand Terminal was provided. Table C.3 in Appendix C shows a sample of a monthly rail activity report. The type of rail car was not known for all the records therefore tonnage estimates were not calculated. Blount Island Terminal is also known to have rail car activity but is completely operated by private companies (i.e. CSX Transportation) and as such, no data was released.

4.3 VESSEL DATA

4.3.1 Port of Palm Beach

The commodity types included in the vessel data received from the Port of Palm Beach are in Table 4.5. Figure 4.10 shows a sample of the vessel data in excel format after import from the file format received. The files were not Microsoft files and therefore had to be converted to excel files. Each file received was separated by daily imported or exported cargo by vessel. The data included fields for the date, SLINE (a code used in for financial tracking purposes), Vessel, TEUs (twenty equivalent units), short tons and commodity. The TEUs are used to measure containerized cargo. The majority of containers are twenty or forty feet in measured length. A short ton is equivalent to two thousand pounds or a normal English unit ton. In order to determine the commodity types for all records, a list of the vessels and their commodity types transported was provided. Table 4.6 lists this information. 982 daily vessel cargo import and export records were received for January through June of year 2000. This data was derived from the Port of Palm Beach's monthly PIERS reports. Sugar exports are recorded on a monthly billing schedule and were received as separate files. Sugar is a domestically transported commodity only and is therefore not included with the regular freight records. Figure 4.11 shows an example of the sugar records received. A contact from Florida Sugar Transportation provided daily breakdowns.

Commodity	Unit Type
BreakBulk	Tons & TEU
Cement	Tons & TEU
Containers	Tons & TEU
Molasses	Tons & TEU
Research Vessel*	
Sugar	Tons & TEU
Vehicles- Haiti	Tons & TEU

*not a freight transport vessel

Table 4.5 Port of Palm Beach Commodity Types

VDATE	SLINE	VESSEL	TEU'S	SHORT TONS	COMMODITY - General Container cargo unless otherwise noted.
JAN, 2000					
103	TRSL	THYRA MOLLER	34.81	195.23	CONTAINER
103	TRSL	TROPIC ISLE	22.34	257.17	
104	MHSC	MARGARITA I	8.14	626.81	
104	TRSL	TROPIC ISLE	10.22	145.87	
104	TRSL	TROPIC PALM	120.21	1163.82	
104	UASC	DUKE OF TOPSAIL	8.02	710.45	BREAK BULK
105	TRSL	TROPIC ISLE	36.14	408.01	
105	TRSL	TROPIC KEY	58.49	440.29	
105	TRSL	TROPIC NIGHT	51.75	509.2	
105	TRSL	TROPIC TIDE	226.84	2182.71	
106	TRSL	BERULAN	192.17	1824.48	
106	TRSL	TROPIC ISLE	30.83	372.07	
106	TRSL	TROPIC PALM	84.02	782.9	
107	TRSL	TROPIC LURE	150.09	1007.62	
107	TRSL	TROPIC NIGHT	61.81	545.59	
107	TRSL	TROPIC SUN	327.28	2902.61	
107	UASC	ISLAND BAY	0	30.3	BREAK BULK
108	TRSL	TROPIC ISLE	35.97	302.1	
108	TRSL	TROPIC PALM	103.24	1095.83	
110	TRSL	THYRA MOLLER	125.19	501.53	
110	TRSL	TROPIC ISLE	22.25	210.49	
111	MHSC	MARGARITA I	8.32	555.65	
111	TRSL	TROPIC ISLE	23.36	217.98	
111	TRSL	TROPIC PALM	140.96	1318.4	
111	UASC	DUKE OF TOPSAIL	4	422.08	BREAK BULK
111	MHSC	UNITED SPIRIT	0	255.87	BREAK BULK
112	TRSL	TROPIC ISLE	50.18	497.57	
112	TRSL	TROPIC KEY	111.25	756.36	
112	TRSL	TROPIC NIGHT	65.1	580.71	
112	TRSL	TROPIC TIDE	229.4	1972	
113	TRSL	AURORA	326.69	2924.35	
113	TRSL	TROPIC ISLE	32.2	317.95	
113	TRSL	TROPIC PALM	104.49	1079.04	
113	UASC	ISLAND BAY	0	45.8	BREAK BULK
114	TRSL	TROPIC LURE	176.5	1118.15	
114	TRSL	TROPIC NIGHT	59.71	549.78	
114	TRSL	TROPIC SUN	355.67	3050.65	
115	TRSL	TROPIC ISLE	43.4	360.34	
115	TRSL	TROPIC PALM	122.32	1204.24	
117	TRSL	THYRA MOLLER	83.42	267.85	
117	TRSL	TROPIC ISLE	38.76	458.49	
118	MHSC	MARGARITA I	5.07	637.61	BREAK BULK
118	TRSL	TROPIC PALM	112.76	1055.23	
118	TRSL	TROPIC REIGN	26.95	286.3	
118	UASC	DUKE OF TOPSAIL	5.66	377.76	
119	TRSL	TROPIC ISLE	55.87	455.26	

Figure 4.10 Port of Palm Beach Vessel Data Sample
(source: Palm Beach Port Authority)

Vessel Name	Commodity Type
AMAZING GRACE	Breakbulk
ASHKHABAD	Molasses
AURORA	Container
BERULAN	Container
DUKE OF TOPSAIL	Breakbulk
FREEPORT FLYER	Container
FRIDA	Cement
GLORIA ELENA	Cement
ISLAND BAY	Breakbulk
KOOS KARRIER	Research Vessel
LIANO	Molasses
MARGARITA I	Breakbulk
MIA DEAN	Breakbulk
MONARCH DUCHESS	Vehicles - Haiti
MONARCH QUEEN	Vehicles - Haiti
PAROS	Molasses
PORTOFINO	Molasses
SEA LION V	Breakbulk
SEI 07	Research Vessel
THAI HO	Molasses
THYRA MOLLER	Container
TOKAI	Container
TROPIC ISLE	Container
TROPIC JADE	Container
TROPIC KEY	Container
TROPIC LURE	Container
TROPIC MIST	Container
TROPIC NIGHT	Container
TROPIC OPAL	Container
TROPIC PALM	Container
TROPIC REIGN	Container
TROPIC SUN	Container
TROPIC TIDE	Container
UNITED SPIRIT	Breakbulk
VINCITA	Molasses

Table 4.6 Port of Palm Beach Vessel Data
(source: Palm Beach Port Authority)

Sugar Barge Tonnage			
	Tug	**Barge**	**Sugar Tonnage**
January	Sea Robin	ATC 350	11,760.00
	Osprey	Sugar Express	14,000.00
	Socrates	Jonathon	14,000.00
	Comet	ATC 12000	11,760.00
February	Sea Robin	ATC 350	11,760.00
	Osprey	Sugar Express	14,000.00
	Socrates	Jonathon	14,000.00
	Socrates	Jonathon	11,760.00
	Comet	ATC 12000	14,000.00
	Comet	ATC 12000	11,760.00
	Comet	ATC 12000	11,760.00
March	Socrates	Jonathon	11,760.00
	Osprey	Sugar Express	14,000.00
	Osprey	Sugar Express	14,000.00
	Comet	ATC 12000	14,000.00

Figure 4.11 Port of Palm Beach Sugar Exports Data Sample
(source: Palm Beach Port Authority)

4.3.2 Port of Everglades

The commodity types included in the vessel data received from the Port of Everglades are in Table 4.7. The unit type is how each commodity is measured in terms of quantity exported or imported. Each is a count of the number of containers, bbl is barrels, mbft is measured board feet and ton is the basic measure in English units. Figure 4.12 shows a sample of the vessel data in excel format. 22129 daily vessel cargo import and export records were received for January through November of year 2000. The files were not Microsoft files and therefore had to be converted to excel files, which were then imported into an access database. The vessel data consisted of the vessel, ID # (a code used in for financial tracking purposes), the arrival month, day, year, time of shipment, the departure month, day, year, time of shipment, whf description (commodity type), units (measured in bbl, each, mbft or ton), and I/O (direction of shipment: inbound or outbound). Once the data was imported into the database, some coding was necessary in order to query the data for use in the model building process. The unit type had to be identified, non-freight transport vessels were removed, and mbft was converted to tons (unit value multiplied by 1.350004, Everglades Port Authority).

Commodity	Unit Type	Commodity	Unit Type
20' EMPTY MAERSK	each	FUEL OIL	bbl
20' MAERSK	each	GASOLINE	bbl
40' EMPTY MAERSK	each	GYPSUM	ton
40' MAERSK	each	HARD/PARTICLE BOARD	ton
AGGREGATE	ton	JET FUEL	bbl
ASPHALT	bbl	LUMBER	mbft
AUTOMOBILES	ton	MAERSK 2000	ton
AVGAS	bbl	PLYWOOD	ton
BREAK BULK-GENERAL	ton	PROPANE	bbl
BUSES	ton	ROCK OR SAND	ton
CEMENT (BULK)	ton	RORO PURE CAR CARRIE	each
CEMENT CLINKERS	ton	S DEBARKED - CRUISE*	
CONT. 20' EMPTY SMBT	each	S DEBARKED - FERRY*	
CONT. 40' EMPTY SMBT	each	S EMBARKED - CRUISE*	
CONT. CARGO ATL-DIV	ton	S EMBARKED - FERRY*	
CONT. CARGO SM-BOAT	ton	S TRANSIT - CRUISE*	
CONT. CARGO-DOLE	ton	SCRAP METAL	ton
CONT. CARGO-MAERSK	ton	SEALAND 1997	ton
CONTAINER 20'	each	SEALAND 1999	ton
CONTAINER 20' EMPTY	each	STEEL	ton
CONTAINER 20'-SMBOAT	each	STEEL COILS	ton
CONTAINER 40'	each	STEEL REBAR	ton
CONTAINER 40' EMPTY	each	TALLOW	ton
CONTAINER 40'-SMBOAT	each	TRACTORS	ton
CONTAINTERIZED CARGO	ton	TRUCKS, TRAILERS	ton
CRUDE OIL (LOADED)	bbl	YACHTS/BOATS	ton
DIESEL	bbl	YACHTS/BOATS FLOATIN	ton

*not a freight transport vessel

Table 4.7 Port of Everglades Commodity Types
(source: Everglades Port Authority)

VESSEL	ID #	Arr Mo	Arr Day	Arr Yr	Arr Time	Dep Mo	Dep Day	Dep Yr	Dep Time	Whf Description	Units	I/O
CROWLEY SENATOR	40898	10	13	2000	600	10	13	2000	1945	CONTAINER 40'	100	IN
SEA CLOUD	41028	10	19	2000	1500	10	20	2000	135	CONT. 20' EMPTY SMBT	(33)	OUT
SEA CLOUD	41028	10	19	2000	1500	10	20	2000	135	CONTAINER 20'	33	OUT
SANMAR PIONEER	41085	10	27	2000	125	11	2	2000	1825	CEMENT (BULK)	43,826	IN
DOCK EXPRESS 11	41122	10	28	2000	2155	11	1	2000	1600	YACHTS/BOATS FLOATIN	483	IN
DOCK EXPRESS 11	41122	10	28	2000	2155	11	1	2000	1600	YACHTS/BOATS FLOATIN	502	OUT
BARGE YUCATAN	41235	10	29	2000	1300	10	29	2000	2400	FUEL OIL	35,622	IN
SEA CRANE	41035	10	30	2000	1115	11	4	2000	720	CEMENT (BULK)	22,443	IN
CORSAR	41218	10	31	2000	1655	11	2	2000	35	CONTAINER 20'	17	IN
CORSAR	41218	10	31	2000	1655	11	2	2000	35	CONTAINER 20'	78	OUT
CORSAR	41218	10	31	2000	1655	11	2	2000	35	CONTAINER 20' EMPTY	50	IN
CORSAR	41218	10	31	2000	1655	11	2	2000	35	CONTAINER 40'	8	IN
CORSAR	41218	10	31	2000	1655	11	2	2000	35	CONTAINER 40'	122	OUT
CORSAR	41218	10	31	2000	1655	11	2	2000	35	CONTAINER 40' EMPTY	94	IN
CORSAR	41218	10	31	2000	1655	11	2	2000	35	CONTAINERIZED CARGO	310	IN
CORSAR	41218	10	31	2000	1655	11	2	2000	35	CONTAINERIZED CARGO	2,776	OUT
DISCOVERY SUN	41168	10	31	2000	2145	11	1	2000	755	S DEBARKED - FERRY	189	IN
DISCOVERY SUN	41168	10	31	2000	2145	11	1	2000	755	S EMBARKED - FERRY	245	OUT
DISCOVERY SUN	41168	10	31	2000	2145	11	1	2000	755	AUTOMOBILES	7	OUT
DISCOVERY SUN	41168	10	31	2000	2145	11	1	2000	755	CONTAINER 20'	5	OUT
DISCOVERY SUN	41168	10	31	2000	2145	11	1	2000	755	CONTAINER 40'	7	OUT
DISCOVERY SUN	41168	10	31	2000	2145	11	1	2000	755	CONTAINERIZED CARGO	148	OUT
DISCOVERY SUN	41168	10	31	2000	2145	11	1	2000	755	TRUCKS, TRAILERS	4	OUT
STENA TIMER	41229	10	31	2000	1300	11	1	2000	2025	AUTOMOBILES	12	OUT
STENA TIMER	41229	10	31	2000	1300	11	1	2000	2025	CONTAINER 20'	1	IN
STENA TIMER	41229	10	31	2000	1300	11	1	2000	2025	CONTAINER 20'	12	OUT
STENA TIMER	41229	10	31	2000	1300	11	1	2000	2025	CONTAINER 20' EMPTY	10	IN
STENA TIMER	41229	10	31	2000	1300	11	1	2000	2025	CONTAINER 40'	5	IN
STENA TIMER	41229	10	31	2000	1300	11	1	2000	2025	CONTAINER 40'	35	OUT
STENA TIMER	41229	10	31	2000	1300	11	1	2000	2025	CONTAINER 40' EMPTY	68	IN
STENA TIMER	41229	10	31	2000	1300	11	1	2000	2025	CONTAINERIZED CARGO	81	IN
STENA TIMER	41229	10	31	2000	1300	11	1	2000	2025	CONTAINERIZED CARGO	833	OUT
STENA TIMER	41229	10	31	2000	1300	11	1	2000	2025	TRUCKS, TRAILERS	65	OUT
YEOCOMICO II	41227	10	31	2000	1400	11	2	2000	105	AUTOMOBILES	1	OUT
YEOCOMICO II	41227	10	31	2000	1400	11	2	2000	105	BREAK BULK-GENERAL	84	OUT
YEOCOMICO II	41227	10	31	2000	1400	11	2	2000	105	TRUCKS, TRAILERS	2	OUT
BAHAMA SKY	41301	11	1	2000	920	11	1	2000	2235	AUTOMOBILES	6	OUT
BAHAMA SKY	41301	11	1	2000	920	11	1	2000	2235	BREAK BULK-GENERAL	1	OUT
BAHAMA SKY	41301	11	1	2000	920	11	1	2000	2235	CONT. CARGO SM-BOAT	1	IN
BAHAMA SKY	41301	11	1	2000	920	11	1	2000	2235	CONT. CARGO SM-BOAT	230	OUT
BAHAMA SKY	41301	11	1	2000	920	11	1	2000	2235	CONT. 20' EMPTY SMBT	2	IN

Figure 4.12 Port of Everglades Vessel Data Sample
(source: Everglades Port Authority)

4.3.3 Port of Tampa

The commodity types included in the vessel data received from the Port of Tampa are in Table 4.8. The unit type is how each commodity is measured in terms of quantity exported or imported. MBF is measured board feet. Figure 4.13 shows a sample of the vessel data in excel format. 4915 daily vessel cargo import and export records were received for March through December of year 2000. The files were not Microsoft files and therefore had to be converted to excel files, which were then imported into an access database. The vessel data consisted of the activity date, berth, commodity description, quantity, tons, number of containers, and import/export. Once the data was imported into the database, some coding was necessary in order to query the data for use in the model building process. The unit type had to be identified and non-freight transport vessels were removed.

There were berths included in the Port of Tampa vessel data that are solely serviced landside by rail. However, because the modeling procedure is so dynamic, it was not necessary to remove any import or export data that was transported by rail. This was one of the reasons Artificial Neural Networks was chosen for modeling. This makes the procedure for obtaining the data and preparing the input data for the model easier. The user does not have to filter the data for mode type in order to prepare it for input.

Commodity	Unit Type	Commodity	Unit Type	Commodity	Unit Type
AGGREGATE, NOS	Tons	CITRUS PELLETS	Tons	FERTILIZER, BAGGED	Tons
ALCOHOL, BULK	Barrels	CITRUS PRODUCTS NOS	Tons	FERTILIZER, BAGGED/CONT	Tons
ALCOHOL,DENTR DRMD	Tons	CITRUS, PULP, DRMD/CTN	Tons	FLOUR & MEAL, BAGGED	Tons
ALCOHOL,DENTR,PKG	Tons	CLAY, BAGGED	Tons	FLYASH, BULK	Tons
ALUMINUM	Tons	CLAY, BULK	Tons	FOOD, NOS	Tons
ALUMINUM SULFATE	Tons	COAL	Tons	FOOD,FRZN/CH,NOS	Tons
AMMONIA, ANHYDROUS	Tons	COAL, PKGD	Tons	FRUIT JUICE, CANNED	Tons
AMMONIUM NITRATE	Tons	COFFEE	Tons	FRUIT, FRESH, (CHILEAN)	Tons
AMMONIUM SULFATE	Tons	COKE	Tons	FRUIT, FRESH, BANANAS	Tons
ANIMALS, LIVE	Each	COMMOD, CONTAINERIZED	Tons	FRUIT, FRESH, CITRUS	Tons
ARAGONITE	Tons	COMMOD,CONTAINZD,USDA	Tons	FRUIT, FRESH, MELONS	Tons
ASPHALT, PACKAGED	Tons	COMMODITIES, NOS, BULK	Tons	FRUIT, FRESH, NOS	Tons
ASPHALT, ROOF FLUX,PKGD	Tons	COMMODITIES, NOS, PCKGD	Tons	FRUIT, FRESH, PLANTAINS	Tons
BATTERIES	Tons	CONCENTR, CITRUS,DRM/CONT	Tons	FRUIT,FROZEN	Tons
BAUXITE, BULK	Tons	CONCENTRATE, APPLE DRMD	Tons	FURNITURE	Tons
BRICK	Tons	CONCENTRATE, CITRS BULK	Tons	GLASS PRODUCTS	Tons
BUILDING MATERIALS	Tons	CONCENTRATE, G/FRUIT DR	Tons	GRAINS, NOS, BAGGED	Tons
BUTTER	Tons	CONCENTRATE, LEMON DRMD	Tons	GRAINS, NOS, BULK	Tons
CALCIUM NITRATE, BAGGED	Tons	CONCENTRATE, LIME DRMD	Tons	GRANITE ROCK, BULK	Tons
CALCIUM NITRATE, DRY BULK	Tons	CONCENTRATE, ORANG DRMD	Tons	GRAVEL, BULK	Tons
CALCIUM NITRATE, LIQ BULK	Tons	CONCENTRATE, OTHER,DRMD	Tons	GYPSUM ROCK	Tons
CANNED GOODS	Tons	CONCENTRATE, PINEAPPLE	Tons	GYPSUM WALLBOARD	Tons
CATTLE, LIVE	Each	CONCRETE PRODUCTS	Tons	HARDBOARD	Tons
CAUSTIC SODA	Tons	CONSTRUCTION EQUIPMENT	Tons	HARDWARE, NOS	Tons
CEMENT, BAGGED	Tons	CORDAGE	Tons	HIDES & SKINS	Tons
CEMENT, BULK	Tons	CORN SYRUP, BULK NOS	Tons	HONEY, PACKAGED	Tons
CEMENT, CLINKER, BULK	Tons	DEMOLITION MATERIALS	Tons	HOUSEHD GDS/PERS EFFECT	Tons
CHEESE	Tons	DIESEL FUEL, DRUMMED	Tons	HOUSEHOLD APPLIANCES	Tons
CHEMICALS, BULK	Tons	DOORSKINS	Tons	INSECT/FUNGICIDES, PKGD	Tons
CHEMICALS, PACKAGED	Tons	EGGS, FRESH	Tons	IRON ORE	Tons
CHIPBOARD	Tons	EGGS, PREPARED/PRESERVD	Tons	IRON SULFATE	Tons
CITRUS JUICE, BOTTLED	Tons	ELECTRICAL EQUIPMENT	Tons	KIESERITE	Tons
CITRUS JUICE, BULK	Tons	ESSENCE, BULK	Tons	LIMESTONE	Tons
CITRUS JUICE, CANNED	Tons	ESSENCE, DRMD	Tons	LINERBOARD	Tons
CITRUS JUICE, GFRT, DRMD	Tons	FEED, BAGGED	Tons	LIQUOR, BEER	Tons
CITRUS JUICE, OR, DRMD	Tons	FEED, BULK	Tons	LIQUOR, NOS	Tons
CITRUS OIL	Tons	FERTILIZER LIQUID BULK	Tons	LIQUOR, WINE	Tons
CITRUS OIL, DRUMMED	Tons	FERTILIZER MATERIALS, BLK	Tons	LOGS	Tons

Table 4.8 Port of Tampa Commodity Types
(source: Tampa Port Authority)

Commodity	Unit Type
LUBE OIL, PACKAGED	Tons
LUMBER, CEDAR	MBF
LUMBER, DOUGLAS FIR	MBF
LUMBER, HEMLOCK	MBF
LUMBER, HEMLOCK-FIR	MBF
LUMBER, NOS	MBF
LUMBER, PINE	MBF
LUMBER, SPRUCE	MBF
LUMBER, TOMATO STAKES	MBF
LUMBER, TRUSSES	MBF
MACHINERY	Tons
MAGNESIUM SULFATE, BGD	Tons
MAGNESIUM SULFATE, BULK	Tons
MEAT (FRESH OR FROZEN)	Tons
MEAT, CANNED	Tons
MEDICAL SUPPLIES	Tons
METALS	Tons
MILLSCALE, BULK	Tons
MINERALS/ORES, BULK	Tons
MINERALS/ORES, PKG	Tons
MOLASSES,BULK	Tons
NEWSPRINT & CORES	Tons
NITRATE OF SODA, BAGGED	Tons
NITRATE OF SODA, BULK	Tons
OFFALS	Tons
PAINTS & LACQUERS	Tons
PALLETS	Tons
PAPER, PULP IN ROLLS	Tons
PAPER, WASTE	Tons
PAPER/PAPER PRODUCTS	Tons
PASSENGERS	Each
PASSENGERS	Each
PASSENGERS, FOUR-DAY	Each
PEANUTS, BULK	Tons
PETROLEUM NOS DRUMMED	Tons
PETROLEUM NOS PKGD	Tons
PETROLEUM PRODUCTS	Barrels
PETROLEUM SOLVENTS PKGD	Tons
PETROLEUM, BKRS, ALL OTHS	Barrels
PETROLEUM, BUNKERS	Barrels
PHOSPHAT CHEMICAL, BULK	Tons
PHOSPHAT CHEMICAL,BAGGD	Tons
PHOSPHATE, BAGGED	Tons
PHOSPHATE, ROCK, BULK	Tons
PHOSPHORIC ACID	Tons
PIPE (OTHER THAN STEEL)	Tons
PIPE,PLASTIC	Tons
PLASTICS	Tons
PLUMBING SUPPLIES	Tons
PLYWOOD	Tons
POMACE	Tons
POTASH, BAGGED	Tons
POTASH, BULK	Tons
POTASSIUM NITRATE, BULK	Tons
POTASSIUM NITRATE,BAGGD	Tons
POULTRY (FRESH OR FROZ)	Tons
PROJECT CARGO	Tons
PUMICE, BULK	Tons
RICE/BAGGED	Tons
ROCK ASPHALT	Tons
RUBBER PRODUCTS	Tons
SALT, BAGGED	Tons
SALT, BULK	Tons
SALT, EPSON, BGD	Tons
SAND, SILICA, BAGGED	Tons
SAND, SILICA, BULK	Tons
SCRAP METAL	Tons
SEAFOOD, FRESH/FROZEN	Tons
SEAFOOD, PREPARD/PRESER	Tons
SLAG	Tons
SLAG, BAGGED	Tons
SPORTING GOODS	Tons
STEEL, ANGLES	Tons
STEEL, BARS	Tons
STEEL, BEAMS	Tons
STEEL, BILLETS	Tons
STEEL, BILLETS & BLOOMS	Tons
STEEL, CHANNEL	Tons
STEEL, COILS	Tons
STEEL, HARDWARE	Tons
STEEL, MISCELLANEOUS	Tons
STEEL, PIPE	Tons
STEEL, PIPE FITTINGS	Tons
STEEL, PLATES/SHEETS	Tons
STEEL, REBAR	Tons
STEEL, REINFORCING RODS	Tons
STEEL, STRIP	Tons
STEEL, TUBING	Tons
STEEL, WIRE IN COILS	Tons
STEEL, WIRE ROD	Tons
STONE,CRUSHED	Tons
SUGAR, BULK	Tons
SUGAR, PACKAGED	Tons
SULPHATE, FERROUS	Tons
SULPHATE, MANGANESE	Tons
SULPHUR, DRY	Tons
SULPHUR, LIQUID	Tons
SULPHURIC ACID	Tons
SULPHURIC ACID/IN	Tons
TALLOW, BULK	Tons
TALLOW, PACKAGED	Tons
TELECOMMUNICATION EQUIP	Tons
TEXTILES	Tons
TILE	Tons
TIN PLATE	Tons
TIRES & TUBES	Tons
TOBACCO, MANUFACTURED	Tons
TOBACCO, NOS (NON-MANU)	Tons
TOOLS	Tons
TRACTORS, MINIMUM	Each
TRACTORS, OTHER	Tons
TRAILERS, MINIMUM	Each
TRAILERS, OTHER	Tons
UREA, BULK	Tons

Table 4.8 Port of Tampa Commodity Types (continued)

Commodity	Unit Type
UTILITY POLES	Tons
VEGETABLES (PREPD/PRES)	Tons
VEGETABLES, FRESH	Tons
VEGETABLES, FRESH, CUKES	Tons
VEHICLES, EACH	Each
VEHICLES, FERRY < 19 FT.	Each
VEHICLES, FERRY > 19 FT.	Each
VEHICLES, MINIMUM	Each
VEHICLES, OTHER	Tons
WALLBOARD	Tons
WOODPULP	Tons
YACHTS & BOATS <19'11	Each
YACHTS & BOATS >19'11	Each
ZINC, BULK	Tons

Table 4.8 Port of Tampa Commodity Types (continued)

Activity Date	Berth	Commodity Description	Unit Type	Quantity	Tons	No of Cont	Import/Export
3/1/00	4148	PHOSPHAT CHEMICAL, BULK	B	7275	7275	0	E
3/1/00	4146	PHOSPHATE, ROCK, BULK	B	18556	18556	0	E
3/1/00	256	CITRUS PELLETS	B	8830	8830	0	E
3/1/00	024B	PETROLEUM, BKRS, ALL OTHS	B	473	71	0	E
3/1/00	024B	PETROLEUM, BKRS, ALL OTHS	B	9208	1599	0	E
3/2/00	4146	PHOSPHAT CHEMICAL, BULK	B	20942	20942	0	E
3/2/00	204	PHOSPHAT CHEMICAL, BULK	B	34294	34294	0	E
3/2/00	272	PASSENGERS	P	1068	1068	0	E
3/2/00	4110	PHOSPHAT CHEMICAL, BULK	B	3637	3637	0	E
3/2/00	024B	PETROLEUM, BKRS, ALL OTHS	B	212	32	0	E
3/3/00	4110	PHOSPHAT CHEMICAL, BULK	B	32159	32159	0	E
3/3/00	4148	PHOSPHAT CHEMICAL, BULK	B	2727	2727	0	E
3/3/00	4103	PHOSPHAT CHEMICAL, BULK	B	995	995	0	E
3/3/00	4132	PHOSPHAT CHEMICAL, BULK	B	14927	14927	0	E
3/3/00	202	COMMOD, CONTAINERIZED	C	232	232	27	E
3/3/00	202	COMMOD, CONTAINERIZED	C	277	277	20	E
3/3/00	024B	PETROLEUM, BKRS, ALL OTHS	B	50	8	0	E
3/3/00	024B	PETROLEUM, BKRS, ALL OTHS	B	995	149	0	E
3/4/00	23	POTASH, BULK	B	8069	8069	0	E
3/4/00	256	CITRUS PELLETS	B	27025	27025	0	E
3/4/00	4103	PHOSPHATE, ROCK, BULK	B	24868	24868	0	E
3/5/00	4148	PHOSPHAT CHEMICAL, BULK	B	4958	4958	0	E
3/5/00	4103	PHOSPHATE, ROCK, BULK	B	37670	37670	0	E
3/5/00	272	PASSENGERS	P	2356	2356	0	E
3/5/00	4103	PHOSPHATE, ROCK, BULK	B	24222	24222	0	E
3/5/00	4132	PHOSPHAT CHEMICAL, BULK	B	52310	52310	0	E
3/5/00	210	PAPER/PAPER PRODUCTS	C	164	164	0	E
3/5/00	210	COMMODITIES, NOS, PCKGD	C	37	37	0	E
3/5/00	4134	SCRAP METAL	C	1400	1400	0	E
3/6/00	024B	PETROLEUM, BKRS, ALL OTHS	B	1417	213	0	E
3/6/00	4146	PHOSPHAT CHEMICAL, BULK	B	6614	6614	0	E
3/6/00	024B	PETROLEUM, BKRS, ALL OTHS	B	100	15	0	E
3/6/00	272	PASSENGERS	P	1257	1257	0	E
3/6/00	4110	PHOSPHAT CHEMICAL, BULK	B	15071	15071	0	E
3/6/00	209	TALLOW, BULK	B	1120	1120	0	E
3/7/00	4318	COMMOD, CONTAINERIZED	C	107	107	21	E
3/7/00	4318	COMMODITIES, NOS, PCKGD	C	23	23	0	E
3/7/00	4318	VEHICLES, MINIMUM	C	19	29	0	E
3/7/00	4318	VEHICLES, OTHER	C	78	78	0	E
3/7/00	4318	UTILITY POLES	C	174	174	0	E
3/7/00	4318	YACHTS & BOATS >19'11	C	1	1	0	E
3/7/00	4318	TRAILERS, OTHER	C	9	9	0	E
3/7/00	4148	PHOSPHAT CHEMICAL, BULK	B	9697	9697	0	E

Figure 4.13 Port of Tampa Vessel Data Sample
(source: Tampa Port Authority)

4.3.4 Port of Jacksonville

The cargo types included in the vessel data received from the Port of Jacksonville are in Table 4.9. The unit type is how each commodity is measured in terms of quantity exported or imported. Figure 4.14 shows a sample of the vessel data in excel format. 1140 daily vessel cargo import and export records were received for October through December of year 1999 and 949 records for January through March of year 2001. The files were not Microsoft files and therefore had to be converted to excel files, which were then imported into an access database. The vessel data consisted of the vessel name, cargo type, arrival year, month, day, departure year, month, day, terminal (A-austin, B-blount island, T-talleyrand), import units, export units, total units, import tons, export tons, total tons, unit of measure (BL-barrels, EA-each, LF-linear foot, ST-short ton, TN-container), and commodity activity date, berth, commodity description, quantity, tons, number of containers, and import/export. Once the data was imported into the database, some coding was necessary in order to query the data for use in the model building process. The unit type had to be identified and non-freight transport vessels were removed.

Cargo Type	Unit Type
Auto	Tons
Breakbulk	Tons
Cargo	Tons
Container	Tons
Dry Bulk	Tons
Liquid Bulk	Tons
Petroleum	Tons

Table 4.9 Port of Jacksonville Commodity Types

Vessel Name	Carto Type	Arrival Yr	Arrival Mo	Arrival Da	Departure Yr	Departure Mo	Departure Da	Terminal	Import Units	Export Units	Total Units	Import Tons	Export Tons	Total Tons	Unit Of Measure	Commodity
EL MORRO	Auto	0	0	0	0	0	0	B	18	111	129	23.00	139.00	162.00	ST	POV
EL MORRO	Auto	0	0	0	0	0	0	B	0	15	15	0.00	141.00	141.00	ST	OTHER MOBILE
EL MORRO	Auto	0	0	0	0	0	0	B	5	79	84	6.00	99.00	105.00	ST	GENERAL MOTORS
EL MORRO	Auto	0	0	0	0	0	0	B	0	4	4	0.00	29.00	29.00	ST	OTHER MOBILE
EL MORRO	Auto	0	0	0	0	0	0	B	2	75	77	2.00	94.00	96.00	ST	POV
EL MORRO	Auto	0	0	0	0	0	0	B	0	8	8	0.00	77.00	77.00	ST	OTHER MOBILE
HUAL TRUBADOUR	Auto	0	10	1	0	10	1	B	0	12	12	0.00	22.80	22.80	EA	POVS
HUAL TRUBADOUR	Auto	0	10	1	0	10	1	B	0	17	17	0.00	120.25	120.25	ST	OTHER MOBILE
HUAL TRAMPER	Auto	0	10	1	0	10	2	B	0	6	6	0.00	11.40	11.40	EA	POVS
HUAL TRAMPER	Auto	0	10	1	0	10	2	B	0	52	52	0.00	104.00	104.00	EA	MERCEDES
HUAL TRAMPER	Auto	0	10	1	0	10	2	B	0	14	14	0.00	74.50	74.50	ST	OTHER MOBILE
HUAL TRAMPER	Auto	0	10	1	0	10	2	B	500	0	500	901.15	0.00	901.15	EA	MERCEDES
HUAL TRAMPER	Auto	0	10	1	0	10	2	B	15	0	15	25.42	0.00	25.42	EA	POVS
HUAL TRAMPER	Auto	0	10	1	0	10	2	B	8	0	8	70.61	0.00	70.61	ST	OTHER MOBILE
PEGASUS HIGHWAY	Auto	0	10	1	0	10	1	B	316	0	316	403.81	0.00	403.81	EA	DAEWOO
PEGASUS HIGHWAY	Auto	0	10	1	0	10	1	B	741	0	741	1,127.08	0.00	1,127.08	EA	MAZDA
PEGASUS HIGHWAY	Auto	0	10	1	0	10	1	B	65	0	65	213.50	0.00	213.50	EA	FUSO
BRILLIANT ACE	Auto	0	10	1	0	10	2	B	480	0	480	864.17	0.00	864.17	EA	MERCEDES
BRILLIANT ACE	Auto	0	10	1	0	10	2	B	0	194	194	0.00	416.93	416.93	EA	MERCEDES
CHICAGO BRIDGE	Auto	0	10	1	0	10	5	B	0	30	30	0.00	48.00	48.00	EA	POV
DON JUAN	Auto	0	10	1	0	10	2	B	14	0	14	21.50	0.00	21.50	EA	POVS
DON JUAN	Auto	0	10	1	0	10	2	B	420	0	420	642.17	0.00	642.17	EA	VOLVOS
DON JUAN	Auto	0	10	1	0	10	2	B	14	0	14	239.50	0.00	239.50	ST	OTHER MOBILE
DON JUAN	Auto	0	10	1	0	10	2	B	9	0	9	181.79	0.00	181.79	ST	OTHER MOBILE
EL YUNQUE	Auto	0	10	4	0	0	0	B	0	102	102	0.00	128.00	128.00	ST	POV
EL YUNQUE	Auto	0	10	4	0	0	0	B	0	18	18	0.00	159.00	159.00	ST	OTHER MOBILE
EL YUNQUE	Auto	0	10	4	0	0	0	B	0	52	52	0.00	65.00	65.00	ST	GENERAL MOTORS
NEW NADA	Auto	0	10	6	0	10	6	B	242	0	242	344.14	0.00	344.14	EA	MAZDA
SAN JUAN JAX	Auto	0	10	6	0	10	7	B	16	119	135	25.60	190.40	216.00	EA	POV
SAN JUAN JAX	Auto	0	10	6	0	10	7	B	0	145	145	0.00	232.00	232.00	EA	GENERAL MOTORS
SAN JUAN JAX	Auto	0	10	6	0	10	7	B	0	73	73	0.00	116.80	116.80	EA	CHRYSLER
SAN JUAN JAX	Auto	0	10	6	0	10	7	B	0	14	14	0.00	22.40	22.40	EA	MERCEDES
SAN JUAN JAX	Auto	0	10	6	0	10	7	B	0	9	9	0.00	27.00	27.00	ST	OTHER MOBILE
CATTLEYA ACE	Auto	0	10	7	0	10	8	B	878	0	878	1,585.16	0.00	1,585.16	EA	NISSAN
CATTLEYA ACE	Auto	0	10	7	0	10	8	B	15	0	15	31.50	0.00	31.50	EA	NISSAN
CATTLEYA ACE	Auto	0	10	7	0	10	8	B	1080	0	1080	1,634.37	0.00	1,634.37	EA	MAZDA
CATTLEYA ACE	Auto	0	10	7	0	10	8	B	0	216	216	0.00	410.40	410.40	EA	POVS
CATTLEYA ACE	Auto	0	10	7	0	10	8	B	0	38	38	0.00	76.00	76.00	EA	MERCEDES
CATTLEYA ACE	Auto	0	10	7	0	10	8	B	0	1	1	0.00	5.50	5.50	ST	OTHER MOBILE
ASTRO COACH	Auto	0	10	7	0	10	7	B	1605	0	1605	2,171.81	0.00	2,171.81	EA	KIAS
COUGAR ACE	Auto	0	10	8	0	10	8	B	780	0	780	812.51	0.00	812.51	EA	KIAS

Figure 4.14 Port of Jacksonville Vessel Data Sample
(source: Jacksonville Port Authority)

CHAPTER 5

MODELING

5.1 INTRODUCTION

Among numerous techniques for modeling, emphasis was on two specific types. Regression and Artificial Neural Networks (ANN) were investigated for modeling truck trip volumes at the selected Florida Ports. Regression has been the traditional modeling tool for many applications. Artificial Neural Networks is a relatively new application and the extent of its capabilities is still being researched. Recent experimentation has demonstrated that ANN offers promising applications in the field of transportation engineering, which was a guiding factor to select ANN over other new modeling techniques.

5.2 COMPARISON OF REGRESSION AND ARTIFICIAL NEURAL NETWORKS

Regression is a good model when there is a clear and very good correlation between the dependent and the independent variables. But once the correlation between dependent and independent variables drops it becomes increasingly difficult for regression to identify hidden trends in the data and thereby producing a poorly performing model with significant errors.

Artificial Neural Network (ANN) simulates human neuron functions in solving complex problems. It further derives its computing power through its massively parallel-distributed structure and ability to learn and generalize. Generalization refers to the ability of a neural network to respond satisfactorily for inputs that were not seen during its training (learning) process. Neural networks are not capable of solving all complex problems, but breaking the complex problem into smaller portions can make neural network perform better than the other popularly known techniques.

ANN was selected as the modeling approach mainly due to its characteristics. ANN provides an analytical alternative to conventional techniques, which are often limited by strict assumptions (i.e. normality, linearity, and variable independence). Because ANN can capture many kinds of relationships it allows the user to quickly and easily model phenomena, which may have been very difficult or impossible to explain otherwise.

5.3 ANN MODEL DEVELOPMENT

Once the independent and dependent variables are decided, programming language code for the model is written in Matlab™. Matlab™ is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Matlab™ features a family of application-specific solutions called toolboxes. Very important to most users of Matlab™, toolboxes allow learning and applying specialized technology. Toolboxes are comprehensive collections of Matlab™ functions (M-files) that extend the Matlab™ environment to solve particular classes of problems. Areas in which toolboxes are available include control systems and neural networks.

Matlab™ utilizes analyses such as Neural Network modeling to estimate desired data based on previously recorded data groups. A previously chosen group of dependent (desired output values) and independent variables (input values) were first fed into the developed Matlab™ model to "teach" it how to predict the truck and rail counts (dependent variables) at each of the selected ports based on vessel data of freight movements from the ports (independent variables).

5.3.1 Matlab™ Code

All the data required by the model is split into two Excel files. One file is used for calibration (training file) and the other for validation (testing file). Data can be stored in any type of file format, but for easy readability and formatting, Excel files are used. The training file consists of all the independent variables with their corresponding dependent variables (outputs desired). This file is used for training the model to produce outputs based on the input.

There are different algorithms used for modeling ANN. The performance of an algorithm depends on the application. So, the model is tested with different algorithms and the algorithm, which produces least Mean Square Error (MSE), is chosen.

When all the records in the input data containing independent variables and their corresponding dependent variables are fed into the model, this is referred to as one Epoch. Usually, neural network model does not give the same MSE for a fixed value of Epochs. In each run the best result may be for a different value of Epochs.

Apart from the input layer (which has all the independent variables) and output layer (which has dependent variables), there are hidden layers also present for producing better results. These hidden layers provide the model with ability to complete additional internal calculations and weight adjustments. Weights are basically adjustment coefficients, a constant value for each of the identified independent variables used to adjust the internal model equations to produce the desired output. Most of the applications need a maximum of 2 or 3 hidden layers, but sometimes models with no hidden layer also produce good results.

5.3.2 Model formulation, Calibration, and Validation

The Mean Square Error (MSE) was used as the performance index for validation of the model. The least MSE was chosen as the best measure. The equation of the MSE is as follows:

$$MSE = \frac{\sum_{i=1}^{N}(d_i - y_i)^2}{N}$$

Where:

MSE	=	the mean square error
d_i	=	the desired output of day i
y_i	=	the actual model output of day i
N	=	the total number of days

The structure of a normal ANN model with only one hidden layer is shown in Figure 5.1. The structure can have more than one hidden layer depending on the problem being considered. The model shown in Figure 5.1 has three sets of layers in the network layout, the input layer, the hidden layer(s) (if applicable), and the output layer. The input layer will always have nodes corresponding to the independent variables. The number of nodes in the hidden layer varies from problem to problem. Having too many nodes will overestimate the network and will not generalize the data well and the network will behave like a look-up table. The output layer in the present report will always have two nodes (two dependent variables- inbound trucks and outbound trucks), which represent the model output. Each of the selected Florida Ports has a specific ANN model. Because each port has its own characteristics including different independent variables that are related to the site-specific information, separate models were developed. Each ANN model was split into two internal modules, one for inbound and one for outbound.

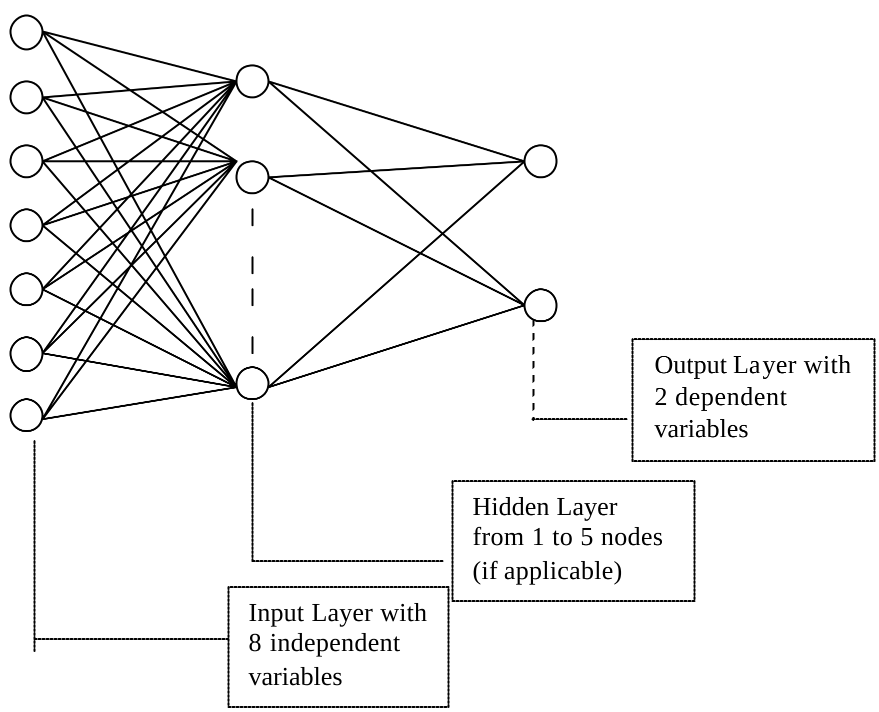


Figure 5.1: Structure of Neural Network Modeling

The type of architecture used for modeling all ports is called as Backpropagation neural network (BPN) architecture. Since BPN uses the supervised learning process to train the model, it may try to modify weights in order to reduce error for one output at the expense of the other output. ANN has a general tendency of performing better when big problem is broken into smaller pieces to get two more outputs. So the BPN model as a whole is broken down into two modules, one for producing inbound trucks and the other for outbound trucks.

Several trials and combinations were conducted where applicable to ensure all the possibilities were investigated for ANN model development. The combinations include the following changes in each module separately:

1. Changing the number of nodes in the hidden layer from 0 to 5.
2. Changing the number of iterations for each run in the range 0 through 500 iterations, (*Epochs*). The training process applies the inputs (independent variables), calculates the outputs, and compares them to the actual outputs. Then, the error is calculated and backpropagated through the network adjusting the weights as it passes through the layers. After all adjustments are made, the next training example is presented to the device. This process continues until all the training data sets are used, and that would be the first iteration. The training process will stop when the least MSE is reached or number of iterations reaches the maximum epochs. (37)(38)

As previously mentioned, if the number of nodes in the hidden layer was overestimated, the model will not generalize the data well. Further, the network will behave like a look-up table, which will produce very low MSE for calibration, but will produce a high MSE for validation. That is why having the calibration and validation process together trial by trial was more efficient and to the benefit of the model. In other words, during the course of training the network, the testing data set was presented to the network every cycle so that the testing error is monitored along with the training error.

5.3.3 Development of a Test Model

In order to find the accuracy and specific applicability of ANN, a test model was developed using sample data from Port of Jacksonville. The sample data consisted of vessel and rail data from the Talleyrand Terminal and truck counts on the access roads to the terminal. The independent and dependent variables were derived from this data.

Dependent variables are always selected based on the desired output of the model. Therefore, inbound and outbound trucks were selected as the dependent variables. Jacksonville's vessel data was analyzed and the commodities were divided into three categories for imported and exported cargo. The categories identified were containers, bulk, and tonnage. It was found that the truck volumes were affected by the day of week category and the vessel cargo can be stored at docks for up to 3 days. So the truck volumes could be affected by the prior three days (lag) and following three days (lead) of vessel activity. Therefore, storage variables (lead and lag) were introduced to capture any storage at the port. A lead variable for a commodity with subscript (+*p*) denotes the independent variables from the vessel data shipped *'p'* days *after* the day of truck counts referred. Similarly a lag variable with subscript (-*p*) denotes the independent variables from the vessel data shipped *'p'* days *prior to* the day of truck counts referred. The following is the list of independent and dependent variables identified for modeling.

Dependent Variables:

IT = Inbound Truck Volume

OT = Outbound Truck Volume

IR= Inbound Rail

OR= Outbound Rail

Independent Variables

WK= **1** if weekday, **0** if not.

SA = **1** if Saturday, **0** if not.

SU = **1** if Sunday, **0** if not.

ECT(7)= Exported Number of Containers.

- ECT_{-3}, ECT_{-2}, ECT_{-1}, ECT_0, ECT_1, ECT_2, ECT_3

ELB(7)= **1** if Exported Commodity type is Liquid Bulk, **0** if not.

- ELB_{-3}, ELB_{-2}, ELB_{-1}, ELB_0, ELB_1, ELB_2, ELB_3

EB(7) = **1** if Exported Commodity type is Bulk, **0** if not.

- EB_{-3}, EB_{-2}, EB_{-1}, EB_0, EB_1, EB_2, EB_3

EBB(7)= **1** if Exported Commodity type is Break Bulk, **0** if not.

- EBB_{-3}, EBB_{-2}, EBB_{-1}, EBB_0, EBB_1, EBB_2, EBB_3

ECD(7)= Exported Commodity Tonnage.

- ECD_{-3}, ECD_{-2}, ECD_{-1}, ECD_0, ECD_1, ECD_2, ECD_3

ICT(7) = Imported Number of Containers.

- ICT_{-3}, ICT_{-2}, ICT_{-1}, ICT_0, ICT_1, ICT_2, ICT_3

ILB(7) = **1** if Imported Commodity type is Liquid Bulk, **0** if not.

- ILB_{-3}, ILB_{-2}, ILB_{-1}, ILB_0, ILB_1, ILB_2, ILB_3

IB(7) = **1** if Imported Commodity type is Bulk, **0** if not.

- IB_{-3}, IB_{-2}, IB_{-1}, IB_0, IB_1, IB_2, IB_3

IBB(7) = **1** if Imported Commodity type is Break Bulk, **0** if not.

- IBB_{-3}, IBB_{-2}, IBB_{-1}, IBB_0, IBB_1, IBB_2, IBB_3

ICD(7) = Imported Commodity Tonnage.

- ICD_{-3}, ICD_{-2}, ICD_{-1}, ICD_0, ICD_1, ICD_2, ICD_3.

Where,

-3: counts 3 days prior to the day under consideration.

-2: counts 2 days prior to the day under consideration.

-1: counts 1 days prior to the day under consideration.

0: counts on the day under consideration.

+1: counts 1 days after the day under consideration.

+2: counts 2 days after the day under consideration.

+3: counts 3 days after the day under consideration.

A model was developed using the above 77 independent variables (39). The model showed good validation when the model counts for trucks and rail were compared to the field counts. The validation results are showed in Table 5.1a.

Inbound Trucks (IT)		Outbound Trucks (OT)		Inbound Rail (IR)		Outbound Rail (OR)	
Actual	Model	Actual	Model	Actual	Model	Actual	Model
258	214	152	206	42	41	11	12
1141	1108	1140	1149	67	67	57	62
1126	1069	1106	1131	5	14	61	67
1079	1069	1133	1131	28	13	65	67
1092	1037	1104	1083	42	45	47	62
1067	1052	1134	1103	33	37	49	64
1100	1090	1177	1130	64	67	51	61
498	424	545	424	36	35	6	5
213	209	182	181	99	100	9	10
1116	1069	1122	1130	31	14	81	67
933	1056	977	1110	22	31	50	65
387	438	401	424	103	102	31	27
151	117	149	112	40	38	23	23
1013	1051	1035	1102	40	36	78	64
1085	1086	1158	1134	46	48	59	64
1072	1071	1130	1122	41	40	66	64
1003	1036	1066	1079	55	54	64	61
1063	1024	1136	1055	78	80	44	57
967	1046	1097	1096	36	40	58	63
380	403	456	420	17	19	35	32

Table 5.1a Validation Results for Model–A (77 Variable Model) (39)

It was also shown with a 95% confidence level that there was no statistically significant difference between the actual and model counts for trucks and rail in each direction. However the model used 77 variables, which was an undesirable quality of the model. To conduct a sensitivity analysis of the model, a new model was developed which reduced the number of independent variables, however without inbound and outbound rail as outputs. Rail was removed because it was thought to be the reason the model required such a large number of independent variables. Rail counts are low compared to the truck counts and had irregular daily fluctuations in the counts.

In the new model, all the storage variables were removed reducing the number of independent variables to thirteen. The new variables identified for the model are:

Dependent Variables

- IT = Inbound Truck Traffic.
- OT = Outbound Truck Traffic.

Independent Variables

- WK = **1** if weekday, **0** if not.
- SA = **1** if Saturday, **0** if not.
- SU = **1** if Sunday, **0** if not.
- ECT = Exported Number of Containers.
- ELB = **1** if Exported Commodity type is Liquid Bulk, **0** if not.
- EB = **1** if Exported Commodity type is Bulk, **0** if not.
- EBB = **1** if Exported Commodity type is Break Bulk, **0** if not.
- ECD = Exported Commodity Tonnage.
- ICT = Imported Number of Containers.
- ILB = **1** if Imported Commodity type is Liquid Bulk, **0** if not.
- IB = **1** if Imported Commodity type is Bulk, **0** if not.
- IBB = **1** if Imported Commodity type is Break Bulk, **0** if not.
- ICD = Imported Commodity Tonnage.

Table 5.1b shows the validation results of Model-B, the new model with only 13 variables. It compares the actual and model counts for inbound and outbound trucks.

Inbound Trucks		Outbound Trucks	
Actual	Model	Actual	Model
258	209	152	201
1141	988	1140	1024
1126	1068	1106	1088
1079	992	1133	1027
1092	1050	1104	1088
1067	1033	1134	1029
1100	988	1177	1097
498	375	545	488
213	209	182	201
1116	988	1122	1024
933	1045	977	1069
387	400	401	415
151	212	149	205
1013	1028	1035	1056
1085	1006	1158	1041
1072	1042	1130	1074
1003	1049	1066	1072
1063	1050	1136	1073
967	991	1097	1026
380	397	456	512

Table 5.1b Comparison of Validation Results for Model –B (13 Variable Model)

The following charts display the results discussed above graphically. Charts for inbound and outbound trucks are displayed in Figures 5.2 and 5.3. The figures show that the new model also produces acceptable results. A Kolmogorov-Smirnov (K-S) Normality Test was performed on the difference between the actual and model truck counts to ensure the assumption that the distributions were normal. Upon confirming that the distribution was normal, Scheffe's test was performed with a 95% confidence level to test the validation results (see Table 5.1c). The test was performed with the null hypothesis that there was no statistically significant difference between the model and actual truck counts. The results show that there is no statistical difference for both inbound and outbound trucks. Therefore, Model–B developed with 13 independent variables was a better model than Model–A (77 independent variables) because of the lower number of required input variables when only trucks are the desired outputs. Model–B was a good model showing the accuracy of ANN model and used as a base model for development of the final models for each of the selected ports.

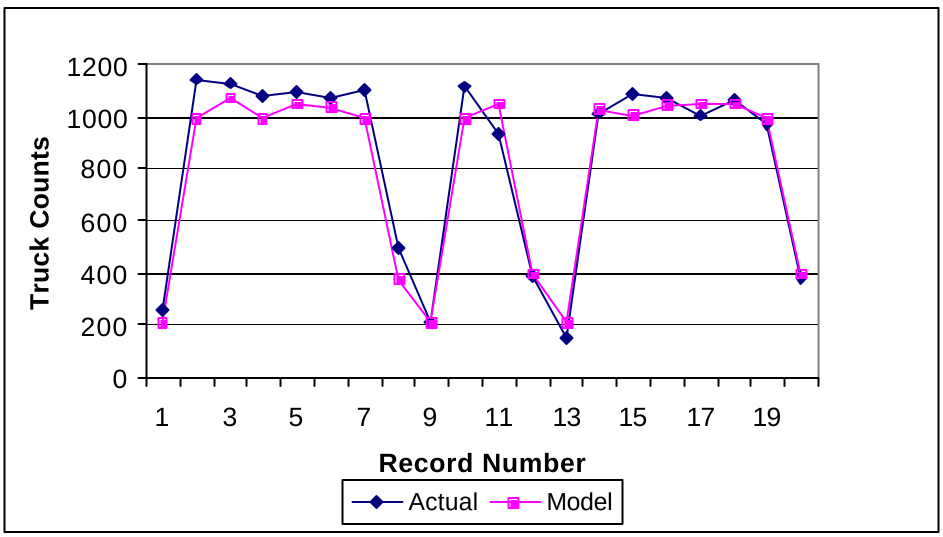


Figure 5.2 Validation Results for Inbound Trucks

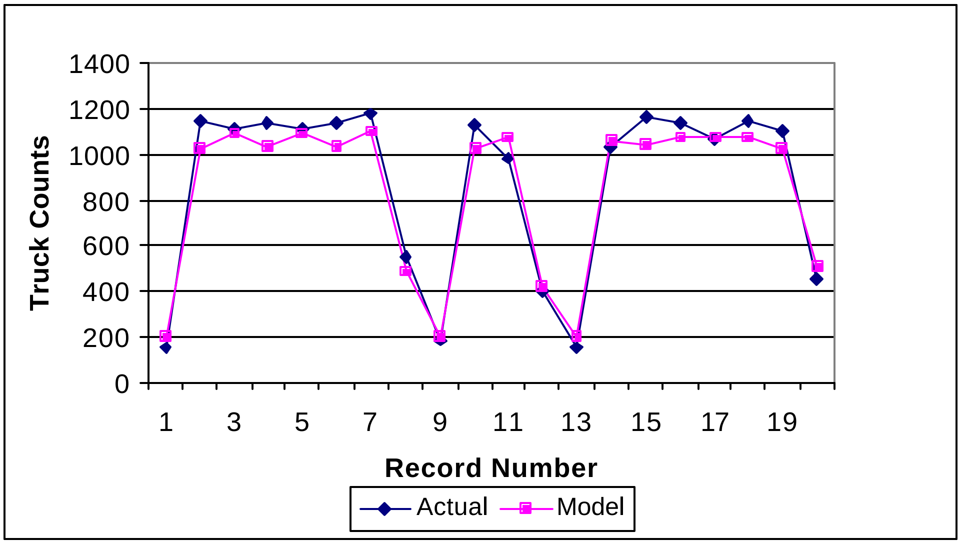


Figure 5.3 Validation Results for Outbound Trucks

Dependent Variable	p-value	Results (reject if the p-value < 0.05)	Conclusions
Inbound Trucks	0.058	Do not reject H_o	*Identical*
Outbound Trucks	0.059	Do not reject H_o	*Identical*

Table 5.1c Model–B Statistical Results Comparing Model and Actual Truck Counts

Error analysis shows the model accuracy at 94%. Accuracy was determined by comparing the model generated truck volumes from the validation and the actual field counts. (For the documented procedure of calculating accuracy, see Appendix M)

All the port models had to go through a series of model development process before a final acceptable model was developed. These steps included using ANN for model development, model experimentation for use in forecasting the dependent (output) variables and using regression coefficients to investigate what independent variables were applicable when necessary. ANN was preferred over regression due to its non-linearity and accuracy. Non-linearity is important for developing accurate models for problems with weak relationship between independent and dependent variables. ANN models provide an analytical alternative to conventional techniques, which are often limited by strict assumptions like normality, linearity and variable independence. Because an ANN can capture the limitations of other techniques it allows the developer to quickly and efficiently model phenomena, which otherwise may have been very difficult or impossible to explain. Some of the ANN port models were developed with no hidden layers, but when the degree of relationship between independent and dependent variables became increasingly difficult, hidden layers were required.

Regression was used to identify significant variables that contribute towards better outputs. Thereafter ANN models were used to exploit the non-linearity in a model if present thereby increasing the accuracy. The regression models developed to identify significant independent variables were basically linear models. This linearity makes output over-sensitive to the variation in the independent variables. When the independent variables in regression models are increased by a percentage, outputs also increase by the same percentage, which is not always realistic. Hence modeling for all ports was done using ANN. The final model developed for each port is assumed to be accurate based on the following points:

- The model should produce accurate present day output based on statistical Scheffe's paired t-test (after K-S Normality Test) with 95 % confidence interval.
- The final model should produce reasonable increase in output based on the increase in independent variables and further it should be non-linear, thus providing indication that the model recognizes variations in the independent variables.

5.4 PORT OF PALM BEACH MODEL

The development of Port of Palm Beach model was started using two dependent variables and ten independent variables (Model–P1).

Dependent Variables

- Inbound Trucks
- Outbound Trucks

Independent Variables

- Weekday (1 if weekday else 0)
- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)
- Imported Bulk
- Imported Cement
- Imported Containers
- Exported Bulk
- Exported Containers
- Exported Molasses
- Exported Sugar

The dependent variables are selected based on the desired output. For all the port models, the desired output is always daily truck volumes on the port access roads. These are divided into inbound and outbound truck counts.

The independent variables are more dynamic in terms of identifying the variables specifically related to modeling for the desired output. The days of the week have a direct relationship to the truck counts. Therefore, the 75 days of truck counts selected for model development were analyzed by day of the week. Selecting the days of truck counts for model development was based on having quality and accurate data for both the dependent and independent variables. As such, if any records displayed irregularity compared to the majority of the available records and could not be explained, the day was excluded. Three qualitative independent variables for day of week were added based on Scheffe's Test results. Scheffe's Test can be used when the distribution of daily truck volumes is normal. In order to test the normality for daily inbound and outbound truck volumes, Kolmogorov-Smirnov (KS) Normality Test was conducted. Table D.1, Appendix D shows results for the K-S test. The results indicate that all inbound and outbound daily truck volumes are normally distributed at a 95% confidence interval. Then, Scheffe's Test was used to compare the truck counts for each day of the week. Tables 5.2 and 5.3 show the results for inbound and outbound trucks.

- Yes: Both days have similar truck volumes
- No: Both days have different truck volumes

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Monday		Yes	Yes	Yes	Yes	No	No
Tuesday	Yes		Yes	Yes	Yes	No	No
Wednesday	Yes	Yes		Yes	Yes	No	No
Thursday	Yes	Yes	Yes		Yes	No	No
Friday	Yes	Yes	Yes	Yes		No	No
Saturday	No	No	No	No	No		Yes
Sunday	No	No	No	No	No	Yes	

Table 5.2 Scheffe's Test Results for Inbound Trucks

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Monday		Yes	Yes	Yes	Yes	No	No
Tuesday	Yes		Yes	Yes	Yes	No	No
Wednesday	Yes	Yes		Yes	Yes	No	No
Thursday	Yes	Yes	Yes		Yes	No	No
Friday	Yes	Yes	Yes	Yes		No	No
Saturday	No	No	No	No	No		No
Sunday	No	No	No	No	No	No	

Table 5.3 Scheffe's Test Results for Outbound Trucks

All weekdays are similar for inbound and outbound truck volumes. Inbound truck volumes are similar for Saturdays and Sundays, however they are significantly different for outbound trucks. The three categories of truck volumes were chosen to be uniform with both inbound and outbound trucks. The rest of the variables were the commodity categories. The Florida Sugar Truck Transport Company provided information stating that sugar is usually only transported to the port on weekdays. Therefore, the monthly sugar tonnage received from the port authority was distributed over weekdays in each respective month. Observations of the vessel data revealed infrequent and irregularity of molasses and cement shipments. Figure 5.4a shows the three molasses records for the study period as an example of the irregularity observed and extremely high tonnage when compared to other commodities shipped. Therefore separate variables were chosen for Cement, Molasses and Sugar for Model-P1.

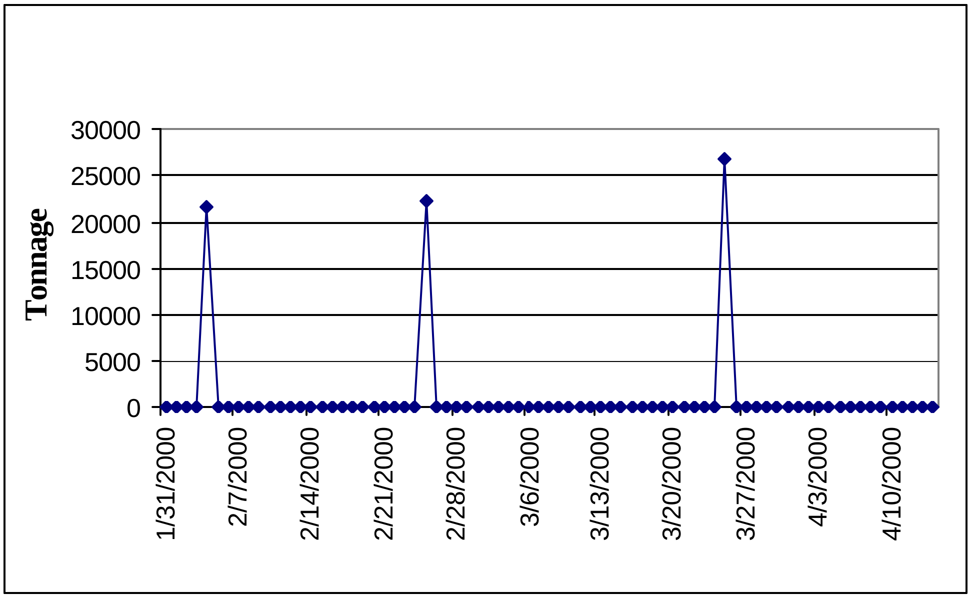


Figure 5.4a Daily Shipments of Molasses

The following figure 5.4b shows ANN model (Model–P1) developed for Port of Palm Beach with two dependent and ten independent variables.

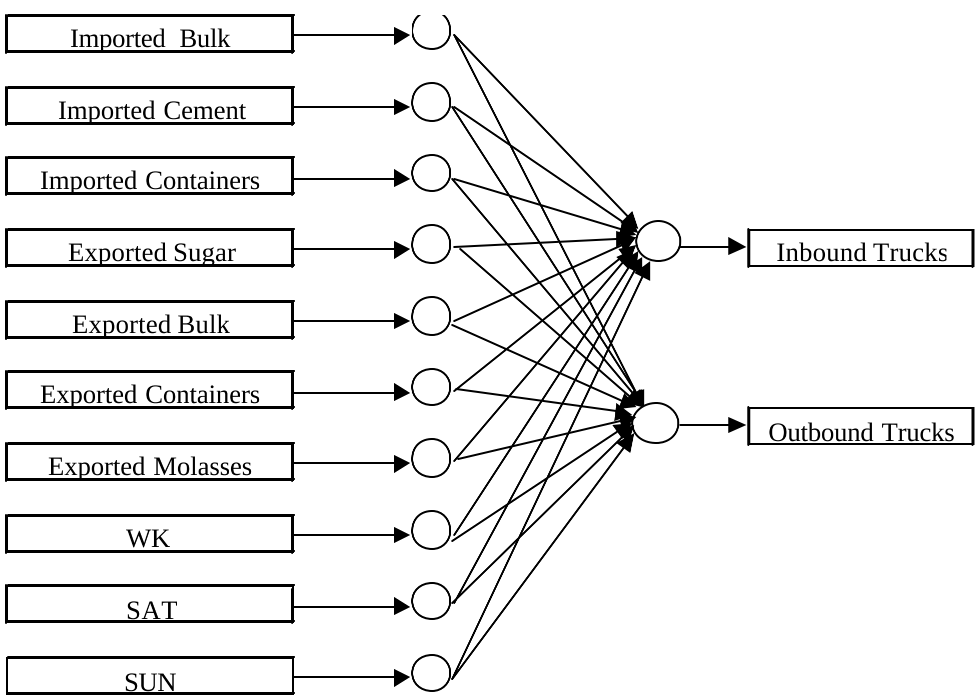


Figure 5.4b Intial ANN Model for Inbound and Outbound Trucks - Port of Palm Beach (Model–P1)

The model was developed after conducting several runs. Each run had a different set of parameters. The parameters are the number of epochs, number of hidden layers and their nodes and an algorithm. In order to complete the model development process calibration and validation must be done for each run. The model (see Figure 5.4) was calibrated (trained) using 50 randomly selected data records out of 75 data records that included dependent and independent variables. Once the model was calibrated, the remaining 25 data records consisting only of independent variables were input into the model for validation. Calibration and validation records for inbound and outbound are displayed in Table D.2 Appendix D. After each calibration and validation process, a Mean Square Error (MSE) was calculated. Table D.3 shows each run and the corresponding MSE. MSE is calculated by averaging the squared differences between actual data and model output. MSE indicates the accuracy of a model. A lower MSE for a run indicates better accuracy. Therefore, the run with the least MSE value was chosen. Table 5.4 displays the model validation output results and the corresponding actual field truck counts that were obtained from the run with the least MSE.

INBOUND		OUTBOUND	
Actual	Model	Actual	Model
31	61	68	67
455	439	454	442
397	465	470	449
443	461	382	443
172	118	182	123
21	14	63	46
492	479	450	459
533	423	442	435
460	430	453	441
423	425	340	439
457	424	377	445
471	434	466	442
526	434	538	443
468	481	447	458
39	24	40	52
457	489	413	465
626	445	473	449
210	69	211	112
513	437	540	443
543	503	502	467
488	460	474	452
512	455	425	453
538	491	467	460
532	489	419	464
607	482	523	456

Table 5.4 Model and Actual Truck Counts for the Initial ANN Model-Port of Palm Beach (Model-P1)

To test the above results, Scheffe's paired t-test was applied. Before Scheffe's test, K-S normality test was conducted. The test results showed a normal distribution for the differences between actual and model results for both inbound and outbound trucks (see Table D.1, Appendix D). Table 5.5 shows the statistical results of Scheffe's test comparing model results with the actual field truck counts for both inbound and outbound directions. The test is performed with the null hypothesis (Ho) that there is no statistical difference between the model and actual truck counts with a 95% confidence level. The results indicate that there is no statistical difference for both inbound and outbound trucks. Error analysis shows the model accuracy at 93%. Accuracy was determined by comparing the model generated truck volumes from the validation and the actual field counts. (For the documented procedure of calculating accuracy, see Appendix M). Figures 5.5a and 5.5b show the graphical comparison between the actual and model truck counts for both the inbound and outbound directions.

Model Vs Actual			
Dependent Variable	p-value	Results (reject if the p-value < = 0.05)	Conclusions
Inbound Trucks	0.481	Do not reject Ho	*Identical*
Outbound Trucks	0.595	Do not reject Ho	*Identical*

Ho: No significant difference between model and actual truck counts

Table 5.5 Statistical Results Comparing Model and Actual Truck Counts for the Initial ANN Model-Port of Palm Beach

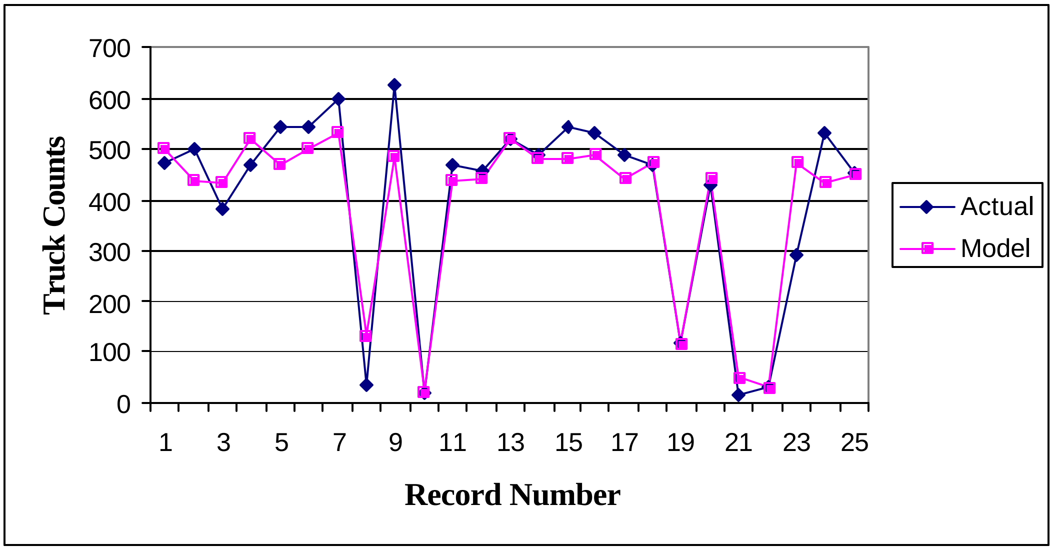


Figure 5.5a Model and Actual Inbound Truck Counts for the Initial ANN Model-Port of Palm Beach

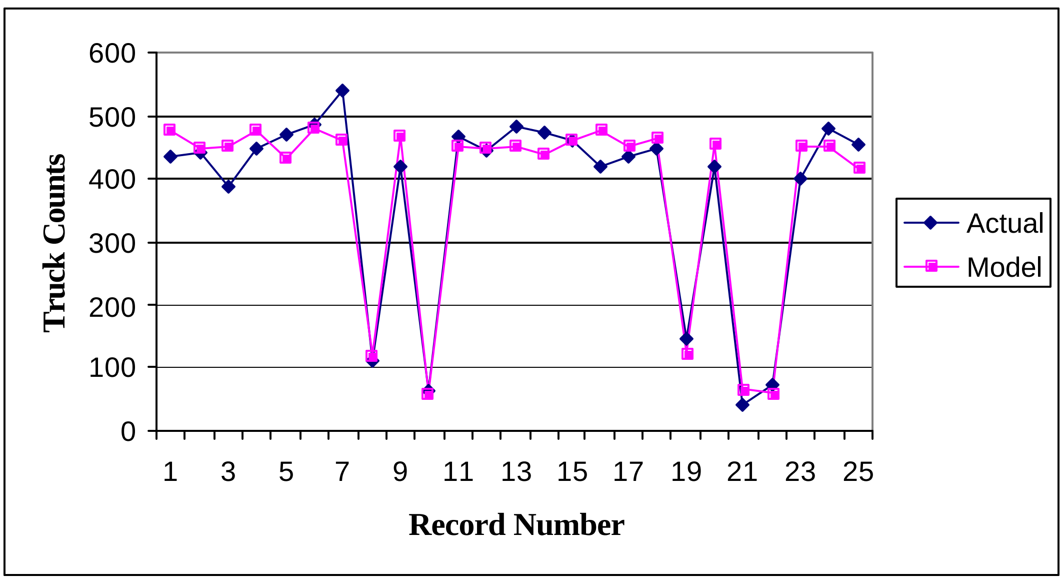
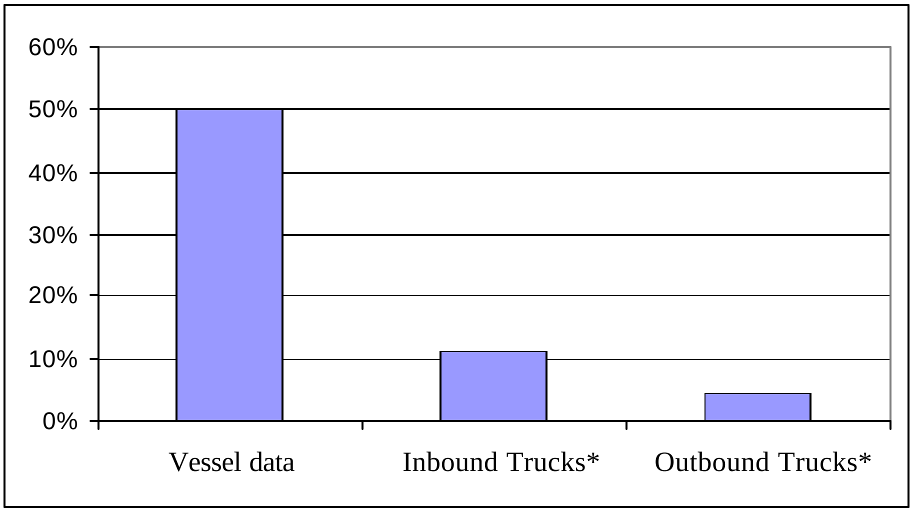


Figure 5.5b Model and Actual Outbound Truck Counts for the Initial ANN Model-Port of Palm Beach

The initial developed model for the port of Palm Beach was tested for the ability to forecast when the quantitative independent variables (vessel data) were increased by

50%. Figure 5.6 shows the increase of inbound and outbound trucks after an increase of 50% of the vessel data.



*neglecting weekends

Figure 5.6 Percent Increase in Vessel data and Truck Counts for the Initial ANN Model-Port of Palm Beach

There was an 11% increase in the inbound trucks and a 4% increase in outbound trucks with a 50% increase in the vessel data. This indicates that the independent variables chosen for model developed do not contribute significantly. Above results indicate however accurate the model is for present day counts, the model may not be a good forecasting model which translates that, validation of a model based on least MSE may not necessarily produce a good model.

After the initial ANN model (Model–P1) failed to produce reasonably acceptable forecasting results, a test Regression model was developed with the same independent variables as Model–P1 to analyze the coefficients of the independent variables. Table 5.6

shows regression coefficients obtained when a linear regression model was developed with inbound and outbound trucks as the desired outputs.

	Coeffecients	
Independent Variables	Inbound Trucks	Outbound Trucks
Imported Bulk	0.1561555	-0.250884
Imported Cement	0.0020142	0.0040324
Imported Containers	-0.025499	0.0020279
Exported Sugar	0.0278338	0.0141265
Exported Bulk	0.0429397	-0.008765
Exported Containers	0.0095178	0.0089904
Exported Molasses	-0.001225	-0.001208
WK	389.45486	381.05863
SAT	100.49035	116.71471
SUN	29.8	56.7

Table 5.6 Port of Palm Beach Model-P1 Independent Variable Coefficients

Some of the independent variables show negative coefficients indicating that when the independent variables are increased there was marginal increase in the outputs. This indicates that even if the vessel imports and exports increase, the truck volumes remain fairly uniform, which is not true.

Mode-P1 was thought to be producing poor results due to too many variables and irregularity of each variable considered, so in the another model all the commodities were converted into tons and were classified into imported and exported tons. The next model (Model-P2) was developed with only tonnage as quantitative variables. Model-P2 included five independent variables and the same two dependent variables.

Dependent Variables

- Inbound Trucks
- Outbound Trucks

Independent Variables

- Weekday (1 if weekday else 0)
- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)
- Total Imported Tonnage
- Total Exported Tonnage

The weekday variables were held constant from Model-P1. Table 5.7 shows the regression coefficients obtained from the linear regression model (Model–P2) with inbound and outbound trucks as desired outputs.

	Coeffecients	
Independent Variables	Inbound Trucks	Outbound Trucks
Daily Imported Tonnage	-0.001419	0.0012091
Daily Exported Tonnage	0.0018312	0.0006451
WK	483.65509	445.7135
SAT	104.24852	128.46416
SUN	29.8	56.7

Table 5.7 Port of Palm Beach Model-P2 Independent Variable Coefficients

Model–P2 also produced a negative coefficient. Observations from Tables 5.6 and 5.7 show a very significant coefficient value for ‘WK’ (weekday variable), indicating this variable significantly reduces the contribution of other variables in the modeling. Hence the marginal increase in model outputs when the quantitative variables are increased significantly (i.e. 50%).

Further analysis of vessel data found no vessel activity on Sunday but there were some truck counts recorded. Instead of a Sunday qualitative variable a constant (intercept) was introduced to capture the trucks on Sundays when there is no vessel activity. Also, the vessel activity on Saturdays was insignificant. Therefore the subsequent models developed for Port of Palm Beach were desired to differentiate between days of the week based on the vessel data itself. It was assumed that excluding the qualitative variables would make the model more sensitive to the quantitative variables, as the model tries to produce actual outputs based on quantitative variables only. Moreover, the qualitative variables were introduced in the earlier models to make the model differentiate weekdays from Saturdays and Sundays. But because of the significant difference of vessel data and truck counts on Saturdays and Sundays compared to the weekdays, model can recognize the variation in the data. Therefore the three qualitative variables for day of week were excluded as input variables. However, if there were no noticeable differences in the vessel data between days of the week, qualitative variables for day of the week would be required. This was discovered during development of other port models. Model–P3 included two dependent and two independent variables.

Dependent Variables

- Inbound Trucks
- Outbound Trucks

Independent Variables

- Daily Imported Tonnage
- Daily Exported Tonnage

Table 5.8 shows the regression coefficients for Model–P3. The model variables show positive coefficients for both independent variables, however the coefficient value of the constant (intercept) is very high. The coefficient value of the constant is high when compared to actual output, which indicates that the model output is less sensitive to the variation of the other two independent variables.

	Coeffecients	
Independent Variables	Inbound Trucks	Outbound Trucks
(Constant)	257.72429	254.13578
Daily Imported Tonnage	0.0316397	0.0292636
Daily Exported Tonnage	0.0144533	0.0115351

Table 5.8 Port of Palm Beach Model-P3 Independent Variable Coefficients

Analysis of weekday vessel data displayed variations in daily shipments but the weekday inbound and outbound truck trips remained constant. Because of this relationship between the daily vessel data and daily truck counts, storage variables (lead and lag) were introduced. A lead variable for a commodity with subscript (+*p*) denotes the independent variables from the vessel data shipped *'p'* days *after* the day of truck counts referred. Similarly a lag variable with subscript (-*p*) denotes the independent variables from the vessel data shipped *'p'* days *prior to* the day of truck counts referred. Therefore, a fourth model Model–4 included storage variables up to three days. Model–4 was developed with two dependent and eight independent variables. The selected variables are listed below:

Dependent Variables

- Inbound Trucks
- Outbound Trucks

Independent Variables

- Daily Imported Tonnage (-3)
- Daily Imported Tonnage (-2)
- Daily Imported Tonnage (-1)
- Daily Imported Tonnage (0)
- Daily Exported Tonnage (0)
- Daily Exported Tonnage (+1)
- Daily Exported Tonnage (+2)
- Daily Exported Tonnage (+3)

Inbound and outbound trucks make trips to the port either for receiving cargo (imports) or delivering cargo on that day or any of the successive three days, which explains the lag variables for imported tonnage for one day of truck counts. Similarly one day of truck deliveries mat be exported on that day or any of the following three days, which explains the lead variables for exported tonnage. The regression coefficients from Model–P4 are showed in Table 5.9.

Independent Variables	Coeffecients Inbound Trucks	Outbound Trucks
(Constant)	184.82077	171.44795
Daily Imported Tonnage (-3)	0.0120138	0.0112915
Daily Imported Tonnage (-2)	0.0008595	0.0003804
Daily Imported Tonnage (-1)	0.0124974	0.0105257
Daily Imported Tonnage (0)	0.0311508	0.0282566
Daily Exported Tonnage (0)	0.0129896	0.0105467
Daily Exported Tonnage (+1)	0.0107581	0.0099632
Daily Exported Tonnage (+2)	0.0029227	0.0045258
Daily Exported Tonnage (+3)	-0.004024	-0.002922

Table 5.9 Port of Palm Beach Model-P4 Independent Variable Coefficients

Daily exported tonnage produced a negative coefficient. Also the coefficient value of the constant is fairly high. The rest of the storage variables show positive coefficients. For the next model developed (Model–P5), a summation of the lead and lag variables were used. Model–P5 was developed using two dependent and four independent variables.

Dependent Variables

- Inbound Trucks
- Outbound Trucks

Independent Variables

- Sum of Last Three days-Imported Tonnage
- Daily Imported Tonnage (0)
- Daily Exported Tonnage (0)
- Sum of Next Three days-Exported Tonnage

The regression coefficients from Model – 5 are shown in Table 5.10.

Independent Variables	Coeffecients Inbound Trucks	Outbound Trucks
(Constant)	143.81921	136.44647
Daily Imported Tonnage (0)	0.031813	0.0287858
Sumof Last 3 days- Daily Imported Tonnage	0.013584	0.0118147
Daily Exported Tonnage (0)	0.0145879	0.0118508
Sumof Next 3 days- Daily Exported Tonnage	0.0042749	0.0047666

Table 5.10 Port of Palm Beach Model-P5 Independent Variable Coefficients

Model–P5 shows positive coefficients for all independent variables, but the constant value is high which may lead to a weak model and be less sensitive to variations of the independent variables.

The high irregularity and infrequency of molasses and cement shipments might be affecting the models. Because of this, the tonnage records for both of these commodity types (molasses and cement) must be filtered out of the vessel data and averaged over the time period between shipments to obtain a daily average. Sugar shipments were already averaged over an entire month. A shipment of molasses was averaged over the total number of weekdays since the previous exported record. Figure 5.7 shows molasses records before and after distribution. A shipment of cement was averaged over the following days until the next shipment was received. All these three commodities are stored near the port and generate truck traffic on a regular basis and are not directly related to the truck volumes for the date these commodities are shipped.

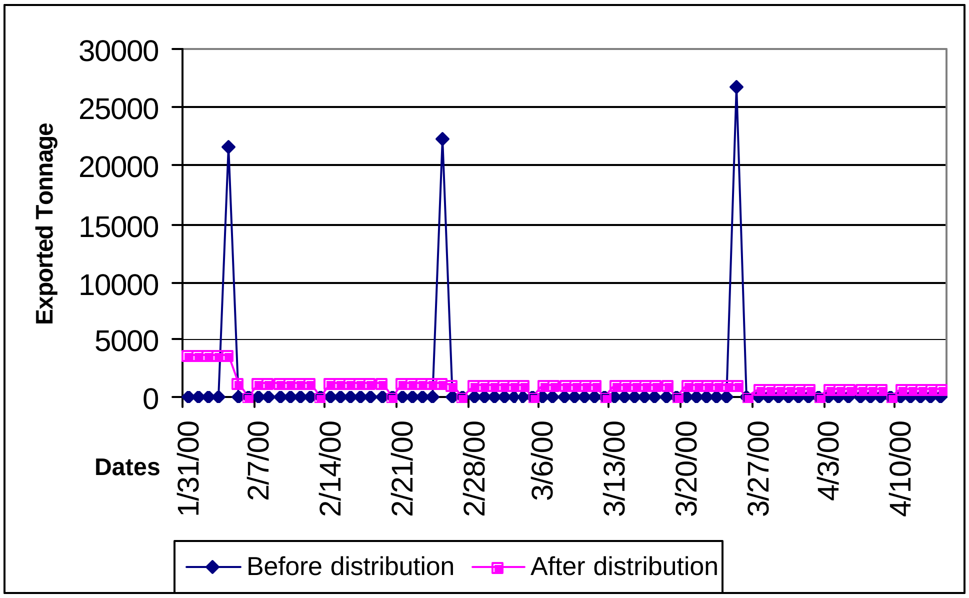


Figure 5.7 Molasses Records Before and After Daily Distribution

Based on the changes made to daily shipments of cement and molasses, Model–P6 was developed. Model–P6 has two independent and two dependent variables as listed below. The two independent variables related to the vessel data were total daily imported and exported tonnage.

Dependent Variables

- Inbound Trucks
- Outbound Trucks

Independent Variables

- Imported Tonnage included average daily cement tonnage and daily tonnage records for all other cargo.
- Exported Tonnage included average daily sugar and molasses tonnage and daily tonnage records for all other cargo.

A regression model was developed and the results of the coefficients are displayed in Table 5.11.

Independent Variables	Coeffecients Inbound Trucks	Outbound Trucks
Constant	45.415	75.006
Daily Imported Tonnage*	0.0557	0.05497
Daily Exported Tonnage*	0.0467	0.03795

* with sugar,cement and molasses averaged

Table 5.11 Port of Palm Beach Model-P6 Independent Variable Coefficients

The results show positive coefficients for both independent variables and the coefficient value of the constant (intercept) is low compared to the previous five models developed. These independent variables were used to develop ANN models for inbound and outbound trucks.

Separate models were developed for output of inbound and outbound trucks. The models were developed with only two layers, the input layer and the output layer. Figures 5.8a and 5.8b show the design of the final developed models for inbound and outbound trucks. The Matlab^{TM} code for the final models developed is displayed in Appendix H.

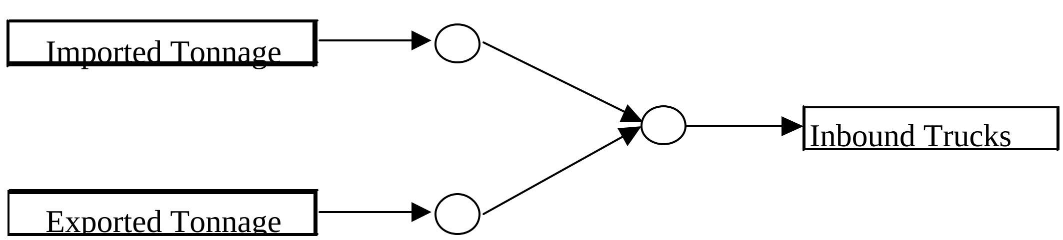


Figure 5.8a Final ANN Model for Inbound Trucks - Port of Palm Beach

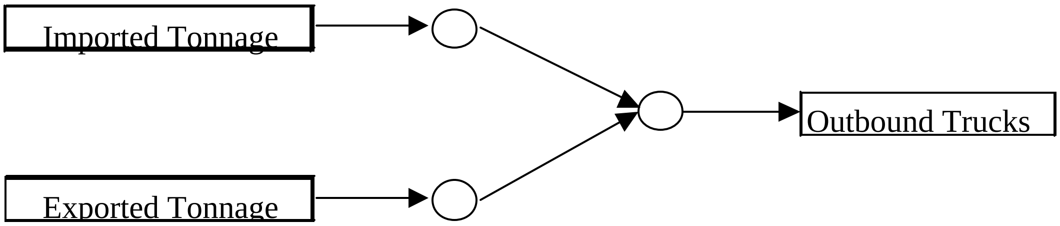


Figure 5.8b Final ANN Model for Outbound Trucks - Port of Palm Beach

Both the models were calibrated (trained) using 50 randomly selected data records out of 75 data records that included dependent and independent variables. Once the model was calibrated, the remaining 25 data records consisting only of independent variables were input into the model for validation. Calibration and validation records for inbound and outbound are displayed in Table D.4 Appendix D. The corresponding actual truck counts for these 25 days were used to measure the accuracy of the model. The actual truck counts were compared to the model output. Table 5.12 displays the model output results and the corresponding actual field truck counts. A K-S Normality Test was performed on the difference between the actual and model truck counts to validate the assumption that the distributions were normal. The results of the K-S test are documented in Table D.5 Appendix D.

	INBOUND		OUTBOUND	
Dates*	**Actual**	**Model**	**Actual**	**Model**
13100	431	503	419	463
20300	558	599	460	530
21100	543	554	461	496
21800	522	536	507	480
21900	210	224	211	227
22200	625	550	419	497
22400	597	550	540	493
22500	543	568	502	508
22700	39	57	40	90
30200	672	425	446	390
30500	21	57	63	90
30900	545	436	515	400
31200	32	57	52	90
31600	513	508	540	462
31700	455	461	454	421
31900	16	57	40	90
32300	256	521	453	474
32700	294	367	401	350
32800	499	466	443	432
33000	533	491	442	450
40500	543	438	472	403
40600	514	498	430	456
41200	423	454	340	415
41300	498	491	457	449

* (mm/dd/yy)

NOTE: gray cells indicate weekends

Table 5.12 Model Output and Actual Truck Volumes for the Final ANN Model-Port of Palm Beach

To test the above results, Scheffe's paired *t*-test was applied. Table 5.13 shows the statistical results comparing model results with the actual field truck counts for both inbound and outbound directions. The test is performed with the null hypothesis that there is no statistical difference between the model and actual truck counts with a 95%

confidence level. The results show no statistical difference for both inbound and outbound trucks. Figures 5.9 and 5.10 show the graphical comparison between the actual and model truck counts for the inbound and outbound directions. Error analysis shows the model accuracy at 88%. Accuracy was determined by comparing the model generated truck volumes from the validation and the actual field counts. (For the documented procedure of calculating accuracy, see Appendix M)

Model Vs Actual

Dependent Variable	p-value	Results (reject if the p-value ≤ 0.05)	Conclusions
Inbound Trucks	0.975	Do not reject H_o	*Identical*
Outbound Trucks	0.849	Do not reject H_o	*Identical*

H_o : No significant difference between model and actual truck counts

Table 5.13 Statistical Results Comparing Model and Actual Truck Counts for the Final ANN Model-Port of Palm Beach

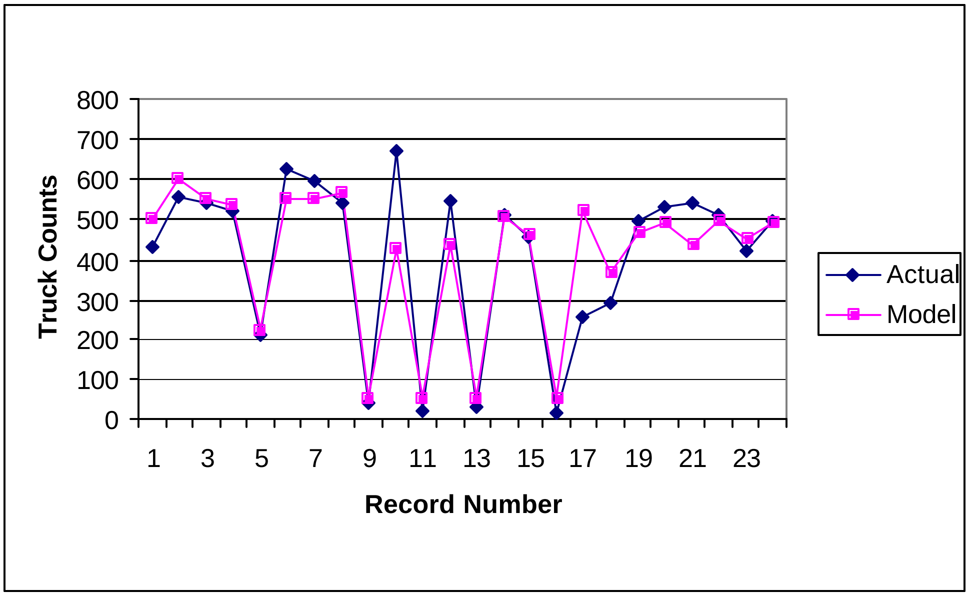


Figure 5.9 Model and Actual Inbound Truck Counts for the Final ANN Model-Port of Palm Beach

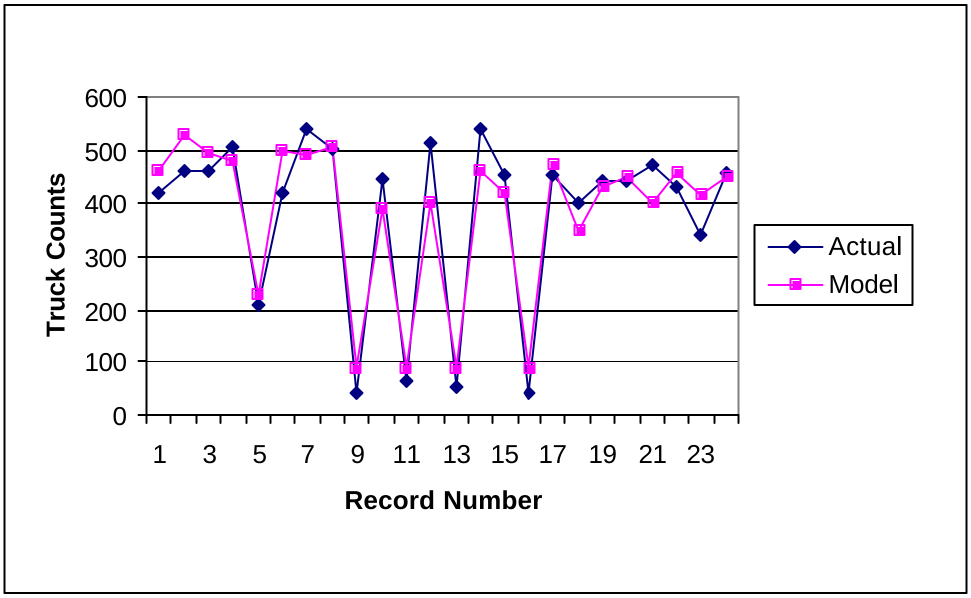


Figure 5.10 Model and Actual Outbound Truck Counts for the Final ANN Model-Port of Palm Beach

The two inbound and outbound models are combined to take input from one spreadsheet. An example of the input window is shown in Figure 5.11 and an example of the output window is shown in Figure 5.12. The "*" indicates necessary input fields which are the independent variables previously explained. A detailed explanation on how to use the model is included in Appendix L.

Enter the number of days for desired Output = **5**

SN	***Date**	***Imported Tonnage**	***Exported Tonnage**
1	010100	2573	6482
2	010200	863	10590
3	010300	622	12413
4	010400	229	12307
5	010500	346	12794

Figure 5.11 Port of Palm Beach Sample Model Input Window

```
----------------------- Inbound Trucks--------------------------
Date          Total-Trucks
      10100          503
      10200          567
      10300          629
      10400          599
      10500          628
----------------------- Outbound Trucks--------------------------
Date          Total-Trucks
      10100          463
      10200          507
      10300          556
      10400          530
      10500          554
```

Figure 5.12 Port of Palm Beach Sample Model Output Window

5.5 PORT OF EVERGLADES

The initial variables selected for modeling the Port of Everglades included two dependent and eight independent variables (Model –E1).

Dependent Variables

- Inbound Trucks
- Outbound Trucks

Independent Variables

- Weekday (1 if weekday else 0)
- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)
- Imported Tonnage
- Imported Barrels
- Imported Containers (Each)

- Exported Tonnage
- Exported Containers (Each)

The dependent variables are selected based on the desired outputs. The developed model will output the daily truck volumes by direction for each of the identified port access roads and a total volume of all inbound and outbound trucks at the port.

The initial independent variables constitute both the quantitative and qualitative variables. Weekday categories are the qualitative variables. Inbound and outbound trucks are heavily affected by the day of week. Hence truck counts had to be analyzed for how they are affected by the day of the week category. Truck counts were separated by direction (inbound and outbound) because during the data collection period, there were a number of days with comprehensive data by direction but because of the frequent damage to the classification units, comprehensive data for both directions and all locations was difficult to obtain. The number of common days for all inbound locations was 73 and the total number of common days for the outbound direction was 77.

These daily records were statistically analyzed for each day of the week. Before using Scheffe's test, a K-S Normality Test was performed. The K-S test showed a normal distribution for daily inbound and outbound truck volumes. Then, Scheffe's test was used to compare the truck counts on each day of the week. Tables 5.14a and 5.14b show the results for inbound and outbound trucks respectively.

- Yes: There is no significant difference in truck volumes
- No: There is a significant difference in truck volumes

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Monday		Yes	Yes	Yes	Yes	No	No
Tuesday	Yes		Yes	Yes	Yes	No	No
Wednesday	Yes	Yes		Yes	Yes	No	No
Thursday	Yes	Yes	Yes		Yes	No	No
Friday	Yes	Yes	Yes	Yes		No	No
Saturday	No	No	No	No	No		Yes
Sunday	No	No	No	No	No	Yes	

Table 5.14a Scheffe's Test Results for Inbound Trucks

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Monday		Yes	Yes	Yes	Yes	No	No
Tuesday	Yes		Yes	Yes	Yes	No	No
Wednesday	Yes	Yes		Yes	Yes	No	No
Thursday	Yes	Yes	Yes		Yes	No	No
Friday	Yes	Yes	Yes	Yes		No	No
Saturday	No	No	No	No	No		No
Sunday	No	No	No	No	No	No	

Table 5.14b Scheffe's Test Results for Outbound Trucks

For inbound trucks, the difference in weekday counts was statistically insignificant. However, weekdays were significantly different from weekends (Saturday and Sunday). Also, Saturday was significantly different from Sunday. For Outbound trucks, the difference in weekday counts was statistically insignificant. Weekdays were significantly different from weekends (Saturday and Sunday). For outbound trucks, there was no statistical difference between Saturday and Sunday. But for uniformity, truck counts were grouped into three categories for both inbound and outbound. These three variables were the initial qualitative variables used in the model.

Analysis of vessel data showed that each commodity imported and exported was measured by unit type (tons, barrels, each, MBFT). Measured Board Feet (MBFT) was converted to tons (see Section 4.3.2). Therefore, the initial independent variables were selected based on unit type and direction (import or export). There were no exported barrels so subsequently no variable could be included for this without available data. Separate ANN models (see Figures 5.13a and 5.13b) for inbound and outbound trucks were developed with the initial set of independent variables.

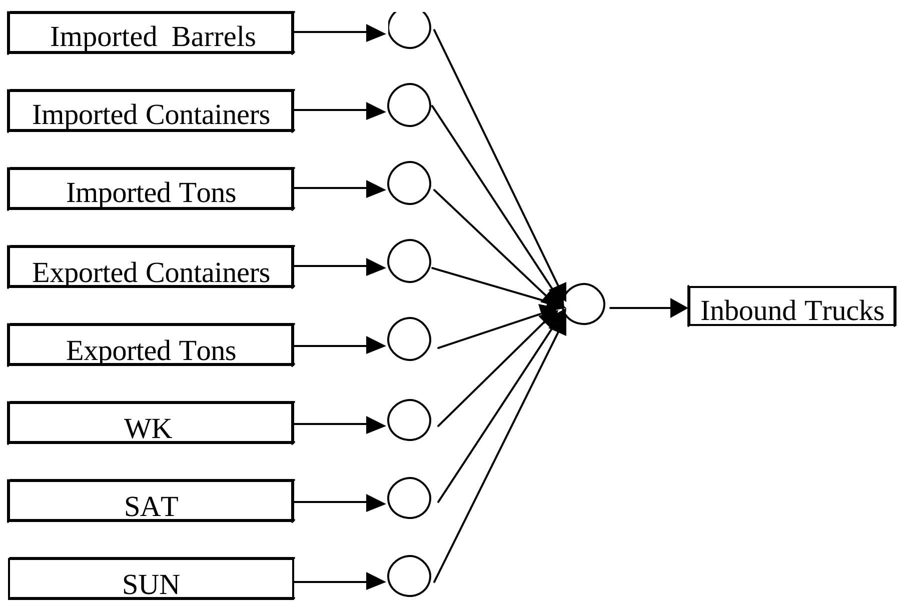


Figure 5.13a Initial ANN Model for Inbound Trucks-Port of Everglades

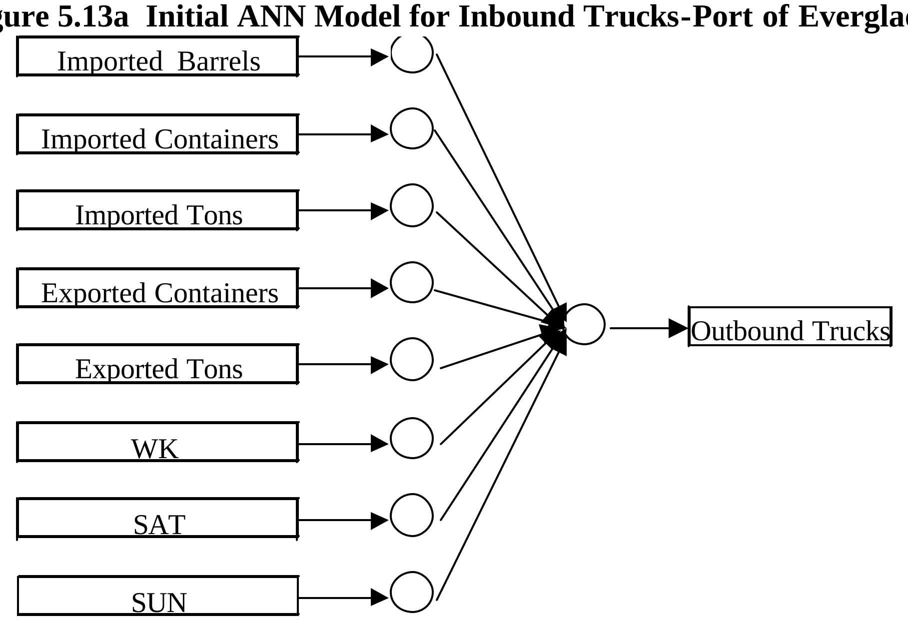


Figure 5.13b Initial ANN Model for Outbound Trucks-Port of Everglades

The model was developed after conducting several runs. Each run had a different set of parameters. The parameters are the number of epochs, number of hidden layers and their nodes and an algorithm. In order to complete the model development process calibration and validation must be done for each run. The inbound model was calibrated (trained) using 40 randomly selected data records out of 61 data records consisting of dependent and independent variables, and outbound model with 52 randomly selected data records out of 78 data records respectively. Once the models were calibrated, the remaining 21 data records for inbound and 26 for outbound consisting only of independent variables were input into the model for validation. Calibration and validation records for inbound and outbound trucks are displayed in Tables E.1 and E.2, Appendix E. Tables E.3 and E.4 show the completed runs with the corresponding Mean Square Error (MSE) for the inbound and outbound truck models. MSE is calculated by averaging the squared differences between actual data and model output. MSE indicates the accuracy of a model. A lower MSE for a run indicates better accuracy. Therefore, the run with the least MSE value was chosen. Validation of the least MSE run (Model-E1) was performed using the same procedure applied for the Port of Palm Beach. The validation results of Model-E1 showed no statistically significant difference between actual and model output. Error analysis shows the model accuracy at 95%. Accuracy was determined by comparing the model generated truck volumes from the validation and the actual field counts. (For the documented procedure of calculating accuracy, see Appendix M). The model was further tested for the ability to forecast when the quantitative independent variables (vessel data) were increased by 50%. The increase in desired outputs was very minimal similar to the initial port of Palm Beach model. Therefore, further model development was required.

In order to verify the behavior of Model–E1 regression coefficients for each of the independent variables used were produced. Table 5.15 displays the coefficients of the independent variables for Model-E1.

	Coefficients	
Independent Variables	Inbound Trucks	Outbound Trucks
Daily Imported Containers	0.21	0.36
Daily Imported Barrels	0.10	0.11
Daily Imported Tonnage (no containers)	0.15	0.01
Daily Exported Containers	-2.26E-05	1.13E-04
Daily Exported Tonnage (no containers)	2.00E-03	4.72E-04
WK	3084.25	2930.79
SAT	1204.78	1096.16
SUN	1027.78	971.74

Table 5.15 Port of Everglades Model-E1 Independent Variable Coefficients

Table 5.15 shows daily exported containers with a negative coefficient that indicates when there is an increase in the exported containers there will be a decrease in the dependent variables, which should not occur. Also the coefficient for exported containers and exported tonnage was nearly equivalent to zero. This indicated that either the independent variables had a weak relationship to the dependent variables or there was a problem with the distribution in the data. Observations from Tables 5.15 show a very significant coefficient value for 'WK' (weekday variable), indicating this variable significantly reduces the contribution of other variables in the modeling.

Regression analysis of Model–E1 independent variables produced unacceptable results for the relation between the dependent and independent variables when the independent variables related to the vessel data were classified into unit-of-measure categories. Therefore, all commodities were converted to one single unit-of-measure (tonnage). The following independent variables were chosen for the second modeling attempt (Model–E2). The dependent variables were the same.

Independent Variables

- Weekday (1 if weekday else 0)
- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)
- Daily Imported Tonnage
- Daily Exported Tonnage

This model used only daily tonnage by direction for all commodities and the day of the week variables as input to estimate dependent variables.

Another test regression model was developed to again examine the contribution each of the independent variables had on the output. Table 5.16 shows the coefficients for each of the initial independent variables used for producing outputs in Model-E2.

Independent Variables	Coefficients Inbound Trucks	Outbound Trucks
Daily Imported Tonnage	-0.00023459	-8.93978E-05
Daily Exported Tonnage	0.037082033	0.038664377
Wk	3084.691745	2940.75415
Sat	1048.45096	984.4519649
Sun	982.5626691	953.0944225

Table 5.16 Port of Everglades Model-E2 Independent Variable Coefficients

The results show daily imported tonnage had a negative coefficient for both inbound and outbound trucks. Also, though exported tonnage had positive coefficients with both outputs, the value was not significant. The qualitative variable 'WK' (Weekday) again had a large coefficient indicating this variable significantly reduces the contribution of other variables in the modeling. This model also showed a weak relationship grouping between the dependent and independent variables. Hence more analysis of the available data was required to investigate what was causing these difficulties.

To further investigate the weekday independent variable, the ANN model was run with and without this variable. The output for both scenarios was almost identical. Therefore, the weekday variable was discarded.

The individual vessel records by commodity type were analyzed in detail. The petroleum products displayed irregularities in the shipments and some of the port contacts indicated that the petroleum is stored when imported by vessel before it is transported out of the port by truck. Therefore, all the petroleum records for each of the months in the study period were totaled. This total was distributed over all the days in the corresponding month to obtain a daily average including weekends.

Irregularities of the imports in cement and aggregate tonnage records were also discovered. The shipments were also infrequent. Figure 5.14 shows a sample of daily cement and aggregate imports for the months of May and June in year 2000. To adjust for this, the monthly total tonnage for cement and aggregate were also distributed over the corresponding month to obtain a daily average.

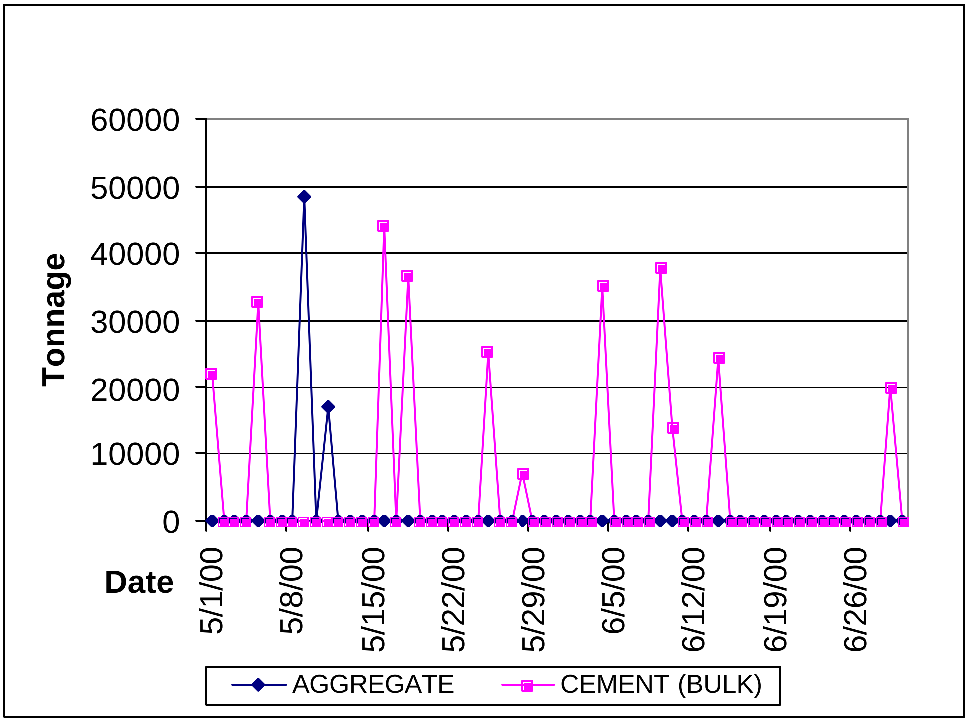


Figure 5.14 Port of Everglades Daily Cement and Aggregate Imports for May and June 2000

There were other commodities, which did not display irregularities in their daily records but did have some infrequency throughout each week. Port contacts also indicated that some storage is available around the port and at the docks. This indicated that storage variables would need to be considered, therefore lag independent variables were added. These storage variables take into account imports and exports prior and following the day of output was desired. Up to three storage days were considered for the model. For each day under consideration, a truck can deliver cargo to be exported at a later date or receive cargo that was imported on a previous day. The variables determined to be appropriate for modeling are listed below. These were used to develop Model-E3. The dependent variables are unchanged.

Independent Variables

- Daily Imported Containers (-2)
- Daily Imported Containers (-1)
- Daily Average Imported Barrels (based on a monthly total)
- Daily Imported Tonnage* (-3)
- Daily Imported Tonnage* (-2)
- Daily Imported Tonnage* (-1)
- Daily Imported Tonnage* (0)
- Daily Exported Containers (0)
- Daily Exported Containers (+1)
- Daily Exported Containers (+2)
- Daily Exported Containers (+3)
- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)

The "*" denotes that cement and aggregate tonnage records were averaged and must be calculated by the model-user. The value in parenthesis indicates if it is a lag (-) variable or lead (+) variable and the number of storage days considered. These are not necessary for the model-user to calculate however it does affect the number of required records for model input. The two qualitative variables, Saturday and Sunday are assigned a value of '0' when the input date is a weekday.

Again an initial test regression model was developed to examine the contribution each of the independent variables had on the output. During the testing, insignificant independent variables were removed. The final group of independent variables for inbound and outbound trucks and their coefficients are displayed in Table 5.17.

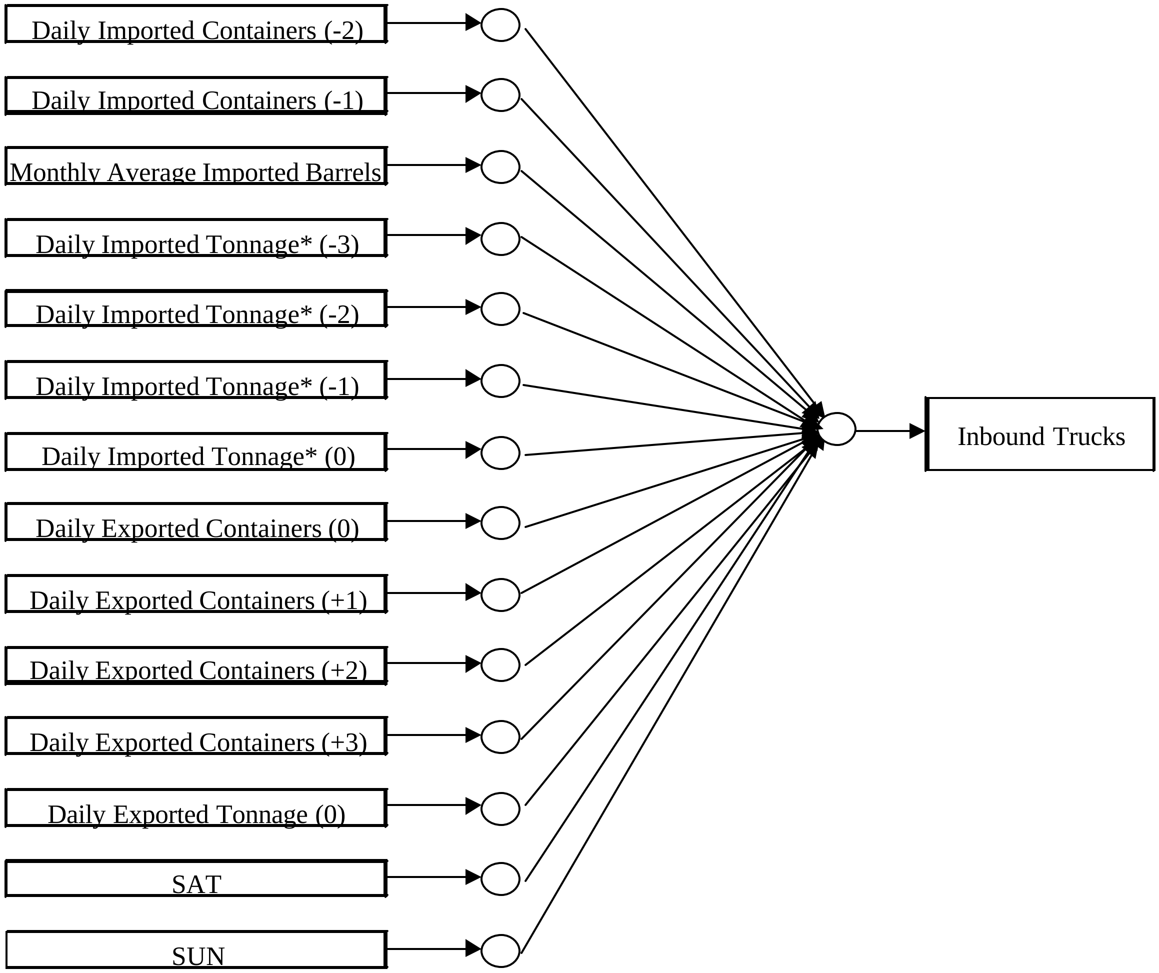
Inbound Trucks		**Outbound Trucks**	
Independent Variables	Coefficients	Independent Variables	Coefficients
Daily Imported Containers(-2)	0.051	Daily Imported Containers(-1)	0.115
Daily Imported Containers(-1)	0.194	Daily Imported Containers(0)	0.138
Monthly Average Imported Barrels	0.008	Monthly Average Imported Barrels	0.009
Daily Imported Tonnage*(-3)	0.005	Daily Imported Tonnage*(-1)	0.004
Daily Imported Tonnage*(-2)	0.001	Daily Exported Containers(0)	0.190
Daily Imported Tonnage*(-1)	0.012	Daily Exported Containers(+1)	0.270
Daily Imported Tonnage*(0)	0.020	Daily Exported Containers(+2)	0.053
Daily Exported Containers(0)	0.339	Daily Exported Tonnage(0)	0.103
Daily Exported Containers(+1)	0.209	SAT	-1660.72
Daily Exported Containers(+2)	0.122	SUN	-1973.41
Daily Exported Containers(+3)	0.202		
Daily Exported Tonnage(0)	0.097		
SAT	-1814.36		
SUN	-1863.99		

* with cement, aggregate averaged

Table 5.17 Port of Everglades Model-E3 Independent Variable Coefficients

The results show that SAT (Saturday) and SUN (Sunday) variables have negative coefficients due to truck volumes being significantly lower on weekends. The storage variables are also affecting the weekend variables because the storage variables are significant in the model. These variables were concluded for use in the final ANN model.

These 14 independent variables for inbound trucks and 10 independent variables for outbound trucks listed in Table 5.17 were used to train (calibrate) the ANN model. The final ANN models developed are documented in Figures 5.15a and 5.15b. The Matlab™ code for the developed models is displayed in Appendix I.



* with cement, aggregate averaged

Figure 5.15a Final ANN Model for Inbound Trucks-Port of Everglades

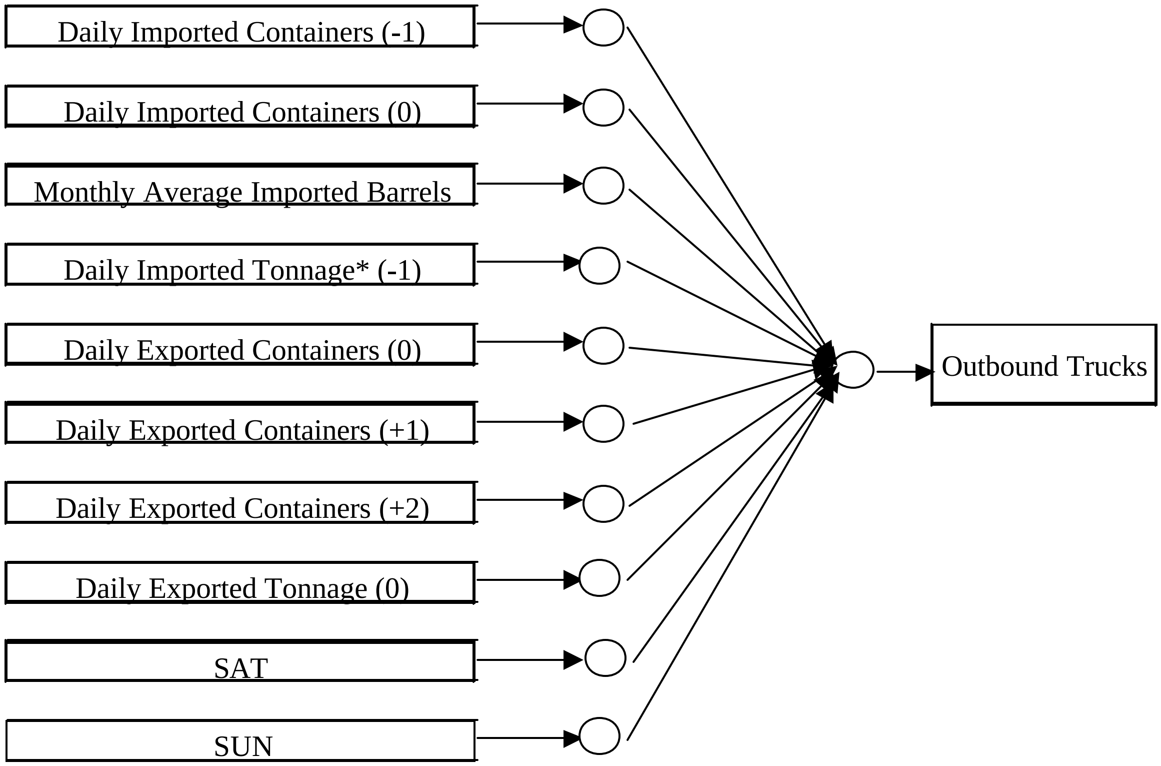


Figure 5.15b Final ANN Model for Outbound Trucks-Port of Everglades

The ANN model in Figure 5.15a included 40 data records for calibration and 21 records for validation selected randomly to produce inbound truck counts. The records are displayed in Table E.5 of Appendix E. Similarly, the ANN model 5.15b used 48 data records for calibration and 25 records for validation selected randomly to produce outbound truck counts. The records are displayed in Table E.6 of Appendix E. These records were randomly selected during the model development process for better comprehension of the input data. For validation, the actual truck counts collected from the field were compared to the model output. Table 5.18 displays the results of this analysis.

INBOUND			OUTBOUND		
Dates *	Actual	Model	Dates *	Actual	Model
52000	1667	1769	62600	2859	3208
52300	3497	3137	63000	3515	3631
52500	3632	3464	71600	976	1112
71000	2880	2882	71700	2845	2931
71100	2980	3338	71800	2897	2945
71300	3164	3307	72500	2859	3193
80200	3005	3125	72600	3002	2919
80400	3326	3623	73100	2772	3028
80700	2777	2955	80200	2974	3179
81000	3135	3532	80300	3022	3065
91100	3192	3141	80700	2788	3127
91300	3370	3266	81000	3205	3188
92100	3322	3386	81100	3206	3268
92500	3282	2893	81400	2843	3009
92700	3452	3375	81600	3067	3195
100500	3527	3169	81700	3152	3249
101600	3119	2930	81800	3601	3303
101800	3524	3091	82300	3412	3176
101900	3349	3167	82700	912	1118
			91000	928	965
			91900	3470	2980
			92400	1488	1029
			92600	3023	2812
			101600	3254	3109
			102000	3830	3371

*(mm/dd/yy)

NOTE: gray cells indicate weekends and hence not considered for calculating accuracy

Table 5.18 Model Output and Actual Truck Volumes for the Final ANN Port of Everglades Model

A K-S Normality Test was performed on the difference between the actual and model truck counts to ensure the assumption that the distributions were normal. Then, to validate the above results, Scheffe's paired t-test was applied. Table 5.19 shows the statistical results obtained from Scheffe's test comparing model results with the actual field truck counts for both inbound and outbound. The test was performed with the null hypothesis that there is no statistical difference between the model and actual truck counts with a 95% confidence level. Error analysis shows the model accuracy at 93%. Accuracy was determined by comparing the model generated truck volumes from the validation and the actual field counts. (For the documented procedure of calculating accuracy, see Appendix M)

Model Vs Actual

Dependent Variable	p-value	Results (reject if the p-value $\leq$ 0.05)	Conclusions
Inbound Trucks	0.562	Do not reject H_o	*Identical*
Outbound Trucks	0.867	Do not reject H_o	*Identical*

H_o: No significant difference between model and actual truck counts

Table 5.19 Statistical Results Comparing Model and Actual Truck Counts for the Final ANN Port of Everglades Model

The results show that there is no statistical difference for both inbound and outbound trucks. Figures 5.16 and 5.17 show a graphical comparison between the actual and model truck counts for the inbound and outbound directions.

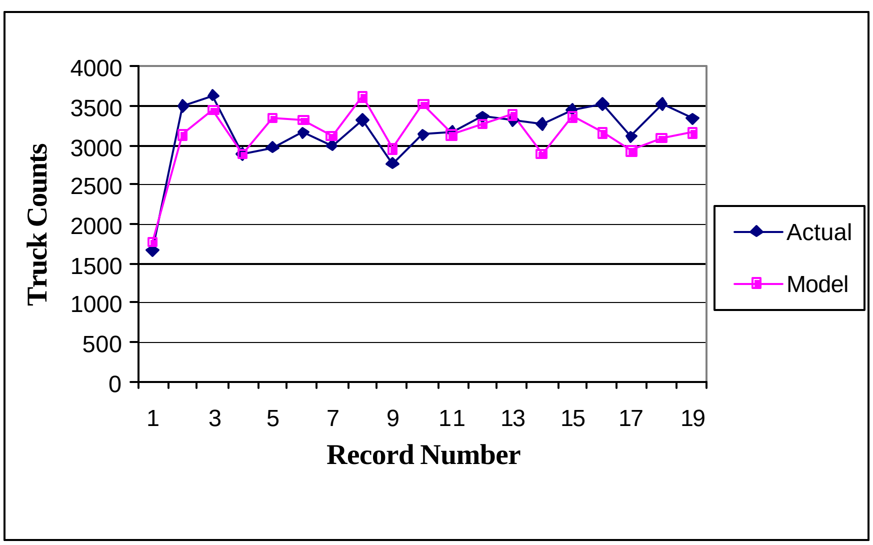


Figure 5.16 Model and Actual Inbound Truck Counts for the Final ANN Port of Everglades Model

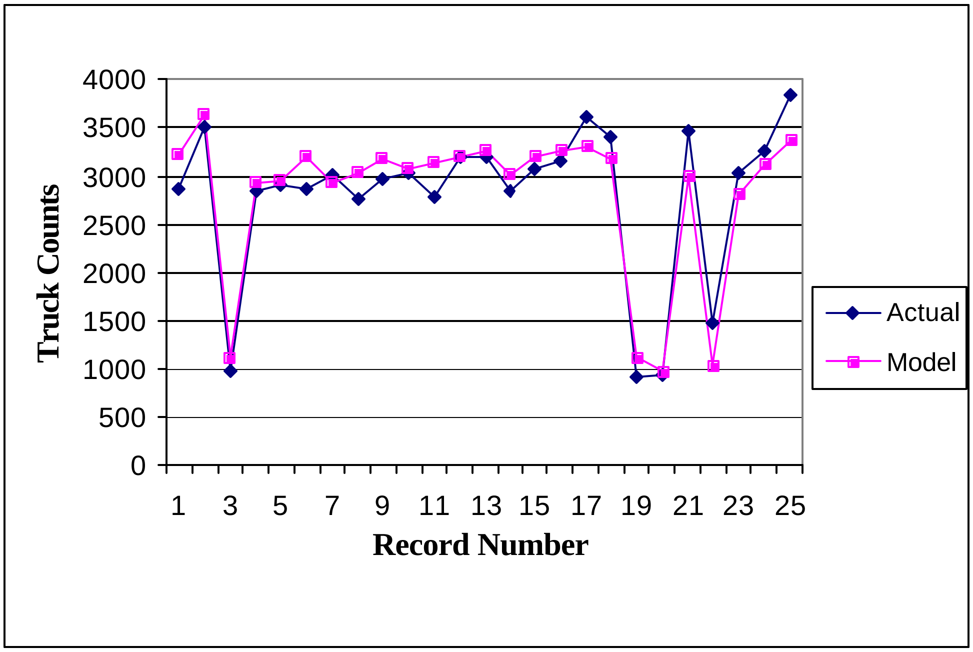


Figure 5.17 Model and Actual Outbound Truck Counts for the Final ANN Port of Everglades Model

The previously listed independent variables are used for the internal calculations of the model to produce the desired output. The actual independent variables required by the user for input is much less complicated. The following are the independent variables used for input into the model for the Port of Everglades by the user.

Independent Variables

- Daily Imported Containers
- Daily Average Imported Barrels (based on a monthly total)
- Daily Imported Tonnage (Cement and aggregate averaged over entire month)
- Daily Exported Containers
- Daily Exported Tonnage
- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)

The two inbound and outbound models are combined to take input from one spreadsheet. An example of the input window is shown in Figure 5.18 and an example of the corresponding output window is shown in Figure 5.19. The "*" indicates necessary input fields which are the independent variables previously described. Because of the storage variables in the model, there are three records required prior to and following the number of days output is desired. For instance, as in Figure 5.18, five days of output are desired, therefore, three prior input records (identified by "Reqd") and three following records (which are SN records # 6, 7, and 8 in this example) are required for input. "SN" is just a serial number for identifying a specific record. A detailed explanation on how to use the model is included in Appendix L.

Enter the number of days output is desired excluding the Reqd fields and the last three records = ***5***

SN	*Date	*Daily Imported Containers	*Daily Imported Tonnage	*Monthly Imported Barrels	*Daily Exported Containers	*Daily Exported Tonnage	*SAT *(1 if Saturday; 0 if not)*	*SUN *(1 if Sunday; 0 if not)*
Reqd	92805	681	22867	394645	1063	269	0	0
Reqd	92905	1070	25762	394645	1648	430	1	0
Reqd	93005	244	807	394645	352	313	0	1
1	100105	375	21381	410533	402	147	0	0
2	100205	262	26311	410533	278	80	0	0
3	100305	558	30754	410533	326	138	0	0
4	100405	744	26404	410533	1160	260	0	0
5	100505	853	29131	410533	1338	334	0	0
6	100605	858	21004	410533	1328	342	1	0
7	100705	196	658	410533	284	249	0	1
8	100805	469	27237	400484	505	183	0	0

note: extra records are required to complete the calculations

Figure 5.18 Port of Everglades Sample Model Input Window

--------------------Inbound Trucks--------------------

InDates	Mod-InTruck-Counts	Eller Inbound	Spangler Inbound	Eisenhower Inbound
100105	3342	2200	964	177
100205	4335	2855	1251	229
100305	4482	2951	1293	237
100405	4876	3211	1407	258
100505	4924	3242	1421	260

---------------------Outbound Trucks---------------------

OutDates	Mod-OutTruck-Counts	Eller Outbound	Spangler Outbound	Eisenhower Outbound
100105	3951	2441	1325	185
100205	3897	2408	1307	182
100305	4048	2501	1358	189
100405	4213	2603	1413	197
100505	4293	2652	1440	201

Figure 5.19 Port of Everglades Sample Model Output Window

5.6 PORT OF TAMPA

The experimental design of model development for the Port of Tampa included three trials before concluding on a statistically accurate model. The initial variables selected for modeling the Port of Tampa included two dependent and eight independent variables (Model-T1).

Dependent Variables

- Inbound Trucks
- Outbound Trucks

Independent Variables

- Weekday (1 if weekday else 0)
- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)

- Imported Tonnage
- Imported Barrels
- Imported Containers (Each)
- Exported Tonnage
- Exported Containers (Each)

The developed model will output the daily truck volumes by direction for each of the identified port access roads and a total volume of all inbound and outbound trucks at the port.

The initial independent variables constitute both the quantitative and qualitative variables. Weekday categories are the qualitative variables. Inbound and outbound trucks are heavily affected by the day of week. Hence truck counts had to be analyzed for how they are affected by the day of the week category. Truck counts were separated by direction (inbound and outbound) because during the data collection period, there were a number of days with comprehensive data by direction but because of the frequent damage to the classification units, comprehensive data for both directions and all locations was difficult to obtain. The number of common days for all inbound locations was 68 and the total number of common days for the outbound direction was 66.

Before using Scheffe's test, K-S Normality Test was performed. The K-S test showed a normal distribution for daily inbound and outbound truck volumes. Then the daily records were statistically analyzed for each day of the week. To compare the truck counts for day of the week, Scheffe's test was used to compare the truck counts on each day of the week. Tables 5.20 and 5.21 show the results for inbound and outbound trucks respectively.

- Yes: There is no significant difference in truck volumes
- No: There is a significant difference in truck volumes

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Monday		Yes	Yes	Yes	Yes	No	No
Tuesday	Yes		Yes	Yes	Yes	No	No
Wednesday	Yes	Yes		Yes	Yes	No	No
Thursday	Yes	Yes	Yes		Yes	No	No
Friday	Yes	Yes	Yes	Yes		No	No
Saturday	No	No	No	No	No		No
Sunday	No	No	No	No	No	No	

Table 5.20 Scheffe Test Results for Inbound Trucks

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Monday		Yes	Yes	Yes	Yes	No	No
Tuesday	Yes		Yes	Yes	Yes	No	No
Wednesday	Yes	Yes		Yes	Yes	No	No
Thursday	Yes	Yes	Yes		Yes	No	No
Friday	Yes	Yes	Yes	Yes		No	No
Saturday	No	No	No	No	No		Yes
Sunday	No	No	No	No	No	Yes	

Table 5.21 Scheffe Test Results for Outbound Trucks

For inbound trucks, the difference in weekday counts was statistically insignificant. However, weekdays were significantly different from weekends (Saturday and Sunday). Also, Saturday was significantly different from Sunday. For Outbound trucks, the difference in weekday counts was statistically insignificant. Weekdays were significantly different from weekends (Saturday and Sunday). For outbound trucks, there was no statistical difference between Saturday and Sunday. But for uniformity, truck counts were grouped into three categories for both inbound and outbound. These three variables were the initial qualitative variables used in the model.

Analysis of vessel data showed that each commodity imported and exported was measured by unit type (tons, barrels, containers, MBFT). Measured Board Feet (MBFT) was converted to tons (see Section 4.3.2). Therefore, the initial independent variables were selected based on unit type and direction (import or export). There were no exported barrels so subsequently no variable could be included for this without available data. Separate ANN models (see Figures 5.20a and 5.20b) for inbound and outbound trucks were developed with the initial set of independent variables.

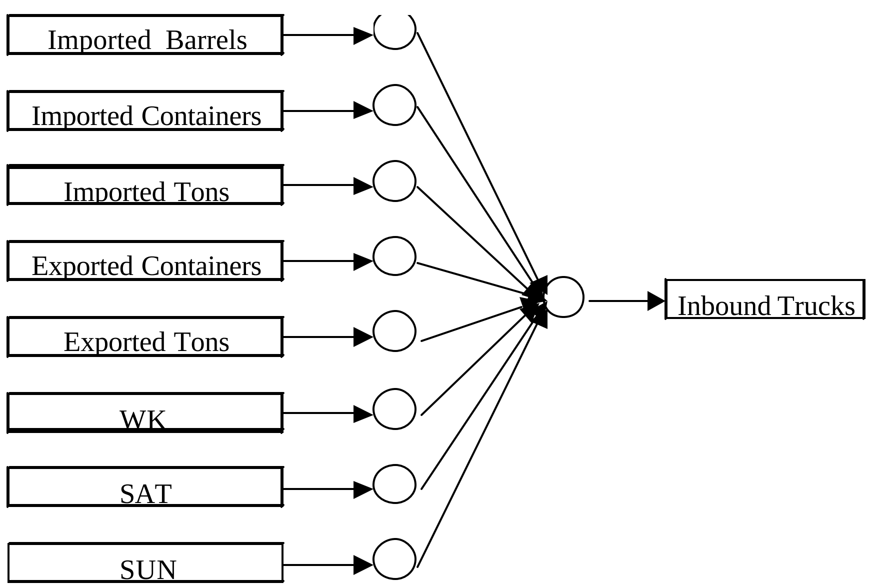


Figure 5.20a Initial ANN Model (Model-T1)for Inbound Trucks-Port of Tampa

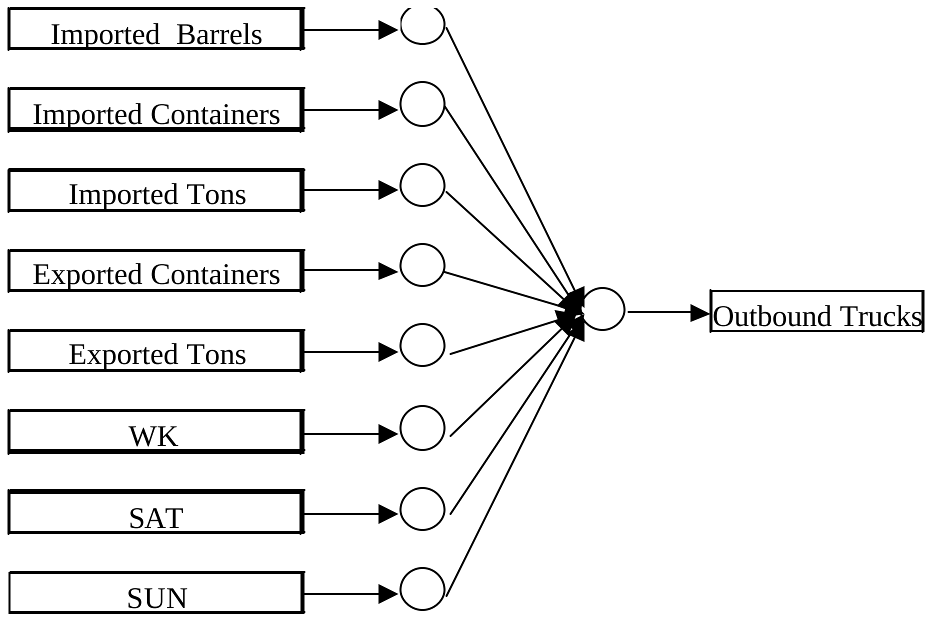


Figure 5.20b Initial ANN Model (Model-T1) for Outbound Trucks-Port of Tampa

The model was developed after conducting several runs. Each run had a different set of parameters. The parameters are the number of epochs, number of hidden layers and their nodes and an algorithm. In order to complete the model development process calibration and validation must be done for each run. The inbound model was calibrated (trained) using 55 randomly selected data records out of 82 data records consisting of dependent and independent variables, and outbound model with 44 randomly selected data records out of 66 data records respectively. Once the models were calibrated, the remaining 27 data records for inbound and 22 for outbound consisting only of independent variables were input into the model for validation. Calibration and validation records for inbound and outbound are displayed in Tables F.1 and F.2, Appendix F. Tables F.3 and F.4 show each run and the corresponding MSE for inbound and outbound model. MSE is calculated by averaging the squared differences between actual data and model output. MSE indicates the accuracy of a model. A lower MSE for a run indicates better accuracy. Therefore, the run with the least MSE value was chosen. Validation of the least MSE run (Model–T1) was performed using the same procedure applied for the Port of Palm Beach. Model-T1 was validated and found to have no statistical difference between the actual and model outputs. Error analysis shows the model accuracy at 96%. Accuracy was determined by comparing the model generated truck volumes from the validation and the actual field counts. (For the documented procedure of calculating accuracy, see Appendix M). Model–T1 was further tested for the ability to forecast when the quantitative independent variables (vessel data) were increased by 50%. The increase in desired outputs was very minimal similar to the initial port of Palm Beach model. Therefore, further model development was required. The results indicate that validating a model based on least MSE may not be conducive for producing a good forecasting model.

The next model (Model–T2) selected for modeling Port of Tampa included five independent variables.

Dependent Variables

- Inbound Trucks
- Outbound Trucks

Independent Variables

- Weekday (1 if weekday else 0)
- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)
- Daily Imported Tons
- Daily Exported Tons

The dependent variables are selected based on the desired outputs. The developed model will output the daily truck volumes by direction for each of the identified port access roads and a total volume of all trucks inbound and outbound at the port.

Analysis of vessel data showed that each commodity imported and exported was measured by tons and unit types (tons, barrels, each, MBFT). Therefore, the independent variables were selected based on tons and direction (import or export). The exported barrel records were related to vessel refueling so these records were subtracted from the previous day's total imported petroleum.

Sensitivity analysis was performed with Model-T2. To test the coefficients of each independent variable for its contribution to estimating the output, a test Regression model was developed. This procedure provided results to indicate whether the selected independent variables were appropriate or if they required adjustments. Table 5.22 shows the coefficients for each of the initial independent variables used for producing outputs in Model-T2.

	Coefficients	
Independent Variables	Inbound Trucks	Outbound Trucks
Daily Imported Tonnage	-0.00024036	0.000120785
Daily Exported Tonnage	-0.00087731	0.000964188
Wk	4266.08235	3877.223969
Sat	2294.53344	1820.615282
Sun	1659.518228	1348.740981

Table 5.22 Port of Tampa Model-T2 Independent Variable Coefficients

The results show daily imported and exported have negative coefficients for inbound trucks. Also, though the coefficients were positive for producing outbound trucks they were not significant. This indicated that the independent variables related to the vessel data needed further investigation. The qualitative variable 'WK' (Weekday) had large coefficient in both directions. Because of the previous analysis from the Port of Everglades modeling, the same analysis was concluded for this variable and subsequently dropped.

The individual vessel records by commodity type were analyzed in detail. The petroleum products displayed irregularities in the shipments and some of the port contacts indicated that the petroleum is stored when imported by vessel before it is transported out of the port by truck. Therefore, all the petroleum records for each of the months in the study period were totaled. This total was distributed over all the days in the corresponding month to obtain a daily average including weekends.

Irregularities of the imports in bulk tonnage records were also discovered over a weekly period. Port area contacts stated that storage around the port was available and widely utilized. Because of this, storage was considered for the imported tonnage variable. It was found that a sum of 7 days for total imported tonnage excluding barrel tonnage provided good representation for each day of truck counts. In other words, it was resolved that for any day of the week, a previous 7 days of total imported tonnage (excluding barrel tonnage) would need to be calculated. This does not include the tonnage for the day truck counts are desired to be modeled for. This summation can include weekend days.

Port of Tampa is famous for its phosphorous exports. Tampa leads the world as the highest exporter of phosphorous products, more than any other port in the world. Bulk phosphate rock and chemical shipments are exported infrequently but in extremely large quantities. Citrus pellets were also exported in significantly large quantities and also infrequently. Port area contacts also stated that large areas for storage of these products were available at the port. Also, the phosphate products and citrus pellets are usually delivered on a regular schedule. Therefore a monthly total was calculated for these products and distributed over the corresponding month to obtain a daily average. This provided a more uniform distribution for these products for relating them to the truck counts. Also, because of the available storage, storage variables for the exported tonnage were included as independent variables selected. This lead to the development of Model-T3. Model-T3 had two dependent and eight independent variables.

Independent Variables

- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)
- Daily Average Imported Barrels (based on a monthly total)
- Imported tons (Sum of last 7 days)
- Daily Exported Tons* (0)
- Daily Exported Tons* (+1)
- Daily Exported Tons* (+2)
- Daily Exported Tons* (+3)

The “*” denotes that phosphate rock, phosphate chemical and citrus pellets tonnage records were averaged and must be calculated by the model-user. The value in parenthesis indicates if it is a lead (+) variable and the number of storage days considered. These are not necessary for the model-user to calculate however it does affect the number of required records for model input. The two qualitative variables, Saturday and Sunday are assigned a value of ‘0’ when the input date is a weekday.

Again an initial test regression model was developed to examine the contribution each of the independent variables had on the output. During the testing, insignificant independent variables were removed. The final group of independent variables for inbound and outbound trucks and their coefficients are displayed in Table 5.23.

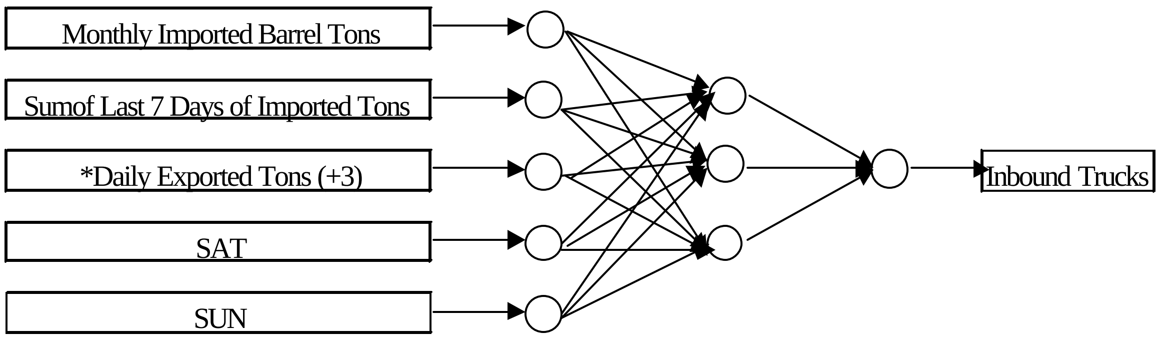
Inbound Trucks		**Outbound Trucks**	
Independent Variables	Coefficients	Independent Variables	Coefficients
Monthly Imported Barrel Tons	0.048	Monthly Imported Barrel Tons	0.09265585
Imported Tons-Sum of Last 7 Days	0.004	Imported Tons-Sum of Last 7 Days	0.0030762
*Daily Exported Tons(+3)	0.032	*Daily Exported Tons(+1)	0.027113673
SAT	-1725.675	SAT	-2034.065892
SUN	-2149.672	SUN	-2402.11551

* with phosphate rock, phosphate chemical citrus pellets averaged

Table 5.23 Port of Tampa Model-T3 Independent Variable Coefficients

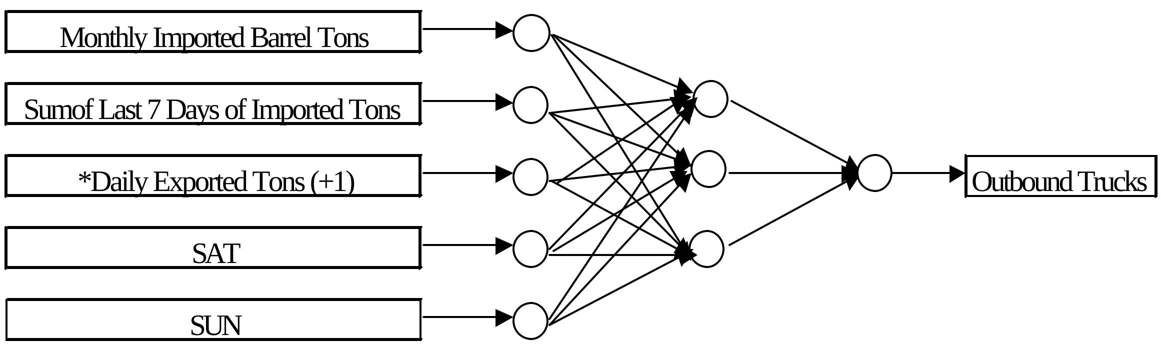
The results show that SAT (Saturday) and SUN (Sunday) variables have negative coefficients due to truck volumes being significantly lower on weekends. The storage variables are also affecting the weekend variables because the storage variables are significant in the model. These variables were concluded for use in the final ANN model.

These 5 independent variables for inbound trucks and 5 independent variables for outbound trucks listed in Table 5.23 were used to train (calibrate) the ANN models. The final ANN models developed are displayed in Figures 5.21a and 5.21b. The Matlab™ code for the developed models is displayed in Appendix J.



* with phosphorous commodities averaged

Figure 5.21a Final ANN Model for Inbound Trucks-Port of Tampa



* with phosphorous commodities averaged

Figure 5.21b Final ANN Model for Outbound Trucks-Port of Tampa

Figures 5.21a and 5.21b show that the ANN models use only 5 variables as input with one hidden layer. Note that the inbound truck model uses a three-day lead variable but the outbound truck model uses only a one-day lead variable. The ANN model 5.21a used 46 data records for calibration and 22 records for validation selected randomly to produce inbound truck counts. These records are displayed in Table F.5 of Appendix F. Similarly, the ANN model 5.21b used 44 data records for calibration and 22 records selected randomly for validation to produce outbound truck counts. These records are displayed in Table F.6 of Appendix F. These records were randomly selected during the model development process for better comprehension of the input data. For validation, the actual truck counts collected from the field were compared to the model output. Table 5.24 displays the results of this analysis.

INBOUND			OUTBOUND		
Date*	Actual	Model	Date*	Actual	Model
71700	4298	4259	80400	3612	3787
71900	4451	4218	80500	1667	1723
72300	1723	1724	80700	3575	3754
72400	4331	4259	80900	3298	3686
80500	2204	2065	90500	3508	3695
81200	2294	1829	90800	3888	4202
90700	4429	4366	91400	4596	4279
91000	1834	1818	91700	1109	1146
91300	4361	4342	92700	4165	4015
91800	4018	4302	92900	4291	4367
92600	4102	4188	93000	1612	1619
92700	3941	4104	100400	3930	4011
93000	2309	2258	101000	4480	3677
100300	4059	4207	101100	4606	4118
102300	4286	4359	101400	1545	1727
103000	4101	4173	101700	3387	3550
110300	4230	4209	103100	4274	4326
110400	2280	2259	110300	4004	3989
110700	4055	4185	110400	2015	2030
111000	2089	2049	110700	3834	3825
111800	2002	2099	111400	3768	3632
111900	1700	2443	111900	1300	1444

*(mm/dd/yy)
NOTE: gray cells indicate weekends and hence not considered for calculating accuracy

Table 5.24 Model Output and Actual Truck Volumes for the Final ANN Port of Tampa Model

A K-S Normality Test was performed on the difference between the actual and model truck counts to ensure the assumption that the distributions were normal. Then to validate the above results, Scheffe's paired t-test was applied. Table 5.25 shows the statistical results obtained from Scheffe's test comparing model results with the actual field truck counts for both inbound and outbound. The test was performed with the null hypothesis that there is no statistical difference between the model and actual truck counts with a 95% confidence level. Error analysis shows the model accuracy at 95%. Accuracy was determined by comparing the model generated truck volumes from the validation and the actual field counts. (For the documented procedure of calculating accuracy, see Appendix M)

Model Vs Actual

Dependent Variable	p-value	Results (reject if the p-value ≤ 0.05)	Conclusions
Inbound Trucks	0.555	Do not reject H_o	*Identical*
Outbound Trucks	0.913	Do not reject H_o	*Identical*

H_o : No significant difference between model and actual truck counts

Table 5.25 Statistical Results Comparing Model and Actual Truck Counts for the Final ANN Port of Tampa Model

The results show that there is no statistical difference for both inbound and outbound trucks. Figures 5.22 and 5.23 show a graphical comparison between the actual and model truck counts for the inbound and outbound directions.

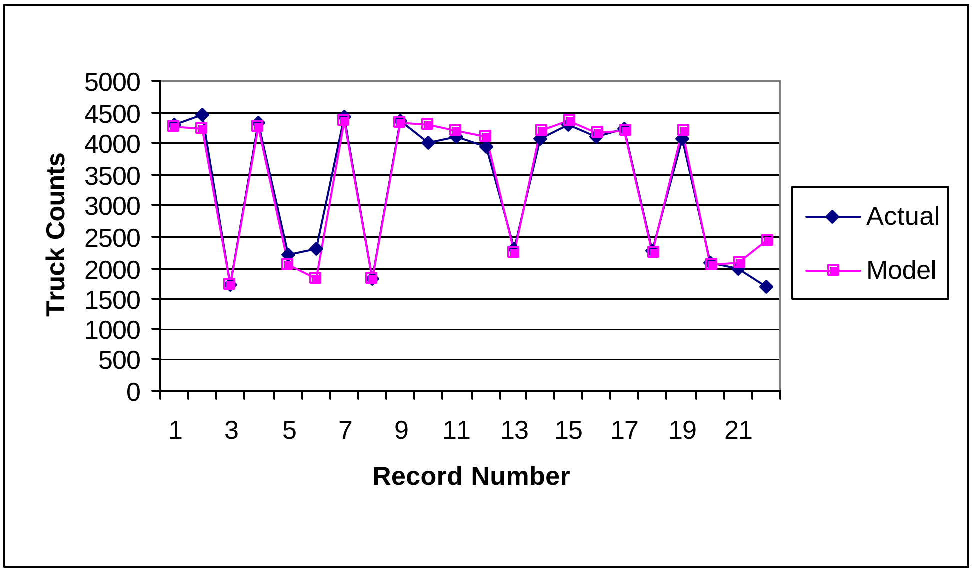


Figure 5.22 Model and Actual Inbound Truck Counts for the Final ANN Port of Tampa Model

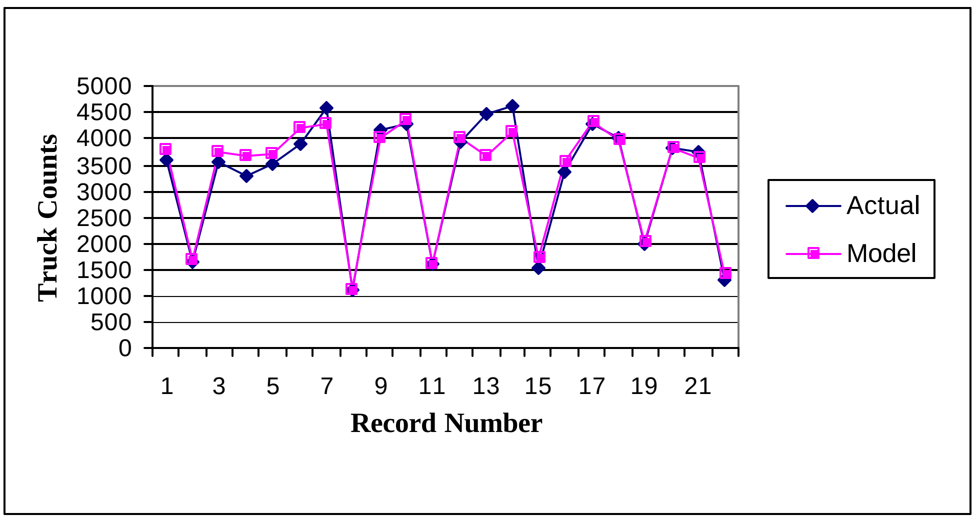


Figure 5.23 Model and Actual Outbound Truck Counts for the Final ANN Port of Tampa Model

The previously listed independent variables are used for the internal calculations of the model to produce the desired output. The actual independent variables required by the model-user for input is much less complicated. The following are the final independent variables used for input into the model for the Port of Tampa by the user.

Independent Variables

- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)
- Monthly Imported Barrels in Tons
- Sum of last 7 days of Imported tons
- Daily Exported Tons (phosphate rock, phosphate chemical and citrus pellets monthly tonnage records distributed for average daily totals)

The two inbound and outbound models are combined to take input from one spreadsheet. An example of the input window is shown in Figure 5.24 and an example of the corresponding output window is shown in Figure 5.25. The "*" indicates necessary input fields which are the independent variables previously described. Because of the storage variables in the model, there are three required records following the number of day's output is desired. For instance, as in Figure 5.24, five days of output are desired, therefore, three following records (which are SN records # 6, 7, and 8 in this example) are required for input. "SN" is just a serial number for identifying a specific record. A detailed explanation on how to use the model is included in Appendix L.

Enter the number of days for which Output is desired except the last the three records = **5**

SN	***Date**	***Daily Average Imported Barrels**	***Sum of Last 7 Days Imported Tons**	***Daily Exported Tonnage**	***SAT** *(1 if Saturday; 0 if not)*	***SUN** *(1 if Sunday; 0 if not)*
1	100105	40029	230282	18637	0	0
2	100205	40029	222788	22287	0	0
3	100305	40029	222602	22629	0	0
4	100405	40029	222424	21816	0	0
5	100505	40029	229044	23028	0	0
6	100605	40029	235242	18472	1	0
7	100705	40029	228729	18232	0	1
8	100805	40029	223785	23127	0	0

note: extra records are required to complete the calculations

Figure 5.24 Port of Tampa Sample Model Input Window

-----------------------INBOUND TRUCKS-----------------------

In Dates	Inbound Trucks	21-st Street	20th Street	Causeway Blvd	Sutton	Pendola point
100105	4321	1241	552	1933	361	234
100205	4305	1236	550	1926	359	233
100305	4385	1259	560	1962	366	238
100405	4383	1259	560	1961	366	238
100505	4176	1199	533	1868	349	226

-----------------------OUTBOUND TRUCKS-----------------------

Out Dates	Outbound Trucks	21-st Street	20th Street	Causeway Blvd	Sutton	Pendola point
100105	4256	996	631	1836	409	383
100205	3337	781	494	1439	321	301
100305	4062	951	602	1752	391	366
100405	3828	896	567	1651	368	345
100505	3961	927	587	1708	381	357

Figure 5.25 Port of Tampa Sample Model Output Window

5.7 PORT OF JACKSONVILLE

Jacksonville had two separate major terminals with some significantly different characteristics. For instance, autos shipped at the Talleyrand Terminal were insignificant compared to the Blount Island Terminal. Because of this, two separate models were developed for each terminal.

5.7.1 Talleyrand Terminal

The variables selected for modeling the Port of Jacksonville Talleyrand Terminal included two dependent and six independent variables.

Dependent Variables

- Inbound Trucks
- Outbound Trucks

Independent Variables

- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)
- Imported Bulk (Monthly Average)
- Imported Containers (Sum of Last 7 days)
- Exported Bulk (Monthly Average)
- Exported Containers (Sum of Next 7 days)

The developed model will output the daily truck volumes by direction for each of the identified port access roads and a total volume of all trucks inbound and outbound at the port.

The independent variables constitute both the quantitative and qualitative variables. Weekday categories are the qualitative variables. Inbound and outbound trucks are heavily affected by the day of week. Hence truck counts had to be analyzed for how they are affected by the day of the week category. Truck counts were separated by direction (inbound and outbound) because during the data collection period, there were a number of days with comprehensive data by direction but because of the frequent damage to the classification units, comprehensive data for both directions and all locations was difficult to obtain. The number of common days for all inbound locations was 94 and the total number of common days for the outbound direction was also 94.

These daily records were statistically analyzed for each day of the week using Scheffe's test. Before Scheffe's test, K-S Normality Test was performed. The K-S test showed a normal distribution for daily inbound and outbound truck volumes. To compare the truck counts for day of the week, Scheffe's test was applied to compare the truck counts on each day of the week. Tables 5.26 and 5.27 show the results for inbound and outbound trucks respectively.

- Yes: There is no significant difference in truck volumes
- No: There is a significant difference in truck volumes

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Monday		Yes	Yes	Yes	Yes	No	No
Tuesday	Yes		Yes	Yes	Yes	No	No
Wednesday	Yes	Yes		Yes	Yes	No	No
Thursday	Yes	Yes	Yes		Yes	No	No
Friday	Yes	Yes	Yes	Yes		No	No
Saturday	No	No	No	No	No		No
Sunday	No	No	No	No	No	No	

Table 5.26 Scheffe Test Results for Inbound Trucks

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Monday		Yes	Yes	Yes	Yes	No	No
Tuesday	Yes		Yes	Yes	Yes	No	No
Wednesday	Yes	Yes		Yes	Yes	No	No
Thursday	Yes	Yes	Yes		Yes	No	No
Friday	Yes	Yes	Yes	Yes		No	No
Saturday	No	No	No	No	No		No
Sunday	No	No	No	No	No	No	

Table 5.27 Scheffe Test Results for Outbound Trucks

For both inbound and outbound trucks, the difference in weekday counts was statistically insignificant. However, weekdays were significantly different from weekends (Saturday and Sunday). Also, Saturday was significantly different from Sunday. Because of the previous analysis from the Port of Everglades modeling, the weekday variable was not used so only independent variables for Saturday and Sunday were included.

The quantitative variables are obtained from vessel data. Analysis of vessel data combining two terminals showed that vessel cargo was classified according to the respective cargo type. Each cargo type has a specific unit-of-measure. Cargo is listed in specific unit-of-measure and tons. Since all the cargo types are also listed in tons, tons are used as unit-of-measure for all cargo types in model development. The basic cargo types are listed in Table 4.10 Section 4.3.4.

Although autos are listed as a cargo type, due to the insignificant quantity shipped at Talleyrand compared to other cargo types, this was included in the bulk variables.

At Talleyrand, vessel shipments are irregular, especially bulk products. For example, Figure 5.26 shows the variation of daily exported and imported bulk at Talleyrand during January, February and March 2001. The record number refers to one day of total tonnage imported or exported.

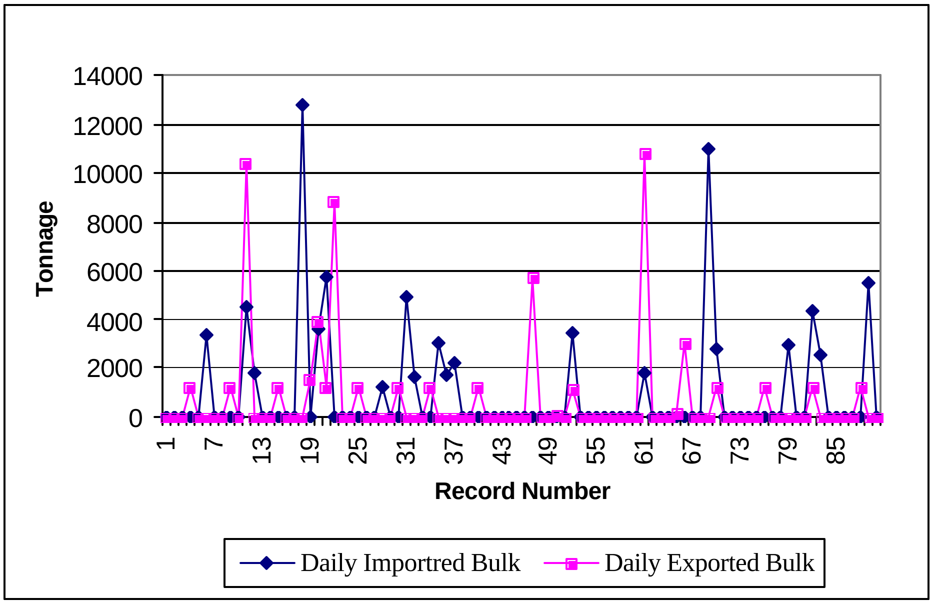


Figure 5.26 Port of Jacksonville Daily Imported and Exported Bulk

Because of these irregular shipments throughout the entire month, daily averages were calculated for imported and exported bulk in tons. Therefore, all the bulk records for each of the months in the study period were totaled for imports and exports separately. These totals were distributed over all the days in the corresponding month to obtain daily averages including weekends.

Irregularities of the imported and exported container records were also discovered over a weekly period. Port area contacts stated that storage around the port was available. Because of this, storage was considered for the container tonnage variable. It was found that a sum of 7 days for total imported or exported container tonnage provided good representation for each day of truck counts. In other words, it was resolved that for any day of the week, a previous 7 days of total imported container tonnage or a following 7 days of total exported container tonnage would need to be calculated. This does not include the tonnage for the day truck counts are desired to be modeled for. This summation can include weekend days.

The 5 independent variables for inbound trucks and 5 independent variables for outbound trucks were used to train (calibrate) the model. The developed ANN models are displayed in Figures 5.27a and 5.27b with one hidden layer. The Matlab™ code for the developed models is displayed in Appendix K.

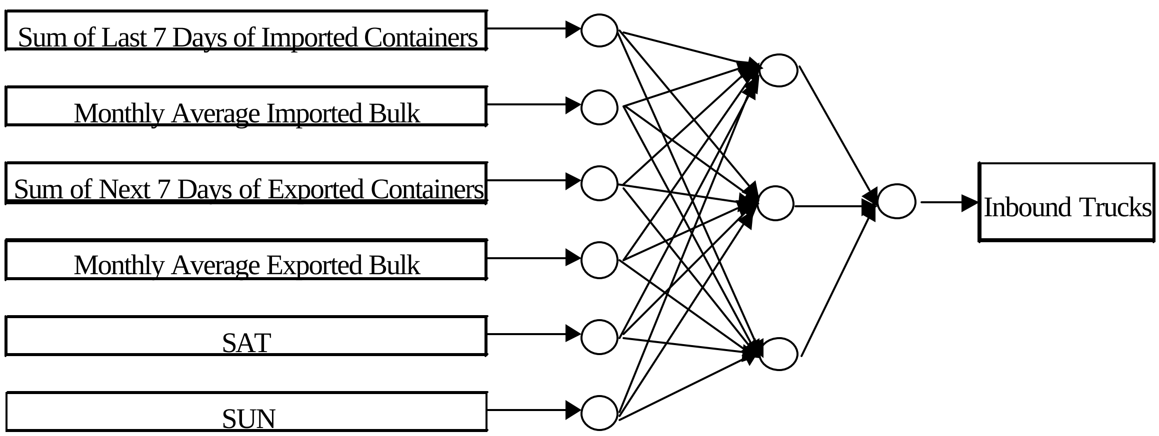


Figure 5.27a Final ANN Model for Inbound Trucks-Talleyrand Terminal

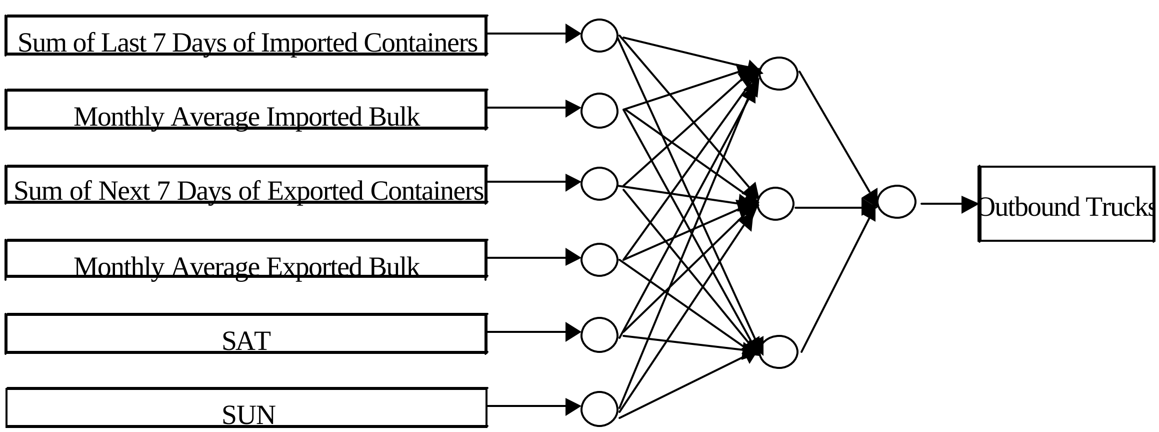


Figure 5.27b Final ANN Model for Outbound Trucks-Talleyrand Terminal

Both ANN models used 46 data records for calibration and 23 records for validation selected randomly to produce the desired output. These records are displayed in Table G.1 of Appendix G. These records were randomly selected during the model development process for better comprehension of the input data. For validation, the actual truck counts collected from the field were compared to the model output. Table 5.28 displays the results of this analysis.

INBOUND			**OUTBOUND**		
Date*	Actual	Model	Date*	Actual	Model
30301	289	296	30101	958	882
30501	890	963	31001	320	238
31201	875	948	31101	162	125
31401	993	952	31301	1046	858
31701	314	308	31701	314	261
31801	130	130	31901	867	753
92699	258	306	92199	1081	1212
92999	1142	949	92499	1079	1173
110199	979	1088	92599	482	200
110299	1001	1014	92899	1126	1110
110399	1019	1019	93099	1091	1148
110699	387	388	110199	979	927
110799	151	102	110299	1001	1199
111099	1072	1077	110799	151	201
111199	1003	1078	111199	1003	1095
111399	328	328	112099	340	403
111599	1064	1080	112299	1111	1122
112199	214	218	112799	283	335
112499	988	958	112999	989	1045
112899	113	115	120399	967	1077
113099	1055	946	120699	1004	1130
120299	1063	1031	121099	959	1075
121099	959	955	121199	390	327

* (mm/dd/yy)

NOTE: All counts are considered for calculating accuracy, because of excessive number of weekends in validation points.

Table 5.28 Model Output and Actual Truck Volumes for the Final ANN Port of Jacksonville-Talleyrand Terminal Model

A K-S Normality Test was performed on the difference between the actual and model truck counts to validate the assumption that the distributions were normal. To validate the above results, Scheffe's paired t-test was applied. Table 5.29 shows the statistical results obtained from Scheffe's test comparing model results with the actual field truck counts for both inbound and outbound. The test was performed with the null hypothesis (Ho) that there is no statistical difference between the model and actual truck counts with a 95% confidence level. Error analysis shows the model accuracy at 89%. Accuracy was determined by comparing the model generated truck volumes from the validation and the actual field counts. (For the documented procedure of calculating accuracy, see Appendix M)

Model Vs Actual

Dependent Variable	p-value	Results (reject if the p-value ≤ 0.05)	Conclusions
Talleyrand Terminal			
Inbound Trucks	0.900	Do not reject H_o	*Identical*
Outbound Trucks	0.725	Do not reject H_o	*Identical*

H_o : No significant difference between model and actual truck counts

Table 5.29 Statistical Results Comparing Model and Actual Truck Counts for the Final ANN Port of Jacksonville-Talleyrand Terminal Model

The results show no statistical difference for both inbound and outbound trucks. Figures 5.28 and 5.29 show a graphical comparison between the actual and model truck counts for the inbound and outbound directions.

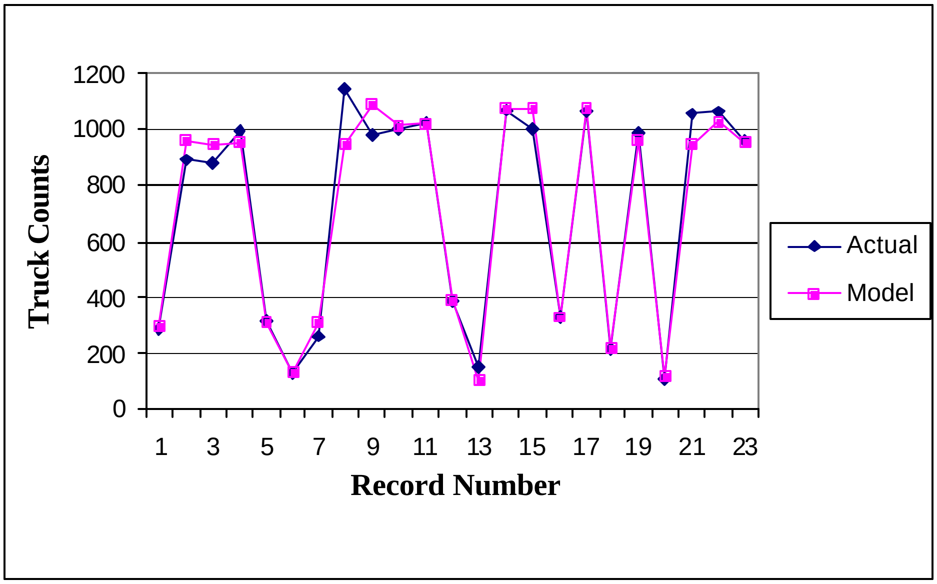


Figure 5.28 Model and Actual Inbound Truck Counts for the Final ANN Port of Jacksonville-Talleyrand Terminal Model

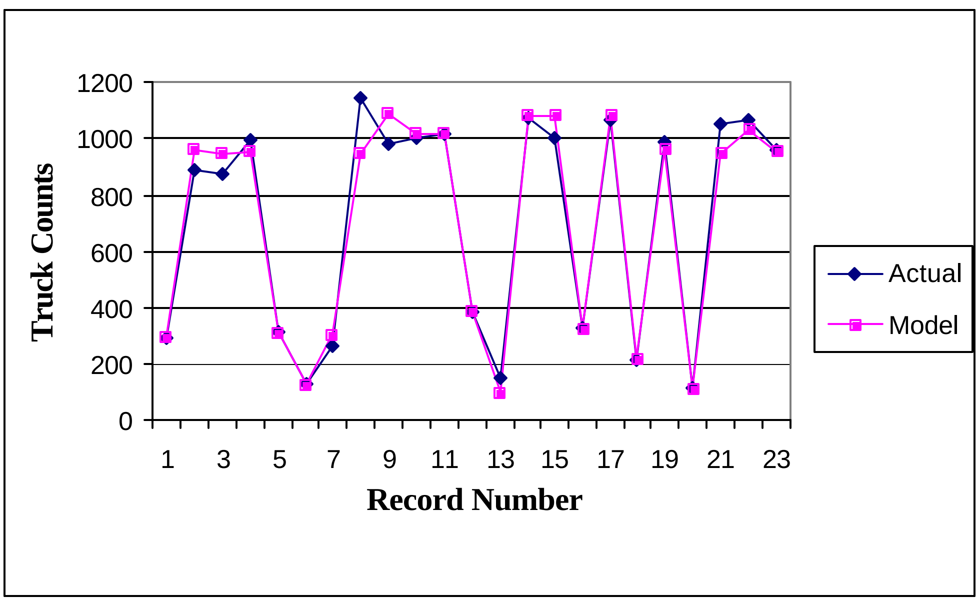


Figure 5.29 Model and Actual Outbound Truck Counts for the Final ANN Port of Jacksonville-Talleyrand Terminal Model

The following are the final independent variables used for input into the model for the Port of Jacksonville-Talleyrand Terminal by the user.

Independent Variables

- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)
- Imported Bulk (Monthly Average)
- Imported Containers (Sum of Last 7 days)
- Exported Bulk (Monthly Average)
- Exported Containers (Sum of Next 7 days)

The two inbound and outbound models are combined to take input from one spreadsheet. An example of the input window is shown in Figure 5.30 and an example of the corresponding output window is shown in Figure 5.31. The "*" indicates necessary input fields which are the independent variables previously explained. "SN" is just a serial number for identifying a specific record. A detailed explanation on how to use the model is included in Appendix L.

Enter the number of days for which Output is desired = ***5***

SN	***Date**	***Daily Average Imported Bulk**	***Sum of Last 7 Days Imported Containers**	***Daily Average Exported Bulk**	***Sum of Next 7 Days Exported Containers**	***SAT** *(1 if Saturday; 0 if not)*	***SUN** *(1 if Sunday; 0 if not)*
1	*092199*	2107	5139	219	11201	0	0
2	*092299*	2107	5284	219	13047	0	0
3	*092399*	2107	7519	219	13708	0	0
4	*092499*	2107	7519	219	13708	0	0
5	*092599*	2107	5224	219	12712	1	0

Figure 5.30 Port of Jacksonville-Talleyrand Terminal Sample Model Input Window

------------------------------INBOUND TRUCKS-------------

Dates	Total Inbound	8th Street	21st Street
92199	966	534	432
92299	1072	593	479
92399	1082	599	483
92499	1082	599	483
92599	487	269	218

------------------------------OUTBOUND TRUCKS----------

Dates	Total Outbound	8th Street	21st Street
92199	1211	588	623
92299	1212	589	623
92399	1173	570	603
92499	1173	570	603
92599	199	97	102

Figure 5.31 Port of Jacksonville-Talleyrand Terminal Sample Model Output Window

5.7.2 Blount Island

The variables selected for modeling the Port of Jacksonville Blount Island Terminal included two dependent and ten independent variables.

Dependent Variables

- Inbound Trucks
- Outbound Trucks

Independent Variables

- Monday or Wednesday (1 if Monday or Wednesday else 0)
- Tuesday, Thursday or Friday (1 if Tuesday or Thursday or Friday else 0)
- Saturday (1 if Saturday else 0)

- Sunday (1 if Sunday else 0)
- Sum of Last 7 days- Imported Autos
- Monthly Average- Imported Bulk
- Sum of Last 3 days- Imported Containers
- Sum of Next 7 days- Exported Autos
- Monthly Average- Exported Bulk
- Sum of Next 7 days- Exported Containers

The independent variables constitute both the quantitative and qualitative variables. Weekday categories are the qualitative variables. Inbound and outbound trucks are heavily affected by the day of week. Hence truck counts had to be analyzed for how they are affected by the day of the week category. Truck counts were separated by direction (inbound and outbound) because during the data collection period, there were a number of days with comprehensive data by direction but because of the frequent damage to the classification units, comprehensive data for both directions and all locations was difficult to obtain. The number of common days for inbound and outbound was 41 days. Selecting the days of truck counts for model development was based on having quality and accurate data for both the dependent and independent variables. As such, if any records displayed irregularity compared to the majority of the available records and could not be explained, the day was excluded.

These daily records were statistically analyzed for each day of the week using Scheffe's test. Before Scheffe's test, K-S Normality Test was performed. The K-S test showed a normal distribution for daily inbound and outbound truck volumes. To compare the truck counts for day of the week, Scheffe's test was used to compare the truck counts on each day of the week. Tables 5.30a and 5.30b show the results for inbound and outbound trucks respectively

- Yes: There is no significant difference in truck volumes
- No: There is a significant difference in truck volumes

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Monday		No	Yes	No	No	No	No
Tuesday	No		No	Yes	Yes	No	No
Wednesday	Yes	No		No	No	No	No
Thursday	No	Yes	No		Yes	No	No
Friday	No	Yes	No	Yes		No	No
Saturday	No	No	No	No	No		No
Sunday	No	No	No	No	No	No	

Table 5.30a Scheffe Test Results for Inbound Trucks

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Monday		No	Yes	No	No	No	No
Tuesday	No		No	Yes	Yes	No	No
Wednesday	Yes	No		No	No	No	No
Thursday	No	Yes	No		Yes	No	No
Friday	No	Yes	No	Yes		No	No
Saturday	No	No	No	No	No		No
Sunday	No	No	No	No	No	No	

Table 5.30b Scheffe Test Results for Outbound Trucks

The results of Scheffe's test for Blount Island showed different results when compared to other ports. There is a statistical difference between some of the weekdays. Mondays and Wednesdays are similar but different from Tuesdays, Thursdays and Fridays. All weekdays are different from weekends. Saturdays and Sundays are different from each other. Hence based on these test results, four day of week variables were introduced.

The quantitative variables are obtained from vessel data. Analysis of vessel data combining two terminals showed that vessel cargo was classified according to the respective cargo type. Each cargo type has a specific unit-of-measure. Cargo is listed in specific unit-of-measure and tons. Since all the cargo types are also listed in tons, tons are used as unit-of-measure for all cargo types in model development. The basic cargo types are listed in Table 4.10 Section 4.3.4.

Auto is a significant cargo type at Blount Island unlike at Talleyrand. Irregularities of the imported and exported auto records were recognized over a weekly period. Port area contacts stated that storage around the port was available. Because of this, storage was considered for the auto tonnage variable. It was found that a sum of 7 days for total imported or exported auto tonnage provided good representation for each day of truck counts. In other words, it was resolved that for any day of the week, a previous 7 days of total imported auto tonnage or a following 7 days of total exported auto tonnage would need to be calculated. This does not include the tonnage for the day truck counts are desired to be modeled for. This summation can include weekend days.

At Blount Island, vessel shipments were quite irregular for bulk products. Because of these irregular shipments throughout the entire month, daily averages were calculated for imported and exported bulk in tons. Therefore, all the bulk records for each of the months in the study period were totaled for imports and exports separately. These totals were distributed over all the days in the corresponding month to obtain daily averages including weekends.

Irregularities of the imported and exported container records were also discovered over a weekly period. Because of this, storage was considered for the container tonnage variable. It was found that a sum of 3 days for total imported and a sum of 7 days exported container tonnage provided good representation for each day of truck counts. In other words, it was resolved that for any day of the week, a previous 3 days of total imported container tonnage or a following 7 days of total exported container tonnage would need to be calculated. This does not include the tonnage for the day truck counts are desired to be modeled for. This summation can include weekend days.

The 10 independent variables for both inbound trucks and outbound trucks were used to train (calibrate) the model. Separate models were developed for output of inbound and outbound trucks. Figures 5.32a and 5.32b show the design of the final developed models for inbound and outbound trucks. The Matlab™ code for the developed models is displayed in Appendix K.

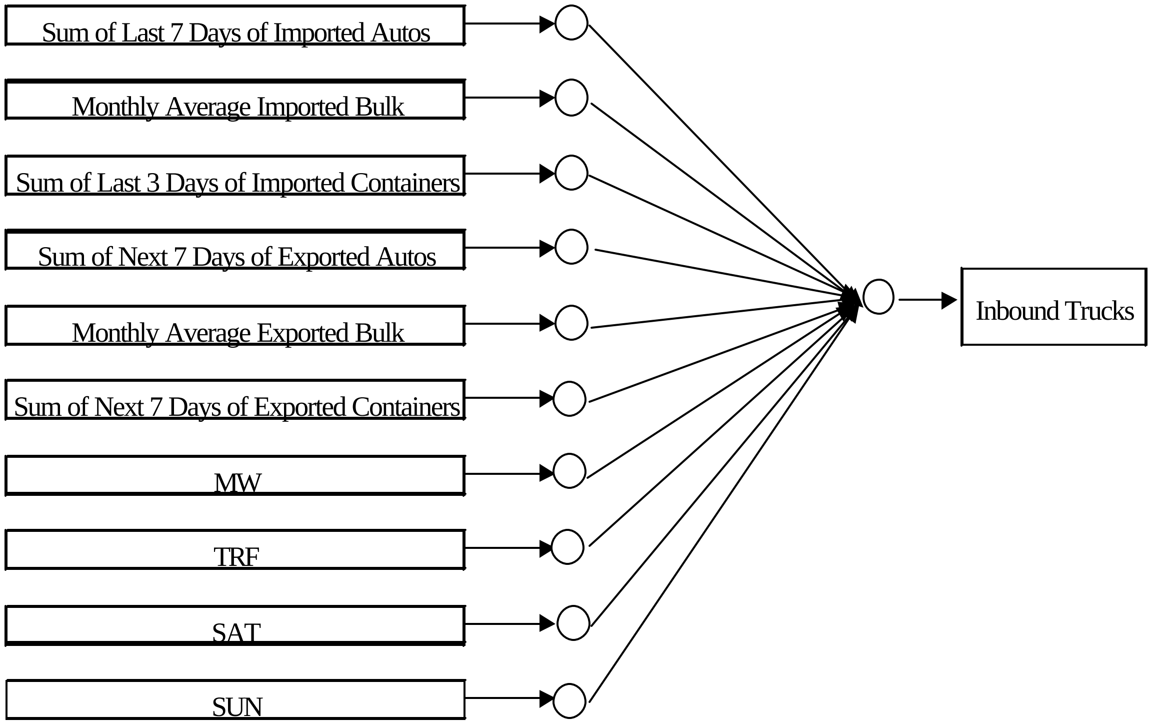


Figure 5.32a Final ANN Model for Inbound Trucks-Blount Island Terminal

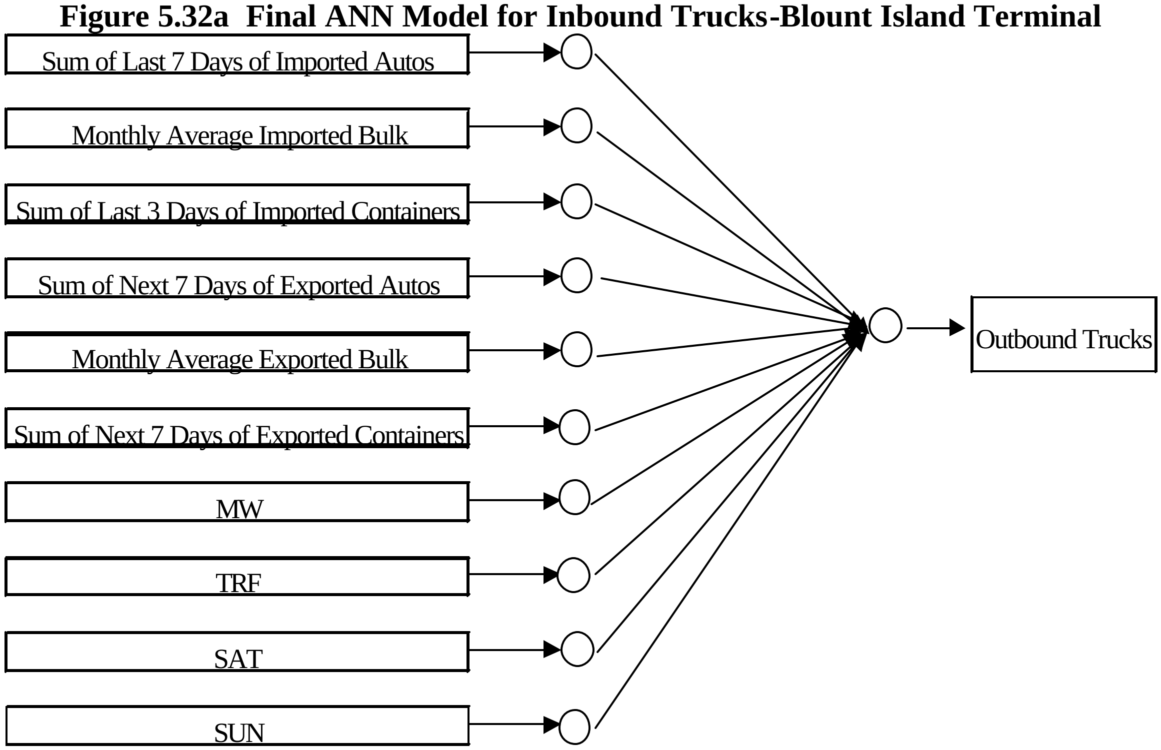


Figure 5.32b Final ANN Model for Outbound Trucks-Blount Island Terminal

Both ANN models used 28 data records for calibration and 13 records for validation selected randomly to produce desired output. These records are displayed in Table G.2 of

Appendix G. These records were randomly selected during the model development process for better comprehension of the input data. For validation, the actual truck counts collected from the field were compared to the model output. Table 5.31 displays the results of this analysis.

INBOUND			**OUTBOUND**		
Date*	Actual	Model	Date*	Actual	Model
21201	824	907	21201	824	862
21301	1020	1056	21401	900	856
21401	900	889	21901	728	850
21801	63	113	22301	1132	1114
21901	728	861	22401	250	203
22501	80	176	30301	241	211
30301	241	231	31301	1096	1053
31301	1096	985	31401	864	866
31501	983	1090	31501	983	1105
31801	98	51	31901	755	874
31901	755	882	32101	884	863
32101	884	853	32201	972	1094
32301	1108	1058	32401	235	182

* (mm/dd/yy)
NOTE: All counts are considered for calculating accuracy due to few validation points

Table 5.31 Model Output and Actual Truck Volumes for the Final ANN Port of Jacksonville-Blount Terminal Model

A K-S Normality Test was performed on the difference between the actual and model truck counts to validate the assumption that the distributions were normal. To validate the above results, Scheffe's paired t-test was used. Table 5.32 shows the statistical results obtained from Scheffe's test comparing model results with the actual field truck counts for both inbound and outbound. The test was performed with the null hypothesis that there is no statistical difference between the model and actual truck counts with a 95% confidence level. Error analysis shows the model accuracy at 89%. Accuracy was determined by comparing the model generated truck volumes from the validation and the actual field counts. (For the documented procedure of calculating accuracy, see Appendix M)

Model Vs Actual

Dependent Variable	p-value	Results (reject if the p-value ≤ 0.05)	Conclusions
Blount Island Terminal			
Inbound Trucks	0.236	Do not reject H_o	*Identical*
Outbound Trucks	0.667	Do not reject H_o	*Identical*

H_o : No significant difference between model and actual truck counts

Table 5.32 Statistical Results Comparing Model and Actual Truck Counts for the Final ANN Port of Jacksonville-Blount Terminal Model

The results show that there is no statistically significant difference for both inbound and outbound trucks. Figures 5.33 and 5.34 show a graphical comparison between the actual and model truck counts for the inbound and outbound directions.

Figure 5.33 Model and Actual Inbound Truck Counts for the Final ANN Port of Jacksonville-Blount Terminal Model

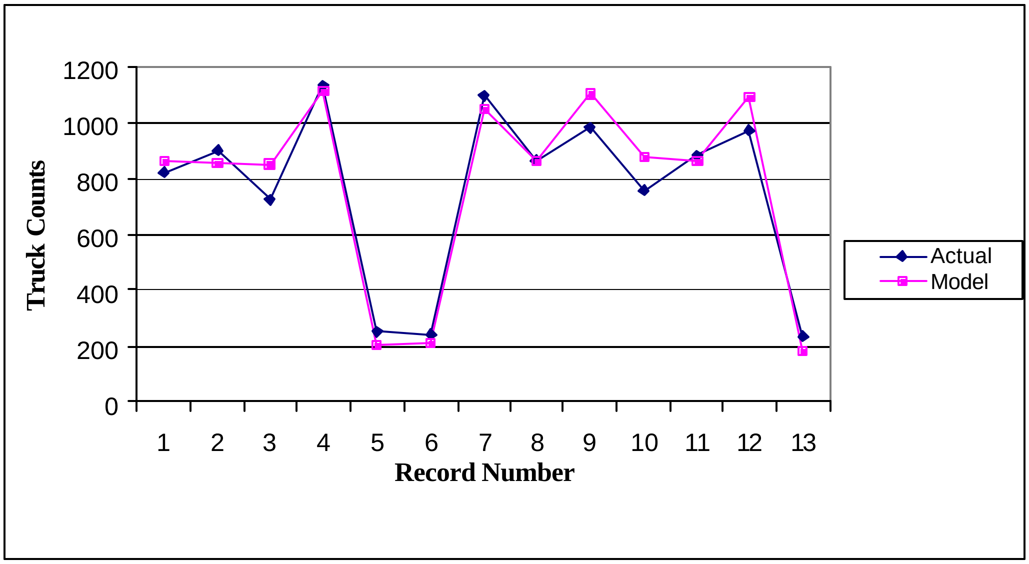


Figure 5.34 Model and Actual Outbound Truck Counts for the Final ANN Port of Jacksonville-Blount Terminal Model

The following are the final independent variables used for input into the model for the Port of Jacksonville-Blount Island Terminal by the user.

Independent Variables

- Monday or Wednesday (1 if Monday or Wednesday else 0)
- Tuesday, Thursday or Friday (1 if Tuesday or Thursday or Friday else 0)
- Saturday (1 if Saturday else 0)
- Sunday (1 if Sunday else 0)
- Sum of Last 7 days- Imported Autos
- Monthly Average- Imported Bulk
- Sum of Last 3 days- Imported Containers
- Sum of Next 7 days- Exported Autos
- Monthly Average- Exported Bulk
- Sum of Next 7 days- Exported Containers

The two inbound and outbound models are combined to take input from one spreadsheet. An example of the input window is shown in Figure 5.35 and an example of the corresponding output window is shown in Figure 5.36. The "*" indicates necessary input fields which are the independent variables previously explained. "SN" is just a serial number for identifying a specific record. A detailed explanation on how to use the model is included in Appendix L.

Enter the number of days for which Output is desired = **5**

SN	*Date	*Sum of Last 7 Days Imported Autos	*Daily Average Imported Bulk	*Sum of Last 3 Days Imported Containers	*Sum of Next 7 Days Exported Autos	*Daily Average Exported Bulk	*Sum of Next 7 Days Exported Containers	*MW (1 if Mon or Wed; 0 if not)	*TRF (1 if Tu, We,Thu; 0 if not)	*SAT (1 if Saturday; 0 if not)	*SUN (1 if Sunday; 0 if not)
1	020901	6385	2593	6149	1540	240	46677	0	1	0	0
2	021001	8361	2593	4515	1538	240	41562	0	0	1	0
3	021101	8361	2593	4025	1105	240	41168	0	0	0	1
4	021201	9937	2593	5487	1042	240	37708	1	0	0	0
5	021301	7996	2593	3303	903	240	37708	0	1	0	0

Figure 5.35 Port of Jacksonville-Blount Island Terminal Sample Model Input Window

Blount Island Terminal

- ------------------INBOUND TRUCKS---------------

Dates	Inbound Trucks
20901	1130
21001	214
21101	60
21201	905
21301	1065

-- ------------------OUTBOUND TRUCKS------------

Dates	Outbound Trucks
20901	1100
21001	181
21101	32
21201	866
21301	1066

Figure 5.36 Port of Jacksonville-Blount Island Terminal Sample Model Output Window

CHAPTER 6

FORECASTING

6.1 INTRODUCTION

In order to predict future trucks on the selected access roads for each of the ports, predicted vessel data was required. To predict future vessel data, a time series analysis was used. Time Series analysis is a statistical approach to understand the special role by time in the relationship between time-ordered variables. Time series is a collection of data obtained by observing a response variable at equal spaced points in time. The main goal of time series analysis is to produce a model that can express a time-structured relationship among some variables or events. After developing the time series model, it can be used to forecast the response variable. A single equation ARIMA (Auto Regression Integrated Moving Average) model states how any value in a single time series is linearly related to its own past values. If a model is a good approximation of a process, the model tends to mimic the behavior of the process. Thus, forecasts from the model provide useful information about future values of the series (40). The software used for the time series modeling was ITSM2000 V6.0 developed by Peter J. Brockwell, Richard A. Davis, and Matthew V. Calder (41).

If the developed models are adequate time series representations of the exported and imported freight volumes, then there should be no future auto-correlation pattern left in the residual series. The Auto Correlation Function (ACF) and the Partial Auto Correlation Function (PACF) are two measures of dependence between observations as a function of their separation along the time axis. The sample ACF and PACF graphs suggest an appropriate ARMA model for the data when their absolute values are smaller than

$$1.96/\sqrt{n}$$

which are represented on the graph by the dotted lines. The auto-correlation residual plots showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to its standard error limits (the dashed line). This suggested that the developed models adequately represent the auto correlation pattern in the data for all series. Chi-square tests were performed to determine if the residual auto correlations were not equal to zero (null hypothesis) for all models. The Chi-square values for all models were less than the critical Chi-square value for 17 degrees of freedom (27.587 for 95% confidence level). The results of these joint tests for all the models suggest that all the models have captured the auto-correlation patterns in the data. See details in sections

In order to complete the forecasting, historical data was required from each of the ports. The ports that historical data was available for were:

- Port of Palm Beach
- Port of Everglades
- Port of Tampa

The output from the forecasting models is predicted monthly freight values for each port. However, the forecasting models had limitations on the number of data points that could be used in the modeling of the historical data. Therefore, in order to utilize all the available historical data to obtain a better trend over more time, monthly records were used to forecast the freight. Once the forecasting models were run for each port, the forecasted records produced were used to calculate daily records.

Daily forecasted freight records were determined by using the present available daily data records for each port to calculate a daily distribution of the monthly forecasting model results. The present monthly freight totals were calculated from the present daily records for each of the independent variables used as input by each of the developed ANN port models. Then, using these present monthly totals and with the available daily totals, a daily percentage of freight for each day of the week was calculated for each month of the year daily vessel data was available for. Then, an average percent for each day of the week (Monday-Sunday) was calculated from the daily percentages of the available months. These were concluded to be the "typical" daily percent for each day of the week for a "typical" month. This procedure was done for the three ports historical data was available for each independent variable used as input to run the previously developed ANN port models.

6.2 PORT OF PALM BEACH

6.2.1 Historical Data

Historical vessel data was available but the port authority indicated that data older than three years may be significantly different because of the accelerated growth that has occurred at the port in the last three years. Historical data for the general cargo, molasses, sugar, and cement was only available as total tonnage and not by direction for October 1996 through March 2001. General Cargo includes all imported and exported freight tonnage except molasses, sugar, and cement. A directional split for general cargo was calculated based on available daily general cargo vessel data for the year 2000. Monthly molasses and cement records were not available for every month of the year during the historical data period due to irregularities in shipments. Also, no directional split was necessary for molasses, sugar, and cement because molasses and sugar are only exported and cement is only imported. The historical data is listed in Tables 6.1a, 6.1b, and 6.1c. Figures 6.1a through 6.1d indicate the historical trend of imported and exported tonnage at the port.

Though the developed Port of Palm Beach ANN Model requires only two input variables, it was necessary to forecast for molasses, sugar, and cement separately from the general cargo because of the irregularities found in the present vessel data. Calculation of a daily average for each record of molasses, sugar, and cement were necessary for developing the ANN model (see section 5.4). Therefore, to be consistent, the same procedure was followed with the forecasted data using the monthly records produced by the forecast models developed for the Port of Palm Beach. Monthly forecasted molasses and sugar model results were distributed for each month of the year to determine daily values for adding to the calculated daily exported general cargo. Monthly forecasted cement model results were distributed for each month of the year to determine daily values for adding to the calculated daily imported general cargo. These calculations concluded the final input variables (imported and exported tonnage) for the Port of Palm Beach ANN Model required to forecast truck volumes.

Date	Gen. Cargo Tonnage	Gen. Cargo Tonnage	Date	Gen. Cargo Tonnage	Gen. Cargo Tonnage
Oct-96	57,019	176,440	Jan-99	46,442	293,325
Nov-96	33,114	212,037	Feb-99	70,068	229,393
Dec-96	55,607	157,251	Mar-99	47,973	261,631
Jan-97	41,694	178,268	Apr-99	59,636	331,365
Feb-97	45,150	258,003	May-99	67,174	257,983
Mar-97	56,364	217,474	Jun-99	60,786	281,812
Apr-97	58,912	212,453	Jul-99	65,077	290,034
May-97	32,624	160,980	Aug-99	66,770	288,023
Jun-97	60,595	243,779	Sep-99	63,108	261,217
Jul-97	52,805	258,047	Oct-99	72,794	281,410
Aug-97	70,103	333,937	Nov-99	50,482	222,443
Sep-97	76,122	223,408	Dec-99	50,809	248,129
Oct-97	54,854	255,525	Jan-00	33,394	187,805
Nov-97	42,741	234,096	Feb-00	43,482	209,256
Dec-97	72,834	219,520	Mar-00	56,825	232,872
Jan-98	71,126	179,215	Apr-00	42,222	172,365
Feb-98	50,141	236,234	May-00	30,509	176,705
Mar-98	41,685	262,094	Jun-00	73,765	291,323
Apr-98	38,773	249,650	Jul-00	49,128	231,397
May-98	63,805	234,327	Aug-00	98,410	289,386
Jun-98	59,947	313,194	Sep-00	81,156	269,919
Jul-98	85,937	430,337	Oct-00	70,950	207,540
Aug-98	67,275	287,694	Nov-00	54,325	263,698
Sep-98	57,869	260,076	Dec-00	52,246	295,084
Oct-98	74,172	354,266	Jan-01	73,313	278,943
Nov-98	83,033	283,992	Feb-01	88,815	316,569
Dec-98	72,825	268,094	Mar-01	46,022	244,993

Table 6.1a Port of Palm Beach Monthly Historical Data (General Cargo)

Date	Sugar Tonnage
Oct-96	57,120
Nov-96	93,520
Dec-96	57,120
Jan-97	65,520
Feb-97	56,000
Mar-97	79,520
Apr-97	81,760
May-97	53,760
Jun-97	128,240
Jul-97	96,880
Aug-97	130,480
Sep-97	82,880
Oct-97	103,040
Nov-97	81,760
Dec-97	65,520
Jan-98	25,788
Feb-98	56,000
Mar-98	93,520
Apr-98	110,880
May-98	82,880
Jun-98	93,520
Jul-98	118,040
Aug-98	94,640
Sep-98	116,480
Oct-98	117,040
Nov-98	53,760
Dec-98	67,760

Date	Sugar Tonnage
Jan-99	53,760
Feb-99	42,000
Mar-99	67,760
Apr-99	82,880
May-99	68,880
Jun-99	119,840
Jul-99	135,520
Aug-99	82,880
Sep-99	51,520
Oct-99	82,880
Nov-99	39,760
Dec-99	75,040
Jan-00	51,520
Feb-00	89,040
Mar-00	53,760
Apr-00	42,000
May-00	11,760
Jun-00	42,000
Jul-00	28,000
Aug-00	67,760
Sep-00	28,000
Oct-00	39,760
Nov-00	75,040
Dec-00	67,760
Jan-01	42,000
Feb-01	42,000
Mar-01	39,760

Date	Molasses Tonnage
Oct-96	33,797
Dec-96	20,817
Jan-97	23,316
Feb-97	90,342
Mar-97	24,263
Apr-97	20,605
Dec-97	44,611
Jan-98	22,424
Feb-98	73,404
Mar-98	47,403
Jul-98	30,471
Sep-98	14,548
Oct-98	23,183
Dec-98	34,907
Jan-99	73,343
Feb-99	47,818
Mar-99	41,919
Apr-99	51,559
May-99	50,043
Aug-99	35,220
Oct-99	40,408
Nov-99	50,087
Dec-99	30,240
Jan-00	44,380
Feb-00	43,804
Mar-00	26,744
May-00	55,751
Jul-00	27,563
Sep-00	27,978
Dec-00	55,291
Jan-01	27,005
Feb-01	55,209
Mar-01	68,468

Table 6.1b Port of Palm Beach Monthly Historical Data (Sugar and Molasses)

Date	Cement Tonnage	Date	Cement Tonnage
Oct-96	33,124	Feb-99	31,070
Dec-96	33,446	Mar-99	5,517
Jan-97	16,707	Apr-99	4,614
Feb-97	13,952	May-99	28,321
Mar-97	24,599	Jun-99	15,531
Apr-97	28,153	Jul-99	21,905
May-97	2,667	Aug-99	19,293
Jun-97	28,313	Sep-99	4,519
Jul-97	7,775	Oct-99	28,614
Aug-97	13,257	Nov-99	13,435
Sep-97	36,858	Dec-99	10,897
Oct-97	12,250	Jan-00	7,716
Nov-97	1,665	Feb-00	22,132
Dec-97	42,270	Mar-00	14,253
Jan-98	34,523	Apr-00	5,798
Feb-98	20,293	Jun-00	4,104
Mar-98	7,830	Aug-00	36,487
May-98	21,490	Sep-00	21,380
Jul-98	7,195	Oct-00	24,072
Aug-98	13,336	Nov-00	3,520
Sep-98	21,813	Dec-00	4,180
Oct-98	14,368	Jan-01	14,656
Nov-98	21,173	Feb-01	27,525
Dec-98	26,604	Mar-01	7,810

Table 6.1c Port of Palm Beach Monthly Historical Data (Cement)

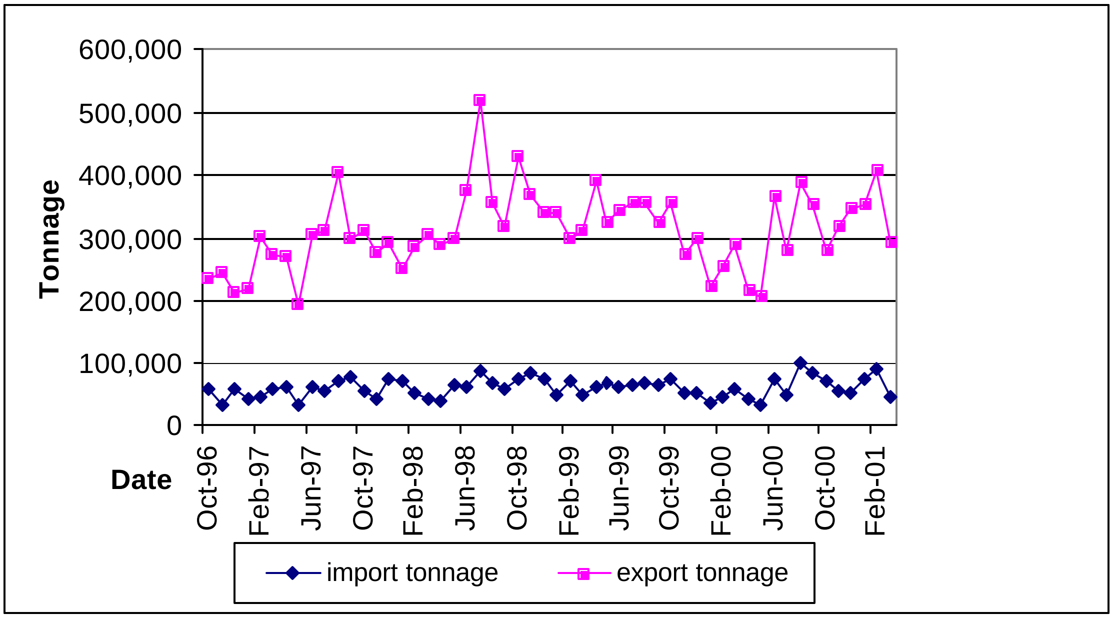


Figure 6.1a Port of Palm Beach Monthly Historical Data Trend (General Cargo)

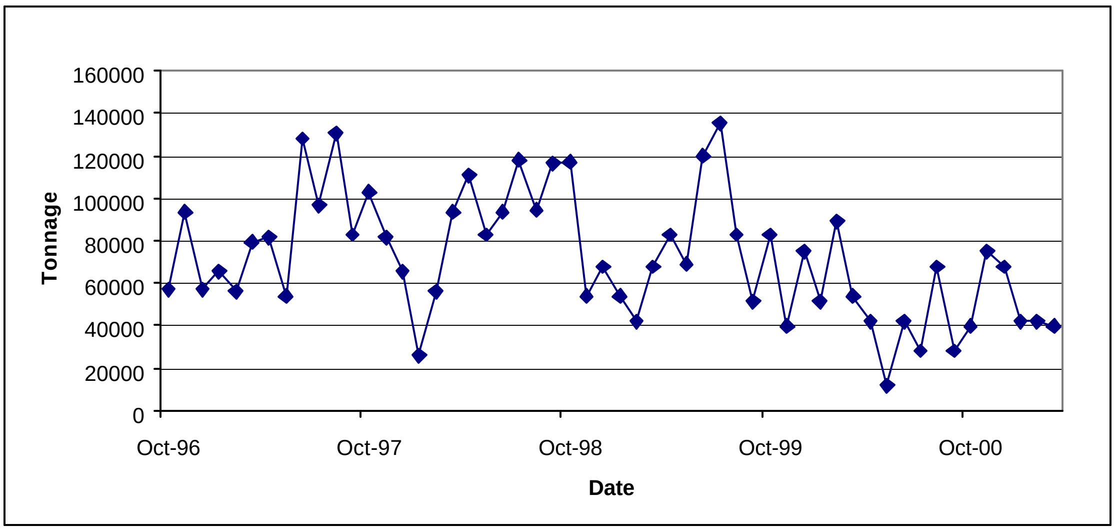


Figure 6.1b Port of Palm Beach Monthly Historical Data Trend (Sugar)

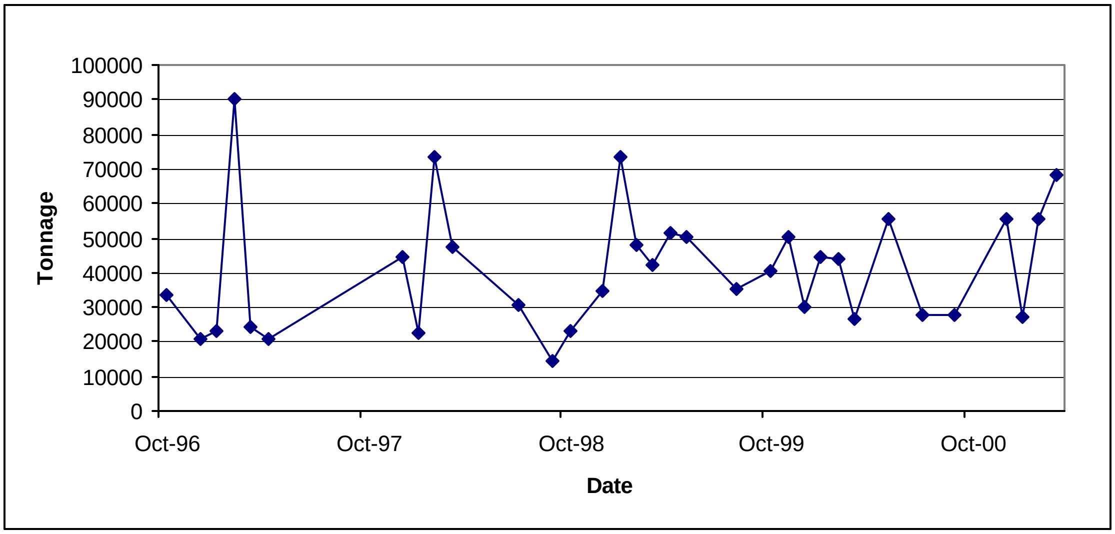


Figure 6.1c Port of Palm Beach Monthly Historical Data Trend (Molasses)

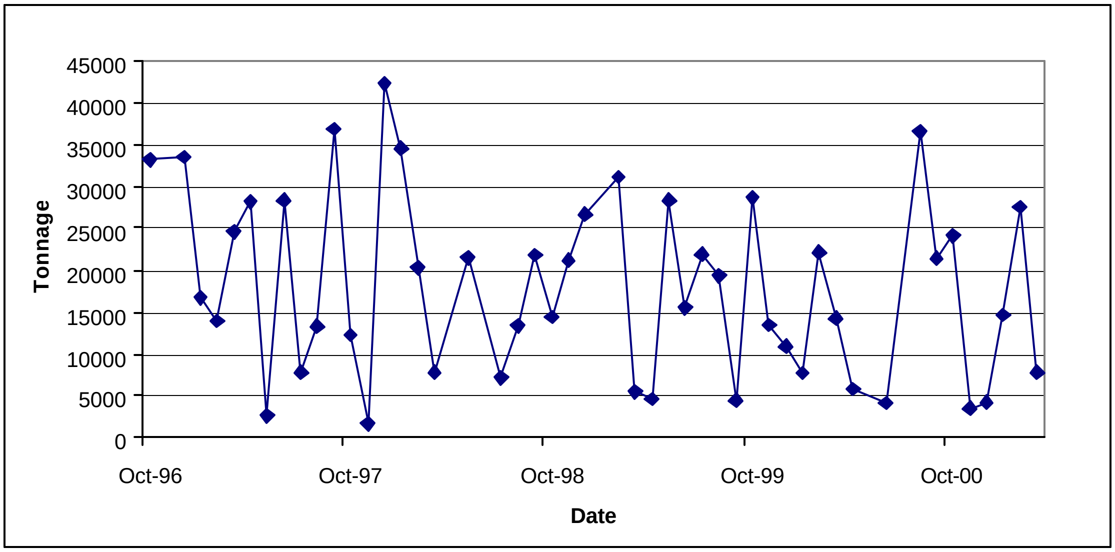


Figure 6.1d Port of Palm Beach Monthly Historical Data Trend (Cement)

6.2.2 Port of Palm Beach Forecasting Models

Because the Port of Palm Beach ANN model development required some specific cargo to be calculated (sugar, molasses, cement) and the shipments were very infrequent, these commodities affected the modeling process. There were also some months with no activity for at least one of these commodities. Therefore, in order to obtain acceptable forecasting models, these commodities were modeled independently from the general cargo. The following sections describe the four individual forecasting models developed for the Port of Palm Beach including the equations and variables used in the model.

6.2.2.1 Port of Palm Beach General Cargo

Let GC_m be the total General Cargo handled by the Port of Palm Beach in month "m" and, then

$$GC_m = 0.2245E+10 + 0.6639\, GC_{m-1} - 0.0686\, GC_{m-2} - 0.4047\, GC_{m-3} - 0.1947\, (GC_{m-4} - GC_{m-5}).$$

A total of 53 points for the monthly general cargo were used in developing this model. The time series model for the total general cargo handled by the Port of Palm Beach of this month (GC_m) is a function of the total general cargo in the last month (GC_{m-1}), two months ago (GC_{m-2}), three months ago (GC_{m-3}), four months ago (GC_{m-4}) and five months ago (GC_{m-5}).

The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.2. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to its standard error limits (the dashed lines) as shown by the plot on the right of Figure 6.2. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.40441 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.3 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.

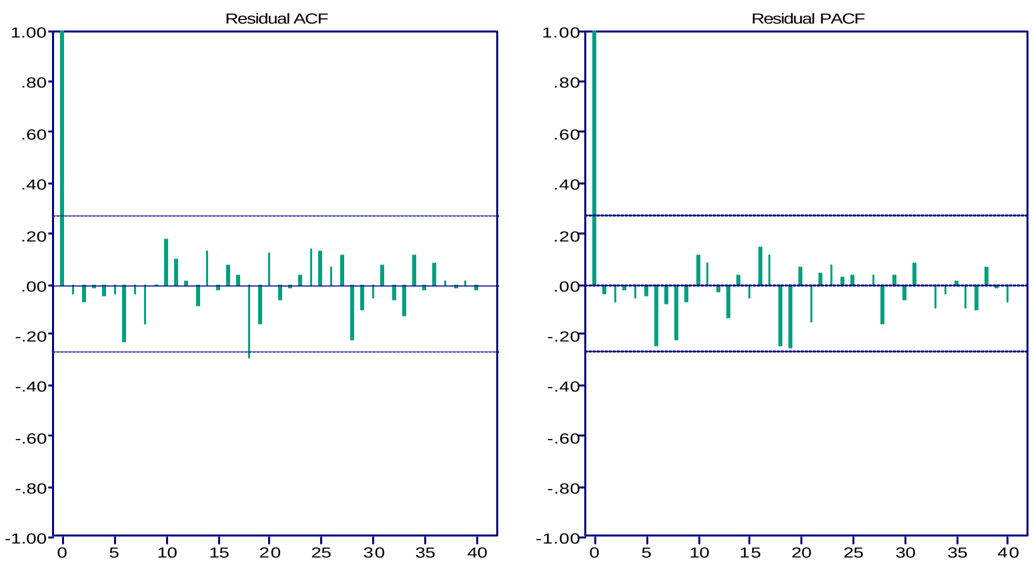


Figure 6.2 Port of Palm Beach General Cargo Forecast Model Residuals

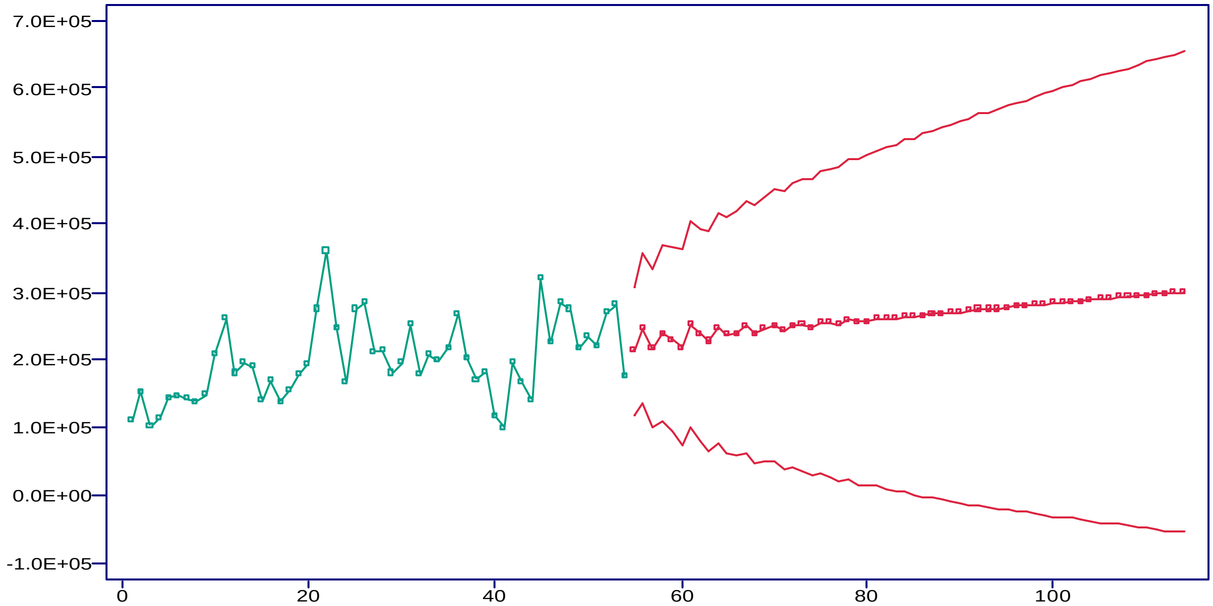


Figure 6.3 Port of Palm Beach General Cargo Forecast for 5 years

6.2.2.2 Port of Palm Beach Cement

Let CM_m be the total cement handled by the Port of Palm Beach in month "m", then

$$CM_m = 1.2900 + 0.0097\, CM_{m-1} - 0.1447\, CM_{m-2} + 0.1250\, CM_{m-3} + 0.3386\, CM_{m-4} + 0.1633 CM_{m-5} - CM_{m-6}.$$

A total of 48 points for the monthly cement tonnage were used in developing this model. The time series model for total cement indicates that the number of freight units for this month (CM_m) is a natural logarithm function of the total cement tonnage in the last month (CM_{m-1}), two months ago (CM_{m-2}), three months ago (CM_{m-3}), four months ago (CM_{m-4}) , five months ago (CM_{m-5}) and six months ago (CM_{m-6}).

The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.4. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to

its standard error limits (the dashed lines) as shown by the plot on the right of Figure 6.4. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.39560 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.5 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.

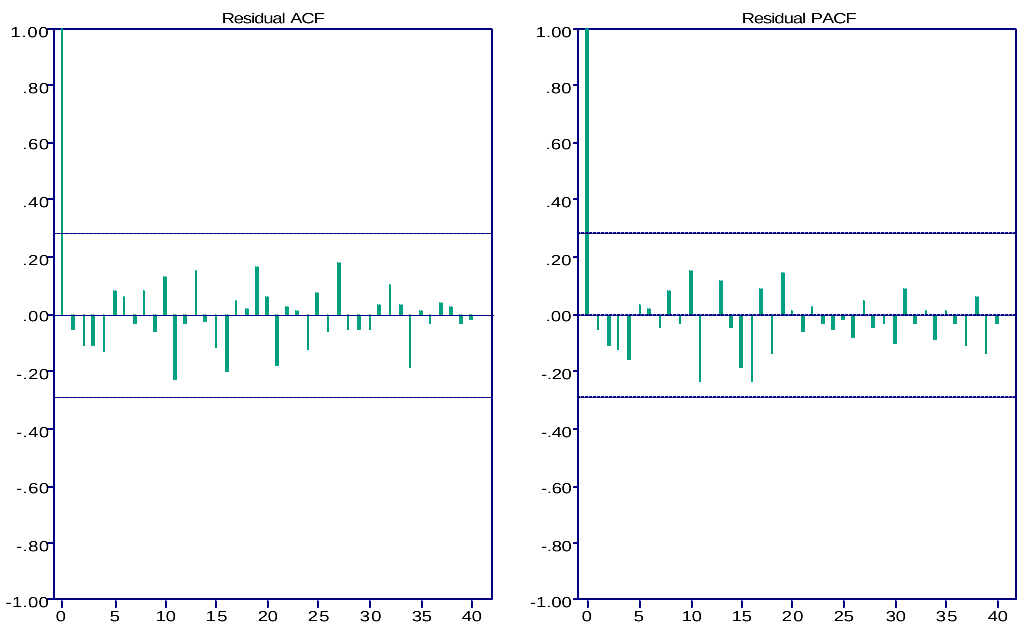


Figure 6.4 Port of Palm Beach Cement Forecast Model Residuals

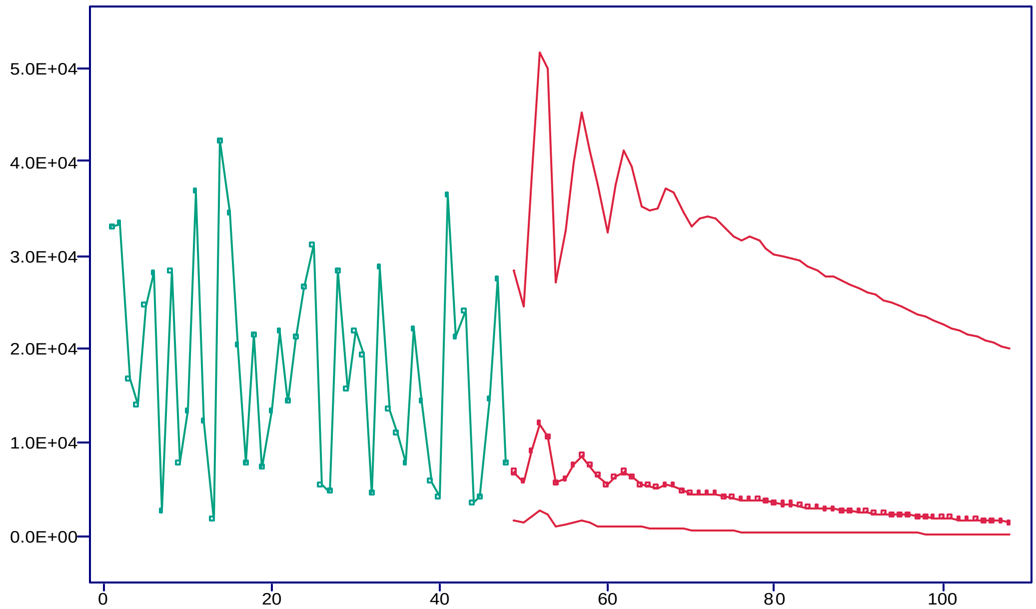


Figure 6.5 Port of Palm Beach Cement Forecast for 5 years

6.2.2.3 Port of Palm Beach Molasses

Let MO_m be the total molasses handled by the Port of Palm Beach in month "m", then

$MO_m = 0.318689{+}09 + 0.4585\, MO_{m-1} + 0.1197\, MO_{m-2} + 0.4213\, MO_{m-3} - 0.4575\, (MO_{m-4} - MO_{m-5})$

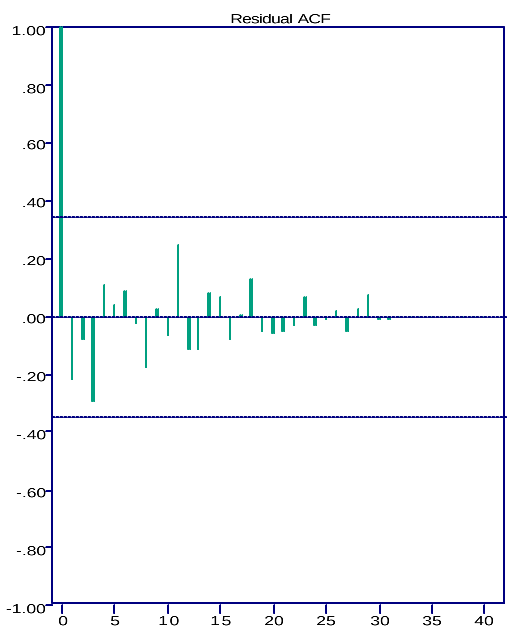
A total of 32 points for the monthly molasses were used in developing this model. The time series model for the molasses handled by the Port of Palm Beach for this month (MO_m) is function of the total molasses in the last month (MO_{m-1}), two months ago (MO_{m-2}), three months ago (MO_{m-3}), four months ago (MO_{m-4}) and five months ago (MO_{m-5}).

The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.6. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to

its standard error limits (the dashed lines) as shown by the plot on the right of Figure 6.6. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.77084 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.7 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.



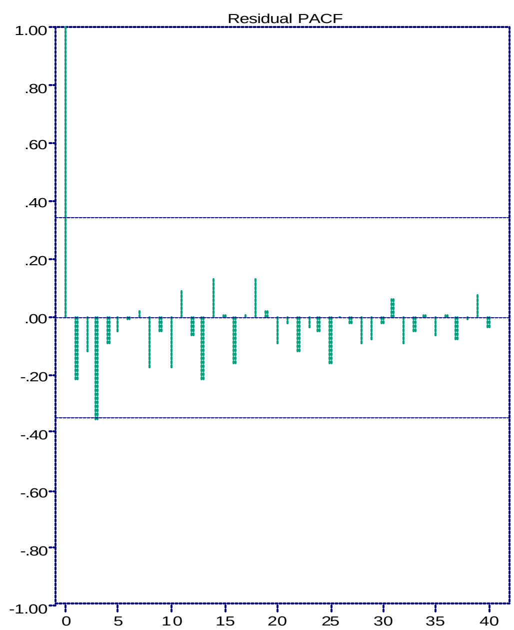


Figure 6.6 Port of Palm Beach Molasses Forecast Model Residuals

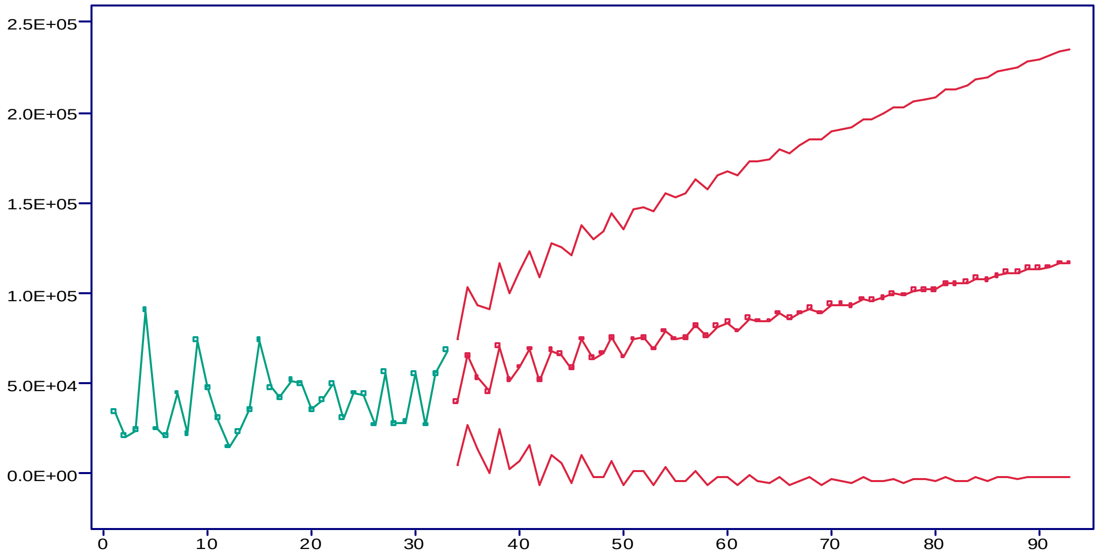


Figure 6.7 Port of Palm Beach Molasses Forecast for 5 years

6.2.2.4 Port of Palm Beach Sugar

Let SU_m be the total sugar handled by the Port of Palm Beach in month "m", then

SU_m = .653267E+09 + 0.5031 SU_{m-1} + 0.2690 SU_{m-2} + 0.0547 SU_{m-3} - 0.1742 SU_{m-4} - 0.2502 SU_{m-5} - 0.0280 SU_{m-6} + 0.0269 SU_{m-7} + 0.1953 SU_{m-8}

A total of 53 points for the monthly sugar were used in developing this model. The time series model for the total sugar handled by the Port of Palm Beach for this month (SU_m) is function of the total sugar in the last month (SU_{m-1}), two months ago (SU_{m-2}), three months ago (SU_{m-3}), four months ago (SU_{m-4}), five months ago (SU_{m-5}), six months ago (SU_{m-6}), seven months ago (SU_{m-7}) and eight months ago (SU_{m-8}).

The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.8. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to

its standard error limits (the dashed lines) as shown by the plot on the right of Figure 6.8. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.83730 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.9 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.

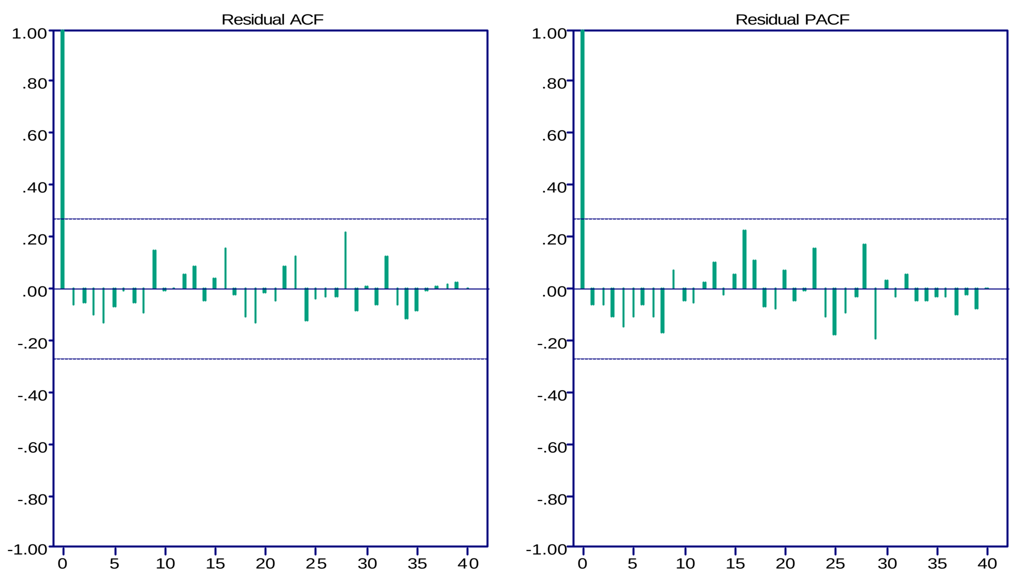


Figure 6.8 Port of Palm Beach Sugar Forecast Model Residuals

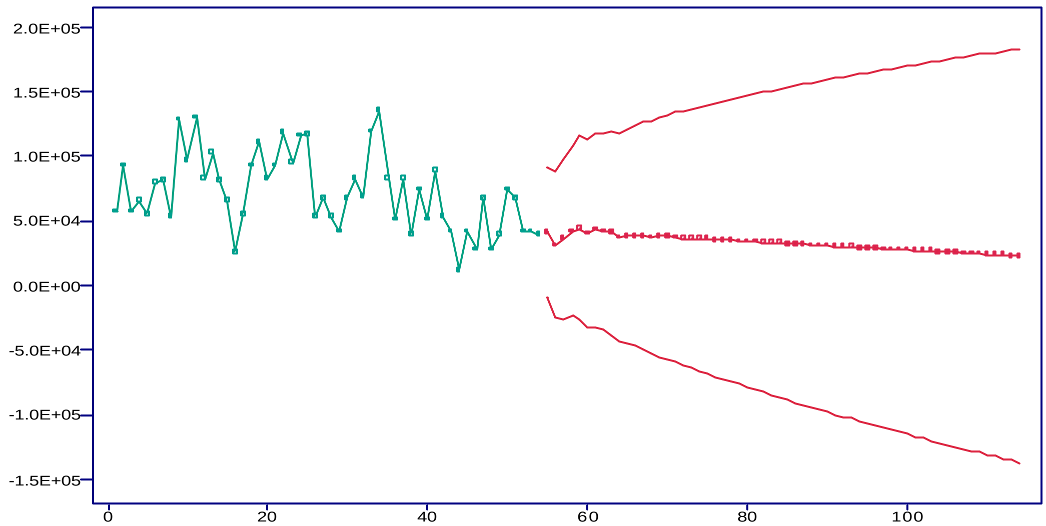


Figure 6.9 Port of Palm Beach Sugar Forecasted for 5 years

6.2.3 Port of Palm Beach Analysis of Forecasting Results

The predicted values produced by the Port of Palm Beach forecasting models were used to calculate the required two input variables for the Port of Palm Beach ANN Model. The calculation results for these two input variables are listed in Table 6.2. These are the values used to predict future truck volumes on the access road at the port (see Section 4.1.1 for a description). Figure 6.10 shows the trends for the historical and predicted vessel data from October 1996 to December 2005. From the base year 2000 the trend indicates that by year 2005, imported tonnage is expected to increase by 51% and the exported tonnage is expected to increase by 58%. Figure 6.11 shows a graphical representation of this.

Date	Import Tonnage	Export Tonnage	Date	Import Tonnage	Export Tonnage
Apr-01	57,670	246,367	Jan-04	72,416	329,396
May-01	70,728	289,085	Feb-04	72,905	333,388
Jun-01	62,410	259,261	Mar-04	73,146	331,495
Jul-01	65,244	274,100	Apr-04	73,272	335,983
Aug-01	63,916	294,934	May-04	73,722	337,186
Sep-01	61,925	262,218	Jun-04	73,912	337,237
Oct-01	69,182	298,974	Jul-04	74,126	341,568
Nov-01	65,771	296,672	Aug-04	74,521	341,325
Dec-01	63,559	269,898	Sep-04	74,698	343,336
Jan-02	67,869	298,584	Oct-04	74,971	346,406
Feb-02	65,644	288,501	Nov-04	75,314	346,096
Mar-02	66,163	282,578	Dec-04	75,502	349,328
Apr-02	68,343	306,595	Jan-05	75,803	350,851
May-02	65,855	286,129	Feb-05	76,105	351,501
Jun-02	67,368	295,273	Mar-05	76,317	354,824
Jul-02	68,725	308,833	Apr-05	76,624	355,385
Aug-02	67,066	292,021	May-05	76,900	357,195
Sep-02	68,513	305,699	Jun-05	77,133	359,850
Oct-02	68,878	307,686	Jul-05	77,439	360,261
Nov-02	68,099	298,402	Aug-05	77,699	362,878
Dec-02	69,538	313,697	Sep-05	77,952	364,604
Jan-03	69,394	307,665	Oct-05	78,249	365,513
Feb-03	69,123	307,220	Nov-05	78,505	368,306
Mar-03	70,280	318,046	Dec-05	78,769	369,357
Apr-03	70,040	310,803	Jan-06	79,057	371,000
May-03	70,187	316,122	Feb-06	79,313	373,438
Jun-03	70,992	320,982	Mar-06	79,586	374,306
Jul-03	70,759	315,742			
Aug-03	71,152	323,572			
Sep-03	71,702	323,374			
Oct-03	71,571	322,396			
Nov-03	72,049	329,031			
Dec-03	72,410	326,819			

Table 6.2 Port of Palm Beach Predicted Vessel Data

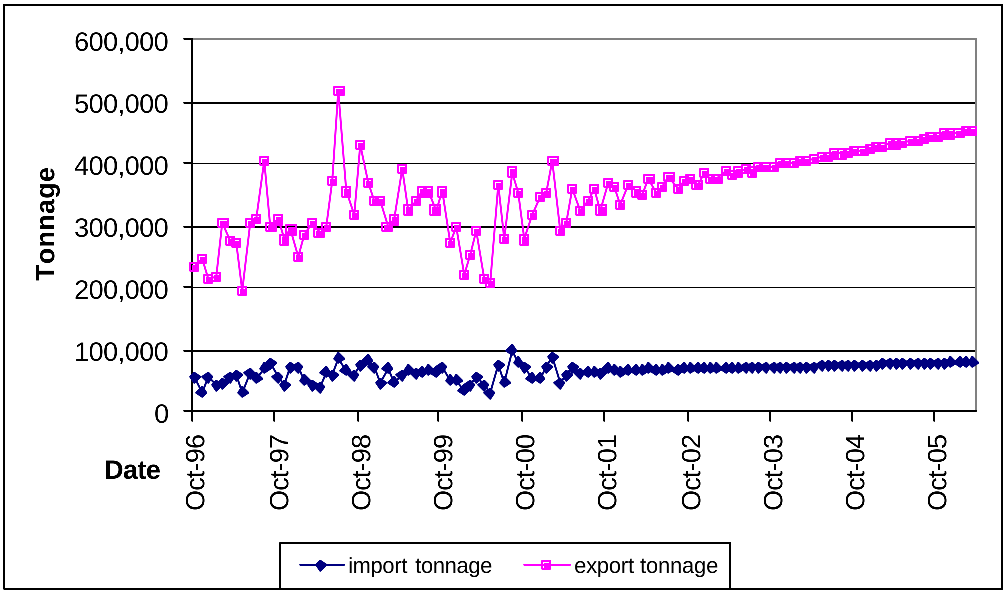


Figure 6.10 Port of Palm Beach Vessel Data Trends

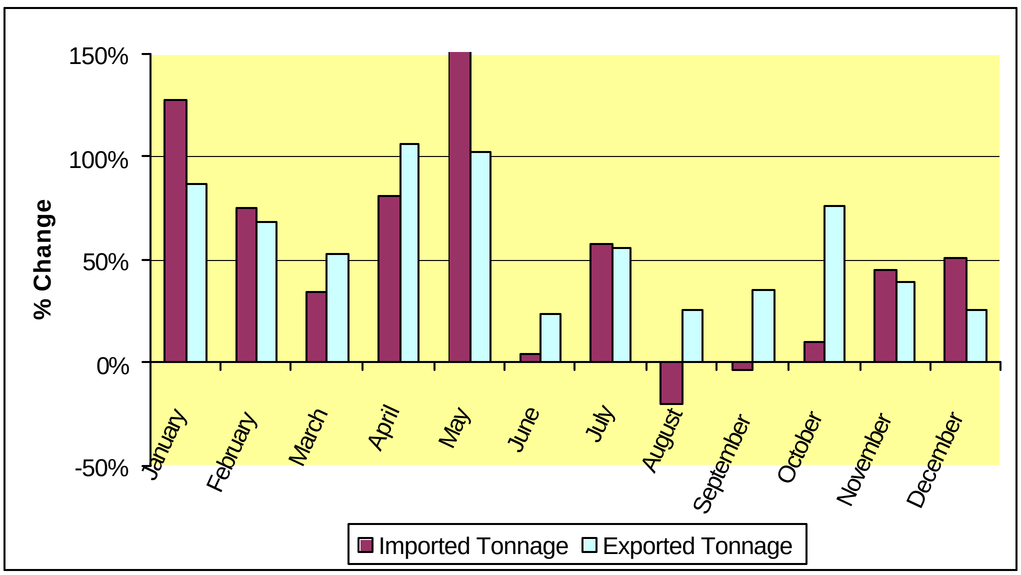


Figure 6.11 Port of Palm Beach Percent Change of Forecasted Freight Input Variables (Year 2000 - 2005)

The previously developed ANN truck trip generation model for the Port of Palm Beach was used to produce truck volumes for the available vessel freight data. The model output is displayed in Tables 6.3 to 6.7. The dates are related to the month, day of the week, and year. The day of the week was numbered sequentially 01-05 for Monday to Friday for ease of interpretation. Weekends were excluded because the truck volumes are minimal on Saturdays and there are no vessel records for Sundays. Figure 6.12 shows the trend for inbound and outbound trucks at the port including data collected in the field for year 2000. The field data is available in Table D.1 Appendix D. The forecasting results show that trucks are expected to increase by 86% for both daily inbound and outbound directions from a comparison of base year 2000 and forecasted year 2005. Figure 6.13 shows the average annual weekday truck volumes for present and future estimates. The future estimates are based on the output from the ANN model.

InDates	Inbound	Outbound	InDates	Inbound	Outbound
10101	469	433	70101	450	416
10201	888	788	70201	841	747
10301	682	605	70301	811	710
10401	874	766	70401	840	737
10501	818	715	70501	792	694
20101	654	587	80101	571	516
20201	1270	1110	80201	1073	940
20301	956	831	80301	696	615
20401	1000	872	80401	717	635
20501	930	809	80501	680	601
30101	468	430	90101	525	479
30201	858	758	90201	991	873
30301	705	622	90301	777	682
30401	589	528	90401	805	708
30501	565	506	90501	759	667
40101	408	381	100101	482	442
40201	932	823	100201	902	798
40301	733	646	100301	712	628
40401	758	669	100401	906	791
40501	716	631	100501	855	745
50101	579	524	110101	577	522
50201	893	791	110201	1088	953
50301	696	616	110301	863	752
50401	722	640	110401	724	641
50501	836	730	110501	686	606
60101	523	477	120101	442	410
60201	988	870	120201	1017	895
60301	772	678	120301	798	699
60401	800	704	120401	826	726
60501	614	548	120501	779	683

Table 6.3 Port of Palm Beach Predicted Truck Volumes for Year 2001 (Model Output)

InDates	Inbound	Outbound	InDates	Inbound	Outbound
10102	584	528	70102	491	450
10202	895	792	70202	917	810
10302	709	626	70302	729	642
10402	732	648	70402	926	807
10502	852	742	70502	876	762
20102	567	513	80102	574	519
20202	1070	938	80202	1086	952
20302	844	737	80302	855	746
20402	873	764	80402	719	637
20502	825	720	80502	680	601
30102	560	508	90102	487	447
30202	1060	931	90202	1124	983
30302	832	727	90302	889	774
30402	861	755	90402	918	801
30502	662	586	90502	869	756
40102	488	447	100102	598	539
40202	911	805	100202	916	809
40302	891	775	100302	727	641
40402	920	803	100402	750	663
40502	870	758	100502	874	761
50102	564	511	110102	585	528
50202	1066	935	110202	1106	968
50302	683	605	110302	872	760
50402	706	626	110402	901	787
50502	667	591	110502	693	612
60102	579	523	120102	497	455
60202	1095	959	120202	929	820
60302	863	753	120302	909	790
60402	892	780	120402	939	818
60502	843	735	120502	889	773

Table 6.4 Port of Palm Beach Predicted Truck Volumes for Year 2002 (Model Output)

InDates	Inbound	Outbound	InDates	Inbound	Outbound
10103	599	540	70103	612	551
10203	1133	991	70203	938	828
10303	728	641	70303	744	655
10403	752	664	70403	769	678
10503	711	627	70503	895	778
20103	598	539	80103	623	560
20203	1131	989	80203	1178	1028
20303	894	778	80303	935	811
20403	923	806	80403	965	840
20503	873	760	80503	742	652
30103	503	460	90103	511	466
30203	1161	1014	90203	956	843
30303	920	800	90303	935	812
30403	950	828	90403	966	841
30503	900	782	90503	914	794
40103	605	544	100103	623	559
40203	927	818	100203	1178	1028
40303	734	647	100303	758	666
40403	934	814	100403	782	689
40503	883	768	100503	741	651
50103	612	550	110103	632	567
50203	1156	1010	110203	1195	1042
50303	916	796	110303	949	823
50403	768	677	110403	979	851
50503	728	640	110503	928	804
60103	507	463	120103	515	470
60203	1171	1023	120203	965	850
60303	929	806	120303	767	674
60403	959	835	120403	975	848
60503	908	788	120503	923	801

Table 6.5 Port of Palm Beach Predicted Truck Volumes for Year 2003 (Model Output)

InDates	Inbound	Outbound	InDates	Inbound	Outbound
10104	633	568	70104	652	584
10204	1198	1045	70204	1234	1075
10304	950	824	70304	981	850
10404	796	700	70404	821	721
10504	755	663	70504	779	682
20104	639	573	80104	534	485
20204	1209	1055	80204	1000	879
20304	960	833	80304	982	850
20404	991	861	80404	1013	879
20504	939	814	80504	960	831
30104	522	475	90104	656	587
30204	977	860	90204	1242	1081
30304	777	682	90304	801	701
30404	988	859	90404	826	725
30504	935	811	90504	965	835
40104	644	576	100104	660	590
40204	1217	1061	100204	1250	1088
40304	967	838	100304	994	860
40404	810	711	100404	1025	889
40504	768	673	100504	789	691
50104	528	481	110104	540	490
50204	1222	1065	110204	1012	889
50304	971	841	110304	994	860
50404	1002	870	110404	1026	890
50504	949	822	110504	972	841
60104	647	579	120104	665	594
60204	990	871	120204	1259	1096
60304	788	691	120304	813	711
60404	1002	871	120404	838	735
60504	949	822	120504	795	696

Table 6.6 Port of Palm Beach Predicted Truck Volumes for Year 2004 (Model Output)

InDates	Inbound	Outbound	InDates	Inbound	Outbound
10105	546	495	70105	683	609
10205	1264	1100	70205	1294	1125
10305	1006	870	70305	1030	890
10405	1037	899	70405	1063	920
10505	983	850	70505	818	714
20105	669	598	80105	561	508
20205	1267	1103	80205	1053	923
20305	1008	871	80305	841	734
20405	1040	901	80405	1069	925
20505	985	852	80505	1014	875
30105	674	602	90105	690	615
30205	1032	906	90205	1307	1135
30305	824	720	90305	1041	899
30405	849	744	90405	870	761
30505	993	858	90505	826	721
40105	675	603	100105	565	511
40205	1279	1112	100205	1310	1139
40305	1018	880	100305	1044	901
40405	1050	909	100405	1076	931
40505	808	706	100505	1021	881
50105	554	502	110105	696	620
50205	1039	912	110205	1066	934
50305	1022	883	110305	852	743
50405	1054	913	110405	1083	937
50505	1000	864	110505	1028	886
60105	682	608	120105	698	621
60205	1291	1123	120205	1322	1148
60305	835	729	120305	1054	909
60405	860	753	120405	880	770
60505	1006	869	120505	836	729

Table 6.7 Port of Palm Beach Predicted Truck Volumes for Year 2005 (Model Output)

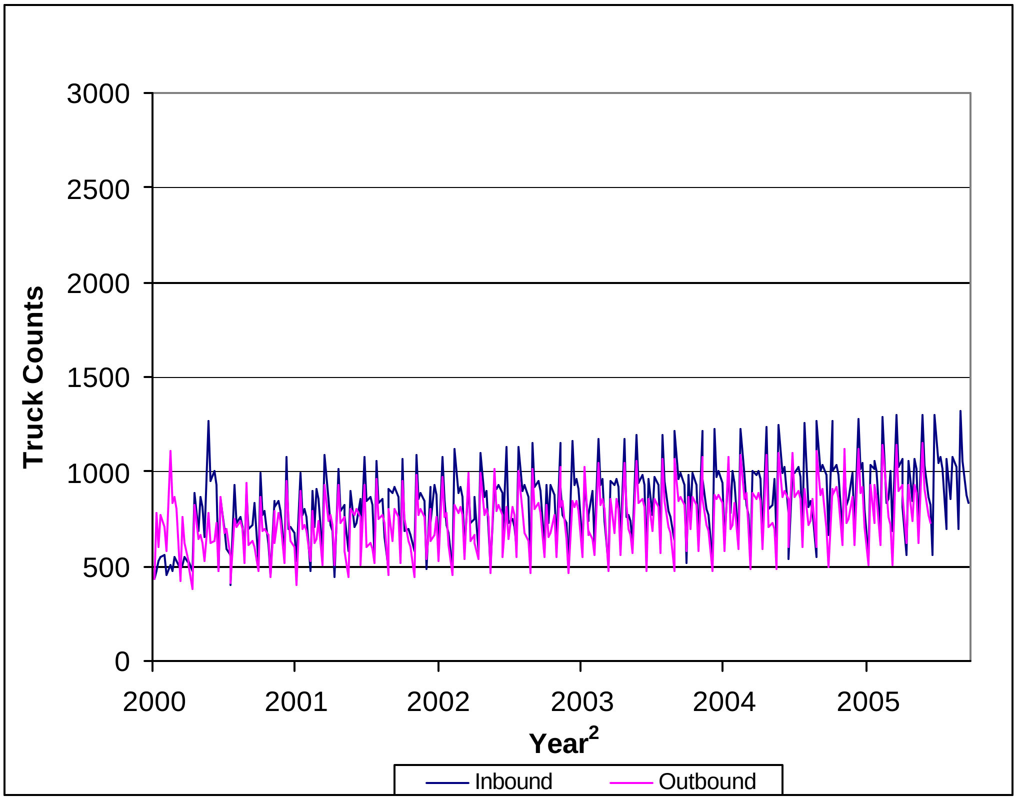


Figure 6.12 Port of Palm Beach Truck Counts (Year 2000-2005)[1]

[1]excludes weekends, [2]annual counts using one week from each month of the year (84 data points)

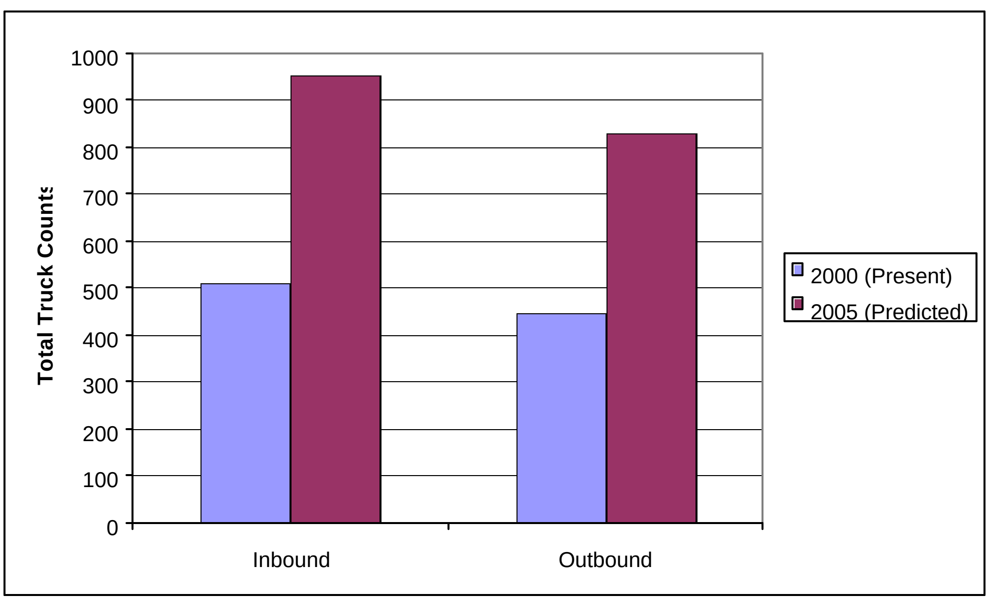


Figure 6.13 Port of Palm Beach Present Vs Predicted Truck Counts Variables (Year 2000 - 2005)

6.3 PORT OF EVERGLADES

6.3.1 Historical Data

Historical vessel data was available for January 1995 through November 2000. This data was divided into the same categories as the input variables for the Port of Everglades ANN model. Figures 6.14 to 6.16 indicate the historical trend of input variables for imported and exported freight at the port. The historical data is listed in Table 6.8.

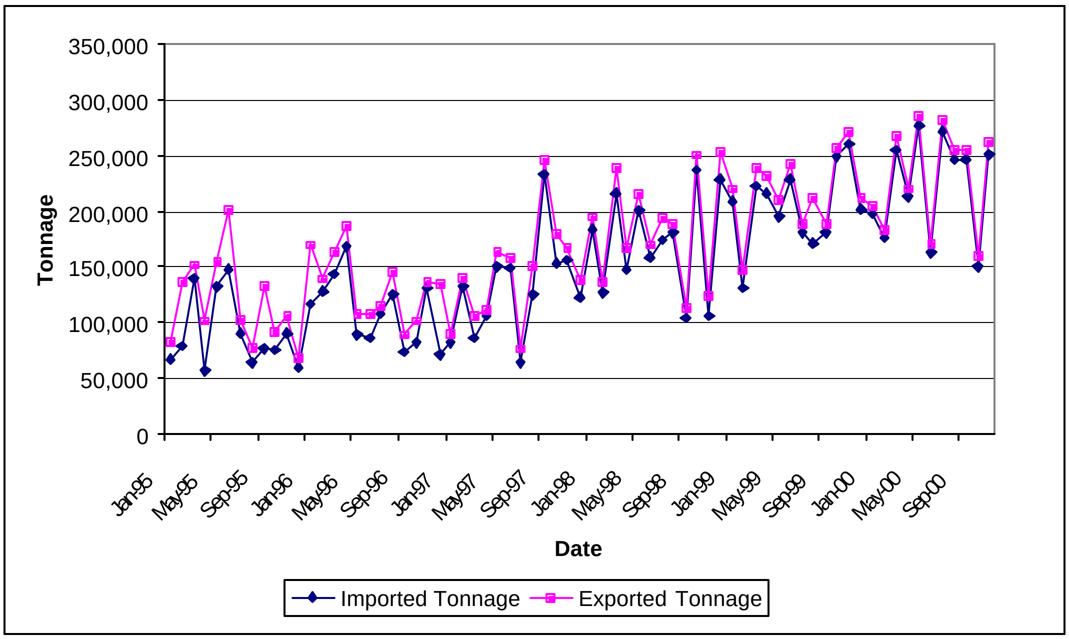


Figure 6.14 Port of Everglades Monthly Historical Data Trend (Tonnage)

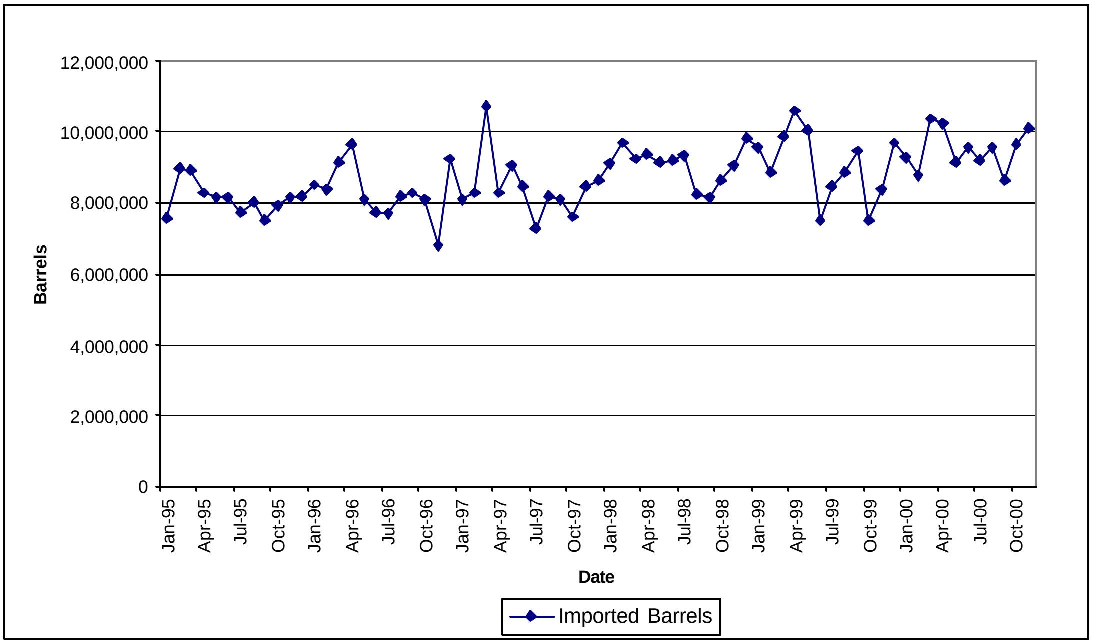


Figure 6.15 Port of Everglades Monthly Historical Data Trend (Barrels)

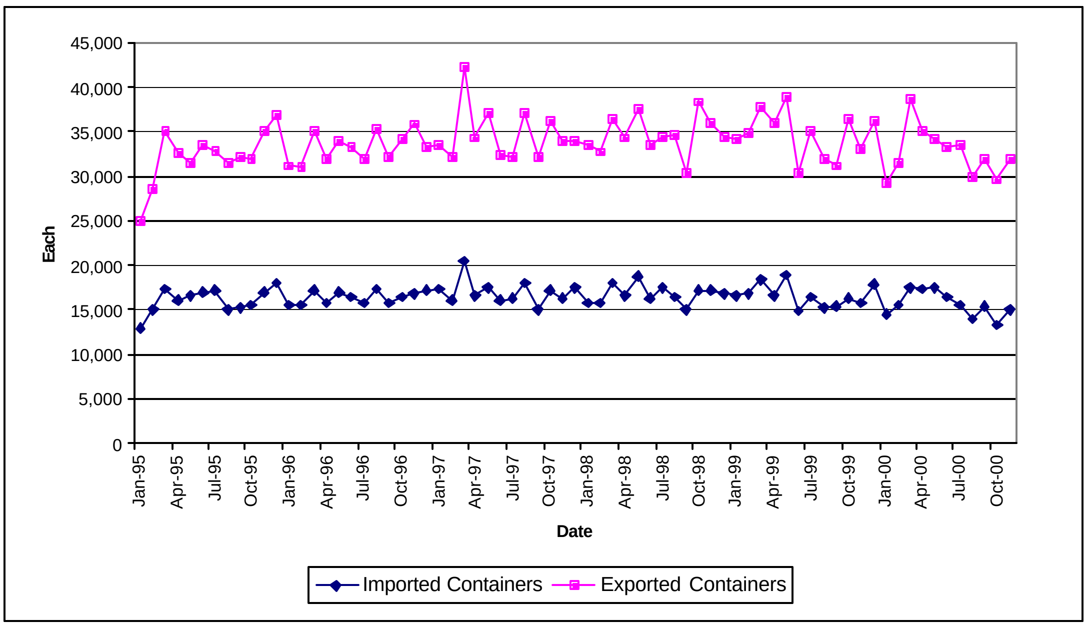


Figure 6.16 Port of Everglades Monthly Historical Data Trend (Containers)

Date	Imported Tonnage	Imported Barrels	Imported Containers	Exported Tonnage	Exported Containers
Jan-95	66,531	7,569,152	13,016	17,134	12,010
Feb-95	79,061	8,983,631	14,999	56,941	13,584
Mar-95	139,831	8,924,283	17,395	12,612	17,811
Apr-95	57,636	8,300,076	16,162	44,686	16,378
May-95	132,387	8,161,599	16,566	22,914	14,931
Jun-95	147,677	8,170,695	16,916	54,278	16,679
Jul-95	90,107	7,737,575	17,127	12,542	15,828
Aug-95	63,801	8,031,903	14,986	14,918	16,457
Sep-95	76,767	7,526,538	15,196	56,029	17,075
Oct-95	75,106	7,942,999	15,595	16,404	16,299
Nov-95	91,096	8,129,184	17,043	14,338	18,196
Dec-95	59,561	8,216,274	18,038	9,111	18,969
Jan-96	117,493	8,504,529	15,554	52,077	15,549
Feb-96	128,565	8,382,483	15,509	10,922	15,558
Mar-96	144,252	9,140,485	17,216	18,748	17,827
Apr-96	168,096	9,629,090	15,687	18,103	16,381
May-96	89,341	8,114,231	16,935	17,352	17,109
Jun-96	86,921	7,727,095	16,523	21,598	16,763
Jul-96	108,168	7,679,035	15,693	7,132	16,154
Aug-96	125,725	8,182,024	17,296	18,649	18,002
Sep-96	73,256	8,279,140	15,829	16,276	16,447
Oct-96	81,988	8,085,908	16,446	19,243	17,736
Nov-96	130,499	6,793,976	16,752	5,626	19,061
Dec-96	71,464	9,259,975	17,222	64,165	16,087
Jan-97	81,673	8,106,938	17,292	9,220	16,240
Feb-97	132,106	8,269,849	16,086	8,448	16,119
Mar-97	85,851	10,745,323	20,412	19,726	21,863
Apr-97	105,743	8,274,178	16,594	6,194	17,736
May-97	150,520	9,038,274	17,553	12,604	19,591
Jun-97	149,784	8,484,723	16,135	8,359	16,276
Jul-97	64,172	7,309,926	16,306	11,970	15,893
Aug-97	125,607	8,175,210	17,971	24,621	19,120
Sep-97	232,323	8,116,273	14,978	14,882	17,176
Oct-97	153,741	7,587,801	17,210	25,590	19,042
Nov-97	156,658	8,455,487	16,200	10,806	17,778
Dec-97	122,571	8,660,133	17,538	15,618	16,443

Date	Imported Tonnage	Imported Barrels	Imported Containers	Exported Tonnage	Exported Containers
Jan-98	184,646	9,112,917	15,703	10,413	17,682
Feb-98	126,589	9,697,608	15,836	10,761	16,891
Mar-98	216,283	9,248,610	17,961	21,621	18,383
Apr-98	148,502	9,376,323	16,656	18,144	17,583
May-98	200,264	9,151,841	18,705	15,671	18,869
Jun-98	158,337	9,181,729	16,343	11,576	17,078
Jul-98	174,764	9,319,384	17,440	19,733	17,058
Aug-98	181,845	8,250,534	16,435	8,388	18,247
Sep-98	104,405	8,161,903	15,082	7,947	15,258
Oct-98	237,215	8,658,965	17,149	13,257	21,167
Nov-98	105,933	9,067,622	17,216	18,125	18,938
Dec-98	229,339	9,803,949	16,786	24,671	17,780
Jan-99	209,596	9,534,475	16,690	10,059	17,408
Feb-99	130,885	8,854,891	16,758	16,340	18,023
Mar-99	223,466	9,852,495	18,392	15,240	19,472
Apr-99	216,696	10,578,378	16,681	14,654	19,347
May-99	195,236	10,034,943	18,838	14,639	19,971
Jun-99	229,057	7,526,900	14,894	13,331	15,632
Jul-99	181,852	8,477,389	16,531	8,478	18,411
Aug-99	172,048	8,864,208	15,153	39,966	16,807
Sep-99	180,666	9,452,475	15,407	9,638	15,702
Oct-99	249,419	7,538,912	16,276	7,278	20,135
Nov-99	260,581	8,378,898	15,826	10,851	17,275
Dec-99	201,748	9,686,822	17,788	10,564	18,402
Jan-00	197,347	9,271,146	14,493	7,396	14,729
Feb-00	177,688	8,801,112	15,562	6,347	15,916
Mar-00	255,307	10,351,827	17,511	11,919	21,112
Apr-00	213,822	10,229,244	17,290	7,142	17,714
May-00	276,952	9,127,531	17,528	9,030	16,687
Jun-00	163,197	9,563,778	16,473	8,212	16,832
Jul-00	272,364	9,187,274	15,578	10,494	18,045
Aug-00	247,279	9,573,578	13,991	8,297	15,993
Sep-00	246,131	8,657,594	15,364	9,268	16,540
Oct-00	151,124	9,655,886	13,320	8,855	16,257
Nov-00	250,776	10,077,105	14,973	11,674	16,949

Table 6.8 Port of Everglades Monthly Historical Data

6.3.2 Port of Everglades Forecasting Models

Unlike the Port of Palm Beach, because the Port of Everglades data was very detailed, no calculations were required before developing the models. The following sections describe the five individual forecasting models developed for the Port of Everglades including the equations and variables used in the models.

6.3.2.1 Port of Everglades Imported Tonnage

Let $IMST_m$ be the total imported tonnage handled by the Port of Everglades in month "m" and Ln be the natural logarithm function, then $Ln(IMST_m) = 0.0928 + 0.1461\,Ln(IMST_{m-1}) + 0.2301\,Ln(IMST_{m-2}) + 0.9045\,Ln(IMST_{m-3}) + 0.2807\,Ln(IMST_{m-4})$

A total of 70 points for the monthly imported tonnage were used in developing this model. The time series model for imported tonnage indicates that the number of freight units for this month ($IMST_m$) is a natural logarithm function of the exported freight units in the last month ($IMST_{m-1}$), two months ago ($IMST_{m-2}$), three months ago ($IMST_{m-3}$) and four months ago ($IMST_{m-4}$).

The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.17. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to its standard error limits (the dashed lines) as shown by the plot on the right of Figure 6.17. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.5152 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.18 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.

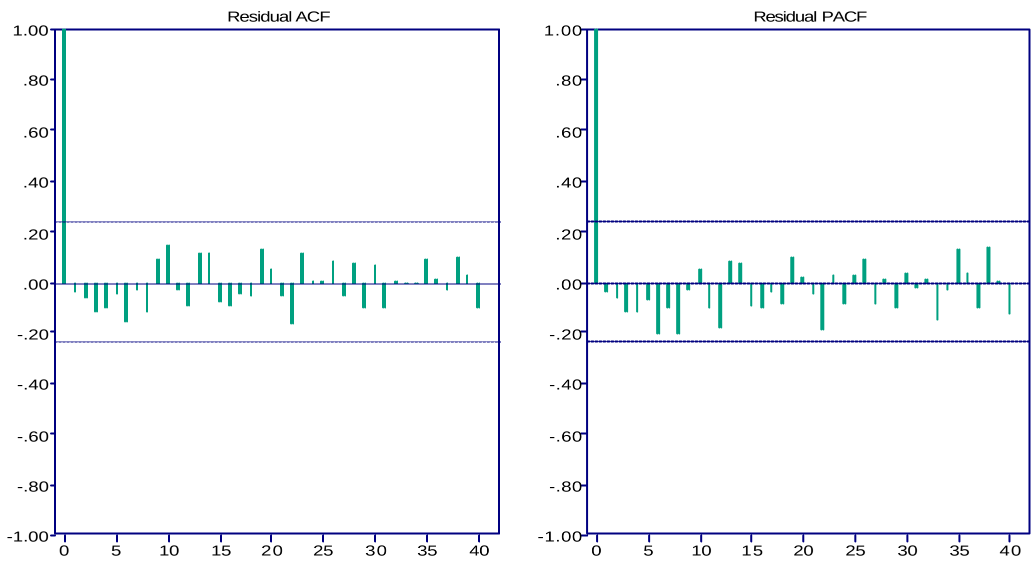


Figure 6.17 Port of Everglades Imported Tonnage Forecast Model Residuals

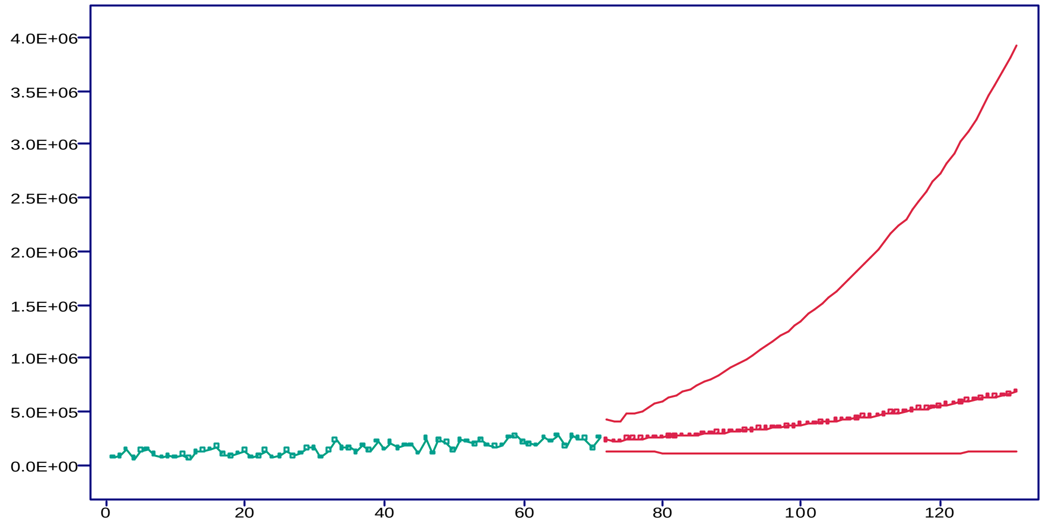


Figure 6.18 Port of Everglades Imported Tonnage Forecast for Five years

6.3.2.2 Port of Everglades Imported Barrels

Let $IMBL_m$ be the total number of imported barrels handled by the Port of Everglades in month "m" and Ln be the natural logarithm function, then $Ln(IMBL_m) = 0.0047 + 0.1664\ Ln(IMBL_{m-1}) - 0.0124\ Ln(IMBL_{m-2}) + 0.2622\ Ln(IMBL_{m-3}) + 0.1393\ Ln(IMBL_{m-4}) + 0.0931\ Ln(IMBL_{m-5}) - 0.2121\ Ln(IMBL_{m-6}) - 0.2120\ Ln(IMBL_{m-7}) + 0.0965\ Ln(IMBL_{m-8}) + 0.1054\ Ln(IMBL_{m-9}) + 0.1740\ Ln(IMBL_{m-10}) - 0.3996\ Ln(IMBL_{m-11})$

A total of 70 points for the monthly imported barrels were used in developing this model. The time series model for the number of imported barrels indicates that the number of freight units for this month ($IMBL_m$) is a natural logarithm function of the number of imported barrels in the last month ($IMBL_{m-1}$), two months ago ($IMBL_{m-2}$), three months ago ($IMBL_{m-3}$), four months ago ($IMBL_{m-4}$), five months ago ($IMBL_{m-5}$), six months ago ($IMBL_{m-6}$), seven months ago ($IMBL_{m-7}$), eight months ago ($IMBL_{m-8}$), nine months ago ($IMBL_{m-9}$), ten months ago ($IMBL_{m-10}$) and eleven months ago ($IMBL_{m-11}$).

The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.19. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to its standard error limits (the dashed lines) as shown by the plot on the right of Figure 6.19. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.7523 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.20 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.

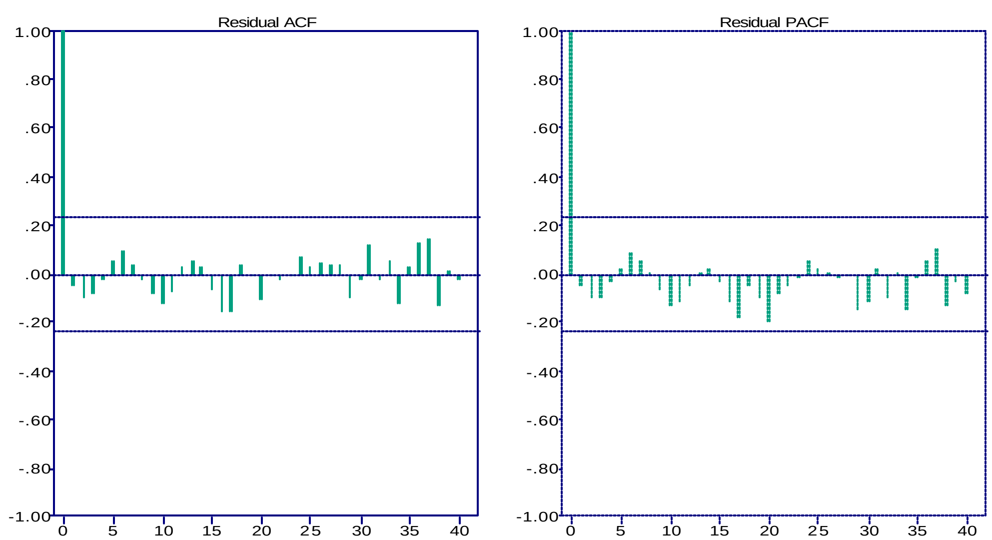


Figure 6.19 Port of Everglades Imported Barrels Forecast Model Residuals

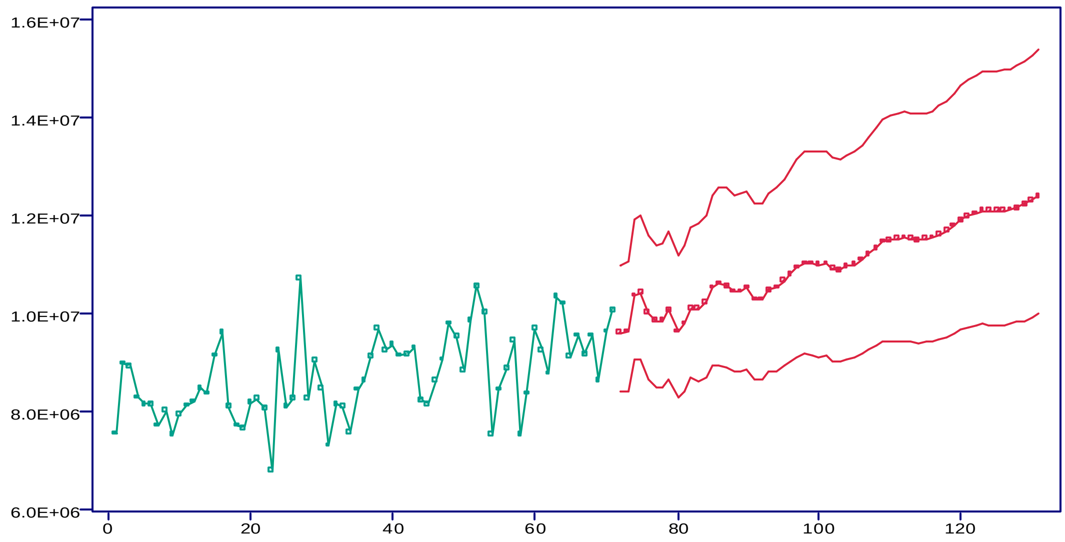


Figure 6.20 Port of Everglades Five years forecast for Imported Barrels

6.3.2.3 Port of Everglades Imported Containers

Let $IMEA_m$ be the total imported containers handled by the Port of Everglades in month "m" and Ln be the natural logarithm function, then $Ln(IMEA_m) = 0.0058 + 0.5201\ Ln(IMEA_{m-1}) - 0.2989(Ln(IMEA_{m-6}) - Ln(IMEA_{m-7}))$

A total of 70 points for the monthly imported containers were used in developing this model. The time series model for imported containers indicates that the number of freight units for this month ($IMEA_m$) is a natural logarithm function of the imported freight units in the last month ($IMEA_{m-1}$), six months ago ($IMEA_{m-6}$) and seven months ago ($IMEA_{m-7}$).

The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.21. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to its standard error limits (the dashed lines) as shown by the plot on the right of Figure

6.21. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.9894 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.22 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.

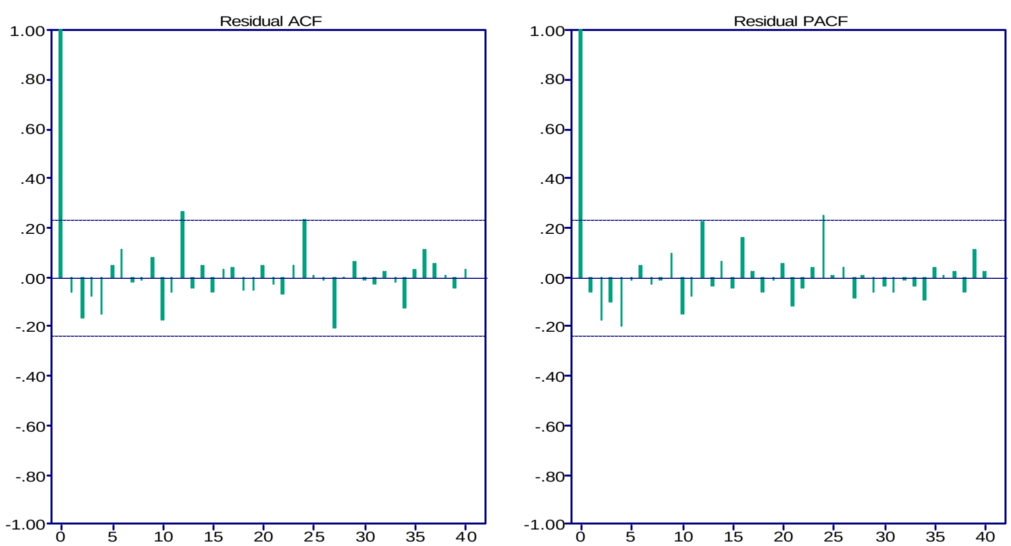


Figure 6.21 Port of Everglades Imported Containers Forecast Model Residuals

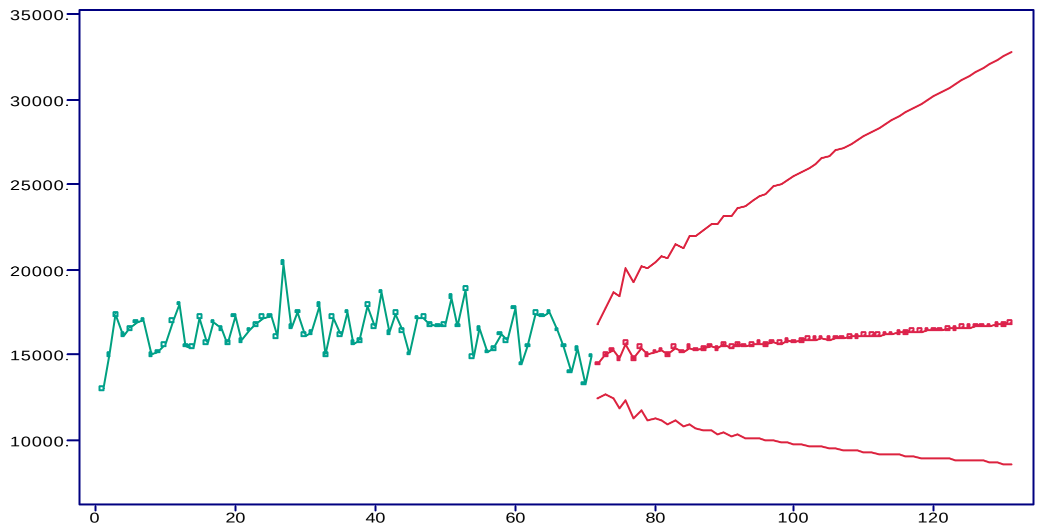


Figure 6.22 Port of Everglades Five year forecast for Imported Containers

6.3.2.4 Port of Everglades Exported Tonnage

Let $EXST_m$ be the total exported tonnage handled by the Port of Everglades in month "m" and Ln be the natural logarithm function, then $Ln(EXST_m) = 0.2282 - 0.0640\, Ln(EXST_{m-1}) + 0.3298\, Ln(EXST_{m-2}) + 0.3895 Ln(EXST_{m-3}) + 0.3447\, Ln(EXST_{m-4}) - 0.2009(Ln(EXST_{m-6}) - Ln(EXST_{m-7}))$

A total of 70 points for the monthly exported tonnage were used in developing this model. The time series model for exported tonnage indicates that the weight of exported freight for this month ($EXST_m$) is a natural logarithm function of the exported freight units in the last month ($EXST_{m-1}$), two months ago ($EXST_{m-2}$), three months ago ($EXST_{m-3}$), four months ago ($EXST_{m-4}$), six months ago ($EXST_{m-6}$) and seven months ago ($EXST_{m-7}$).

The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.23. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to its standard error limits (the dashed lines) as shown by the plot on the right of Figure 6.23. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.1866 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.24 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.

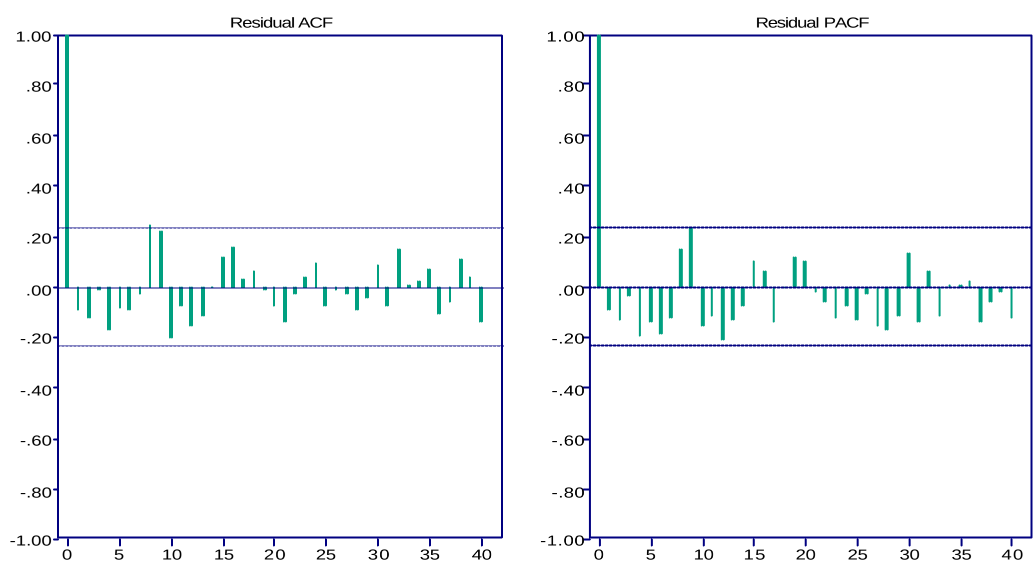


Figure 6.23 Port of Everglades Exported Tonnage Forecast Model Residuals

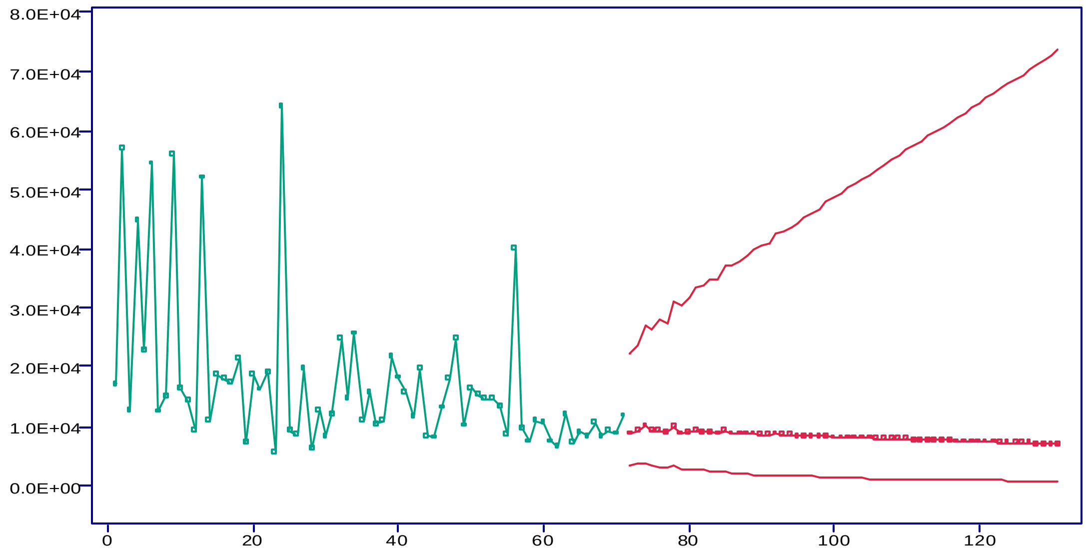


Figure 6.24 Port of Everglades Five Year Forecast for Exported Tonnage

6.3.2.5 Port of Everglades Exported Containers

Let $EXEA_m$ be the total exported containers handled by the Port of Everglades in month "m" and Ln be the natural logarithm function, then $Ln(EXEA_m) = 0.0068 + 0.2230\ Ln(EXEA_{m-1}) - 0.0958\ Ln(EXEA_{m-2}) + 0.2759\ Ln(EXEA_{m-3}) + 0.0168\ Ln(EXEA_{m-4}) - 0.5801\ Ln(EXEA_{m-5}) - 0.1976\ Ln(EXEA_{m-7}) + 0.2932\ (Ln(EXEA_{m-9}) - Ln(EXEA_{m-10}))$

A total of 70 points for the monthly exported containers were used in developing this model. The time series model for exported containers indicates that the number of freight units for this month ($EXEA_m$) is a natural logarithm function of the exported freight units in the last month ($EXEA_{m-1}$), two months ago ($EXEA_{m-2}$), three months ago ($EXEA_{m-3}$), four months ago ($EXEA_{m-4}$), five months ago ($EXEA_{m-5}$), seven months ago ($EXEA_{m-7}$), nine months ago ($EXEA_{m-9}$) and ten months ago ($EXEA_{m-10}$).

The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.25. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to its standard error limits (the dashed lines) as shown by the plot on the right of Figure 6.25. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.5755 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.26 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.

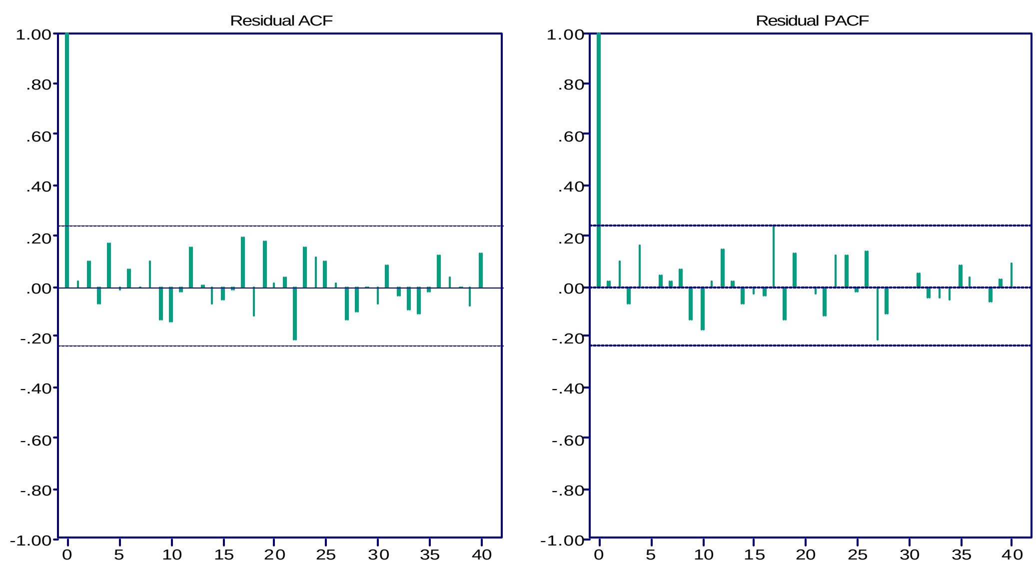


Figure 6.25 Port of Everglades Exported Containers Forecast Model Residuals

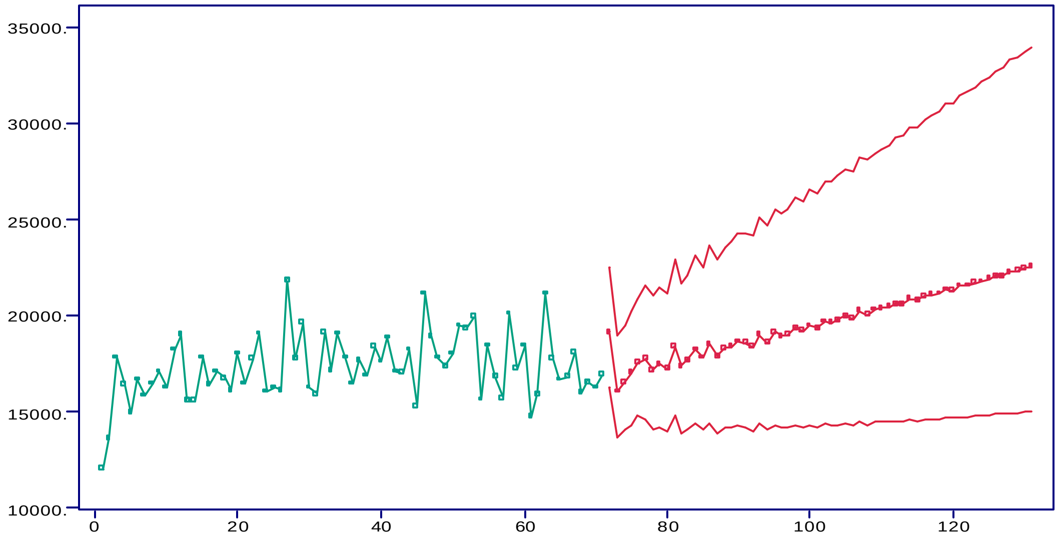


Figure 6.26 Port of Everglades Five Year Forecast for Exported Containers

6.3.3 Port of Everglades Analysis of Forecasting Results

The predicted values produced by the Port of Everglades forecasting model are listed in Table 6.9. The predicted values are the same fields required as input for the developed Port of Everglades ANN model for generating truck counts. These are the values used to predict future truck volumes on the access roads at the port (see Section 4.1.2 for a description). Figures 6.27 to 6.29 show the trends for the historical and predicted vessel data from January 1995 to November 2005. From the base year 2000 the trend indicates that by year 2005, the imported tonnage is expected to increase by 189%. This extreme increase is attributed to the high fluctuation in the historical data. The imported barrels is expected to increase by 28%. The imported containers is expected to increase by 7%. The exported tonnage is expected to *decrease* by 18%. The exported containers is expected to increase by 31%. Figure 6.30 shows a graphical representation of this.

Date	Imported Tonnage	Imported Barrels	Imported Containers	Exported Tonnage	Exported Containers
Dec-00	232,740	9,617,100	14,472	8,665	19,112
Jan-01	218,530	9,655,200	15,011	9,223	16,088
Feb-01	220,830	10,390,000	15,286	10,051	16,525
Mar-01	244,940	10,442,000	14,788	9,323	17,007
Apr-01	238,880	10,022,000	15,736	9,195	17,540
May-01	240,340	9,850,000	14,801	8,892	17,760
Jun-01	248,560	9,864,200	15,453	9,959	17,152
Jul-01	255,310	10,072,000	15,026	8,814	17,432
Aug-01	257,030	9,639,100	15,201	9,017	17,208
Sep-01	262,330	9,798,900	15,321	9,228	18,390
Oct-01	268,480	10,111,000	15,036	9,093	17,350
Nov-01	273,330	10,103,000	15,508	8,906	17,629
Dec-01	277,960	10,244,000	15,138	8,763	18,230
Jan-02	283,650	10,537,000	15,498	9,155	17,777
Feb-02	289,230	10,625,000	15,326	8,705	18,462
Mar-02	294,570	10,583,000	15,427	8,741	17,862
Apr-02	300,170	10,474,000	15,520	8,760	18,269
May-02	306,030	10,478,000	15,388	8,741	18,351
Jun-02	311,870	10,537,000	15,618	8,604	18,604
Jul-02	317,790	10,308,000	15,453	8,523	18,551
Aug-02	323,890	10,309,000	15,640	8,645	18,378
Sep-02	330,100	10,481,000	15,575	8,458	18,989
Oct-02	336,410	10,551,000	15,634	8,436	18,595
Nov-02	342,840	10,673,000	15,701	8,403	19,103
Dec-02	349,410	10,825,000	15,655	8,390	18,930
Jan-03	356,090	10,948,000	15,783	8,298	18,983
Feb-03	362,900	11,048,000	15,721	8,240	19,348
Mar-03	369,850	11,027,000	15,827	8,258	19,177
Apr-03	376,930	11,022,000	15,814	8,166	19,485
May-03	384,140	11,037,000	15,856	8,127	19,328
Jun-03	391,490	10,930,000	15,906	8,083	19,679
Jul-03	398,980	10,910,000	15,900	8,059	19,623
Aug-03	406,620	10,975,000	15,979	7,994	19,760
Sep-03	414,400	11,023,000	15,966	7,945	19,929
Oct-03	422,330	11,117,000	16,033	7,924	19,811
Nov-03	430,410	11,229,000	16,045	7,867	20,207
Dec-03	438,650	11,352,000	16,081	7,824	20,065

Date	Imported Tonnage	Imported Barrels	Imported Containers	Exported Tonnage	Exported Containers
Jan-04	447,040	11,477,000	16,123	7,780	20,296
Feb-04	455,600	11,516,000	16,136	7,748	20,345
Mar-04	464,320	11,541,000	16,191	7,696	20,425
Apr-04	473,200	11,566,000	16,202	7,652	20,618
May-04	482,260	11,527,000	16,251	7,618	20,586
Jun-04	491,490	11,511,000	16,275	7,573	20,836
Jul-04	500,890	11,527,000	16,309	7,531	20,781
Aug-04	510,480	11,551,000	16,346	7,488	21,021
Sep-04	520,240	11,620,000	16,370	7,452	21,061
Oct-04	530,200	11,704,000	16,413	7,408	21,138
Nov-04	540,350	11,809,000	16,436	7,367	21,333
Dec-04	550,690	11,924,000	16,477	7,329	21,315
Jan-05	561,220	11,997,000	16,506	7,288	21,549
Feb-05	571,960	12,055,000	16,539	7,248	21,551
Mar-05	582,910	12,100,000	16,575	7,207	21,719
Apr-05	594,060	12,104,000	16,603	7,170	21,803
May-05	605,430	12,104,000	16,642	7,129	21,897
Jun-05	617,020	12,111,000	16,670	7,090	22,059
Jul-05	628,830	12,126,000	16,707	7,052	22,082
Aug-05	640,860	12,172,000	16,739	7,013	22,287
Sep-05	653,120	12,234,000	16,773	6,975	22,314
Oct-05	665,620	12,316,000	16,808	6,936	22,477
Nov-05	678,360	12,415,000	16,839	6,899	22,576

Table 6.9 Port of Everglades Predicted Vessel Data

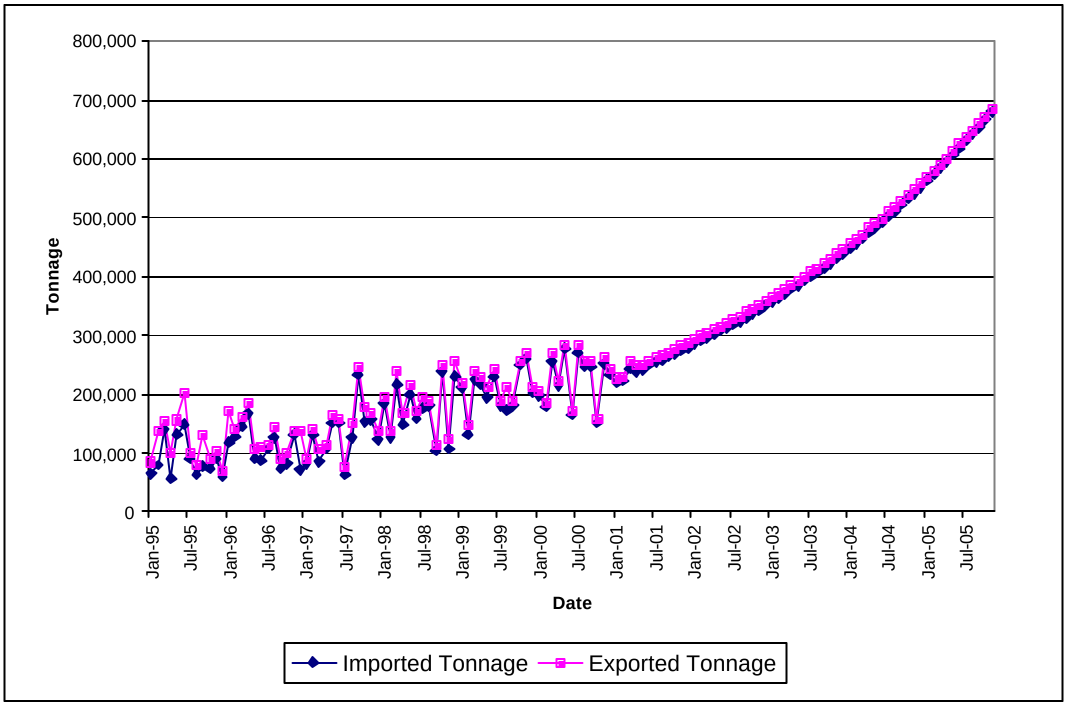


Figure 6.27 Port of Everglades Vessel Data Trends (Tonnage)

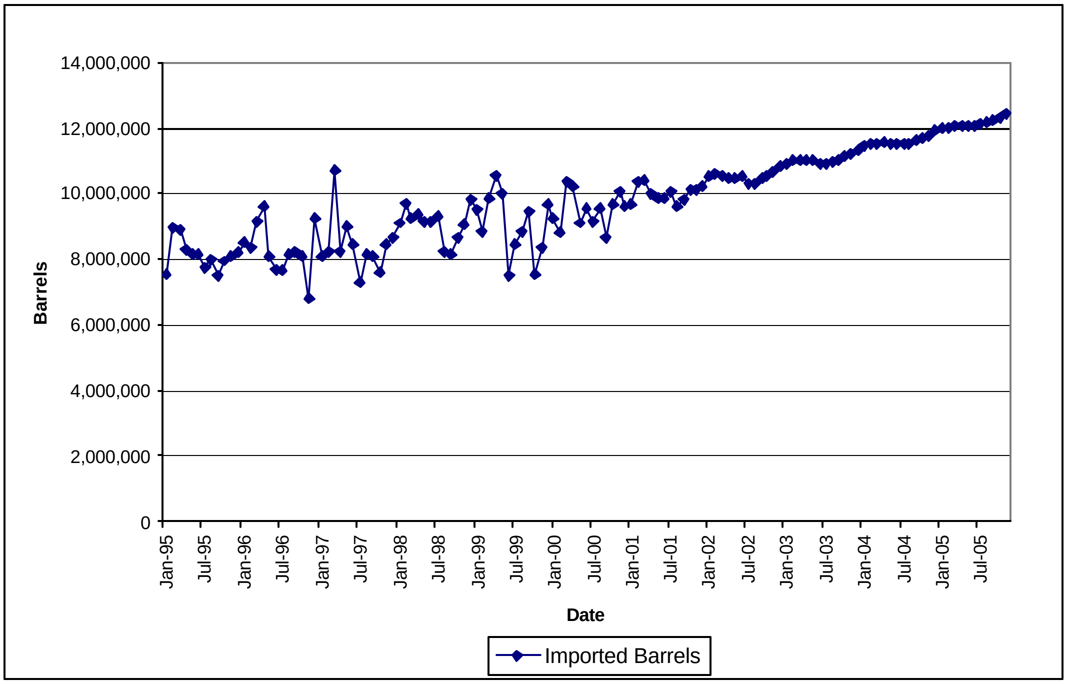


Figure 6.28 Port of Everglades Vessel Data Trends (Barrels)

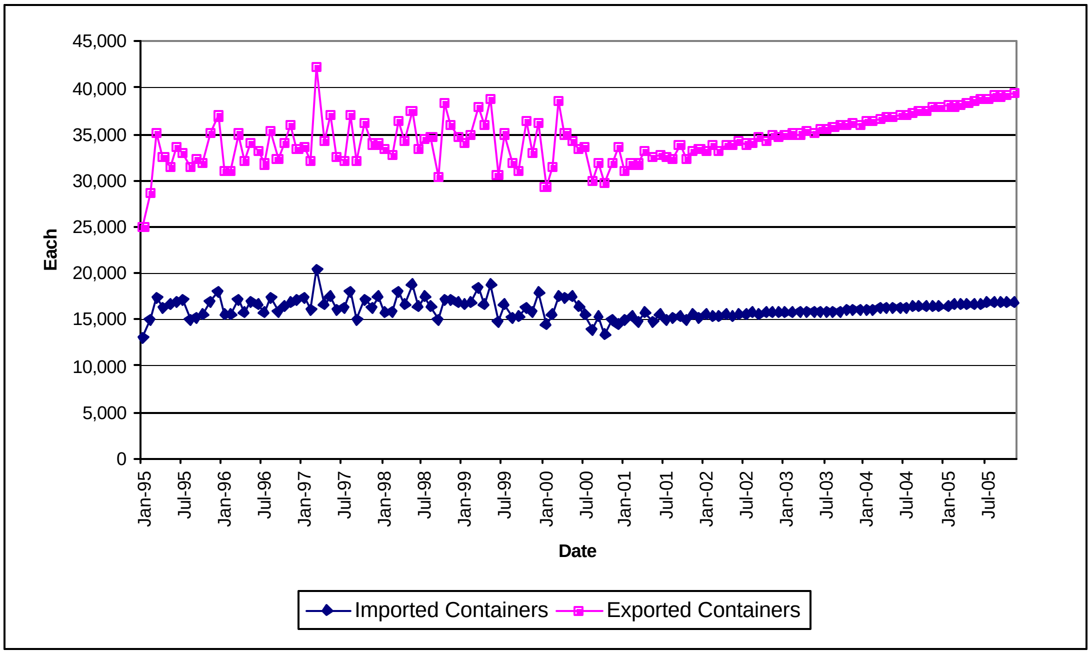


Figure 6.29 Port of Everglades Vessel Data Trends (Containers)

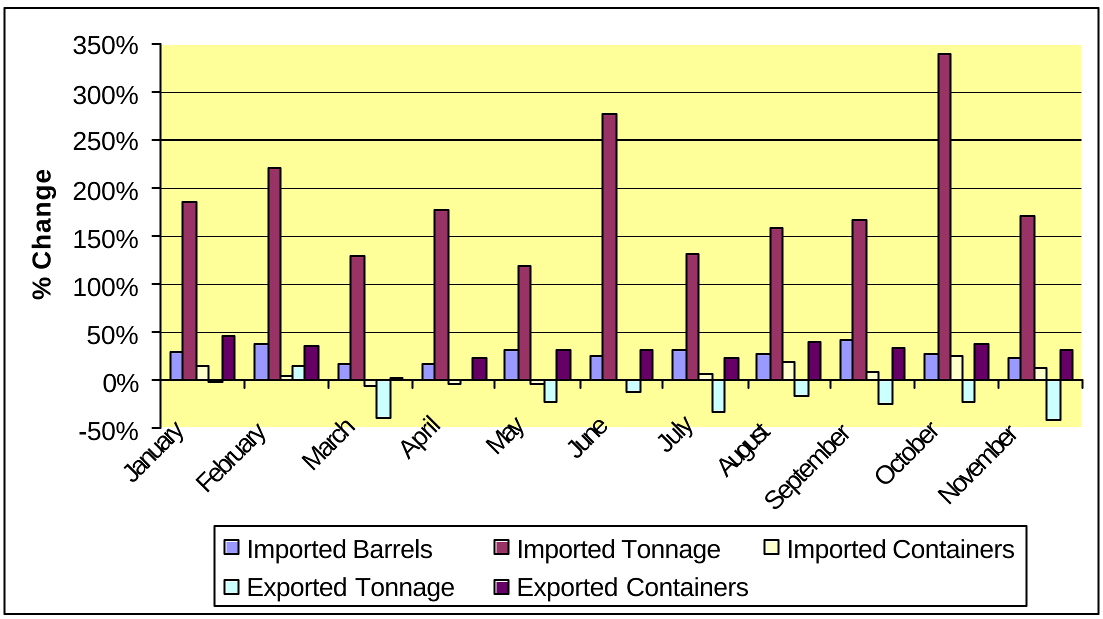


Figure 6.30 Port of Everglades Percent Change of Forecasted Freight Input Variables (Year 2000 - 2005)

The previously developed ANN truck trip generation model for the Port of Everglades was used to produce truck volumes for the available vessel freight data. The model output is displayed in Tables 6.10 to 6.14. The dates are related to the month, day of the week, and year. The day of the week was numbered sequentially 01-07 for Monday to Saturday for ease of interpretation. Figure 6.31 shows the trend for inbound and outbound trucks at the port including data collected in the field for year 2000. Weekends were excluded in the graph because of the high variation compared to the weekdays. The field data is available in Table E.1 andE.2 Appendix E. The forecasting results show that trucks are expected to increase by 33% for daily inbound trucks and 30% for daily outbound trucks from a comparison of base year 2000 and forecasted year 2005. Figure 6.32 shows the average annual weekday truck volumes for present and future estimates. The future estimates are based on the output from the ANN model.

InDates	Mod-InTruck-Counts	Eller Inbound	Spangler Inbound	Eisenhower Inbound	InDates	Mod-InTruck-Counts	Eller Inbound	Spangler Inbound	Eisenhower Inbound	InDates	Mod-OutTruck-Counts	Eller Outbound	Spangler Outbound	Eisenhower Outbound	InDates	Mod-OutTruck-Counts	Eller Outbound	Spangler Outbound	Eisenhower Outbound
10101	3330	2193	961	176	70101	2997	1974	865	159	10101	3354	2072	1125	157	70101	3215	1986	1078	150
10201	3254	2142	939	172	70201	3319	2186	958	176	10201	3421	2113	1147	160	70201	3292	2034	1104	154
10301	3404	2241	982	180	70301	3451	2273	996	183	10301	3503	2164	1175	164	70301	3345	2066	1122	157
10401	3440	2265	993	182	70401	3560	2344	1027	188	10401	3497	2160	1173	164	70401	3333	2059	1118	156
10501	3687	2428	1064	195	70501	3699	2436	1067	196	10501	3607	2229	1210	169	70501	3446	2129	1156	161
10601	1725	1136	498	91	70601	1742	1147	503	92	10601	1743	1077	585	82	70601	1567	968	526	73
10701	1349	888	389	71	70701	1311	863	378	69	10701	1513	935	507	71	70701	1338	827	449	63
20101	3097	2039	894	164	80101	3030	1995	874	160	20101	3313	2047	1111	155	80101	3187	1969	1069	149
20201	3416	2249	986	181	80201	3413	2247	985	181	20201	3384	2091	1135	158	80201	3224	1992	1081	151
20301	3523	2320	1017	186	80301	3480	2291	1004	184	20301	3433	2121	1151	161	80301	3274	2023	1098	153
20401	3527	2323	1018	187	80401	3349	2205	966	177	20401	3431	2120	1151	161	80401	3262	2015	1094	153
20501	3677	2421	1061	194	80501	3513	2313	1014	186	20501	3540	2187	1187	166	80501	3414	2109	1145	160
20601	1721	1133	497	91	80601	1624	1069	469	86	20601	1673	1033	561	78	80601	1547	956	519	72
20701	1331	876	384	70	80701	1344	885	388	71	20701	1436	887	482	67	80701	1325	819	445	62
30101	3098	2040	894	164	90101	3047	2007	879	161	30101	3397	2099	1139	159	90101	3165	1955	1062	148
30201	3464	2281	1000	183	90201	3454	2275	997	183	30201	3457	2136	1160	162	90201	3229	1995	1083	151
30301	3532	2326	1019	187	90301	3506	2309	1012	185	30301	3461	2138	1161	162	90301	3261	2015	1094	153
30401	3513	2313	1014	186	90401	3567	2349	1029	189	30401	3466	2141	1162	162	90401	3270	2021	1097	153
30501	3506	2309	1012	185	90501	3662	2411	1057	194	30501	3548	2192	1190	166	90501	3317	2049	1113	155
30601	1564	1030	451	83	90601	1640	1080	473	87	30601	1750	1081	587	82	90601	1494	923	501	70
30701	1266	834	366	67	90701	1181	778	341	62	30701	1496	924	502	70	90701	1231	760	413	58
40101	3004	1978	867	159	100101	3027	1993	874	160	40101	3222	1991	1081	151	100101	3304	2041	1108	155
40201	3333	2195	962	176	100201	3351	2207	967	177	40201	3295	2036	1105	154	100201	3354	2072	1125	157
40301	3542	2333	1022	187	100301	3441	2266	993	182	40301	3346	2067	1122	157	100301	3436	2123	1152	161
40401	3536	2329	1021	187	100401	3501	2306	1010	185	40401	3339	2063	1120	156	100401	3428	2118	1150	160
40501	3698	2435	1067	196	100501	3755	2473	1084	199	40501	3454	2134	1158	162	100501	3539	2186	1187	166
40601	1730	1139	499	92	100601	1800	1185	519	95	40601	1561	965	524	73	100601	1673	1034	561	78
40701	1298	855	375	69	100701	1405	925	406	74	40701	1331	822	446	62	100701	1446	893	485	68
50101	3043	2004	878	161	110101	3048	2007	880	161	50101	3225	1993	1082	151	110101	3230	1995	1083	151
50201	3389	2232	978	179	110201	3482	2293	1005	184	50201	3288	2031	1103	154	110201	3293	2034	1104	154
50301	3355	2209	968	177	110301	3587	2362	1035	190	50301	3328	2056	1116	156	110301	3313	2047	1111	155
50401	3359	2212	969	178	110401	3520	2318	1016	186	50401	3359	2075	1127	157	110401	3301	2039	1107	154
50501	3574	2354	1032	189	110501	3532	2326	1019	187	50501	3464	2140	1162	162	110501	3446	2129	1156	161
50601	1712	1127	494	91	110601	1681	1107	485	89	50601	1609	994	540	75	110601	1582	978	531	74
50701	1334	879	385	71	110701	1375	905	397	73	50701	1381	853	463	65	110701	1332	823	447	62
60101	3055	2012	882	162	120101	3030	1996	875	160	60101	3183	1966	1068	149	120101	3273	2022	1098	153
60201	3402	2240	982	180	120201	3407	2243	983	180	60201	3238	2000	1086	152	120201	3334	2060	1118	156
60301	3504	2307	1011	185	120301	3567	2349	1029	189	60301	3283	2028	1101	154	120301	3365	2079	1129	157
60401	3539	2331	1021	187	120401	3624	2386	1046	192	60401	3249	2007	1090	152	120401	3374	2084	1131	158
60501	3562	2346	1028	188	120501	3801	2503	1097	201	60501	3337	2062	1119	156	120501	3457	2136	1160	162
60601	1514	997	437	80	120601	1784	1175	515	94	60601	1521	940	510	71	120601	1649	1019	553	77
60701	1210	797	349	64	120701	1199	789	346	63	60701	1263	780	424	59	120701	1452	897	487	68

Table 6.10 Port of Everglades Predicted Truck Volumes for Year 2001 (Model Output)

InDates	Mod-InTruck-Counts	Eller Inbound	Spangler Inbound	Eisenhower Inbound
10102	3580	2358	1033	189
10202	3558	2343	1027	188
10302	3533	2326	1020	187
10402	3674	2420	1060	194
10502	3940	2594	1137	208
10602	2103	1385	607	111
10702	1507	992	435	80
20102	3180	2094	918	168
20202	3586	2361	1035	190
20302	3628	2389	1047	192
20402	3839	2528	1108	203
20502	4001	2634	1155	212
20602	2059	1356	594	109
20702	1435	945	414	76
30102	3189	2100	920	169
30202	3569	2350	1030	189
30302	3610	2377	1042	191
30402	3837	2527	1107	203
30502	3857	2540	1113	204
30602	1790	1179	517	95
30702	1301	856	375	69
40102	3084	2031	890	163
40202	3432	2260	991	182
40302	3525	2321	1017	186
40402	3854	2538	1112	204
40502	4001	2635	1155	212
40602	2063	1358	595	109
40702	1432	943	413	76
50102	3158	2080	911	167
50202	3597	2369	1038	190
50302	3623	2386	1046	192
50402	3616	2381	1044	191
50502	3810	2509	1100	202
50602	1959	1290	565	104
50702	1475	971	426	78
60102	3169	2087	915	168
60202	3628	2389	1047	192
60302	3609	2376	1042	191
60402	3889	2561	1122	206
60502	3995	2631	1153	211
60602	1950	1284	563	103
60702	1288	848	372	68

InDates	Mod-InTruck-Counts	Eller Inbound	Spangler Inbound	Eisenhower Inbound
70102	3084	2031	890	163
70202	3446	2269	994	182
70302	3503	2307	1011	185
70402	3739	2462	1079	198
70502	4035	2657	1165	213
70602	2088	1375	603	110
70702	1456	959	420	77
80102	3139	2067	906	166
80202	3627	2389	1047	192
80302	3625	2387	1046	192
80402	3798	2501	1096	201
80502	3764	2479	1086	199
80602	1845	1215	532	98
80702	1344	885	388	71
90102	3113	2050	898	165
90202	3533	2326	1020	187
90302	3708	2441	1070	196
90402	3910	2574	1128	207
90502	4085	2690	1179	216
90602	2130	1403	615	113
90702	1457	959	420	77
100102	3153	2076	910	167
100202	3673	2419	1060	194
100302	3543	2333	1022	187
100402	3718	2449	1073	197
100502	3983	2623	1150	211
100602	2176	1433	628	115
100702	1534	1010	443	81
110102	3195	2104	922	169
110202	3665	2413	1058	194
110302	3697	2434	1067	196
110402	3960	2608	1143	210
110502	3950	2601	1140	209
110602	1886	1242	544	100
110702	1380	909	398	73
120102	3133	2063	904	166
120202	3558	2343	1027	188
120302	3635	2394	1049	192
120402	3990	2628	1152	211
120502	4280	2818	1235	226
120602	2385	1571	688	126
120702	1523	1003	439	81

InDates	Mod-OutTruck-Counts	Eller Outbound	Spangler Outbound	Eisenhower Outbound
10102	3582	2213	1201	168
10202	3617	2234	1213	169
10302	3732	2306	1252	175
10402	3876	2395	1300	181
10502	4019	2483	1348	188
10602	2085	1288	699	98
10702	1738	1074	583	81
20102	3387	2092	1136	158
20202	3380	2088	1134	158
20302	3529	2180	1184	165
20402	3655	2258	1226	171
20502	3791	2342	1272	177
20602	1842	1138	618	86
20702	1475	911	495	69
30102	3454	2134	1159	162
30202	3431	2120	1151	161
30302	3566	2203	1196	167
30402	3640	2249	1221	170
30502	3738	2309	1254	175
30602	1852	1144	621	87
30702	1508	931	506	71
40102	3326	2055	1115	156
40202	3339	2063	1120	156
40302	3488	2155	1170	163
40402	3607	2228	1210	169
40502	3743	2313	1255	175
40602	1795	1109	602	84
40702	1434	886	481	67
50102	3419	2112	1147	160
50202	3391	2095	1137	159
50302	3527	2179	1183	165
50402	3615	2233	1212	169
50502	3810	2354	1278	178
50602	1880	1161	631	88
50702	1528	944	512	72
60102	3364	2078	1128	157
60202	3356	2073	1126	154
60302	3481	2150	1167	154
60402	3625	2240	1216	162
60502	3677	2272	1233	167
60602	1770	1093	594	174
60702	1406	869	472	82

InDates	Mod-OutTruck-Counts	Eller Outbound	Spangler Outbound	Eisenhower Outbound
70102	3288	2031	1103	65
70202	3282	2028	1101	158
70302	3465	2140	1162	157
70402	3573	2207	1198	161
70502	3710	2292	1244	167
70602	1758	1086	590	172
70702	1395	862	468	85
80102	3373	2084	1131	68
80202	3361	2076	1127	157
80302	3443	2127	1155	157
80402	3565	2203	1196	164
80502	3673	2269	1232	169
80602	1808	1117	606	176
80702	1447	894	485	84
90102	3355	2073	1125	67
90202	3345	2067	1122	160
90302	3497	2160	1173	160
90402	3621	2237	1214	166
90502	3767	2327	1263	173
90602	1786	1103	599	180
90702	1428	882	479	89
100102	3419	2112	1147	72
100202	3426	2116	1149	159
100302	3551	2194	1191	158
100402	3701	2286	1241	165
100502	3852	2379	1292	169
100602	1902	1175	638	173
100702	1546	955	519	85
110102	3404	2103	1142	68
110202	3371	2082	1131	160
110302	3520	2175	1181	160
110402	3604	2226	1209	168
110502	3701	2286	1241	173
110602	1820	1124	610	183
110702	1452	897	487	92
120102	3425	2116	1149	81
120202	3427	2117	1150	160
120302	3584	2214	1202	168
120402	3699	2285	1241	173
120502	3907	2414	1310	183
120602	1969	1216	660	93
120702	1731	1070	581	80

Table 6.11 Port of Everglades Predicted Truck Volumes for Year 2002 (Model Output)

InDates	Mod-InTruck-Counts	Eller Inbound	Spangler Inbound	Eisenhower Inbound
10103	3746	2467	1081	198
10203	3728	2455	1076	197
10303	3838	2527	1108	203
10403	3811	2510	1100	202
10503	4004	2637	1156	212
10603	2166	1426	625	115
10703	1667	1098	481	88
20103	3226	2124	931	171
20203	3785	2492	1092	200
20303	3806	2506	1098	201
20403	4046	2664	1168	214
20503	4179	2752	1206	221
20603	2274	1497	656	120
20703	1584	1043	457	84
30103	3199	2106	923	169
30203	3679	2422	1062	195
30303	3797	2500	1096	201
30403	4086	2691	1179	216
30503	4200	2766	1212	222
30603	2138	1408	617	113
30703	1440	948	416	76
40103	3212	2115	927	170
40203	3761	2477	1085	199
40303	3647	2402	1053	193
40403	3924	2584	1133	208
40503	4234	2788	1222	224
40603	2294	1511	662	121
40703	1616	1064	466	85
50103	3217	2118	928	170
50203	3824	2518	1104	202
50303	3803	2504	1098	201
50403	3999	2633	1154	212
50503	3929	2587	1134	208
50603	2026	1334	585	107
50703	1486	979	429	79
60103	3161	2082	912	167
60203	3683	2425	1063	195
60303	3866	2546	1116	205
60403	4087	2692	1180	216
60503	4253	2801	1227	225
60603	2309	1521	667	122
60703	1595	1051	460	84

InDates	Mod-InTruck-Counts	Eller Inbound	Spangler Inbound	Eisenhower Inbound
70103	3172	2089	915	168
70203	3816	2513	1101	202
70303	3644	2400	1052	193
70403	3845	2532	1110	203
70503	4110	2706	1186	217
70603	2338	1540	675	124
70703	1640	1080	473	87
80103	3260	2147	941	172
80203	3858	2540	1113	204
80303	3870	2548	1117	205
80403	4147	2731	1197	219
80503	4134	2722	1193	219
80603	2046	1347	590	108
80703	1490	981	430	79
90103	3158	2079	911	167
90203	3688	2429	1064	195
90303	3764	2478	1086	199
90403	4181	2753	1207	221
90503	4300	2831	1241	227
90603	2387	1572	689	126
90703	1667	1098	481	88
100103	3236	2131	934	171
100203	3909	2574	1128	207
100303	3897	2566	1125	206
100403	3882	2556	1120	205
100503	4072	2681	1175	215
100603	2250	1482	649	119
100703	1732	1140	500	92
110103	3256	2144	940	172
110203	3952	2602	1141	209
110303	3893	2564	1124	206
110403	4228	2784	1220	224
110503	4308	2837	1243	228
110603	2275	1498	657	120
110703	1494	984	431	79
120103	3194	2103	922	169
120203	3749	2469	1082	198
120303	3781	2490	1091	200
120403	4064	2676	1173	215
120503	4540	2990	1310	240
120603	2655	1748	766	140
120703	1757	1157	507	93

InDates	Mod-OutTruck-Counts	Eller Outbound	Spangler Outbound	Eisenhower Outbound
10103	3710	2292	1244	174
10203	3710	2292	1244	174
10303	3852	2380	1292	180
10403	3942	2436	1322	184
10503	4145	2561	1390	194
10603	2204	1362	739	103
10703	1850	1143	621	87
20103	3501	2163	1174	164
20203	3483	2152	1168	163
20303	3640	2249	1221	170
20403	3771	2329	1265	176
20503	3908	2415	1311	183
20603	1950	1205	654	91
20703	1555	961	522	73
30103	3584	2214	1202	168
30203	3569	2205	1197	167
30303	3696	2283	1240	173
30403	3844	2375	1289	180
30503	3906	2413	1310	183
30603	1981	1224	665	93
30703	1646	1017	552	77
40103	3476	2147	1166	163
40203	3458	2136	1160	162
40303	3655	2258	1226	171
40403	3768	2328	1264	176
40503	3911	2416	1312	183
40603	1943	1200	652	91
40703	1575	973	528	74
50103	3571	2206	1198	167
50203	3548	2192	1190	166
50303	3638	2248	1220	170
50403	3764	2325	1262	176
50503	3880	2397	1301	182
50603	2003	1238	672	94
50703	1634	1009	548	76
60103	3474	2146	1165	163
60203	3456	2135	1159	162
60303	3613	2232	1212	169
60403	3739	2310	1254	175
60503	3893	2405	1306	182
60603	1898	1172	637	89
60703	1540	951	517	72

InDates	Mod-OutTruck-Counts	Eller Outbound	Spangler Outbound	Eisenhower Outbound
70103	3432	2120	1151	161
70203	3428	2118	1150	160
70303	3564	2202	1196	167
70403	3722	2299	1248	174
70503	3882	2398	1302	182
70603	1913	1182	642	90
70703	1547	956	519	72
80103	3578	2210	1200	167
80203	3533	2182	1185	165
80303	3689	2279	1237	173
80403	3768	2328	1264	176
80503	3875	2394	1300	181
80603	1968	1216	660	92
80703	1610	995	540	75
90103	3480	2150	1167	163
90203	3479	2149	1167	163
90303	3647	2253	1223	171
90403	3771	2329	1265	176
90503	3921	2422	1315	184
90603	1945	1202	652	91
90703	1569	969	526	73
100103	3597	2222	1206	168
100203	3549	2193	1190	166
100303	3699	2285	1241	173
100403	3794	2344	1272	178
100503	4007	2475	1344	188
100603	2053	1269	689	96
100703	1691	1045	567	79
110103	3556	2197	1193	166
110203	3526	2178	1183	165
110303	3667	2266	1230	172
110403	3822	2361	1282	179
110503	3880	2397	1302	182
110603	1947	1203	653	91
110703	1577	974	529	74
120103	3562	2201	1195	167
120203	3541	2187	1188	166
120303	3741	2311	1255	175
120403	3857	2383	1294	180
120503	4067	2512	1364	190
120603	2129	1316	714	100
120703	1886	1165	633	88

Table 6.12 Port of Everglades Predicted Truck Volumes for Year 2003 (Model Output)

InDates	Mod-InTruck-Counts	Eller Inbound	Spangler Inbound	Eisenhower Inbound
10104	4157	2737	1200	220
10204	3938	2593	1137	208
10304	4056	2671	1170	215
10404	4249	2798	1226	225
10504	4160	2739	1201	220
10604	2250	1482	649	119
10704	1687	1111	487	89
20104	3279	2159	946	173
20204	4024	2650	1161	213
20304	4021	2648	1160	213
20404	4285	2821	1237	227
20504	4415	2908	1274	234
20604	2509	1652	724	133
20704	1735	1142	501	92
30104	3247	2138	937	172
30204	3846	2533	1110	203
30304	3869	2548	1117	205
30404	4162	2741	1201	220
30504	4497	2961	1298	238
30604	2568	1691	741	136
30704	1834	1208	529	97
40104	3253	2142	939	172
40204	4039	2660	1166	214
40304	4051	2667	1169	214
40404	4197	2763	1211	222
40504	4132	2721	1193	219
40604	2378	1566	686	126
40704	1814	1195	524	96
50104	3255	2144	940	172
50204	3932	2589	1135	208
50304	4062	2675	1172	215
50404	4392	2892	1267	232
50504	4482	2952	1294	237
50604	2432	1602	702	129
50704	1624	1069	469	86
60104	3282	2161	947	174
60204	4050	2667	1169	214
60304	3860	2542	1114	204
60404	4191	2759	1209	222
60504	4527	2981	1306	239
60604	2601	1713	751	138
60704	1846	1215	533	98

InDates	Mod-InTruck-Counts	Eller Inbound	Spangler Inbound	Eisenhower Inbound
70104	3252	2141	938	172
70204	4095	2696	1182	217
70304	4036	2658	1165	214
70404	4272	2813	1233	226
70504	4133	2721	1193	219
70604	2251	1482	649	119
70704	1658	1092	478	88
80104	3259	2146	941	172
80204	3941	2595	1137	209
80304	3993	2630	1153	211
80404	4470	2943	1290	236
80504	4580	3016	1322	242
80604	2676	1762	772	142
80704	1866	1229	538	99
90104	3257	2145	940	172
90204	4182	2754	1207	221
90304	4076	2684	1176	216
90404	4103	2702	1184	217
90504	4395	2894	1268	232
90604	2687	1769	775	142
90704	1896	1248	547	100
100104	3346	2203	966	177
100204	4190	2759	1209	222
100304	4164	2742	1202	220
100404	4492	2958	1296	238
100504	4439	2923	1281	235
100604	2329	1533	672	123
100704	1714	1129	495	91
110104	3243	2136	936	172
110204	3978	2620	1148	210
110304	4031	2655	1163	213
110404	4543	2992	1311	240
110504	4627	3047	1335	245
110604	2743	1806	791	145
110704	1937	1275	559	102
120104	3296	2170	951	174
120204	4228	2784	1220	224
120304	4173	2748	1204	221
120404	4148	2732	1197	219
120504	4436	2921	1280	235
120604	2766	1821	798	146
120704	1967	1296	568	104

InDates	Mod-OutTruck-Counts	Eller Outbound	Spangler Outbound	Eisenhower Outbound
10104	3850	2378	1291	180
10204	3872	2392	1299	181
10304	3969	2452	1331	186
10404	4099	2533	1375	192
10504	4231	2614	1419	198
10604	2335	1443	783	109
10704	1985	1226	666	93
20104	3628	2242	1217	170
20204	3595	2221	1206	168
20304	3763	2325	1262	176
20404	3891	2404	1305	182
20504	4044	2498	1356	189
20604	2044	1263	686	96
20704	1655	1023	555	77
30104	3709	2291	1244	174
30204	3684	2276	1236	172
30304	3889	2402	1304	182
30404	4006	2475	1344	187
30504	4155	2567	1394	194
30604	2170	1341	728	102
30704	1799	1111	603	84
40104	3626	2240	1216	170
40204	3586	2216	1203	168
40304	3713	2294	1245	174
40404	3818	2359	1281	179
40504	4039	2495	1355	189
40604	2083	1287	698	97
40704	1680	1038	563	79
50104	3728	2303	1250	174
50204	3698	2285	1240	173
50304	3836	2370	1286	180
50404	3991	2466	1339	187
50504	4061	2509	1362	190
50604	2112	1305	708	99
50704	1774	1096	595	83
60104	3612	2231	1211	169
60204	3574	2208	1199	167
60304	3791	2342	1272	177
60404	3911	2416	1312	183
60504	4062	2510	1363	190
60604	2070	1279	694	97
60704	1694	1046	568	79

InDates	Mod-OutTruck-Counts	Eller Outbound	Spangler Outbound	Eisenhower Outbound
70104	3617	2235	1213	169
70204	3573	2208	1198	167
70304	3675	2270	1233	172
70404	3806	2351	1277	178
70504	3936	2432	1320	184
70604	2037	1258	683	95
70704	1662	1027	557	78
80104	3723	2300	1249	174
80204	3705	2289	1243	173
80304	3886	2401	1303	182
80404	4005	2474	1343	187
80504	4172	2577	1399	195
80604	2156	1332	723	101
80704	1786	1103	599	84
90104	3639	2248	1220	170
90204	3599	2223	1207	168
90304	3739	2310	1254	175
90404	3919	2421	1314	183
90504	4094	2530	1373	192
90604	2096	1295	703	98
90704	1719	1062	577	80
100104	3781	2336	1268	177
100204	3713	2294	1245	174
100304	3885	2400	1303	182
100404	3966	2450	1330	186
100504	4082	2522	1369	191
100604	2159	1334	724	101
100704	1795	1109	602	84
110104	3689	2279	1237	173
110204	3673	2269	1232	172
110304	3857	2383	1294	181
110404	3982	2460	1336	186
110504	4146	2562	1391	194
110604	2145	1325	720	100
110704	1760	1087	590	82
120104	3722	2299	1248	174
120204	3650	2255	1224	171
120304	3815	2357	1279	179
120404	3918	2421	1314	183
120504	4195	2591	1407	196
120604	2285	1412	766	107
120704	1961	1211	658	92

Table 6.13 Port of Everglades Predicted Truck Volumes for Year 2004 (Model Output)

InDates	Mod-InTruck-Counts	Eller Inbound	Spangler Inbound	Eisenhower Inbound
10105	4427	2915	1278	234
10205	4011	2641	1158	212
10305	4358	2870	1258	231
10405	4686	3085	1352	248
10505	4758	3133	1373	252
10605	2728	1796	787	144
10705	1840	1212	531	97
20105	3344	2202	965	177
20205	4317	2843	1246	228
20305	4285	2821	1237	227
20405	4607	3034	1330	244
20505	4714	3104	1361	249
20605	2820	1857	814	149
20705	2011	1324	580	106
30105	3342	2201	964	177
30205	4353	2866	1256	230
30305	4046	2664	1168	214
30405	4318	2843	1246	228
30505	4572	3011	1319	242
30605	2904	1912	838	154
30705	2068	1362	597	109
40105	3359	2212	969	178
40205	4331	2852	1250	229
40305	4285	2821	1237	227
40405	4652	3064	1343	246
40505	4559	3002	1316	241
40605	2451	1614	707	130
40705	1833	1207	529	97
50105	3319	2186	958	176
50205	4155	2736	1199	220
50305	4189	2758	1209	222
50405	4735	3118	1366	250
50505	4818	3173	1391	255
50605	2934	1932	847	155
50705	2063	1359	595	109
60105	3310	2180	955	175
60205	4435	2921	1280	235
60305	4293	2827	1239	227
60405	4314	2841	1245	228
60505	4607	3034	1330	244
60605	2953	1944	852	156
60705	2091	1377	604	111

InDates	Mod-InTruck-Counts	Eller Inbound	Spangler Inbound	Eisenhower Inbound
70105	3365	2216	971	178
70205	4408	2903	1272	233
70305	4350	2864	1255	230
70405	4717	3106	1361	250
70505	4631	3050	1337	245
70605	2504	1649	723	132
70705	1833	1207	529	97
80105	3323	2188	959	176
80205	4210	2772	1215	223
80305	4196	2763	1211	222
80405	4556	3000	1315	241
80505	4928	3245	1422	261
80605	3023	1991	872	160
80705	2173	1431	627	115
90105	3332	2194	961	176
90205	4485	2953	1294	237
90305	4441	2924	1282	235
90405	4641	3056	1339	245
90505	4469	2943	1290	236
90605	2777	1829	801	147
90705	2170	1429	626	115
100105	3342	2200	964	177
100205	4335	2855	1251	229
100305	4482	2951	1293	237
100405	4876	3211	1407	258
100505	4924	3242	1421	260
100605	2895	1907	836	153
100705	1916	1262	553	101
110105	3393	2235	979	180
110205	4522	2978	1305	239
110305	4205	2769	1214	222
110405	4619	3042	1333	244
110505	5159	3397	1489	273
110605	3311	2180	956	175
110705	2235	1471	645	118

InDates	Mod-OutTruck-Counts	Eller Outbound	Spangler Outbound	Eisenhower Outbound
10105	4000	2471	1342	187
10205	4040	2496	1355	189
10305	4184	2585	1403	196
10405	4346	2685	1458	203
10505	4420	2730	1482	207
10605	2460	1520	825	115
10705	2119	1309	711	99
20105	3771	2330	1265	176
20205	3722	2300	1248	174
20305	3904	2412	1309	183
20405	4043	2498	1356	189
20505	4210	2601	1412	197
20605	2200	1359	738	103
20705	1820	1124	610	85
30105	3854	2381	1293	180
30205	3814	2356	1279	178
30305	3976	2457	1334	186
30405	4147	2562	1391	194
30505	4330	2675	1452	203
30605	2318	1432	777	108
30705	1937	1196	650	91
40105	3791	2342	1272	177
40205	3711	2293	1245	174
40305	3890	2404	1305	182
40405	3979	2458	1334	186
40505	4093	2529	1373	192
40605	2184	1349	733	102
40705	1802	1114	605	84
50105	3874	2393	1299	181
50205	3844	2375	1289	180
50305	4034	2492	1353	189
50405	4153	2566	1393	194
50505	4330	2675	1452	203
50605	2297	1419	770	107
50705	1923	1188	645	90
60105	3772	2330	1265	177
60205	3715	2295	1246	174
60305	3864	2387	1296	181
60405	4053	2504	1359	190
60505	4240	2619	1422	198
60605	2221	1372	745	104
60705	1836	1135	616	86

InDates	Mod-OutTruck-Counts	Eller Outbound	Spangler Outbound	Eisenhower Outbound
70105	3800	2348	1274	178
70205	3714	2294	1246	174
70305	3896	2407	1307	182
70405	3978	2458	1334	186
70505	4101	2533	1375	192
70605	2168	1339	727	101
70705	1793	1108	601	84
80105	3890	2403	1305	182
80205	3841	2373	1288	180
80305	4069	2514	1365	190
80405	4196	2592	1407	196
80505	4355	2691	1461	204
80605	2337	1444	784	109
80705	1951	1206	654	91
90105	3810	2354	1278	178
90205	3739	2310	1254	175
90305	3881	2397	1302	182
90405	3988	2464	1338	187
90505	4238	2618	1421	198
90605	2255	1393	756	106
90705	1834	1133	615	86
100105	3951	2441	1325	185
100205	3897	2408	1307	182
100305	4048	2501	1358	189
100405	4213	2603	1413	197
100505	4293	2652	1440	201
100605	2312	1428	775	108
100705	1971	1218	661	92
110105	3855	2382	1293	180
110205	3784	2338	1269	177
110305	4029	2489	1351	189
110405	4157	2568	1394	195
110505	4390	2712	1472	205
110605	2414	1491	809	113
110705	2168	1340	727	101

Table 6.14 Port of Everglades Predicted Truck Volumes for Year 2005 (Model Output)

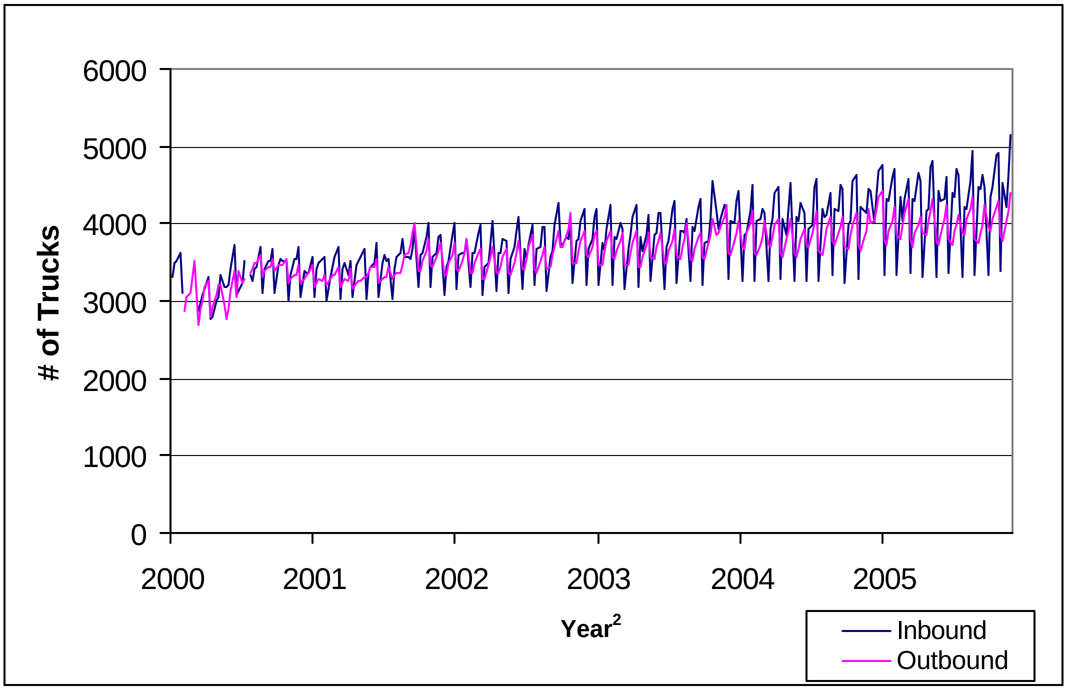


Figure 6.31 Port of Everglades Truck Counts (Year 2000-2005)[1]

[1]excludes weekends, [2]annual counts using one week from each month of the year (84 data points)

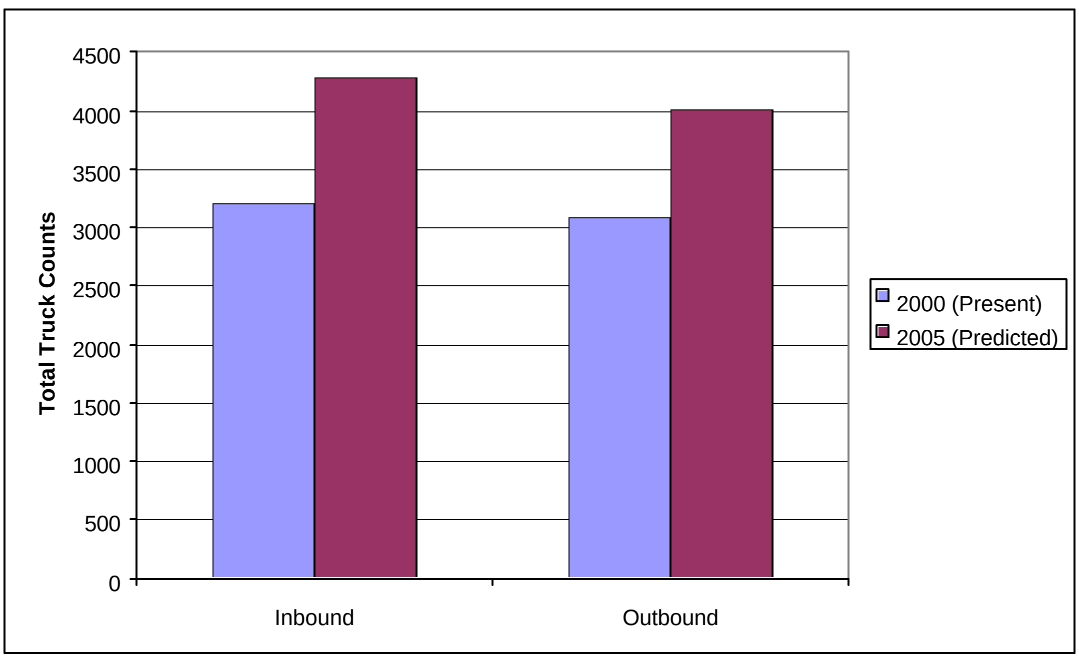


Figure 6.32 Port of Everglades Present Vs Predicted Truck Counts Variables (Year 2000 - 2005)

6.4 PORT OF TAMPA

6.4.1 Historical Data

Historical vessel data was available for January 1992 through December 2000. This data was divided into the same categories as the input variables for the Port of Tampa ANN model. However, the sum of last 7 days of imported tons variable is computed from individual daily records. Therefore, in order to run the developed Port of Tampa ANN Model, the same procedure for determining the sum of last 7 days of imported tons variable must be applied (see section 5.6) once the daily imported tons is calculated from the forecast model results for monthly imported tons. Figures 6.33 and 6.34 indicate the historical trend of input variables for imported and exported tonnage at the port. The historical data is listed in Table 6.15.

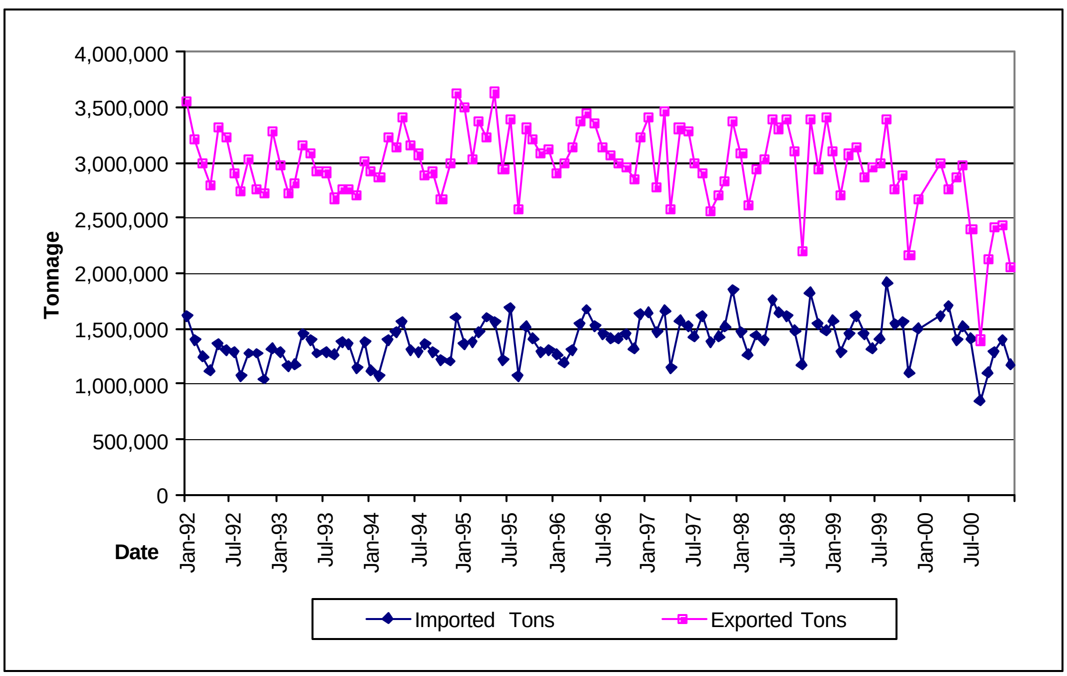


Figure 6.33 Port of Tampa Monthly Historical Data Trend (Tons)

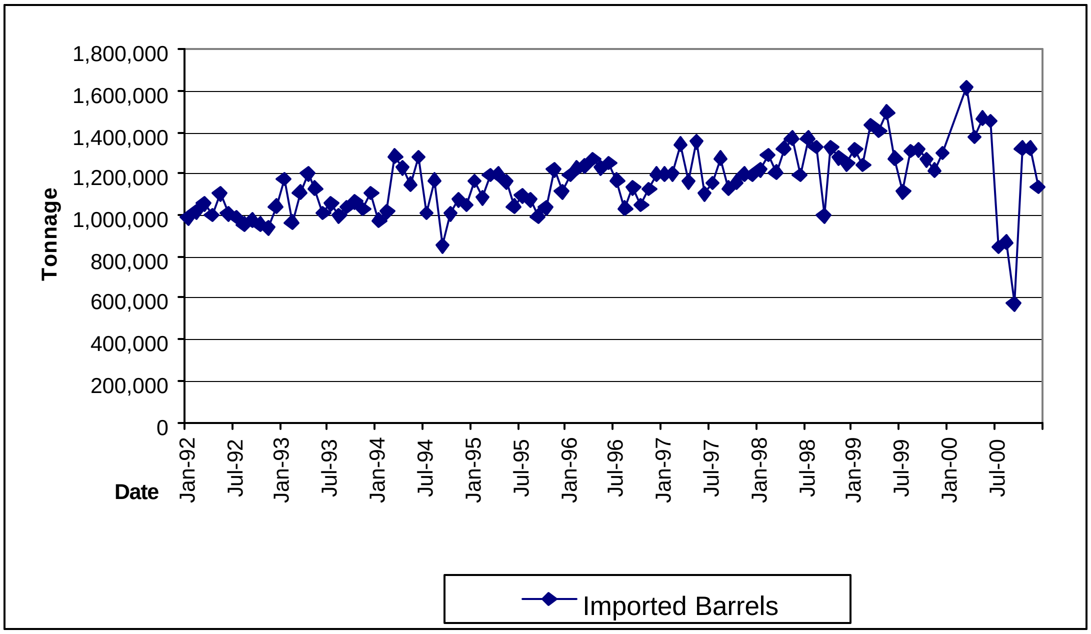


Figure 6.34 Port of Tampa Monthly Historical Data Trend (Barrels)

Date	Imported Tons	Imported Barrels	Exported Tons
Jan-92	1,622,529	988,090	1,942,879
Feb-92	1,400,536	1,016,973	1,802,580
Mar-92	1,245,750	1,054,396	1,754,848
Apr-92	1,115,523	998,551	1,685,349
May-92	1,374,139	1,104,235	1,942,435
Jun-92	1,315,479	1,006,404	1,919,910
Jul-92	1,296,630	991,299	1,594,178
Aug-92	1,077,975	954,301	1,660,459
Sep-92	1,281,542	972,028	1,741,465
Oct-92	1,276,360	956,101	1,469,098
Nov-92	1,042,128	937,910	1,682,744
Dec-92	1,328,821	1,041,002	1,950,640
Jan-93	1,298,514	1,172,768	1,672,436
Feb-93	1,163,430	965,320	1,550,727
Mar-93	1,181,886	1,107,817	1,625,557
Apr-93	1,458,413	1,198,589	1,698,709
May-93	1,397,699	1,129,021	1,688,789
Jun-93	1,279,535	1,008,682	1,649,074
Jul-93	1,286,940	1,055,029	1,630,851
Aug-93	1,264,637	996,504	1,418,596
Sep-93	1,384,197	1,039,392	1,369,986
Oct-93	1,373,194	1,065,573	1,396,013
Nov-93	1,145,421	1,028,055	1,563,338
Dec-93	1,388,905	1,105,221	1,623,097
Jan-94	1,112,750	973,967	1,810,686
Feb-94	1,080,537	1,016,359	1,782,017
Mar-94	1,391,865	1,284,000	1,825,070
Apr-94	1,475,690	1,228,437	1,658,111
May-94	1,562,978	1,148,746	1,854,264
Jun-94	1,312,286	1,279,168	1,849,537
Jul-94	1,288,576	1,009,390	1,790,977
Aug-94	1,370,420	1,167,640	1,509,468
Sep-94	1,298,584	851,309	1,606,883
Oct-94	1,214,516	1,006,480	1,442,584
Nov-94	1,199,195	1,074,395	1,802,203
Dec-94	1,601,022	1,048,846	2,012,906

Date	Imported Tons	Imported Barrels	Exported Tons
Jan-95	1,363,734	1,163,082	2,139,192
Feb-95	1,375,548	1,083,635	1,652,382
Mar-95	1,468,327	1,191,939	1,905,614
Apr-95	1,607,364	1,196,671	1,631,054
May-95	1,560,718	1,160,679	2,069,976
Jun-95	1,220,866	1,042,201	1,718,121
Jul-95	1,691,809	1,094,877	1,708,697
Aug-95	1,067,129	1,072,358	1,506,967
Sep-95	1,507,433	994,361	1,802,663
Oct-95	1,414,584	1,035,457	1,789,945
Nov-95	1,292,552	1,219,859	1,793,544
Dec-95	1,311,848	1,112,536	1,803,478
Jan-96	1,261,353	1,192,986	1,639,500
Feb-96	1,192,438	1,225,929	1,797,886
Mar-96	1,313,525	1,236,288	1,817,839
Apr-96	1,542,552	1,268,653	1,824,602
May-96	1,678,450	1,227,179	1,758,886
Jun-96	1,536,676	1,252,536	1,814,722
Jul-96	1,458,716	1,165,219	1,680,282
Aug-96	1,418,889	1,033,008	1,642,312
Sep-96	1,415,827	1,131,149	1,588,424
Oct-96	1,450,834	1,047,512	1,507,591
Nov-96	1,322,983	1,124,438	1,531,897
Dec-96	1,630,890	1,195,547	1,605,363
Jan-97	1,647,555	1,197,019	1,765,902
Feb-97	1,474,959	1,198,108	1,297,712
Mar-97	1,657,385	1,339,543	1,791,315
Apr-97	1,141,008	1,159,963	1,428,884
May-97	1,577,950	1,355,093	1,733,357
Jun-97	1,528,715	1,102,121	1,753,378
Jul-97	1,427,307	1,154,074	1,556,261
Aug-97	1,617,518	1,273,527	1,280,441
Sep-97	1,379,225	1,127,878	1,184,168
Oct-97	1,424,042	1,157,790	1,285,215
Nov-97	1,511,410	1,195,289	1,318,713
Dec-97	1,846,642	1,192,643	1,519,752

Date	Imported Tons	Imported Barrels	Exported Tons
Jan-98	1,477,371	1,220,173	1,616,232
Feb-98	1,270,074	1,291,262	1,350,963
Mar-98	1,440,694	1,205,511	1,504,412
Apr-98	1,393,973	1,322,450	1,631,255
May-98	1,759,593	1,369,049	1,625,710
Jun-98	1,639,822	1,192,468	1,664,425
Jul-98	1,617,565	1,368,658	1,779,764
Aug-98	1,485,425	1,329,032	1,621,974
Sep-98	1,174,566	997,793	1,021,058
Oct-98	1,821,131	1,326,620	1,579,711
Nov-98	1,536,772	1,274,706	1,406,589
Dec-98	1,492,445	1,249,644	1,915,540
Jan-99	1,578,160	1,313,563	1,525,441
Feb-99	1,288,244	1,241,183	1,422,694
Mar-99	1,456,484	1,434,430	1,615,541
Apr-99	1,616,056	1,405,849	1,521,229
May-99	1,451,092	1,495,621	1,414,803
Jun-99	1,328,500	1,271,281	1,634,046
Jul-99	1,409,744	1,111,945	1,584,901
Aug-99	1,909,477	1,308,856	1,469,494
Sep-99	1,547,938	1,313,555	1,218,702
Oct-99	1,562,496	1,267,447	1,315,905
Nov-99	1,104,758	1,214,707	1,063,128
Dec-99	1,494,889	1,300,556	1,173,930
Jan-00	N/A	N/A	N/A
Feb-00	N/A	N/A	N/A
Mar-00	1,616,501	1,613,847	1,380,063
Apr-00	1,707,594	1,377,782	1,037,510
May-00	1,399,010	1,466,091	1,465,465
Jun-00	1,512,088	1,452,401	1,451,684
Jul-00	1,411,917	843,896	985,315
Aug-00	855,973	868,658	546,234
Sep-00	1,099,622	573,041	1,033,531
Oct-00	1,300,707	1,322,851	1,113,765
Nov-00	1,391,703	1,322,700	1,045,104
Dec-00	1,174,014	1,135,106	886,069

Table 6.15 Port of Tampa Monthly Historical Data

6.4.2 Port of Tampa Forecasting Models

Because the Port of Tampa data was very detailed, no calculations were required before developing the models. The following sections describe the three individual forecasting models developed for the Port of Tampa including the equations and variables used in the models.

6.4.2.1 Port of Tampa Imported Tons

Let IMT_m be the total tons imported by the Port of Tampa in month "m" and, then

$IMT_m = 0.337414E+11 + 0.3299\ IMT_{m-1} + 0.1748\ IMT_{m-2} + 0.1231\ IMT_{m-3} + 0.0938\ IMT_{m-4} + 0.2784\ IMT$

A total of 107 points for the monthly imported tons were used in developing this model. The time series model for the total number of imported tons handled by the Port of Tampa for this month (IMT_m) is function of the total number of imported tons in the last month (IMT_{m-1}), two months ago (IMT_{m-2}), three months ago (IMT_{m-3}), four months ago (IMT_{m-4}) and five months ago (IMT_{m-5}).

The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.35. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to its standard error limits (the dashed lines) as shown by the plot on the right of Figure 6.35. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.7409 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.36 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.

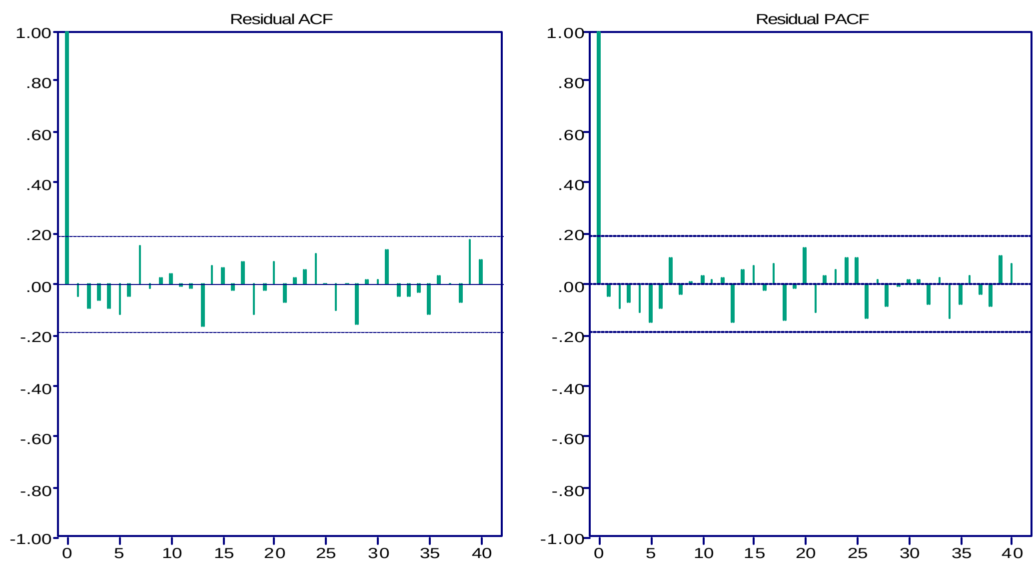


Figure 6.35 Port of Tampa Imported Tons Forecast Model Residuals

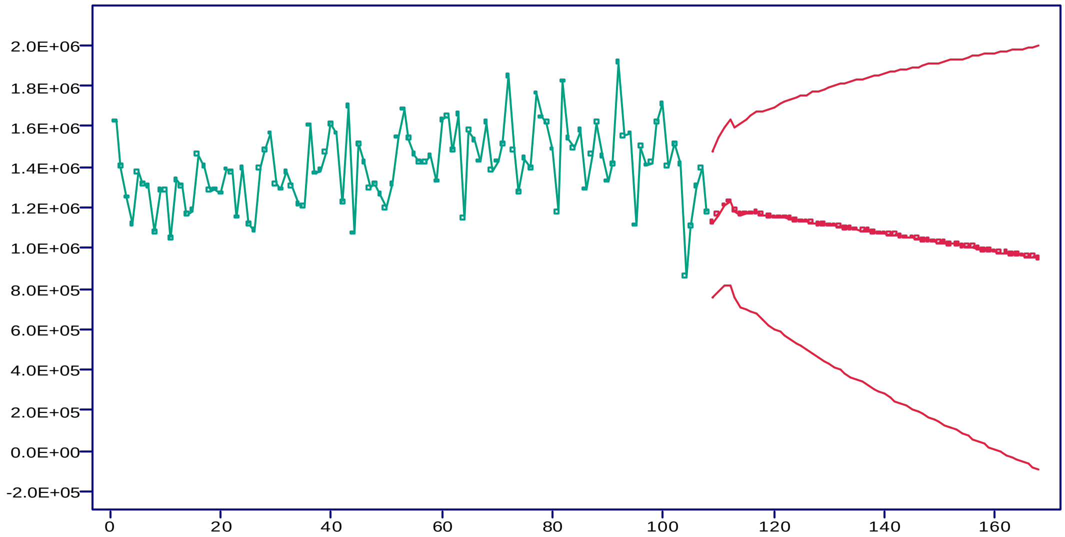


Figure 6.36 Port of Tampa 5 Year Forecast for Imported Tons

6.4.2.2 Port of Tampa Imported Barrels

Let EXB_m be the total number of barrels imported by the Port of Tampa in month "m" and, then

$$EXB_m = 0.1446E+11 + 0.3745\ EXB_{m-1} + 0.1291\ EXB_{m-2} - 0.0174\ EXB_{m-3} - 0.1023\ EXB_{m-4} + 0.1707\ EXB_{m-5} - 0.1114\ EXB_{m-6} + 0.1289\ EXB_{m-7} + 0.2885\ EXB_{m-8} - 0.0385\ EXB_{m-9} + 0.1058\ EXB_{m-10}$$

A total of 105 points for the monthly imported barrels were used in developing this model. The time series model for the total number of imported barrels handled by the Port of Tampa for this month (EXB_m) is function of the total imported barrels in the last month (EXB_{m-1}), two months ago (EXB_{m-2}), three months ago (EXB_{m-3}), four months ago (EXB_{m-4}), five months ago (EXB_{m-5}), six months ago (EXB_{m-6}), seven months ago (EXB_{m-7}), eight months ago (EXB_{m-8}), nine months ago (EXB_{m-9}) and ten months ago (EXB_{m-10}).

The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.37. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to its standard error limits (the dashed lines) as shown by the plot on the right of Figure 6.37. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.6596 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.38 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.

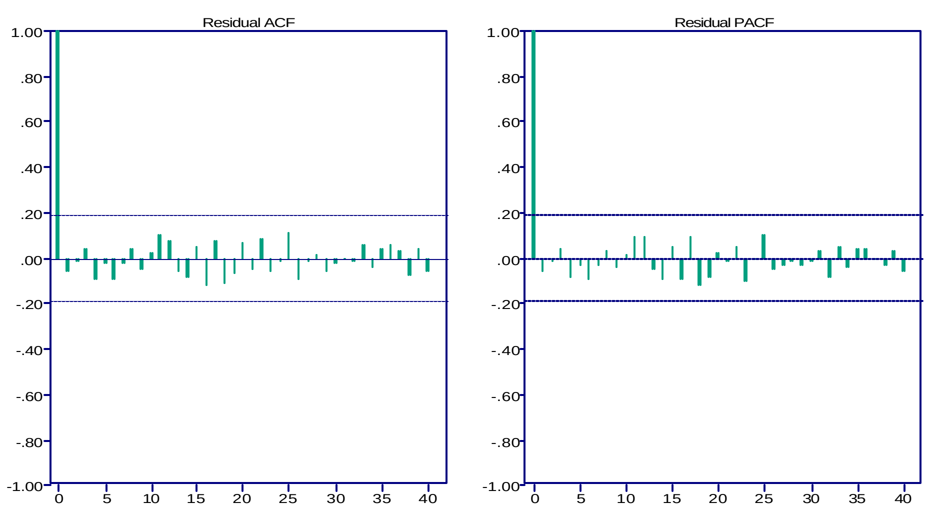


Figure 6.37 Port of Tampa Imported Barrels Forecast Model Residuals

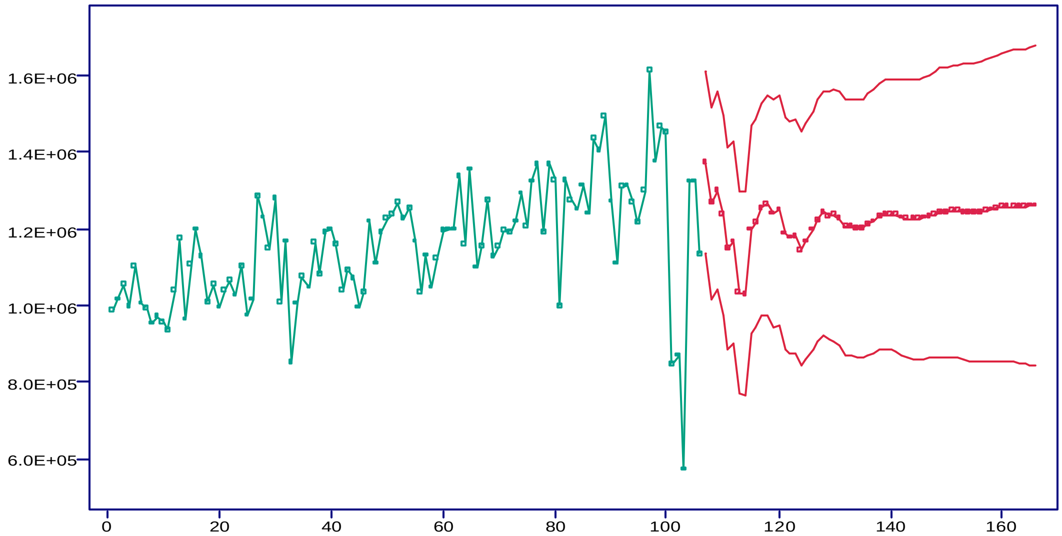


Figure 6.38 Port of Tampa 5 Year Forecast for Imported Barrels

6.4.2.3 Port of Tampa Exported Tons

Let EXT_m be the total exported tons handled by the Port of Tampa in month "m" and Ln be the natural logarithm function, then

$$Ln(EXT_m) = 0.0200 + 0.5245\, Ln(EXT_{m-1}) + 0.0835\, Ln(EXT_{m-2}) - 0.0226\, Ln(EXT_{m-3}) - 0.4146(Ln(EXT_{m-3}) - Ln(EXT_{m-4}))$$

A total of 107 points for the monthly exported tons were used in developing this model. The time series model for exported tons indicates that the exported tons for this month (EXT_m) is a natural logarithm function of the exported tons in the last month (EXT_{m-1}), two months ago (EXT_{m-2}), three months ago (EXT_{m-3}) and four months ago ($EXEA_{m-4}$). The auto-correlation residual plot showed that all Residual Auto-Correlation Functions (ACF) fall within the two standard error limits (the dashed lines) as shown by the plot on the left of Figure 6.39. The Residual Partial Auto-Correlation Functions (PACF) for the developed models showed that each residual partial auto-correlation was small relative to its standard error limits (the dashed lines) as shown by the plot on the right of Figure

6.39. This suggested that the developed models adequately represent the auto correlation pattern in the data.

A Chi-Square statistical test for the first twenty residuals produced a p-value = 0.2081 which is compared to 0.05 for a 95% confidence level. This comparison concludes the model has captured the auto-correlation pattern thus proving the model provides a good representation of the data.

Figure 6.40 shows a model generated forecast of the data. The normal line with unshaded points represents the historical data and the dark line with shaded points represents the forecasted values that fall between the upper and lower limits as shown for the desired 95% confidence level.

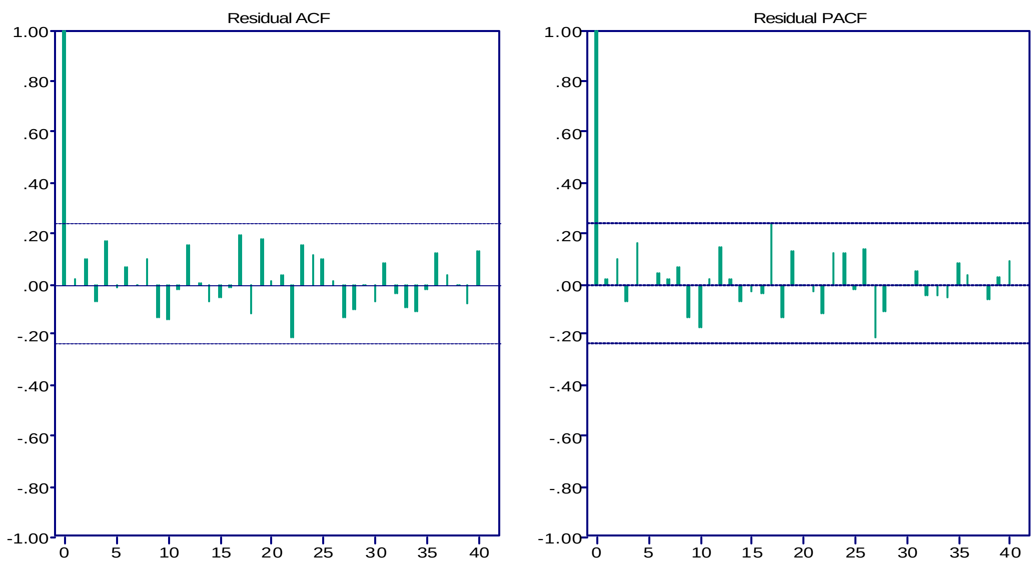


Figure 6.39 Port of Tampa Exported Tons Forecast Model Residuals

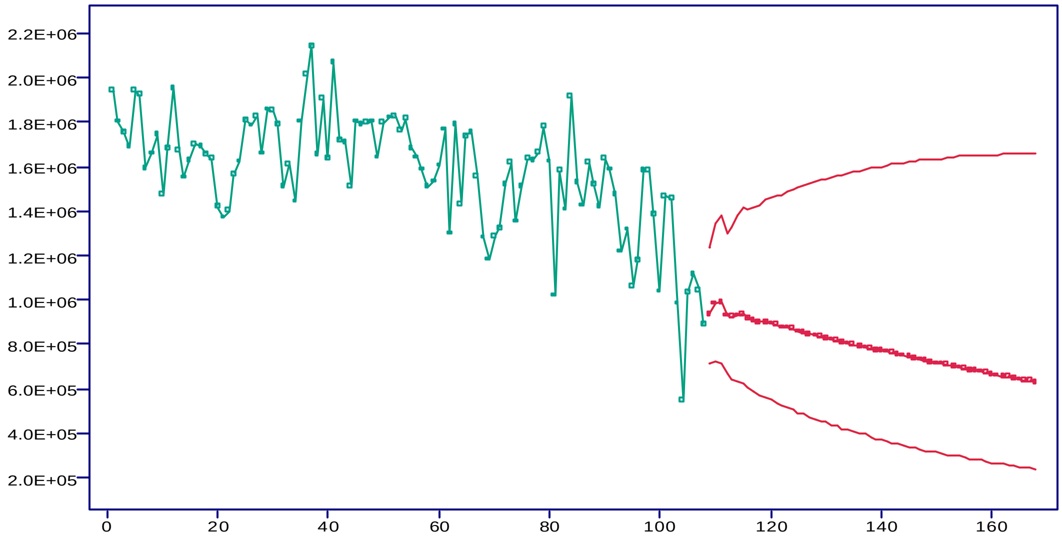


Figure 6.40 Port of Tampa 5 Year Forecast for Exported Tons

6.4.3 Port of Tampa Analysis of Forecasting Results

The predicted values produced by the Port of Tampa forecasting model were used to determine the input variables for the developed Port of Tampa ANN Model. The predicted values are listed in Table 6.16. The predicted values are the same fields required to compute the input for the developed Port of Tampa ANN model for generating truck counts. These are the values used to predict future truck volumes on the access roads at the port (see Section 4.1.3 for a description). Figures 6.41 to 6.42 show the trends for the historical and predicted vessel data from January 1992 to December 2005. From the base year 2000 the trend indicates that by year 2005, the imported tons is expected The trend indicates imported tons is expected to *decrease* by 25%. The imported barrels is expected to increase by 16%. The exported tons is expected to *decrease* by 36%. Figure 6.43 shows a graphical representation of this.

Date	Imported Tons	Imported Barrels	Exported Tons
Jan-01	1,203,100	1,423,400	936,820
Feb-01	1,217,800	1,271,800	982,760
Mar-01	1,132,200	1,303,600	989,760
Apr-01	1,190,500	1,215,100	930,270
May-01	1,204,100	1,130,700	921,100
Jun-01	1,224,500	1,160,000	929,730
Jul-01	1,181,900	995,360	937,580
Aug-01	1,166,500	1,028,300	918,750
Sep-01	1,174,800	1,219,800	905,740
Oct-01	1,157,900	1,233,700	900,770
Nov-01	1,169,900	1,282,000	900,660
Dec-01	1,165,600	1,281,300	892,930
Jan-02	1,164,200	1,250,600	883,760
Feb-02	1,154,200	1,242,400	876,370
Mar-02	1,144,900	1,156,000	871,880
Apr-02	1,145,300	1,162,100	866,030
May-02	1,139,100	1,167,600	859,090
Jun-02	1,138,600	1,133,200	852,110
Jul-02	1,133,900	1,174,600	846,240
Aug-02	1,129,300	1,211,100	840,400
Sep-02	1,124,600	1,244,300	834,240
Oct-02	1,118,900	1,260,200	827,870
Nov-02	1,116,100	1,241,000	821,810
Dec-02	1,111,600	1,239,400	815,920
Jan-03	1,108,100	1,214,500	810,010
Feb-03	1,103,800	1,186,900	804,020
Mar-03	1,099,200	1,192,100	798,100
Apr-03	1,095,100	1,192,500	792,290
May-03	1,090,600	1,202,000	786,530
Jun-03	1,086,700	1,217,000	780,770
Jul-03	1,082,500	1,230,200	775,050
Aug-03	1,078,400	1,247,000	769,380
Sep-03	1,074,200	1,245,100	763,760
Oct-03	1,069,900	1,238,800	758,180
Nov-03	1,065,700	1,234,200	752,630
Dec-03	1,061,500	1,222,000	747,130

Date	Imported Tons	Imported Barrels	Exported Tons
Jan-04	1,057,400	1,216,800	741,670
Feb-04	1,053,200	1,217,600	736,250
Mar-04	1,049,000	1,222,900	730,870
Apr-04	1,044,800	1,232,200	725,520
May-04	1,040,600	1,238,400	720,220
Jun-04	1,036,400	1,245,700	714,950
Jul-04	1,032,200	1,250,100	709,730
Aug-04	1,028,000	1,248,200	704,540
Sep-04	1,023,800	1,245,800	699,390
Oct-04	1,019,600	1,242,100	694,270
Nov-04	1,015,500	1,239,300	689,200
Dec-04	1,011,300	1,239,100	684,160
Jan-05	1,007,100	1,240,900	679,160
Feb-05	1,002,900	1,245,900	674,190
Mar-05	998,680	1,250,900	669,260
Apr-05	994,490	1,254,700	664,370
May-05	990,300	1,258,000	659,510
Jun-05	986,110	1,259,000	654,690
Jul-05	981,910	1,258,600	649,900
Aug-05	977,720	1,257,600	645,150
Sep-05	973,530	1,256,600	640,440
Oct-05	969,340	1,257,000	635,750
Nov-05	965,150	1,258,200	631,110
Dec-05	960,960	1,260,600	626,490

Table 6.16 Port of Tampa Predicted Vessel Data

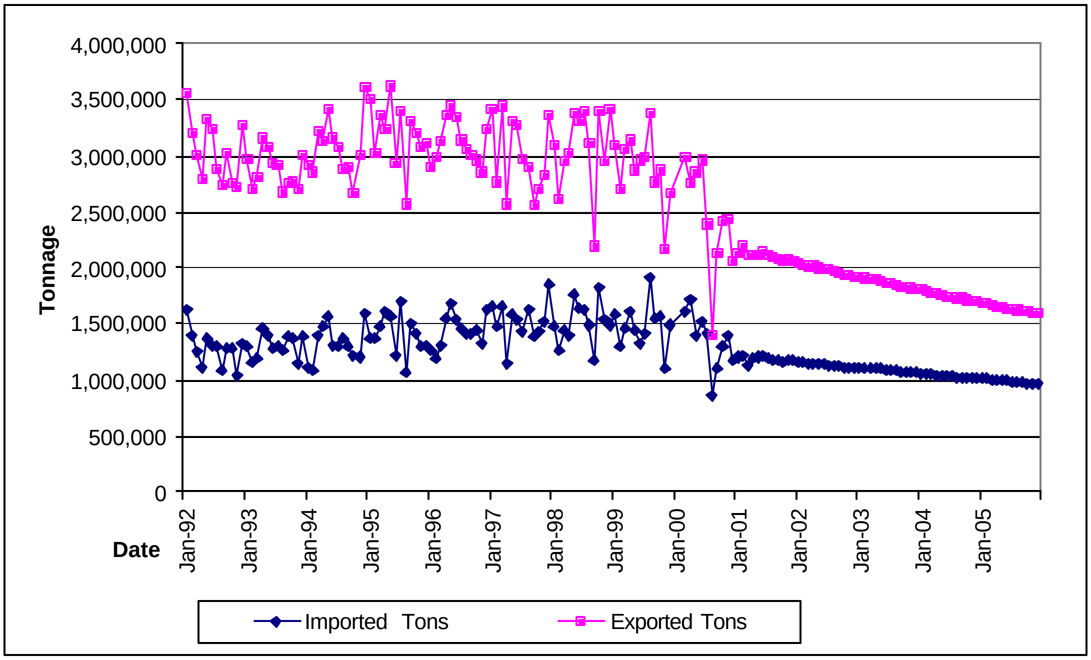


Figure 6.41 Port of Tampa Vessel Data Trends (Tons)

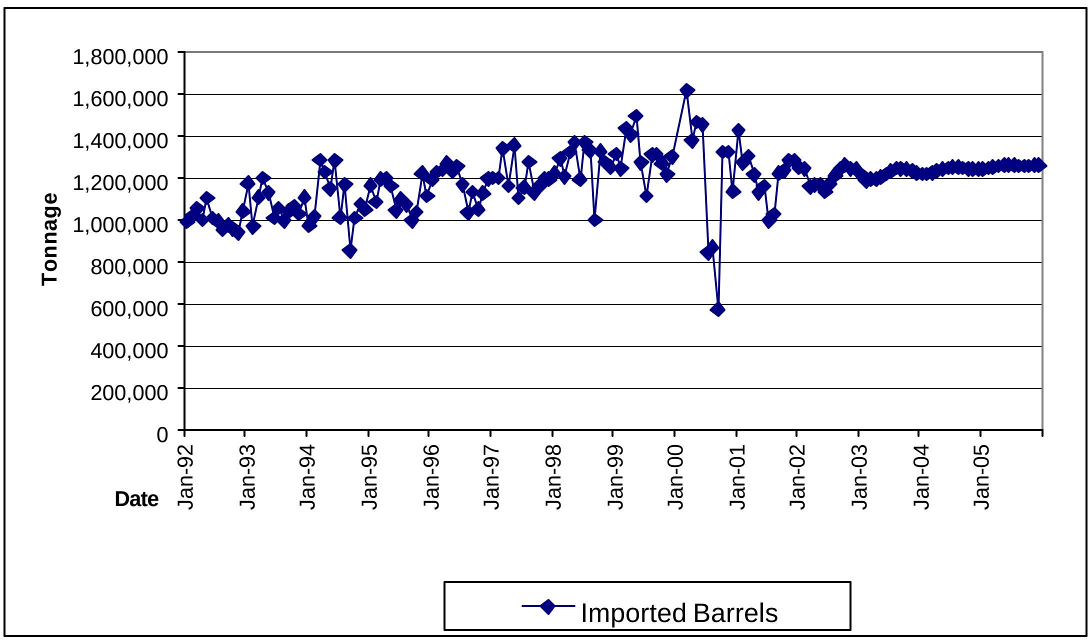


Figure 6.42 Port of Tampa Vessel Data Trends (Barrels)

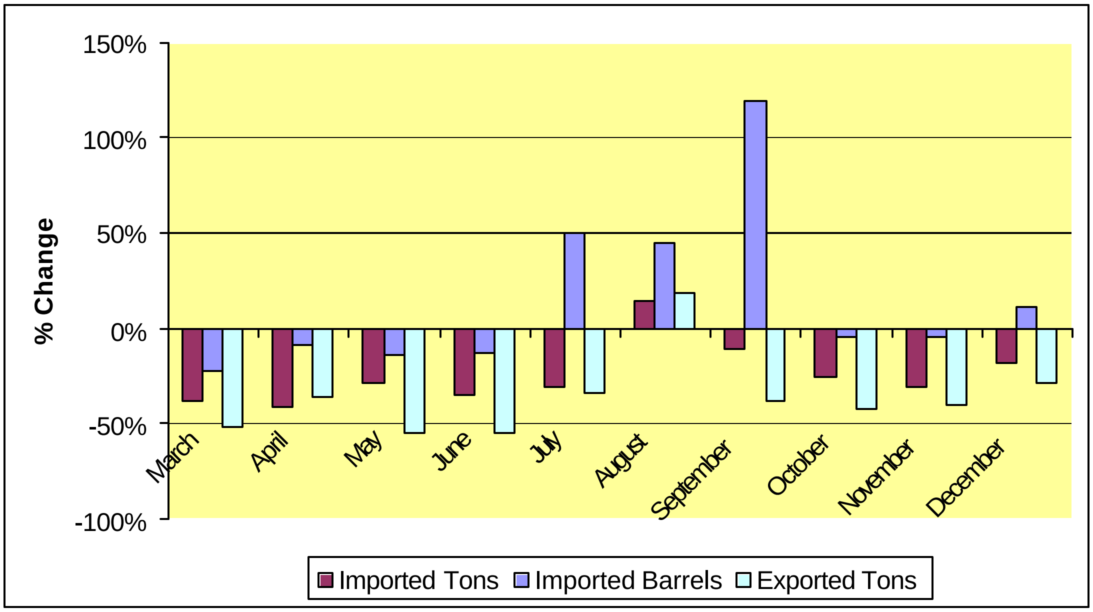


Figure 6.43 Port of Tampa Percent Change of Forecasted Freight Input Variables (Year 2000 - 2005)

The previously developed ANN truck trip generation model for the Port of Tampa was used to produce truck volumes for the available vessel freight data. The model output is displayed in Tables 6.17 to 6.26. The dates are related to the month, day of the week, and year. The day of the week was numbered sequentially 01-07 for Monday to Saturday for ease of interpretation. Figure 6.44 shows the trend for inbound and outbound trucks at the port including data collected in the field for year 2000. Weekends were excluded in the graph because of the high variation compared to the weekdays. The field data is available in Tables F.1 and F.2 Appendix F. From the base year 2000 the forecasting results indicates that by year 2005, trucks are expected to *decrease* by 3% for daily inbound trucks and 4% for daily outbound trucks from a comparison of base year 2000 and forecasted year 2005. Figure 6.45 shows the average annual weekday truck volumes for present and future estimates. The future estimates are based on the output from the ANN model.

Dates	Inbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point	Dates	Inbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point
10101	4170	1197	532	1865	348	226	70101	4442	1276	567	1987	371	241
10201	4202	1207	537	1880	351	228	70201	4426	1271	565	1980	370	240
10301	4204	1207	537	1881	351	228	70301	4375	1256	559	1957	365	237
10401	4196	1205	536	1877	350	227	70401	4255	1222	543	1904	355	231
10501	4241	1218	542	1898	354	230	70501	4355	1251	556	1948	364	236
10601	2187	628	279	979	183	119	70601	2187	628	279	979	183	119
10701	1566	450	200	701	131	85	70701	1566	450	200	701	131	85
20101	4188	1203	535	1874	350	227	80101	4267	1225	545	1909	356	231
20201	4270	1226	545	1911	357	231	80201	4322	1241	552	1934	361	234
20301	4329	1243	553	1937	361	235	80301	4474	1285	571	2002	374	242
20401	4375	1257	559	1957	365	237	80401	4421	1270	565	1978	369	240
20501	4395	1262	561	1966	367	238	80501	4388	1260	560	1963	366	238
20601	2187	628	279	979	183	119	80601	2187	628	279	979	183	119
20701	1566	450	200	701	131	85	80701	1566	450	200	701	131	85
30101	4159	1195	531	1861	347	225	90101	4045	1162	517	1810	338	219
30201	4171	1198	533	1866	348	226	90201	4085	1173	522	1828	341	221
30301	4155	1193	531	1859	347	225	90301	3953	1135	505	1769	330	214
30401	4261	1224	544	1907	356	231	90401	3987	1145	509	1784	333	216
30501	4062	1167	519	1817	339	220	90501	4031	1158	515	1803	337	218
30601	2187	628	279	979	183	119	90601	2187	628	279	979	183	119
30701	1566	450	200	701	131	85	90701	1566	450	200	701	131	85
40101	4132	1187	528	1849	345	224	100101	4072	1169	520	1822	340	221
40201	4362	1253	557	1952	364	236	100201	4113	1181	525	1840	343	223
40301	4315	1239	551	1930	360	234	100301	4336	1245	554	1940	362	235
40401	3973	1141	507	1777	332	215	100401	4398	1263	562	1968	367	238
40501	4110	1180	525	1839	343	223	100501	4411	1267	563	1973	368	239
40601	2187	628	279	979	183	119	100601	2187	628	279	979	183	119
40701	1566	450	200	701	131	85	100701	1566	450	200	701	131	85
50101	4195	1205	536	1877	350	227	110101	3934	1130	502	1760	329	213
50201	4339	1246	554	1941	362	235	110201	3997	1148	510	1788	334	217
50301	4484	1288	573	2006	374	243	110301	4161	1195	531	1862	347	226
50401	4459	1281	569	1995	372	242	110401	4203	1207	537	1880	351	228
50501	4444	1276	568	1988	371	241	110501	4058	1165	518	1815	339	220
50601	2187	628	279	979	183	119	110601	2187	628	279	979	183	119
50701	1566	450	200	701	131	85	110701	1566	450	200	701	131	85
60101	4268	1226	545	1910	356	231	120101	4079	1171	521	1825	341	221
60201	4037	1159	515	1806	337	219	120201	4072	1169	520	1822	340	221
60301	4003	1150	511	1791	334	217	120301	3959	1137	506	1771	331	215
60401	4160	1195	531	1861	347	225	120401	3953	1135	505	1768	330	214
60501	4096	1176	523	1833	342	222	120501	4103	1178	524	1836	343	222
60601	2187	628	279	979	183	119	120601	2187	628	279	979	183	119
60701	1566	450	200	701	131	85	120701	1566	450	200	701	131	85

Table 6.17 Port of Tampa Predicted Inbound Truck Volumes for Year 2001 (Model Output)

Dates	Outbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point
10101	3979	931	590	1716	383	359
10201	3990	934	591	1721	384	359
10301	4106	961	608	1771	395	370
10401	4135	968	613	1784	398	373
10501	4137	968	613	1784	398	373
10601	2128	498	315	918	205	192
10701	1170	274	173	504	113	105
20101	4144	970	614	1787	399	373
20201	4115	963	610	1775	396	371
20301	3772	883	559	1627	363	340
20401	3795	888	562	1637	365	342
20501	3796	888	563	1637	365	342
20601	1851	433	274	798	178	167
20701	882	206	131	380	85	79
30101	3792	887	562	1635	365	342
30201	3795	888	562	1637	365	342
30301	4061	950	602	1752	391	366
30401	4085	956	605	1762	393	368
30501	4071	953	603	1756	392	367
30601	1791	419	265	772	172	161
30701	1209	283	179	522	116	109
40101	4114	963	610	1774	396	371
40201	4113	963	610	1774	396	371
40301	4096	958	607	1767	394	369
40401	4129	966	612	1781	397	372
40501	4143	969	614	1787	399	373
40601	2014	471	298	869	194	181
40701	773	181	115	333	74	70
50101	4025	942	597	1736	387	363
50201	4050	948	600	1747	390	365
50301	4011	939	594	1730	386	361
50401	4040	945	599	1743	389	364
50501	4142	969	614	1786	398	373
50601	1502	352	223	648	145	135
50701	1159	271	172	500	112	104
60101	4132	967	612	1782	397	372
60201	4138	968	613	1785	398	373
60301	3845	900	570	1658	370	346
60401	4062	950	602	1752	391	366
60501	3715	869	551	1602	357	335
60601	1808	423	268	780	174	163
60701	1344	314	199	580	129	121
70101	4026	942	597	1736	387	363
70201	3769	882	559	1626	363	340
70301	4114	963	610	1775	396	371
70401	3853	902	571	1662	371	347
70501	3932	920	583	1696	378	354
70601	1917	449	284	827	184	173
70701	773	181	115	333	74	70
80101	4082	955	605	1761	393	368
80201	4036	945	598	1741	388	364
80301	4032	944	598	1739	388	363
80401	4045	947	600	1745	389	364
80501	3865	904	573	1667	372	348
80601	1458	341	216	629	140	131
80701	1169	274	173	504	112	105
90101	4106	961	609	1771	395	370
90201	4115	963	610	1775	396	371
90301	4095	958	607	1766	394	369
90401	4135	967	613	1783	398	373
90501	4027	942	597	1737	387	363
90601	2022	473	300	872	194	182
90701	1776	416	263	766	171	160
100101	3995	935	592	1723	384	360
100201	3986	933	591	1719	383	359
100301	4084	956	605	1761	393	368
100401	4101	960	608	1769	394	369
100501	4101	960	608	1769	395	370
100601	1526	357	226	658	147	138
100701	1170	274	173	505	113	105
110101	4090	957	606	1764	393	368
110201	4111	962	609	1773	395	370
110301	3971	929	589	1713	382	358
110401	4025	942	596	1736	387	363
110501	4118	964	610	1776	396	371
110601	2115	495	313	912	203	191
110701	1789	419	265	772	172	161
120101	4111	962	609	1773	395	370
120201	4107	961	609	1771	395	370
120301	4086	956	606	1762	393	368
120401	4116	963	610	1775	396	371
120501	3997	935	592	1724	385	360
120601	2001	468	296	863	192	180
120701	1170	274	173	505	113	105

Table 6.18 Port of Tampa Predicted Outbound Truck Volumes for Year 2001 (Model Output)

Dates	Inbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point	Dates	Inbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point
10102	4218	1211	539	1887	352	229	70102	4267	1225	545	1909	356	231
10202	4232	1215	540	1893	353	229	70202	4263	1224	544	1907	356	231
10302	4281	1229	547	1915	357	232	70302	4277	1228	546	1913	357	232
10402	4279	1229	546	1914	357	232	70402	4302	1236	549	1925	359	233
10502	4266	1225	545	1909	356	231	70502	4222	1213	539	1889	353	229
10602	2229	640	285	997	186	121	70602	2132	612	272	954	178	116
10702	2066	593	264	924	172	112	70702	1869	537	239	836	156	101
20102	4203	1207	537	1881	351	228	80102	4261	1224	544	1906	356	231
20202	4236	1217	541	1895	354	230	80202	4213	1210	538	1885	352	228
20302	4186	1202	535	1873	349	227	80302	4217	1211	538	1887	352	229
20402	4161	1195	531	1862	347	226	80402	4230	1215	540	1893	353	229
20502	4232	1215	540	1893	353	229	80502	4169	1197	532	1865	348	226
20602	2244	645	287	1004	187	122	80602	2045	587	261	915	171	111
20702	2202	633	281	985	184	119	80702	1976	568	252	884	165	107
30102	4148	1191	530	1856	346	225	90102	4291	1232	548	1920	358	233
30202	4176	1199	533	1868	349	226	90202	4237	1217	541	1896	354	230
30302	4181	1201	534	1871	349	227	90302	4264	1225	545	1908	356	231
30402	4169	1197	532	1865	348	226	90402	4272	1227	546	1911	357	232
30502	4177	1200	533	1869	349	226	90502	4259	1223	544	1905	356	231
30602	2019	580	258	903	169	109	90602	2202	633	281	985	184	119
30702	1648	473	210	737	138	89	90702	1681	483	215	752	140	91
40102	4278	1229	546	1914	357	232	100102	4207	1208	537	1882	351	228
40202	4284	1230	547	1917	358	232	100202	4192	1204	535	1875	350	227
40302	4303	1236	549	1925	359	233	100302	4279	1229	546	1914	357	232
40402	4289	1232	548	1919	358	232	100402	4299	1235	549	1924	359	233
40502	4235	1216	541	1895	354	230	100502	4255	1222	543	1904	355	231
40602	2156	619	275	964	180	117	100602	2200	632	281	984	184	119
40702	1863	535	238	834	156	101	100702	1970	566	252	881	164	107
50102	4230	1215	540	1893	353	229	110102	4240	1218	541	1897	354	230
50202	4188	1203	535	1874	350	227	110202	4234	1216	541	1895	354	230
50302	4234	1216	541	1894	354	229	110302	4249	1220	543	1901	355	230
50402	4255	1222	543	1904	355	231	110402	4185	1202	534	1873	349	227
50502	4166	1196	532	1864	348	226	110502	4193	1204	535	1876	350	227
50602	2172	624	277	972	181	118	110602	2041	586	261	913	170	111
50702	1921	552	245	859	160	104	110702	2039	586	260	912	170	111
60102	4250	1220	543	1901	355	230	120102	4281	1230	547	1915	357	232
60202	4206	1208	537	1882	351	228	120202	4271	1227	545	1911	357	231
60302	4290	1232	548	1919	358	233	120302	4288	1231	548	1918	358	232
60402	4243	1219	542	1898	354	230	120402	4295	1233	548	1921	359	233
60502	4223	1213	539	1889	353	229	120502	4241	1218	542	1897	354	230
60602	2017	579	258	902	168	109	120602	2201	632	281	985	184	119
60702	1587	456	203	710	133	86	120702	1603	460	205	717	134	87

Table 6.19 Port of Tampa Predicted Inbound Truck Volumes for Year 2002 (Model Output)

Dates	Outbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point	Dates	Outbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point
10102	3613	845	535	1558	348	326	70102	4247	994	629	1832	409	383
10202	4124	965	611	1779	397	372	70202	4253	995	630	1834	409	383
10302	4245	993	629	1831	408	382	70302	4222	988	626	1821	406	380
10402	4267	998	632	1840	410	384	70402	3907	914	579	1685	376	352
10502	4220	987	625	1820	406	380	70502	4099	959	607	1768	394	369
10602	1437	336	213	620	138	129	70602	1406	329	208	606	135	127
10702	1378	322	204	594	133	124	70702	1378	322	204	594	133	124
20102	3494	818	518	1507	336	315	80102	3646	853	540	1573	351	329
20202	3306	774	490	1426	318	298	80202	3325	778	493	1434	320	300
20302	3793	887	562	1636	365	342	80302	4112	962	609	1773	396	370
20402	3535	827	524	1524	340	318	80402	4262	997	632	1838	410	384
20502	4234	991	627	1826	407	381	80502	3544	829	525	1529	341	319
20602	1444	338	214	623	139	130	80602	1386	324	205	598	133	125
20702	1378	322	204	594	133	124	80702	1378	322	204	594	133	124
30102	3797	889	563	1638	365	342	90102	4267	998	632	1840	410	384
30202	3364	787	499	1451	324	303	90202	3310	775	491	1428	318	298
30302	4102	960	608	1769	395	370	90302	3869	905	573	1669	372	349
30402	4068	952	603	1754	391	366	90402	3610	845	535	1557	347	325
30502	3486	816	517	1504	335	314	90502	4193	981	621	1808	403	378
30602	1382	323	205	596	133	125	90602	1411	330	209	608	136	127
30702	1378	322	204	594	133	124	90702	1378	322	204	594	133	124
40102	4239	992	628	1828	408	382	100102	3614	846	536	1559	348	326
40202	4213	986	624	1817	405	380	100202	4119	964	610	1777	396	371
40302	4133	967	613	1783	398	372	100302	4242	993	629	1830	408	382
40402	3931	920	583	1695	378	354	100402	4269	999	633	1841	411	385
40502	4101	960	608	1769	394	369	100502	4193	981	621	1808	403	378
40602	1407	329	209	607	135	127	100602	1427	334	211	615	137	129
40702	1378	322	204	594	133	124	100702	1378	322	204	594	133	124
50102	3796	888	563	1637	365	342	110102	3555	832	527	1533	342	320
50202	3429	802	508	1479	330	309	110202	3312	775	491	1429	319	298
50302	4195	982	622	1809	404	378	110302	3877	907	575	1672	373	349
50402	4237	991	628	1827	408	382	110402	3789	887	562	1634	365	341
50502	3659	856	542	1578	352	330	110502	3611	845	535	1557	347	325
50602	1409	330	209	608	136	127	110602	1387	325	206	598	133	125
50702	1378	322	204	594	133	124	110702	1378	322	204	594	133	124
60102	3968	929	588	1711	382	358	120102	4266	998	632	1840	410	384
60202	3433	803	509	1481	330	309	120202	4076	954	604	1758	392	367
60302	4193	981	621	1808	403	378	120302	3918	917	581	1690	377	353
60402	4026	942	597	1736	387	363	120402	3656	856	542	1577	352	329
60502	3977	931	589	1715	383	358	120502	4166	975	617	1797	401	375
60602	1381	323	205	596	133	124	120602	1406	329	208	606	135	127
60702	1378	322	204	594	133	124	120702	1378	322	204	594	133	124

Table 6.20 Port of Tampa Predicted Outbound Truck Volumes for Year 2002 (Model Output)

Dates	Inbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point	Dates	Inbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point
10103	4272	1227	545	1911	357	232	70103	4250	1221	543	1901	355	230
10203	4232	1215	540	1893	353	229	70203	4243	1218	542	1898	354	230
10303	4288	1231	548	1918	358	232	70303	4289	1232	548	1919	358	232
10403	4300	1235	549	1924	359	233	70403	4308	1237	550	1927	360	233
10503	4135	1188	528	1850	345	224	70503	4217	1211	539	1887	352	229
10603	2179	626	278	975	182	118	70603	2152	618	275	963	180	117
10703	1930	554	246	863	161	105	70703	1862	535	238	833	156	101
20103	4261	1224	544	1906	356	231	80103	4273	1227	546	1912	357	232
20203	4224	1213	539	1890	353	229	80203	4251	1221	543	1902	355	230
20303	4284	1230	547	1917	358	232	80303	4285	1231	547	1917	358	232
20403	4234	1216	541	1894	354	229	80403	4235	1216	541	1895	354	230
20503	4220	1212	539	1888	352	229	80503	4157	1194	531	1860	347	225
20603	2205	633	282	986	184	120	80603	2011	578	257	900	168	109
20703	2020	580	258	904	169	109	80703	1626	467	208	728	136	88
30103	4257	1223	544	1905	355	231	90103	4313	1239	551	1930	360	234
30203	4205	1208	537	1881	351	228	90203	4323	1242	552	1934	361	234
30303	4251	1221	543	1902	355	230	90303	4340	1247	554	1942	362	235
30403	4235	1216	541	1895	354	230	90403	4327	1243	553	1936	361	235
30503	4247	1220	542	1900	355	230	90503	4206	1208	537	1882	351	228
30603	1993	572	254	892	166	108	90603	2159	620	276	966	180	117
30703	1541	443	197	690	129	84	90703	1862	535	238	833	155	101
40103	4257	1222	544	1904	355	231	100103	4275	1228	546	1912	357	232
40203	4268	1226	545	1909	356	231	100203	4226	1214	540	1891	353	229
40303	4279	1229	546	1915	357	232	100303	4275	1228	546	1913	357	232
40403	4303	1236	550	1925	359	233	100403	4295	1234	548	1922	359	233
40503	4211	1209	538	1884	352	228	100503	4132	1187	528	1849	345	224
40603	2135	613	273	955	178	116	100603	2168	623	277	970	181	117
40703	1873	538	239	838	156	102	100703	1897	545	242	849	158	103
50103	4272	1227	546	1911	357	232	110103	4282	1230	547	1916	358	232
50203	4229	1215	540	1892	353	229	110203	4245	1219	542	1899	354	230
50303	4261	1224	544	1906	356	231	110303	4325	1242	552	1935	361	234
50403	4264	1225	545	1908	356	231	110403	4278	1229	546	1914	357	232
50503	4121	1184	526	1844	344	223	110503	4224	1213	539	1890	353	229
50603	2003	575	256	896	167	109	110603	2012	578	257	900	168	109
50703	1893	544	242	847	158	103	110703	1575	452	201	705	132	85
60103	4307	1237	550	1927	360	233	120103	4304	1236	550	1926	359	233
60203	4246	1219	542	1900	355	230	120203	4317	1240	551	1932	361	234
60303	4312	1239	551	1929	360	234	120303	4279	1229	546	1915	357	232
60403	4319	1240	552	1932	361	234	120403	4353	1250	556	1947	363	236
60503	4231	1215	540	1893	353	229	120503	4171	1198	533	1866	348	226
60603	2159	620	276	966	180	117	120603	2113	607	270	946	176	115
60703	1586	455	203	710	132	86	120703	1815	521	232	812	152	98

Table 6.21 Port of Tampa Predicted Inbound Truck Volumes for Year 2003 (Model Output)

Dates	Outbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point
10103	3668	858	544	1582	353	331
10203	3371	789	500	1454	324	304
10303	4192	981	621	1808	403	378
10403	4241	992	629	1829	408	382
10503	3653	855	541	1575	351	329
10603	1414	331	209	610	136	127
10703	1378	322	204	594	133	124
20103	3797	889	563	1638	365	342
20203	3360	786	498	1449	323	303
20303	4105	960	608	1770	395	370
20403	3871	906	574	1670	372	349
20503	4131	967	612	1782	397	372
20603	1412	330	209	609	136	127
20703	1378	322	204	594	133	124
30103	4273	1000	633	1843	411	385
30203	3349	784	496	1444	322	302
30303	4076	954	604	1758	392	367
30403	3846	900	570	1659	370	347
30503	4028	943	597	1737	387	363
30603	1382	323	205	596	133	124
30703	1378	322	204	594	133	124
40103	3962	927	587	1709	381	357
40203	4249	994	630	1833	409	383
40303	4220	987	625	1820	406	380
40403	3892	911	577	1679	374	351
40503	4091	957	606	1764	394	369
40603	1405	329	208	606	135	127
40703	1378	322	204	594	133	124
50103	3746	876	555	1615	360	337
50203	3346	783	496	1443	322	301
50303	4170	976	618	1799	401	376
50403	4243	993	629	1830	408	382
50503	3429	802	508	1479	330	309
50603	1384	324	205	597	133	125
50703	1378	322	204	594	133	124
60103	4268	999	633	1841	411	385
60203	3336	781	494	1439	321	301
60303	4042	946	599	1743	389	364
60403	3799	889	563	1638	365	342
60503	4128	966	612	1780	397	372
60603	1401	328	208	604	135	126
60703	1378	322	204	594	133	124
70103	3804	890	564	1641	366	343
70203	4211	985	624	1816	405	379
70303	4201	983	623	1812	404	378
70403	4266	998	632	1840	410	384
70503	4126	966	611	1780	397	372
70603	1411	330	209	608	136	127
70703	1378	322	204	594	133	124
80103	3593	841	532	1550	346	324
80203	3317	776	492	1431	319	299
80303	3924	918	582	1693	378	354
80403	3828	896	567	1651	368	345
80503	3538	828	524	1526	340	319
80603	1383	324	205	596	133	125
80703	1378	322	204	594	133	124
90103	4257	996	631	1836	410	384
90203	4118	964	610	1776	396	371
90303	3971	929	589	1713	382	358
90403	3713	869	550	1601	357	335
90503	4128	966	612	1780	397	372
90603	1413	331	209	609	136	127
90703	1378	322	204	594	133	124
100103	3626	848	537	1564	349	327
100203	3350	784	496	1445	322	302
100303	4215	986	625	1818	405	380
100403	4250	994	630	1833	409	383
100503	3638	851	539	1569	350	328
100603	1412	331	209	609	136	127
100703	1378	322	204	594	133	124
110103	3661	857	543	1579	352	330
110203	3327	779	493	1435	320	300
110303	4006	937	594	1728	385	361
110403	3739	875	554	1612	360	337
110503	4057	949	601	1750	390	366
110603	1382	323	205	596	133	125
110703	1378	322	204	594	133	124
120103	4247	994	629	1832	409	383
120203	4236	991	628	1827	408	382
120303	4216	987	625	1819	406	380
120403	3842	899	569	1657	370	346
120503	4078	954	604	1759	392	367
120603	1404	329	208	606	135	127
120703	1378	322	204	594	133	124

Table 6.22 Port of Tampa Predicted Outbound Truck Volumes for Year 2003 (Model Output)

Dates	Inbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point	Dates	Inbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point
10104	4313	1239	551	1930	360	234	70104	4312	1238	551	1929	360	234
10204	4259	1223	544	1905	356	231	70204	4262	1224	544	1907	356	231
10304	4331	1244	553	1938	362	235	70304	4304	1236	550	1925	359	233
10404	4303	1236	550	1925	359	233	70404	4298	1234	549	1923	359	233
10504	4080	1172	521	1825	341	221	70504	4076	1171	521	1824	340	221
10604	1958	562	250	876	163	106	70604	1948	559	249	871	163	106
10704	1855	533	237	830	155	101	70704	1859	534	237	832	155	101
20104	4294	1233	548	1921	359	233	80104	4323	1242	552	1934	361	234
20204	4247	1220	542	1900	355	230	80204	4360	1252	557	1951	364	236
20304	4316	1240	551	1931	360	234	80304	4379	1258	559	1959	366	237
20404	4322	1241	552	1933	361	234	80404	4386	1260	560	1962	366	238
20504	4192	1204	535	1876	350	227	80504	4180	1200	534	1870	349	227
20604	2154	619	275	964	180	117	80604	2138	614	273	956	179	116
20704	1574	452	201	704	131	85	80704	1475	424	188	660	123	80
30104	4299	1235	549	1923	359	233	90104	4336	1245	554	1940	362	235
30204	4307	1237	550	1927	360	233	90204	4250	1221	543	1901	355	230
30304	4282	1230	547	1916	358	232	90304	4293	1233	548	1921	358	233
30404	4340	1247	554	1942	362	235	90404	4312	1238	551	1929	360	234
30504	4181	1201	534	1871	349	227	90504	4200	1206	536	1879	351	228
30604	2117	608	270	947	177	115	90604	2140	615	273	957	179	116
30704	1791	515	229	802	150	97	90704	1836	527	234	821	153	100
40104	4335	1245	554	1939	362	235	100104	4301	1235	549	1924	359	233
40204	4256	1222	543	1904	355	231	100204	4266	1225	545	1909	356	231
40304	4277	1228	546	1913	357	232	100304	4340	1247	554	1942	362	235
40404	4291	1232	548	1920	358	233	100404	4297	1234	549	1923	359	233
40504	4083	1173	521	1827	341	221	100504	4083	1173	521	1827	341	221
40604	2165	622	276	969	181	117	100604	1953	561	249	874	163	106
40704	1894	544	242	847	158	103	100704	1520	437	194	680	127	82
50104	4315	1239	551	1931	360	234	110104	4318	1240	551	1932	361	234
50204	4256	1222	544	1904	355	231	110204	4362	1253	557	1952	364	236
50304	4341	1247	554	1942	363	235	110304	4382	1258	560	1960	366	237
50404	4330	1244	553	1937	362	235	110404	4378	1257	559	1959	366	237
50504	4223	1213	539	1890	353	229	110504	4143	1190	529	1854	346	225
50604	1967	565	251	880	164	107	110604	2106	605	269	942	176	114
50704	1497	430	191	670	125	81	110704	1758	505	224	786	147	95
60104	4296	1234	549	1922	359	233	120104	4333	1244	553	1938	362	235
60204	4310	1238	550	1928	360	234	120204	4255	1222	543	1904	355	231
60304	4291	1232	548	1920	358	233	120304	4289	1232	548	1919	358	232
60404	4341	1247	554	1942	362	235	120404	4308	1237	550	1928	360	234
60504	4188	1203	535	1874	350	227	120504	4004	1150	511	1791	334	217
60604	2126	611	272	951	178	115	120604	2125	610	271	951	177	115
60704	1846	530	236	826	154	100	120704	1800	517	230	805	150	98

Table 6.23 Port of Tampa Predicted Inbound Truck Volumes for Year 2004 (Model Output)

Dates	Outbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point
10104	3750	877	556	1617	361	338
10204	3345	783	496	1443	322	301
10304	4175	977	619	1801	402	376
10404	4221	988	626	1821	406	380
10504	3311	775	491	1428	319	298
10604	1383	324	205	596	133	125
10704	1378	322	204	594	133	124
20104	3753	878	556	1618	361	338
20204	3346	783	496	1443	322	301
20304	4078	954	604	1759	392	367
20404	3848	901	570	1660	370	347
20504	4103	960	608	1770	395	370
20604	1399	327	207	603	135	126
20704	1378	322	204	594	133	124
30104	4247	994	629	1832	409	383
30204	4237	992	628	1828	408	382
30304	4216	986	625	1818	406	380
30404	3851	901	571	1661	370	347
30504	4076	954	604	1758	392	367
30604	1404	329	208	606	135	127
30704	1378	322	204	594	133	124
40104	3712	869	550	1601	357	334
40204	3334	780	494	1438	321	300
40304	4140	969	614	1786	398	373
40404	4242	993	629	1830	408	382
40504	3592	840	532	1549	346	324
40604	1409	330	209	608	136	127
40704	1378	322	204	594	133	124
50104	4266	998	632	1840	410	384
50204	3331	779	494	1437	320	300
50304	4028	943	597	1737	388	363
50404	3782	885	560	1631	364	341
50504	4019	940	596	1733	387	362
50604	1382	323	205	596	133	124
50704	1378	322	204	594	133	124
60104	3820	894	566	1647	367	344
60204	4217	987	625	1819	406	380
60304	4227	989	626	1823	407	381
60404	3772	883	559	1627	363	340
60504	4096	958	607	1767	394	369
60604	1407	329	209	607	135	127
60704	1378	322	204	594	133	124
70104	3645	853	540	1572	351	328
70204	3324	778	493	1434	320	299
70304	4105	961	608	1770	395	370
70404	4247	994	629	1832	409	383
70504	3408	798	505	1470	328	307
70604	1384	324	205	597	133	125
70704	1378	322	204	594	133	124
80104	4244	993	629	1830	408	382
80204	4161	974	617	1795	400	375
80304	4034	944	598	1740	388	363
80404	3789	887	562	1634	365	341
80504	4089	957	606	1764	393	368
80604	1398	327	207	603	135	126
80704	1378	322	204	594	133	124
90104	3684	862	546	1589	354	332
90204	3361	786	498	1450	323	303
90304	4189	980	621	1807	403	377
90404	4260	997	631	1837	410	384
90504	4097	959	607	1767	394	369
90604	1407	329	209	607	135	127
90704	1378	322	204	594	133	124
100104	3697	865	548	1594	356	333
100204	3333	780	494	1437	321	300
100304	4038	945	598	1742	388	364
100404	3943	923	584	1701	379	355
100504	3388	793	502	1461	326	305
100604	1381	323	205	596	133	124
100704	1378	322	204	594	133	124
110104	4235	991	628	1827	407	382
110204	4187	980	620	1806	403	377
110304	4077	954	604	1758	392	367
110404	3848	900	570	1660	370	347
110504	4049	948	600	1747	390	365
110604	1403	328	208	605	135	126
110704	1378	322	204	594	133	124
120104	3726	872	552	1607	358	336
120204	3373	789	500	1455	325	304
120304	4179	978	619	1803	402	377
120404	4226	989	626	1823	407	381
120504	3471	812	514	1497	334	313
120604	1404	328	208	605	135	126
120704	1378	322	204	594	133	124

Table 6.24 Port of Tampa Predicted Outbound Truck Volumes for Year 2004 (Model Output)

Dates	Inbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point
10105	4317	1240	551	1932	361	234
10205	4276	1228	546	1913	357	232
10305	4361	1253	557	1951	364	236
10405	4354	1250	556	1948	364	236
10505	4184	1202	534	1872	349	227
10605	1927	553	246	862	161	104
10705	1466	421	187	656	122	79
20105	4330	1244	553	1937	362	235
20205	4257	1223	544	1905	355	231
20305	4326	1242	552	1935	361	234
20405	4311	1238	550	1929	360	234
20505	4205	1208	537	1881	351	228
20605	2121	609	271	949	177	115
20705	1838	528	235	822	153	100
30105	4280	1229	547	1915	357	232
30205	4305	1236	550	1926	359	233
30305	4291	1232	548	1920	358	233
30405	4310	1238	550	1928	360	234
30505	4169	1197	532	1865	348	226
30605	2111	606	270	945	176	114
30705	1779	511	227	796	149	96
40105	4354	1250	556	1948	364	236
40205	4311	1238	551	1929	360	234
40305	4357	1251	556	1949	364	236
40405	4299	1235	549	1924	359	233
40505	4056	1165	518	1815	339	220
40605	1937	556	247	867	162	105
40705	1839	528	235	823	154	100
50105	4324	1242	552	1935	361	234
50205	4365	1254	557	1953	365	237
50305	4384	1259	560	1961	366	238
50405	4391	1261	561	1965	367	238
50505	4149	1192	530	1856	346	225
50605	2113	607	270	945	176	115
50705	1427	410	182	638	119	77
60105	4366	1254	558	1953	365	237
60205	4272	1227	546	1911	357	232
60305	4294	1233	548	1921	359	233
60405	4313	1239	551	1930	360	234
60505	4175	1199	533	1868	349	226
60605	2118	608	270	947	177	115
60705	1791	514	229	801	150	97
70105	4333	1244	553	1939	362	235
70205	4292	1233	548	1920	358	233
70305	4365	1254	557	1953	365	237
70405	4329	1243	553	1937	361	235
70505	4041	1160	516	1808	337	219
70605	1928	554	246	862	161	104
70705	1432	411	183	641	120	78
80105	4320	1241	552	1933	361	234
80205	4378	1257	559	1959	366	237
80305	4239	1217	541	1897	354	230
80405	4419	1269	564	1977	369	239
80505	4084	1173	522	1827	341	221
80605	2062	592	263	923	172	112
80705	1723	495	220	771	144	93
90105	4387	1260	560	1963	366	238
90205	4306	1237	550	1926	360	233
90305	4340	1246	554	1942	362	235
90405	4313	1239	551	1929	360	234
90505	3999	1148	511	1789	334	217
90605	2124	610	271	950	177	115
90705	1804	518	230	807	151	98
100105	4321	1241	552	1933	361	234
100205	4305	1236	550	1926	359	233
100305	4385	1259	560	1962	366	238
100405	4383	1259	560	1961	366	238
100505	4176	1199	533	1868	349	226
100605	1911	549	244	855	160	104
100705	1406	404	179	629	117	76
110105	4362	1253	557	1952	364	236
110205	4361	1252	557	1951	364	236
110305	4263	1224	544	1907	356	231
110405	4395	1262	561	1967	367	238
110505	4124	1184	527	1845	344	223
110605	2074	596	265	928	173	112
110705	1744	501	223	780	146	95
120105	4374	1256	559	1957	365	237
120205	4316	1239	551	1931	360	234
120305	4362	1253	557	1952	364	236
120405	4314	1239	551	1930	360	234
120505	3982	1144	508	1782	332	216
120605	1892	543	242	847	158	103
120705	1756	504	224	786	147	95

Table 6.25 Port of Tampa Predicted Inbound Truck Volumes for Year 2005 (Model Output)

Dates	Outbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point	Dates	Outbound Trucks	21-st Street	20th Street	Causeway Blvd	Port Sutton	Pendola point
10105	4257	996	631	1836	410	384	70105	3689	863	547	1591	355	332
10205	3339	781	495	1440	321	301	70205	3330	779	494	1436	320	300
10305	4064	951	602	1753	391	366	70305	4034	944	598	1740	388	363
10405	3831	896	568	1652	368	345	70405	3929	919	582	1694	378	354
10505	3968	928	588	1711	382	357	70505	3337	781	495	1439	321	301
10605	1381	323	205	596	133	124	70605	1381	323	205	596	133	124
10705	1378	322	204	594	133	124	70705	1378	322	204	594	133	124
20105	3715	869	551	1602	357	335	80105	4233	990	627	1826	407	381
20205	3333	780	494	1438	321	300	80205	4231	990	627	1825	407	381
20305	4043	946	599	1744	389	364	80305	4190	980	621	1807	403	377
20405	3802	890	563	1640	366	343	80405	3847	900	570	1659	370	347
20505	4088	957	606	1763	393	368	80505	4000	936	593	1725	385	360
20605	1406	329	208	606	135	127	80605	1401	328	208	604	135	126
20705	1378	322	204	594	133	124	80705	1378	322	204	594	133	124
30105	3821	894	566	1648	368	344	90105	3726	872	552	1607	358	336
30205	4222	988	626	1821	406	380	90205	3335	780	494	1438	321	300
30305	4173	977	619	1800	401	376	90305	4140	969	614	1786	398	373
30405	4252	995	630	1834	409	383	90405	4228	989	627	1824	407	381
30505	4068	952	603	1754	391	366	90505	3453	808	512	1489	332	311
30605	1404	328	208	605	135	126	90605	1404	328	208	605	135	126
30705	1378	322	204	594	133	124	90705	1378	322	204	594	133	124
40105	3699	866	548	1596	356	333	100105	4256	996	631	1836	409	383
40205	3332	780	494	1437	321	300	100205	3337	781	494	1439	321	301
40305	4030	943	597	1738	388	363	100305	4062	951	602	1752	391	366
40405	3927	919	582	1694	378	354	100405	3828	896	567	1651	368	345
40505	3359	786	498	1449	323	303	100505	3961	927	587	1708	381	357
40605	1383	324	205	596	133	125	100605	1381	323	205	596	133	124
40705	1378	322	204	594	133	124	100705	1378	322	204	594	133	124
50105	4241	992	628	1829	408	382	110105	3868	905	573	1668	372	349
50205	4168	975	618	1798	401	376	110205	4230	990	627	1824	407	381
50305	4043	946	599	1744	389	364	110305	4197	982	622	1810	404	378
50405	3802	890	563	1640	366	343	110405	3843	899	570	1657	370	346
50505	4058	950	601	1750	390	366	110505	4026	942	597	1736	387	363
50605	1396	327	207	602	134	126	110605	1401	328	208	604	135	126
50705	1378	322	204	594	133	124	110705	1378	322	204	594	133	124
60105	3690	863	547	1591	355	332	120105	3717	870	551	1603	358	335
60205	3358	786	498	1448	323	303	120205	3335	780	494	1438	321	300
60305	4178	978	619	1802	402	376	120305	4140	969	614	1786	398	373
60405	4254	995	630	1835	409	383	120405	4225	989	626	1822	406	381
60505	4072	953	603	1756	392	367	120505	3228	755	478	1392	311	291
60605	1404	329	208	606	135	127	120605	1382	323	205	596	133	125
60705	1378	322	204	594	133	124	120705	1378	322	204	594	133	124

Table 6.26 Port of Tampa Predicted Outbound Truck Volumes for Year 2005 (Model Output)

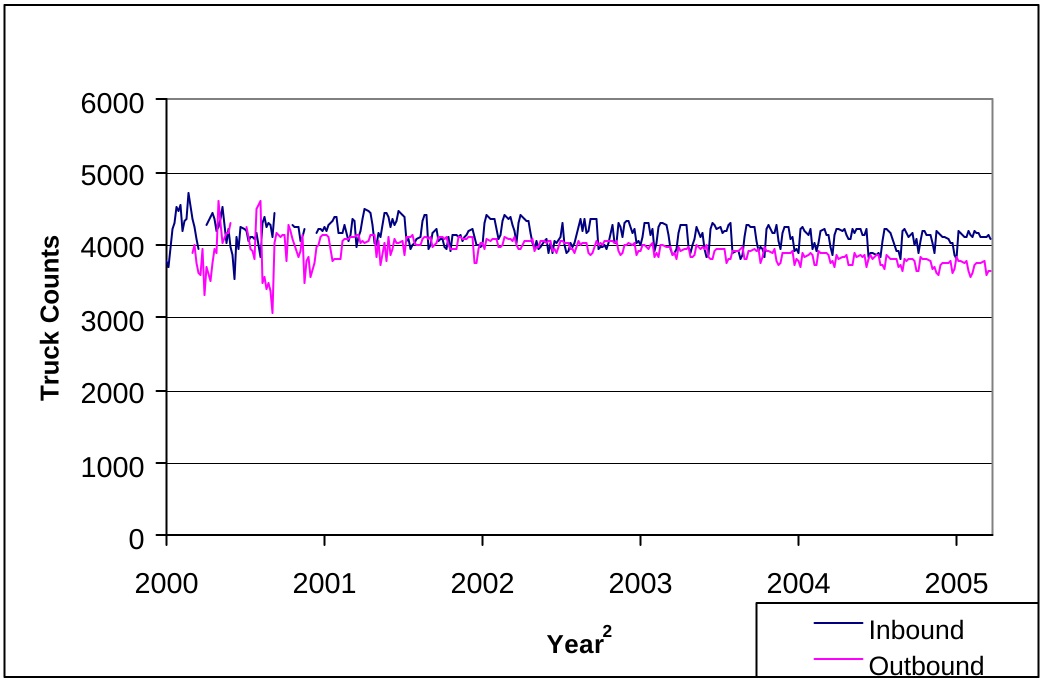


Figure 6.44 Port of Tampa Truck Counts (Year 2000-2005)[1]

[1]excludes weekends, [2]annual counts using one week from each month of the year (84 data points)

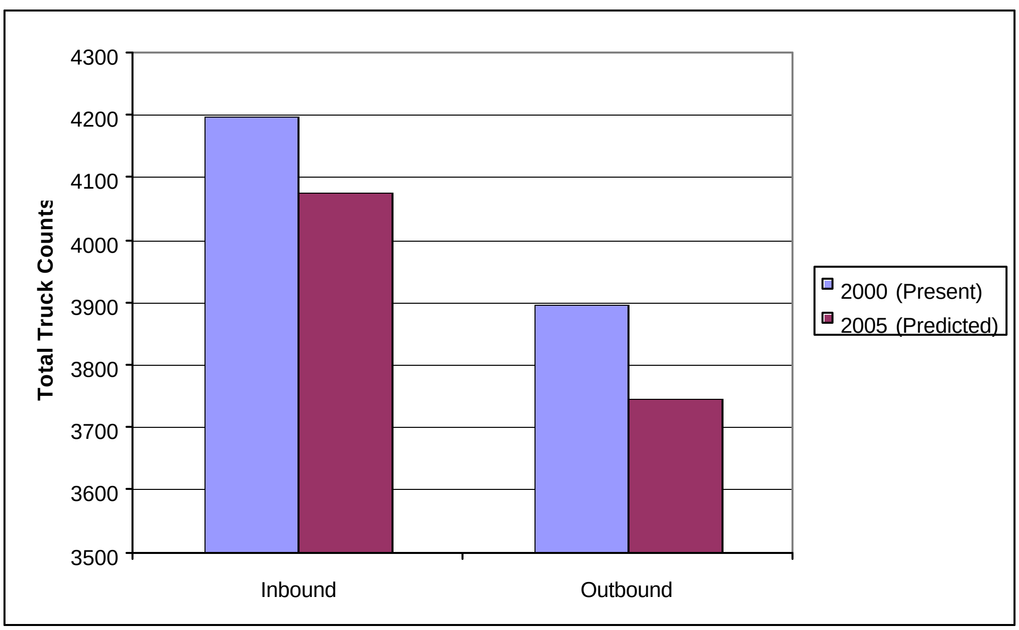


Figure 6.45 Port of Tampa Present Vs Predicted Truck Counts Variables (Year 2000 - 2005)

CHAPTER 7

CONCLUSIONS & RECOMMENDATIONS

The Florida seaports are major truck trip generators. This study (PhaseII) has developed a non-traditional and new methodology for estimating present (and forecasting future) daily truck trips at Florida ports using economic indicators at the port (exports/imports and vessel activity). The new approach utilizes Artificial Neural Networks (ANN); it uses vessel data as input and has output as inbound and outbound truck trips at the ports. There were four Florida ports investigated in this study: Palm Beach, Everglades, Tampa, and Jacksonville.

The truck traffic varies for each of the four ports selected. The Port of Palm Beach had average daily truck volumes of 496 for the inbound direction and 453 for the outbound direction. The Port of Everglades had average daily truck volumes of 3267 for the inbound direction and 3134 for the outbound direction. The Port of Tampa had average daily truck volumes of 4197 for the inbound direction and 3897 for the outbound direction. The Port of Jacksonville-Talleyrand Terminal had average daily truck volumes of 1032 for the inbound direction and 1037 for the outbound direction. The Port of Jacksonville-Blount Island Terminal had average daily truck volumes of 986 for the inbound direction and 993 for the outbound direction.

It was difficult to obtain any useful information about the rail traffic that transported cargo in and out of the ports. The most useful data was from the Port of Palm Beach. A modal split was calculated for inbound traffic. It is estimated that 94% of the total tonnage exported is transported by truck and 6% by rail cars.

To develop the truck trip generation models for the selected ports, Regression and Artificial Neural Networks (ANN) models were investigated. It was found that ANN models produce more accurate results than Regression. Hence all the port models were developed using ANN. All the models used Backpropagation Neural Network Architecture. The developed port models produce inbound and outbound truck volumes as outputs. After vessel input data is provided to the model, truck volumes are calculated for all the access roads to each of the ports and also collectively by direction. ANN results in terms of accuracy have been precise for the port models. Accuracy was determined by comparing the model generated truck volumes from the validation and the actual field counts. It was found that the Port of Palm Beach model has 88% accuracy, Port of Everglades model has 93% accuracy, Port of Tampa model has 95% accuracy, and the Port of Jacksonville-Talleyrand and Blount Island Terminal models both have 89% accuracy. It is recognized that the ports with the higher average daily truck volumes produced more accuracy in the modeling.

Historical vessel data for the Ports of Palm Beach, Everglades and Tampa were used in developing time series models to forecast vessel data for future years. This forecasted data would also be used as input variables for the developed ANN port models to predict future truck volumes. The forecasting results for the three ports also provided insight of possible future trends for the imported and exported vessel freight cargo movements. Using 2000 as the base year, by year 2005, the Port of Palm Beach is forecasted to have a 51% increase in imported tonnage and 58% increase in exported tonnage. The Port of

Everglades is forecasted to have a 189% increase for imported tonnage, 28% increase for imported barrels, 7% increase for imported containers, a 31% increase for exported containers but an 18% *decrease* in exported tonnage. The unusually high increase is attributed to the high variability in the historical monthly imported tonnage records thus creating an unusually high prediction. The Port of Tampa is forecasted to have a 16% increase for imported barrels but a *decrease* of 25% for imported tonnage and 36% for exported tonnage.

The results of the forecasting models for the Ports of Palm Beach, Everglades and Tampa were input into the developed truck trip generation models for each of the respective ports. Truck volumes up through the year 2005 were output from each model for both inbound and outbound directions for each of the ports' access roads. Using 2000 as the base year, the Port of Palm Beach ANN model generated truck volumes predicted an 86% (441 trucks) daily increase for inbound trucks and an 86% (382 trucks) daily increase for outbound trucks by the year 2005. The Port of Everglades ANN model generated truck volumes predicted a 33% (1067 trucks) daily increase for inbound trucks and a 30% (915 trucks) daily increase for outbound trucks by the year 2005. The Port of Tampa ANN model generated truck volumes predicted a 3% (122 trucks) daily *decrease* for inbound trucks and a 4% (150 trucks) daily *decrease* for outbound trucks by the year 2005.

Data collection was extremely important for producing accurate and acceptable results for developing truck trip generation models. Various technologies were investigated of vehicle classification equipment in order to achieve the most accurate data set. This included road air tubes and fiber optic road sensors.

As part of this study (PhaseII), new technology that uses fiber optic sensors for collecting truck counts was investigated. Fiber optic sensors are accurate and fairly durable but in locations such as the ones near the port with the variable types of vehicular activity, they are only useful for short data collection periods. Extensive periods of data collection such as these required for this research project expose the sensors to a high probability of damage thus making them not cost efficient. Further investigation of the sensors with varied conditions of weather, traffic and road types is required to specifically identify the extent of their durability. It was also concluded that the Metrocount Vehicle Classifiers were more dependable than the Diamond Phoenix Vehicle Classifiers. The only hardware failures that occurred with the Metrocount Classifiers were due to water intrusion from heavy rains. The Diamond Phoenix Classifiers failed due to battery failures and other unidentified internal hardware problems possibly related to a damaged chipset board.

FUTURE RESEARCH

Determining what routes the trucks traveling to and from the port use is a challenging endeavor. Time of day, destination, and commodity being hauled can all influence the route choice. Phase III of this project investigates these route choices using the Port of Tampa as the initial port for analysis. Application of a simulation package with traffic assignment to this analysis is desired in order to use the ANN port models to generate the trucks at the port and then determine what routes these trucks would select on a predefined network around the port.

Other areas of interest include economic evaluation, travel time and trip costs, GPS applications, Advanced Traveler Information System (ATIS) application and even improvements in air quality. It may be useful to determine what commodities are most important to the economic development of the port, the surrounding area, and the state. The use of GPS could build a database of trips and determine alternatives for routes where impedances are frequently encountered. Use of ATIS could have similar applications for improving travel time, especially on frequently traveled routes. This could reduce the idle time of trucks in traffic and thus improve air quality, especially in areas where the truck vehicle fleet has a higher percentage of older trucks.

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Appendix A

Wilcoxon Rank Sum Test

The Wilcoxon Rank Sum Test for Large Samples
(n1 >= 10 and n2 >= 10)

Ho: Relative frequency distributions for populations 1 and 2 are identical.

Ha: Relative frequency distribution for population 1 is shifted either to the left or to the right of the distribution of population 2.

Test Statistic :

$$Z = \frac{T1 - [\frac{n1 * n2 + n1 * (n1 + 1)}{2}]}{\sqrt{\frac{n1 * n2 * (n1 + n2 + 1)}{12}}}$$

n1 = Size of Sample 1

n2 = Size of Sample 2

T1 = Sum of Rank of Sample 1

Rejection Region : $Z > Z_{\alpha/2}$ or $Z < -Z_{\alpha/2}$

Appendix B

Wilcoxon Rank Sum Test Results

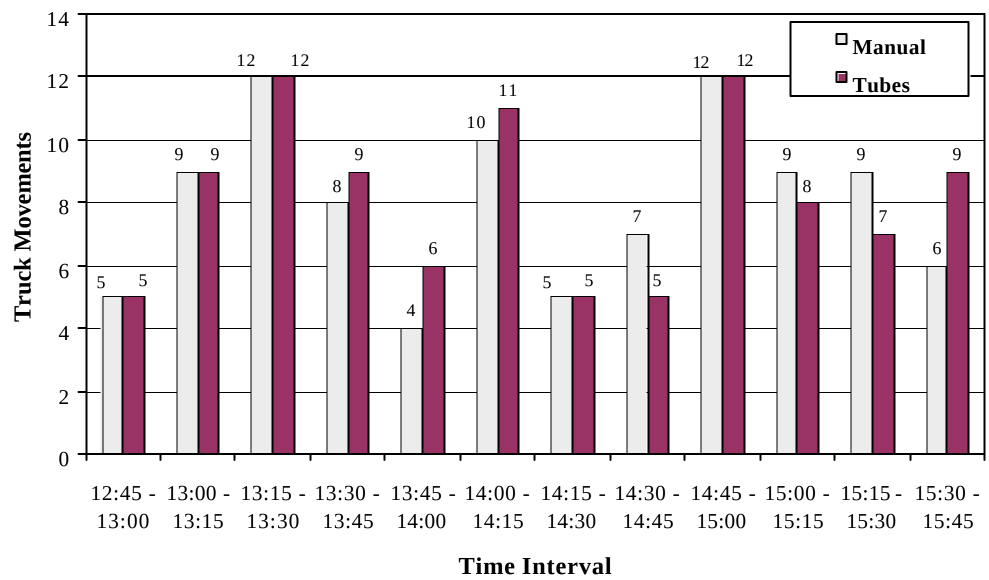

Figure B-1: Graphical Comparison of Truck Tube counts with Actual Manual Truck Counts (Tuesday 8/10/999)

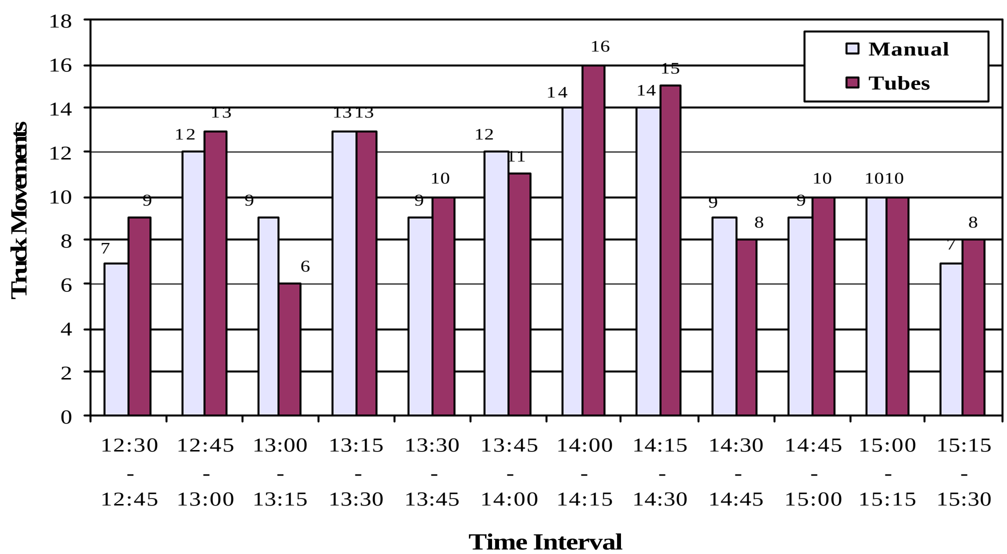

Figure B-2: Graphical Comparison of Truck Tube counts with Actual Manual Truck Counts (Tuesday 8/17/999)

The Wilcoxon Rank Sum Test to Compare							
Time Range			**Manual Counts**	**Rank**	**Tube Counts**	**Rank**
12:45	-	13:00	5	4	5	4
13:00	-	13:15	9	15.5	9	15.5
13:15	-	13:30	12	22.5	12	22.5
13:30	-	13:45	8	11.5	9	15.5
13:45	-	14:00	4	1	6	7.5
14:00	-	14:15	10	19	11	20
14:15	-	14:30	5	4	5	4
14:30	-	14:45	7	9.5	5	4
14:45	-	15:00	12	22.5	12	22.5
15:00	-	15:15	9	15.5	8	11.5
15:15	-	15:30	9	15.5	7	9.5
15:30	-	15:45	6	7.5	9	15.5
Total			96	148	98	152
Results:						
For 95% Confidence				$Z_{0.025}$ =	*1.960*	
				$Z_{statistic}$	*0.115*	

t-test: Two-Samples Assuming Equal Variances		
	Manual	***Tunes***
Mean	8.000	8.167
Variance	7.091	6.879
Observations	12	12
Pooled Variance	6.985	
Hypothesized Mean Difference	0	
df	22	
t Stat	-0.154	
P(T<=t) one-tail	0.439	
t Critical one-tail	1.717	
P(T<=t) two-tail	0.879	
t Critical two-tail	2.074	

Table B-1: Comparison of Heavy Truck Manual Counts with Tube Counts (Tuesday, 8/10/99)

The Wilcoxon Rank Sum Test to Compare					
Time Range		**Manual Counts**	**Rank**	**Tube Counts**	**Rank**
12:30 - 12:45		7	2.5	9	8
12:45 - 13:00		12	16.5	13	19
13:00 - 13:15		9	8	6	1
13:15 - 13:30		13	19	13	19
13:30 - 13:45		9	8	10	12.5
13:45 - 14:00		12	16.5	11	15
14:00 - 14:15		14	21.5	16	24
14:15 - 14:30		14	21.5	15	23
14:30 - 14:45		9	8	8	4.5
14:45 - 15:00		9	8	10	12.5
15:00 - 15:15		10	12.5	10	12.5
15:15 - 15:30		7	2.5	8	4.5
Total		125	144.5	129	155.5
Results:					
For 95% Confidence			$Z_{0.025}$ =	*-1.960*	
			$Z_{statistic}$ =	*-0.318*	

t-test: Two-Samples Assuming Equal Variances		
	Manual	***Tunes***
Mean	10.167	10.750
Variance	6.152	8.932
Observations	12	12
Pooled Variance	7.542	
Hypothesized Mean Difference	0	
df	22	
t Stat	-0.520	
P(T<=t) one-tail	0.304	
t Critical one-tail	1.717	
P(T<=t) two-tail	0.608	
t Critical two-tail	2.074	

Table B-2: Comparison of Heavy Truck Manual Counts with Tube Counts (Tuesday, 8/17/99)

Appendix C

Rail Data

date	2	3	4	5	B	F	H	T
1/29/00		1		4		3		2
1/31/00	1			2		7		
2/1/00				6		6		
2/2/00	1	2		3	1	2		4
2/3/00	1			3		5		
2/4/00	1		2	1		8		2
2/5/00	1	1		2		6		
2/7/00				2		6		1
2/8/00	1		1			7		
2/9/00	1	1		3		8		1
2/10/00	1		1	2		14		
2/11/00	1	1				9		
2/12/00	2	2		1	1	15		5
2/14/00	1			1		6		2
2/15/00	1	1		1		5		
2/16/00		2		4		8		1
2/17/00	4			3	1	9		
2/18/00		5		3		3		
2/19/00	1			1		5		
2/21/00	1		1	2		5		
2/22/00	1	1		1		6		1
2/23/00	1	3		3		10		
2/24/00	1	1		3		13	2	
2/25/00		1		5		6	4	
2/26/00				1	1	3	3	
2/28/00				3		6		
2/29/00		2				6	11	
3/1/00				2		1		
3/2/00	1	2		1		12		
3/3/00				3		10		
3/4/00	1	1				15	8	
3/6/00				2		9		
3/7/00		2	1	2		7		
3/8/00	1	2		1	1	4		4
3/9/00								
3/10/00	2	1		8		13		1
3/11/00		1		3		6		
3/13/00				1		4		
3/14/00	1			1	1	5		3
3/15/00	2	1		3		9		
3/16/00		3		3		14		
3/17/00				3		9		1
3/18/00		1		1		8		
3/20/00	2	1		2		12		2
3/21/00	1			4	4	3	2	
3/22/00	1	1		3		2		1
3/23/00	1	1		2		7		
3/24/00	1	1		7		5		
3/25/00				4		10		
3/27/00	3			1		4		
3/28/00	1	2		3		8		1
3/29/00	1			3		7	4	
3/30/00	1	2		3		9		2
3/31/00	2			6		5		1
4/1/00		1		3		15	9	
4/3/00				3	1	8		
4/4/00				3	1	6	16	
4/5/00		2		3		7		
4/6/00		2		5		4		
4/7/00				2		13		
4/8/00	1	2		2		3		
4/10/00		3				10		
4/11/00		3		2		10	5	
4/12/00		2		3		10		
4/13/00	2			5		9		
4/14/00	1	2	1	4		4		
4/15/00				3		8		

Table C.1 Port of Palm Beach Inbound Rail Car Counts

date	2	3	4	5	B	F	H	T
1/31/00	1			2		7		
2/1/00				6		6		
2/2/00	1	2		3	1	2		4
2/3/00	1			3		5		
2/4/00	1		2	1		8		2
2/5/00	1	1		2		6		
2/7/00				2		6		1
2/8/00	1		1			7		
2/9/00	1	1		3		8		1
2/10/00	1		1	2		14		
2/11/00	1	1				9		
2/12/00	2	2		1	1	15		5
2/14/00	1			1		6		2
2/15/00	1	1		1		5		
2/16/00		2		4		8		1
2/17/00	4			3	1	9		
2/18/00		5		3		3		
2/19/00	1			1		5		
2/21/00	1		1	2		5		
2/22/00	1	1		1		6		1
2/23/00	1	3		3		10		
2/24/00	1	1		3		13	2	
2/25/00		1		5		6	4	
2/26/00				1	1	3	3	
2/28/00				3		6		
2/29/00		2				6	11	
3/1/00				2		1		
3/2/00	1	2		1		12		
3/3/00				3		10		
3/4/00	1	1				15	8	
3/6/00				2		9		
3/7/00		2	1	2		7		
3/8/00	1	2		1	1	4		4
3/9/00								
3/10/00	2	1		8		13		1
3/11/00		1		3		6		
3/13/00				1		4		
3/14/00	1			1	1	5		3
3/15/00	2	1		3		9		
3/16/00		3		3		14		
3/17/00				3		9		1
3/18/00		1		1		8		
3/20/00	2	1		2		12		2
3/21/00	1			4	4	3	2	
3/22/00	1	1		3		2		1
3/23/00	1	1		2		7		
3/24/00	1	1		7		5		
3/25/00				4		10		
3/27/00	3			1		4		
3/28/00	1	2		3		8		1
3/29/00	1			3		7	4	
3/30/00	1	2		3		9		2
3/31/00	2			6		5		1
4/1/00		1		3		15	9	
4/3/00				3	1	8		
4/4/00				3	1	6	16	
4/5/00		2		3		7		
4/6/00		2		5		4		
4/7/00				2		13		
4/8/00	1	2		2		3		
4/10/00		3				10		
4/11/00		3		2		10	5	
4/12/00		2		3		10		
4/13/00	2			5		9		
4/14/00	1	2	1	4		4		
4/15/00				3		8		

Table C.2 Port of Palm Beach Outbound Rail Car Counts

TALLEYRAND TERMINAL RAILROAD
REPORT FOR JANUARY 2000

	CSX	NS	CSX	NS
~~TMT/SUD/GLOBAL/JTO~~	**LOADS IN**	**LOADS IN**	**LOADS OUT**	**LOADS OUT**
1 SECTION	61	38	9	26
2 SECTION	1	1	0	0
3 SECTION	25	25	5	14
4 SECTION	0	1	0	0
5 SECTION	58	66	12	37
TOTAL	145	131	26	77

~~CONTAINERS~~	**LOADS IN**	**LOADS IN**	**LOADS OUT**	**LOADS OUT**
AMTRANS	397	42	69	6
HAMBURG SUD	197	559	20	406
JTO	16	0	0	0
GLOBAL				
PIONEER				

	CSX	NS	CSX	NS
	LOADS IN	**LOADS IN**	**LOADS OUT**	**LOADS OUT**
TOYOTA	338	437	0	0
JEFFERSON SMURFIT	23	0	16	0
BERMAN BROTHERS	0	0	11	0
AMTRANS	1	0	0	0
CITY	0	0	0	0
GLOBAL	12	1	0	0
JAXPORT	3	9	1	0
JACKSONVILLE COLD STORAGE	1	0	0	0
WESTWAY	27	7	12	15
TOTAL	405	454	40	15

	CSX	NS	CSX	NS
	LOADS IN	**LOADS IN**	**LOADS OUT**	**LOADS OUT**
TOTAL	**550**	**585**	**66**	**92**

Table C.3 Port of Jacksonville Rail Car Report for January 2001

Appendix D

Port of Palm Beach

Variable	No. of Data	Mean	Std. Dev.	p-value	Result	Conclusion
Monday- Inbound Trucks	11	452.36	67.43	0.80	p-value>.05	Normal
Monday- Outbound Trucks	11	431.18	34.48	1.00	p-value>.05	Normal
Tuesday- Inbound Trucks	11	496.82	66.81	0.62	p-value>.05	Normal
Tuesday- Outbound Trucks	11	433.73	39.79	0.99	p-value>.05	Normal
Wednesday- Inbound Trucks	11	512.55	95.31	0.96	p-value>.05	Normal
Wednesday- Outbound Trucks	11	461.27	51.64	0.90	p-value>.05	Normal
Thursday- Inbound Trucks	11	516.82	102.10	0.52	p-value>.05	Normal
Thursday- Outbound Trucks	11	475.27	40.44	0.34	p-value>.05	Normal
Friday- Inbound Trucks	11	497.09	79.66	0.45	p-value>.05	Normal
Friday- Outbound Trucks	11	459.27	46.09	1.00	p-value>.05	Normal
Saturday- Inbound Trucks	10	112.60	49.02	0.70	p-value>.05	Normal
Saturdayday- Outbound Trucks	10	131.70	43.32	1.00	p-value>.05	Normal
Sunday- Inbound Trucks	10	29.80	11.16	0.71	p-value>.05	Normal
Sunday- Outbound Trucks	10	56.70	11.56	0.78	p-value>.05	Normal

Table D.1 Kolmorgorov-Smirnov Normality Test Results for Daily Truck Counts at Port of Palm Beach

Truck Counts				Vessel data							Day	
				IMPORTS			*EXPORTS*					
Date	**Day**	**Total Inbound**	**Total Outbound**	**BREAK BULK**	**CEMENT**	**CONTAINER**	**SUGAR**	**BREAK BULK**	**CONTAINER**	**MOLASSES**	**WK**	**SAT**
31-Jan-00	Mon	431	419	29	0	835	2453	1048	1708	0	1	0
1-Feb-00	Tue	474	437	0	0	622	4240	0	4580	0	1	0
2-Feb-00	Wed	532	419	2	0	227	4240	30	4443	0	1	0
3-Feb-00	Thu	558	460	0	0	346	4240	0	4960	21561	1	0
4-Feb-00	Fri	567	401	0	0	417	4240	0	1916	0	1	0
5-Feb-00	Sat	119	146	0	7858	1290	0	0	332	0	0	1
6-Feb-00	Sun	27	50	16	0	1129	0	1233	1666	0	0	0
7-Feb-00	Mon	469	447	1	0	1313	4240	58	3958	0	1	0
8-Feb-00	Tue	470	422	0	0	539	4240	148	4093	0	1	0
9-Feb-00	Wed	544	486	0	0	543	4240	0	4872	0	1	0
10-Feb-00	Thu	468	447	0	0	79	4240	0	1610	0	1	0
11-Feb-00	Fri	543	461	0	0	410	4240	0	211	0	1	0
12-Feb-00	Sat	172	182	0	0	2390	0	811	1757	0	0	1
13-Feb-00	Sun	55	65	7	0	353	0	539	4771	0	0	0
14-Feb-00	Mon	468	434	0	0	808	4240	0	4884	0	1	0
15-Feb-00	Tue	457	413	3	0	270	4240	104	4754	0	1	0
16-Feb-00	Wed	492	450	0	0	146	4240	163	1842	0	1	0
17-Feb-00	Thu	531	498	0	0	785	4240	0	681	0	1	0
18-Feb-00	Fri	522	507	47	0	1522	4240	1406	1785	0	1	0
19-Feb-00	Sat	210	211	0	0	206	0	463	4631	0	0	1
20-Feb-00	Sun	30	73	0	0	705	0	0	4515	0	0	0
21-Feb-00	Mon	521	483	0	0	574	4240	493	4664	22241	1	0
22-Feb-00	Tue	625	419	0	0	371	4240	0	1799	0	1	0
23-Feb-00	Wed	629	533	0	0	552	4240	0	456	0	1	0
24-Feb-00	Thu	597	540	7	0	2213	4240	1202	2148	0	1	0
25-Feb-00	Fri	543	502	0	0	697	4240	0	4234	0	1	0
26-Feb-00	Sat	96	123	0	0	206	0	0	4441	0	0	1
27-Feb-00	Sun	39	40	0	0	280	0	0	5058	0	0	0
28-Feb-00	Mon	538	467	0	0	396	4240	0	1887	0	1	0
29-Feb-00	Tue	607	523	0	0	148	4240	0	612	0	1	0
1-Mar-00	Wed	626	473	11	0	1885	2337	1118	1672	0	1	0
2-Mar-00	Thu	672	446	0	0	780	2337	0	4766	0	1	0
3-Mar-00	Fri	494	451	4	0	359	2337	0	4458	0	1	0
4-Mar-00	Sat	122	129	0	7026	400	0	575	4992	0	0	1
5-Mar-00	Sun	21	63	0	0	80	0	0	2078	0	0	0
6-Mar-00	Mon	454	412	0	0	458	2337	0	442	0	1	0
7-Mar-00	Tue	512	425	20	0	2343	2337	1238	1739	0	1	0

Table D.2 Initial ANN Model Calibration and Validation for Inbound and Outbound Trucks at Port of Palm Beach

Truck Counts				Vessel data							Day	
				IMPORTS			*EXPORTS*					
Date	Day	Total Inbound	Total Outbound	BREAK BULK	CEMENT	CONTAINER	SUGAR	BREAK BULK	CONTAINER	MOLASSES	WK	SAT
8-Mar-00	Wed	471	466	0	0	286	2337	0	4712	0	1	0
9-Mar-00	Thu	545	515	0	0	941	2337	0	4970	0	1	0
10-Mar-00	Fri	526	538	2	0	371	2337	100	4629	0	1	0
11-Mar-00	Sat	113	160	0	0	32	0	0	1846	0	0	1
12-Mar-00	Sun	32	52	0	0	1468	0	55	721	0	0	0
13-Mar-00	Mon	488	474	10	0	2300	2337	1023	1822	0	1	0
14-Mar-00	Tue	460	453	0	0	120	2337	0	4727	0	1	0
15-Mar-00	Wed	570	516	0	0	1397	2337	0	4567	0	1	0
16-Mar-00	Thu	513	540	0	0	361	2337	0	4778	0	1	0
17-Mar-00	Fri	455	454	0	0	48	2337	0	1960	26743	1	0
18-Mar-00	Sat	73	93	0	0	1524	0	0	1126	0	0	1
19-Mar-00	Sun	16	40	32	7226	1908	0	1073	1752	0	0	0
20-Mar-00	Mon	383	387	0	0	136	2337	0	5075	0	1	0
21-Mar-00	Tue	397	470	0	0	1403	2337	0	4158	0	1	0
22-Mar-00	Wed	292	482	0	0	354	2337	810	4212	0	1	0
23-Mar-00	Thu	256	453	0	0	67	2337	0	2249	0	1	0
24-Mar-00	Fri	283	428	1	0	229	2337	53	605	0	1	0
25-Mar-00	Sat	37	109	4	0	1850	0	1148	1577	0	0	1
26-Mar-00	Sun	19	64	0	0	426	0	0	4639	0	0	0
27-Mar-00	Mon	294	401	0	0	1414	2337	0	4527	0	1	0
28-Mar-00	Tue	499	443	0	0	372	2337	55	3682	0	1	0
29-Mar-00	Wed	516	437	0	0	81	2337	0	2845	0	1	0
30-Mar-00	Thu	533	442	0	0	87	2337	0	1064	0	1	0
31-Mar-00	Fri	548	383	7	0	2011	2337	1161	1539	0	1	0
1-Apr-00	Sat	98	78	0	0	276	0	318	4934	0	0	1
2-Apr-00	Sun	31	68	0	5798	1228	0	0	4644	0	0	0
3-Apr-00	Mon	487	437	6	0	589	2100	95	4575	0	1	0
4-Apr-00	Tue	507	389	0	0	51	2100	0	2037	0	1	0
5-Apr-00	Wed	543	472	1	0	2046	2100	390	1057	0	1	0
6-Apr-00	Thu	514	430	1	0	2257	2100	792	1793	0	1	0
7-Apr-00	Fri	530	481	0	0	255	2100	0	5163	0	1	0
8-Apr-00	Sat	86	86	0	0	742	0	0	2837	0	0	1
9-Apr-00	Sun	28	52	0	0	1131	0	15	5749	0	0	0
10-Apr-00	Mon	443	382	0	0	1679	2100	0	1179	0	1	0
11-Apr-00	Tue	457	377	6	0	1459	2100	1205	2071	0	1	0
12-Apr-00	Wed	423	340	0	0	219	2100	0	4446	0	1	0
13-Apr-00	Thu	498	457	0	0	30	2100	0	4626	0	1	0
14-Apr-00	Fri	457	446	0	0	684	2100	0	4317	0	1	0

Table D.2 Initial ANN Model Calibration and Validation for Inbound and Outbound Trucks at Port of Palm Beach (cotd.)

h1	h2	EPOCHS	Algorithm	INBOUND MSE	OUTBOUND MSE	TOTAL MSE
0	0	100	Trainlm	1984	5563	7548
0	0	200	Trainlm	2554	4733	7288
0	0	300	Trainlm	3021	5395	8416
0	0	400	Trainlm	2535	4946	7481
0	0	100	Traincgb	2213	10064	12277
0	0	200	Traincgb	2805	7414	10218
0	0	300	Traincgb	1846	6450	8296
0	0	100	Trainrp	1429	9031	10460
0	0	200	Trainrp	3067	8917	11984
0	0	300	Trainrp	3244	4871	8114
1	1	100	Trainlm	3558	5742	9299
1	2	200	Trainlm	1076	5422	8498
1	3	300	Trainlm	2160	6025	8185
2	1	400	Trainlm	2071	6747	8818
2	2	100	Traincgb	3173	3727	8900
2	3	200	Traincgb	2631	5333	7964
3	1	300	Traincgb	3076	6931	10007
3	2	100	Trainrp	2212	6670	8883
3	3	200	Trainrp	2133	5933	8065
1	1	300	Trainrp	3755	5992	9747
1	2	100	Trainlm	3590	9048	12638
1	3	200	Trainlm	7302	47616	54919
2	1	300	Trainlm	3872	7595	11467
2	2	400	Trainlm	3800	5808	9608
2	3	100	Traincgb	2252	6807	9059
3	1	200	Traincgb	2127	7741	9868
3	2	300	Traincgb	5464	6031	11494
3	3	100	Trainrp	3576	5982	9558
1	1	200	Trainrp	2035	11048	13083
1	2	300	Trainrp	2373	4923	7295
1	3	100	Trainlm	1621	11784	13405
2	1	200	Trainlm	1769	5486	7655
2	2	300	Trainlm	2528	7122	9651
2	3	400	Trainlm	28390	24837	53227
3	1	100	Traincgb	21202	28356	49558
3	2	200	Traincgb	8019	75849	83868
3	3	300	Traincgb	3032	8267	11300
1	1	100	Trainrp	8601	14745	23347
1	2	200	Trainrp	22623	35114	57737
1	3	300	Trainrp	6263	12450	18713
2	1	100	Trainlm	3092	8633	11725
2	2	200	Trainlm	1998	8283	10282
2	3	300	Trainlm	2695	6609	9304
3	1	400	Trainlm	10127	16113	26240
3	2	100	Traincgb	6908	12614	19522
3	3	200	Traincgb	9427	16920	26347
1	1	300	Traincgb	1695	7267	8962
1	2	100	Trainrp	3721	13276	16997
1	3	200	Trainrp	1906	8769	10675
2	1	300	Trainrp	1949	8248	10198

Table D.3 Initial ANN Model Run Results for Inbound and Outbound Trucks at Port of Palm Beach

h1	h2	EPOCHS	Algorithm	INBOUND MSE	OUTBOUND MSE	TOTAL MSE
2	2	100	Trainlm	9648	16541	26188
2	3	200	Trainlm	7280	21655	28935
3	1	300	Trainlm	40395	68767	109162
3	2	400	Trainlm	25773	35162	60934
3	3	100	Traincgb	15064	20895	35959
1	1	200	Traincgb	2545	6985	9531
1	2	300	Traincgb	5896	11657	17552
1	3	100	Trainrp	3158	12013	15170
2	1	200	Trainrp	3670	8552	12222
2	2	300	Trainrp	2309	6151	8459
2	3	100	Trainlm	4664	14036	18700
3	1	200	Trainlm	8046	14414	22460
3	2	300	Trainlm	2826	7913	10740
3	3	400	Trainlm	8098	11114	19212
1	1	100	Traincgb	6892	13929	20821
1	2	200	Traincgb	3585	10377	13962
1	3	300	Traincgb	2650	6606	9256
2	1	100	Trainrp	3015	6624	9639
2	2	200	Trainrp	16227	58109	74336
2	3	300	Trainrp	2134	5657	7791
3	1	100	Trainlm	3952	7599	11550
3	2	200	Trainlm	22615	41090	63705
3	3	300	Trainlm	12018	19102	31119
1	1	400	Trainlm	1594	6398	7992
1	2	100	Traincgb	4233	8031	12264
1	3	200	Traincgb	3448	7740	11188
2	1	300	Traincgb	2489	6655	9144
2	2	100	Trainrp	8965	16920	25885
2	3	200	Trainrp	4354	10417	14771
3	1	300	Trainrp	4086	9369	13455
3	2	100	Trainlm	9785	14633	24418
3	3	200	Trainlm	7151	23634	30786
1	1	300	Trainlm	2060	6266	8326
1	2	400	Trainlm	1519	6032	7552
1	3	100	Traincgb	2186	10473	12659
2	1	200	Traincgb	5265	10782	16048
2	2	300	Traincgb	2673	7180	9853
2	3	100	Trainrp	14874	240499	255373
3	1	200	Trainrp	10869	23035	33904
3	2	300	Trainrp	4783	11937	16720
3	3	100	Trainlm	28679	30738	59417
1	1	200	Trainlm	1433	4493	7926
1	2	300	Trainlm	8785	17165	25951
1	3	400	Trainlm	3466	10025	13492
2	1	100	Traincgb	12945	24029	36975
2	2	200	Traincgb	3703	10100	13802
2	3	300	Traincgb	1609	8382	9991
3	1	100	Trainrp	5529	9072	14600
3	2	200	Trainrp	9373	19077	28450
3	3	300	Trainrp	33790	50800	84590

Table D.3 Initial ANN Model Run Results for Inbound and Outbound Trucks at the Port of Palm Beach (Cotd.)

Date (mm/dd/yy)	Imported Tonnage	Exported Tonnage	Inbound Trucks	Outbound Trucks
13100	2573	6482	431	419
20100	863	10590	474	437
20200	622	12413	532	419
20300	229	12307	558	460
20400	346	12794	567	401
20500	417	3152	119	146
20600	0	0	27	50
20700	1290	5808	469	447
20800	1426	8374	470	422
20900	1594	9492	544	486
21000	819	9716	468	447
21100	824	10348	543	461
21200	360	2846	172	182
21300	0	0	55	65
21400	691	5687	468	434
21500	2671	8043	457	413
21600	640	10786	492	450
21700	1089	10360	531	498
21800	554	10334	522	507
21900	427	3240	210	211
22000	0	0	30	73
22100	1065	6156	521	483
22200	1850	8667	625	419
22300	487	10570	629	533
22400	986	9991	597	540
22500	855	10632	543	502
22600	652	2868	96	123
22700	0	0	39	40
22800	833	5766	538	467
22900	2500	8660	607	523
30100	978	7642	626	473
30200	486	7848	672	446
30300	560	8465	494	451
30400	677	2957	122	129
30500	0	0	21	63
30600	429	4020	454	412
30700	2177	6197	512	425
30800	1061	8174	471	466
30900	644	7865	545	515

Date (mm/dd/yy)	Imported Tonnage	Exported Tonnage	Inbound Trucks	Outbound Trucks
31000	681	8974	526	538
31100	549	3148	113	160
31200	0	0	32	52
31300	926	3850	488	474
31400	2831	6383	460	453
31500	754	8119	570	516
31600	1409	8377	513	540
31700	841	8136	455	454
31800	500	2916	73	93
31900	0	0	16	40
32000	1936	4183	383	387
32100	2778	6253	397	470
32200	588	8134	292	482
32300	1865	7974	256	453
32400	830	8185	283	428
32500	516	3030	37	109
32600	0	0	19	64
32700	1993	4172	294	401
32800	2408	5871	499	443
32900	652	8122	516	437
33000	1919	7204	533	442
33100	871	8068	548	383
40100	583	2957	98	78
40200	0	0	31	68
40300	746	3466	487	437
40400	2370	5534	507	389
40500	943	7448	543	472
40600	1930	7336	514	430
40700	888	6545	530	481
40800	597	3554	86	86
40900	0	0	28	52
41000	604	3873	443	382
41100	2535	5508	457	377
41200	792	8060	423	340
41300	1744	7453	498	457
41400	1009	7478	457	446

Table D.4 Final ANN Model Calibration and Validation Data for Inbound and Outbound Trucks at the Port of Palm Beach

Variable	No. of Data Points	Average	Std. Dev	P-value	Conclusion
Difference between Actual and Model Validation Inbound Trucks	24	0.5833	89.2977	>0.15	Normal
Difference between Actual and Model Validation Outbound Trucks	24	-2.0417	52.0597	>0.15	Normal

Table D.5 Kolmorgorov-Smirnov Normality Test Results for the Port of Palm Beach Final ANN Model

Appendix E

Port of Everglades

Day	Date	Exported Containers	Exported Tons	Imported Containers	Imported Barrel	Imported Tons	WK	SAT	SUN	Inbound Trucks
Thu	18-May-00	718	9130	660	159973	42594	1	0	0	3709
Fri	19-May-00	546	7885	647	167327	1243	1	0	0	3909
Sat	20-May-00	1502	14953	1050	388731	9895	0	1	0	1667
Sun	21-May-00	366	4678	152	603858	2134	0	0	1	1280
Mon	22-May-00	528	6997	718	319282	6786	1	0	0	3323
Tue	23-May-00	122	2320	105	158228	1362	1	0	0	3497
Wed	24-May-00	256	3316	417	0	4112	1	0	0	3518
Thu	25-May-00	1018	11706	1072	843400	30651	1	0	0	3632
Fri	26-May-00	340	3659	165	190776	32	1	0	0	3098
Mon	10-Jul-00	266	4509	523	147246	3171	1	0	0	2880
Tue	11-Jul-00	119	2021	162	145493	159	1	0	0	2980
Wed	12-Jul-00	228	2977	468	68203	38536	1	0	0	3090
Thu	13-Jul-00	509	5754	480	513159	2359	1	0	0	3164
Fri	14-Jul-00	937	10265	648	849022	4232	1	0	0	3311
Sat	15-Jul-00	1161	15251	993	21733	54055	0	1	0	1429
Sun	16-Jul-00	180	4146	160	587723	1881	0	0	1	1082
Mon	17-Jul-00	347	4789	389	376385	3032	1	0	0	3001
Mon	31-Jul-00	328	3544	338	0	9378	1	0	0	2830
Tue	1-Aug-00	482	4200	266	318285	2193	1	0	0	2792
Wed	2-Aug-00	133	1540	254	553214	4018	1	0	0	3005
Thu	3-Aug-00	760	9629	925	65684	12133	1	0	0	3062
Fri	4-Aug-00	642	9186	760	199194	19896	1	0	0	3326
Sat	5-Aug-00	1238	14946	652	7816	3705	0	1	0	1336
Sun	6-Aug-00	203	6721	135	260300	4224	0	0	1	905
Mon	7-Aug-00	316	5246	172	0	1644	1	0	0	2777
Tue	8-Aug-00	258	3037	283	384897	2713	1	0	0	2842
Wed	9-Aug-00	85	1502	378	698533	10268	1	0	0	2984
Thu	10-Aug-00	736	6195	513	0	3891	1	0	0	3135

Table E.1 Port of Everglades -Initial ANN Model Calibration and Validation for the Inbound Trucks

Day	Date	Exported Containers	Exported Tons	Imported Containers	Imported Barrel	Imported Tons	WK	SAT	SUN	Inbound Trucks
Mon	21-Aug-00	306	3451	362	276130	2837	1	0	0	3037
Tue	22-Aug-00	119	1495	137	719691	1017	1	0	0	3074
Wed	23-Aug-00	134	2445	413	258943	13778	1	0	0	3357
Tue	5-Sep-00	95	1669	200	788251	2801	1	0	0	3179
Wed	6-Sep-00	429	5583	441	96277	5830	1	0	0	3215
Thu	7-Sep-00	914	9503	631	738216	3494	1	0	0	3404
Fri	8-Sep-00	533	8597	535	133571	2129	1	0	0	3722
Sat	9-Sep-00	888	14352	846	335868	2339	0	1	0	1730
Sun	10-Sep-00	72	2314	103	21532	9254	0	0	1	1075
Mon	11-Sep-00	200	3912	192	0	1510	1	0	0	3192
Tue	12-Sep-00	93	1640	126	714897	1256	1	0	0	3094
Wed	13-Sep-00	91	1206	237	72324	5404	1	0	0	3370
Thu	14-Sep-00	816	5745	510	327351	4886	1	0	0	3557
Tue	19-Sep-00	202	1333	55	94903	4006	1	0	0	3557
Wed	20-Sep-00	276	3906	421	0	4099	1	0	0	3679
Thu	21-Sep-00	577	6285	916	488625	2780	1	0	0	3322
Fri	22-Sep-00	1145	14207	1032	204503	4583	1	0	0	3840
Sat	23-Sep-00	977	16509	8	761910	52046	0	1	0	1708
Sun	24-Sep-00	103	3687	175	362397	1867	0	0	1	1184
Mon	25-Sep-00	129	3388	675	0	29853	1	0	0	3282
Tue	26-Sep-00	308	3745	105	492832	54099	1	0	0	3166
Wed	27-Sep-00	167	4129	362	314405	1655	1	0	0	3452
Mon	2-Oct-00	447	6372	453	223074	3525	1	0	0	3073
Tue	3-Oct-00	221	2817	154	494541	1567	1	0	0	3117
Wed	4-Oct-00	199	2464	515	624427	6439	1	0	0	3224
Thu	5-Oct-00	724	7791	454	0	38753	1	0	0	3527
Mon	16-Oct-00	434	7923	480	0	5015	1	0	0	3119
Tue	17-Oct-00	277	5151	222	461476	2378	1	0	0	3311
Wed	18-Oct-00	200	4161	366	407806	4545	1	0	0	3524
Thu	19-Oct-00	385	3896	219	72255	1997	1	0	0	3349
Fri	20-Oct-00	1102	14587	872	454398	7140	1	0	0	3488
Sat	21-Oct-00	853	14865	513	262159	2150	0	1	0	1696
Sun	22-Oct-00	395	5422	277	264563	2030	0	0	1	1290
Mon	23-Oct-00	213	7841	234	366681	9495	1	0	0	3216

Table E.1 Port of Everglades- Initial ANN Model Calibration and Validation for Inbound Trucks (cotd.)

Day	Date	Exported Containers	Exported Tons	Imported Containers	Imported Barrel	Imported Tons	WK	SAT	SUN	Outbound Trucks
Mon	26-Jun-00	495	6506	471	102857	2797	1	0	0	2859
Tue	27-Jun-00	213	3131	174	569482	11345	1	0	0	3049
Wed	28-Jun-00	254	3691	1043	336690	11338	1	0	0	3111
Thu	29-Jun-00	471	6261	684	3796	25199	1	0	0	3321
Fri	30-Jun-00	1027	12447	677	143926	3932	1	0	0	3515
Sat	1-Jul-00	1198	15215	1099	0	8454	0	1	0	1354
Mon	10-Jul-00	266	4509	523	147246	3171	1	0	0	2698
Tue	11-Jul-00	119	2021	162	145493	159	1	0	0	2892
Wed	12-Jul-00	228	2977	468	68203	38536	1	0	0	3003
Thu	13-Jul-00	509	5754	480	513159	2359	1	0	0	3182
Fri	14-Jul-00	937	10265	648	849022	4232	1	0	0	3263
Sat	15-Jul-00	1161	15251	993	21733	54055	0	1	0	1486
Sun	16-Jul-00	180	4146	160	587723	1881	0	0	1	976
Mon	17-Jul-00	347	4789	389	376385	3032	1	0	0	2845
Tue	18-Jul-00	40	522	76	0	1145	1	0	0	2897
Wed	19-Jul-00	74	1020	292	2393	4679	1	0	0	2948
Thu	20-Jul-00	758	10417	690	165679	5571	1	0	0	3014
Fri	21-Jul-00	941	12253	569	564913	3297	1	0	0	3593
Tue	25-Jul-00	515	3584	101	276323	5	1	0	0	2859
Wed	26-Jul-00	406	6699	731	507985	40537	1	0	0	3002
Thu	27-Jul-00	266	4254	408	290841	3037	1	0	0	3089
Mon	31-Jul-00	328	3544	338	0	9378	1	0	0	2772
Tue	1-Aug-00	482	4200	266	318285	2193	1	0	0	2783
Wed	2-Aug-00	133	1540	254	553214	4018	1	0	0	2974
Thu	3-Aug-00	760	9629	925	65684	12133	1	0	0	3022
Fri	4-Aug-00	642	9186	760	199194	19896	1	0	0	3395
Sat	5-Aug-00	1238	14946	652	7816	3705	0	1	0	1370
Sun	6-Aug-00	203	6721	135	260300	4224	0	0	1	940
Mon	7-Aug-00	316	5246	172	0	1644	1	0	0	2788
Tue	8-Aug-00	258	3037	283	384897	2713	1	0	0	2918
Wed	9-Aug-00	85	1502	378	698533	10268	1	0	0	3073
Thu	10-Aug-00	736	6195	513	0	3891	1	0	0	3205
Fri	11-Aug-00	723	9896	733	292795	2160	1	0	0	3206
Sat	12-Aug-00	1009	15153	574	515055	2821	0	1	0	1413
Sun	13-Aug-00	122	2959	50	36710	2473	0	0	1	955
Mon	14-Aug-00	348	4941	289	312246	3266	1	0	0	2843
Tue	15-Aug-00	25	491	0	253514	42013	1	0	0	2753
Wed	16-Aug-00	69	1027	225	421250	3324	1	0	0	3067
Thu	17-Aug-00	972	8087	597	854955	3790	1	0	0	3152
Fri	18-Aug-00	749	10743	652	295174	4760	1	0	0	3601

Table E.2 Port of Everglades-Initial ANN Model Calibration and Validation for Outbound Trucks

Day	Date	Exported Containers	Exported Tons	Imported Containers	Imported Barrel	Imported Tons	WK	SAT	SUN	Outbound Trucks
Sun	20-Aug-00	146	3262	68	0	5755	0	0	1	1302
Mon	21-Aug-00	306	3451	362	276130	2837	1	0	0	3082
Tue	22-Aug-00	119	1495	137	719691	1017	1	0	0	3170
Wed	23-Aug-00	134	2445	413	258943	13778	1	0	0	3412
Thu	24-Aug-00	984	11260	773	0	46027	1	0	0	3405
Fri	25-Aug-00	694	9764	600	321465	51529	1	0	0	3156
Sat	26-Aug-00	805	12204	572	555925	2965	0	1	0	1252
Sun	27-Aug-00	33	3580	34	489223	2811	0	0	1	912
Mon	28-Aug-00	495	7750	379	0	37258	1	0	0	2834
Tue	29-Aug-00	103	701	329	460622	561	1	0	0	3402
Wed	30-Aug-00	71	1171	188	353635	3524	1	0	0	3348
Tue	5-Sep-00	95	1669	200	788251	2801	1	0	0	2764
Wed	6-Sep-00	429	5583	441	96277	5830	1	0	0	2893
Thu	7-Sep-00	914	9503	631	738216	3494	1	0	0	3119
Fri	8-Sep-00	533	8597	535	133571	2129	1	0	0	3376
Sat	9-Sep-00	888	14352	846	335868	2339	0	1	0	1465
Sun	10-Sep-00	72	2314	103	21532	9254	0	0	1	928
Mon	11-Sep-00	200	3912	192	0	1510	1	0	0	2941
Tue	19-Sep-00	202	1333	55	94903	4006	1	0	0	3470
Wed	20-Sep-00	276	3906	421	0	4099	1	0	0	3543
Thu	21-Sep-00	577	6285	916	488625	2780	1	0	0	3191
Fri	22-Sep-00	1145	14207	1032	204503	4583	1	0	0	3880
Sat	23-Sep-00	977	16509	8	761910	52046	0	1	0	2153
Sun	24-Sep-00	103	3687	175	362397	1867	0	0	1	1488
Mon	25-Sep-00	129	3388	675	0	29853	1	0	0	3320
Tue	26-Sep-00	308	3745	105	492832	54099	1	0	0	3023
Wed	27-Sep-00	167	4129	362	314405	1655	1	0	0	3205
Thu	28-Sep-00	662	6962	601	160936	2613	1	0	0	3174
Fri	29-Sep-00	739	8510	1121	113973	2994	1	0	0	3531
Mon	2-Oct-00	447	6372	453	223074	3525	1	0	0	3048
Tue	3-Oct-00	221	2817	154	494541	1567	1	0	0	2812
Wed	4-Oct-00	199	2464	515	624427	6439	1	0	0	2987
Thu	5-Oct-00	724	7791	454	0	38753	1	0	0	3272
Mon	16-Oct-00	434	7923	480	0	5015	1	0	0	3254
Tue	17-Oct-00	277	5151	222	461476	2378	1	0	0	3393
Wed	18-Oct-00	200	4161	366	407806	4545	1	0	0	3723
Thu	19-Oct-00	385	3896	219	72255	1997	1	0	0	3637
Fri	20-Oct-00	1102	14587	872	454398	7140	1	0	0	3830
Sat	21-Oct-00	853	14865	513	262159	2150	0	1	0	1923
Sun	22-Oct-00	395	5422	277	264563	2030	0	0	1	1329

Table E.2 Port of Everglades-Initial ANN Model Calibration and Validation for Outbound Trucks (cotd)

INBOUND									
h1	**h2**	**EPOCHS**	**Algorithm**	**MSE**	**h1**	**h2**	**EPOCHS**	**Algorithm**	**MSE**
0	0	100	Trainlm	55432	2	2	100	Trainlm	71714
0	0	200	Trainlm	52983	2	2	200	Trainlm	81137
0	0	300	Trainlm	56332	2	2	300	Trainlm	433939
0	0	400	Trainlm	50511	2	2	400	Trainlm	116678
0	0	100	Traincgb	39042	2	2	100	Traincgb	94920
0	0	200	Traincgb	93350	2	2	200	Traincgb	97327
0	0	300	Traincgb	58105	2	2	300	Traincgb	143960
0	0	100	Trainrp	49600	2	2	100	Trainrp	85673
0	0	200	Trainrp	84363	2	2	200	Trainrp	233089
0	0	300	Trainrp	74690	2	2	300	Trainrp	63159
1	1	100	Trainlm	80096	2	3	100	Trainlm	932442
1	1	200	Trainlm	55237	2	3	200	Trainlm	66579
1	1	300	Trainlm	67312	2	3	300	Trainlm	252621
1	1	400	Trainlm	57189	2	3	400	Trainlm	72928
1	1	100	Traincgb	78776	2	3	100	Traincgb	83626
1	1	200	Traincgb	107824	2	3	200	Traincgb	124762
1	1	300	Traincgb	461810	2	3	300	Traincgb	72170
1	1	100	Trainrp	64349	2	3	100	Trainrp	127295
1	1	200	Trainrp	56904	2	3	200	Trainrp	147770
1	1	300	Trainrp	185698	2	3	300	Trainrp	174599
1	2	100	Trainlm	69353	3	1	100	Trainlm	166447
1	2	200	Trainlm	103304	3	1	200	Trainlm	213588
1	2	300	Trainlm	54268	3	1	300	Trainlm	358188
1	2	400	Trainlm	103564	3	1	400	Trainlm	54304
1	2	100	Traincgb	56286	3	1	100	Traincgb	192226
1	2	200	Traincgb	66041	3	1	200	Traincgb	466999
1	2	300	Traincgb	86543	3	1	300	Traincgb	82959
1	2	100	Trainrp	187623	3	1	100	Trainrp	358345
1	2	200	Trainrp	89776	3	1	200	Trainrp	212777
1	2	300	Trainrp	62227	3	1	300	Trainrp	137326
1	3	100	Trainlm	481088	3	2	100	Trainlm	216484
1	3	200	Trainlm	433978	3	2	200	Trainlm	122146
1	3	300	Trainlm	223517	3	2	300	Trainlm	101271
1	3	400	Trainlm	80572	3	2	400	Trainlm	349864
1	3	100	Traincgb	366243	3	2	100	Traincgb	608215
1	3	200	Traincgb	126703	3	2	200	Traincgb	122756
1	3	300	Traincgb	308143	3	2	300	Traincgb	126630
1	3	100	Trainrp	154924	3	2	100	Trainrp	561738
1	3	200	Trainrp	610350	3	2	200	Trainrp	166214
1	3	300	Trainrp	89311	3	2	300	Trainrp	312158
2	1	100	Trainlm	45398	3	3	100	Trainlm	208958
2	1	200	Trainlm	68711	3	3	200	Trainlm	815672
2	1	300	Trainlm	72855	3	3	300	Trainlm	72946
2	1	400	Trainlm	54793	3	3	400	Trainlm	301828
2	1	100	Traincgb	118437	3	3	100	Traincgb	78470
2	1	200	Traincgb	55677	3	3	200	Traincgb	358839
2	1	300	Traincgb	58311	3	3	300	Traincgb	63962
2	1	100	Trainrp	264148	3	3	100	Trainrp	179972
2	1	200	Trainrp	546929	3	3	200	Trainrp	306450
2	1	300	Trainrp	78404	3	3	300	Trainrp	140358

Table E. 3 Port of Everglades-Initial ANN Model Run Results for Inbound Trucks

OUTBOUND									
h1	h2	EPOCHS	Algorithm	MSE	h1	h2	EPOCHS	Algorithm	MSE
0	0	100	Trainlm	92377	2	2	100	Trainlm	8237514
0	0	200	Trainlm	75050	2	2	200	Trainlm	284905
0	0	300	Trainlm	52486	2	2	300	Trainlm	103564
0	0	400	Trainlm	86108	2	2	400	Trainlm	115089
0	0	100	Traincgb	70986	2	2	100	Traincgb	131975
0	0	200	Traincgb	54038	2	2	200	Traincgb	310781
0	0	300	Traincgb	88087	2	2	300	Traincgb	134880
0	0	100	Trainrp	90989	2	2	100	Trainrp	187777
0	0	200	Trainrp	90464	2	2	200	Trainrp	461587
0	0	300	Trainrp	75999	2	2	300	Trainrp	103566
1	1	100	Trainlm	90951	2	3	100	Trainlm	1734385
1	1	200	Trainlm	87199	2	3	200	Trainlm	199586
1	1	300	Trainlm	79517	2	3	300	Trainlm	625695
1	1	400	Trainlm	69077	2	3	400	Trainlm	179207
1	1	100	Traincgb	98531	2	3	100	Traincgb	65781
1	1	200	Traincgb	101026	2	3	200	Traincgb	1201983
1	1	300	Traincgb	93737	2	3	300	Traincgb	25033253
1	1	100	Trainrp	86402	2	3	100	Trainrp	41753133
1	1	200	Trainrp	66287	2	3	200	Trainrp	137594
1	1	300	Trainrp	117170	2	3	300	Trainrp	15403414
1	2	100	Trainlm	111202	3	1	100	Trainlm	246034
1	2	200	Trainlm	62828	3	1	200	Trainlm	251336
1	2	300	Trainlm	80120	3	1	300	Trainlm	581884
1	2	400	Trainlm	209698	3	1	400	Trainlm	6602296
1	2	100	Traincgb	79460	3	1	100	Traincgb	611083
1	2	200	Traincgb	83103	3	1	200	Traincgb	587236
1	2	300	Traincgb	64791	3	1	300	Traincgb	241723
1	2	100	Trainrp	580024	3	1	100	Trainrp	628786
1	2	200	Trainrp	139892	3	1	200	Trainrp	792058
1	2	300	Trainrp	75230	3	1	300	Trainrp	648711
1	3	100	Trainlm	86591	3	2	100	Trainlm	827559
1	3	200	Trainlm	58660	3	2	200	Trainlm	291986
1	3	300	Trainlm	119295	3	2	300	Trainlm	976147
1	3	400	Trainlm	210491	3	2	400	Trainlm	97724
1	3	100	Traincgb	70086	3	2	100	Traincgb	685439
1	3	200	Traincgb	83318	3	2	200	Traincgb	153319
1	3	300	Traincgb	75762	3	2	300	Traincgb	1128344
1	3	100	Trainrp	63161	3	2	100	Trainrp	15830635
1	3	200	Trainrp	68908	3	2	200	Trainrp	5190791
1	3	300	Trainrp	78155	3	2	300	Trainrp	82841775
2	1	100	Trainlm	363247	3	3	100	Trainlm	22883916
2	1	200	Trainlm	509723	3	3	200	Trainlm	618078
2	1	300	Trainlm	114450	3	3	300	Trainlm	3815637
2	1	400	Trainlm	10582786	3	3	400	Trainlm	707920
2	1	100	Traincgb	419546	3	3	100	Traincgb	3192371
2	1	200	Traincgb	828615	3	3	200	Traincgb	1829904
2	1	300	Traincgb	107580	3	3	300	Traincgb	246681
2	1	100	Trainrp	748767	3	3	100	Trainrp	1899131
2	1	200	Trainrp	216853	3	3	200	Trainrp	2270274
2	1	300	Trainrp	141964	3	3	300	Trainrp	2373768

Table E.4 Port of Everglades-Initial ANN Model Run Results for Outbound Trucks

Date	Imported Containers (-2)	Imported Containers (-1)	Monthly Average-Imported Barrels	Imported Tonnage (-3)	Imported Tonnage (-2)	Imported Tonnage (-1)	Imported Tonnage (0)	Exported Containers (0)	Exported Containers (+1)	Exported Containers (+2)	Exported Containers (+3)	Exported Tonnage (+3)	Sat	Sun
051800	275	561	294436	8997	9496	8632	11045	718	546	1502	366	86	0	0
051900	561	660	294436	9496	8632	11045	8633	546	1502	366	528	188	0	0
052000	660	647	294436	8632	11045	8633	8631	1502	366	528	122	228	1	0
052100	647	1050	294436	11045	8633	8631	0	366	528	122	256	362	0	1
052200	1050	152	294436	8633	8631	0	8730	528	122	256	1018	382	0	0
052300	152	718	294436	8631	0	8730	8631	122	256	1018	340	77	0	0
052400	718	105	294436	0	8730	8631	8631	256	1018	340	1259	244	0	0
052500	105	417	294436	8730	8631	8631	8930	1018	340	1259	433	1059	0	0
052600	417	1072	294436	8631	8631	8930	8631	340	1259	433	290	16	0	0
071000	974	242	296364	9920	9806	1	9804	266	119	228	509	198	0	0
071100	242	523	296364	9806	1	9804	9883	119	228	509	937	11	0	0
071200	523	162	296364	1	9804	9883	9804	228	509	937	1161	61	0	0
071300	162	468	296364	9804	9883	9804	9804	509	937	1161	180	21	0	0
071400	468	480	296364	9883	9804	9804	9811	937	1161	180	347	306	0	0
071500	480	648	296364	9804	9804	9811	9810	1161	180	347	40	300	1	0
071600	648	993	296364	9804	9811	9810	0	180	347	40	74	1034	0	1
071700	993	160	296364	9811	9810	0	9804	347	40	74	758	21	0	0
073100	934	302	296364	9857	9804	5	16157	328	268	133	760	34	0	0
080100	302	338	302820	9804	5	16157	6703	268	133	760	642	255	0	0
080200	338	47	302820	5	16157	6703	6703	133	760	642	1238	39	0	0
080300	47	254	302820	16157	6703	6703	10357	760	642	1238	203	155	0	0
080400	254	925	302820	6703	6703	10357	6993	642	1238	203	316	184	0	0
080500	925	760	302820	6703	10357	6993	7033	1238	203	316	258	829	1	0
080600	760	652	302820	10357	6993	7033	279	203	316	258	85	298	0	1
080700	652	135	302820	6993	7033	279	6761	316	258	85	736	670	0	0
080800	135	172	302820	7033	279	6761	6771	258	85	736	723	159	0	0
080900	172	283	302820	279	6761	6771	12122	85	736	723	1009	113	0	0
081000	283	378	302820	6761	6771	12122	6739	736	723	1009	122	204	0	0

Table E.5 Port of Everglades-Final ANN Model Calibration and Validation for Inbound Trucks

Date	Imported Containers (-2)	Imported Containers (-1)	Monthly Average-Imported Barrels	Imported Tonnage (-3)	Imported Tonnage (-2)	Imported Tonnage (-1)	Imported Tonnage (0)	Exported Containers (0)	Exported Containers (+1)	Exported Containers (+2)	Exported Containers (+3)	Exported Tonnage (+3)	Sat	Sun
082100	857	68	302820	6769	6703	0	6723	306	119	134	984	67	0	0
082200	68	362	302820	6703	0	6723	6734	119	134	984	694	56	0	0
082300	362	137	302820	0	6723	6734	15476	134	984	694	806	48	0	0
090500	28	153	293126	15729	0	9993	9993	95	429	914	533	0	0	0
090600	153	175	293126	0	9993	9993	9996	429	914	533	888	379	0	0
090700	175	441	293126	9993	9993	9996	10197	914	533	888	72	185	0	0
090800	441	631	293126	9993	9996	10197	10008	533	888	72	200	1216	0	0
090900	631	535	293126	9996	10197	10008	9996	888	72	200	224	392	1	0
091000	535	846	293126	10197	10008	9996	5560	72	200	224	91	78	0	1
091100	846	103	293126	10008	9996	5560	9993	200	224	91	816	120	0	0
091200	103	192	293126	9996	5560	9993	9995	224	91	816	923	274	0	0
091300	192	278	293126	5560	9993	9995	10913	91	816	923	1054	39	0	0
091400	278	237	293126	9993	9995	10913	9995	816	923	1054	23	185	0	0
091900	8	267	293126	10672	0	10057	12663	202	276	577	1145	104	0	0
092000	267	254	293126	0	10057	12663	11686	276	577	1145	977	89	0	0
092100	254	55	293126	10057	12663	11686	9996	577	1145	977	103	157	0	0
092200	55	421	293126	12663	11686	9996	9998	1145	977	103	129	248	0	0
092300	421	916	293126	11686	9996	9998	9993	977	103	129	308	335	1	0
092400	916	1032	293126	9996	9998	9993	1011	103	129	308	167	514	0	1
092500	1032	8	293126	9998	9993	1011	9993	129	308	167	662	0	0	0
092600	8	175	293126	9993	1011	9993	9998	308	167	662	739	176	0	0
092700	175	675	293126	1011	9993	9998	9993	167	662	739	1198	1690	0	0
100200	1121	19	311480	9993	10012	0	4965	447	221	199	724	170	0	0
100300	19	453	311480	10012	0	4965	5134	221	199	724	420	107	0	0
100400	453	154	311480	0	4965	5134	4957	199	724	420	1184	76	0	0
100500	154	515	311480	4965	5134	4957	4955	724	420	1184	108	269	0	0
101600	487	182	311480	4966	4960	0	5037	434	277	200	385	448	0	0
101700	182	480	311480	4960	0	5037	5107	277	200	385	1102	997	0	0
101800	480	222	311480	0	5037	5107	4995	200	385	1102	853	258	0	0
101900	222	366	311480	5037	5107	4995	4955	385	1102	853	395	170	0	0
102000	366	219	311480	5107	4995	4955	7009	1102	853	395	213	1363	0	0
102100	219	872	311480	4995	4955	7009	4955	853	395	213	128	78	1	0
102200	872	513	311480	4955	7009	4955	121	395	213	128	213	276	0	1

Table E.5 Port of Everglades-Final ANN Model Calibration and Validation for Inbound Trucks (Cotd.)

Date	Imported Containers (-1)	Imported Containers (0)	Monthly Average-Imported Barrels	Imported Tonnage (1)	Exported Containers (0)	Exported Containers (+1)	Exported Containers (+3)	Exported Tonnage (+3)	Sat	Sun	Outbound Trucks
062600	243	471	324287.1	0.0	494	213	471	136	0	0	2859
062700	471	174	324287.1	5041.2	213	254	1027	132	0	0	3049
062800	174	1043	324287.1	14957.2	254	471	1198	392	0	0	3111
062900	1043	684	324287.1	10883.2	471	1027	525	87	0	0	3321
063000	684	677	324287.1	5039.2	1027	1198	347	393	0	0	3515
070100	677	1099	296363.7	5056.2	1198	525	18	588	1	0	1354
071000	242	523	296363.7	1.0	266	119	509	198	0	0	2698
071100	523	162	296363.7	9803.7	119	228	937	11	0	0	2892
071200	162	468	296363.7	9882.7	228	509	1161	61	0	0	3003
071300	468	480	296363.7	9803.7	509	937	180	21	0	0	3182
071400	480	648	296363.7	9803.7	937	1161	347	306	0	0	3263
071500	648	993	296363.7	9810.7	1161	180	40	300	1	0	1486
071600	993	160	296363.7	9809.7	180	347	74	1034	0	1	976
071700	160	389	296363.7	0.0	347	40	758	21	0	0	2845
071800	389	76	296363.7	9803.7	40	74	941	45	0	0	2897
071900	76	292	296363.7	9803.7	74	758	1570	67	0	0	2948
072000	292	690	296363.7	10926.7	758	941	144	203	0	0	3014
072100	690	569	296363.7	9808.7	941	1570	108	306	0	0	3593
072500	342	101	296363.7	9803.7	515	406	1208	105	0	0	2859
072600	101	731	296363.7	9805.7	406	266	1119	498	0	0	3002
072700	731	408	296363.7	9851.7	266	1208	229	1178	0	0	3089
073100	302	338	296363.7	5.0	328	268	760	34	0	0	2772
080100	338	47	302820.3	16156.7	268	133	642	255	0	0	2783
080200	47	254	302820.3	6702.5	133	760	1238	39	0	0	2974
080300	254	925	302820.3	6702.5	760	642	203	155	0	0	3022
080400	925	760	302820.3	10356.5	642	1238	316	184	0	0	3395
080500	760	652	302820.3	6992.5	1238	203	258	829	1	0	1370
080600	652	135	302820.3	7032.5	203	316	85	298	0	1	940
080700	135	172	302820.3	279.0	316	258	736	670	0	0	2788
080800	172	283	302820.3	6760.5	258	85	723	159	0	0	2918
080900	283	378	302820.3	6770.5	85	736	1009	113	0	0	3073
081000	378	513	302820.3	12121.5	736	723	122	204	0	0	3205
081100	513	733	302820.3	6738.5	723	1009	348	176	0	0	3206

Table E.6 Port of Everglades-Final ANN Model Calibration and Validation for Outbound Trucks

Date	Imported Containers (-1)	Imported Containers (0)	Monthly Average-Imported Barrels	Imported Tonnage (-1)	Exported Containers (0)	Exported Containers (+1)	Exported Containers (+3)	Exported Tonnage (+3)	Sat	Sun	Outbound Trucks
081200	733	574	302820.3	6727.5	1009	122	25	480	1	0	1413
081300	574	50	302820.3	6703.5	122	348	69	93	0	1	955
081400	50	289	302820.3	3.0	348	25	972	2	0	0	2843
081500	289	0	302820.3	6808.5	25	69	749	9	0	0	2753
081600	0	225	302820.3	8929.5	69	972	975	19	0	0	3067
081700	225	597	302820.3	6702.5	972	749	146	250.65	0	0	3152
081800	597	652	302820.3	6704.5	749	975	306	352	0	0	3601
082000	857	68	302820.3	6702.5	146	306	134	1086	0	1	1302
082100	68	362	302820.3	0.0	306	119	984	67	0	0	3082
082200	362	137	302820.3	6722.5	119	134	694	56	0	0	3170
082300	137	413	302820.3	6733.5	134	984	806	48	0	0	3412
082400	413	773	302820.3	15475.5	984	694	33	1346	0	0	3405
082500	773	600	302820.3	6737.5	694	806	495	177	0	0	3156
082600	600	572	302820.3	6702.5	806	33	103	430	1	0	1252
082700	572	34	302820.3	6704.5	33	495	71	29	0	1	912
082800	34	379	302820.3	1.0	495	103	627	162	0	0	2834
082900	379	329	302820.3	6702.5	103	71	998	0	0	0	3402
083000	329	188	302820.3	6741.5	71	627	1075	67	0	0	3348
090500	153	175	293126.2	9993.1	95	429	533	0	0	0	2764
090600	175	441	293126.2	9993.1	429	914	888	379	0	0	2893
090700	441	631	293126.2	9996.1	914	533	72	185	0	0	3119
090800	631	535	293126.2	10197.1	533	888	200	1216	0	0	3376
090900	535	846	293126.2	10008.1	888	72	224	392	1	0	1465
091000	846	103	293126.2	9996.1	72	200	91	78	0	1	928
091100	103	192	293126.2	5560.0	200	224	816	120	0	0	2941
091900	267	254	293126.2	10057.1	202	276	1145	104	0	0	3470
092000	254	55	293126.2	12663.1	276	577	977	89	0	0	3543
092100	55	421	293126.2	11686.1	577	1145	103	157	0	0	3191
092400	1032	8	293126.2	9993.1	103	129	167	514	0	1	1488
092500	8	175	293126.2	1011.0	129	308	662	0	0	0	3320
092600	175	675	293126.2	9993.1	308	167	739	176	0	0	3023
092700	675	105	293126.2	9998.1	167	662	1198	1690	0	0	3205
100200	19	453	311480.2	0.0	447	221	724	170	0	0	3048
100500	515	479	311480.2	4957.2	724	420	108	269	0	0	3272
101600	182	480	311480.2	0.0	434	277	385	448	0	0	3254
101700	480	222	311480.2	5037.2	277	200	1102	997	0	0	3393
101900	366	219	311480.2	4995.2	385	1102	395	170	0	0	3637
102000	219	872	311480.2	4955.2	1102	853	213	1363	0	0	3830
102100	872	513	311480.2	7009.2	853	395	128	78	1	0	1923
102200	513	277	311480.2	4955.2	395	213	213	276	0	1	1329

Table E.6 Port of Everglades-Final ANN Model Calibration and Validation for Outbound Trucks (Cotd.)

Appendix F

Port of Tampa

Exported Containers	Exported Tons	Imported Containers	Imported Barrels	Imported Tons	Wk	Sat	Sun	Inbound Trucks
80	48663	0	268148	50522	1	0	0	3780
0	75338	0	526623	34371	1	0	0	3691
86	794	4	373997	43403	1	0	0	4298
4	44616	0	433032	37235	1	0	0	4221
0	19783	0	293792	62748	1	0	0	4516
68	88901	0	0	12349	1	0	0	4451
0	1400	0	378713	60537	1	0	0	4542
0	113705	0	0	64866	1	0	0	4191
61	17595	0	0	27799	0	1	0	3019
0	26668	318	0	29568	0	0	1	1723
0	24250	0	140812	72693	1	0	0	4331
0	0	0	630524	84412	1	0	0	4346
0	59948	0	291972	15671	1	0	0	4707
0	24248	0	235796	52093	1	0	0	4342
0	2424	0	75856	88201	1	0	0	4236
71	28521	229	395917	25397	0	1	0	2177
0	661	0	162824	87298	0	0	1	1588
0	68448	0	199356	39265	1	0	0	4078
48	51468	1	319844	32938	0	1	0	2204
0	14960	0	429792	36232	1	0	0	4707
51	8625	1	37304	0	0	1	0	2294
0	0	0	106069	2964	0	0	1	1775
4	53454	1	300262	403	1	0	0	4344
0	1400	0	209791	28947	1	0	0	4303
41	0	2	234661	97317	0	1	0	2376
0	6833	0	30252	21882	0	0	1	1700
0	0	0	312015	65085	1	0	0	4427
0	61841	329	352993	13807	1	0	0	4529
0	0	0	123783	41430	1	0	0	4510
0	0	0	264446	38512	1	0	0	4422
0	42934	0	0	30456	1	0	0	3950
0	0	220	0	0	0	0	1	1181
1	61120	0	237910	84448	1	0	0	4271
0	26999	0	374432	55678	1	0	0	4383
25	24847	0	18020	23341	1	0	0	4429
14	303	16	285843	40950	1	0	0	4348
167	45407	348	183036	1000	0	1	0	2258
0	45823	0	181565	0	0	0	1	1834

Table F.1 Port of Tampa-Initial Model Calibration and Validation for Inbound Trucks

Exported Containers	Exported Tons	Imported Containers	Imported Barrels	Imported Tons	Wk	Sat	Sun	Inbound Trucks
0	0	0	407156	40391	1	0	0	4191
211	29316	0	705530	65893	1	0	0	4233
0	31810	0	528565	53453	1	0	0	4361
0	63675	0	89964	18313	1	0	0	4517
64	60741	2	223117	13063	0	1	0	2047
0	0	0	0	0	0	0	1	1667
0	26308	0	154756	27795	1	0	0	4018
17	54	0	664850	34561	1	0	0	4222
0	38723	0	510447	54578	1	0	0	3961
0	43946	254	661720	48496	1	0	0	3867
0	49153	0	36240	102659	1	0	0	3526
0	23146	203	570118	16748	1	0	0	4102
104	8136	0	192609	27016	1	0	0	3941
0	30729	0	257512	53972	1	0	0	4249
0	31768	0	574323	20518	1	0	0	4213
57	4847	1	38309	85416	0	1	0	2309
0	12638	0	279769	0	0	0	1	1666
0	22062	0	104256	67638	1	0	0	4183
0	15218	0	167723	106062	1	0	0	4059
138	4	0	0	26130	1	0	0	4113
0	9000	0	0	0	1	0	0	4113
0	30489	0	124827	24428	1	0	0	4087
0	0	0	73075	21342	1	0	0	4166
127	31062	0	17565	38185	1	0	0	3842
0	0	0	277617	28396	1	0	0	4286
0	0	0	175330	0	1	0	0	4388
0	0	0	10193	27375	1	0	0	4257
0	0	0	30096	6878	1	0	0	4299
0	0	0	0	32340	1	0	0	4274
71	0	1	114138	0	0	1	0	2124
0	0	0	266319	0	0	0	1	1548
0	0	0	162535	16689	1	0	0	4101
0	22372	0	0	0	1	0	0	4438
0	0	0	14971	0	1	0	0	4272
0	0	0	163778	0	1	0	0	4232
0	0	0	0	21778	1	0	0	4230
40	0	4	0	0	0	1	0	2280
0	15484	0	14933	0	1	0	0	4055
0	0	0	0	0	1	0	0	4111
0	0	0	0	11293	1	0	0	4213
62	0	2	0	73087	0	1	0	2089
0	0	0	0	10049	0	0	1	1671
64	0	0	18486	22869	0	1	0	2002
0	22498	0	162888	9106	0	0	1	1700

Table F.1 Port of Tampa-Initial Model Calibration and Validation for Inbound Trucks (Cotd)

Exported Containers	Exported Tons	Imported Containers	Imported Barrels	Imported Tons	Wk	Sat	Sun	Outbound Trucks
0	56471	0	326533	54808	1	0	0	3889
0	4627	0	250776	62566	1	0	0	4004
0	11048	0	247183	375	1	0	0	3747
0	68448	0	199356	39265	1	0	0	3612
48	51468	1	319844	32938	0	1	0	1667
0	0	0	77793	74963	0	0	1	1364
0	41589	491	284689	16135	1	0	0	3575
0	11980	0	17816	5254	1	0	0	3946
0	10000	0	498475	40369	1	0	0	3298
0	14960	0	429792	36232	1	0	0	3697
1	61120	0	237910	84448	1	0	0	3508
0	26999	0	374432	55678	1	0	0	3756
25	24847	0	18020	23341	1	0	0	3949
14	303	16	285843	40950	1	0	0	3888
167	45407	348	183036	1000	0	1	0	1765
0	63675	0	89964	18313	1	0	0	4596
0	0	0	270213	0	1	0	0	4311
64	60741	2	223117	13063	0	1	0	2020
0	0	0	0	0	0	0	1	1109
0	23146	203	570118	16748	1	0	0	4032
104	8136	0	192609	27016	1	0	0	4165
0	30729	0	257512	53972	1	0	0	4159
0	31768	0	574323	20518	1	0	0	4291
57	4847	1	38309	85416	0	1	0	2202
0	12638	0	279769	0	0	0	1	1617
0	22062	0	104256	67638	1	0	0	4231
0	15218	0	167723	106062	1	0	0	4104
138	4	0	0	26130	1	0	0	3930
0	9000	0	0	0	1	0	0	3899
0	30489	0	124827	24428	1	0	0	3792
0	0	0	0	22040	0	1	0	1881
0	0	0	73075	21342	1	0	0	4480
127	31062	0	17565	38185	1	0	0	4606

Table F.2 Port of Tampa-Initial Model Calibration and Validation Data for Outbound Trucks

Exported Containers	Exported Tons	Imported Containers	Imported Barrels	Imported Tons	Wk	Sat	Sun	Outbound Trucks
0	992	0	33712	2574	1	0	0	3481
0	21204	0	94163	58815	0	1	0	1545
50	0	54	79668	0	0	0	1	1413
0	0	0	58489	1208	1	0	0	3562
0	0	0	168096	0	1	0	0	3387
0	0	0	148733	38191	1	0	0	3469
0	0	0	333235	0	1	0	0	3369
0	0	0	0	7649	1	0	0	3071
0	0	0	277617	28396	1	0	0	4034
0	0	0	175330	0	1	0	0	4168
0	0	0	10193	27375	1	0	0	4098
0	0	0	30096	6878	1	0	0	4148
0	0	0	0	32340	1	0	0	4123
71	0	1	114138	0	0	1	0	1811
0	0	0	266319	0	0	0	1	1444
0	0	0	162535	16689	1	0	0	3783
0	22372	0	0	0	1	0	0	4274
0	0	0	14971	0	1	0	0	4178
0	0	0	163778	0	1	0	0	4083
0	0	0	0	21778	1	0	0	4004
40	0	4	0	0	0	1	0	2015
0	15484	0	14933	0	1	0	0	3834
0	0	0	0	0	1	0	0	3926
0	0	0	0	11293	1	0	0	4126
0	22507	0	0	8503	1	0	0	3460
62	0	2	0	73087	0	1	0	1751
0	0	0	0	10049	0	0	1	1270
0	18002	441	85532	0	1	0	0	3768
0	0	0	0	11745	1	0	0	3820
0	0	0	0	8033	1	0	0	3562
0	0	0	0	0	1	0	0	3737
64	0	0	18486	22869	0	1	0	1796
0	22498	0	162888	9106	0	0	1	1300

Table F.2 Port of Tampa-Initial Model Calibration and Validation Data for Outbound Trucks (Cotd.)

INBOUND

h1	h2	EPOCHS	Algorithm	MSE	h1	h2	EPOCHS	Algorithm	MSE
0	0	100	Trainlm	39450	2	2	100	Trainlm	67791
0	0	200	Trainlm	142571	2	2	200	Trainlm	82953
0	0	300	Trainlm	46021	2	2	300	Trainlm	340990
0	0	400	Trainlm	70769	2	2	400	Trainlm	58826
0	0	100	Traincgb	125625	2	2	100	Traincgb	84291
0	0	200	Traincgb	52255	2	2	200	Traincgb	397778
0	0	300	Traincgb	57206	2	2	300	Traincgb	83692
0	0	100	Trainrp	51266	2	2	100	Trainrp	58681
0	0	200	Trainrp	78860	2	2	200	Trainrp	75006
0	0	300	Trainrp	44637	2	2	300	Trainrp	158818
1	1	100	Trainlm	42789	2	3	100	Trainlm	194671
1	1	200	Trainlm	73450	2	3	200	Trainlm	111008
1	1	300	Trainlm	100098	2	3	300	Trainlm	64489
1	1	400	Trainlm	64281	2	3	400	Trainlm	44514
1	1	100	Traincgb	95479	2	3	100	Traincgb	79227
1	1	200	Traincgb	75941	2	3	200	Traincgb	405412
1	1	300	Traincgb	156018	2	3	300	Traincgb	218722
1	1	100	Trainrp	196993	2	3	100	Trainrp	202203
1	1	200	Trainrp	304456	2	3	200	Trainrp	194200
1	1	300	Trainrp	65365	2	3	300	Trainrp	195279
1	2	100	Trainlm	63171	3	1	100	Trainlm	71676
1	2	200	Trainlm	67501	3	1	200	Trainlm	203987
1	2	300	Trainlm	79142	3	1	300	Trainlm	146436
1	2	400	Trainlm	136806	3	1	400	Trainlm	29815
1	2	100	Traincgb	109643	3	1	100	Traincgb	180468
1	2	200	Traincgb	51126	3	1	200	Traincgb	58482
1	2	300	Traincgb	72792	3	1	300	Traincgb	127499
1	2	100	Trainrp	131728	3	1	100	Trainrp	418895
1	2	200	Trainrp	192011	3	1	200	Trainrp	107340
1	2	300	Trainrp	292704	3	1	300	Trainrp	154722
1	3	100	Trainlm	64429	3	2	100	Trainlm	273484
1	3	200	Trainlm	74920	3	2	200	Trainlm	225510
1	3	300	Trainlm	112199	3	2	300	Trainlm	162912
1	3	400	Trainlm	36872	3	2	400	Trainlm	212353
1	3	100	Traincgb	320324	3	2	100	Traincgb	95422
1	3	200	Traincgb	243907	3	2	200	Traincgb	322680
1	3	300	Traincgb	223627	3	2	300	Traincgb	285927
1	3	100	Trainrp	177669	3	2	100	Trainrp	73155
1	3	200	Trainrp	44303	3	2	200	Trainrp	133631
1	3	300	Trainrp	1484576	3	2	300	Trainrp	167282
2	1	100	Trainlm	237890	3	3	100	Trainlm	155526
2	1	200	Trainlm	138815	3	3	200	Trainlm	82783
2	1	300	Trainlm	128152	3	3	300	Trainlm	195848
2	1	400	Trainlm	224721	3	3	400	Trainlm	151651
2	1	100	Traincgb	70102	3	3	100	Traincgb	80888
2	1	200	Traincgb	60440	3	3	200	Traincgb	145218
2	1	300	Traincgb	139504	3	3	300	Traincgb	102337
2	1	100	Trainrp	181005	3	3	100	Trainrp	89571
2	1	200	Trainrp	120882	3	3	200	Trainrp	103254
2	1	300	Trainrp	46733	3	3	300	Trainrp	209654

Table F.3 Port of Tampa-ANN Model Runs for Inbound Trucks– Port of Tampa

OUTBOUND

h1	h2	EPOCHS	Algorithm	MSE	h1	h2	EPOCHS	Algorithm	MSE
0	0	100	Trainlm	101117	2	2	100	Trainlm	650133
0	0	200	Trainlm	107454	2	2	200	Trainlm	178439
0	0	300	Trainlm	60928	2	2	300	Trainlm	1480207
0	0	400	Trainlm	185935	2	2	400	Trainlm	90378
0	0	100	Traincgb	89836	2	2	100	Traincgb	4079672
0	0	200	Traincgb	105746	2	2	200	Traincgb	310116
0	0	300	Traincgb	95506	2	2	300	Traincgb	946342
0	0	100	Trainrp	146834	2	2	100	Trainrp	1028454
0	0	200	Trainrp	142472	2	2	200	Trainrp	271697
0	0	300	Trainrp	79042	2	2	300	Trainrp	2190425
1	1	100	Trainlm	80427	2	3	100	Trainlm	2498906
1	1	200	Trainlm	138971	2	3	200	Trainlm	199419
1	1	300	Trainlm	117056	2	3	300	Trainlm	`
1	1	400	Trainlm	271719	2	3	400	Trainlm	241728
1	1	100	Traincgb	1235562	2	3	100	Traincgb	183660
1	1	200	Traincgb	145935	2	3	200	Traincgb	1194400
1	1	300	Traincgb	1068590	2	3	300	Traincgb	108088
1	1	100	Trainrp	136022	2	3	100	Trainrp	711249
1	1	200	Trainrp	445555	2	3	200	Trainrp	211331
1	1	300	Trainrp	1096071	2	3	300	Trainrp	731894
1	2	100	Trainlm	253486	3	1	100	Trainlm	231554
1	2	200	Trainlm	122289	3	1	200	Trainlm	2223187
1	2	300	Trainlm	264475	3	1	300	Trainlm	518233
1	2	400	Trainlm	72788	3	1	400	Trainlm	419474
1	2	100	Traincgb	242852	3	1	100	Traincgb	473095
1	2	200	Traincgb	109284	3	1	200	Traincgb	449586
1	2	300	Traincgb	141197	3	1	300	Traincgb	3155388
1	2	100	Trainrp	358268	3	1	100	Trainrp	455974
1	2	200	Trainrp	334440	3	1	200	Trainrp	203309
1	2	300	Trainrp	1341458	3	1	300	Trainrp	132947
1	3	100	Trainlm	116100	3	2	100	Trainlm	192434
1	3	200	Trainlm	268723	3	2	200	Trainlm	100524
1	3	300	Trainlm	525485	3	2	300	Trainlm	378390
1	3	400	Trainlm	296908	3	2	400	Trainlm	1277925
1	3	100	Traincgb	522515	3	2	100	Traincgb	867580
1	3	200	Traincgb	326249	3	2	200	Traincgb	1002031
1	3	300	Traincgb	311269	3	2	300	Traincgb	139283
1	3	100	Trainrp	159021	3	2	100	Trainrp	7322169
1	3	200	Trainrp	151741	3	2	200	Trainrp	604249
1	3	300	Trainrp	199354	3	2	300	Trainrp	811755
2	1	100	Trainlm	4494484	3	3	100	Trainlm	467944
2	1	200	Trainlm	846006	3	3	200	Trainlm	1970613
2	1	300	Trainlm	344173	3	3	300	Trainlm	855817
2	1	400	Trainlm	168118	3	3	400	Trainlm	669749
2	1	100	Traincgb	204444	3	3	100	Traincgb	566303
2	1	200	Traincgb	128880	3	3	200	Traincgb	275406
2	1	300	Traincgb	89667	3	3	300	Traincgb	379983
2	1	100	Trainrp	374570	3	3	100	Trainrp	311295
2	1	200	Trainrp	331155	3	3	200	Trainrp	460359
2	1	300	Trainrp	334270	3	3	300	Trainrp	4341405

Table F.4 Port of Tampa-ANN Model Runs for Outbound Trucks– Port of Tampa

Date	Monthly Average Imported Barrel in Tons	Sum of last 7 days - Imported Tonnage	Exported Tonnage (+3)	SAT	SUN	Inbound Trucks
070500	27222	402951	30381	0	0	3780
070600	27222	326198	33181	0	0	3691
070700	27222	300464	30381	0	0	4221
071700	27222	288599	31781	0	0	4298
071800	27222	302908	30381	0	0	4516
071900	27222	335911	30381	0	0	4451
072000	27222	297858	31781	0	0	4542
072100	27222	325550	30381	0	0	4191
072300	27222	297603	30381	0	1	1723
072400	27222	295102	30381	0	0	4331
072500	27222	330560	30381	0	0	4346
072600	27222	352224	58902	0	0	4707
072700	27222	355546	30381	0	0	4342
072800	27222	347102	31781	0	0	4236
072900	27222	370437	17018	1	0	2177
073000	27222	368035	17018	0	1	1588
080400	28021	357032	19818	0	0	4078
080500	28021	308096	18418	1	0	2204
081200	28021	227891	18418	1	0	2294
082500	28021	276934	17018	0	0	3950
082700	28021	214940	17018	0	1	1181
090500	40924	118305	28578	0	0	4271
090600	40924	163896	28327	0	0	4383
090700	40924	207661	49706	0	0	4429
090800	40924	217243	28275	0	0	4348
090900	40924	257678	32492	1	0	2258
091000	40924	205662	28275	0	1	1834
091100	40924	204299	28275	0	0	4191
091200	40924	244690	28275	0	0	4233
091300	40924	226229	28275	0	0	4361
091400	40924	224004	28275	0	0	4517
091600	40924	179050	28329	1	0	2047

Table F.5 Port of Tampa-Final ANN Model Calibration and Validation Data for Inbound Trucks

Date	Monthly Average Imported Barrel in Tons	Sum of last 7 days - Imported Tonnage	Exported Tonnage (+3)	SAT	SUN	Inbound Trucks
091700	40924	191113	32475	0	1	1667
091800	40924	191113	28275	0	0	4018
091900	40924	178517	28275	0	0	4222
092000	40924	146675	29269	0	0	3961
092100	40924	147800	28275	0	0	3867
092200	40924	177983	30256	0	0	3526
092600	40924	411820	31795	0	0	4102
092700	40924	394517	28275	0	0	3941
092800	40924	366955	38784	0	0	4249
092900	40924	371103	33511	0	0	4213
093000	40924	288962	33511	1	0	2309
100100	43954	352840	33950	0	1	1666
100200	43954	259775	33511	0	0	4183
100300	43954	270003	33929	0	0	4059
100400	43954	359317	33511	0	0	4113
100500	43954	359221	34096	0	0	4113
100600	43954	334549	35320	0	0	4087
101000	43954	273251	34966	0	0	4166
101100	43954	188047	34911	0	0	3842
102300	43954	224187	33511	0	0	4286
102400	43954	174667	33647	0	0	4388
102500	43954	269086	34379	0	0	4257
102600	43954	306475	34911	0	0	4299
102700	43954	355998	33543	0	0	4274
103000	43954	376691	32711	0	0	4101
103100	43954	426685	32724	0	0	4438
110100	43988	372074	33234	0	0	4272
110200	43988	286660	32711	0	0	4232
110300	43988	270150	33172	0	0	4230
110400	43988	281488	34621	1	0	2280
110700	43988	340761	51596	0	0	4055
110800	43988	336385	45481	0	0	4111
110900	43988	346385	33459	0	0	4213
111000	43988	334248	32711	1	0	2089
111800	43988	322051	34241	1	0	2002
111900	43988	280961	32711	0	1	1700

Table F.5 Port of Tampa-Final ANN Model Calibration and Validation Data for Inbound Trucks (Cotd)

Date	Monthly Average Imported Barrel in Tons	Sum of last 7 days - Imported Tonnage	Exported Tonnage (+1)	Sat	Sun	Outbound Trucks
080100	28021.2	391459.0	17018.1	0	0	3889
080200	28021.2	361855.0	17018.1	0	0	4004
080300	28021.2	408750.0	17018.1	0	0	3747
080400	28021.2	357032.0	17018.1	0	0	3612
080500	28021.2	308096.0	17018.1	1	0	1667
080600	28021.2	315637.0	19818.1	0	1	1364
080700	28021.2	303329.0	18418.1	0	0	3575
080800	28021.2	279080.0	17018.1	0	0	3946
080900	28021.2	229526.0	18418.1	0	0	3298
081000	28021.2	207329.0	17018.1	0	0	3697
090500	40924.3	118305.0	28274.5	0	0	3508
090600	40924.3	163896.0	28529.5	0	0	3756
090700	40924.3	207661.0	28577.5	0	0	3949
090800	40924.3	217243.0	28326.5	0	0	3888
090900	40924.3	257678.0	49705.5	1	0	1765
091400	40924.3	224004.0	28274.5	0	0	4596
091500	40924.3	219486.0	28274.5	0	0	4311
091600	40924.3	179050.0	28274.5	1	0	2020
091700	40924.3	191113.0	28274.5	0	1	1109
092600	40924.3	411820.0	29802.5	0	0	4032
092700	40924.3	394517.0	34308.5	0	0	4165
092800	40924.3	366955.0	31794.5	0	0	4159
092900	40924.3	371103.0	28274.5	0	0	4291
093000	40924.3	288962.0	38784.0	1	0	1612
100100	43953.9	352840.0	33511.0	0	1	1452
100200	43953.9	259775.0	33511.0	0	0	4231
100300	43953.9	270003.0	33950.0	0	0	4104
100400	43953.9	359317.0	33511.0	0	0	3930
100500	43953.9	359221.0	33928.6	0	0	3899
100600	43953.9	334549.0	33511.0	0	0	3792
100700	43953.9	338542.0	34096.0	1	0	1881
101000	43953.9	273251.0	34151.0	0	0	4480

Table F.6 Port of Tampa-Final ANN Model Calibration and Validation Data for Outbound Trucks

Date	Monthly Average Imported Barrel in Tons	Sum of last 7 days - Imported Tonnage	Exported Tonnage (+1)	Sat	Sun	Outbound Trucks
101100	43953.9	188047.0	34911.0	0	0	4606
101200	43953.9	217324.0	34966.0	0	0	3481
101400	43953.9	237216.0	34109.0	1	0	1545
101500	43953.9	274916.0	63407.0	0	1	1413
101600	43953.9	243066.0	33610.0	0	0	3562
101700	43953.9	302423.0	33705.5	0	0	3387
101800	43953.9	297777.0	33511.0	0	0	3469
101900	43953.9	289605.0	59399.0	0	0	3369
102000	43953.9	293668.0	34426.0	0	0	3071
102300	43953.9	224187.0	34095.5	0	0	4034
102400	43953.9	174667.0	33748.0	0	0	4168
102500	43953.9	269086.0	33511.0	0	0	4098
102600	43953.9	306475.0	33647.3	0	0	4148
102700	43953.9	355998.0	34379.0	0	0	4123
102800	43953.9	395593.0	34911.0	1	0	1811
102900	43953.9	395947.0	33543.0	0	1	1444
103000	43953.9	376691.0	36311.0	0	0	3783
103100	43953.9	426685.0	32710.9	0	0	4274
110100	43987.8	372074.0	32710.9	0	0	4178
110200	43987.8	286660.0	32724.1	0	0	4083
110300	43987.8	270150.0	33233.9	0	0	4004
110400	43987.8	281488.2	32710.9	1	0	2015
110700	43987.8	340761.2	33672.7	0	0	3834
110800	43987.8	336385.2	32710.9	0	0	3926
110900	43987.8	346385.2	51595.9	0	0	4126
111000	43987.8	334248.2	45480.9	0	0	3460
111100	43987.8	310496.0	33458.9	1	0	1751
111200	43987.8	299484.0	32710.9	0	1	1270
111400	43987.8	338219.3	35523.9	0	0	3768
111500	43987.8	290780.8	32710.9	0	0	3820
111600	43987.8	336179.8	32710.9	0	0	3562
111700	43987.8	341243.8	33388.9	0	0	3737
111800	43987.8	322050.8	35993.9	1	0	1796
111900	43987.8	280960.8	50011.9	0	1	1300

Table F.6 Port of Tampa-Final ANN Model Calibration and Validation Data for Outbound Trucks (Cotd)

Appendix G

Port of Jacksonville

Date	Monthly Average-Imported Bulk	Sum of Last 7 days- Imported Containers	Monthly Average-Exported Bulk	Sum of Next 7 days-Exported Containers	Inbound Trucks	Outbound Trucks	Sat	Sun
92199	2107	5139	219	11201	1081	1211	0	0
92299	2107	5284	219	13047	1152	1215	0	0
92399	2107	7519	219	13708	1146	1148	0	0
92499	2107	7519	219	13708	1079	1144	0	0
92599	2107	5224	219	12712	482	433	1	0
92699	2107	7299	219	11919	258	152	0	1
92799	2107	7299	219	11919	1141	1140	0	0
92899	2107	7299	219	11919	1126	1106	0	0
92999	2107	5744	219	10581	1142	1182	0	0
93099	2107	6748	219	10526	1091	1149	0	0
110199	978	6584	303	12672	979	925	0	0
110299	978	8671	303	9148	1001	1056	0	0
110399	978	8909	303	7896	1019	1131	0	0
110599	978	7042	303	8510	933	977	0	0
110699	978	8170	303	6718	387	401	1	0
110799	978	4909	303	10367	151	149	0	1
110899	978	4909	303	9835	1013	1035	0	0
110999	978	4909	303	9835	1085	1158	0	0
111099	978	2941	303	10424	1072	1130	0	0
111199	978	3229	303	10680	1003	1066	0	0
111299	978	5374	303	9736	1004	1058	0	0
111399	978	5374	303	9986	328	398	1	0
111499	978	6487	303	9783	242	244	0	1
111599	978	6487	303	10267	1064	1168	0	0
111699	978	6487	303	10267	1201	1252	0	0
111799	978	6651	303	13602	1117	1203	0	0
111899	978	9487	303	12766	1131	1185	0	0
111999	978	9688	303	11398	1084	1146	0	0
112099	978	6087	303	11298	340	405	1	0
112199	978	7601	303	7852	214	212	0	1
112299	978	5360	303	10347	1111	1172	0	0
112399	978	5360	303	11227	1151	1186	0	0
112499	978	6606	303	7854	988	1049	0	0

Table G.1 Port of Jacksonville, Talleyrand Terminal-Calibration and Validation Data for Inbound and Outbound Trucks

Date	Monthly Average-Imported Bulk	Sum of Last 7 days- Imported Containers	Monthly Average-Exported Bulk	Sum of Next 7 days-Exported Containers	Inbound Trucks	Outbound Trucks	Sat	Sun
112799	978	4114	303	8306	283	305	1	0
112899	978	4114	303	10416	113	162	0	1
112999	978	4872	303	8167	989	1051	0	0
113099	978	4872	303	7287	1055	1151	0	0
120199	1079	4907	271	7463	1001	1060	0	0
120299	1079	4309	271	9079	1063	1136	0	0
120399	1079	4278	271	8429	967	1097	0	0
120499	1079	4278	271	9215	380	456	1	0
120599	1079	5958	271	9415	188	207	0	1
120699	1079	5958	271	8685	1004	1049	0	0
120799	1079	3686	271	8685	1039	1105	0	0
120899	1079	3742	271	9055	1034	1112	0	0
120999	1079	5506	271	7488	990	1056	0	0
121099	1079	4858	271	7984	959	1029	0	0
121199	1079	3535	271	7156	390	407	1	0
30101	1000	3636	603	12356	958	884	0	0
30201	1000	1328	603	12356	931	866	0	0
30301	1000	1593	603	11874	289	301	1	0
30401	1000	1593	603	11255	120	131	0	1
30501	1000	2828	603	7916	890	854	0	0
30601	1000	2828	603	8413	1052	984	0	0
31001	1000	2588	603	9333	320	299	1	0
31101	1000	3427	603	10144	162	160	0	1
31201	1000	3427	603	10853	875	796	0	0
31301	1000	3208	603	10356	1046	991	0	0
31401	1000	3793	603	10635	993	943	0	0
31501	1000	3786	603	10331	1054	1013	0	0
31601	1000	3485	603	10331	966	708	0	0
31701	1000	3485	603	10331	314	270	1	0
31801	1000	4706	603	5492	130	95	0	1
31901	1000	3854	603	5318	867	666	0	0
32001	1000	3854	603	5318	1005	801	0	0
32101	1000	3406	603	4734	987	787	0	0
32201	1000	3266	603	11052	1007	784	0	0
32301	1000	2486	603	11052	916	680	0	0
32401	1000	2486	603	11052	312	255	1	0

Table G.1 Port of Jacksonville, Talleyrand Terminal-Calibration and Validation Data for Inbound and Outbound Trucks (Cotd.)

Date	Sum of Last 7 Days-Imported Auto	Monthly Average-Imported Bulk	Sum of Last 3 Days-Imported Containers	Sum of Next 7 Days-Exported Autos	Monthly Average-Exported Bulk	Sum of Next 7 Days-Exported Containers	MW	TThF	Sat	Sun	Inbound Trucks	Outbound Trucks
20901	6385	2593	6149	946	240	40499	0	1	0	0	1057	1040
21001	8361	2593	4515	934	240	40889	0	0	1	0	211	217
21101	8361	2593	4025	487	240	40171	0	0	0	1	73	70
21201	9937	2593	5487	487	240	40171	1	0	0	0	824	840
21301	7996	2593	3303	478	240	33397	0	1	0	0	1020	1019
21401	4896	2593	6822	478	240	33397	1	0	0	0	900	901
21501	8170	2593	4092	1882	240	36005	0	1	0	0	1108	1089
21601	8170	2593	7113	1882	240	34076	0	1	0	0	1214	1198
21701	6414	2593	5607	2209	240	47782	0	0	1	0	200	197
21801	6414	2593	6480	2209	240	47782	0	0	0	1	63	63
21901	6316	2593	3459	2305	240	47782	1	0	0	0	728	738
22001	7113	2593	877	3971	240	50961	0	1	0	0	1087	1085
22101	10235	2593	2232	4225	240	54703	1	0	0	0	924	927
22201	8694	2593	2232	3004	240	51019	0	1	0	0	1044	1037
22301	10008	2593	5185	3004	240	44726	0	1	0	0	1132	1098
22401	9788	2593	5312	2990	240	31379	0	0	1	0	250	254
22501	11006	2593	8579	3698	240	35902	0	0	0	1	80	85
22601	11085	2593	5622	3602	240	35902	1	0	0	0	871	880
22701	8987	2593	3267	1915	240	38675	0	1	0	0	1050	1009

Table G.2 Port of Jacksonville, Blount Island Terminal- Calibration and Validation Data for Inbound and Outbound Trucks

Date	Sum of Last 7 Days-Imported Auto	Monthly Average-Imported Bulk	Sum of Last 3 Days-Imported Containers	Sum of Next 7 Days-Exported Autos	Monthly Average-Exported Bulk	Sum of Next 7 Days-Exported Containers	MW	TThF	Sat	Sun	Inbound Trucks	Outbound Trucks
30301	11799	1044	6370	2102	289	50296	0	0	1	0	241	232
30401	11566	1044	5757	1505	289	45773	0	0	0	1	63	62
30501	10604	1044	6132	1639	289	45773	1	0	0	0	915	830
30601	10604	1044	3130	1883	289	45029	0	1	0	0	1050	1073
30701	9154	1044	7220	1816	289	44162	1	0	0	0	877	915
30801	4834	1044	5602	1820	289	44815	0	1	0	0	994	1033
30901	8673	1044	7567	1045	289	41964	0	1	0	0	1124	1122
31001	6674	1044	6754	1361	289	44817	0	0	1	0	177	181
31101	8153	1044	6655	2895	289	48974	0	0	0	1	58	58
31201	7558	1044	4671	2761	289	48974	1	0	0	0	813	830
31301	10205	1044	323	2517	289	50473	0	1	0	0	1096	1089
31401	10044	1044	4446	2561	289	51169	1	0	0	0	864	883
31501	10848	1044	5145	2475	289	51077	0	1	0	0	983	960
31601	9672	1044	6318	2861	289	53139	0	1	0	0	1197	1142
31701	13024	1044	5230	3078	289	50531	0	0	1	0	180	178
31801	10624	1044	5319	1520	289	46374	0	0	0	1	98	39
31901	10624	1044	5734	1632	289	53237	1	0	0	0	755	871
32001	10157	1044	2376	1632	289	45159	0	1	0	0	1022	1124
32101	9126	1044	5673	1575	289	42382	1	0	0	0	884	904
32201	8324	1044	4676	2938	289	46389	0	1	0	0	972	1029
32301	5661	1044	6044	2368	289	41334	0	1	0	0	1108	1146
32401	3691	1044	6420	2013	289	41919	0	0	1	0	235	210

Table G.2 Port of Jacksonville, Blount Island Terminal- Calibration and Validation Data for Inbound and Outbound Trucks (Cotd.)

Appendix H

Matlab Code for Port of Palm Beach

```
%===========================================================================
===================================================
% First Module  ///////////////////MODELING INBOUND TRUCKS///////////////////



% Opening trucks and vessel data File
%=============================================
File     =   load('c:\palmbeach\Final Report\PalmBeachTons.txt'); % Opens Text file 'Everglades Intons' and
takes the data to train and validate.
order    =   load('c:\palmbeach\Final Report\Truck_Order.txt');

% Constants
%===========
dpIn = 75; %number of data points
tpIn = 50; % number of training points.
vsIn = tpIn+1;% validation starts from.
vpIn = dpIn-tpIn;% number of validation points.
channel=ddeinit('excel','run-results.xls');

% Dependent Variables
% ===================

Dates    = File(:,1);
InTruc  = File(:,4);
OutTruc = File(:,5);



%Independent Variables
%=====================
InITon= File(:,2);
InOTon= File(:,3);




%Normalizing Between -1 and 1
```

```
%============================
[InITonN,minInITon,maxInITon]    = premnmx(InITon);
[InOTonN,minInOTon,maxInOTon]    = premnmx(InOTon);
[InTrucN,minInTruc,maxInTruc]    = premnmx(InTruc);
[OutTrucN,minOutTruc,maxOutTruc] = premnmx(OutTruc);



%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%FDOT INPUT
%%%%%%%%%%%%%%%%%%%%%%%%%%%%


channel=ddeinit('excel','Final Report\PalmBeach FDOT Input.xls');
reqFIELD=ddereq(channel,'r10c13:r10c13');
fdotinput = ddereq(channel,'r13c4:r432c6');

fdotdates = fdotinput(:,1);
fdotdates90 = rot90(fdotdates);
Itons   = fdotinput(:,2);
Otons   = fdotinput(:,3);



ItonsN   = tramnmx(Itons,minInITon,maxInITon);
OtonsN   = tramnmx(Otons,minInOTon,maxInOTon);

min_truc_mse =31000;

fid1 = fopen('c:\palmbeach\PalmBeach Output.xls','w+');
fid2 = fopen('c:\palmbeach\Final Report\PalmBeach FDOT Output.xls','w+');

fprintf(fid1,'\n\nh1\tEPOCHS\tIntruck_calib_mse\tIntruck_valid_mse\tTotal_Intruck_mse\tOuttruck_calib_
mse\tOuttruck_valid_mse\tTotal_Outtruck_mse\tTotal_truck_mse\tOrder');

for EP = 25 %1st for
   for h1 =0
```

```
for it = 1:1 % 3rd for


    for r =1:tpIn      %4th for

        %Independent Variables:
        InOTonT(r,:) = InOTonN(order(r),:);
        InITonT(r,:) = InITonN(order(r),:);

        %Dates of independent variables
        inbound_truc_trained(r,:) = InTruc(order(r),:);
        outbound_truc_trained(r,:) = OutTruc(order(r),:);

        % Dependent Variables:
        InTrucT(r,:) = InTrucN(order(r),:);
        OutTrucT(r,:) =OutTrucN(order(r),:);


    end % end of '4th for'


    % Validating records randomly
    % ============================
     x = 0;

    for r =vsIn:dpIn   % 5th for

        x = x+1;
        %Independent Variables:
        InOTonV(x,:) = InOTonN(order(r),:);
        InITonV(x,:) = InITonN(order(r),:);
        valid_dates(x,:)  = Dates(order(r),:);
        % Dependent Variables:
        InTrucV(x,:) = InTrucN(order(r),:);
        OutTrucV(x,:) = OutTrucN(order(r),:);
        inbound_truc_validated(x,:) = InTruc(order(r),:);
```

```
    outbound_truc_validated(x,:) =OutTruc(order(r),:);

end % end of '5th for'

Inpt=[InOTonT InITonT];
Inp = rot90(Inpt);

Inpvt=[InOTonV InITonV ];
Inpv = rot90(Inpvt);

InTrucT90  = rot90(InTrucT);
InTrucV90  = rot90(InTrucV);
OutTrucT90  = rot90(OutTrucT);
OutTrucV90  = rot90(OutTrucV);
valid_dates90 = rot90(valid_dates);

%%%%%%%%%%%%%%%%
% Inbound Truck
%%%%%%%%%%%%%%%%

net=newff([-1 1;-1 1],[1],{'purelin'},'trainlm');
net.trainParam.epochs=EP;
net.trainParam.show=100;
net.trainParam.min_grad  = 0;
net.trainParam.minstep  = 0;
net = train(net,Inp,InTrucT90);

Insim=sim(net,Inp);
[Ina]=postmnmx(Insim,minInTruc,maxInTruc);
```

```
Innewsim=sim(net,Inpv);
[Inav]=postmnmx(Innewsim,minInTruc,maxInTruc)

%%%%%%%%%%%%%%%
InTO = Inav(1:vpIn);
InTI = rot90(inbound_truc_validated);
Intruc_calib_mse  = mse(Ina - rot90(inbound_truc_trained));
Intruc_valid_mse  = mse(Inav - rot90(inbound_truc_validated));
total_Intruc_mse  = Intruc_calib_mse + Intruc_valid_mse;


%%%%%%%%%%%%%%%%%%FDOT Output%%%%%%%%%%%%%%%
pr=[OtonsN ItonsN];
fdotinmodel= rot90(pr);


ar=sim(net,fdotinmodel);
[InTr]=postmnmx(ar,minInTruc,maxInTruc);


%%%%%%%%%%%%%%%%%
% Outbound Truck
%%%%%%%%%%%%%%%%%

net = train(net,Inp,OutTrucT90);
Insim=sim(net,Inp);
[Ina]=postmnmx(Insim,minOutTruc,maxOutTruc);

Innewsim=sim(net,Inpv);
[Inav]=postmnmx(Innewsim,minOutTruc,maxOutTruc)


OutTO = Inav(1:vpIn);
OutTI = rot90(outbound_truc_validated);
Outtruc_calib_mse  = mse(Ina - rot90(outbound_truc_trained));
Outtruc_valid_mse  = mse(Inav - rot90(outbound_truc_validated));
total_Outtruc_mse  = Outtruc_calib_mse + Outtruc_valid_mse;
```

```
Total_Truc_Mse  = total_Intruc_mse+total_Outtruc_mse;



fprintf(fid1,'\n%d\t%d\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f',h1,EP,Intruc_calib_mse,Intruc_
valid_mse,total_Intruc_mse,Outtruc_calib_mse,Outtruc_valid_mse,total_Outtruc_mse,Total_Truc_Mse);
    for ordix = 1:dpIn
        fprintf(fid1,'\t%d',order(ordix));
    end
    Itons90 = rot90(Itons);
    Otons90 = rot90(Otons);
    fprintf(fid2,'\n------------------------ Inbound Trucks---------------------------');
    fprintf(fid2,'\nDate\tTotal-Trucks');


    for col = 1:reqFIELD
        fprintf(fid2,'\n%d\t%5.0f',fdotdates90(1,col),InTr(1,col));%                    \t%5.0f\t%5.0f/
,(0.6585*InTr(1,col)),(0.2886*InTr(1,col)),(0.0529*InTr(1,col)));
    end




    if ( Total_Truc_Mse <= min_truc_mse )
        flag = 0;
        fprintf(fid1,'\n\tDates\tAct-InTruck-Counts\tMod-InTruck-Counts\tAct-OutTruck-
Counts\tMod-OutTruck-Counts\n');
        for c2 = 1:vpIn

fprintf(fid1,'\n\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t',valid_dates90(1,c2),InTI(1,c2),InTO(1,c2),OutTI(1,c
2),OutTO(1,c2));
        end

    end
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%FDOT
OUTPUT%%%%%%%%%%%%
arout=sim(net,fdotinmodel);
[OutTr]=postmnmx(arout,minOutTruc,maxOutTruc);

fprintf(fid2,'\n\n\n------------------------ Outbound Trucks ---------------------------');
fprintf(fid2,'\nDate\tTotal-Trucks');
for col = 1:reqFIELD

    fprintf(fid2,'\n%d\t%5.0f',fdotdates90(1,col),OutTr(1,col));%\t%5.0f\t%5.0f/
,(0.6178*OutTr(1,col)),(0.3354*OutTr(1,col)),(0.0468*OutTr(1,col)));
end




      end
    end
  end
end







disp('MODEL RUN IS FINISHED, OUTPUT CAN BE VIEWED IN THE FILE:"Palm Beach Tons
Model Output"')
  disp('IMPORTANT: PLEASE CLOSE THE FILE ""Palm Beach FDOT Output" BEFORE RUNNING
THE MODEL AGAIN')

fclose(fid2);

fclose(fid1);
```

Appendix I

Matlab Code for Port of Everglades

```
%==========================================================================
===================================================
% First Module  ///////////////////MODELING INBOUND TRUCKS//////////////////



% % Opening Inbound trucks and vessel data InFile
%=============================================
InFile      =    load('c:\Everglades\Everglades InTruck data.txt'); % Opens Text file 'Everglades Intons' and
takes the data to train and validate.
%InOrder    =    load('c:\palmbeach\Truck_Order.txt');

% Constants
%===========
dpIn = 61; %number of data points
tpIn = 41; % number of training points.
vsIn = tpIn+1;% validation starts from.
vpIn = dpIn-tpIn;% number of validation points.

% Dependent Variables
% ===================

InDates      = InFile(:,1);
InTruc      = InFile(:,2);


%Independent Variables
%====================

InImpCont_2          =  InFile(:,3);
InImpCont_1          =  InFile(:,4);

InMonAvgImpBarrels    =  InFile(:,5);

InImpTons_3          =  InFile(:,6);
InImpTons_2          =  InFile(:,7);
```

```
InImpTons_1          =  InFile(:,8);
InImpTons_0          =  InFile(:,9);

InExpCont_0          =  InFile(:,10);
InExpCont_1          =  InFile(:,11);
InExpCont_2          =  InFile(:,12);
InExpCont_3          =  InFile(:,13);

InExpTons_0          =  InFile(:,14);

InSat                =  InFile(:,15);
InSun                =  InFile(:,16);
InWK                 =  InFile(:,17);




%Normalizing Between -1 and 1
%===========================
[InImpCont_2N,minInImpCont_2,maxInImpCont_2]            = premnmx(InImpCont_2);
[InImpCont_1N,minInImpCont_1,maxInImpCont_1]            = premnmx(InImpCont_1);
[InMonAvgImpBarrelsN,minInMonAvgImpBarrels,maxInMonAvgImpBarrels]            =
premnmx(InMonAvgImpBarrels);

[InImpTons_3N,minInImpTons_3,maxInImpTons_3]            = premnmx(InImpTons_3);
[InImpTons_2N,minInImpTons_2,maxInImpTons_2]            = premnmx(InImpTons_2);
[InImpTons_1N,minInImpTons_1,maxInImpTons_1]            = premnmx(InImpTons_1);
[InImpTons_0N,minInImpTons_0,maxInImpTons_0]            = premnmx(InImpTons_0);



[InExpCont_0N,minInExpCont_0,maxInExpCont_0]            = premnmx(InExpCont_0);
[InExpCont_1N,minInExpCont_1,maxInExpCont_1]            = premnmx(InExpCont_1);
[InExpCont_2N,minInExpCont_2,maxInExpCont_2]            = premnmx(InExpCont_2);
[InExpCont_3N,minInExpCont_3,maxInExpCont_3]            = premnmx(InExpCont_3);

[InExpTons_0N,minInExpTons_0,maxInExpTons_0]            = premnmx(InExpTons_0);

[InTrucN,minInTruc,maxInTruc]            = premnmx(InTruc);
```

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%FDOT INPUT
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


channel=ddeinit('excel','c:\Everglades\Everglades FDOT Input.xls');
reqFIELD=ddereq(channel,'r10c15:r10c15');
fdotinput = ddereq(channel,'r13c5:r102c12');

fdotdates           = fdotinput(4:(reqFIELD+3),1);
fdotdates90         = rot90(fdotdates);

fdotImpCont_2       = fdotinput(2:(reqFIELD+1),2);
fdotImpCont_1       = fdotinput(3:(reqFIELD+2),2);

fdotImpTons_3       = fdotinput(1:(reqFIELD),3);
fdotImpTons_2       = fdotinput(2:(reqFIELD+1),3);
fdotImpTons_1       = fdotinput(3:(reqFIELD+2),3);
fdotImpTons_0       = fdotinput(4:(reqFIELD+3),3);

fdotMonAvgImpBarrels= fdotinput(4:(reqFIELD+3),4);

fdotExpCont_0       = fdotinput(4:(reqFIELD+3),5);
fdotExpCont_1       = fdotinput(5:(reqFIELD+4),5);
fdotExpCont_2       = fdotinput(6:(reqFIELD+5),5);
fdotExpCont_3       = fdotinput(7:(reqFIELD+6),5);

fdotExpTons_0       = fdotinput(4:(reqFIELD+3),6);

fdotSat             = fdotinput(4:(reqFIELD+3),7);
fdotSun             = fdotinput(4:(reqFIELD+3),8);
%fdotWK              = fdotinput(4:(reqFIELD+3):,8);

%%%%Normalizing
fdotImpCont_2N          = tramnmx(fdotImpCont_2,minInImpCont_2,maxInImpCont_2);
```

```
fdotImpCont_1N          = tramnmx(fdotImpCont_1,minInImpCont_1,maxInImpCont_1);

fdotMonAvgImpBarrelsN                                                                =
tramnmx(fdotMonAvgImpBarrels,minInMonAvgImpBarrels,maxInMonAvgImpBarrels);
fdotImpTons_3N          = tramnmx(fdotImpTons_3,minInImpTons_3,maxInImpTons_3);
fdotImpTons_2N          = tramnmx(fdotImpTons_2,minInImpTons_2,maxInImpTons_2);
fdotImpTons_1N          = tramnmx(fdotImpTons_1,minInImpTons_1,maxInImpTons_1);
fdotImpTons_0N          = tramnmx(fdotImpTons_0,minInImpTons_0,maxInImpTons_0);

fdotExpCont_0N          = tramnmx(fdotExpCont_0,minInExpCont_0,maxInExpCont_0);
fdotExpCont_1N          = tramnmx(fdotExpCont_1,minInExpCont_1,maxInExpCont_1);
fdotExpCont_2N          = tramnmx(fdotExpCont_2,minInExpCont_2,maxInExpCont_2);
fdotExpCont_3N          = tramnmx(fdotExpCont_3,minInExpCont_3,maxInExpCont_3);

fdotExpTons_0N          = tramnmx(fdotExpTons_0,minInExpTons_0,maxInExpTons_0);
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%

min_truc_mse =3100000;

flag                                                                                 =
1;%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%------------> set flag for trucks in and In
fid1 = fopen('c:\Everglades\Everglades Output.xls','w+');
fid2 = fopen('c:\Everglades\Everglades FDOT Output.xls','w+');
InOrder = [52   17   41   4    56   39   23   51   61   5    30
           36   37   35   16   47   34   7    14   42   12   29
           26   21   60   2    46   18   1    45   9    24   31
           43   33   32   27   49   53   15   59   48   25   20
           44   54   38   22   40   13   28   11   3    19   10
           57   58   50   55   8    6];

fprintf(fid1,'\n\nh1\tEPOCHS\tIntruck_calib_mse\tIntruck_valid_mse\tTotal_Intruck_mse\tIntruck_calib_
mse\tIntruck_valid_mse\tTotal_Intruck_mse\tTotal_truck_mse\tOrder');
  for h1 =0


     for it = 1:1 % 3rd for
```

```
%InOrder =  randperm(dpIn);
if flag == 1

   for r =1:tpIn      %4th for

      %Independent Variables:
      InImpCont_2Train(r,:)          =  InImpCont_2N(InOrder(r),:);
      InImpCont_1Train(r,:)          =  InImpCont_1N(InOrder(r),:);

      InMonAvgImpBarrelsTrain(r,:)     =  InMonAvgImpBarrelsN(InOrder(r),:);

      InImpTons_3Train(r,:)          =  InImpTons_3N(InOrder(r),:);
      InImpTons_2Train(r,:)          =  InImpTons_2N(InOrder(r),:);
      InImpTons_1Train(r,:)          =  InImpTons_1N(InOrder(r),:);
      InImpTons_0Train(r,:)          =  InImpTons_0N(InOrder(r),:);

      InExpTons_0Train(r,:)          =  InExpTons_0N(InOrder(r),:);

      InExpCont_0Train(r,:)          =  InExpCont_0N(InOrder(r),:);
      InExpCont_1Train(r,:)          =  InExpCont_1N(InOrder(r),:);
      InExpCont_2Train(r,:)          =  InExpCont_2N(InOrder(r),:);
      InExpCont_3Train(r,:)          =  InExpCont_3N(InOrder(r),:);

      InSatTrain(r,:)                =  InSat(InOrder(r),:);
      InSunTrain(r,:)                =  InSun(InOrder(r),:);
      InWKTrain(r,:)                 =  InWK(InOrder(r),:);

      % Dependent Variables:
      InTrucTrain(r,:)               = InTrucN(InOrder(r),:);
      Inbound_truc_trained(r,:)      = InTruc(InOrder(r),:);
      InTrainDates(r,:)              = InDates(InOrder(r),:);
   end % end of '4th for'


   % Validating records randomly
   % ==============================
   x = 0;
```

```
for r =vsIn:dpIn   % 5th for

    x = x+1;
    %Independent Variables:
    In_Valid_Dates(x,:)           =  InDates(InOrder(r),:);
    InImpCont_2Valid(x,:)         =  InImpCont_2N(InOrder(r),:);
    InImpCont_1Valid(x,:)         =  InImpCont_1N(InOrder(r),:);
    InMonAvgImpBarrelsValid(x,:)   =  InMonAvgImpBarrelsN(InOrder(r),:);
    InImpTons_3Valid(x,:)         =  InImpTons_3N(InOrder(r),:);
    InImpTons_2Valid(x,:)         =  InImpTons_2N(InOrder(r),:);
    InImpTons_1Valid(x,:)         =  InImpTons_1N(InOrder(r),:);
    InImpTons_0Valid(x,:)         =  InImpTons_0N(InOrder(r),:);

    InExpTons_0Valid(x,:)         =  InExpTons_0N(InOrder(r),:);
    InExpCont_0Valid(x,:)         =  InExpCont_0N(InOrder(r),:);
    InExpCont_1Valid(x,:)         =  InExpCont_1N(InOrder(r),:);
    InExpCont_2Valid(x,:)         =  InExpCont_2N(InOrder(r),:);
    InExpCont_3Valid(x,:)         =  InExpCont_3N(InOrder(r),:);
    InSatValid(x,:)               =  InSat(InOrder(r),:);
    InSunValid(x,:)               =  InSun(InOrder(r),:);
    InWKValid(x,:)                =  InWK(InOrder(r),:);

    % Dependent Variables:

    InTrucValid(x,:)             = InTrucN(InOrder(r),:);
    Inbound_truc_validated(x,:)   = InTruc(InOrder(r),:);


end % end of '5th for'

  Inpt = [InImpCont_2Train  InImpCont_1Train  InMonAvgImpBarrelsTrain  InImpTons_3Train
InImpTons_2Train    InImpTons_1Train    InImpTons_0Train    InExpTons_0Train    InExpCont_0Train
InExpCont_1Train  InExpCont_2Train  InExpCont_3Train  InSatTrain  InSunTrain];
Inp = rot90(Inpt);
```

```
Inpvt=[InImpCont_2Valid InImpCont_1Valid InMonAvgImpBarrelsValid InImpTons_3Valid InImpTons_2Valid InImpTons_1Valid InImpTons_0Valid InExpTons_0Valid InExpCont_0Valid InExpCont_1Valid InExpCont_2Valid InExpCont_3Valid InSatValid InSunValid];

Inpv = rot90(Inpvt);


InTrucT90       = rot90(InTrucTrain);
InTrucV90       = rot90(InTrucValid);
In_Valid_Dates90    = rot90(In_Valid_Dates);


%%%%%%%%%%%%%%%%%
% Inbound Truck
%%%%%%%%%%%%%%%%%
net=newff([-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;0 1;0 1],[1],{'purelin'},'trainlm');
net.trainParam.epochs=EP;
net.trainParam.show=100;
net.trainParam.min_grad  = 0;
net.trainParam.minstep  = 0;
%net.biasConnect =0;
net = train(net,Inp,InTrucT90);


Insim=sim(net,Inp);
[Ina]=postmnmx(Insim,minInTruc,maxInTruc);

Innewsim=sim(net,Inpv);
[Inav]=postmnmx(Innewsim,minInTruc,maxInTruc);

%%%%%%%%%%%%%%%
InTO = Inav(1:vpIn);
InTI = rot90(Inbound_truc_validated);
Intruc_calib_mse  = mse(Ina - rot90(Inbound_truc_trained));
Intruc_valid_mse  = mse(Inav - rot90(Inbound_truc_validated));
total_Intruc_mse  = Intruc_calib_mse + Intruc_valid_mse;
```

```
%%%%%%%%%%%%%%%%%%FDOT Input%%%%%%%%%%%%%%
pr=[fdotImpCont_2N fdotImpCont_1N fdotMonAvgImpBarrelsN fdotImpTons_3N fdotImpTons_2N fdotImpTons_1N fdotImpTons_0N fdotExpTons_0N fdotExpCont_0N fdotExpCont_1N fdotExpCont_2N fdotExpCont_3N fdotSat fdotSun];
fdotmodel= rot90(pr);

% pr=[fdotImpCont_1N fdotImpCont_0N fdotMonAvgImpBarrelsN fdotImpTons_1N fdotExpTons_0N fdotExpCont_0N fdotExpCont_1N fdotExpCont_3N fdotSat fdotSun];

ar=sim(net,fdotmodel);
[InTr]=postmnmx(ar,minInTruc,maxInTruc);


fprintf(fid1,'\n\tInDates\tAct-InTruck-Counts\tMod-InTruck-Counts\tEller Inbound\tSpangler Inbound\tEisenhower Inbound');
for c2 = 1:vpIn

fprintf(fid1,'\n\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f',In_Valid_Dates90(1,c2),InTI(1,c2),InTO(1,c2),(0.6585*InTO(1,c2)),(0.2886*InTO(1,c2)),(0.0529*InTO(1,c2)));
end
fprintf(fid2,'\n---------------------Inbound Trucks---------------------');

fprintf(fid2,'\n\nInDates\tMod-InTruck-Counts\tEller Inbound\tSpangler Inbound\tEisenhower Inbound');

  IW  = net.IW{1,1}
  b1  = net.b{1}

  for col = 1:reqFIELD


fprintf(fid2,'\n%d\t%5.0f\t%5.0f\t%5.0f\t%5.0f',fdotdates90(1,col),InTr(1,col),(0.6585*InTr(1,col)),(0.2886*InTr(1,col)),(0.0529*InTr(1,col)));
  end
  %end
```

```
        end
      end
   end
end

%=============================================================================================================================================
% Second Module  ///////////////////MODELING OUTBOUND TRUCKS//////////////////


% % Opening Outbound trucks and vessel data OutFile
%=============================================
OutFile      =    load('c:\Everglades\Everglades Outtruck data.txt'); % Opens Text file 'Everglades Outtons' and takes the data to traOut and validate.

% Constants
%===========
dpOut = 73; %number of data poOutts
tpOut = 48; % number of traOutOutg poOutts.
vsOut = tpOut+1;% validation starts from.
vpOut = dpOut-tpOut;% number of validation poOutts.

% Dependent Variables
% ===================

OutDates        = OutFile(:,1);
OutTruc         = OutFile(:,2);


%Independent Variables
%====================
ImpCont_1           =  OutFile(:,3);
ImpCont_0           =  OutFile(:,4);
MonAvgImpBarrels    =  OutFile(:,5);
```

```
ImpTons_1          =  OutFile(:,10);

ExpCont_0          =  OutFile(:,6);
ExpCont_1          =  OutFile(:,7);
ExpCont_3          =  OutFile(:,8);

ExpTons_0          =  OutFile(:,9);

Sat             =  OutFile(:,11);
Sun              =  OutFile(:,12);
WK               =  OutFile(:,13);



%Normalizing Between -1 and 1
%============================
[ImpCont_1N,minImpCont_1,maxImpCont_1]                = premnmx(ImpCont_1);
[ImpCont_0N,minImpCont_0,maxImpCont_0]                = premnmx(ImpCont_0);
[MonAvgImpBarrelsN,minMonAvgImpBarrels,maxMonAvgImpBarrels]                        =
premnmx(MonAvgImpBarrels);

[ImpTons_1N,minImpTons_1,maxImpTons_1]                = premnmx(ImpTons_1);

[ExpCont_0N,minExpCont_0,maxExpCont_0]                = premnmx(ExpCont_0);
[ExpCont_1N,minExpCont_1,maxExpCont_1]                = premnmx(ExpCont_1);
[ExpCont_3N,minExpCont_3,maxExpCont_3]                = premnmx(ExpCont_3);

[ExpTons_0N,minExpTons_0,maxExpTons_0]                = premnmx(ExpTons_0);

[OutTrucN,minOutTruc,maxOutTruc]                = premnmx(OutTruc);


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%FDOT INPUT
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

channel=ddeinit('excel','c:\Everglades\Everglades FDOT Input.xls');
```

```
reqFIELD=ddereq(channel,'r10c15:r10c15');
fdotinput = ddereq(channel,'r13c5:r102c12');

fdotdates         = fdotinput(4:(reqFIELD+3),1);
fdotdates90       = rot90(fdotdates);

fdotImpCont_1     = fdotinput(3:(reqFIELD+2),2);
fdotImpCont_0     = fdotinput(4:(reqFIELD+3),2);

fdotImpTons_3     = fdotinput(1:(reqFIELD),3);
fdotImpTons_2     = fdotinput(2:(reqFIELD+1),3);
fdotImpTons_1     = fdotinput(3:(reqFIELD+2),3);
fdotImpTons_0     = fdotinput(4:(reqFIELD+3),3);

fdotMonAvgImpBarrels= fdotinput(4:(reqFIELD+3),4);

fdotExpCont_0     = fdotinput(4:(reqFIELD+3),5);
fdotExpCont_1     = fdotinput(5:(reqFIELD+4),5);
fdotExpCont_2     = fdotinput(6:(reqFIELD+5),5);
fdotExpCont_3     = fdotinput(7:(reqFIELD+6),5);

fdotExpTons_0     = fdotinput(4:(reqFIELD+3),6);

fdotSat           = fdotinput(4:(reqFIELD+3),7);
fdotSun           = fdotinput(4:(reqFIELD+3),8);


fdotImpCont_1N      = tramnmx(fdotImpCont_1,minImpCont_1,maxImpCont_1);
fdotImpCont_0N      = tramnmx(fdotImpCont_0,minImpCont_0,maxImpCont_0);
fdotMonAvgImpBarrelsN                                                    =
tramnmx(fdotMonAvgImpBarrels,minMonAvgImpBarrels,maxMonAvgImpBarrels);
fdotImpTons_1N      = tramnmx(fdotImpTons_1,minImpTons_1,maxImpTons_1);

fdotExpCont_0N      = tramnmx(fdotExpCont_0,minExpCont_0,maxExpCont_0);
fdotExpCont_1N      = tramnmx(fdotExpCont_1,minExpCont_1,maxExpCont_1);
fdotExpCont_3N      = tramnmx(fdotExpCont_3,minExpCont_3,maxExpCont_3);
```

```
fdotExpTons_0N          = tramnmx(fdotExp Tons_0,minExpTons_0,maxExpTons_0);
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%

min_truc_mse =3100000;

flag                                                                              =
1;%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%------------> set flag for trucks in and out

fprintf(fid1,'\n\nh1\tEPOCHS\tIntruck_calib_mse\tIntruck_valid_mse\tTotal_Intruck_mse\tOuttruck_calib_
mse\tOuttruck_valid_mse\tTotal_Outtruck_mse\tTotal_truck_mse\tOrder');

order = [17     60     31     52     69     66     50     43     9      65     56
         54     37     2      28     51     41     72     21     26     67     35
         70     34     63     12     46     30     11     49     47     58     3
         10     8      27     42     7      73     4      23     55     16     45
         53     6      18     61     39     22     25     5      32     14     57
         19     59     1      40     44     13     48     64     33     36     24
         68     38     62     15     29     20     71]

for EP = 25 %1st for
  for h1 =0;

    for it = 1 % 3rd for

      if flag == 1

        %order = randperm(dpOut);
        for r =1:tpOut      %4th for

          %Independent Variables:
          ImpCont_0Train(r,:)           =  ImpCont_0N(order(r),:);
          ImpCont_1Train(r,:)           =  ImpCont_1N(order(r),:);
          MonAvgImpBarrelsTrain(r,:)    =  MonAvgImpBarrelsN(order(r),:);
          ImpTons_1Train(r,:)           =  ImpTons_1N(order(r),:);
```

```
    ExpTons_0Train(r,:)          =  ExpTons_0N(order(r),:);
    ExpCont_0Train(r,:)          =  ExpCont_0N(order(r),:);
    ExpCont_1Train(r,:)          =  ExpCont_1N(order(r),:);
    ExpCont_3Train(r,:)          =  Exp Cont_3N(order(r),:);
    SatTrain(r,:)                =  Sat(order(r),:);
    SunTrain(r,:)                =  Sun(order(r),:);
    WKTrain(r,:)                 =  WK(order(r),:);

    % Dependent Variables:
    OutTrucTrain(r,:)            = OutTrucN(order(r),:);
    outbound_truc_trained(r,:)   = OutTruc(order(r),:);
    train_dates(r,:)             = OutDates(order(r),:);
end % end of '4th for'



% Validating records randomly
% ==============================
 x = 0;

 for r =vsOut:dpOut   % 5th for

    x = x+1;
    %Independent Variables:
    valid_dates(x,:)             =  OutDates(order(r),:);
    ImpCont_0Valid(x,:)          =  ImpCont_0N(order(r),:);
    ImpCont_1Valid(x,:)          =  ImpCont_1N(order(r),:);
    MonAvgImpBarrelsValid(x,:)   =  MonAvgImpBarrelsN(order(r),:);
    ImpTons_1Valid(x,:)          =  ImpTons_1N(order(r),:);

    ExpTons_0Valid(x,:)          =  ExpTons_0N(order(r),:);
    ExpCont_0Valid(x,:)          =  ExpCont_0N(order(r),:);
    ExpCont_1Valid(x,:)          =  ExpCont_1N(order(r),:);
    ExpCont_3Valid(x,:)          =  ExpCont_3N(order(r),:);
    SatValid(x,:)                =  Sat(order(r),:);
    SunValid(x,:)                =  Sun(order(r),:);
    WKValid(x,:)                 =  WK(order(r),:);
```

```
% Dependent Variables:

OutTrucValid(x,:)             = OutTrucN(order(r),:);
outbound_truc_validated(x,:)   = OutTruc(order(r),:);


end % end of '5th for'

Outpt = [ImpCont_1Train ImpCont_0Train MonAvgImpBarrelsTrain ImpTons_1Train ExpTons_0Train ExpCont_0Train ExpCont_1Train ExpCont_3Train SatTrain SunTrain];
Outp = rot90(Outpt);

Outpvt=[ImpCont_1Valid ImpCont_0Valid MonAvgImpBarrelsValid ImpTons_1Valid ExpTons_0Valid ExpCont_0Valid ExpCont_1Valid ExpCont_3Valid SatValid SunValid];
Outpv = rot90(Outpvt);


OutTrucT90        = rot90(OutTrucTrain);
OutTrucV90        = rot90(OutTrucValid);
valid_dates90    = rot90(valid_dates);


%%%%%%%%%%%%%%%%
% Outbound Truck
%%%%%%%%%%%%%%%%
net=newff([-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;0 1;0 1],[1],{'purelin'},'trainlm');
net.trainParam.epochs=EP;
net.trainParam.show=100;
net.trainParam.min_grad  = 0;
net.trainParam.minstep  = 0;
%net.biasConnect =0;
net = train(net,Outp,OutTrucT90);


Outsim=sim(net,Outp);
[Outa]=postmnmx(Outsim,minOutTruc,maxOutTruc);
```

```
Outnewsim=sim(net,Outpv);
[Outav]=postmnmx(Outnewsim,minOutTruc,maxOutTruc);

%%%%%%%%%%%%%%%
OutTO = Outav(1:vpOut);
OutTI = rot90(outbound_truc_validated);
Outtruc_calib_mse  = mse(Outa - rot90(outbound_truc_trained));
Outtruc_valid_mse  = mse(Outav - rot90(outbound_truc_validated));
total_Outtruc_mse  = Outtruc_calib_mse + Outtruc_valid_mse;


%%%%%%%%%%%%%%%%%%FDOT Output%%%%%%%%%%%%%%
pr=[fdotImpCont_1N fdotImpCont_0N fdotMonAvgImpBarrelsN fdotImpTons_1N
fdotExpTons_0N fdotExpCont_0N fdotExpCont_1N fdotExpCont_3N fdotSat fdotSun];
fdotoutmodel= rot90(pr);


ar=sim(net,fdotoutmodel);
[OutTr]=postmnmx(ar,minOutTruc,maxOutTruc);


fprintf(fid1,'\n\tOutDates\tAct-OutTruck-Counts\tMod-OutTruck-Counts\tEller
Outbound\tSpangler Outbound\tEisenhower Outbound');
for c2 = 1:vpOut

fprintf(fid1,'\n\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f',valid_dates90(1,c2),OutTI(1,c2),OutTO(1,c2),(
0.6178*OutTO(1,c2)),(0.3354*OutTO(1,c2)),(0.0468*OutTO(1,c2)));
end
fprintf(fid2,'\n---------------------Outbound Trucks---------------------');

fprintf(fid2,'\n\n\tOutDates\tMod-OutTruck-Counts\tEller Outbound\tSpangler
Outbound\tEisenhower Outbound');
fprintf(fid1,'\nORDER=>');
for ordindex = 1:dpOut
   fprintf(fid1,'\t%d',order(ordindex));
end
```

```
            for col = 1:reqFIELD


fprintf(fid2,'\n\t%d\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f',fdotdates90(1,col),OutTr(1,col),(0.6178*OutTr(1,
col)),(0.3354*OutTr(1,col)),(0.0468*OutTr(1,col)));
            end




         end
      end
   end
end



fclose(fid2);

fclose(fid1);

disp('DONE')
disp('NOTE: OUTPUT CAN BE VIEWED IN THE FILE "EVERGLADES FDOT OUTPUT"');
```

Appendix J

Matlab Code for Port of Tampa

```
% First Module  ///////////////////MODELING INBOUND TRUCKS///////////////////

fid1 = fopen('c:\Tampa\Tampa Output.xls','w+');
fid2 = fopen('c:\Tampa\Final Report\Tampa FDOT Output.xls','w+');


% % Opening Inbound trucks and vessel data InFile
%============================================
InFile      =   load('c:\Tampa\Final Report\Tampa InTruck Data.txt'); % Opens Text file 'Tampa Intons' and
takes the data to train and validate.

% Constants
%===========
dpIn = 68; %number of data points
tpIn = 46; % number of training points.
vsIn = tpIn+1;% validation starts from.
vpIn = dpIn-tpIn;% number of validation points.

% Dependent Variables
% ===================

InDates       = InFile(:,1);
InTruc        = InFile(:,11);


%Independent Variables
%====================

InMonAvgImpBarrelTons    =  InFile(:,2);
InSumLast7DaysImpTons       =  InFile(:,3);
InExpTons_0          =  InFile(:,4);
InExpTons_1          =  InFile(:,5);
InExpTons_2          =  InFile(:,6);
InExpTons_3          =  InFile(:,7);
```

```
InSat                    =  InFile(:,8);
InSun                    =  InFile(:,9);
InWK                     =  InFile(:,10);
for index=1:dpIn
    InImpBarXExpTons_3(index,1) = InExpTons_3(index,1)*InMonAvgImpBarrelTons(index,1) ;
end




%Normalizing Between -1 and 1
%============================
[InMonAvgImpBarrelTonsN,minInMonAvgImpBarrelTons,maxInMonAvgImpBarrelTons]                    =
premnmx(InMonAvgImpBarrelTons);
[InSumLast7DaysImpTonsN,minInSumLast7DaysImpTons,maxInSumLast7DaysImpTons]
= premnmx(InSumLast7DaysImpTons);
[InExpTons_0N,minInExpTons_0,maxInExpTons_0]                       = premnmx(InExpTons_0);
[InExpTons_1N,minInExpTons_1,maxInExpTons_1]                       = premnmx(InExpTons_1);
[InExpTons_2N,minInExpTons_2,maxInExpTons_2]                       = premnmx(InExpTons_2);
[InExpTons_3N,minInExpTons_3,maxInExpTons_3]                       = premnmx(InExpTons_3);

[InTrucN,minInTruc,maxInTruc]                                      = premnmx(InTruc);

[InImpBarXExpTons_3N,minInImpBarXExpTons_3,maxInImpBarXExpTons_3]                              =
premnmx(InImpBarXExpTons_3);
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%fdotIn INPUT
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%



channel=ddeinit('excel','c:\Tampa\Final Report\Tampa FDOT Input.xls');
reqFIELD=ddereq(channel,'r10c15:r10c15');

fdotIninput = ddereq(channel,'r13c5:r435c10');

fdotIndates          = fdotIninput(1:(reqFIELD),1);
fdotIndates90        = rot90(fdotIndates);
```

```
%
fdotInMonAvgImpBarrelTons= fdotIninput(1:(reqFIELD),2);
%
fdotInSumLast7DaysImpTons       = fdotIninput(1:(reqFIELD),3);
fdotInExpTons_0       = fdotIninput(1:(reqFIELD),4);
fdotInExpTons_1       = fdotIninput(2:(reqFIELD+1),4);
fdotInExpTons_2       = fdotIninput(3:(reqFIELD+2),4);
fdotInExpTons_3       = fdotIninput(4:(reqFIELD+3),4);


%
fdotInSat             = fdotIninput(1:(reqFIELD),5);
fdotInSun             = fdotIninput(1:(reqFIELD),6);



fdotInMonAvgImpBarrelTonsN                                                          =
tramnmx(fdotInMonAvgImpBarrelTons,minInMonAvgImpBarrelTons,maxInMonAvgImpBarrelTons);
fdotInSumLast7DaysImpTonsN                                                          =
tramnmx(fdotInSumLast7DaysImp Tons,minInSumLast7DaysImpTons,maxInSumLast7DaysImpTons);
fdotInExpTons_0N          = tramnmx(fdotInExpTons_0,minInExpTons_0,maxInExpTons_0);
fdotInExpTons_1N          = tramnmx(fdotInExpTons_1,minInExpTons_1,maxInExpTons_1);
fdotInExpTons_2N          = tra mnmx(fdotInExpTons_2,minInExpTons_2,maxInExpTons_2);
fdotInExpTons_3N          = tramnmx(fdotInExpTons_3,minInExpTons_3,maxInExpTons_3);

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%

min_truc_mse =3100000;

flag                                                                                =
1;%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%------------> set flag for trucks in and out
InOrder = [12     56     3      8      1      32     25     20     14     31     59
           28     42     49     2      47     50     33     60     16     36     22
           35     54     15     64     29     26     45     44     48     13     41
           37     23     65     58     17     38     5      53     55     11     51
```

```
        7       21      34      6       40      66      10      24      52      46      18
        39      63      4       30      62      27      68      57      43      61      19
        67      9];

fprintf(fid1,'\n\nh1\tEPOCHS\tIntruck_calib_mse\tIntruck_valid_mse\tTotal_Intruck_mse\tIntruck_calib_
mse\tIntruck_valid_mse\tTotal_Intruck_mse\tTotal_truck_mse\tOrder');

for EP = 100 %1st for
  for h1 =3;

    for it = 1:1 % 3rd for
    InOrder = randperm(dpIn);
      if flag == 1

        for r =1:tpIn      %4th for

          %Independent Variables:
          InMonAvgImpBarrelTonsTrain(r,:)     =  InMonAvgImpBarrelTonsN(InOrder(r),:);
          InImpBarXExpTons_3Train(r,:)     =  InImpBarXExpTons_3N(InOrder(r),:);
          InSumLast7DaysImpTonsTrain(r,:)          =  InSumLast7DaysImpTonsN(InOrder(r),:);
          InExpTons_0Train(r,:)          =  InExpTons_0N(InOrder(r),:);
          InExpTons_1Train(r,:)          =  InExpTons_1N(InOrder(r),:);
          InExpTons_2Train(r,:)          =  InExpTons_2N(InOrder(r),:);
          InExpTons_3Train(r,:)          =  InExpTons_3N(InOrder(r),:);

          InSatTrain(r,:)                    =  InSat(InOrder(r),:);
          InSunTrain(r,:)                    =  InSun(InOrder(r),:);
          % InWKTrain(r,:)                   =  InWK(InOrder(r),:);

          % Dependent Variables:
          InTrucTrain(r,:)                  = InTrucN(InOrder(r),:);
          Inbound_Truc_Trained(r,:)      = InTruc(InOrder(r),:);
          InTrainDates(r,:)                 = InDates(InOrder(r),:);
        end % end of '4th for'


        % Validating records randomly
```

```
% =============================
 x = 0;

for r =vsIn:dpIn   % 5th for

    x = x+1;
    %Independent Variables:
    In_Valid_Dates(x,:)              =  InDates(InOrder(r),:);
    InMonAvgImpBarrelTonsValid(x,:)    =  InMonAvgImpBarrelTonsN(InOrder(r),:);
    InImpBarXExpTons_3Valid(x,:)    =  InImpBarXExpTons_3N(InOrder(r),:);

    InSumLast7DaysImpTonsValid(x,:)           =  InSumLast7DaysImpTonsN(InOrder(r),:);
    InExpTons_0Valid(x,:)          =  InExpTons_0N(InOrder(r),:);
    InExpTons_1Valid(x,:)          =  InExpTons_1N(InOrder(r),:);
    InExpTons_2Valid(x,:)          =  InExpTons_2N(InOrder(r),:);
    InExpTons_3Valid(x,:)          =  InExpTons_3N(InOrder(r),:);
    InSatValid(x,:)                =  InSat(InOrder(r),:);
    InSunValid(x,:)                 =  InSun(InOrder(r),:);
    %InWKValid(x,:)                  =  InWK(InOrder(r),:);

    % Dependent Variables:

    InTrucValid(x,:)             = InTrucN(InOrder(r),:);
    Inbound_Truc_Validated(x,:)   = InTruc(InOrder(r),:);



end % end of '5th for'

  Inpt = [ InMonAvgImpBarrelTonsTrain    InSumLast7DaysImpTonsTrain    InExpTons_3Train
InSatTrain  InSunTrain];   % InMonAvgImpBarrelTonsTrain
 Inp = rot90(Inpt);

  Inpvt=[ InMonAvgImpBarrelTonsValid    InSumLast7DaysImpTonsValid     InExpTons_3Valid
InSatValid  InSunValid];   % InExpTons_3Valid  InMonAvgImpBarrelTonsValid
 Inpv = rot90(Inpvt);
```

```
InTrucT90        = rot90(InTrucTrain);
InTrucV90        = rot90(InTrucValid);
In_Valid_Dates90    = rot90(In_Valid_Dates);



%%%%%%%%%%%%%%%%%
% Inbound Truck
%%%%%%%%%%%%%%%%%
net=newff([-1 1;-1 1;-1 1;0 1;0 1],[h1,1],{'tansig','purelin'},'trainlm');
net.trainParam.epochs=EP;
net.trainParam.show=100;
net.trainParam.min_grad  = 0;
net.trainParam.minstep  = 0;
%net = train(net,Inp,InTrucT90);

net.IW{1,1}=[    22.0945   14.2483   -2.7932   19.9006    9.3078
   10.4170    5.2706   -0.1070   -0.2045   -0.0482
   29.9732   -4.9732   17.9677   16.8034   -2.0796];

net.LW{2,1}= [-0.1292   -5.6649   -0.1763];

net.b{1}=[-4.1691
1.1301
-2.025];



net.b{2}=5.1885;



%              net.IW{1,1} =  [-7.9074    0.7754   -0.3590   -1.7100   -0.5699
%     0.2164    0.5765   -0.0488   -0.1968   -0.0881
%    -6.7286   -3.0855    1.8814   -0.7003   -3.7183];
%
%              net.LW{2,1} = [0.5008   -2.7079    0.0272];
%              net.b{1} = [0.3698
%     0.0383
%    -1.5057];
```

```
%
%           net.b{2} = 0.6944;




         Insim=sim(net,Inp);
         [Ina]=postmnmx(Insim,minInTruc,maxInTruc);

         Innewsim=sim(net,Inpv);
         [Inav]=postmnmx(Innewsim,minInTruc,maxInTruc);

         %%%%%%%%%%%%%%%
         InTO = Inav(1:vpIn);
         InTI = rot90(Inbound_Truc_Validated);
         Intruc_calib_mse  = mse(Ina - rot90(Inbound_Truc_Trained));
         Intruc_valid_mse  = mse(Inav - rot90(Inbound_Truc_Validated));
         total_Intruc_mse  = Intruc_calib_mse + Intruc_valid_mse;



         %%%%%%%%%%%%%%%%%%fdotIn Input%%%%%%%%%%%%%%
         pr=[fdotInMonAvgImpBarrelTonsN    fdotInSumLast7DaysImpTonsN    fdotInExpTons_3N
fdotInSat  fdotInSun];   % fdotInExpTons_3N
         fdotInmodel= rot90(pr);



         ar=sim(net,fdotInmodel);
         [InTr]=postmnmx(ar,minInTruc,maxInTruc);

        avgsum =0;
        for x1=1:(reqFIELD/2)
           avgsum = avgsum + (  ( InTr(1,(x1+(reqFIELD/2))) - InTr(1,x1))/ InTr(1,x1));
        end
        avg = avgsum/(reqFIELD/2);
```

```
fprintf(fid1,'\n\n\n\tInDates\tAct-InTruck-Counts\tMod-InTruck-Counts');
fprintf(fid1,'\nAVG= %5.2f\th1 =%d\tTotalMSE =\t %5.2f\nOrder=',avg,  h1,total_Intruc_mse );
 for ordindex = 1:dpIn
     fprintf(fid1,'\t%d',InOrder(ordindex));
 end
 for c2 = 1:vpIn
     fprintf(fid1,'\n\t%5.0f\t%5.0f\t%5.0f',In_Valid_Dates90(1,c2),InTI(1,c2),InTO(1,c2));
 end
%               fprintf(fid2,'\n\n\tInDates\tMod-InTruck-Counts');
%               fprintf(fid2,'\nOrder');
%               for ordindex = 1:dpIn
%                   fprintf(fid2,'\t%d',InOrder(ordindex));
%               end

%fprintf(fid2,'\nAVG= %5.2f\th1 =%d\tTotalMSE =\t %5.2f\nOrder=',avg,  h1,total_Intruc_mse
);
% if  ((avg<0.5)& (avg>0.38))
    avg1 = avg
    iteration =it
 p=net.IW{1,1}
 q = net.LW{2,1}
 r1 = net.b{1}
 r2 = net.b{2}
fprintf(fid2,'\n------------------------INBOUND TRUCKS------------------------');
fprintf(fid2,'It= %d',it);
fprintf(fid1,'IT= %d',it);

fprintf(fid2,'\n Dates\tInbound Trucks\t21-st Street\t20th Street\tCauseway Blvd\tSutton \tPendola
point');

 for col = 1:(reqFIELD)

fprintf(fid2,'\n%d\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f',fdotIndates90(1,col),InTr(1,col),(0.2872*In
Tr(1,col)),(0.1277*InTr(1,col)),(0.4474*InTr(1,col)),(0.0835*InTr(1,col)),(0.0542*InTr(1,col)));
   end
   % end
```

```
            end
        end
    end
end




%==============================================================================
=====================================================
% Second Module  ////////////////////MODELING OUTBOUND TRUCKS///////////////////



% % Opening Outbound trucks and vessel data OutFile
%==============================================
OutFile     =   load('c:\Tampa\Final Report\Tampa OutTruck Data.txt'); % Opens Text file 'Tampa Outtons' and takes the data to train and validate.

% Constants
%===========
dpOut = 66; %number of data points
tpOut = 44; % number of training points.
vsOut = tpOut+1;% validation starts from.
vpOut = dpOut-tpOut;% number of validation points.

% Dependent Variables
% ===================

OutDates      = OutFile(:,1);
OutTruc       = OutFile(:,2);


%Outdependent Variables
```

```
%====================
OutYear = OutFile(:,3);
OutMonAvgImpBarrelTons    =  OutFile(:,4);
OutSumLast7DaysImpBar        = OutFile(:,14);
OutSumLast7DaysImpTons      =  OutFile(:,5);
OutExpTons_0          =  OutFile(:,6);
OutExpTons_1          =  OutFile(:,7);
OutExpTons_2          =  OutFile(:,8);
OutExpTons_3          =  OutFile(:,9);
OutExpTons_3DAvg          =  OutFile(:,10);

OutSat                   =  OutFile(:,11);
OutSun                   =  OutFile(:,12);
OutWK                    =  OutFile(:,13);



%Normalizing Between -1 and 1
%===========================
[OutMonAvgImpBarrelTonsN,minOutMonAvgImpBarrelTons,maxOutMonAvgImpBarrelTons]              =
premnmx(OutMonAvgImpBarrelTons);
[OutSumLast7DaysImpBarN,minOutSumLast7DaysImpBar,maxOutSumLast7DaysImpBar]                 =
premnmx(OutSumLast7DaysImpBar);
[OutSumLast7DaysImpTonsN,minOutSumLast7DaysImpTons,maxOutSumLast7DaysImpTons]              =
premnmx(OutSumLast7DaysImpTons);
[OutExpTons_0N,minOutExpTons_0,maxOutExpTons_0]                        = premnmx(OutExpTons_0);
[OutExpTons_1N,minOutExpTons_1,maxOutExpTons_1]                        = premnmx(OutExpTons_1);
[OutExpTons_2N,minOutExpTons_2,maxOutExpTons_2]                        = premnmx(OutExpTons_2);
[OutExpTons_3N,minOutExpTons_3,maxOutExpTons_3]                        = premnmx(OutExpTons_3);
[OutExpTons_3DAvgN,minOutExpTons_3DAvg,maxOutExpTons_3DAvg]                                =
premnmx(OutExpTons_3DAvg);

[OutTrucN,minOutTruc,maxOutTruc]                                          = premnmx(OutTruc);

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%fdot INPUT
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
channel=ddeinit('excel','c:\Tampa\Final Report\Tampa FDOT Input.xls');
reqFIELD=ddereq(channel,'r10c15:r10c15');

fdotOutinput = ddereq(channel,'r13c5:r435c10');

fdotOutdates          = fdotOutinput(1:(reqFIELD),1);
fdotOutdates90        = rot90(fdotOutdates);
%
fdotOutMonAvgImpBarrelTons= fdotOutinput(1:(reqFIELD),2);
%
fdotOutSumLast7DaysImpTons      = fdotOutinput(1:(reqFIELD),3);
fdotOutExpTons_0      = fdotOutinput(1:(reqFIELD),4);
fdotOutExpTons_1      = fdotOutinput(2:(reqFIELD+1),4);
fdotOutExpTons_2      = fdotOutinput(3:(reqFIELD+2),4);
fdotOutExpTons_3      = fdotOutinput(4:(reqFIELD+3),4);



%
fdotOutSat            = fdotOutinput(1:(reqFIELD),5);
fdotOutSun            = fdotOutinput(1:(reqFIELD),6);



fdotOutMonAvgImpBarrelTonsN                                                          =
tramnmx(fdotOutMonAvgImpBarrelTons,minOutMonAvgImpBarrelTons,maxOutMonAvgImpBarrelTons
);
fdotOutSumLast7DaysImpTonsN                                                          =
tramnmx(fdotOutSumLast7DaysImpTons,minOutSumLast7DaysImpTons,maxOutSumLast7DaysImpTons
);

fdotOutExpTons_0N        = tramnmx(fdotOutExpTons_0,minOutExpTons_0,maxOutExpTons_0);
fdotOutExpTons_1N        = tramnmx(fdotOutExpTons_1,minOutExpTons_1,maxOutExpTons_1);
fdotOutExpTons_2N        = tramnmx(fdotOutExpTons_2,minOutExpTons_2,maxOutExpTons_2);
fdotOutExpTons_3N        = tramnmx(fdotOutExpTons_3,minOutExpTons_3,maxOutExpTons_3);
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%
```

```
min_truc_mse =3100000;

flag                                                                                                    =
1;%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%------------> set flag for trucks in and out


fprintf(fid1,'\n\nh1\tEPOCHS\tOuttruck_calib_mse\tOuttruck_valid_mse\tTotal_Outtruck_mse\tOuttruck_c
alib_mse\tOuttruck_valid_mse\tTotal_Outtruck_mse\tTotal_truck_mse\tOrder');

for EP = 100 %1st for
  for h1 =3;

     for it = 1:1 % 3rd for
       OutOrder = randperm(dpOut);


       if flag == 1

          for r =1:tpOut     %4th for

            %Outdependent Variables:
            OutMonAvgImpBarrelTonsTrain(r,:)     =  OutMonAvgImpBarrelTonsN(OutOrder(r),:);
            OutSumLast7DaysImpBarTrain(r,:)           =  OutSumLast7DaysImpBarN(OutOrder(r),:);
            OutSumLast7DaysImpTonsTrain(r,:)           =  OutSumLast7DaysImpTonsN(OutOrder(r),:);

            OutExpTons_0Train(r,:)          =  OutExpTons_0N(OutOrder(r),:);
            OutExpTons_1Train(r,:)          =  OutExpTons_1N(OutOrder(r),:);
            OutExpTons_2Train(r,:)          =  OutExpTons_2N(OutOrder(r),:);
            OutExpTons_3Train(r,:)          =  OutExpTons_3N(OutOrder(r),:);

            OutSatTrain(r,:)                    =  OutSat(OutOrder(r),:);
            OutSunTrain(r,:)                    =  OutSun(OutOrder(r),:);
            % OutWKTrain(r,:)                    =  OutWK(OutOrder(r),:);

            % Dependent Variables:
```

```
    OutTrucTrain(r,:)                = OutTrucN(OutOrder(r),:);
    Outbound_Truc_Trained(r,:)       = OutTruc(OutOrder(r),:);
    OutTrainDates(r,:)               = OutDates(OutOrder(r),:);
end % end of '4th for'



% Validating records randomly
% ============================
x = 0;

for r =vsOut:dpOut   % 5th for

    x = x+1;
    %Outdependent Variables:
    Out_Valid_Dates(x,:)             =  OutDates(OutOrder(r),:);
    OutMonAvgImpBarrelTonsValid(x,:)    =  OutMonAvgImpBarrelTonsN(OutOrder(r),:);
    OutSumLast7DaysImpBarValid(x,:)          =  OutSumLast7DaysImpBarN(OutOrder(r),:);
    OutSumLast7DaysImpTonsValid(x,:)         =  OutSumLast7DaysImpTonsN(OutOrder(r),:);
    OutExpTons_0Valid(x,:)          =  OutExpTons_0N(OutOrder(r),:);
    OutExpTons_1Valid(x,:)          =  OutExpTons_1N(OutOrder(r),:);
    OutExpTons_2Valid(x,:)          =  OutExpTons_2N(OutOrder(r),:);
    OutExpTons_3Valid(x,:)          =  OutExpTons_3N(OutOrder(r),:);

    OutSatValid(x,:)                =  OutSat(OutOrder(r),:);
    OutSunValid(x,:)                =  OutSun(OutOrder(r),:);
    %OutWKValid(x,:)                 =  OutWK(OutOrder(r),:);

    % Dependent Variables:

    OutTrucValid(x,:)            = OutTrucN(OutOrder(r),:);
    Outbound_Truc_Validated(x,:)   = OutTruc(OutOrder(r),:);



end % end of '5th for'
%Outpt = [OutMonAvgImpBarrelTonsTrain OutSumLast7DaysImpTonsTrain
OutExpTons_0Train OutExpTons_1Train OutExpTons_2Train OutExpTons_3Train
OutExpTons_3DAvgTrain OutSatTrain  OutSunTrain];
```

```
Outpt = [ OutMonAvgImpBarrelTonsTrain OutSumLast7DaysImpTonsTrain
OutExpTons_1Train  OutSatTrain  OutSunTrain];   %  OutExpTons_2Train
Outp = rot90(Outpt);

%Outpvt=[OutMonAvgImpBarrelTonsValid OutSumLast7DaysImpTonsValid
OutExpTons_0Valid OutExpTons_1Valid OutExpTons_2Valid OutExpTons_3Valid
OutExpTons_3DAvgValid  OutSatValid  OutSunValid];
Outpvt=[ OutMonAvgImpBarrelTonsValid OutSumLast7DaysImpTonsValid
OutExpTons_1Valid  OutSatValid  OutSunValid];  %   OutExpTons_2Valid
Outpv = rot90(Outpvt);



OutTrucT90        = rot90(OutTrucTrain);
OutTrucV90        = rot90(OutTrucValid);
Out_Valid_Dates90    = rot90(Out_Valid_Dates);



%%%%%%%%%%%%%%%%%
% Outbound Truck
%%%%%%%%%%%%%%%%%
net=newff([-1 1;-1 1;-1 1;0 1;0 1],[h1,1],{'tansig','purelin'},'trainlm');
net.trainParam.epochs=EP;
net.trainParam.show=100;
net.trainParam.min_grad  = 0;
net.trainParam.minstep  = 0;
%net = train(net,Outp,OutTrucT90);




net.IW{1,1} =[-25.3972  -16.0994  -22.1999   23.0830    7.0164
  15.9083    2.1625   -0.9818   -0.5074    0.0500
  -0.4825   -2.6616  -36.4267  -63.9294    5.6686];
%
%
%
% %               %
% %               %
```

```
            net.LW{2,1} = [0.1786   -0.7262    0.1135];
% %              %
% %              %
            net.b{1} =[ 7.8405
  -1.5667
 -10.6377];
% %              %
% %              %
            net.b{2} =-0.1738;
%

           Outsim=sim(net,Outp);
           [Outa]=postmnmx(Outsim,minOutTruc,maxOutTruc);

           Outnewsim=sim(net,Outpv);
           [Outav]=postmnmx(Outnewsim,minOutTruc,maxOutTruc);

           %%%%%%%%%%%%%%%
           OutTO = Outav(1:vpOut);
           OutTI = rot90(Outbound_Truc_Validated);
           Outtruc_calib_mse  = mse(Outa - rot90(Outbound_Truc_Trained));
           Outtruc_valid_mse  = mse(Outav - rot90(Outbound_Truc_Validated));
           total_Outtruc_mse  = Outtruc_calib_mse + Outtruc_valid_mse;


           %%%%%%%%%%%%%%%%%%fdotOut Output%%%%%%%%%%%%%%
           pr=[fdotOutMonAvgImpBarrelTonsN   fdotOutSumLast7DaysImpTonsN   fdotOutExpTons_1N
fdotOutSat  fdotOutSun];   %  fdotOutExpTons_2N
           fdotOutmodel= rot90(pr);


           ar=sim(net,fdotOutmodel);
           [OutTr]=postmnmx(ar,minOutTruc,maxOutTruc);


           fprintf(fid1,'\n\tOutDates\tAct-OutTruck-Counts\tMod-OutTruck-Counts');
           for c2 = 1:vpOut
```

```
        fprintf(fid1,'\n\t%5.0f\t%5.0f\t%5.0f',Out_Valid_Dates90(1,c2),OutTI(1,c2),OutTO(1,c2));
      end
      fprintf(fid2,'\n\n\n\n------------------------OUTBOUND TRUCKS------------------------');

      avgsum =0;
      for x1=1:(reqFIELD/2)
          avgsum = avgsum + (  ( OutTr(1,(x1+(reqFIELD/2))) - OutTr(1,x1))/ OutTr(1,x1));
      end
      avg = avgsum/(reqFIELD/2);
      ITERATION = it
      AVERAGE = avg
      IW = net.IW{1,1}
      LW = net.LW{2,1}
      b1 = net.b{1}

      b2  = net.b{2}
      fprintf(fid2,'\n  Dates\tOutbound  Trucks\t21-st  Street\t20th  Street\tCauseway  Blvd\tSutton
\tPendola point');

      for col = 1:(reqFIELD)

fprintf(fid2,'\n%d\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f\t%5.0f',fdotOutdates90(1,col),OutTr(1,col),(0.234*
OutTr(1,col)),(0.1482*OutTr(1,col)),(0.4313*OutTr(1,col)),(0.0962*OutTr(1,col)),(0.0901*OutTr(1,col)));

      end
      %end




     end
    end
  end
end

disp('Modeling Done')
disp('NOTE:-->Output can be viewed in the file "Tampa FDOT Output"')
```

```
fclose(fid2);

fclose(fid1);
```

Appendix K

Matlab Code for Port of Jacksonville

==

TALLEYRAND TERMINAL

==

```
% First Module  ////////////////////MODELI NG INBOUND TRUCKS///////////////////



% Opening Outbound trucks and vessel data File
%==============================================
File      =    load('c:\jax\Tally\Tally Data.txt'); % Opens Text file 'Everglades Intons' and takes the data to train and validate.

% Constants
%===========
dpIn = 69; %number of data points
tpIn = 46; % number of training points.
vsIn = tpIn+1;% validation starts from.
vpIn = dpIn-tpIn;% number of validation points.

% Dependent Variables
% ===================

Dates      = File(:,1);
InTruc      = File(:,2);
OutTruc     = File(:,3);


%Independent Variables
%=====================

Sat             =  File(:,5);
Sun              =  File(:,6);
WK               =  File(:,4);

IB_MonAvg         =  File(:,7);
IC_SUM7          =  File(:,8);
```

```
EB_MonAvg          =  File(:,11);
EC_SUM7            =  File(:,13);



%Normalizing Between -1 and 1
%============================


[IB_MonAvgN,minIB_MonAvg,maxIB_MonAvg]     =      premnmx(IB_MonAvg);
[IC_SUM7N,minIC_SUM7,maxIC_SUM7]        =      premnmx(IC_SUM7);
[EB_MonAvgN,minEB_MonAvg,maxEB_MonAvg]    =      premnmx(EB_MonAvg);
[EC_SUM7N,minEC_SUM7,maxEC_SUM7]        =      premnmx(EC_SUM7);


[InTrucN,minInTruc,maxInTruc]                       = premnmx(InTruc);
[OutTrucN,minOutTruc,maxOutTruc]                     = premnmx(OutTruc);


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%FDOT INPUT
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


channel=ddeinit('excel','c:\JAX\Jax FDOT Input.xls');
reqFIELD=ddereq(channel,'r11c17:r11c17');
fdotinput = ddereq(channel,'r14c3:r53c10');

fdotdates          = fdotinput(:,1);
fdotdates90         = rot90(fdotdates);

fdotWK                 =  fdotinput(:,6);
fdotSat                =  fdotinput(:,6);
fdotSun                =  fdotinput(:,7);

fdotIB_MonAvg          =  fdotinput(:,2);
fdotIC_SUM7            =  fdotinput(:,3);
```

```
fdotEB_MonAvg          =  fdotinput(:,4);
fdotEC_SUM7            =  fdotinput(:,5);
fdotIB_MonAvgN          = tramnmx(fdotIB_MonAvg,minIB_MonAvg,maxIB_MonAvg);
fdotIC_SUM7N            = tramnmx(fdotIC_SUM7,minIC_SUM7,maxIC_SUM7);
fdotEB_MonAvgN          = tramnmx(fdotEB_MonAvg,minEB_MonAvg,maxEB_MonAvg);
fdotEC_SUM7N            = tramnmx(fdotEC_SUM7,minEC_SUM7,maxEC_SUM7);



%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

min_truc_mse =3100000;

flag                                                                                                              =
1;%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%------------> set flag for trucks in and out
fid1 = fopen('c:\Jax\Tally\Tally Output.xls','w+');
fid2 = fopen('c:\Jax\Tally\Tally FDOT Output.xls','w+');


for EP = 100 %EP for
  for h1 =3%h1 for

     for it = 1:1% it for
        for switch_flag = 1:2   %switch_flag for
           order = randperm(dpIn);


              for r =1:tpIn      %r-1st for

                %Independent Variables:

                IB_MonAvgN_Train(r,:)           =  IB_MonAvgN(order(r),:);

                IC_SUM7N_Train(r,:)             =  IC_SUM7N(order(r),:);
```

```
    EB_MonAvgN_Train(r,:)            =  EB_MonAvgN(order(r),:);

    EC_SUM7N_Train(r,:)              =  EC_SUM7N(order(r),:);

    SatTrain(r,:)                    =  Sat(order(r),:);
    SunTrain(r,:)                    =  Sun(order(r),:);
    WKTrain(r,:)                     =  WK(order(r),:);



    % Dependent Variables:
    InTrucTrain(r,:)                 = InTrucN(order(r),:);
    OutTrucTrain(r,:)                = OutTrucN(order(r),:);
    inbound_truc_trained(r,:)        = InTruc(order(r),:);
    outbound_truc_trained(r,:)       = OutTruc(order(r),:);
    train_dates(r,:)                 = Dates(order(r),:);
end % end of '4th for'



% Validating records randomly
% =============================
 x = 0;

 for r =vsIn:dpIn   % r-2nd for

    x = x+1;
    %Independent Variables:
    valid_dates(x,:)                 =  Dates(order(r),:);
    IB_MonAvgN_Valid(x,:)            =  IB_MonAvgN(order(r),:);
    IC_SUM7N_Valid(x,:)              =  IC_SUM7N(order(r),:);
    EB_MonAvgN_Valid(x,:)            =  EB_MonAvgN(order(r),:);
    EC_SUM7N_Valid(x,:)              =  EC_SUM7N(order(r),:);



    SatValid(x,:)                    =  Sat(order(r),:);
    SunValid(x,:)                    =  Sun(order(r),:);
    WKValid(x,:)                     =  WK(order(r),:);
```

```
    % Dependent Variables:

    InTrucValid(x,:)               = InTrucN(order(r),:);
    OutTrucValid(x,:)              = OutTrucN(order(r),:);
    inbound_truc_validated(x,:)    = InTruc(order(r),:);
    outbound_truc_validated(x,:)   = OutTruc(order(r),:);


end % end of '5th for'



 Inpt = [IB_MonAvgN_Train   IC_SUM7N_Train    EB_MonAvgN_Train    EC_SUM7N_Train
SatTrain  SunTrain];   % WKTrain
Inp = rot90(Inpt);



  Inpvt =[IB_MonAvgN_Valid   IC_SUM7N_Valid  EB_MonAvgN_Valid    EC_SUM7N_Valid
SatValid  SunValid];   %WKValid
Inpv = rot90(Inpvt);


InTrucT90       = rot90(InTrucTrain);
InTrucV90       = rot90(InTrucValid);
OutTrucT90      = rot90(OutTrucTrain);
OutTrucV90      = rot90(OutTrucValid);
valid_dates90   = rot90(valid_dates);


%%%%%%%%%%%%%%%%%
% Inbound Truck
%%%%%%%%%%%%%%%%%
if (switch_flag == 1)

    net=newff([-1 1;-1 1;-1 1;-1 1;0 1;0 1],[h1,1],{'tansig','purelin'},'trainlm');
```

```
net.trainParam.epochs=EP;
net.trainParam.show=100;
net.trainParam.min_grad  = 0;
net.trainParam.minstep  = 0;
 net.IW{1,1} = [   -2.0175   -1.2487   -0.0813   -0.2677    0.0855    0.1125
   40.6104   -3.2184  -18.7777   -2.7114   46.1105   17.2091
    1.6318    3.0218   -2.9551   -1.7006    0.7072    1.0758];

 net.LW{2,1} = [    1.0459    0.1690   -0.1983];
 net.b{1} = [1.0298
-27.5083
-0.5552];



 net.b{2}= -0.0432;




Insim=sim(net,Inp);
[Ina]=postmnmx(Insim,minInTruc,maxInTruc);

Innewsim=sim(net,Inpv);
[Inav]=postmnmx(Innewsim,minInTruc,maxInTruc);

%%%%%%%%%%%%%%%
InTO = Inav(1:vpIn);
InTI = rot90(inbound_truc_validated);
Intruc_calib_mse  = mse(Ina - rot90(inbound_truc_trained));
Intruc_valid_mse  = mse(Inav - rot90(inbound_truc_validated));
total_Intruc_mse  = Intruc_calib_mse + Intruc_valid_mse;


 pr=[ fdotIB_MonAvgN    fdotIC_SUM7N     fdotEB_MonAvgN     fdotEC_SUM7N    fdotSat
fdotSun];  % fdotWK
fdotinmodel= rot90(pr);
```

```
ar=sim(net,fdotinmodel);
[InTr]=postmnmx(ar,minInTruc,maxInTruc);

fprintf(fid2,'\n------------------------------INBOUND TRUCKS------------------------------');


compare_field = reqFIELD -5;
avgsum =0;
for x1=1:(compare_field/2)
   avgsum = avgsum + (  ( InTr(1,(x1+(compare_field/2))) - InTr(1,x1))/ InTr(1,x1));
end
avg = avgsum/(compare_field/2);



fprintf(fid2,'\n\nDates\tInbound Trucks');

if (avg>0.15)
   AVERAGE = avg
   Iteration = it
   Epoch = h1
   IW     = net.IW{1,1}
   LW     = net.LW{2,1}
   b1     = net.b{1}
   b2     = net.b{2}



   for col = 1:reqFIELD
       fprintf(fid2,'\n%d\t%5.0f',fdotdates90(1,col),InTr(1,col));%
   end
end
fprintf(fid1,'\n\nValidating');
for c2 = 1:vpIn
   fprintf(fid1,'\n\t%5.0f\t%5.0f\t%5.0f',valid_dates90(1,c2),InTI(1,c2),InTO(1,c2));
end
```

```
else

    %       % Outbound Truck
    %       %%%%%%%%%%%%%%%%

    fprintf(fid2,'\n\n\n-------------------------------OUTBOUND   TRUCKS-------------------------------
');
    fprintf(fid1,'\n-------------------------------OUTBOUND TRUCKS-------------------------------');
    net=newff([-1 1;-1 1;-1 1;-1 1;0 1;0 1],[h1,1],{'tansig','purelin'},'trainlm');
    net.trainParam.epochs=EP;
    net.trainParam.show=100;
    net.trainParam.min_grad  = 0;
    net.trainParam.minstep  = 0;
    %net.biasConnect =0;
    %net = train(net,Inp,OutTrucT90);
    net.IW{1,1} = [2.9799    0.3296   -7.7295    0.3492   -1.4319   -1.4487
   -3.1028  -10.5497    0.2875   -5.6550   -6.2087    0.6134
   -0.9042   -0.6287    0.0848   -0.0890    0.0915    0.0482];

net.LW{2,1} = [0.2976    0.6325    2.8554];
net.b{1}    = [4.0262
-7.5586
-0.302];
net.b{2}    = [1.8957];

    Outsim=sim(net,Inp);
    [Outa]=postmnmx(Outsim,minOutTruc,maxOutTruc);

    Outnewsim=sim(net,Inpv);
    [Outav]=postmnmx(Outnewsim,minOutTruc,maxOutTruc);

    %%%%%%%%%%%%%%
    OutTO = Outav(1:vpIn);
    OutTI = rot90(inbound_truc_validated);
```

```
Outtruc_calib_mse  = mse(Outa - rot90(inbound_truc_trained));
Outtruc_valid_mse  = mse(Outav - rot90(inbound_truc_validated));
total_Outtruc_mse  = Outtruc_calib_mse + Outtruc_valid_mse;


pr=[ fdotIB_MonAvgN    fdotIC_SUM7N     fdotEB_MonAvgN     fdotEC_SUM7N    fdotSat
fdotSun];  % fdotWK
fdotinmodel= rot90(pr);


ar=sim(net,fdotinmodel);
[OutTr]=postmnmx(ar,minOutTruc,maxOutTruc);


%
compare_field = reqFIELD -5;
avgsum =0;
for x1=1:(compare_field/2)
   avgsum = avgsum + (  ( OutTr(1,(x1+(compare_field/2))) - OutTr(1,x1))/ OutTr(1,x1));
end
avg = avgsum/(compare_field/2);


fprintf(fid2,'\n\nDates\tOutbound Trucks');
if (avg>0.20)
   AVERAGE = avg
   Iteration = it
   IW      = net.IW{1,1}
   H1      = h1
   LW      = net.LW{2,1}
   b1      = net.b{1}
   b2      = net.b{2}
   for col = 1:reqFIELD
      fprintf(fid2,'\n%d\t%5.0f',fdotdates90(1,col),OutTr(1,col));%                    \t%5.0f\t%5.0f/
,(0.6585*InTr(1,col)),(0.2886*OutTr(1,col)),(0.0529*OutTr(1,col)));
   end
```

```
            end
            fprintf(fid1,'\n\nValidating');
            for c2 = 1:vpIn
                fprintf(fid1,'\n\t%5.0f\t%5.0f\t%5.0f',valid_dates90(1,c2),OutTI(1,c2),OutTO(1,c2));
            end
        end

      end
    end




  end
end


disp('\nNOTE: -->Output can be viewed in file:Tally FDOT Output');
fclose(fid2);

fclose(fid1);
```

```
================================================================================
% First Module  ////////////////////MODELING INBOUND TRUCKS////////////////////
fid1 = fopen('c:\Jax\Blount\Blount Output.xls','w+');
fid2 = fopen('c:\Jax\Blount\Blount FDOT Output.xls','w+');



% Opening Outbound trucks and vessel data File
%=============================================
File = load('c:\jax\Blount\Blount Data.txt'); % Opens Text file 'Everglades Intons' and takes the data to train and validate.

% Constants
%===========
dpIn = 41; %number of data points
tpIn = 28; % number of training points.
vsIn = tpIn+1;% validation starts from.
vpIn = dpIn-tpIn;% number of validation points.
% Dependent Variables
% ===================

Dates      = File(:,1);
InTruc     = File(:,12);
OutTruc    = File(:,13);



%Independent Variables
%=====================
MW            =  File(:,8);
TThF          =  File(:,9);
Sat           =  File(:,10);
Sun           =  File(:,11);
IA_SUM7       =  File(:,2);
IB_MonAvg     =  File(:,3);
IC_SUM3       =  File(:,4);
```

```
EA_SUM7            =  File(:,5);
EB_MonAvg          =  File(:,6);
EC_SUM7            =  File(:,7);



%Normalizing Between -1 and 1
%============================
[IA_SUM7N,minIA_SUM7,maxIA_SUM7]           =      premnmx(IA_SUM7);
[IB_MonAvgN,minIB_MonAvg,maxIB_MonAvg]     =      premnmx(IB_MonAvg);
[IC_SUM3N,minIC_SUM3,maxIC_SUM3]        =      premnmx(IC_SUM3);
[EA_SUM7N,minEA_SUM7,maxEA_SUM7]           =      premnmx(EA_SUM7);
[EB_MonAvgN,minEB_MonAvg,maxEB_MonAvg]    =      premnmx(EB_MonAvg);
[EC_SUM7N,minEC_SUM7,maxEC_SUM7]        =      premnmx(EC_SUM7);


[InTrucN,minInTruc,maxInTruc]                      = premnmx(InTruc);
[OutTrucN,minOutTruc,maxOutTruc]                   = premnmx(OutTruc);


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%FDOT INPUT
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%


channel=ddeinit('excel','c:\JAX\Jax FDOT Input.xls');
reqFIELD=ddereq(channel,'r11c17:r11c17');
fdotinput = ddereq(channel,'r14c3:r53c13');

fdotdates          = fdotinput(:,1);
fdotdates90        = rot90(fdotdates);

fdotMW              =  fdotinput(:,8);
fdotTThF            =  fdotinput(:,9);
fdotSat             =  fdotinput(:,10);
fdotSun             =  fdotinput(:,11);
```

```
fdotIA_SUM7           =  fdotinput(:,2);
fdotIB_MonAvg         =  fdotinput(:,3);
fdotIC_SUM3           =  fdotinput(:,4);
fdotEA_SUM7           =  fdotinput(:,5);
fdotEB_MonAvg         =  fdotinput(:,6);
fdotEC_SUM7           =  fdotinput(:,7);

fdotIA_SUM7N          = tramnmx(fdotIA_SUM7,minIA_SUM7,maxIA_SUM7);
fdotIB_MonAvgN        = tramnmx(fdotIB_MonAvg,minIB_MonAvg,maxIB_MonAvg);
fdotIC_SUM3N          = tramnmx(fdotIC_SUM3,minIC_SUM3,maxIC_SUM3);
fdotEA_SUM7N          = tramnmx(fdotEA_SUM7,minEA_SUM7,maxEA_SUM7);
fdotEB_MonAvgN        = tramnmx(fdotEB_MonAvg,minEB_MonAvg,maxEB_MonAvg);
fdotEC_SUM7N          = tramnmx(fdotEC_SUM7,minEC_SUM7,maxEC_SUM7);



%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

min_truc_mse =3100000;

flag                                                                                          =
1;%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%------------> set flag for trucks in and out

fprintf(fid1,'\n\nh1\tEPOCHS\tIntruck_calib_mse\tIntruck_valid_mse\tTotal_Intruck_mse\tOuttruck_calib_
mse\tOuttruck_valid_mse\tTotal_Outtruck_mse\tTotal_truck_mse\tOrder');

for EP = 100 %EP for
   for h1 =0%h1 for


       for it = 1:1
          for switch_flag = 1:2   %switch_flag for



              order = randperm(dpIn);
```

```
for r =1:tpIn      %r-1st for

    %Independent Variables:
    IA_SUM7N_Train(r,:)            =  IA_SUM7N(order(r),:);
    IB_MonAvgN_Train(r,:)          =  IB_MonAvgN(order(r),:);
    IC_SUM3N_Train(r,:)            =  IC_SUM3N(order(r),:);
    EA_SUM7N_Train(r,:)            =  EA_SUM7N(order(r),:);
    EB_MonAvgN_Train(r,:)          =  EB_MonAvgN(order(r),:);
    EC_SUM7N_Train(r,:)            =  EC_SUM7N(order(r),:);

    MWTrain(r,:)                   =  MW(order(r),:);
    TThFTrain(r,:)                 =  TThF(order(r),:);
    SatTrain(r,:)                  =  Sat(order(r),:);
    SunTrain(r,:)                  =  Sun(order(r),:);



    % Dependent Variables:
    InTrucTrain(r,:)               = InTrucN(order(r),:);
    OutTrucTrain(r,:)              = OutTrucN(order(r),:);
    inbound_truc_trained(r,:)      = InTruc(order(r),:);
    outbound_truc_trained(r,:)     = OutTruc(order(r),:);
    train_dates(r,:)               = Dates(order(r),:);
end % end of '4th for'


% Validating records randomly
% =============================
 x = 0;

for r =vsIn:dpIn   % r-2nd for

    x = x+1;
    %Independent Variables:
    valid_dates(x,:)               =  Dates(order(r),:);
    IA_SUM7N_Valid(x,:)            =  IA_SUM7N(order(r),:);
    IB_MonAvgN_Valid(x,:)          =  IB_MonAvgN(order(r),:);
```

```
    IC_SUM3N_Valid(x,:)           =  IC_SUM3N(order(r),:);
    EA_SUM7N_Valid(x,:)           =  EA_SUM7N(order(r),:);
    EB_MonAvgN_Valid(x,:)         =  EB_MonAvgN(order(r),:);
    EC_SUM7N_Valid(x,:)           =  EC_SUM7N(order(r),:);


    SatValid(x,:)                 =  Sat(order(r),:);
    SunValid(x,:)                 =  Sun(order(r),:);
    MWValid(x,:)                  =  MW(order(r),:);
    TThFValid(x,:)                =  TThF(order(r),:);

    % Dependent Variables:

    InTrucValid(x,:)              = InTrucN(order(r),:);
    OutTrucValid(x,:)             = OutTrucN(order(r),:);
    inbound_truc_validated(x,:)   = InTruc(order(r),:);
    outbound_truc_validated(x,:)  = OutTruc(order(r),:);


  end % end of '5th for'


   Inpt = [IA_SUM7N_Train   IB_MonAvgN_Train    IC_SUM3N_Train     EA_SUM7N_Train
EB_MonAvgN_Train    EC_SUM7N_Train   MWTrain   TThFTrain   SatTrain  SunTrain];
  Inp = rot90(Inpt);

    Inpvt =[IA_SUM7N_Valid  IB_MonAvgN_Valid   IC_SUM3N_Valid    EA_SUM7N_Valid
EB_MonAvgN_Valid   EC_SUM7N_Valid  MWValid  TThFValid  SatValid  SunValid];
  Inpv = rot90(Inpvt);


  InTrucT90       = rot90(InTrucTrain);
  InTrucV90       = rot90(InTrucValid);
  OutTrucT90      = rot90(OutTrucTrain);
  OutTrucV90      = rot90(OutTrucValid);
  valid_dates90   = rot90(valid_dates);
```

```
%%%%%%%%%%%%%%%%%
% Inbound Truck
%%%%%%%%%%%%%%%%%
if (switch_flag == 1)

    net=newff([-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;0 1;0 1;0 1;0 1],[1],{'purelin'},'trainlm');
    net.trainParam.epochs=EP;
    net.trainParam.show=100;
    net.trainParam.min_grad  = 0;
    net.trainParam.minstep  = 0;
    net.biasConnect =0;
    net.IW{1,1} = [-1.01891         -0.774910.761     0.38311  0.03177  0.04115  0.01547  0.14816
0.09363  0.05464];

    Insim=sim(net,Inp);
    [Ina]=postmnmx(Insim,minInTruc,maxInTruc);

    Innewsim=sim(net,Inpv);
    [Inav]=postmnmx(Innewsim,minInTruc,maxInTruc);

    %%%%%%%%%%%%%%%
    InTO = Inav(1:vpIn);
    InTI = rot90(inbound_truc_validated);
    Intruc_calib_mse  = mse(Ina - rot90(inbound_truc_trained));
    Intruc_valid_mse  = mse(Inav - rot90(inbound_truc_validated));
    total_Intruc_mse  = Intruc_calib_mse + Intruc_valid_mse;


    pr=[fdotIA_SUM7N      fdotIB_MonAvgN         fdotIC_SUM3N               fdotEA_SUM7N
fdotEB_MonAvgN    fdotEC_SUM7N  fdotMW fdotTThF  fdotSat fdotSun];
    fdotinmodel= rot90(pr);


    ar=sim(net,fdotinmodel);
    [InTr]=postmnmx(ar,minInTruc,maxInTruc);
```

```
compare_field = reqFIELD-6;
avgsum =0;
for x1=1:(compare_field/2)
    avgsum = avgsum + (  ( InTr(1,(x1+(compare_field/2))) - InTr(1,x1))/ InTr(1,x1));
end

avg = avgsum/(compare_field/2);



fprintf(fid2,'\n--------------------------------INBOUND TRUCKS--------------------------------');
fprintf(fid2,'\n\nDates\tInbound Trucks');

if (avg>0.2)
    AVERAGE = avg
    Iteration = it
    IW      = net.IW{1,1}
    fprintf(fid1,'\n\nInbound -->IT= %d',it);


    for col = 1:reqFIELD
        fprintf(fid2,'\n%d\t%5.0f',fdotdates90(1,col),InTr(1,col));%                    \t%5.0f\t%5.0f/
,(0.6585*InTr(1,col)),(0.2886*InTr(1,col)),(0.0529*InTr(1,col)));
    end


end
fprintf(fid1,'\n\nValidating');
for c2 = 1:vpIn
    fprintf(fid1,'\n\t%5.0f\t%5.0f\t%5.0f',valid_dates90(1,c2),InTI(1,c2),InTO(1,c2));
end

else


%             % Outbound Truck
```

```
%                %%%%%%%%%%%%%%%%%%

fprintf(fid2,'\n\n\n-------------------------------OUTBOUND   TRUCKS-------------------------------
');

net=newff([-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;0 1;0 1;0 1;0 1],[1],{'purelin'},'trainlm');
net.trainParam.epochs=EP;
net.trainParam.show=100;
net.trainParam.min_grad  = 0;
net.trainParam.minstep  = 0;
net.biasConnect =0;
net.IW{1,1} = [-0.99027          -0.749370.8134   0.41678  0.00928  0.10979  0.03008  0.07332
    0.11787  0.02519];

Outsim=sim(net,Inp);
[Outa]=postmnmx(Outsim,minOutTruc,maxOutTruc);

Outnewsim=sim(net,Inpv);
[Outav]=postmnmx(Outnewsim,minOutTruc,maxOutTruc);

%%%%%%%%%%%%%%%%
OutTO = Outav(1:vpIn);
OutTI = rot90(inbound_truc_validated);
Outtruc_calib_mse  = mse(Outa - rot90(inbound_truc_trained));
Outtruc_valid_mse  = mse(Outav - rot90(inbound_truc_validated));
total_Outtruc_mse  = Outtruc_calib_mse + Outtruc_valid_mse;

pr=[fdotIA_SUM7N      fdotIB_MonAvgN        fdotIC_SUM3N             fdotEA_SUM7N
fdotEB_MonAvgN    fdotEC_SUM7N  fdotMW fdotTThF  fdotSat  fdotSun];   %
fdotinmodel= rot90(pr);

ar=sim(net,fdotinmodel);
[OutTr]=postmnmx(ar,minOutTruc,maxOutTruc);
```

```
avgsum =0;
for x1=1:(compare_field/2)
    avgsum = avgsum + (  ( OutTr(1,(x1+(compare_field/2))) - OutTr(1,x1))/ OutTr(1,x1));
end
avg = avgsum/(compare_field/2);



fprintf(fid2,'\n\nDates\tOutbound Trucks');
fprintf(fid1,'\n\nOutbound -->IT= %d',it);

if (avg>0.3)
    AVERAGE = avg
    IT = it
    IW      = net.IW{1,1}
    for col = 1:reqFIELD
        fprintf(fid2,'\n%d\t%5.0f',fdotdates90(1,col),OutTr(1,col));%                    \t%5.0f\t%5.0f/
,(0.6585*InTr(1,col)),(0.2886*OutTr(1,col)),(0.0529*OutTr(1,col)));
    end

end
fprintf(fid1,'\n\nValidating');
for c2 = 1:vpIn
    fprintf(fid1,'\n\t%5.0f\t%5.0f\t%5.0f',valid_dates90(1,c2),OutTI(1,c2),OutTO(1,c2));
end
end

end



end
```

```
  end
end
end
end

        disp('Output can be viewed in file: "Blount FDOT Output');
fclose(fid2);

fclose(fid1);
```

Appendix L

USER MANUAL

INTRODUCTION

Each of the four ports selected have site-specific characteristics. Because of this, it was necessary to develop individual models for each port. Although all the port models are different, there are some common guidelines to run any model in the Matlab™ Software used for this port modeling. All the files pertaining to each port are located in a single port folder named for each respective port. Each folder includes a Matlab™ file, an Excel input file and an Excel output file. Fields are referred as columns and records are referred to rows. The model can predict up to 31 days of output. So the number of records user wants to input depends on the days of output required. The following are the file name format with their details present in each port folder.

- <port-name>FDOTModel (e.g: PalmBeachFDOTModel). This is a Matlab™ file, notice that there are no spaces or any special characters in the Matlab™ file name.
- <port-name>FDOT Input (e.g: PalmBeach FDOT Input.xls). This is the Excel file for input. The model takes input data from this file.
- <port-name>FDOT Output (e.g PalmBeach FDOT Output.xls). This is the Excel file for output. The model directs the output to this file.

Common Guidelines for Running a Model

The following are common guidelines to be followed to run any port model.

1. Copy the "FDOT_Port_Models" folder to your "C drive" on your computer. See Figure L-1 for an example.

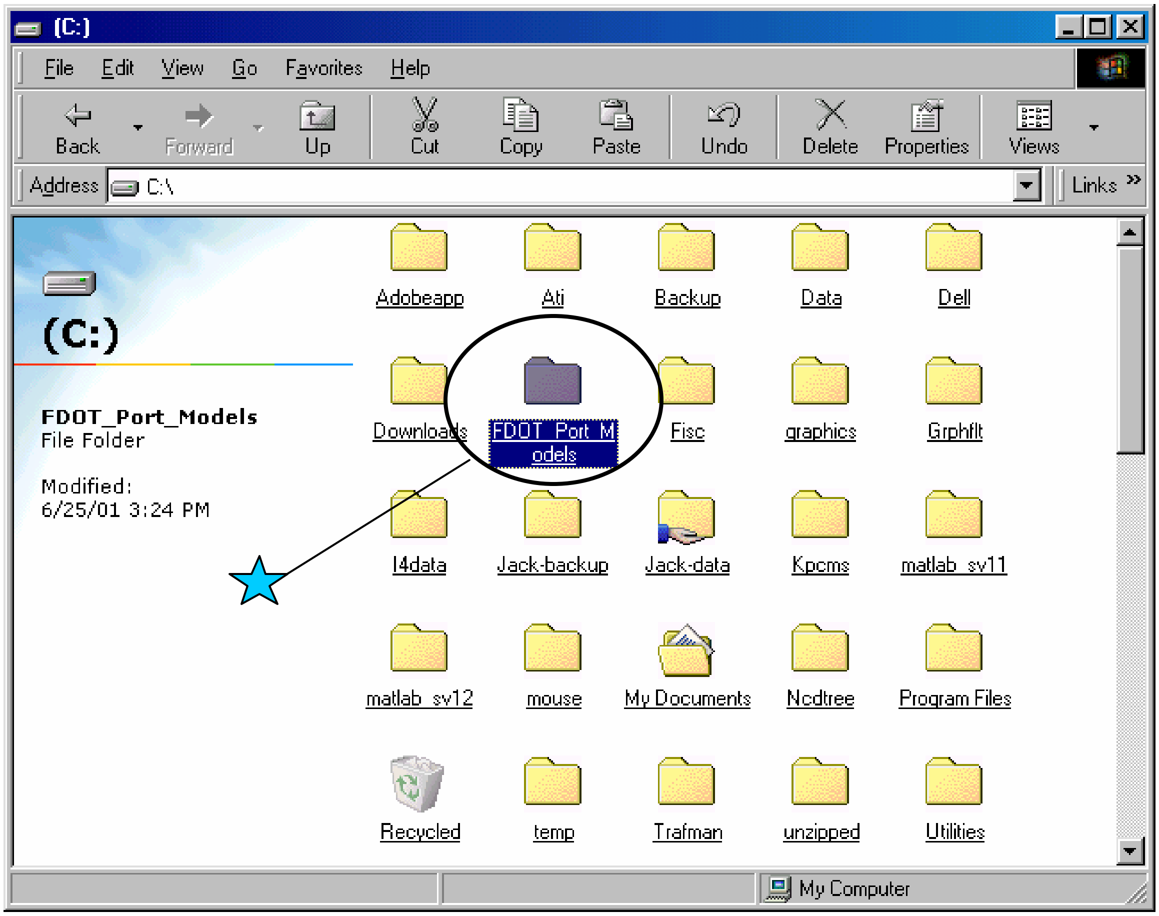

Figure L-1: "FDOT_Port_Models" Folder on "C drive"

2. Open the Excel input file for the port you want to model for which is located in the "FDOT_Port_Models" folder, see Figure L-1. The contents of this folder are displayed in Figure L-2. The file is located in the respective port folder (i.e. PalmBeach FDOT Input, see Figure L-3). An example of this input file (for the Palm Beach Model) is shown in Figure L-4.

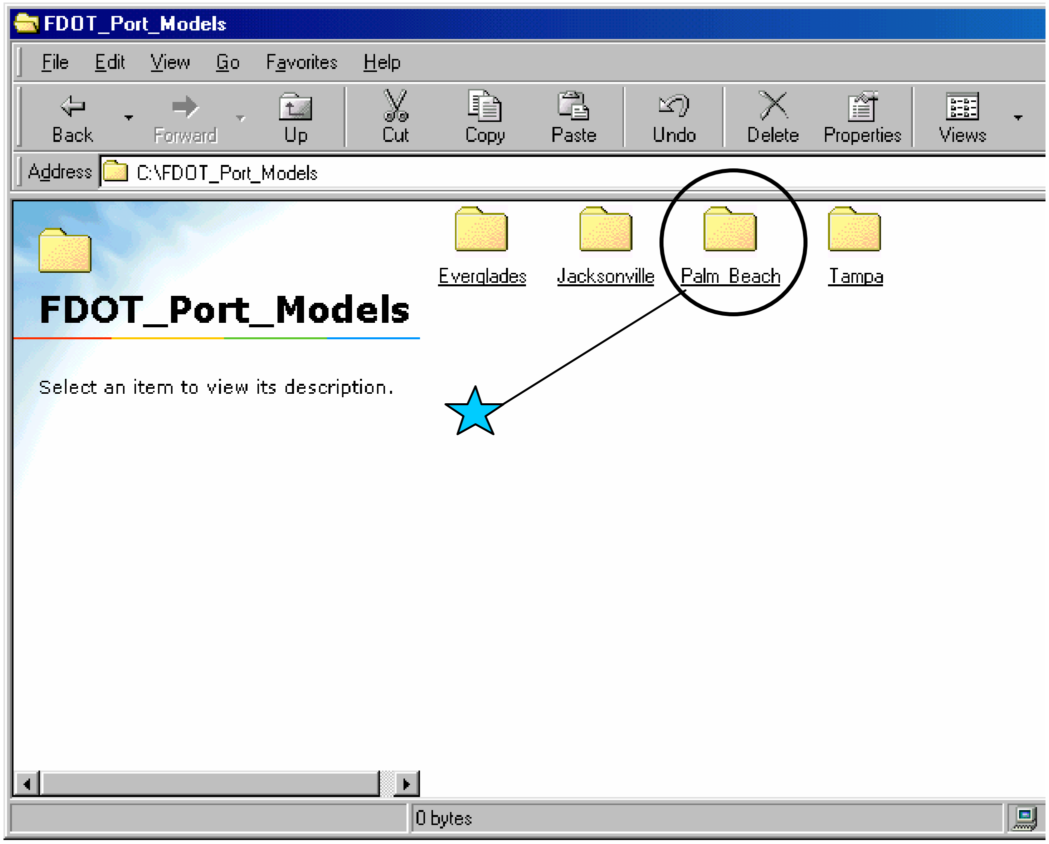

Figure L-2: Contents of "FDOT_Port_Models" Folder

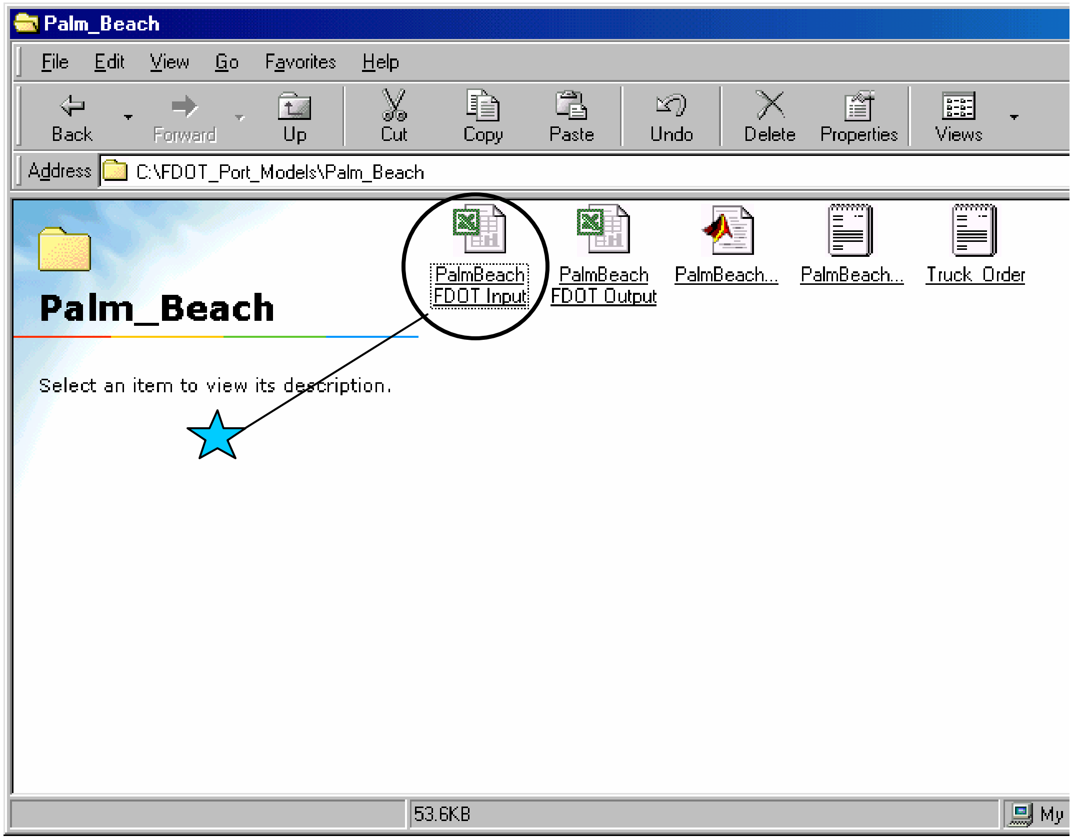

Figure L-3: Contents of "Palm_Beach" Folder

PALM BEACH FDOT INPUT

NOTES:--> All the bold fields (with *) are required.
--> Do not close this file when the Model is running.
--> The input for number of days for which output is desired must be any number between 1 and 31 only.
--> Output can be viewed in the file' Palm Beach FDOT Output'.
--> User can input in yellow cells only.

Enter the number of days for which Output is desired (Reqd) = ***5***

INPUT

Step 3a

Step 3b

Step 3c

1	2	3	4
SN	***Date**	***Imported Tonnage**	***Exported Tonnage**
1	10101	1996.205431	6559.261632
2	10201	5411.525272	11119.65306
3	10301	1874.120028	11734.33753
4	10401	3198.52841	14175.62018
5	10501	2044.470716	14628.2178
6			
7			
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Figure L-4: PalmBeach FDOT Input File

3. Enter the number of output records desired, see Figure L-4, step 3a. Then, click on the INPUT button, step 3b. This will highlight the actual number of records required for input (step 3c) to generate the desired number of output records as indicated by the user.

4. Fill in the highlighted cells only. An example is shown in Figure L-4, step 3c. This is the data the model requires to complete a model run. An example of a completed input file for 5 desired output records is Figure L-4. <u>Leave this file open!</u> It must remain open while the model is running.

5. Start the Matlab™ Software. You should have a window similar to the one in Figure L-5. (note: the program used in model development is Matlab™ Student Version 12 with the Neural Network toolbox add in).

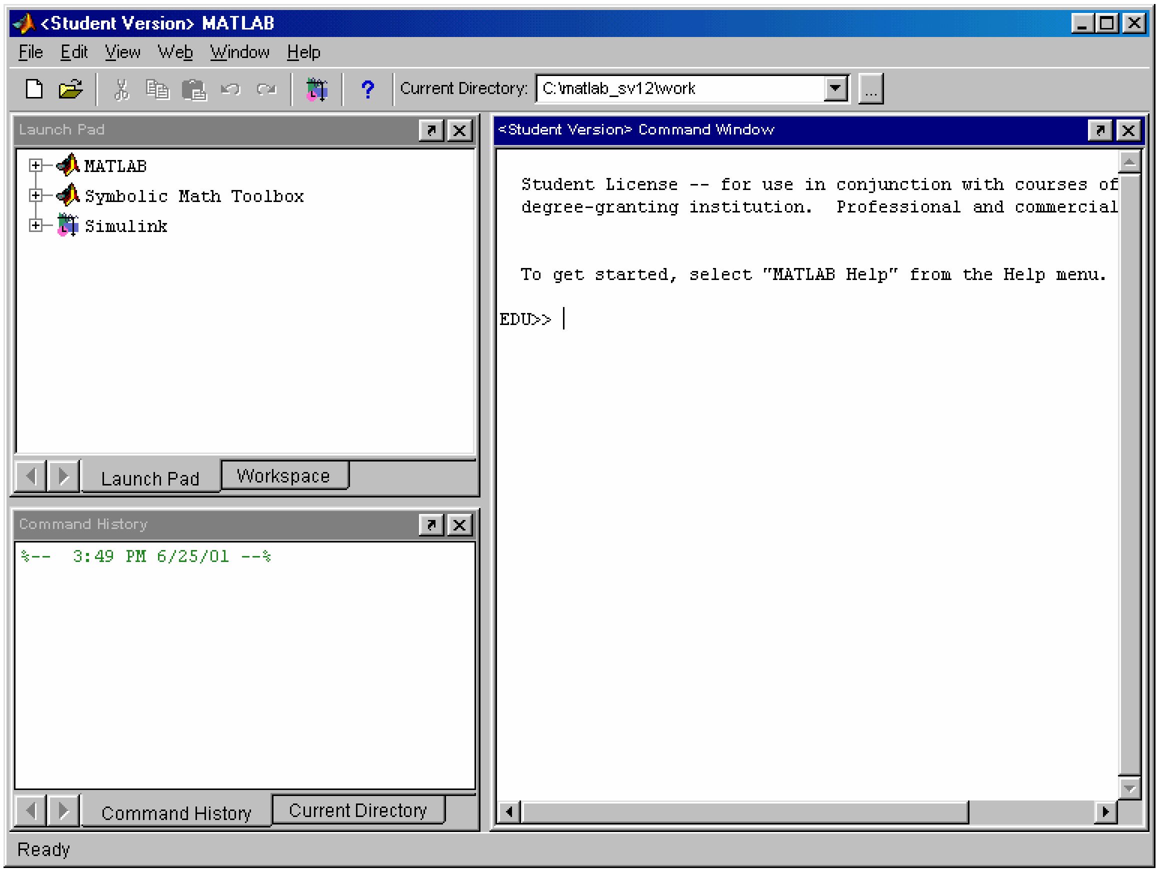

Figure L-5: Matlab™ Start Window

6. In Matlab™, change the directory to the port folder "FDOT_Port_Models", step 6a. You should have a window command like the one in Figure L-6. Also shown in the window is an example of an error message when the command is not entered correctly.

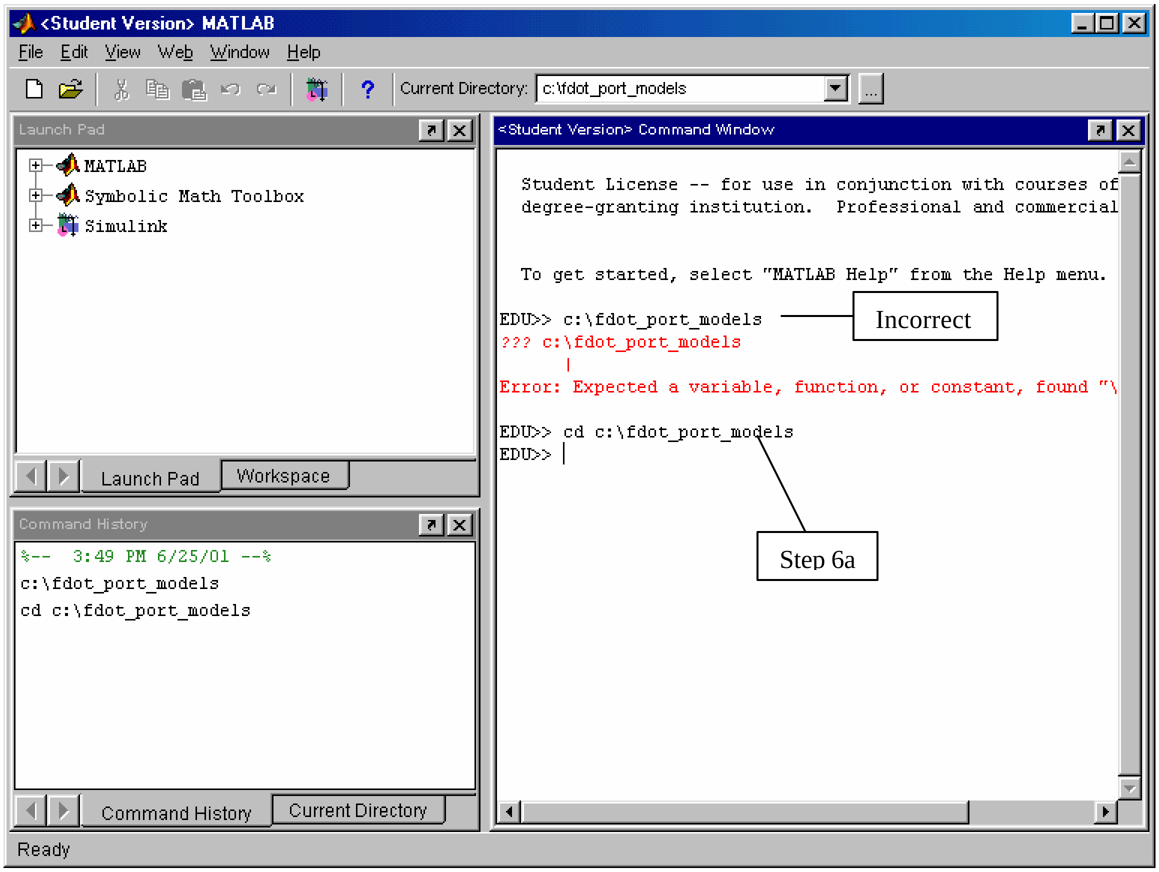

Figure L-6: Matlab™ Change Directory Window 1

7. Now change the directory again so that it is directed to the respective port model folder for the port that modeling is desired for, step 7a. Figure L-7, step 7a shows an example command line for the "Palm_Beach" port. The port folders to choose from are:

- Palm_Beach
- Everglades
- Tampa
- Jacksonville\Blount_Island
- Jacksonville\Talleyrand

The available folders in the "FDOT_Port_Models" directory can be viewed using the DIR command as shown in Figure L-7.

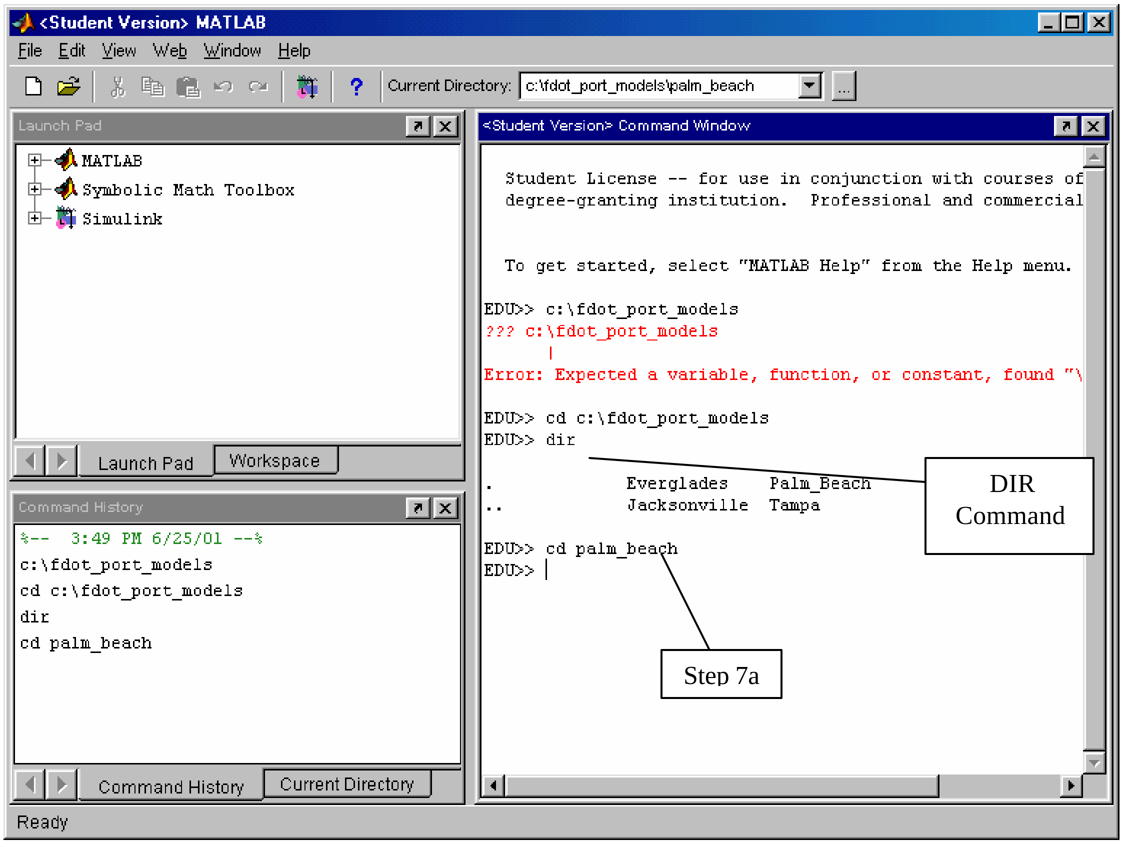

Figure L-7: Matlab™ Change Directory Window 2

8. Now type the RUN command, step 8a, “run <portname>fdotmodel” (i.e. run palmbeachfdotmodel) and hit enter. Note: there is a space between run and the file name and the <u>file name itself has no spaces</u> in it. An example of this is shown in Figure L-8, step 8a. Also, if the steps are not followed correctly, an error message such as the one in Figure L-8 will be displayed. This can be from:

   - Not having an open excel file
   - Not having the Neural Network toolbox add in

   While the model is running, a “Training With Trainlm” Window is open. Figure L-9 displays an example of this window.

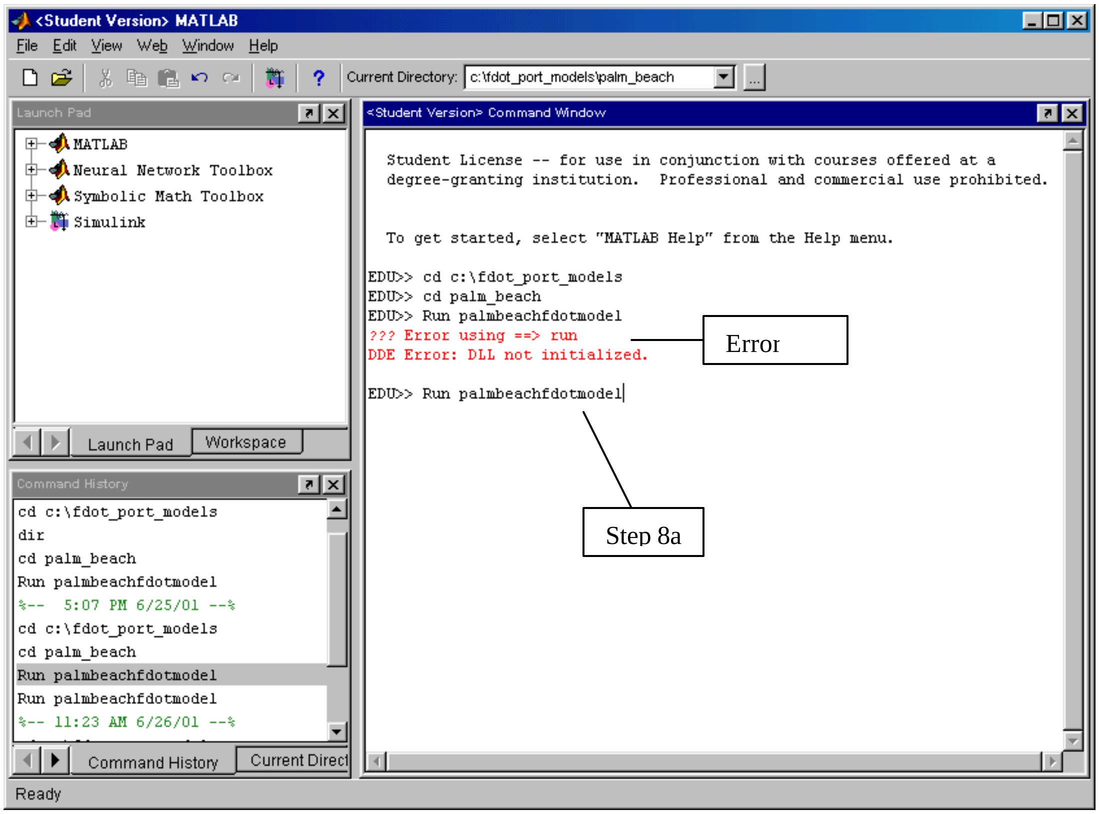

Figure L-8: Matlab™ Run Window

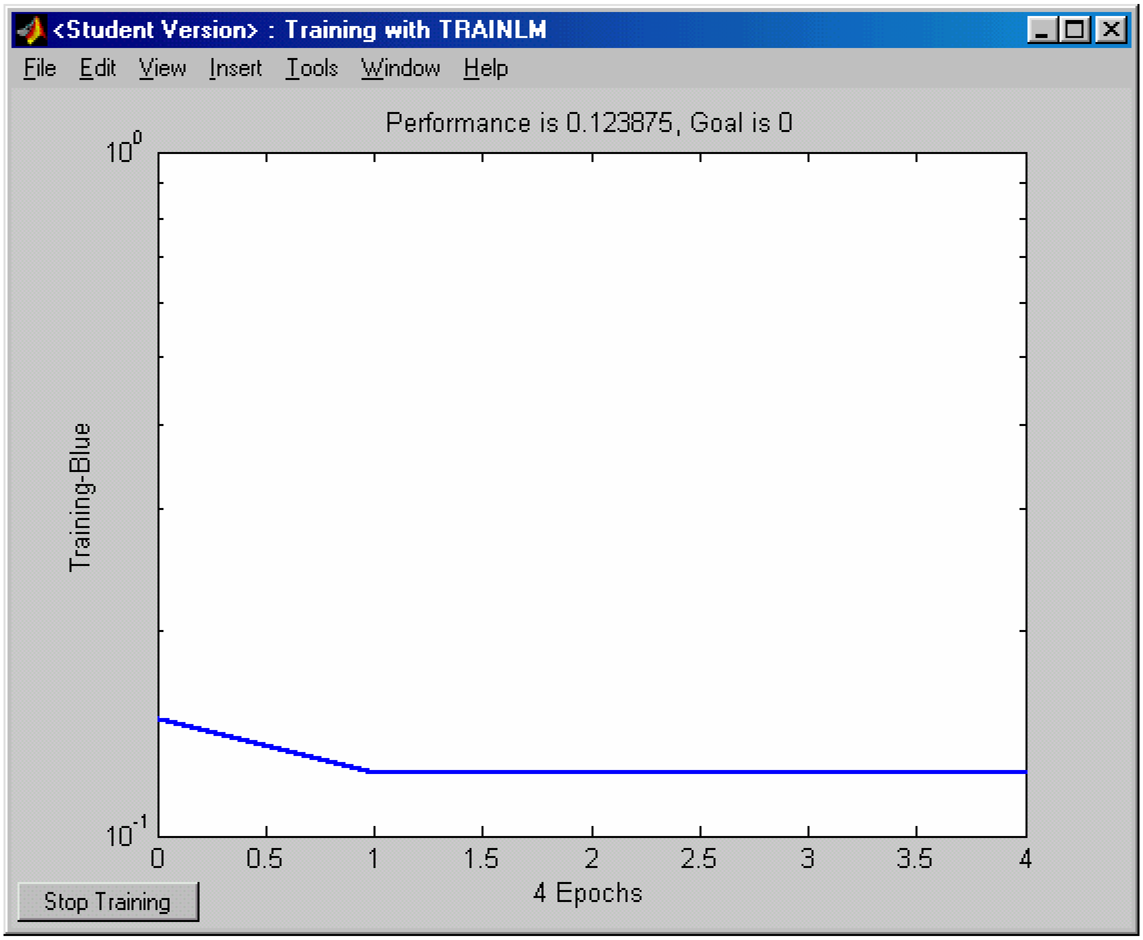

Figure L-9: Matlab™ "Training With Trainlm" Window

9. The model run is completed after the window behind the "Training With Trainlm" Window states that the model run is finished, see Figure L-10. Once the model run is finished, the "Training With Trainlm" Window can be closed.

   The model output is viewed by opening the excel output file, "<port name>fdot output", see Figure L-11. An example of this output file for the Port of Palm Beach is displayed in Figure L-12.

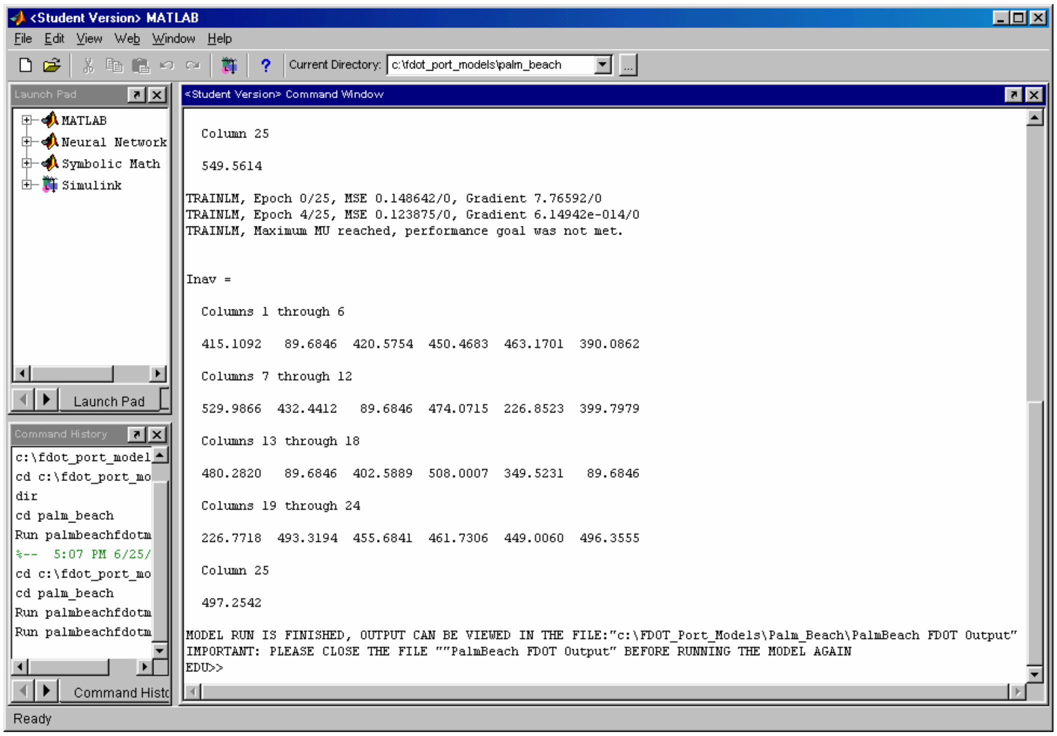

Figure L-10: Matlab™ Finished Window

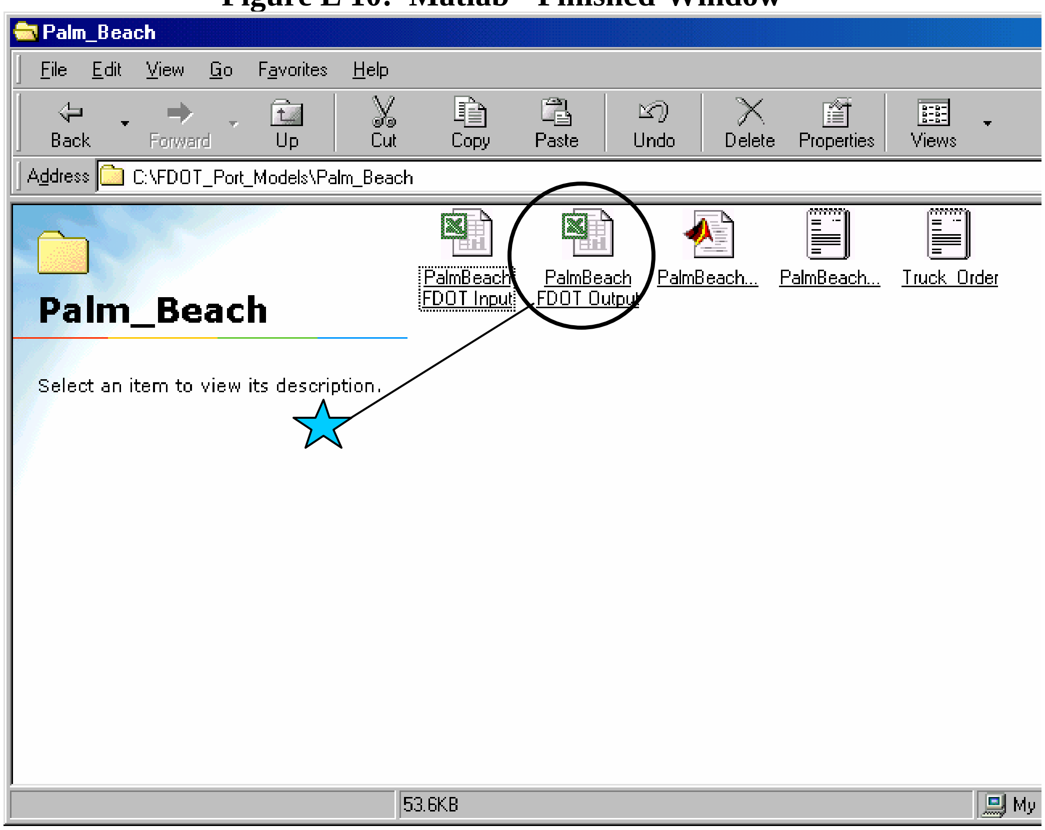

Figure L-11: Location of "PalmBeach FDOT Output" File

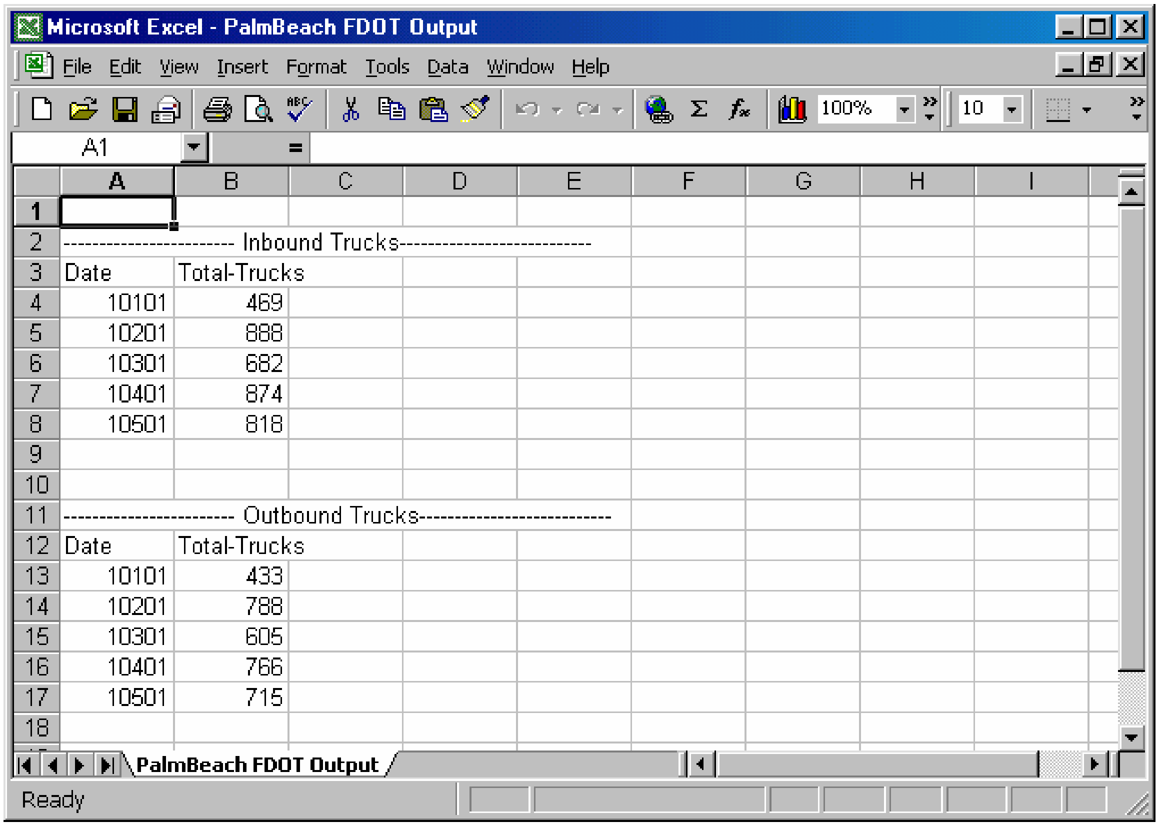

Figure L-12: PalmBeach FDOT Output File

10. To run the model again, the output file must be closed while the model is running.

The following pages describe the input variables for each of the developed port models.

PORT OF PALM BEACH

Port of Palm Beach model requires one day of input data to estimate one day of output. So in order to predict 'n' days of output 'n' days of input data are required. There are three fields in the input data window (see Figure L-13) that require input data.

2. **Date:** (format: mm/dd/yy) corresponds to the individual record(s) entered.
3. **Imported Tonnage:** (units: tons) total daily imported tonnage. This consists of the sum of daily imported tonnage for break-bulk, containerized cargo and daily average of cement. Cement must be averaged on all days trucks hauling cement operate (during this study, Cement was averaged on all days except Sundays).
4. **Exported Tonnage:** (units: tons) total daily exported tonnage. This consists of total daily exported tonnage of break bulk, containerized cargo, and daily averages for Molasses and Sugar. Molasses and Sugar must be averaged on all days trucks hauling these commodities operate (during this study, Molasses was averaged on all days except Sundays and Sugar was averaged on all days except Saturdays and Sundays). Therefore, a total daily shipment of Molasses or Sugar is averaged over the total number of days after the date of last shipment until the date of the next shipment, including the day of shipment.

Once the data entry is completed in the data input window, the model can be run to get the output. Figure L-14 displays sample output window for the input data entered in Figure L-13. The Output window lists the date for which input was entered and the outputs, which are inbound and outbound trucks.

PALM BEACH FDOT INPUT

NOTES: --> **All the bold fields (with *) are required.**

--> **Do not close this file when the Model is running.**

--> **The input for number of days for which output is desired must be any number between 1 and 31 only.**

--> **Output can be viewed in the file' Palm Beach FDOT Output'.**

--> **User can input in yellow cells only.**

Enter the number of days for which Output is desired (Reqd) = ***5***

INPUT

1	2	3	4
SN	***Date**	***Imported Tonnage**	***Exported Tonnage**
1	10101	1996.205431	6559.261632
2	10201	5411.525272	11119.65306
3	10301	1874.120028	11734.33753
4	10401	3198.52841	14175.62018
5	10501	2044.470716	14628.2178
6			
7			
8			
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Figure L-13: Port of Palm Beach Sample Model Input Window

------------------------ Inbound Trucks---------------------------

Date	Total-Trucks
10101	469
10201	888
10301	682
10401	874
10501	818

------------------------ Outbound Trucks---------------------------

Date	Total-Trucks
10101	433
10201	788
10301	605
10401	766
10501	715

Figure L-14: Port of Palm Beach Sample Model Output Window

PORT OF EVERGLADES

Port of Everglades model needs extra input data in order to compute truck counts for the desired number of output days. The first three cells under *'SN'* field are labeled '*Reqd*', which indicates that values must be entered for all the cells in those three rows. The Everglades model has storage variables. In other words, the model requires data for three days prior and three days after the required day(s) of output, a total of 6 extra records for any one model run. So in order to predict 'n' days of output 'n+6' days of input data are required. There are eight fields in the input data window (see Figure L-15) that require input data.

2. **Date:** (format: mm/dd/yy) corresponds to the individual record(s) entered.
3. **Daily Imported Containers:** (units: each) The daily imported cargo commodities measured in units of each (usually containers).

4. **Daily Imported Tonnage:** (units: tons) total daily imported tonnage. The sum of all commodities listed in tons imported on that day with daily averages of cement and aggregate. A daily average from the monthly total of cement and aggregate is computed excluding Sundays.
5. **Monthly Imported Barrels:** (units: barrels) A daily average from the monthly total of all commodities measured in units of barrels is computed.
6. **Daily Exported Containers :** (units: each) The daily exported cargo commodities measured in units of each (usually containers).
7. **Daily Exported Tonnage:** (units: tons) total daily exported tonnage. The sum of all commodities listed in tons exported on that day.
8. **SAT:** (1 or 0) This field requires a '1' for Saturday otherwise '0'.
9. **SUN:** (1 or 0) This field requires a '1' for Sunday otherwise '0'.

Once the data entry is completed in the data input window, the model can be run to get the output. Figure L-16 displays sample output window for the input data entered in Figure L-15. The Output window lists the date for which input was entered and the outputs, which are inbound and outbound trucks.

EVERGLADES FDOT INPUT

--> All the bold fields (with *) are required.
--> Do not close this file when the model is running.
--> The input for number of days for which output is required should be any number between 1 and 31 only.
--> Output can be viewed in the file' Everglades FDOT Output'.
--> User can input in only yellow cells.

NOTE: For specific input data field calculations refer to the user manual

-->Enter the number of days for which Output is desired (Reqd) = ***5***

1	2	3	4	5	6	7	8	9
SN	***Date**	***Daily Imported Containers**	***Daily Imported Tonnage**	***Monthly Imported Barrels**	***Daily Exported Containers**	***Daily Exported Tonnage (excl. cont. cargo)**	***SAT** *(1 if Saturday; 0 if not)*	***SUN** *(1 if Sunday; 0 if not)*
Reqd	050205	428	18688	390452	504	302	0	0
Reqd	050305	249	18896	390452	182	19	0	0
Reqd	050405	596	29094	390452	353	146	0	0
1	050505	808	24905	390452	1130	321	0	0
2	050605	514	23343	390452	882	176	0	0
3	050705	1049	27035	390452	1784	439	1	0
4	050805	278	0	390452	375	240	0	1
5	060605	348	22506	403700	386	49	0	0
6	060705	220	22126	403700	294	45	0	0
7	060805	596	24121	403700	274	192	0	0
8	060905	575	17658	403700	872	51	0	0
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INPUT

Figure L-15: Port of Everglades Sample Model Input Window

--------------------Inbound Trucks--------------------

InDates	Mod-InTruc	Eller Inbou	Spangler Ir	Eisenhower Inbound
50505	4728	3113	1364	250
50605	4608	3035	1330	244
50705	2843	1872	820	150
50805	2182	1437	630	115
60605	3222	2122	930	170

--------------------Outbound Trucks--------------------

OutDates	Mod-OutTr	Eller Outbc	Spangler C	Eisenhower Outbound
50505	3913	2418	1313	183
50605	4246	2623	1424	199
50705	2254	1393	756	105
50805	1777	1098	596	83
60605	3885	2400	1303	182

Figure L-16: Port of Everglades Sample Model Output Window

PORT OF TAMPA

Port of Tampa model needs extra input data in order to compute truck counts for the desired number of output days. The Tampa model has storage variables. In other words, the model requires data for three days after the required day(s) of output, a total of 3 extra records for any one model run. So in order to predict ‘n’ days of output ‘n+3’ days of input data are required. There are six fields in the input data window (see Figure L-17) that require input data.

2. **Date:** (format: mm/dd/yy) corresponds to the individual record(s) entered.
3. **Daily Average Imported Barrels:** (units: tons) A daily average from the monthly total of all petroleum measured in units of tons is computed.

4. **Sum of Last 7 Days –Imported Tonnage:** (units: tons) The total tonnage for a previous seven days of daily imported bulk commodities, NOT including the tonnage for that day.
5. **Daily Exported Tonnage:** (units: tons) The sum of all commodities listed in tons exported on that day with daily averages of phosphate rock, phosphate chemical, and citrus pellets. A daily average from the monthly total of phosphate rock, phosphate chemical, and citrus pellets is computed.
6. **SAT:** (1 or 0) This field requires a '1' for Saturday otherwise '0'.
7. **SUN:** (1 or 0) This field requires a '1' for Sunday otherwise '0'.

Once the data entry is completed in the data input window, the model can be run to get the output. Figure L-18 displays sample output window for the input data entered in Figure L-17. The Output window lists the date for which input was entered and the outputs, which are inbound and outbound trucks.

TAMPA FDOT INPUT

--> All the bold fields (with *) are required.
--> Do not close this file when the model is running.
--> The input for number of days for which output is required should be any number between 1 and 31 only.
--> Output can be viewed in the file' Tampa FDOT Output'.
--> User can input in only yellow cells.

NOTE: For specific input data field calculations refer to the user manual

-->Enter the number of days for which Output is desired (Reqd) = ***5***

INPUT

1	2	3	4	5	6	7
SN	***Date**	***Monthly Imported Barrels**	***Sum of Last 7 Days Imported Tons**	***Daily Exported Tonnage**	***SAT** *(1 if Saturday; 0 if not)*	***SUN** *(1 if Sunday; 0 if not)*
1	10101	45916	270728	27463	0	0
2	10201	45916	270728	26273	0	0
3	10301	45916	270728	26676	0	0
4	10401	45916	270728	32148	0	0
5	10501	45916	270728	33934	0	0
6	10601	45916	270728	34025	1	0
7	10701	45916	270728	33583	0	1
8	20101	45421	270728	36013	0	0
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Figure L-17: Port of Tampa Sample Model Input Window

------------------------INBOUND TRUCKS------------------------

Dates	Inbound Tr	22nd-st Str	20th Street	Causeway	Sutton	Pendola pc
10101	4169	1197	532	1865	348	226
10201	4202	1207	537	1880	351	228
10301	4204	1207	537	1881	351	228
10401	4196	1205	536	1877	350	227
10501	4241	1218	542	1897	354	230

------------------------OUTBOUND TRUCKS------------------------

Dates	Outbound `	22nd-st Str	20th Street	Causeway	Sutton	Pendola pc
10101	3979	931	590	1716	383	359
10201	3990	934	591	1721	384	359
10301	4106	961	608	1771	395	370
10401	4135	968	613	1784	398	373
10501	4137	968	613	1784	398	373

Figure L-18: Port of Tampa Sample Model Output Window

PORT OF JACKSONVILLE-TALLEYRAND TERMINAL

Port of Jacksonville-Talleyrand model requires one day of input data to estimate one day of output. So in order to predict ‘n’ days of output ‘n’ days of input data are required. There are seven fields in the input data window (see Figure L-19) that require input data.

2. **Date:** (format: mm/dd/yy) corresponds to the individual record(s) entered.
3. **Daily Average Imported Bulk:** (units tons) A daily average from the monthly total of all imported bulk cargo measured in units of tons is computed.
4. **Sum of Last 7 Days – Imported Containers:** (units: tons) The total tonnage for a previous seven days of daily imported containerized commodities, NOT including the tonnage for that day.
5. **Daily Average Exported Bulk:** (units: tons) A daily average from the monthly total of all imported bulk cargo measured in units of tons is computed.

6. **Sum of Next 7 Days – Exported Containers:** (units: tons) The total tonnage for a following seven days of daily exported containerized commodities, NOT including the tonnage for that day.
7. **SAT:** (1 or 0) This field requires a '1' for Saturday otherwise '0'.
8. **SUN:** (1 or 0) This field requires a '1' for Sunday otherwise '0'.

Once the data entry is completed in the data input window, the model can be run to get the output. Figure L-20 displays sample output window for the input data entered in Figure L-19. The Output window lists the date for which input was entered and the outputs, which are inbound and outbound trucks.

JACKSONVILLE-TALLEYRAND FDOT INPUT

NOTES: --> All the bold fields (with *) are required.

--> Do not close this file when the model is running.

--> The input for number of days for which output is required should be any number between 1 and 31 only.

--> Output can be viewed in the file' Talleyrand FDOT Output'.

--> User can input in only yellow cells.

NOTE: For specific input data field calculations refer to the user manual

-->Enter the number of days for which Output is desired (Reqd) = *5*

INPUT

1	2	3	4	5	6	7	8
SN	***Date**	***Monthly Average Imported Bulk**	***Sum of Last 7 days Imported Containers**	***Monthly Average Exported Bulk**	***Sum of Next 7 days Exported Containers**	***SAT** *(1 if Saturday; else 0)*	***SUN** *(1 if Sunday; else 0)*
1	*092199*	2107	5139	219	11201	0	0
2	*092299*	2107	5284	219	13047	0	0
3	*092399*	2107	7519	219	13708	0	0
4	*092499*	2107	7519	219	13708	0	0
5	*092599*	2107	5224	219	12712	1	0
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Figure L-19: Port of Jacksonville-Talleyrand Sample Model Input Window

------------------------------INBOUND TRUCKS-----------------

Dates	Inbound Tr	8th-Street	21st- Street
92199	966	534	432
92299	1072	593	479
92399	1082	599	483
92499	1082	599	483
92599	487	269	218

------------------------------OUTBOUND TRUCKS--------------

Dates	Outbound ˉ	8th-Street	21st- Street
92199	1211	588	623
92299	1212	589	623
92399	1173	570	603
92499	1173	570	603
92599	199	97	102

Figure L-20: Port of Jacksonville-Talleyrand Sample Model Output Window

PORT OF JACKSONVILLE-BLOUNT ISLAND TERMINAL

Port of Jacksonville-Blount Island model requires one day of input data to estimate one day of output. So in order to predict 'n' days of output 'n' days of input data are required. There are eleven fields in the input data window (see Figure L-21) that require input data.

2. **Date:** (format: mm/dd/yy) corresponds to the individual record(s) entered.
3. **Sum of Last 7 Days –Imported Autos:** (units: tons) The total tonnage for a previous seven days of daily imported automobiles, NOT including the tonnage for that day.
4. **Daily Average Imported Bulk:** (units: tons) A daily average from the monthly total of all imported bulk cargo measured in units of tons is computed.

5. **Sum of Last 3 days- Imported Containers:** (units: tons) The total tonnage for a previous three days of daily imported containerized commodities, NOT including the tonnage for that day.
6. **Sum of Next 7 Days –Exported Autos:** (units: tons) The total tonnage for a following seven days of daily exported automobiles, NOT including the tonnage for that day.
7. **Daily Average Exported Bulk:** (units: tons) A daily average from the monthly total of all exported bulk cargo measured in units of tons is computed.
8. **Sum of Next 7 days- Exported Containers:** (units: tons) The total tonnage for a following seven days of daily exported containerized commodities, NOT including the tonnage for that day.
9. **MW:** (1 or 0) This field requires a '1' for Monday or Wednesday, otherwise '0'.
10. **TRF:** (1 or 0) This field requires a '1' for Tuesday, Thursday, or Friday, otherwise '0'.
11. **SAT:** (1 or 0) This field requires a '1' for Saturday otherwise '0'.
12. **SUN:** (1 or 0) This field requires a '1' for Sunday otherwise '0'.

Once the data entry is completed in the data input window, the model can be run to get the output. Figure L-22 displays sample output window for the input data entered in Figure L-21. The Output window lists the date for which input was entered and the outputs, which are inbound and outbound trucks.

JACKSONVILLE-BLOUNT FDOT INPUT

NOTES: **--> All the bold fields (with *) are required.**
--> Do not close this file when the model is running.
--> The input for number of days for which output is required should be any number between 1 and 31 only.
--> Output can be viewed in the file' Blount FDOT Output'.
--> User can input in only yellow cells.
NOTE: For specific input data field calculations refer to the user manual

-->Enter the number of days for which Output is desired (Read) = ***5***

1	2	3	4	5	6	7	8	9	10	11	12
SN	***Date**	***Sum of Last 7 Days Imported Autos**	***Daily Average Imported Bulk**	***Sum of Last 3 Days Imported Containers**	***Sum of Next 7 Days Exported Autos**	***Daily Average Exported Bulk**	***Sum of Next 7 Days Exported Containers**	***MW** *(1 if Mon or Wed; 0 if not)*	***TRF** *(1 if Tu, We,Thu; 0 if not)*	***SAT** *(1 if Saturday; 0 if not)*	***SUN** *(1 if Sunday; 0 if not)*
1	020901	6385	2593	6149	1540	240	46677	0	1	0	0
2	021001	8361	2593	4515	1538	240	41562	0	0	1	0
3	021101	8361	2593	4025	1105	240	41168	0	0	0	1
4	021201	9937	2593	5487	1042	240	37708	1	0	0	0
5	021301	7996	2593	3303	903	240	37708	0	1	0	0
6											
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INPUT

Figure L-21: Port of Jacksonville-Blount Island Sample Model Input Window

-------------------------------INBOUND TRUCKS-----------------

Dates	Inbound Trucks
20901	1130
21001	214
21101	60
21201	905
21301	1065

-------------------------------OUTBOUND TRUCKS--------------

Dates	Outbound Trucks
20901	1100
21001	181
21101	32
21201	866
21301	1066

Figure L-22: Port of Jacksonville- Blount Island Sample Model Output Window

Appendix M

CALCULATION OF MODEL ACCURACY

CALCULATION OF ACCURACY

Step 1: Calculation of percentage error

$$\textbf{\textit{Percentage Error}} = \frac{\sum_{i=1}^{x}\left(\frac{|T_A - T_M|}{T_A}\times 100\right)}{x}$$

T_A = Actual Trucks

T_M = Model Trucks

X = Number of validation records (excluding weekends, because weekends are known to have high variability)

Step 2: Calculate percentage error for trucks inbound and outbound. Calculate average of the two percentage errors to get total percentage error.

Step 3: Accuracy is calculated by subtracting the percentage error from 100.

Accuracy = 100 – (total percentage error)

Inbound Trucks

Dates	Actual	Model	Percentage Error	Absolute Percentage Error
52000	1667	1769	6.12	6.12
52300	3497	3137	-10.29	10.29
52500	3632	3464	-4.63	4.63
71000	2880	2882	0.07	0.07
71100	2980	3338	12.01	12.01
71300	3164	3307	4.52	4.52
80200	3005	3125	3.99	3.99
80400	3326	3623	8.93	8.93
80700	2777	2955	6.41	6.41
81000	3135	3532	12.66	12.66
91100	3192	3141	-1.60	1.60
91300	3370	3266	-3.09	3.09
92100	3322	3386	1.93	1.93
92500	3282	2893	-11.85	11.85
92700	3452	3375	-2.23	2.23
100500	3527	3169	-10.15	10.15
101600	3119	2930	-6.06	6.06
101800	3524	3091	-12.29	12.29
101900	3349	3167	-5.43	5.43

Outbound Trucks

Dates	Actual	Model	Percentage Error	Absolute Percentage Error
62600	2859	3208	12.207065	12.21
63000	3515	3631	3.3001422	3.30
71600	976	1112	13.934426	13.93
71700	2845	2931	3.0228471	3.02
71800	2897	2945	1.6568864	1.66
72500	2859	3193	11.682406	11.68
72600	3002	2919	-2.7648235	2.76
73100	2772	3028	9.2352092	9.24
80200	2974	3179	6.8930733	6.89
80300	3022	3065	1.4228987	1.42
80700	2788	3127	12.159254	12.16
81000	3205	3188	-0.5304212	0.53
81100	3206	3268	1.933874	1.93
81400	2843	3009	5.8389026	5.84
81600	3067	3195	4.1734594	4.17
81700	3152	3249	3.0774112	3.08
81800	3601	3303	-8.275479	8.28
82300	3412	3176	-6.9167644	6.92
82700	912	1118	22.587719	22.59
91000	928	965	3.987069	3.99
91900	3470	2980	-14.121037	14.12
92400	1488	1029	-30.846774	30.85
92600	3023	2812	-6.9798214	6.98
101600	3254	3109	-4.4560541	4.46
102000	3830	3371	-11.984334	11.98

(NOTE: Gray records indicate weekends; therfore are not used in calculating % error)

Table M.1 Absolute Errors for Inbound and Outbound Validation Results for Port of Everglades

Inbound Average Percentage Error = 6.564

Outbound Average Percentage Error = 6.316

Total Average Percentage Error = 6.44

Accuracy = 100 – Total Average Percentage Error

= 100 – 6.44

= 93 % (approx)