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Florida Aviation Activity Forecast Methodologies and Tools Development

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Disclaimer

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation.

Unit Conversion Table

APPROXIMATE CONCERSIONS TO SI UNITS

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	M
mi	miles	1.61	kilometers	km

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
AREA				
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
t	short tons (2000 lb)	0.907	megagrams (or “metric ton”)	Mg (or “t”)

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 Or (F-32)/1.8	Celsius	°C

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
ILLUMINATION				
fc	foot-candies	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

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16. Abstract Aviation activity forecast is a necessary tool in airport planning and financing decisions. It provides inputs for understanding commercial and financial requirements and for decision making in defining future capacity and operational strategies. Accurate forecasts drive appropriate investment policy that will lead to effective investment return and stimulate regional economic development. Nevertheless, the forecast tool currently in use by FDOT was developed years ago, based on basic forecasting methods. This research developed new methodologies for airport activity forecasting and updated the aviation activity forecast function in existing Florida Aviation Database with advanced forecasting methodologies. Specifically, the autoregressive integrated average model (ARIMA) and Monte Carlo simulation were used and corresponding automatic forecasting algorithms were developed after the review of existing methodologies and analysis of their advantages and disadvantages. It is expected that the forecast tool with the new methodologies can provide more insights and better decision support for FDOT personnel making financial and resource allocation decisions.			
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Executive Summary

The Florida Department of Transportation (FDOT) Aviation and Spaceports Office (ASO) maintains an aviation grant program to assist in providing a safe, cost-effective, and efficient statewide aviation system. The FDOT Aviation Grant Program helps airports build and maintain runways and taxiways, eliminate airport hazards, protect airspace, develop plans, acquire land, and build terminals and other facilities Aviation activity forecasts are essential for airport planning and financial decisions that supports the grant program. They provide inputs for decision making in defining future capacity and commercial and financial requirements. Therefore, it is important to be able to forecast to relatively accurate levels the future demands for aviation services.

Section 1 of this final report details the project background and objectives. Realizing the necessity and importance of making a reasonable aviation activity forecast, the objectives of this research project are: (1) to develop new methodologies for airport aviation activity forecasting for FDOT and (2) to update the existing Florida Aviation Database (FAD) aviation activity forecast tool with advanced forecast methodology.

Section 2 includes a comprehensive literature review of forecast methodologies utilizing the existing documentation, including parameters influencing aviation forecast. These documents include:

- ACRP Synthesis 2: Airport Aviation Activity Forecasting
- TRB E-Circular E-C040: Aviation Demand Forecasting a Survey of Methodologies
- FAA: Forecasting Aviation Activity by Airport
- FDOT Guidebook for Airport Master Planning
- ACRP Synthesis 4: Counting Aircraft Operations at Non-Towered Airports
- ACRP Report 76: Addressing Uncertainty about Future Airport Activity Levels in Airport Decision Making
- ICAO Doc 8891: Manual on Air Traffic Forecasting

Case studies of master plan forecasts of two general aviation airports and two commercial airports in Florida are also illustrated.

Section 3 compares advantages and disadvantages of commonly used forecasting methodologies, including trend projection, exponential smoothing, moving averages, Box-Jenkins (ARIMA), standard linear regression, and regression with distributed lagged variable. The ARIMA method and Monte Carlo simulation were finally chosen for their ability to handle complex time series data and provide the most accurate forecasts with minimal data requirements. Other time series techniques reviewed in the previous section were not selected due to their relatively poor performance (i.e., Trend Projection) and/or short-term applicability of the forecasts produced (i.e., Exponential Smoothing and Moving Averages).

Section 4 introduces the methodology details of the ARIMA model and Monte Carlo simulation and illustrates the automatic forecast algorithm process for the aviation activity. The estimation of ARIMA model usually follows the Box-Jenkins approach, which includes model identification and selection, parameter estimation, and model diagnosis. The detailed algorithm process for aviation activity forecast includes:

Step 1: Available historical air traffic data and years to forecast are input into the tool. Also, the location to save the forecast results is defined.

Step 2: The historical air traffic data will then be transformed to time series class data that can be used in ARIMA model estimation functions in R.

Step 3: With the transformed data, a stationary test (i.e., Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test) is conducted. If the result indicates that the data series is non-stationary, the data will be differenced and tested again until stationarity is achieved. The number of times for differencing is the value of ***d***.

Step 4: For determined ***d,*** with each combination of (p, q) there will be an ARIMA (p, d, q) model to be estimated. We make the maximum value of p and q less than 6 and estimate all combinations of (p, q).

Step 5: Obtain the AIC value (i.e., a statistical metric indicating the fitness of the model) for each model and search for the best-fit model.

Step 6: For the best-fit model, diagnose its statistical characteristics, including parameter significance and residual correlations.

Step 7: If the best-fit model passes the test, terminate ARIMA model fitting, and the corresponding (p, d, q) values will be used for forecast. Otherwise, increase the value of d by 1, and repeat the step 4 – step 6.

Step 8: With the given (p, d, q), calculate the air traffic forecast values for expected years.

Step 9: Save the forecast results to the designated location.

Monte Carlo simulation relies on repeated sampling to obtain numerical results. The algorithm process for Monte Carlo simulation in the forecast tool in includes the following 5 steps:

Step 1: Calculate the growth rate of the historical air traffic data.

Step 2: Fit the historical growth rate to a normal distribution and obtain the mean, variance, and standard deviation.

Step 3: Predict the growth rate of air traffic for the years to be forecast by randomly generating growth rate based on the normal distribution.

Step 4: Calculate the forecast values of air traffic.

Step 5: Repeat step 3 and step 4 to obtain multiple forecast values, and take the mean values of the forecast.

In addition, this section provides forecast results obtained from the algorithms above of two general aviation airports and two commercial airports in Florida, which are used in section 2. The forecast results are also compared and analyzed to provide insights regarding characteristics of forecast methodologies used.

Section 5 presents a step-by-step user guide to assist the Florida Department of Transportation Aviation Office and designated users with the efficient use of the ***Florida Aviation Database Forecasting Module.*** The module is equipped with the following functions:

Access the Forecasting Module
View a Facility Forecast
Run an Updated Forecast
Update the FDOT Saved Forecast
Enter Historic Data
View Forecast Data

View Archived Data
View Import Data
Bulk Import Data for Multiple Facilities
Import the Completed Download Template
View Reports
Run Report

Section 6 presents a brief a summary of this research project.

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1. Introduction

1.1 Background

Air traffic forecasting is a necessary tool in airport planning and financing decisions. The construction, operation, and future expansion of airports require significant initial and continuous investments, a large share of which is usually paid with public funds. Therefore, it is important to be able to forecast to relatively accurate levels the future demands for aviation services. Forecasting models are developed by various agencies to understand and assist airport authorities and other stakeholders in preparing for the future – both from the infrastructural as well as the operational point of view. However, the ability of traditional forecasting models to produce reliable estimates and paint an accurate picture of estimates has been questioned. Forecasting is an inherently uncertain activity because past experiences can only provide a sneak peek into the future performance. In recent years, this has become an even bigger issue, with unforeseen events and developments that have had a significant effect of the realization of airport development plans.

The type of forecast and the effort required depend on the purpose which the forecasts serve. Additionally, forecast types also vary based on the size of the airport. Short-term forecasts are often required in order to support operational planning and assess personnel requirements at airports. Recently, events such as the September 2001 terror attacks have also prompted the need for short-term forecasts in order to review security arrangements. Longer forecasts (intermediate-term or long-term) up to 20 years are used to plan major capital investments. Forecasts longer than 20 years are sometimes undertaken to understand the need for aviation-related improvements at a regional level – i.e., the need for a new airport and additional capacity enhancement drives at a regional level.

Another important aspect that is often discounted is the assessment and sophisticated incorporation of uncertainty in the forecasting process. There is a lot of uncertainty and volatility in many parameters that are essential for preparation of air traffic forecasts. While the traditional approach for accommodating uncertainty was to supplement base forecasts with high and low scenarios, this only provides a limited range of outcomes – a basic understanding of the risk profile. Traditional forecasting models do not accurately account for shock events, such as economic recessions, terrorist attacks, health pandemics, and natural disasters, and this has led to a further decrease in the reliability of estimates produced by the models.

Currently, Florida has 20 commercial and 109 general aviation airports plus 11 military airports. Aviation in Florida contributes significantly to the state economy. In 2014, Florida attracted more than 46 million visitors coming to Florida via air (43.1 million on commercial airlines and 2.9 million on general aviation aircraft). As the gateway to Latin America, Florida airports are also responsible for significant volumes of air cargo. The Florida Statewide Aviation Economic Impact Study Update (FDOT, 2014) shows that for all benefit categories measured, aviation in Florida is responsible for an estimated $144.0 billion in annual economic activity or output.

To ensure the efficient and safe operation and healthy development of state airport system, the Florida Department of Transportation (FDOT) Aviation Grant Program helps airports build and maintain runways and taxiways, eliminate airport hazards, protect airspace, develop plans, acquire land, and build terminals and other facilities. Aviation activity forecasts are essential for airport planning and financial decisions. They provide inputs for decision making in defining future capacity, commercial, and financial requirements. Accurate forecasts drive appropriate investment policy that will lead to effective investment return and stimulate the regional economic development. Additionally, the 129 public use airports in Florida that are eligible to receive state funds, in which 100 are also eligible for Federal funds, are required to submit their proposed forecasts to the Federal Aviation Administration (FAA) and FDOT for review and approval. The FAA currently allows Florida's airports to use the FDOT forecast tool as part of their forecast submittals. Nevertheless, the tools were developed years ago based on basic forecasting methods. The tool and its related methodology are in need of updating to be more useful to both commercial service and General Aviation airports in Florida.

1.2 Project Objectives

In this context, the objectives of the current project are as follows:

1. Develop new methodologies for airport aviation activity forecasting for Florida airports.
2. Update the existing Florida Aviation Database (FAD) aviation activity forecast tool with advanced forecast methodology. Data-driven methods, such as time-series, data fitting, and simulation, will be applied to forecast the aviation activity in addition to conventional what-if and scenario analysis.

1.3 Report Organization

This final report is organized into six sections along with references and appendices:

1. Introduction
2. Literature Review
3. Forecasting Methodology Comparison
4. Methodology Implementation Strategies and Cast Studies
5. Forecasting Module User Manual
6. Conclusions

2. Literature Review

For choice of appropriate forecast methodologies, the research team conducted a comprehensive literature review to collect all related documents to study the existing forecasting methodologies and factors considered in implementing those methodologies.

2.1 Existing Documentation on Aviation Forecasting

There are numerous documents as well as peer-reviewed academic literature available that provide information on aviation forecasting methodologies. These documents include:

- ACRP Synthesis 2: Airport Aviation Activity Forecasting
- TRB E-Circular E-C040: Aviation Demand Forecasting a Survey of Methodologies
- FAA: Forecasting Aviation Activity by Airport
- FDOT Guidebook for Airport Master Planning
- ACRP Synthesis 4: Counting Aircraft Operations at Non-Towered Airports
- ACRP Report 76: Addressing Uncertainty about Future Airport Activity Levels in Airport Decision Making
- ICAO Doc 8891: Manual on Air Traffic Forecasting

These documents provide comprehensive insights as well as best practices for aviation forecasting.

2.1.1 ACRP Synthesis 2: Airport Aviation Activity Forecasting

This synthesis study by ACRP is a collection of information gathered from multiple sources of literature on current aviation activity forecasting methodologies including academic, professional literature as well as documentation obtained from various airport authorities. Based on numerous research efforts, ACRP Synthesis 2 identifies four standard methodologies associated with aviation forecasting. The four standard methodologies include:

Market-share analysis

- Top down approach where activity at a particular airport is assumed to be tied to growth in some aggregate external measure (typically a regional, state, or national aviation growth rate).
- For reasonable predictions, it is important that presumed relation between airport activity and larger aggregate measure is constant over time.

Econometric modeling

- Utilize explanatory variables – factors thought to explain changes in the demand and/or supply of aviation activities
- Variables - macroeconomic and demographic factors, airline market factors, air transport production costs and technology, regulatory factors, infrastructure constraints or improvements, and potential substitutes for air travel
- Higher possibilities of going wrong even though they are a sound and powerful method, potentially (non-linearity in the relationship between the dependent and the independent variables).
- Relevant literature: Maddala (1983); Ishii et al., (2006); TRB E-C040 (2002)

Time series modeling

- Extrapolating existing data into the future – in its simplest form, very low-cost compared to econometric modeling.
- More accurate when a long series of historical data are available
- Useful method when the relationship between local activity and other external factors are unstable.
- ARIMA vs. regression model – ARIMA seemingly better (Pitfield, 1993)
- Relevant literature: Armstrong (2001); Grubb and Mason (2001).

Simulation modeling

- Used to obtain high-fidelity snapshot forecasts of traffic flows in a network or at an airport.
- Such models impose precise rules that govern how passengers or aircraft are routed and then aggregate the results so that planners can assess the infrastructure needs of the network or airport to be able to handle the estimated traffic.

Selection of appropriate method

Purpose of Activity Forecast	Historical Data Availability		
	INCREASING DATA REQUIREMENTS →		
	Stable Trend	Stable Relationship With:	
		External Forecasts	Causal Variables
Short-Term Operational Planning; Annual Budgeting	Time series trend extrapolation, or smoothing/Box–Jenkins if complex time dependencies	Market share forecasting	Econometric modeling
Identify Long-Term Capacity Needs; Financial Planning to Support Facility Expansion	Market share forecasting or econometric modeling	Market share forecasting	Econometric modeling
Examine Alternative Environments; Compare Alternative Policies	Econometric modeling		
Obtain High-Fidelity Estimates of Travel Time and Delays (aircraft or passengers)	Simulation modeling		

Figure 1 Recommended Forecasting Methods in ACRP Synthesis Report

Selection of the appropriate method should be based a tradeoff between the purpose of the aviation activity forecast – both from an operational/planning context as well as the desired outcome of the forecasting process and the availability of historical aviation data that will aid in the production of reliable estimates.

Additionally, the report points out that airport forecasting studies often neglect the issues of uncertainty and accuracy. Most often, forecasts are presented only as point estimates, although it is common to also present alternative "high", or "low" estimates that are based on differing assumptions about external factors thought to affect the forecast. Although this can provide a reasonable range of estimates, there are additional sources of uncertainty related to the statistical properties of the models employed that are often neglected entirely.

Data issues at non-towered airports

FAA (2001) has published Model for Estimating General Aviation Operations at Non-Towered Airports, a document describing a statistical model to estimate operations at non-towered airports based on data from other towered and non-towered airports.

Other methods include automatic counters or visual observation. Both methods are expensive to collect a true census over longer periods. Thus, sampling is used. GA airports aircraft ops vary based on weather, day of the week, and season. Typical sampling is 14 days, four times a year, i.e. once in each quarter. As of this day, various counting instruments are available such as pneumatic tubes, inductance loops, and acoustical counters.

The report summarizes by pointing out that each methodology identified has certain characteristics that are analyzed to determine which method is most appropriate to the airport in the study. In some cases, more than one forecasting methodology will be utilized to provide a more accurate forecast to the airport based on differing characteristics and evolving situations.

2.1.2 Transportation Research Board (TRB) E-Circular E-C040: Aviation Demand Forecasting a Survey of Methodologies

This document surveyed multiple airports to determine how they forecast aviation activity. The results were categorized into single airport and multi-airport regions. Further, the studies were broken down into methodologies identified for airports with varying characteristics. These are just a few of several methodologies and approaches analyzed and discussed within this TRB E-Circular. For instance, the forecasting model for a small general aviation airport's operations is a case study category adopted in the circular.

Objectives

- To identify common characteristics among a group of towered GA airports
- To use these characteristics to construct models of airport activity at non-towered GA airports which are less closely observed and monitored.

This model does not generate forecasts of future activity – an estimating model that uses available information about an airport and its surroundings to estimate the number of operations that can reasonably be believed to occur over the course of a year.

Methodology

Assumption: GA aircraft activity at GA airports is related to demographic features of the area surrounding the airport along with other characteristics of the airport.

Data

- 127 small towered GA airports for which accurate tower counts exist
- 105 non-towered GA airports for which activity estimates have been made by state aviation authorities using sampling and extrapolation

Model Result

$$\text{GAOPS} = -571 + 355\,\text{BA} - 0.46\,\text{BA}^2 - 40{,}510\,\text{\%in100mi} + 3{,}795\,\text{VITFSnum} + 0.001\,\text{Pop100}$$

(−0.25) (8.41) (−3.83) (−2.79) (1.87) (3.48)

$$-8{,}587\,\text{WACAORAK} + 24{,}102\,\text{Pop25/100} + 13{,}674\,\text{TOWDUM} \qquad R^2 = 0.743$$

(−3.61) (2.67) (6.44) t-score in parentheses

Figure 2 Model Results based on Demographic Features for GA Operation Forecast

2.1.3 FAA: Forecasting Aviation Activity by Airport

This document addresses airport authorities with a step-by-step process to develop and review a standardized aviation forecast. All federally obligated airports must have their forecasts approved by the FAA. The seven steps of this forecasting methodology are:

1. Identify Aviation Activity Parameters and Measures to Forecast
2. Collect and Review Previous Airport Forecasts
3. Gather Data
4. Select Forecast Methods
5. Apply Forecast Methods and Evaluate Results
6. Summarize and Document Results
7. Compare Airport Planning Forecast Results with Federal Aviation Administration's (FAA) Terminal Area Forecast (TAF)

Three major types of forecasting methods are identified as:

1. Regression and trend analysis
2. Share analysis
3. Other techniques

Regression analysis incorporates independent variables (such as income and fares) to influence and define a dependent variable (such as passenger enplanements). Depending on data availability complexities, the next recommended method is to perform a trend analysis where simple historic trends are simply extrapolated into the future.

A share analysis uses a figure of the airport's performance in relativity to a larger holistic figure of which the airport is a piece of, to identify and analyze the trends. For example, an airport's percentage of U.S. total passenger enplanement (the same figure used to determine hub size) over a certain period, can be used to identify trends that might continue into the future. More complex figures and techniques within the share analysis are discussed to ensure successful and proper usage.

The final methodology is a collection of other techniques selected as a set of best practices that agencies and airports can use including:

- Exponential Smoothing
- Comparison with Other Airports
- Survey Techniques, Cohort Analysis
- Choice and Distribution Models
- Range Projections for Risk Management and Extraordinary Events

It is important that forecasters analyze these methodologies to determine which could be applicable and beneficial to their particular study.

2.1.4 FDOT: Guidebook for Airport Master Planning

The Guidebook for Airport Master Planning is a required to be used by all public use airports in developing their master plans. Although this Guidebook is specifically tailored to airports undergoing a master plan, it provides useful information regarding the forecasting process and methodologies used in developing a master plan. The forecasting methodologies discussed include:

- Regression Analysis
- Linear Trend or Line Analysis
- Share Analysis
- Exponential Smoothing
- Comparison with Other Airports
- Survey Techniques
- Cohort Analysis
- Choice and Distribution Modeling

2.1.5 ACRP Synthesis 4: Counting Aircraft Operations at Non-Towered Airports

This ACRP Synthesis used questionnaires to obtain information from 50 state aviation agencies, seven airports, and four metropolitan or regional planning organizations regarding how these entities forecast aviation activity at non-towered airports. Further, the study for this ACRP report analyzed the different types of air-traffic counting technology currently and historically used.

At non-towered airports, the report suggested the use of automated acoustical counter that measures aircraft takeoff noise to count operations on a runway. Like all acoustical counters identified, this equipment assumes that for every takeoff there is a subsequent landing, therefore this equipment simply doubles the number of takeoffs obtained. This document can be used to determine methods of obtaining aircraft activity data at non-towered airports to aid in developing forecasts at numerous general aviation (GA) airports.

2.1.6 ACRP Report 76: Addressing Uncertainty about Future Airport Activity Levels in Airport Decision Making

In a turbulent and variable environment, this ACRP reports serves to address uncertainty through various ways and enable aviation stakeholders to arrive at better forecasts. The purpose of this ACRP report is threefold:

- To provide a straightforward and transparent systems analysis methodology to assist airport management in making decisions in the face of an uncertain traffic outlook.
- To offer tools for improving the understanding of risk and uncertainty in air traffic forecasting and provides approaches for enhancing the robustness of airport planning and decision making.
- To augment standard master planning and strategic planning approaches with methodologies that directly address risk and uncertainty and allow the incorporation of relevant risk mitigation measures.

Three procedures have been outlined to account for uncertainty:

- High and low forecasts
- What-if analysis (impact analysis)
- Sensitivity analysis

The high and low method produces a forecast based on best possible scenario (high) and then a forecast based on worst possible scenario (low). The what-if analysis evaluates the impact of a single major event and compares the potential effects to the baseline assessment. This method is assumed to be easier than the high and low method. The Sensitivity Analysis updates the forecasting assumptions and their outcomes proactively, resulting in frequently updated forecasts. This method is recommended when variables are anticipated to have major impacts to forecasts.

Additional methodologies that could be adopted to address uncertainty are:

- <u>Delphi or formal elicitation methods:</u> broad set of techniques that incorporate inputs from subject matter experts and stakeholders – allow risk matters to be identified and explored.
- <u>Scenario analysis:</u> a large number of separate scenarios are developed and played out to assess the impact of different sets of events occurring together.
- <u>Monte Carlo:</u> Statistical simulation techniques that make use of randomization and probability statistics to generate a wide range of possible traffic outcomes and provide probability of such outcomes.

These techniques do not provide more accurate forecasts but are designed to increase our understanding and awareness of future uncertainty. Incorporating Flexibility into Airport Planning is a very important aspect in times of uncertainty. The report states that the use of enhanced forecasting techniques combined with an efficient planning process will lead to maximum flexibility in an uncertain future.

To this end, the report suggests the use of the real options approach. Real options concept started in the 70s and 80s to improve the valuation of capital-investment programs and offer greater managerial flexibility to organizations.

2.1.7 ICAO Doc 8891: Manual on Air Traffic Forecasting

This manual was drafted to serve as a reference for airports to consult when developing aviation forecasts. Because this manual encompasses so many airports, numerous aviation forecasting methodologies are identified. The methodologies are broken into two main categories: quantitative and qualitative methodologies, as shown in figure below.

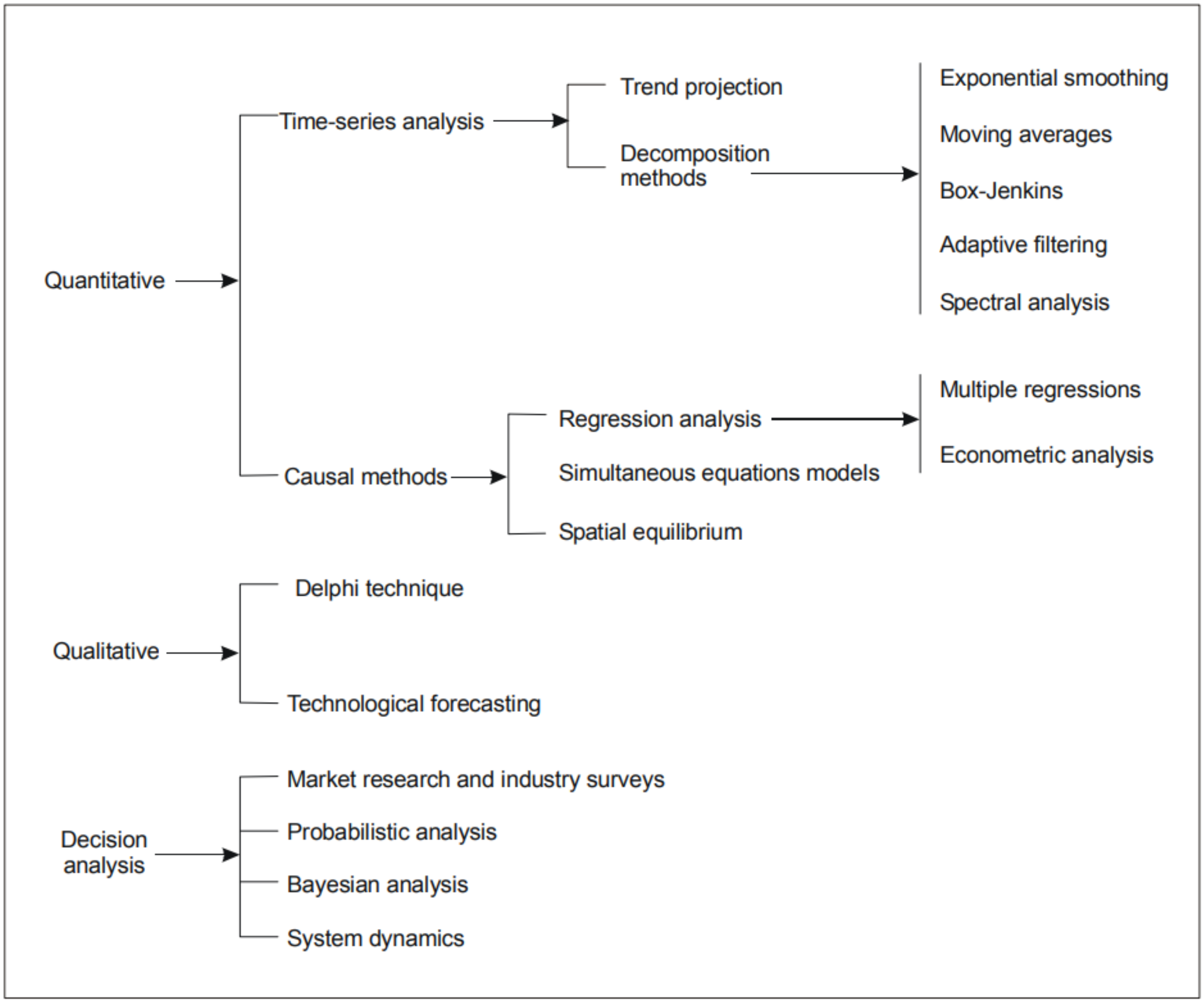


Figure 3 Alternative Forecasting Techniques in ICAO Doc 8891

2.2 Parameters Influencing Aviation Forecasting

Perry (2009) provides a very comprehensive list of parameters that could be considered as part of the data collection process for aviation forecasting. They are categorized as follows:

Socioeconomic Data: Population, Employment, Income, Regional data on tourism, hotel rooms, and other sources of activity that would contribute to airline travel.

Aviation Data: Airport data for enplaned passengers, air cargo, commercial airline landings, aircraft operations, and based aircraft, USDOT data for origin-destination passengers, fares, yield, and load factors by market, published airline schedules (OAG), Air Traffic Activity Data System (ATADS), Radar data (e.g., Passur, Stars), Automated Noise and Operations Monitoring System (ANOMS).

Interviews and Surveys of Key Stakeholders: Airport Operator, Airlines, Local Economic and Planning Organization Representatives, Other stakeholders.

Identification of Key Issues and Trends: Aircraft capacity (seats), Aircraft technology, Airline consolidation/merger, Airline travel substitutes (i.e., alternative modes, video conferencing), Biological events, Cost of travel (yield), Economic recessions/Global economic crisis, Enplaned passenger load factors, Leakage to Other Airports / Other Modes, Fuel Costs, Security Concerns, terrorist attacks, legislation regulations, industry changes, etc.

Additionally, TRB (2002) provides different approaches and methodologies for forecasting aviation activities based on the type of the airfield. Although this document was last updated in 2002, it provides insightful details into possible significant parameters for predicting aviation demand.

2.3 Master Plan Forecasting Case Studies for Airports in Florida

Forecasts are frequently derived from the FAA TAF. The TAF is generated for airports in the National Plan of Integrated Airport Systems (NPIAS) and contains historical and forecast data for enplanements, airport operations, terminal radar approach control operations, and based aircraft. This section will use Vero Beach Regional Airport, Ormond Beach Municipal Airport, Jacksonville International Airport and Orlando-Melbourne International Airport as case studies for an analysis of how airports develop forecasts by analyzing the historical traffic information, factors that could influence aviation activities, data collection methods, socioeconomic data, and existing forecasting methods.

2.3.1 Vero Beach Regional Airport (VRB) – General Aviation Airport

Vero Beach Regional Airport is owned and operated by the City of Vero Beach. In 2013, the airport began the process of updating the airports master plan, which was last revised in 2000. The masterplan update was finished in February of 2016, in accordance with the FAA regulations and advisory circulars. The goal of the master plan update is to describe short, medium, and long-term developments for the airport to meet the needs of future aviation demand. The case study for VRB is focused on Chapter B, "Basic Aeronautical Forecasts" of the airport's masterplan update.

Historic Traffic

Due to the location and operations that are accommodated at VRB, traffic is a mix of private pilots, corporate jets, and flight training. A large portion of annual operations are single-engine aircrafts due to flight training activities based on the airport and local flight schools who perform touch and go operations at the airport. Operational traffic for VRB from 2003 to 2013 can be seen below in Figure 3, in addition to the forecast for operations.

Socioeconomic data for VRB

The Vero Beach master plan update document does not have any section discussing or outlining the socioeconomic characteristics of the communities being serviced by the airport.

Table 1 Historical and Forecast Total Aircraft Operations at VRB from Master Plan

FISCAL YEAR	ITINERANT	LOCAL	TOTAL OPERATIONS
Historical			
2003	93,649	90,083	183,732
2004	87,815	66,959	154,774
2005	81,424	65,174	146,598
2006	74,905	55,867	130,772
2007	83,316	64,279	147,595
2008	93,793	77,569	171,362
2009	87,391	76,794	164,185
2010	77,655	81,939	159,594
2011	77,534	75,867	153,401
2012	71,909	77,604	149,513
2013	81,607	104,092	185,699
Forecast			
2014	82,274	106,122	188,396
2015	82,947	108,192	191,139
2016	83,624	110,305	193,929
2017	84,308	112,458	196,766
2018	84,997	114,656	199,653
2019	85,692	116,897	202,589
2020	86,392	119,183	205,575
2021	87,098	121,515	208,613
2022	87,810	123,892	211,704
2023	88,528	126,320	214,848
2024	89,253	128,795	218,046
2025	89,981	131,319	221,300
2026	90,717	133,894	224,611
2027	91,458	136,521	227,979
2028	92,206	139,200	231,406
2029	92,959	141,933	234,892
2030	93,719	144,721	238,440
2031	94,485	147,565	242,050
2032	95,256	150,465	245,723
2033	96,036	153,424	249,460
Compound Annual Growth Rate			
2003-2013	-1.4%	1.5%	0.1%
2013-2023	0.8%	2.0%	1.5%
2013-2033	0.8%	2.0%	1.5%

SOURCES: Federal Aviation Administration, *Terminal Area Forecast*, January 2014; FAA Air Traffic Activity Data System, January 2014.

Outside Factors that Influence Forecasts

Vero Beach has noted that creating a forecast is very difficult for many reasons. Some unforeseen circumstances include changes in local demand, changes in the aviation industry or external factors, and changes in available transportation modes. Additionally, identifying how airport users will react to changes in operating costs or demand is also difficult to forecast. Due to the airports Air Traffic Control Tower (ATCT) only operating from 7:00 am to 9:00 pm, some operations may not be accounted for in the operations forecasts. These are the primary reasons given by VRB in the master plan update for inaccurate forecasts.

Data Collection Methods

The VRB master plan update notes that data for the forecasts were developed from various sources throughout the airport. Sources include the airport staff, FBO, flight school, ATCT, Vero Beach city workers, and other airport stakeholders. Discussions with these various airports users and stakeholders allow for the best possible forecasts to be developed. For example, the growth rate for multi-engine aircraft was adjusted to reflect more accurate operations after meeting with local pilots. Additionally, more emphasis was put into local operations due to the strong presence of flight training at VRB.

Forecast Methodologies

The preferred based aircraft forecasts were derived from the national growth rate of the based aircraft at VRB, and included the FAA Aerospace Forecasts FY 2014-2034. The growth rate was adjusted to reflect more modest growth of the multi-engine aircraft segment at VRB based on discussions with airport staff and stakeholders. The preferred local aircraft operations forecasts were derived from the based aircraft forecast. The preferred itinerant and annual instrument aircraft operations forecasts were based on the FAA Terminal Area Forecast (TAF), with the assumption that the TAF was based on a more comprehensive review of itinerant aircraft trends in Florida and across the nation. The critical design aircraft was taken from AC 150/5300-13A "Design Aircraft," as the airport used the composite methodology using three separate private jet operations to combine for the necessary 500 operations to qualify as the critical design aircraft.

Table 2 Historical and Forecast-Based Aircraft at VRB from Master Plan

YEAR	HELICOPTERS	JETS	SINGLE ENGINE PISTON/TURBOPROP	MULTI-ENGINE PISTON/TURBOPROP	TOTAL
Historical					
2003	4	4	132	51	191
2013	4	5	154	49	212
Forecast					
2014	4	5	157	50	216
2015	4	5	160	51	220
2016	4	5	163	52	224
2017	4	6	166	53	229
2018	4	6	169	54	233
2019	4	6	173	55	238
2020	4	6	176	56	242
2021	4	6	179	58	247
2022	4	6	183	59	252
2023	4	7	186	59	256
2024	4	7	189	61	261
2025	4	7	193	62	266
2026	4	7	197	63	271
2027	4	7	201	65	277
2028	4	8	204	66	282
2029	4	8	208	67	287
2030	4	8	212	69	293
2031	4	8	217	70	299
2032	4	9	220	71	304
2033	4	9	224	73	310
Compound Annual Growth Rate					
2003-2013	0.0%	2.3%	1.6%	-0.4%	1.0%
2013-2023	0.0%	2.8%	1.9%	2.0%	1.9%
2013-2033	0.0%	2.8%	1.9%	2.0%	1.9%

SOURCES: Vero Beach Regional Airport Records; Federal Aviation Administration, *Terminal Area Forecast*, June 2014.
PREPARED BY: Ricondo & Associates, Inc., June 2015.

Forecast Results

The growth rates for the aircraft fleet at VRB were derived from FAA forecasts and based on discussions with local stakeholders. The average annual growth rate for multi-engine aircraft at VRB was reduced from 3.9 percent annually, per the TAF, to 2.0 percent to account for the local use and trends for this type of aircraft. The annual growth rate for jets, helicopters, and single-engine aircraft at VRB is 1.9 percent, taken from the FAA's TAF 2013 Model, which can be seen in Figure 4. The future GA operations at Vero Beach were derived from the FAA's TAF for itinerant operations and from the based aircraft forecast for local operations. It was also assumed that the average number of operations per based aircraft would remain constant at 491 per based aircraft. The resulting average annual growth rate for aircraft operations at VRB over the planning period is 1.5 percent. Critical design aircraft operations were projected to grow consistently with VRB's jet aircraft fleet at an annual rate of 2.8 percent. The forecast for operations can be seen above in Figure 4.

Conclusion

Vero Beach is a GA airport with high levels of local and itinerant operations from private pilots and flight schools. The airports master plan was analyzed to determine the methodologies used to create the airport's forecasts. The unique aspects of the airport were taken into consideration during the development of the forecasts to create the most realistic model possible. The data used for the creation of the forecasts were taken from the ATCT, local tenants, and airport management. The forecast that was selected for VRB was created from the TAF with adjustments to the CAGR to reflect the unique aspects of the airport and its users.

2.3.2 Ormond Beach Municipal Airport (OMN) – General Aviation Airport

Ormond Beach Municipal Airport is owned and operated by the city of Ormond Beach. The airport's initial master plan was completed in 1988 and updated in 2004. The most recent master plan update was completed in October 2015, in accordance with the FAA regulations and advisory circulars. The purpose of the master plan is to show short, medium, and long-term developments for the airport to accommodate future operations at the airport. The case study for OMN is based on chapter five of the master plan: Forecast.

Historic Traffic

The primary users of the airport are the locally based flight schools, private pilots, and itinerant GA operations, with approximately 99 percent of all operations at OMN. Military operations, air carrier, and air taxi operations (making short flights on demand) operations happen occasionally, accounting for the remaining one percent of the annual operations. OMN has intermittently been used for precision approach military and flight school training or for refueling for both fixed wing and rotary aircraft. Operational traffic for OMN from 2005 to 2014 and the FAA TAF from 2015 to 2034 can be seen below in Figure 5.

Table 3 Historical Operations and FAA Terminal Area Forecast at OMN from Master Plan

Fiscal Year	Itinerant					Local			Total Operations	Based Aircraft
	Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total		
2005	2	58	70,546	59	70,665	65,925	180	66,105	136,770	169
2006	728	20	81,046	307	82,101	61,757	128	61,885	143,986	169
2007	719	15	79,746	24	80,504	69,689	120	69,809	150,313	169
2008	0	5	72,987	2	72,994	74,068	2	74,070	147,064	107
2009	0	5	77,768	9	77,782	88,758	8	88,766	166,548	99
2010	31	6	68,352	13	68,402	55,246	28	55,274	123,676	99
2011	51	2	68,707	10	68,770	64,431	12	64,443	133,213	100
2012	0	0	66,603	12	66,615	54,771	10	54,781	121,396	100
2013	32	5	67,726	1	67,764	56,915	16	56,931	124,695	99
2014	0	3	58,436	5	58,444	50,999	4	51,003	109,447	103
2015	0	3	58,947	5	58,955	49,368	4	49,372	108,327	106
2016	0	3	59,241	5	59,249	49,615	4	49,619	108,868	111
2017	0	3	59,537	5	59,545	49,864	4	49,868	109,413	114
2018	0	3	59,835	5	59,843	50,113	4	50,117	109,960	118
2019	0	3	60,134	5	60,142	50,363	4	50,367	110,509	123
2020	0	3	60,434	5	60,442	50,614	4	50,618	111,060	126
2021	0	3	60,736	5	60,744	50,866	4	50,870	111,614	130
2022	0	3	61,040	5	61,048	51,120	4	51,124	112,172	134
2023	0	3	61,345	5	61,353	51,375	4	51,379	112,732	138
2024	0	3	61,651	5	61,659	51,632	4	51,636	113,295	142
2025	0	3	61,959	5	61,967	51,890	4	51,894	113,861	146
2026	0	3	62,269	5	62,277	52,150	4	52,154	114,431	149
2027	0	3	62,580	5	62,588	52,411	4	52,415	115,003	153
2028	0	3	62,892	5	62,900	52,673	4	52,677	115,577	156
2029	0	3	63,206	5	63,214	52,936	4	52,940	116,154	160
2030	0	3	63,522	5	63,530	53,201	4	53,205	116,735	164
2031	0	3	63,839	5	63,847	53,467	4	53,471	117,318	167
2032	0	3	64,158	5	64,166	53,735	4	53,739	117,905	171
2033	0	3	64,479	5	64,487	54,004	4	54,008	118,495	175
2034	0	3	64,801	5	64,809	54,275	4	54,279	119,088	178

Source: FAA Terminal Area Forecast (TAF) Fiscal Years 2014-2040

Socioeconomic data for OMN

According to the Ormond Beach master plan, the local economy and demographic growth are very favorable. OMN notes that the characteristics of the community surrounding an airport will affect the demand for aeronautical services. Some factors include:

- Population
- Per capita income
- Employment
- Airport prominence
- Complexity of the based aircraft
- Presence of a certificated flight school
- Region the airport is located

The communities around OMN are observed to be growing with a strong economy. However, the master plan update notes that the demographics in the surrounding area do not necessarily correlate to an increase in aviation activity. The Economic Development Department for the City of Ormond Beach is actively seeking to develop the airport's business park and bring new businesses, both aviation and non-aeronautical related, to the area. The city expects that businesses that come in may drive up the demand for aviation activities related to business jet operations and aircraft maintenance.

Outside Factors that Influence Aviation Forecasts

Ormond Beach's most recent master plan attributes much of the fluctuating demand for airport services to business activity, changes in the aviation industry, and local aviation actions. Local activity can include a change in FBO services, pricing structures on the airfield, airport configuration, and noise abatement procedures. One major factor that cannot be accounted for during the creation of a forecast is weather.

Should weather conditions deteriorate, many private pilots will be unable to fly due to only having clearance to fly in Visual Meteorological Conditions (VMC). Due to more inclement weather throughout 2014, the number of Instrument Meteorological Conditions (IMC) operations at OMN rose three percent, while the number of operations fell by 12 percent, as shown in Figure 6. Other activities that are noted to affect aviation are economic downturns and the changes that occurred to the industry after 2007, including the rise in the cost of aviation gas and how it has stunted the growth of small piston aircraft operations. Conversely, the increased demand for commercial pilots has helped offset the reduced number of private pilots, as flight schools are training more students than before during the downturn. The airport's ATCT only operates from 7:00 am to 7:00 pm, causing some operations not to be recorded, affecting aircraft and itinerant operation forecasts of the master plan.

Table 4 VMC vs. IMC Operations at OMN from Master Plan

Fiscal Year	Visual Meteorological Conditions (VMC)	Instrument Meteorological Conditions (IMC)
2005	93%	7%
2006	94%	6%
2007	94%	6%
2008	93%	7%
2009	95%	5%
2010	95%	5%
2011	94%	6%
2012	95%	5%
2013	93%	7%
2014	90%	10%

Source: National Climatic Data Center (NCDC)
Station Ormond Beach Municipal Airport, USAF 722341, WBAN 92822

Data Collection Methods

The OMN master plan notes that the addition of the ATCT allows them to utilize the FAA Operations Network (OPSNET). This results in far more accurate operation counts and trends to be collected and analyzed. It is noted that the airport's based aircraft and aviation activity was also collected for forecasting using the airport management records, air traffic control records, FAA's 5010 master record, and the National Based Aircraft Inventory Program. Data was also collected from the local FBOs and flight schools.

Forecast Methodologies

OMN reviewed the FAA's TAF, Aerospace Forecast, and the Florida Department of Transportation's Florida Aviation System Plan (FASP) forecast in preparation for their analysis. While they acknowledged that the most common forecasting methodologies include regression analysis, trend analysis and extrapolation, market share analysis or ratio analysis, and smoothing, it was observed that these methodologies would need more extensive historical aviation activities and demographic data than OMN currently possesses. According to the masterplan for Ormond Beach, the forecasting methodology chosen for the airport is a Compound Annual Growth Rate (CAGR). The forecasts of the airport's CAGR are derived from the TAF and the FASP.

Forecast Results

Ormond Beach used the FAA's TAF and the FASP CAGR forecasts for annual operations and based single and multi-engine aircraft, jets, and helicopters. The derived average between the FASP and TAF was taken to create a new forecast. For the based aircraft forecast, the TAF CAGR of 1.43 percent and the FASP CAGR of 0.96 percent were averaged to create a growth rate of approximately 1.2 percent. The results for the based aircraft forecast can be seen in Figure 7.

Table 5 Based Aircraft Forecast at OMN from Master Plan

	Low Forecast - FDOT Growth Rate					Forecast - Derived					High Forecast - FAA TAF Growth Rate				
Fiscal Year	Single Engine	Multi Engine	Jet	Helo	Total	Single Engine	Multi Engine	Jet	Helo	Total	Single Engine	Multi Engine	Jet	Helo	Total
2015	127	26	2	9	164	128	26	2	9	165	128	26	2	9	165
2016	128	27	2	9	166	129	27	2	9	167	130	27	2	9	168
2017	130	27	2	9	168	130	27	3	9	169	131	27	2	9	169
2018	131	27	2	9	169	131	27	3	9	170	133	28	2	10	173
2019	132	27	2	9	170	132	28	4	10	174	135	28	2	10	175
2020	133	28	2	10	173	133	28	4	10	175	137	28	2	10	177
2021	135	28	2	10	175	135	28	4	10	177	139	29	2	10	180
2022	136	28	2	10	176	136	29	5	10	180	141	29	2	10	182
2023	137	28	2	10	177	136	29	6	10	181	143	30	2	10	185
2024	139	29	2	10	180	136	29	8	10	183	145	30	2	10	187
2025	140	29	2	10	181	138	30	8	10	186	147	30	2	11	190
2026	141	29	2	10	182	139	30	8	10	187	149	31	2	11	193
2027	143	29	2	10	184	140	30	9	11	190	152	31	2	11	196
2028	144	30	2	10	186	142	31	9	11	193	154	32	2	11	199
2029	145	30	2	10	187	143	31	10	11	195	156	32	2	11	201
2030	147	30	2	10	189	144	31	10	11	196	158	33	3	11	205
2031	148	31	2	11	192	146	32	10	11	199	160	33	3	11	207
2032	150	31	2	11	194	147	32	11	11	201	163	34	3	12	212
2033	151	31	2	11	195	150	33	11	11	205	165	34	3	12	214
2034	153	31	2	11	197	151	33	12	11	207	167	35	3	12	217

Source: Hoyle, Tanner, & Associates Derived Forecast

For the aircraft operations forecast, the TAF CAGR of 0.33 percent and the FASP CAGR of 1.62 percent were averaged to create a growth rate of approximately 1.0 percent. These results are broken into local vs. itinerant operation forecasts, and then further into air carrier, air taxi, GA, and military operations. The full results for itinerant, local, and total annual operations for OMN can be seen below in Figure 8.

Conclusion

Ormond Beach Municipal Airport is a busy GA airport, serving local and itinerant operations in addition to flight school operations. The master plan for the airport was used to analyze the methodologies used to develop the forecasts. Data collected for the development of the forecast was taken from the ATCT and local tenants. The methodology selected was an average between the FAA's TAF and the FDOT's FASP for the growth of annual operations and based aircraft at OMN.

Table 6 Annual Operations Forecast at OMN from Master Plan

Fiscal Year	Itinerant					Local			Total Operations
	Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total	
2015	0	69	69,178	4	69,251	56,660	0	56,660	125,910
2016	0	70	69,855	4	69,929	57,215	0	57,215	127,144
2017	0	71	70,542	4	70,617	57,777	0	57,777	128,394
2018	0	71	71,239	4	71,314	58,348	0	58,348	129,661
2019	0	72	71,945	4	72,021	58,926	0	58,926	130,947
2020	0	87	72,647	4	72,738	59,513	0	59,513	132,251
2021	0	88	73,373	4	73,465	60,108	0	60,108	133,573
2022	0	89	74,109	4	74,203	60,711	0	60,711	134,914
2023	0	90	74,856	4	74,950	61,323	0	61,323	136,273
2024	0	91	75,614	4	75,709	61,944	0	61,944	137,653
2025	0	107	76,367	4	76,478	62,573	0	62,573	139,051
2026	0	108	77,146	4	77,259	63,212	0	63,212	140,470
2027	0	109	77,936	4	78,050	63,859	0	63,859	141,909
2028	0	110	78,738	4	78,853	64,516	0	64,516	143,368
2029	0	112	79,551	4	79,667	65,182	0	65,182	144,849
2030	0	121	80,368	4	80,493	65,858	0	65,858	146,350
2031	0	122	81,204	4	81,330	66,543	0	66,543	147,873
2032	0	123	82,052	4	82,180	67,238	0	67,238	149,418
2033	0	125	82,913	5	83,042	67,943	0	67,943	150,985
2034	0	126	83,786	5	83,916	68,659	0	68,659	152,575

Source: Hoyle, Tanner, & Associates Derived Forecast

Summary

Vero Beach Regional and Ormond Beach Municipal Airport master plans were reviewed to analyze and assess the methods and resources used to create forecasts. It was determined that the FAA's TAF was the most common resource utilized. Other notable resources used in the master plans are the FDOT's Florida Aviation System Plan forecast, ATCT, and local on-airport tenants. Final forecasts for the airports involved some slight alteration to the TAF, making the rate of growth more consistent with the operational activity at each respective airport.

2.3.3 Orlando Melbourne Airport (MLB) – Commercial Airport

Orlando Melbourne Airport is owned and operated by the City of Melbourne, FL. In 2014, the airport began the process of updating the airport's master plan, which was last done in 2004. The master plan update is slated to be completed by mid-2017, per the FAA regulations and advisory circulars. The Master Plan's essential purpose is to evaluate current and projected aviation demand and identify what airport improvements would be needed to satisfy the demand, as well as customer expectations, over a 20-year planning horizon.

Historic Traffic

Table 7 Historical and Forecast Total Aircraft Operations at MLB from Master Plan

TABLE 3-1
MLB HISTORIC AVIATION ACTIVITY

Year	Passenger Enplanements	Annual Aircraft Operations
2001	280,962	186,269
2002	201,056	189,410
2003	199,865	166,046
2004	203,386	161,551
2005	232,986	156,520
2006	167,738	158,867
2007	141,252	163,329
2008	149,012	144,265
2009	115,483	141,162
2010	183,971	146,244
2011	205,350	197,334
2012	214,371	166,180
2013	222,980	131,111
2014	224,260	122,655

Source: MAA Records; FAA OPSNET, 2015.

Socioeconomic data for MLB

Population, income, and employment data were evaluated in this master plan for their impacts on air travel and transport activity. Overall growth rates and annual average growth rate for Brevard, Indian River Counties, Florida, and to include the United States are presented based on socioeconomic data obtained from Woods & Poole Economics, Inc. (CEEDS) with historical data available back to 1969.

Outside Factors that Influence Forecasts

Melbourne emphasizes the need to understand the relationship between the aviation industry trends and the airport operating environment. By comparing the historical trends to these elements, it is possible to determine the impact of economic fluctuations and changes in market/industry to aviation activity at MLB. Factors such as the events of September 11, 2001 and the economic downturn of 2008 have been considered. The master plan used the two counties – Brevard and Indian River – as MLB's passenger market area although it recognizes that some users also originate from outside the two-county region. The report points out that the presence of so many airports in the region (MCO, SFB, PBI, FLL, MIA, and DAB) significantly affects MLB's market area.

Data Collection Methods

The MLB master plan update notes that data for the forecasts were developed from various sources throughout the airport. Sources include the airport staff, ATCT (OPSNET), and other airport stakeholders.

Forecast Methodologies and results

Most of MLB's traffic is domestic with international enplanements limited to flights conducted by on-demand charter services. Because of fluctuations in international enplanement, an international charter scenario was developed for this forecast. And since the addition of just a few new services could have a large-scale impact on annual passengers enplaned at MLB, a high growth scenario was also used in this forecast. In its historical trend analysis, the report applies a 3.7 percent growth experienced between 2006 and 2014 to achieve 480,600 annual passenger enplanements by 2035. A forecast was generated based on FAA's expected growth rate (1.9 percent) for all domestic enplanements in the USA. The master plan forecasts 333,000 enplanements at MLB by the year 2035.

Another projection based on FAA's domestic enplanement forecast was created using market share analysis. Here, the historic enplanement data for MLB was compared to the national enplanement data. The calculated average of the nation's domestic passengers originating from MLB (local market share) was then applied to the FAA's future passenger enplanement projections for the nation showing 354,000 enplanements by the year 2035. Lastly, a multivariate regression model was used to estimate the enplanements for the planning period using three key socioeconomic variables – population, employment, and income – to predict 693,100 enplanements by the year 2035. The report then goes to explain the reasons for eliminating national growth, market share, and historical trends from further evaluation.

Table 8 Projections of MLB Passenger Enplanements from Master Plan

	Historic Trend	National Growth	Market Share	Regression Model
Base Year				
2014	224,260	224,260	224,260	224,260
Projected Forecast				
2020	278,832	251,071	278,497	253,907
2025	334,324	275,847	301,203	317,479
2035	480,638	332,974	354,535	693,093
Average Annual Change	3.7%	1.9%	2.2%	5.5%

Source: ESA Airports, 2015.

As a result of the above-mentioned exercise, the estimates obtained through regression were altered slightly in order to better accommodate current local area dynamics which have the potential to increase passenger demand at MLB over the next ten years.

Table 9 Recommended Passenger Enplanement Forecast from Master Plan

	Selected Projection
Base Year	
2014	224,260
Forecast	
2020	309,600
2025	405,000
2035	693,100
Average Annual Change	5.5%

SOURCE: ESA Airports, 2015.

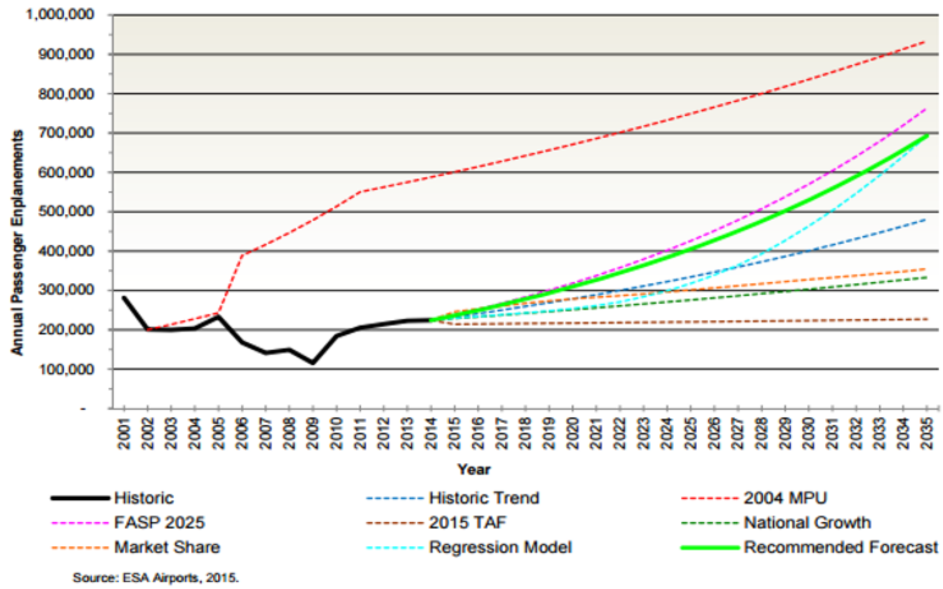


Figure 4 Recommended Passenger Enplanement Forecast from Master Plan

Conclusion

Orlando Melbourne airport's master plan was analyzed to determine the methodologies used to create the airport's forecasts. The unique aspects of the airport were taken into consideration during the development of the passenger enplanement forecasts to create the most realistic model possible. The data used for the creation of the forecasts were taken from the ATCT, local tenants, and airport management. The forecast that was selected for MLB was created from the regression model involving socioeconomic variables with adjustments to better reflect the local area dynamics.

2.3.4 Jacksonville International Airport (JAX) – Commercial Airport

Jacksonville International Airport is a civil-military public airport owned and operated by the Jacksonville Aviation Authority. The airports last master plan (before the current update) was completed in 2001. The most recent master plan update is intended to provide a vision for the growth and development of the Airport over the next 20 years (2007-2027). The case study for JAX is based on chapter three of the master plan: (i.e. Aviation Activity Forecasts).

Historic Traffic

The primary users of the airport are approximately 1.1 million people who live within a 1-hour drive distance to JAX and a further million who live within a 2-hour driving distance to JAX. Unlike other FL airports with a predominantly leisure travel segment, JAX accommodates a significant share of passengers who travel for business.

Table 10 Historical Enplanement in JAX from Master Plan

Historical Enplaned Passengers

Fiscal Year	Enplaned Passengers	Growth Rate (percent)
1987	1,478,371	
1988	1,350,157	-8.7%
1989	1,306,831	-3.2%
1990	1,365,972	4.5%
1991	1,300,171	-4.8%
1992	1,324,911	1.9%
1993	1,331,879	0.5%
1994	1,828,960	37.3%
1995	1,808,936	-1.1%
1996	1,838,935	1.7%
1997	2,069,730	12.6%
1998	2,280,387	10.2%
1999	2,437,169	6.9%
2000	2,603,168	6.8%
2001	2,645,551	1.6%
2002	2,425,734	-8.3%
2003	2,433,317	0.3%
2004	2,567,586	5.5%
2005	2,848,830	11.0%
2006	2,919,794	2.5%
2007	3,160,829	8.3%
Average Annual Growth Rate		
1987-2007	3.9%	

Source: Jacksonville Aviation Authority records, 1997 through 2007
Prepared by: Ricondo & Associates, Inc., February 2008

Due to its geographic location, there is little leakage of potential JAX passenger traffic to airports surrounding it with an hour's drive – GNW, BQK.

Socioeconomic data for JAX

The report states that geographical area served by the airport comprises the five FL counties – Baker, Clay, Duval, Nassau, and St. Johns – the Jacksonville MSA, also called as the Air Trade Area. The socio-economic variables considered in this report include population (sourced from the Bureau of Economic and Business Research), income (sourced from National Planning Association (NPA) Data Services Inc.), and civilian labor force and unemployment rates (sourced from the Bureau of Labor Statistics), retail sales per household (sourced from Survey of Buying Power, 2000-2005).

Outside Factors that Influence Aviation Forecasts

The report lists the need to account for uncertainty in forecasts and also highlights some of the main factors (including the events of September 11, 2001, economy, the price of oil, airline mergers/acquisitions, and airline bankruptcies) influencing aviation wide at JAX and nationwide.

Data Collection Methods

The report collects historical passenger activity from airport records and other socioeconomic data from the sources mentioned previously (under socioeconomic data). No data collection methods are specified.

Forecast Methodologies and results

JAX reviewed FAA's Aerospace forecast which assumed that in the absence of local influences, the activity would increase at a rate comparable to the national rate to forecast 5.6 million enplanements by the year 2027. The report also employs socioeconomic regression analysis as well as a linear trend analysis to produce different estimates as shown below:

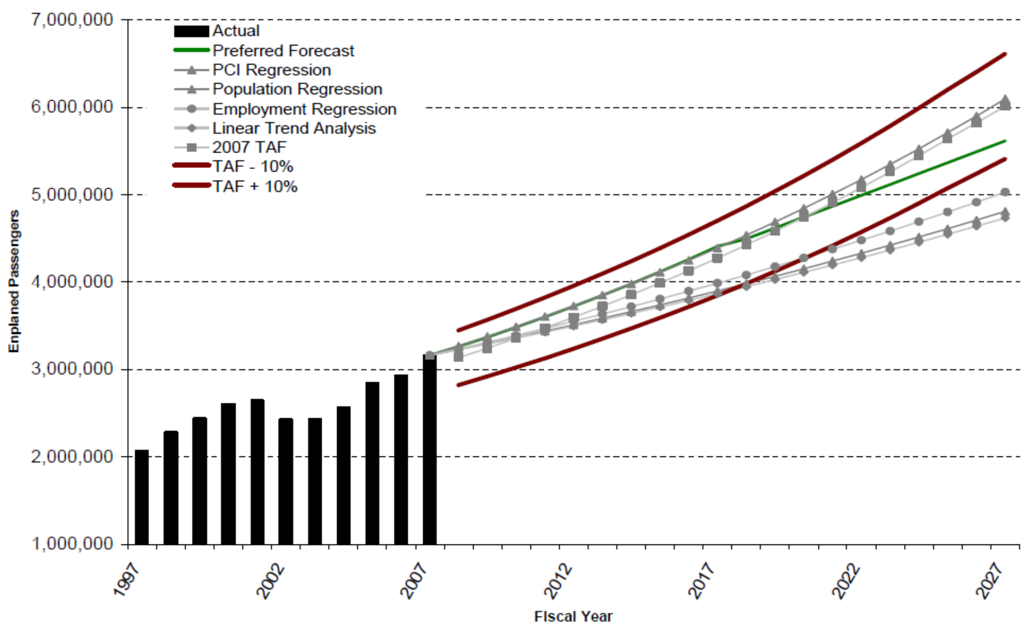
Table 11 Regression Analysis Results for JAX in Master Plan

Regression Analyses – Summary

Fiscal Year	Total Enplaned Passengers	Enplaned Passengers Forecasts: Regression Analyses – Population	Employment	Per Capita Income	Linear Trend
2007 act.	3,160,829				
2012		3,424,839	3,663,389	$3,967,968	3,404,151
2017		3,868,132	4,178,665	$4,742,641	3,848,744
2022		4,328,664	4,619,000	$5,438,986	4,293,337
2027		4,811,925	5,033,372	$6,101,482	4,737,930
R- Square		0.90	0.94	0.95	0.90

Source: Ricondo & Associates, Inc., February 2008
Prepared by: Ricondo & Associates, Inc., February 2008

Exhibit III-6
Enplaned Passenger Forecast Summary and Comparison to FAA 2007 TAF



Sources: FAA *Terminal Area Forecast*, December 2007; Ricondo & Associates, Inc., February 2008
Prepared by: Ricondo & Associates, Inc., February 2008

Figure 5 Enplaned Passenger Forecast Summary and Comparison to FAA 2007 TAF in Master Plan

Lastly, JAX also reviewed the FAA's TAF for both enplaned passengers as well as aircraft operations. The 2007 TAF forecasts are based on actual 2006 data, extended to 2025, which were extended beyond 2025 for the master plan. This forecast leads to 6,012,116 enplanements and 191,330 for the year 2027.

The JAX master plan adopted the market share methodology for the airport.

Conclusion

The master plan for the JAX airport was reviewed to analyze the methodologies used to develop the forecasts. Data collected for the development of the forecast was taken from the ATCT and local tenants.

The methodology selected was an average between the FAA's TAF and the FDOT's FASP for the growth of annual operations and based aircraft at OMN.

Summary

Orlando Melbourne and Jacksonville International Airport master plans were used to analyze and assess the methods and resources used to create forecasts. While socioeconomic regression models with slight alterations to reflect local dynamics was used as the preferred method in Melbourne, the market share methodology was adopted by Jacksonville as their preferred forecast.

3. Forecasting Methodology Comparison

The previous section provided insights on the existing documentation on aviation forecasting methodologies as well as a more comprehensive list of variables that could be used for forecasting air traffic for Florida airports. It is important to understand the advantages and disadvantages of each approach before making an informed decision on the adopted methodology. This section attempts to determine the salient points under each forecasting methodology and select appropriate aviation forecasting methodologies for this study.

3.1 Methodology Comparison

Based on an extensive review of aviation forecasting methodologies from the literature (refer 1, 2, 3, 4), the following methods were considered for applying historic aviation data (enplanements and operations for commercial service airports, operations and based aircraft for general aviation airports) to obtain the most reliable forecasts for the case study airports. Table 1 describes the forecasting methodologies considered for this report.

Table 12 Overview of Forecast Methodologies Studied for Forecasting Air Traffic in Florida Airports

<table>
<tr><th>Methodology</th><th>Description</th><th>Advantages</th><th>Disadvantages</th><th>Data requirements</th></tr>
<tr><td rowspan="2">Trend Projection</td><td>Study the historic data and determine the trend in traffic development - could be linear or others (exponential, parabolic, Gompertz)</td><td rowspan="2">Relatively simple to estimate by extrapolating from historical trends</td><td rowspan="2">Absence of any objective criterion to establishing which trend line best fits the data</td><td rowspan="2">Minimal - Dependent variable is the only requirement - for instance, historical enplanement data (available) or historical aircraft operations (available)</td></tr>
<tr><td>When deriving medium-term or long-term forecasts, the forecaster assumes that current trends will continue in future</td></tr>
<tr><td rowspan="2">Exponential Smoothing</td><td>Forecasting technique that attempts to deal with fluctuations in a time series - seasonal, cyclic or trends</td><td>Smoothing factor used to place emphasis on seasonal, monthly variations</td><td rowspan="2">--</td><td rowspan="2">Minimal - Dependent variable is the only requirement - for instance, historical enplanement data (available) or historical aircraft operations (available)</td></tr>
<tr><td>Places influence on more recent data to increase their influence on the forecast</td><td>Straightforward</td></tr>
<tr><td>Moving Averages</td><td>Same as exponential smoothing except that all observations are weighed equally</td><td>Simpler than exponential smoothing</td><td>Lack of emphasis on current trends due to equal weighting</td><td>Minimal - Dependent variable is the only requirement - for instance, historical enplanement data (available) or historical aircraft operations (available)</td></tr>
<tr><td rowspan="2">Box-Jenkins (ARIMA)</td><td>Handles complex time series data in which a variety of patterns exist</td><td>Allows for much flexibility</td><td>Requires long data series to produce accurate estimates</td><td rowspan="2">Minimal - Dependent variable is the only requirement - for instance, historical enplanement data (available) or historical aircraft operations (available)</td></tr>
<tr><td>Uses most recent data as a starting point and analyze forecasting errors to establish the adjustment</td><td>Better prediction than modeling</td><td>Subjectivity of the analyst required</td></tr>
</table>

	factors for future time periods			
Standard Linear Regression	Model that postulates a causal relationship between dependent variable and one or more independent variables (linear, log-log, linear-log, log-linear)	Allows for the inclusion of dummy variables to incorporate qualitative or categorical variables in a model	Data intensive and the accuracy depends on the accuracy of the forecast scenarios of the explanatory variables in the model	**Extensive** - Population^, employment^, income^, tourism data^, fares, seat data, consolidation/merger data*, incentive programs*, fuel costs, airport competitiveness, hub/no hub, economic factors*, security factors*
Regression with distributed lagged variables	A causal relationship where the influence of a change in an explanatory variable is expected to spread over a longer time period	Improvement over standard linear regression model	--	**Extensive** - Population^, employment^, income^, tourism data^, fares, seat data, consolidation/merger data*, incentive programs*, fuel costs, airport competitiveness, hub/no hub, economic factors*, security factors*
^ - owned by various stakeholders * - possible dummy variables taking values of 0 or 1				

3.1.1 Overview of Trend Progression

As seen from the table, the simplest method that can be adopted for forecasting is trend projection, where historical data are studied and forecasts are generated by extrapolating from historical data. The data requirement for trend projections is very minimal, with only the variable of interest (ex: based aircraft or number of operations) being used to estimate forecasts. This method is currently being used by some airports for forecasting purposes, owing to the relative ease of its application in producing estimates. However, the assumption that current trends will continue into the future often produces erroneous forecasts in a fast-changing aviation environment.

3.1.2 Overview of Exponential Smoothing and Moving Averages

Seasonal or cyclic trends are accounted for in exponential smoothing by the use of smoothing factors. Based on the values of smoothing factors adopted, the methodology places influence on more recent/past data in order to come up with more reliable forecasts. A similar technique that accounts for seasonality, the Moving Averages method, is a simpler form of the exponential smoothing with same weights applied to all the data points. A potential disadvantage of the moving averages approach is its inability to account for current trends with appropriate weighting. Similar to trend projections, both exponential smoothing and moving averages require minimal data for producing forecasts. Nevertheless, both methods are more suitable for near-term forecasts because the prediction errors would accumulate if the methods are being used for long-term forecast.

3.1.3 Overview of Box-Jenkins (ARIMA)

A more complex method which can handle large time series data, allowing for higher levels of flexibility, is the Box-Jenkins (ARIMA) approach. ARIMA stands for Autoregressive Integrated Moving Average. This method uses the most recent data as the starting point and analyses forecasting errors to establish adjustment factors that would be used for future periods. This allows for much flexibility with very minimal data requirements.

3.1.4 Overview of Econometric Modeling

Econometric modeling is the final category of forecasting methodologies reviewed for the purpose of this report. Econometric modeling techniques are often used in airport master plans to come up with reliable forecasts. The models postulate a causal relationship between a dependent variable and one or more independent variables and allow for the inclusion of dummy variables to incorporate qualitative or categorical variables in the models. Furthermore, the models could include lagged variables where the influence of a change in an explanatory variable is expected to spread over a longer time period. However, compared to aforementioned methods, econometric modeling is data intensive (refer to Table 1 for an understanding of the data requirements) and when it is used for forecasting purposes, the accuracy of prediction relies heavily on the accuracy of predicted explanatory variables, which most of time is hard to guarantee. For aviation activity forecast, the data that may be used in developing econometric models are not always publicly available so that it will be costly to develop and maintain the models.

3.2 Methodology Selection

Understanding the pros and cons of the forecasting methodologies and in consultation with FDOT project manager and other partners, USF research team initially chose the ARIMA method of time series analysis to be used for forecasting aviation activities for Florida airports. ARIMA forecasting was chosen for its ability to handle complex time series data and provide the most accurate forecasts with minimal data requirements. Other time series techniques reviewed in the previous section were not selected due to their relatively poor performance (in case of Trend Projection), and/or short-term applicability of the forecasts produced (in case of Exponential Smoothing, and Moving Averages).

Nevertheless, in case studies of the new methodology, it was found that the limited sample size of historical air traffic data always led to low values of ARIMA model parameters and limited years of data could not show full cycles of air traffic variations. As a result, the mean point forecast from ARIMA model always tend to be conservative. Therefore, a 90% confidence level forecast is adopted to provide an upper limit of the forecast, which believes that the future air traffic for each year will be within this limit with 90% probability.

In addition, airport master plans usually assume positive future growth rates, however, from historical data, we have seen both positive and negative growth rates. To mimic the historical positive and negative growth of aviation activities, a Monte Carlo simulation based forecast method is also developed for the forecast module.

In the following section, a detailed introduction of both the ARIMA method and Monte Carlo simulation method and the algorithm process in the automatic forecast tool will be provided.

4. Methodology Implementation Strategies and Case Study

4.1 ARIMA Model

4.1.1 Introduction

ARIMA model, autoregressive integrated moving average model, is a generalization of an autoregressive moving average (ARMA) model. Both of these models are fitted to time series data either to better understand the data or to predict future points in the series. ARIMA models are applied in cases where data show evidence of non-stationary, by differencing (corresponding to the "integrated" part of the model) the data series one or more times to eliminate the non-stationarity (a phenomenon where mean and variance, if present, change over time).

Non-stationary ARIMA models are generally denoted by ARIMA (*p, d, q*) where *p*, *d,* and *q* are non-negative integers; *p* is the order of the *AR* model, *d* is the degree of differencing (the number of times the data had the prior values subtracted). The *AR* part of the ARIMA model indicates that the variable of interest is regressed on its prior values. The *MA* part indicates that the regression error is a linear combination of error terms whose values occurred simultaneously and at various times in the past. The degree of differencing indicates the data values that have been replaced with the difference between the values and their previous values with the main aim being to fit the data in the best manner possible.

The ARMA forecasting equation for a stationary time series is a linear equation in which the predictors consist of lags of the dependent variable and/or lags of the forecast errors. That is:

Predicted value of Y = a constant + a weighted sum of one or more recent values of Y + a weighted sum of one or more recent values of the errors

In mathematical form, ARMA (p, q) is given by:

$$\boldsymbol{y'_t = \mu + \varphi_1 y_{t-1} + \cdots + \varphi_p y_{t-p} + \theta_1 e_{t-1} + \cdots + \varphi_q e_{t-q}}$$

Where $\boldsymbol{\mu}$ is constant; $\boldsymbol{y_{t-1}}$…$\boldsymbol{y_{t-p}}$ are prior values correlated with the predicted variable and $\boldsymbol{\varphi_1}$…$\boldsymbol{\varphi_{t-p}}$ are corresponding parameters for AR part; $\boldsymbol{e_{t-1}}$…$\boldsymbol{e_{t-q}}$ are errors and $\boldsymbol{\theta_1}$…$\boldsymbol{\theta_{t-q}}$ are corresponding parameters for MA part.

In order to difference the data, the difference between consecutive observations is computed. Mathematically, this is shown as

$$\boldsymbol{y'_t = y_t - y_{t-1}}$$

The forecast based on ARIMA model can provide both point forecast and forecast intervals. Point forecasts assume that the future errors in the model are zero and using the parameters obtained and historical data to calculate the forecast value $\boldsymbol{y'_t}$ while forecast intervals consider the variation of future errors and assume that the residuals are uncorrelated and normally distributed. For example, the 95% forecast interval can be written as $\boldsymbol{y'_t} \pm 1.96\sqrt{V_t}$, where V_t is the variance of $\boldsymbol{y'_t}$**.**

4.1.2 ARIMA Model Estimation

ARIMA models can be estimated following the Box-Jenkins approach. This involves three stages:

I. **Model Identification and Selection:** The first step is to determine whether the time series is stationary and detect any significant seasonality that needs to be modeled. Differencing technique is used to formulate a stationary data series such that the assumption of AR and MA model can be satisfied and their parameters can be estimated.

II. **Parameter Estimation:** Computational algorithms are used to arrive at the coefficients that best fit the selected ARIMA model. The Maximum Likelihood Estimation method and minimize conditional sum-of-squares method are always used to aid this process.

III. **Model Diagnosis:** This step tests whether the estimated model parameters are significant and whether the model conforms to the specifications of a stationary univariate process. In particular, the assumption of stationarity needs to be established and this can be done using autocorrelation and partial autocorrelation plots of the residuals or Ljung-box test.

Conventionally, ARIMA model estimation process is achieved manually. First, autocorrelation, as well as partial autocorrelation functions of the dependent time series are used in order to identify if the time series data is stationary (i.e. determine whether differencing is required) and decide if any autoregressive or moving average component should be used in the model, namely picking the value of p and q. Literature (such as Hyndman & Athanasopoulos, 2015) identifies many trends that the sample autocorrelation function takes in order to aid in model identification. After estimation of parameters and proceed diagnosis, estimate the model again using new (p, d, q) until estimated parameters are significant and there is no more autocorrelations. In the process, the analysis needs to select values for (p, d, q) based on the pattern of autocorrelation and the diagnosis results and requires much trial and error.

Instead of using the conventional way, the USF research team build up a forecast tool in R language to predict the air traffic automatically. The algorithm process is as illustrated in Figure 1. Specifically, the forecast tool includes the following steps and the overall process is also depicted in Figure 12.

Step 1: Available historical air traffic data and years to forecast are input into the tool. Also the location to save the forecast results is defined.

Step 2: The historical air traffic data will then be transformed to time series class data that can be used in ARIMA model estimation functions in R.

Step 3: With the transformed data, stationary test (i.e. KPSS test) will be conducted. If the result indicates that the data series is non-stationary, the data will be differenced and tested again until stationary is achieved. The number of times for differencing is the value of ***d***.

Step 4: For determined ***d,*** with each combination of (p, q) there will be an ARIMA (p, d, q) model to be estimated. We make the maximum value of p and q less than 6 and estimate all combinations of (p, q).

Step 5: Obtain the AIC (i.e. a statistical metric indicating the fitness of the model) value for each model and search for the best-fit model.

Step 6: For the best-fit model, diagnose its statistical characteristics, including parameter significance and residual correlations.

Step 7: If the best-fit model passes the test, terminate ARIMA model fitting and the corresponding (p, d, q) values will be used for forecast. Otherwise, increase the value of d by 1 and repeat the step 4 – step 6.

Step 8: With the given (p, d, q), calculate the air traffic forecast values for expected years.

Step 9: Save the forecast results to the designated location.

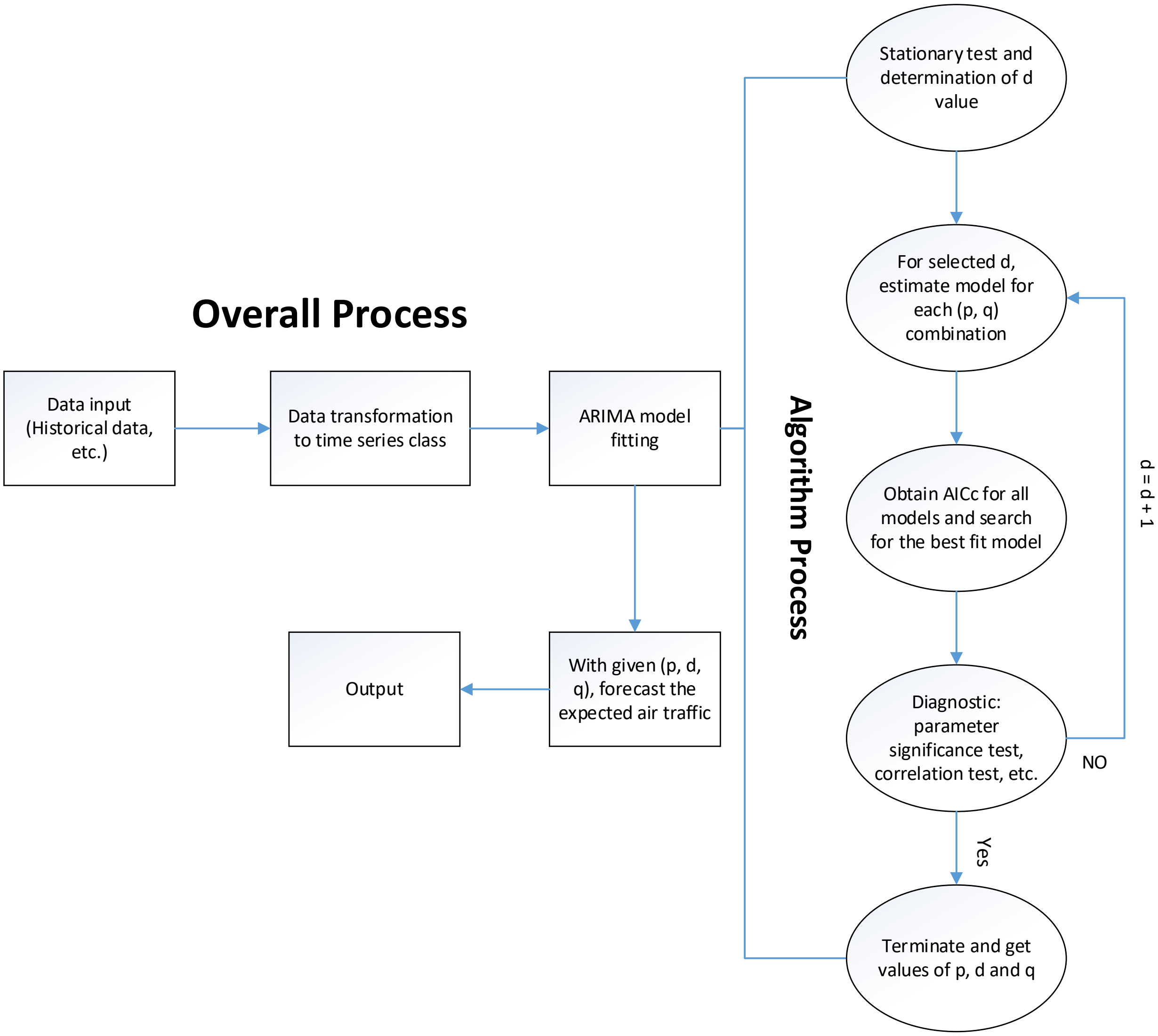


Figure 6 Air Traffic Forecast Tool – ARIMA Model Estimation and Forecast Process

4.2 Monte Carlo Simulation

Monte Carlo methods contain a broad class of computational algorithms that rely on repeated sampling to obtain numerical results. Monte Carlo methods are mainly used in three problem classes: optimization, numerical integration, and generating draws from a probability distribution. Although Monte Carlo methods vary, they tend to follow a particular pattern:

1. Define a domain of possible inputs
2. Generating inputs randomly from a probability distribution over the domain
3. Perform a deterministic computation on the inputs
4. Aggregate results

In application of Monte Carlo simulation to forecast air traffic, we also follow a similar pattern. The essential idea is to predict the future air traffic growth rate based on the historical growth rate and then calculate the forecast values.

Growth rates of historical air traffic data are firstly calculated. In the trials of a significant number of airports, it was found that growth rates of air traffic can be well fitted by normal distributions. The mean and standard deviation of the normal distribution could be estimated by fitting the data with maximal log likelihood method. It is reasonable to assume that growth rates of future air traffic will follow the same normal distribution. In this way, a domain of possible inputs, i.e. growth rates, for forecast can be defined for each dataset.

Given the fitted normal distribution, the growth rates for the forecast years are randomly generated and the forecast values of air traffic are calculated. Due to the randomness in the process of predicting the future growth rate, the process will be repeated multiple times to calculate a mean forecast value, which will provide a relatively stable and clear trend of the forecast air traffic.

In summary, the Monte Carlo simulation method including the follow steps. It is coded in R language.

Step 1: Calculate the growth rate of the historical air traffic data

Step 2: Fit the historical growth rate to a normal distribution and obtain the mean, and standard deviation.

Step 3: Predict the growth rates of air traffic for the years to be forecast by randomly generating growth rates given the fitted normal distribution

Step 4: Calculate the forecast values of air traffic

Step 5: Repeat step 3 and step 4 to obtain multiple forecast values and take the mean values of the forecast

4.3 Case Study

4.3.1 Introduction

This section presents the forecasting outcomes of passenger enplanements and aircraft operations at two commercial service airports: Orlando-Melbourne International Airport (MLB) and Jacksonville International Airport (JAX) and aircraft operations and based aircraft at two general aviation airports: Ormond Beach Municipal Airport (OMN) and Flagler Executive Airport (FIN).

Aviation data (both historical and forecasted) was collected from the year 1996 to the year 2035 (current data: the year 1996 to the year 2015; forecast data: the year 2016 to the year 2035) to be used for analysis. Aviation data from FDOT ASO was used and available for download from the web, specifically:

a. Commercial Enplanements data
b. Commercial Operations data
c. General Aviation Operations data
d. General Aviation Based Aircraft data

Data from the respective airport master plans was not used because of the different timelines observed between different master plans.

4.3.2 Results Analysis

Historical data and forecasts results from different methodologies were presented from *Table 6* to *Table 13* and their corresponding trends were illustrated from *Figure 13* to *Figure 20*. The forecast tool was coded in R and the methodology details and algorithm processes have been introduced in the previous sections. Briefly speaking, forecast results from ARIMA model provides a 90% confidence level forecast results. In other words, we have 90% confidence to say that the forecasted value of aviation activities will be under the forecast results, considering the variations in the forecast results of ARIMA model. Meanwhile, the forecast results of Monte Carlo simulation is based on the distribution of the historical air traffic growth rate, which considered both negative and positive growth rates, consequently, providing a more conservative but also realistic forecast result compared to using a pure positive growth rate for forecast.

Commercial Enplanements

For commercial enplanements in Melbourne International Airport (MLB), the forecast results from ARIMA method is slightly higher to that from user growth rate in short term (2016 - 2025) but more conservative in the long run. The results from the Monte Carlo simulation also present a more conservative and flat future trend, indicating that the historical air traffic does not vary greatly from year to year. Considering the ARIMA model provides the upper limit of the forecast, the results from two methodologies are believed to be consistent with each other. Therefore, it can be concluded that the future enplanements should be expected to have a high probability to be more flat and within the results from ARIMA and Monte Carlo simulation.

Meanwhile, the forecast results of commercial enplanements in Jacksonville International Airport showing similar trends and close results from three methodologies. Henceforth, similar increasing enplanements can be expected in the forecasting years.

Commercial Operations

With variations in the Monte Carlo simulation forecast, it shows a positive growing trend for the future operation in MLB, similar with the results from FDOT forecast. The trend of the ARIMA forecast indicates that there may be a relative large variation in the short-term forecast as there is great separation between the forecast results of ARIMA method and that from other two methods and low variation in the long term forecast due to smaller gaps in the forecast results among those methods. Commercial operation in JAX present similar results except that the forecast from simulation method is more conservative.

GA Operations

Forecast results for GA operations in Ormond Beach Municipal Airport (OMN) presents a similar growing trend from three methods while the results from FDOT forecast is most conservative. At the same time, the forecast results are close for all three methods in the short term for GA operations in Flagler Executive Airport (FIN) while forecast based on simulation methods shows a most conservative result in the long term and forecast from ARIMA method indicating a growing variation in the long term forecast.

GA-Based Aircraft

For GA based Aircraft in OMN, ARIMA method results indicate a significant and increasing variation in the forecast of future aircraft while FDOT forecast and Monte-Carlo simulation shows a more stable result, representing a flat trend for the future GA based aircraft at the airport. As for the GA based aircraft in FIN, ARIMA model and Monte Carlo simulation exhibit a similar flat future trend while FDOT forecast shows a steady growing trend.

Table 13 Commercial Enplanement data for Melbourne International Airport (MLB) Using Forecast Module

Year	FDOT Historical Data	Year	User Growth Forecast	ARIMA Forecast	Monte-Carlo Simulation Forecast
1996	319,825	2016	233,617	271,133	213,306
1997	289,641	2017	247,634	292,151	221,787
1998	259,426	2018	262,492	308,278	217,418
1999	273,813	2019	278,241	321,873	210,501
2000	262,004	2020	294,936	333,852	216,783
2001	262,069	2021	312,632	344,681	224,332
2002	201,247	2022	331,390	354,639	227,247
2003	194,409	2023	351,273	363,908	224,602
2004	201,148	2024	372,349	372,614	219,239
2005	226,207	2025	394,690	380,848	233,035
2006	162,079	2026	418,372	388,679	226,698
2007	137,102	2027	443,474	396,162	223,764
2008	145,117	2028	470,082	403,340	222,663
2009	110,510	2029	498,287	410,246	211,960
2010	180,441	2030	528,185	416,909	209,036
2011	207,829	2031	559,876	423,354	220,332
2012	215,300	2032	593,468	429,600	231,368
2013	211,702	2033	629,076	435,666	228,830
2014	214,704	2034	666,821	441,565	233,762
2015	220,393	2035	706,830	447,310	200,315

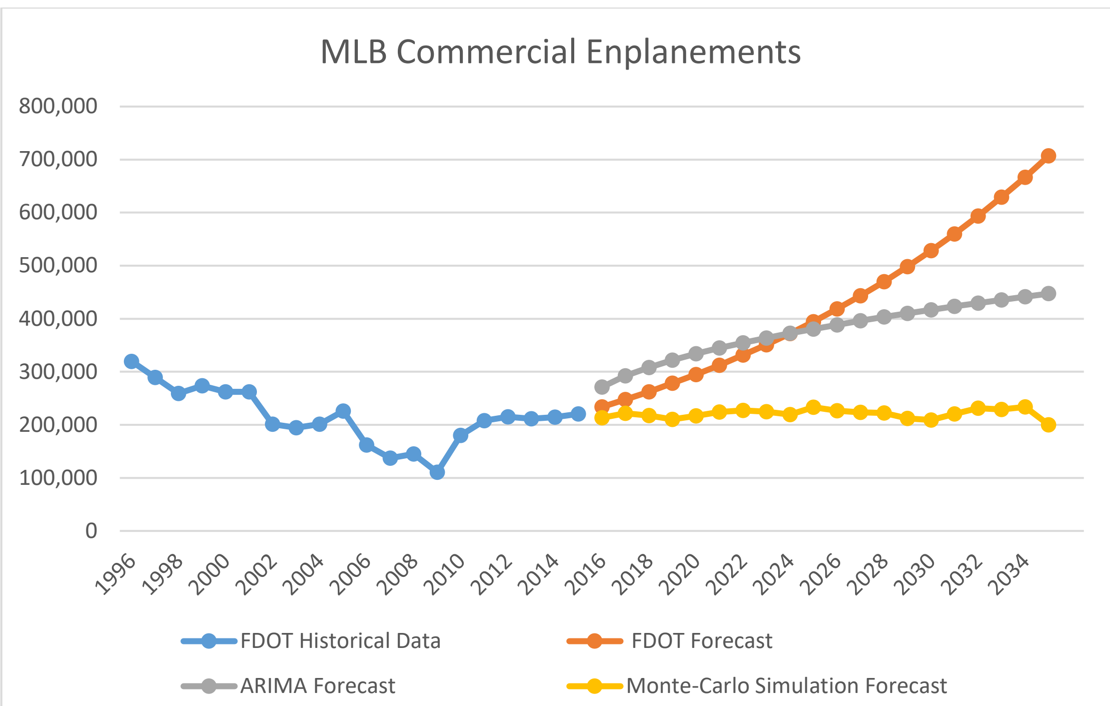


Figure 7 Commercial Enplanement Forecasts for Melbourne International Airport using Forecast Module

Table 14 Commercial Enplanement Data for Jacksonville International Airport (JAX) Using Forecast Module

Year	FDOT Historical Data	Year	User Growth Forecast	ARIMA Forecast	Monte-Carlo Simulation Forecast
1996	1,833,378	2016	2,792,534	2,995,359	2,725,112
1997	2,119,640	2017	2,870,725	3,182,737	2,873,450
1998	2,295,438	2018	2,951,106	3,306,927	2,876,922
1999	2,445,231	2019	3,033,736	3,406,872	3,046,787
2000	2,616,211	2020	3,118,681	3,492,886	3,063,816
2001	2,523,809	2021	3,206,004	3,569,550	3,052,724
2002	2,462,399	2022	3,295,772	3,639,380	3,205,807
2003	2,415,747	2023	3,388,054	3,703,930	3,250,258
2004	2,619,494	2024	3,482,919	3,764,244	3,305,354
2005	2,890,298	2025	3,580,441	3,821,060	3,388,896
2006	2,971,953	2026	3,680,693	3,874,924	3,362,362
2007	3,138,015	2027	3,783,753	3,926,254	3,498,258
2008	2,965,973	2028	3,889,698	3,975,376	3,553,378
2009	2,777,041	2029	3,998,610	4,022,553	3,529,089
2010	2,755,719	2030	4,110,571	4,067,999	3,537,156
2011	2,700,514	2031	4,225,667	4,111,892	3,505,502
2012	2,579,023	2032	4,343,985	4,154,382	3,607,435
2013	2,549,070	2033	4,465,617	4,195,594	3,721,292
2014	2,589,198	2034	4,590,654	4,235,637	3,762,475
2015	2,716,473	2035	4,719,192	4,274,606	3,844,097

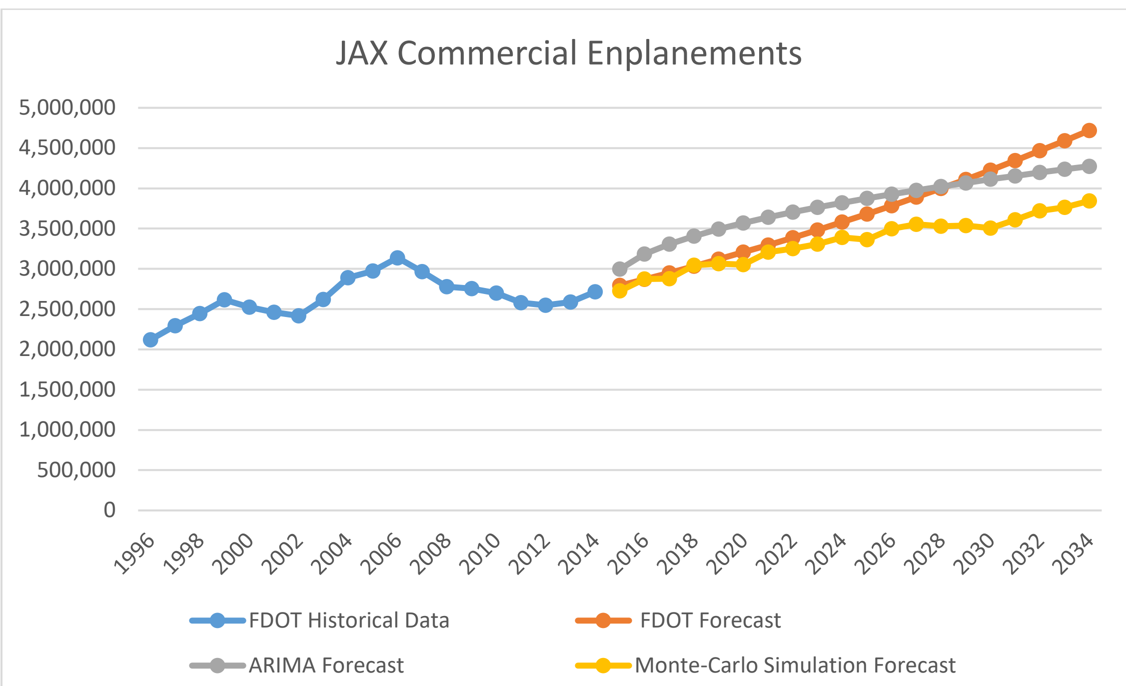


Figure 8 Commercial Enplanement Forecasts for Jacksonville International Airport using Forecast Module

Table 15 Commercial Operation Data for Melbourne International Airport (MLB) Using Forecast Module

Year	FDOT Historical Data	Year	User Growth Forecast	ARIMA Forecast	Monte-Carlo Simulation Forecast
1996	11,579	2016	7,778	9,970	8,193
1997	7,350	2017	8,027	11,767	8,252
1998	5,119	2018	8,284	12,261	8,197
1999	7,105	2019	8,549	12,261	7,932
2000	7,365	2020	8,823	12,261	8,524
2001	7,133	2021	9,105	12,261	8,396
2002	9,002	2022	9,396	12,261	8,372
2003	8,706	2023	9,697	12,261	9,133
2004	9,128	2024	10,007	12,261	8,409
2005	6,894	2025	10,328	12,261	8,466
2006	8,086	2026	10,658	12,261	8,442
2007	7,225	2027	10,999	12,261	8,879
2008	6,618	2028	11,351	12,261	9,252
2009	5,460	2029	11,714	12,261	9,863
2010	7,286	2030	12,089	12,261	10,106
2011	6,600	2031	12,476	12,261	10,122
2012	6,000	2032	12,875	12,261	12,003
2013	5,836	2033	13,287	12,261	12,950
2014	7,097	2034	13,712	12,261	10,907
2015	7,537	2035	14,151	12,261	10,420

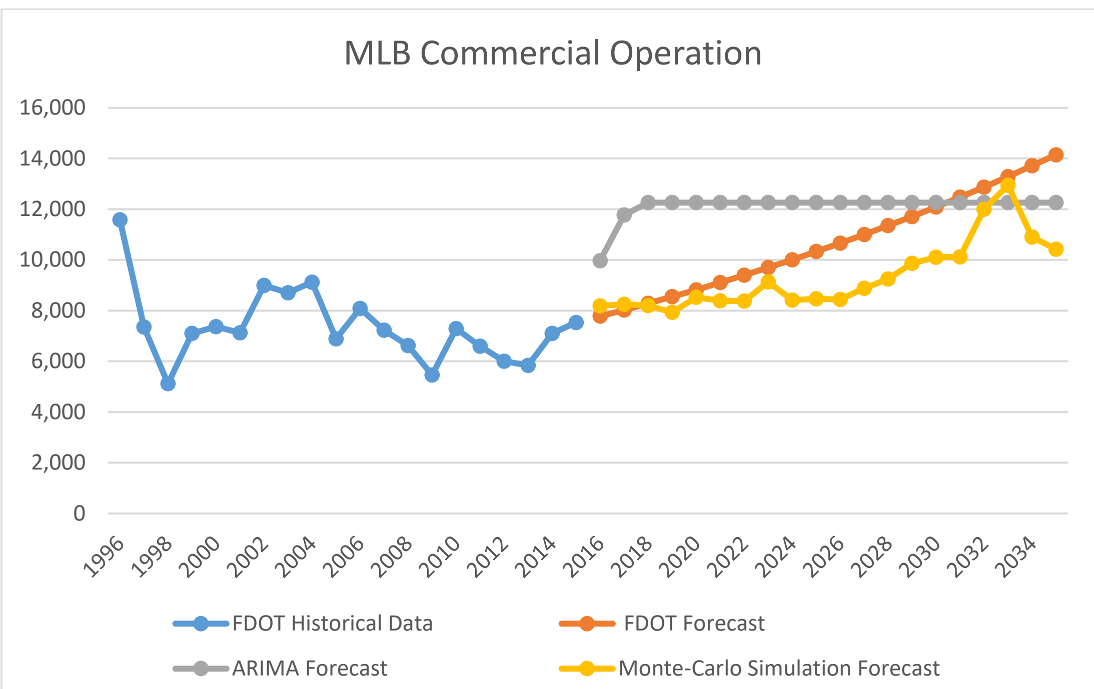


Figure 9 Commercial Operation Forecasts for Melbourne International Airport using Forecast Module

Table 16 Commercial Operation Data for Jacksonville International Airport (JAX) Using Forecast Module

Year	FDOT Historical Data	Year	User Growth Forecast	ARIMA Forecast	Monte-Carlo Simulation Forecast
1996	88,867	2016	74,227	92,406	73,384
1997	79,281	2017	75,712	98,206	73,122
1998	65,981	2018	77,226	98,206	74,366
1999	86,608	2019	78,771	98,206	76,212
2000	93,253	2020	80,346	98,206	75,775
2001	87,552	2021	81,953	98,206	78,472
2002	82,292	2022	83,592	98,206	75,400
2003	81,641	2023	85,264	98,206	76,795
2004	89,337	2024	86,969	98,206	77,876
2005	94,821	2025	88,709	98,206	79,286
2006	94,575	2026	90,483	98,206	80,432
2007	99,294	2027	92,292	98,206	82,283
2008	89,915	2028	94,138	98,206	81,285
2009	78,162	2029	96,021	98,206	82,196
2010	76,263	2030	97,942	98,206	76,289
2011	77,304	2031	99,900	98,206	79,351
2012	69,028	2032	101,898	98,206	79,290
2013	69,337	2033	103,936	98,206	81,350
2014	70,831	2034	106,015	98,206	81,765
2015	72,772	2035	108,135	98,206	81,162

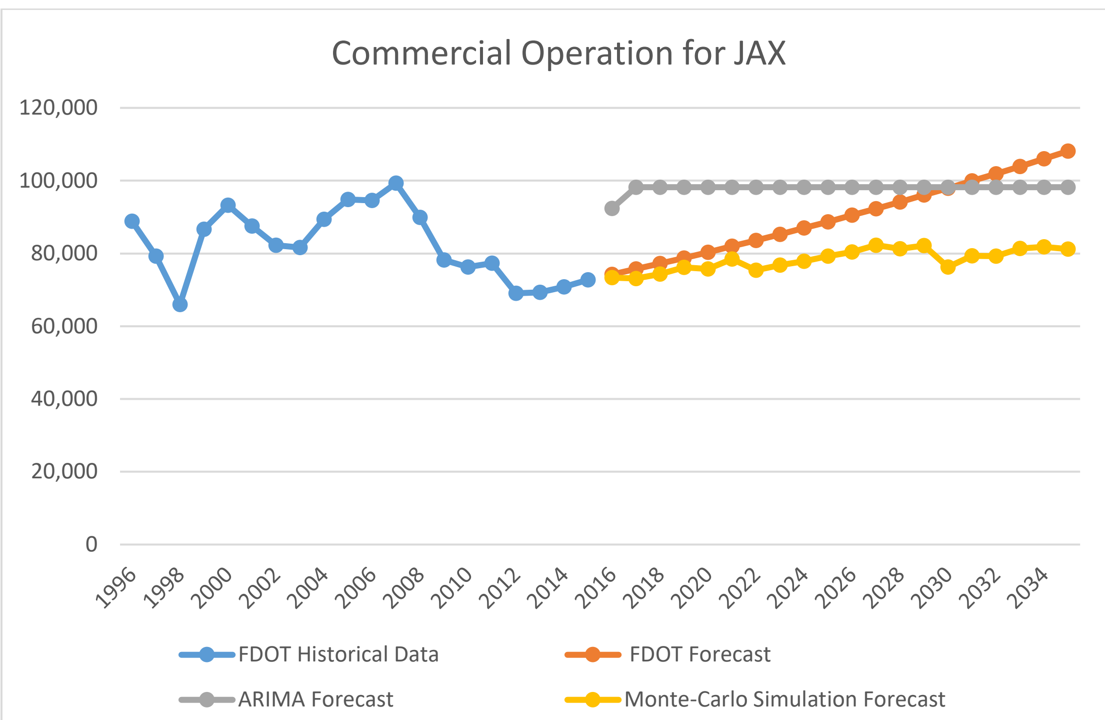


Figure 10 Commercial Operation Forecasts for Jacksonville International Airport using Forecast Module

Table 17 GA Operation Data for Ormond Beach Municipal Airport (OMN) Using Forecast Module

Year	FDOT Historical Data	Year	User Growth Forecast	ARIMA Forecast	Monte-Carlo Simulation Forecast
1996	118,000	2016	110,668	151,369	117,880
1997	118,000	2017	112,461	154,583	124,583
1998	118,000	2018	114,283	157,554	135,110
1999	135,000	2019	116,134	160,329	137,980
2000	135,000	2020	118,016	162,942	136,621
2001	200,000	2021	119,928	165,419	137,047
2002	127,000	2022	121,870	167,780	143,407
2003	127,000	2023	123,845	170,038	145,861
2004	127,000	2024	125,851	172,208	143,509
2005	143,642	2025	127,890	174,297	145,110
2006	148,987	2026	129,962	176,315	144,746
2007	145,884	2027	132,067	178,268	149,896
2008	162,352	2028	134,206	180,163	151,654
2009	153,957	2029	136,381	182,003	158,946
2010	127,000	2030	138,590	183,795	161,325
2011	132,016	2031	140,835	185,540	173,066
2012	115,399	2032	143,117	187,243	167,723
2013	126,409	2033	145,435	188,907	166,020
2014	110,786	2034	147,791	190,534	177,999
2015	108,904	2035	150,185	192,127	183,999

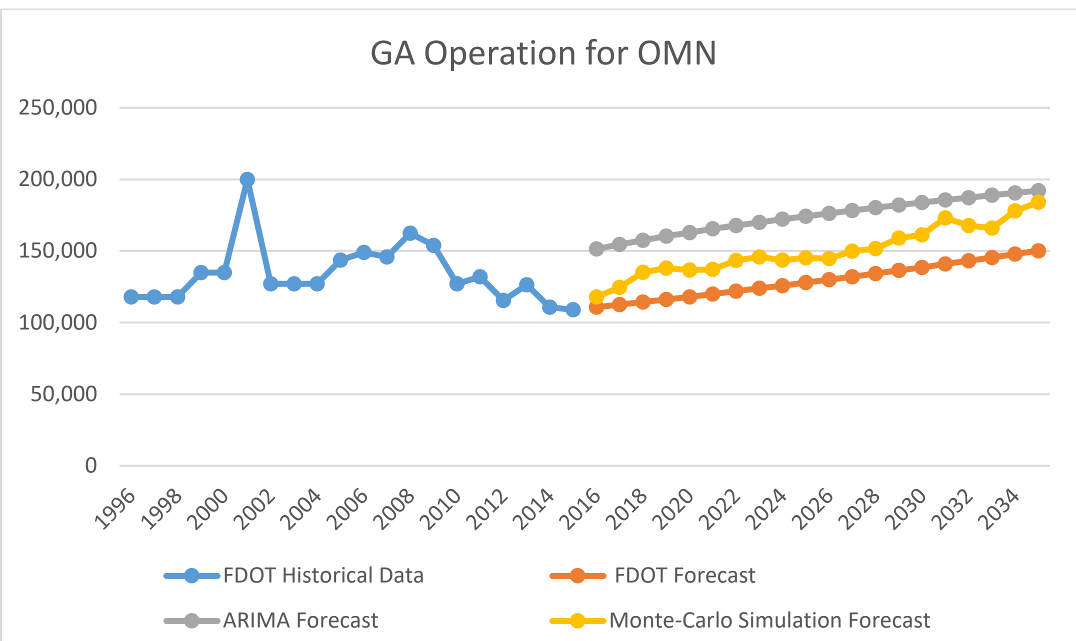


Figure 11 GA Operation Forecasts for Ormond Beach Municipal Airport using Forecast Module

Table 18 GA Operation Data for Flagler Executive Airport (FIN) Using Forecast Module

Year	FDOT Historical Data	Year	User Growth Forecast	ARIMA Forecast	Monte-Carlo Simulation Forecast
1996	190,110	2016	128,070	151,341	133,434
1997	190,110	2017	131,016	129,509	135,623
1998	190,110	2018	134,029	135,233	138,733
1999	190,110	2019	137,112	139,923	146,924
2000	190,010	2020	140,266	144,666	143,638
2001	190,010	2021	143,492	149,789	141,765
2002	190,010	2022	146,792	155,422	144,916
2003	190,010	2023	150,168	161,620	145,621
2004	190,010	2024	153,622	168,405	147,455
2005	227,661	2025	157,155	175,783	148,547
2006	195,710	2026	160,770	183,752	144,118
2007	202,460	2027	164,468	192,304	144,476
2008	202,460	2028	168,250	201,430	153,293
2009	190,010	2029	172,120	211,120	149,015
2010	170,902	2030	176,079	221,363	151,506
2011	176,107	2031	180,129	232,147	153,784
2012	153,585	2032	184,272	243,461	153,868
2013	164,027	2033	188,510	255,296	160,170
2014	144,415	2034	192,846	267,640	157,315
2015	125,191	2035	197,281	280,485	157,118

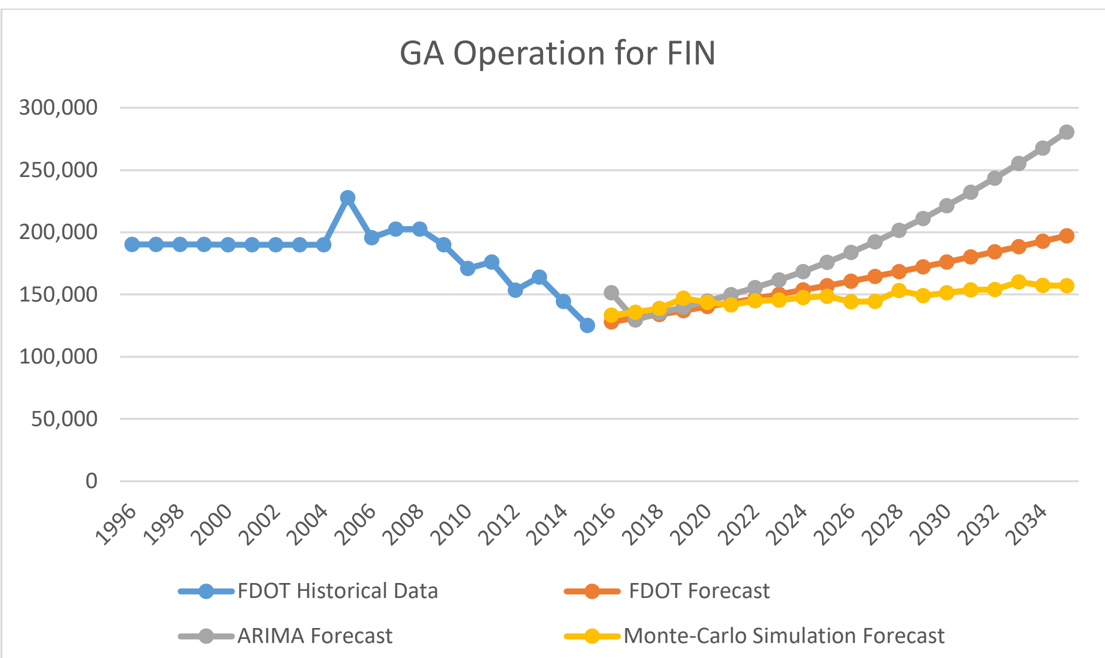


Figure 12 GA Operation Forecast for Flagler Executive Airport using Forecast Module

Table 19 GA Based Aircraft Data for Ormond Beach Municipal Airport (OMN) Using Forecast Module

Year	FDOT Historical Data	Year	User Growth Forecast	ARIMA Forecast	Monte-Carlo Simulation Forecast
1996	89	2016	148	191	152
1997	106	2017	150	210	145
1998	106	2018	151	224	132
1999	138	2019	153	235	135
2000	108	2020	154	246	137
2001	169	2021	156	255	140
2002	169	2022	157	264	140
2003	169	2023	159	272	134
2004	169	2024	160	280	134
2005	169	2025	162	287	132
2006	169	2026	163	294	130
2007	113	2027	165	300	134
2008	99	2028	166	307	131
2009	169	2029	168	313	139
2010	169	2030	170	318	141
2011	169	2031	171	324	148
2012	169	2032	173	329	146
2013	170	2033	175	335	148
2014	163	2034	176	340	152
2015	147	2035	178	345	145

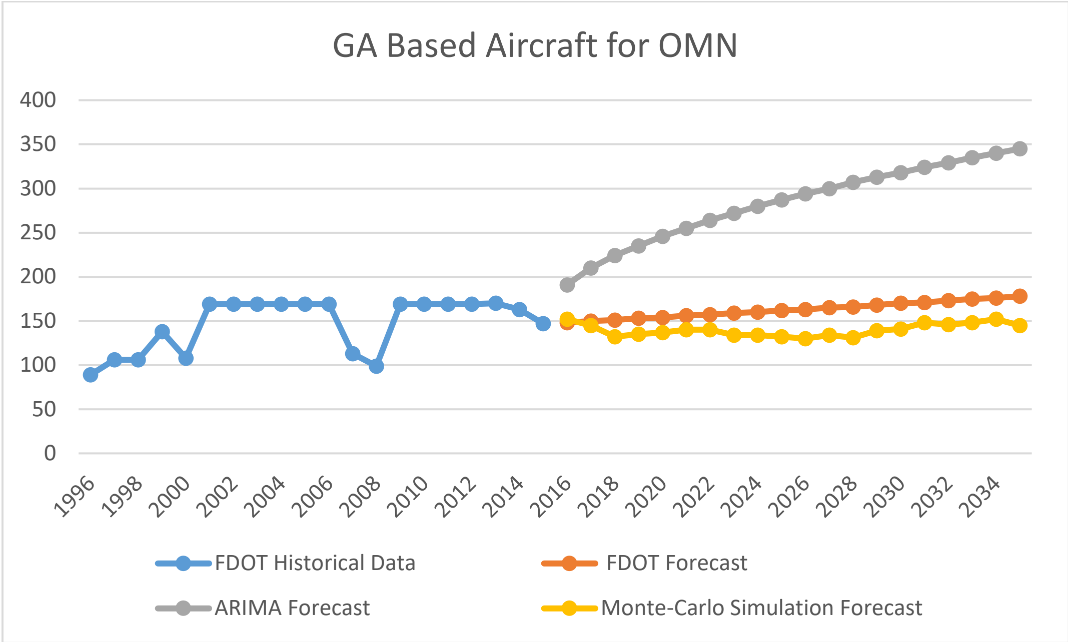


Figure 13 GA Based Aircraft Forecasts for Ormond Beach Municipal Airport using Forecast Module

Table 20 GA Based Aircraft Data for Flagler Executive Airport (FIN) Using Forecast Module

Year	FDOT Historical Data	Year	User Growth Forecast	ARIMA Forecast	Monte-Carlo Simulation Forecast
1996	79	2016	70	83	68
1997	96	2017	73	90	66
1998	96	2018	75	90	68
1999	66	2019	77	90	67
2000	63	2020	80	90	70
2001	61	2021	83	90	72
2002	57	2022	85	90	74
2003	58	2023	88	90	75
2004	65	2024	91	90	73
2005	65	2025	94	90	76
2006	83	2026	97	90	75
2007	86	2027	100	90	74
2008	80	2028	104	90	74
2009	75	2029	107	90	76
2010	72	2030	111	90	76
2011	72	2031	114	90	76
2012	79	2032	118	90	79
2013	75	2033	122	90	80
2014	75	2034	126	90	78
2015	68	2035	130	90	75

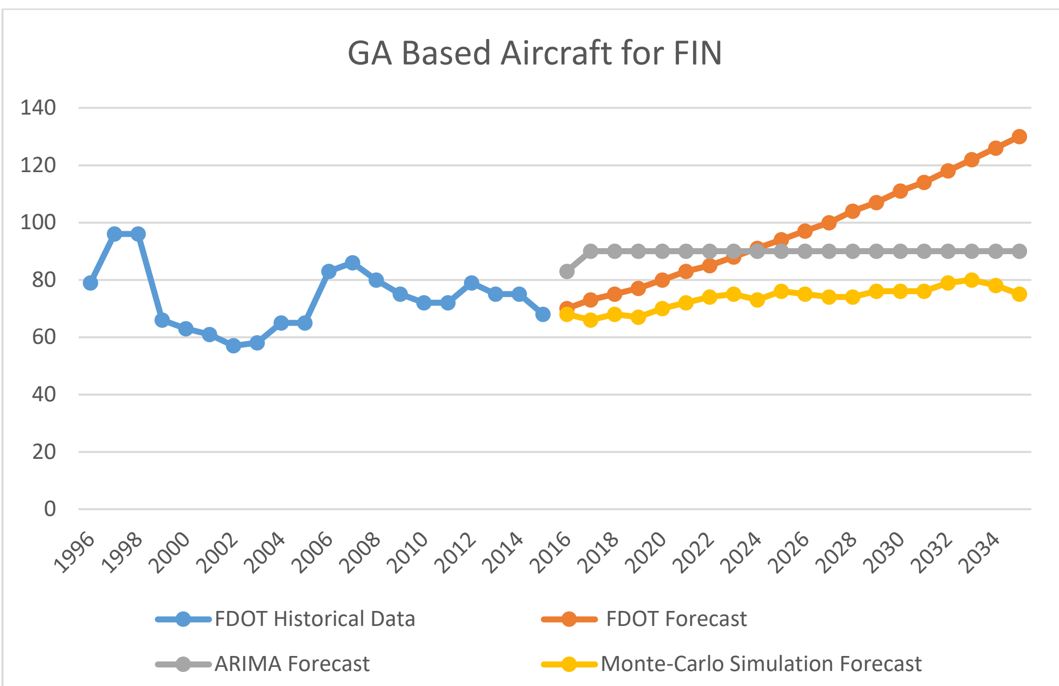


Figure 14 GA Based Aircraft Forecast for Flagler Executive Airport using Forecast Module

5. Forecast Module User Guide

This user guide was created to assist the Florida Department of Transportation Aviation Office and designated users with the efficient use of the ***Florida Aviation Database Forecasting Module.*** This Guide will walk you through each step of how to use the module. The module is equipped with following functions:

Access the Forecasting Module

View a Facility Forecast

Run an Updated Forecast

Update the FDOT Saved Forecast

Enter Historic Data

View Forecast Data

View Archived Data

View Import Data

Bulk Import Data for Multiple Facilities

Import the Completed Download Template

View Reports

Run Report

Note: Due to differences between internet browsers, your view may differ slightly from the view in the screenshot utilized to create this manual. While internet browsers may cause a variation in look and feel, all systems components should continue to function in all internet browsers.

***Disclaimer**: All screenshots in this guide are from our test site and while the names and data may be familiar, the information is test information we have entered and is not accurate.*

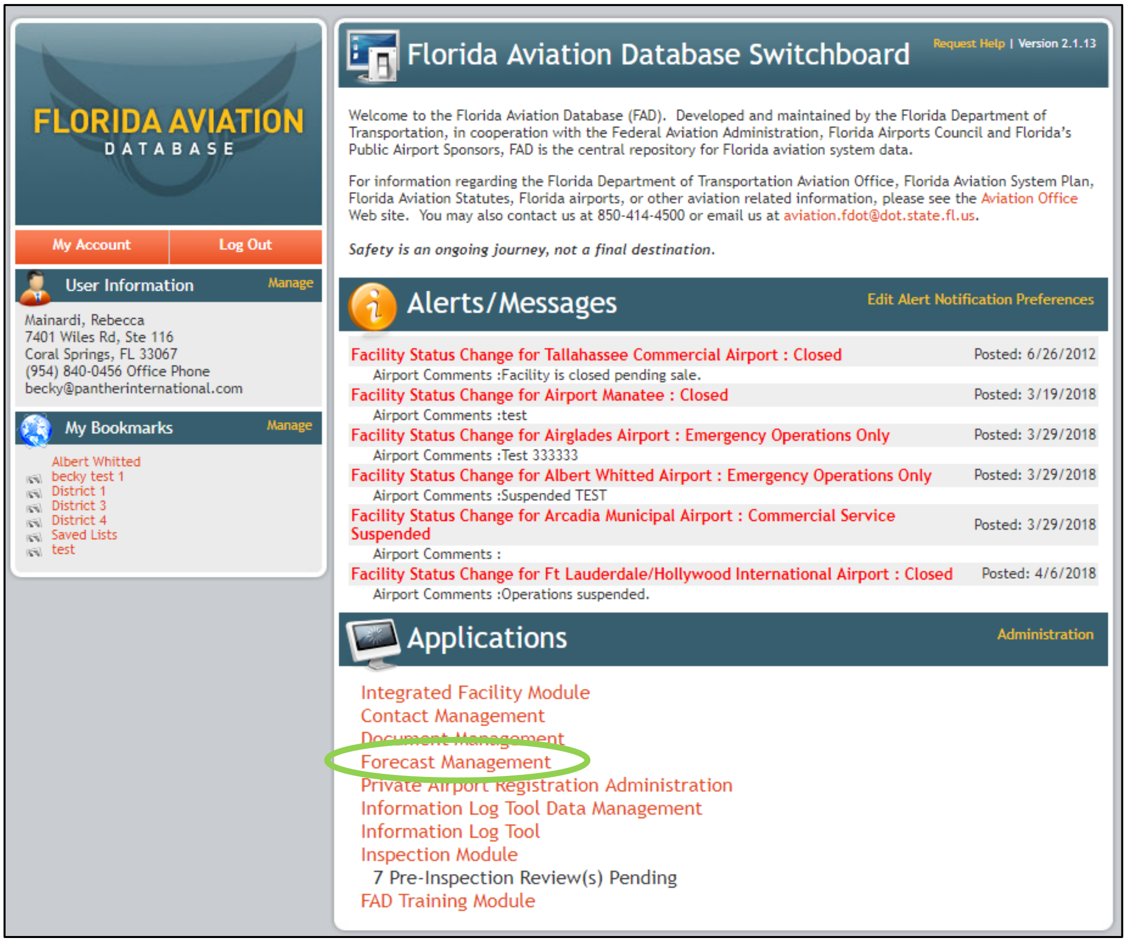
Access the Forecasting Module

I. Locate the ***Florida Aviation Database*** login screen at https://www.florida-aviation-database.com

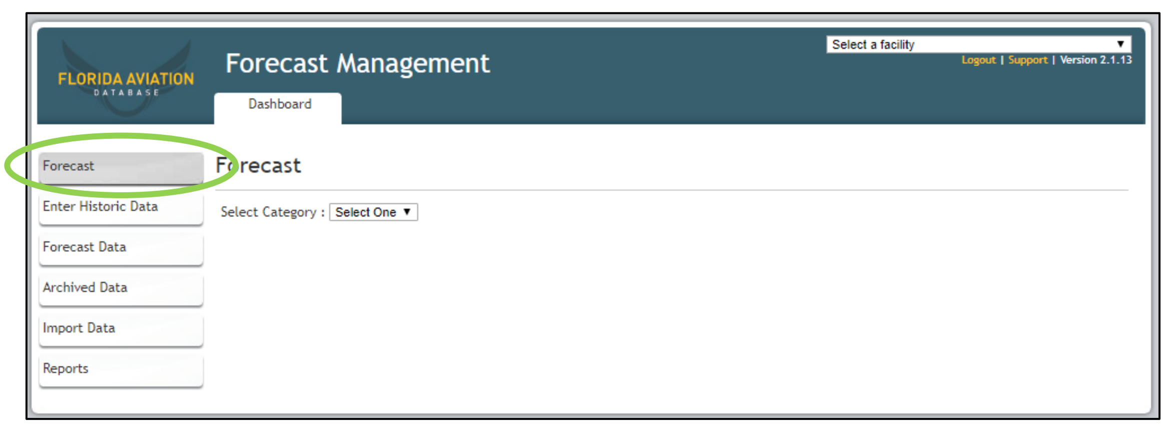
II. Login to the ***Florida Aviation Database***
   a. Enter your **username**
   b. Enter your **password**
   c. Select **Log In**

View a Facility Forecast

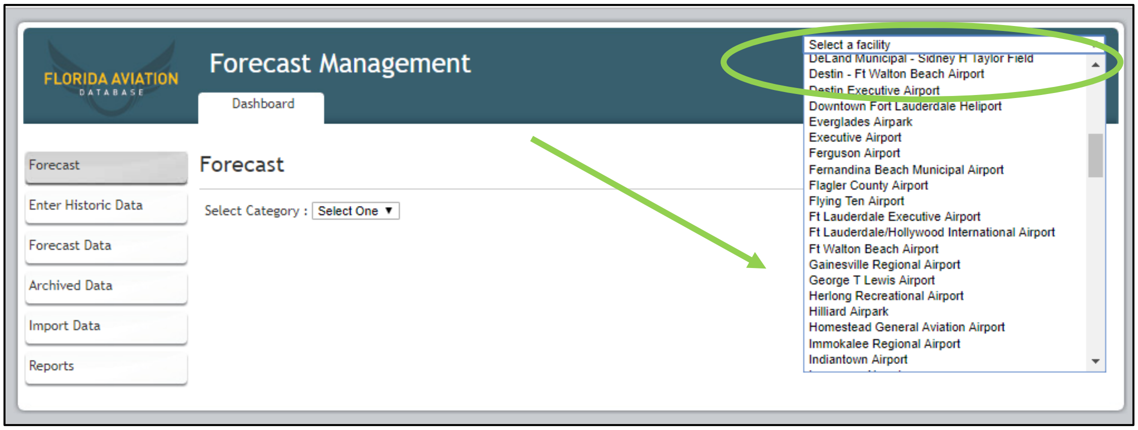
I. Select **Forecast Module:**



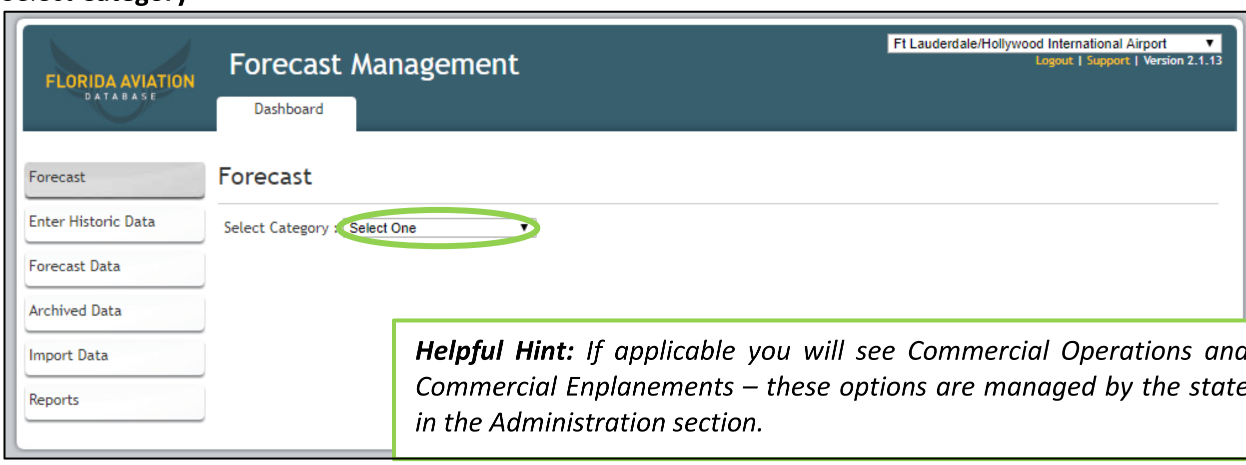
II. Select the **Forecast Tab**



III. Select a **Facility:**

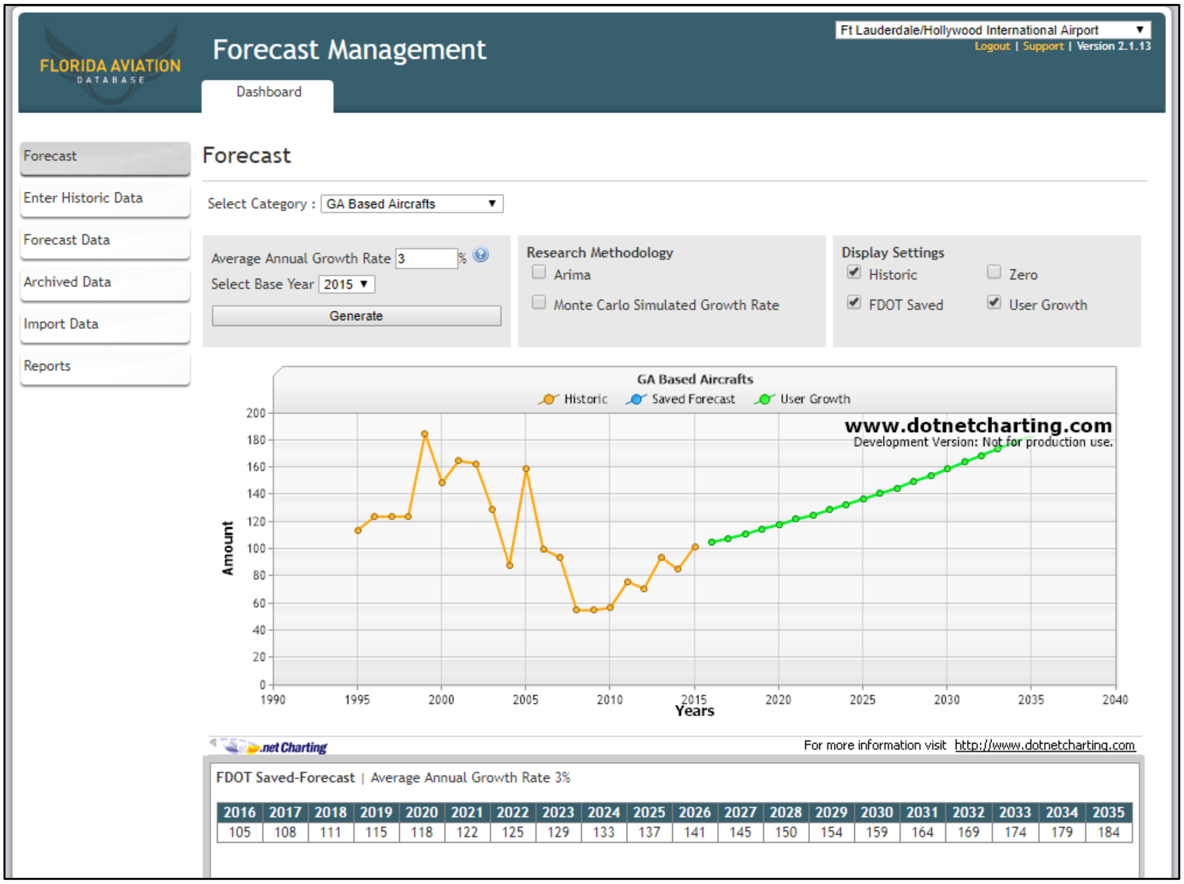


IV. Select **Category**



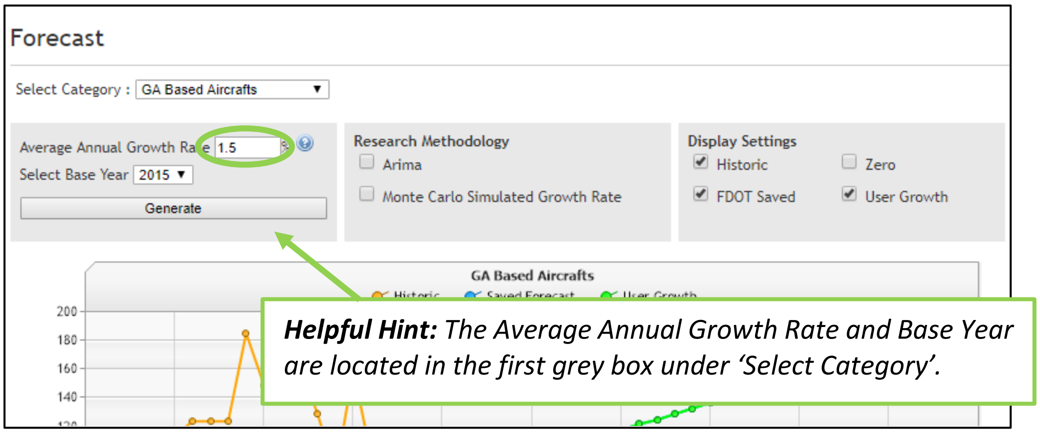
Helpful Hint: *If applicable you will see Commercial Operations and Commercial Enplanements – these options are managed by the state in the Administration section.*

V. The **Forecast** for the Facility selected will now display:

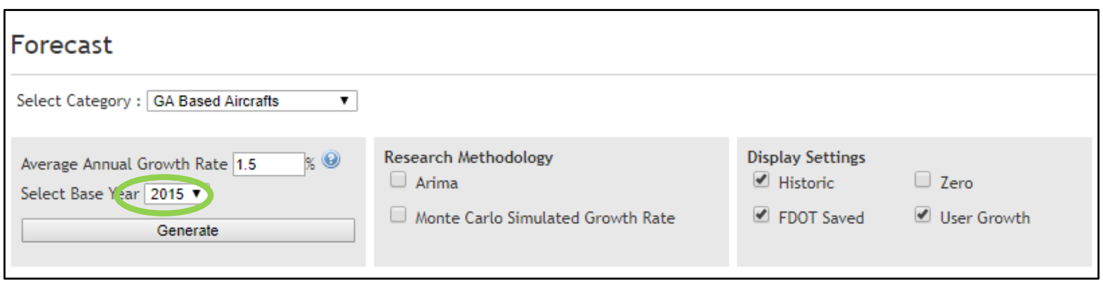


Run an Updated Forecast

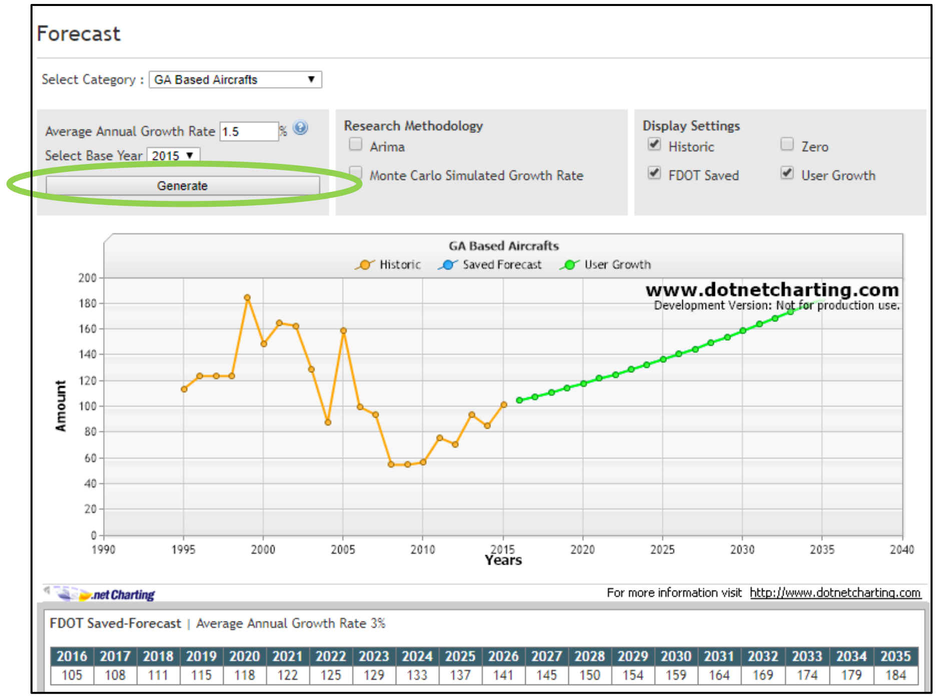
a) Select the Average Annual Growth Rate and Base Year, please note these will default to the numbers from the most recent saved FDOT Forecast:



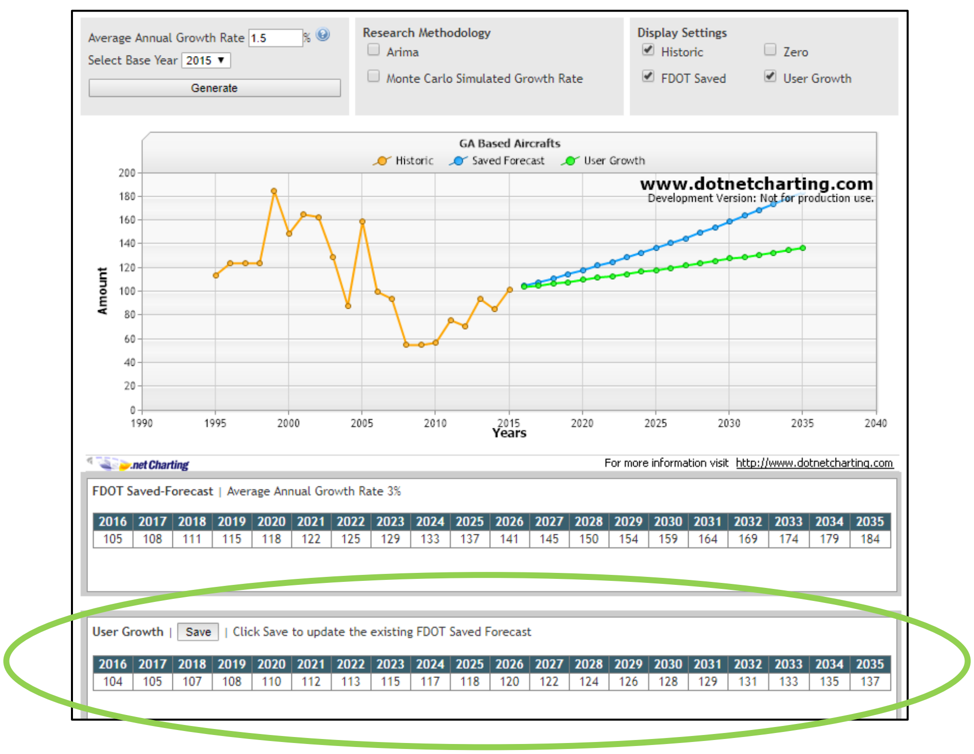
b) Edit **Average Annual Growth Rate** Base Year as needed



c) Select **Generate**



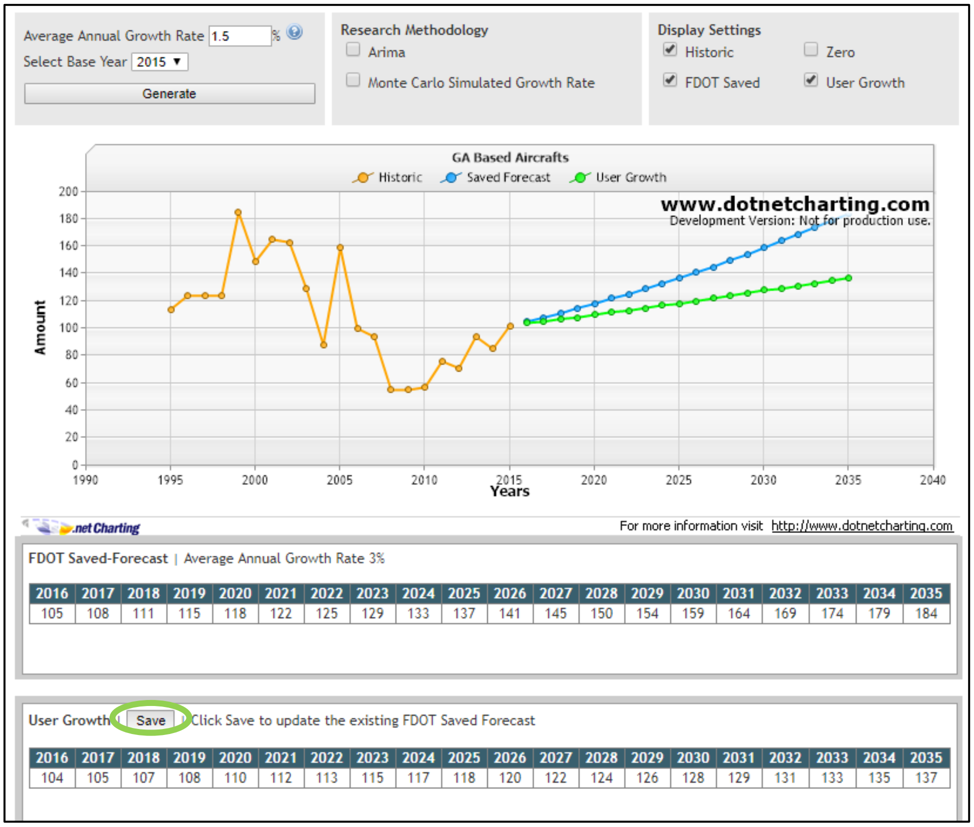
d) Note the **User Growth** data row and graph will update



e) Adjust the Average Annual Growth Rate and Base year as needed to see various forecast before saving.

Update the FDOT Saved Forecast

I. Select **Save** button next to User Growth line



FDOT Saved-Forecast | Average Annual Growth Rate 3%

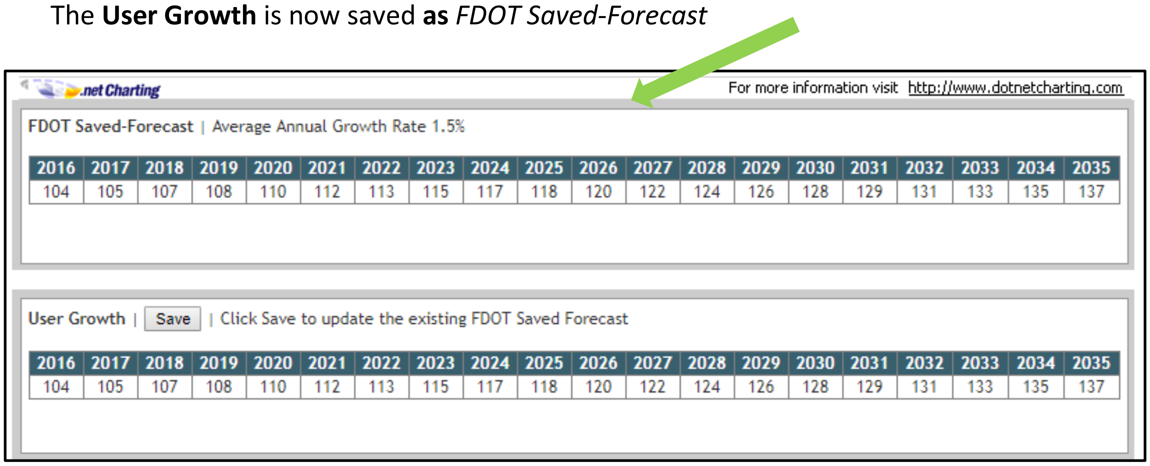
2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
105	108	111	115	118	122	125	129	133	137	141	145	150	154	159	164	169	174	179	184

User Growth | Save | Click Save to update the existing FDOT Saved Forecast

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
104	105	107	108	110	112	113	115	117	118	120	122	124	126	128	129	131	133	135	137

II. Select **OK**

III. The **User Growth** is now saved **as** *FDOT Saved-Forecast*



FDOT Saved-Forecast | Average Annual Growth Rate 1.5%

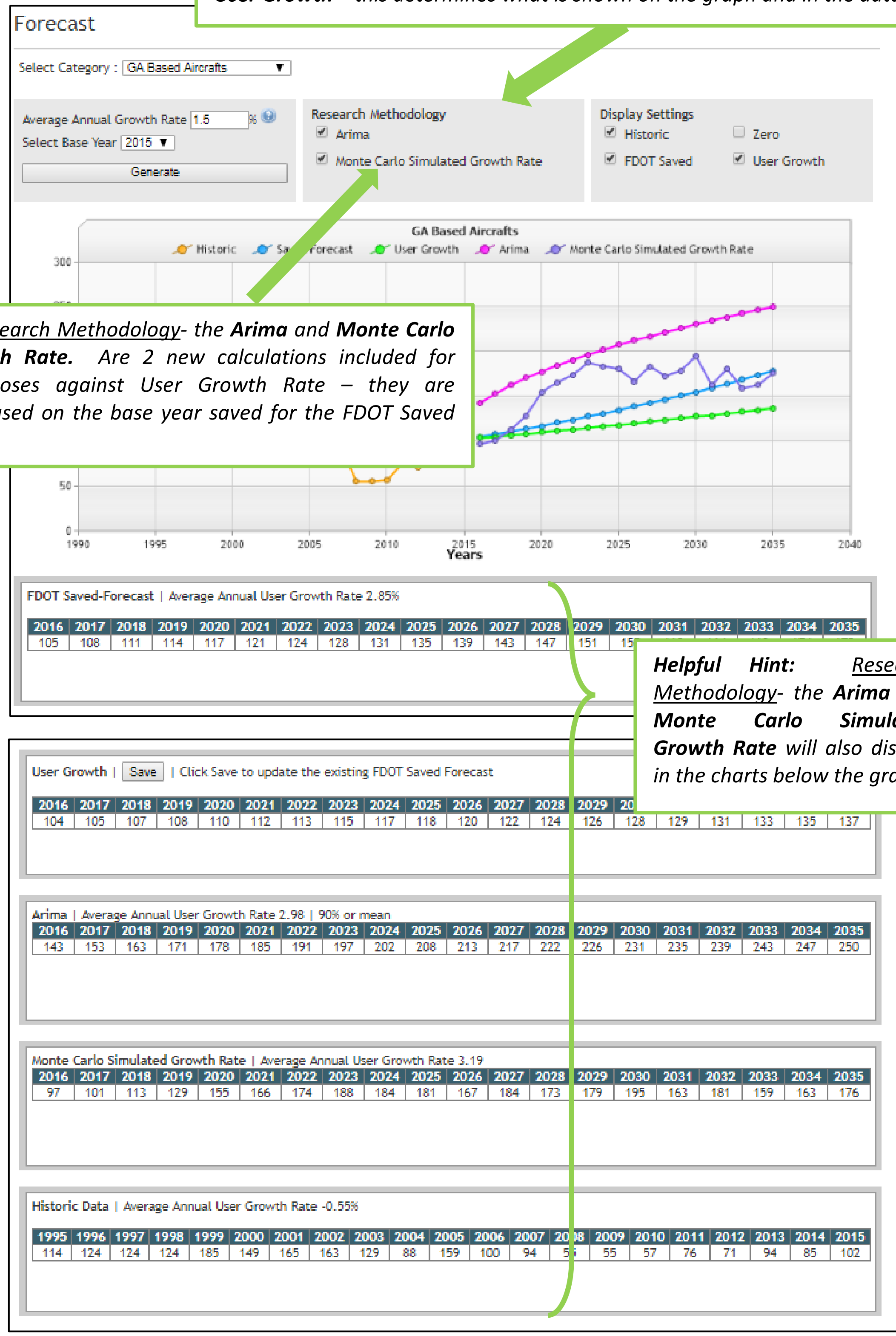
2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
104	105	107	108	110	112	113	115	117	118	120	122	124	126	128	129	131	133	135	137

User Growth | Save | Click Save to update the existing FDOT Saved Forecast

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
104	105	107	108	110	112	113	115	117	118	120	122	124	126	128	129	131	133	135	137

IV. To manage displayed data and **graphical information** that is viewed on this page use the second 2 grey boxes.

Helpful Hint: *Display Settings Box – Allows you to check **Historic, FDOT Saved, Zero,** and **User Growth** – this determines what is shown on the graph and in the data boxes below.*

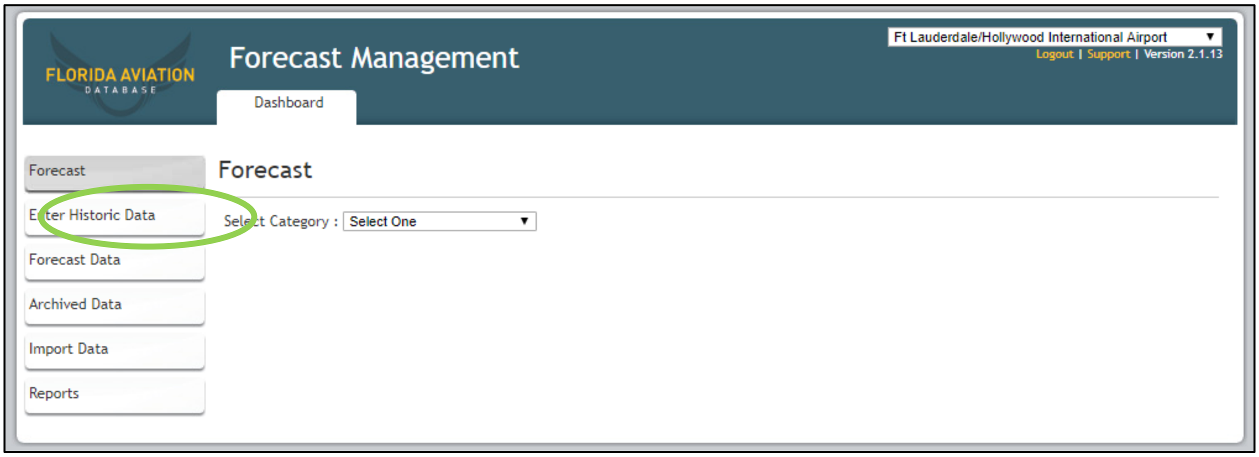


Helpful Hint: *Research Methodology- the **Arima** and **Monte Carlo Simulated Growth Rate.** Are 2 new calculations included for comparison purposes against User Growth Rate – they are autogenerated based on the base year saved for the FDOT Saved Forecast.*

Helpful Hint: *Research Methodology- the **Arima** and **Monte Carlo Simulated Growth Rate** will also display in the charts below the graph.*

Enter Historic Data

I. Select the **Enter Historic Data** tab



II. The Enter Historic Data Table will display

Enter Historic Data

Enter data for current year you are using to develop the forecast

	Year	GA Based Aircraft	GA Operations	Commercial Operations	Commercial Enplanements
	2018	102	38,000	230,000	10,000,000
	2017	102	38,065	239,940	13,061,632
	2016	102	38,065	239,940	13,061,632
	2015	102	38,065	239,940	13,061,632
	2014	85	36,070	222,324	12,031,860
	2013	94	36,209	219,197	11,538,140
	2012	71	36,034	228,838	11,445,103
	2011	76	40,059	227,089	11,332,466
	2010	57	45,562	226,731	10,829,810
	2009	55	43,661	226,494	10,258,118
	2008	55	47,924	247,572	11,020,091
	2007	94	54,067	253,908	11,079,250
	2006	100	56,875	240,213	10,204,579
	2005	159	68,533	262,230	10,729,468
	2004	88	73,466	242,022	10,040,598
	2003	129	62,941	224,652	8,682,781
	2002	163	63,486	217,251	8,266,788
	2001	165	87,539	213,398	8,015,055
	2000	149	88,686		
	1999	185	97,977		
	1998	124	81,774		

Helpful Hint: *Years displayed on this tab default to the most recent 22 years and will auto-update annually on January 1st adding a new year and archiving the oldest year to the Archived Data Tab.*

Edit Historic Data

Select the **Pencil Icon**

	Year	GA Based Aircraft	GA Operations	Commercial Operations	Commercial Enplanements
	2018	102	38,000	230,000	10,000,000
	2017	102	38,065	239,940	13,061,632
	2016	102	38,065	239,940	13,061,632

To Edit Historic Data

a) Select the **Field**

	2017	102	38,065	239,940	13,061,632
	2016	102	38,065	239,940	13,061,632
	2015	102	38,065	239,940	13,061,632

Helpful Hint: *Data may also be bulk imported for multiple Facilities on the Import Data tab*

b) Select **Save Icon**

	2017	102	38,065	239,940	13,061,632
	2016	102	38,065	239,940	13,061,632
	2015	102	38,065	239,940	13,061,632

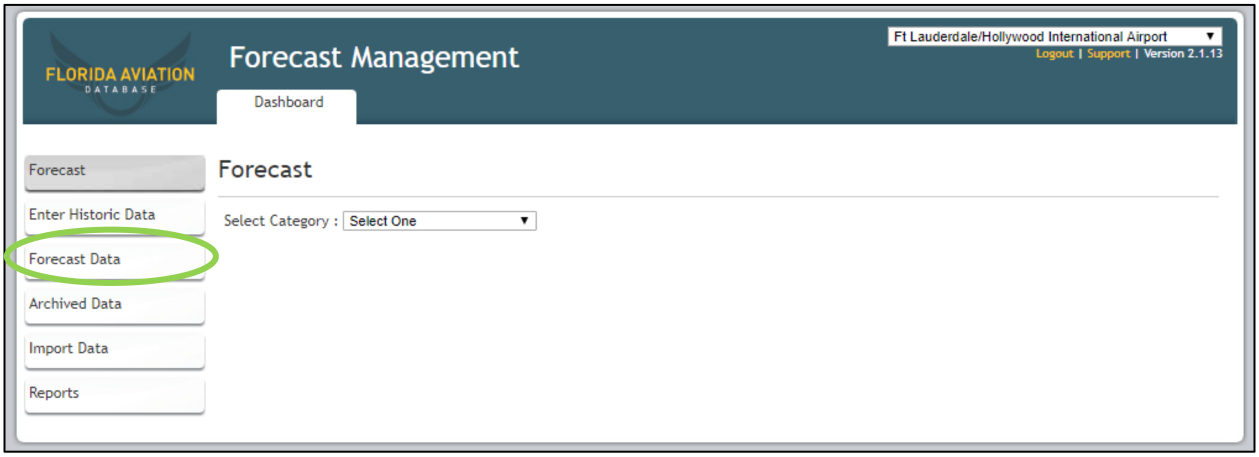
To **Cancel** Editing Historic Data:

a) Select the **Red Icon**

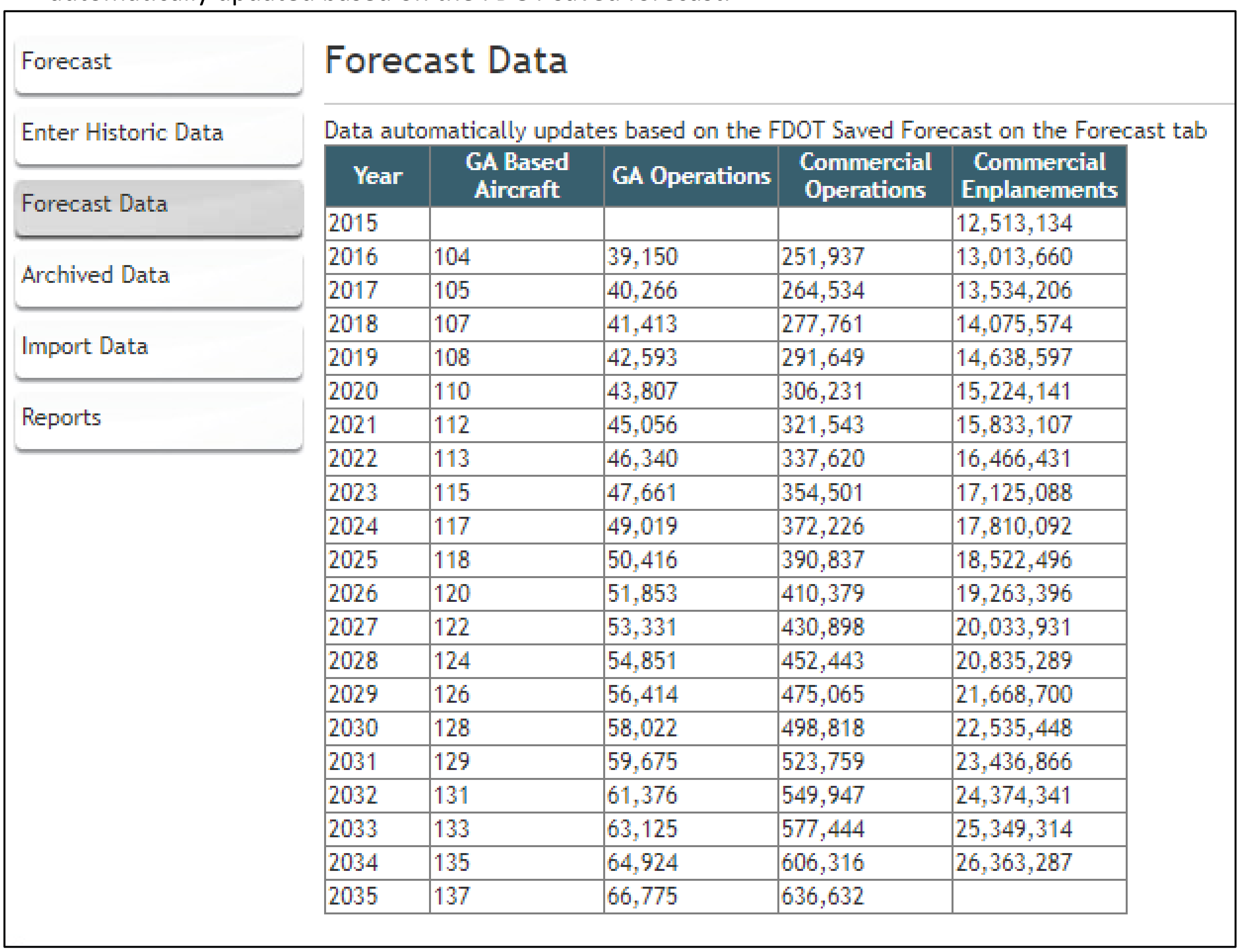
	2017	102	38,065	239,940	13,061,632
	2016	102	38,065	239,940	13,061,632
	2015	102	38,065	239,940	13,061,632

View Forecast Data

I. Select the **Forecast Data** tab



II. The **Forecast Data** will now display the data that is managed on the Forecast Tab and it is automatically updated based on the FDOT saved forecast.



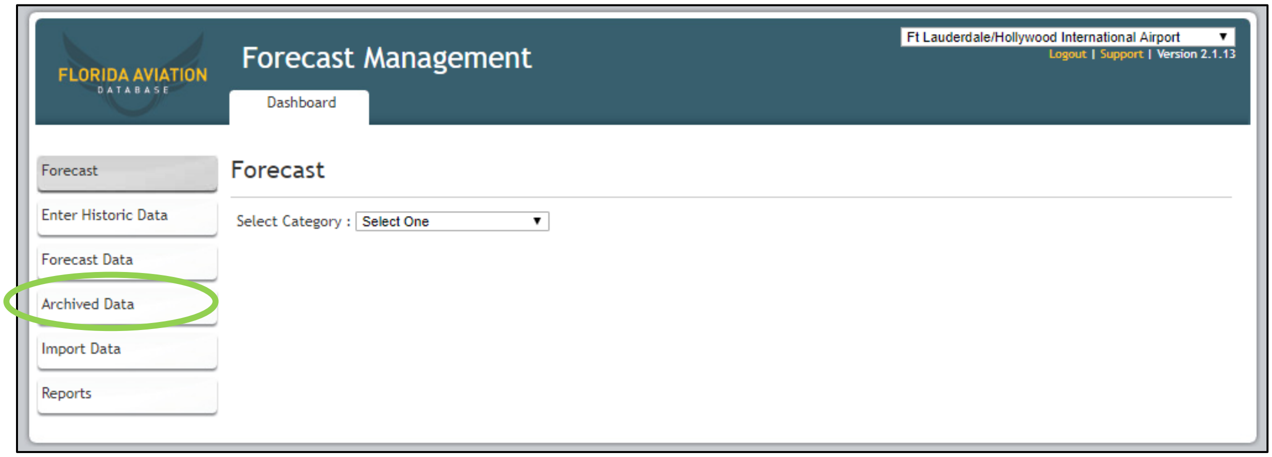
Forecast Data

Data automatically updates based on the FDOT Saved Forecast on the Forecast tab

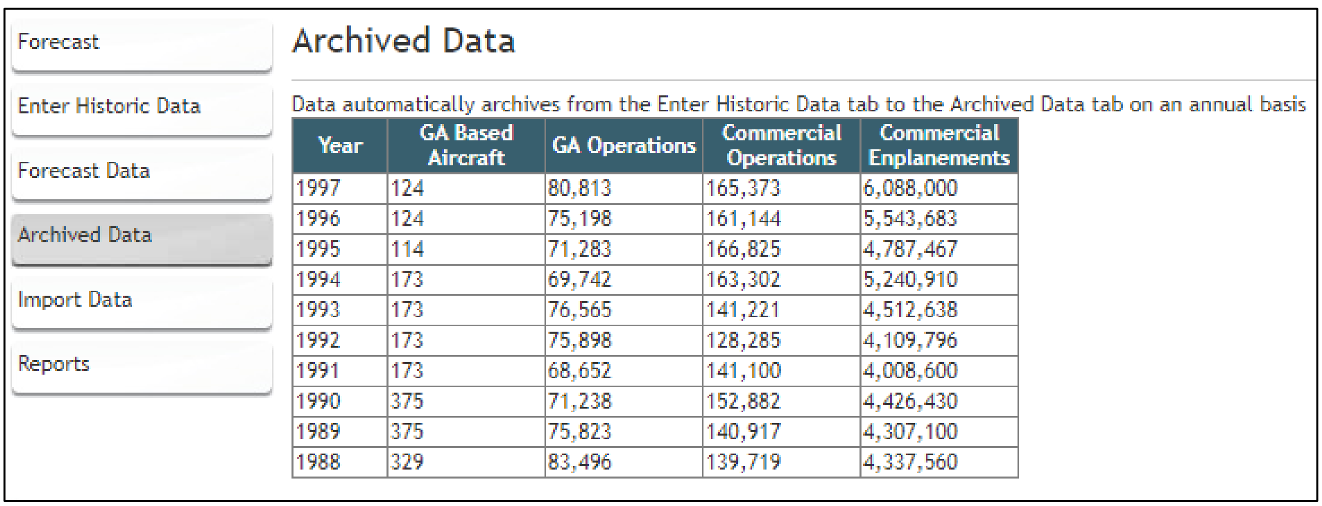
Year	GA Based Aircraft	GA Operations	Commercial Operations	Commercial Enplanements
2015				12,513,134
2016	104	39,150	251,937	13,013,660
2017	105	40,266	264,534	13,534,206
2018	107	41,413	277,761	14,075,574
2019	108	42,593	291,649	14,638,597
2020	110	43,807	306,231	15,224,141
2021	112	45,056	321,543	15,833,107
2022	113	46,340	337,620	16,466,431
2023	115	47,661	354,501	17,125,088
2024	117	49,019	372,226	17,810,092
2025	118	50,416	390,837	18,522,496
2026	120	51,853	410,379	19,263,396
2027	122	53,331	430,898	20,033,931
2028	124	54,851	452,443	20,835,289
2029	126	56,414	475,065	21,668,700
2030	128	58,022	498,818	22,535,448
2031	129	59,675	523,759	23,436,866
2032	131	61,376	549,947	24,374,341
2033	133	63,125	577,444	25,349,314
2034	135	64,924	606,316	26,363,287
2035	137	66,775	636,632	

View Archived Data

I. Select the **Archived Data** tab



II. The Archived Data will now display- Data is automatically archived here from the Enter Historic Data tab on an annual basis.



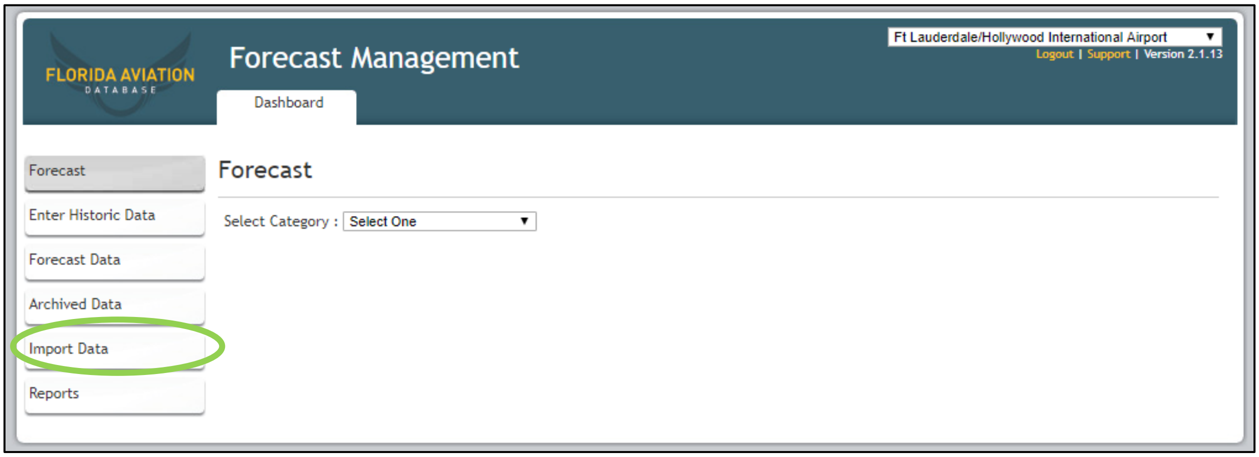
Archived Data

Data automatically archives from the Enter Historic Data tab to the Archived Data tab on an annual basis

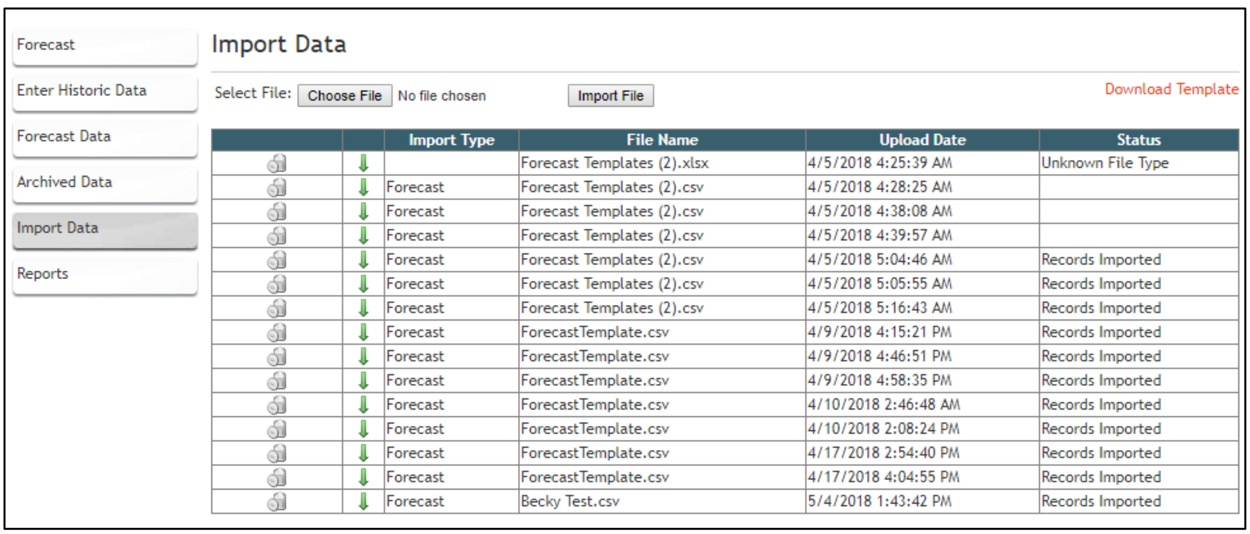
Year	GA Based Aircraft	GA Operations	Commercial Operations	Commercial Enplanements
1997	124	80,813	165,373	6,088,000
1996	124	75,198	161,144	5,543,683
1995	114	71,283	166,825	4,787,467
1994	173	69,742	163,302	5,240,910
1993	173	76,565	141,221	4,512,638
1992	173	75,898	128,285	4,109,796
1991	173	68,652	141,100	4,008,600
1990	375	71,238	152,882	4,426,430
1989	375	75,823	140,917	4,307,100
1988	329	83,496	139,719	4,337,560

View Import Data

a) Select the **Import Data** tab



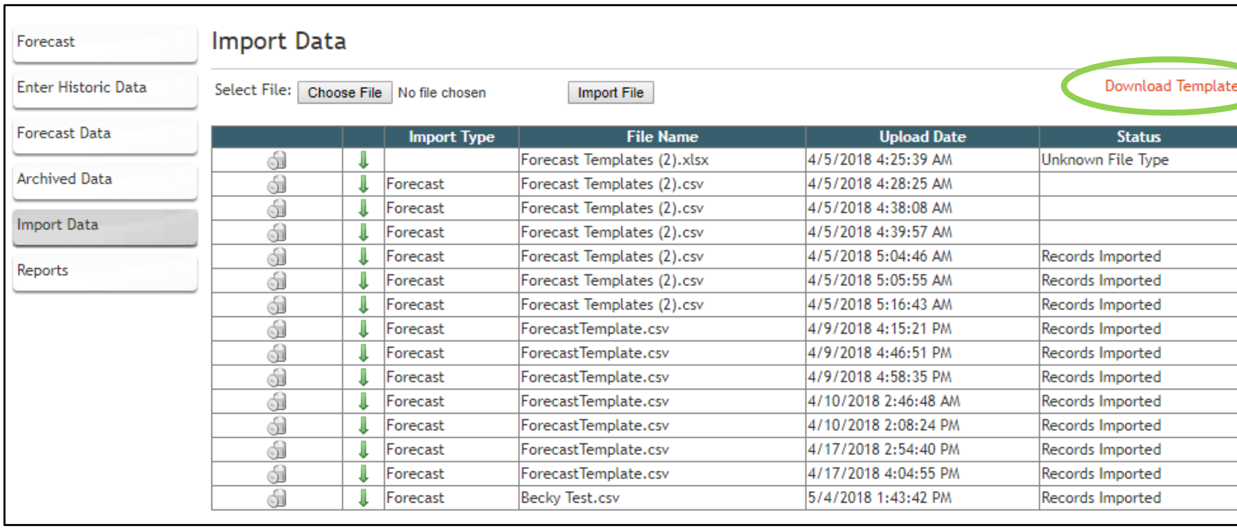
b) The **Import Data** will now display



		Import Type	File Name	Upload Date	Status
			Forecast Templates (2).xlsx	4/5/2018 4:25:39 AM	Unknown File Type
		Forecast	Forecast Templates (2).csv	4/5/2018 4:28:25 AM	
		Forecast	Forecast Templates (2).csv	4/5/2018 4:38:08 AM	
		Forecast	Forecast Templates (2).csv	4/5/2018 4:39:57 AM	
		Forecast	Forecast Templates (2).csv	4/5/2018 5:04:46 AM	Records Imported
		Forecast	Forecast Templates (2).csv	4/5/2018 5:05:55 AM	Records Imported
		Forecast	Forecast Templates (2).csv	4/5/2018 5:16:43 AM	Records Imported
		Forecast	ForecastTemplate.csv	4/9/2018 4:15:21 PM	Records Imported
		Forecast	ForecastTemplate.csv	4/9/2018 4:46:51 PM	Records Imported
		Forecast	ForecastTemplate.csv	4/9/2018 4:58:35 PM	Records Imported
		Forecast	ForecastTemplate.csv	4/10/2018 2:46:48 AM	Records Imported
		Forecast	ForecastTemplate.csv	4/10/2018 2:08:24 PM	Records Imported
		Forecast	ForecastTemplate.csv	4/17/2018 2:54:40 PM	Records Imported
		Forecast	ForecastTemplate.csv	4/17/2018 4:04:55 PM	Records Imported
		Forecast	Becky Test.csv	5/4/2018 1:43:42 PM	Records Imported

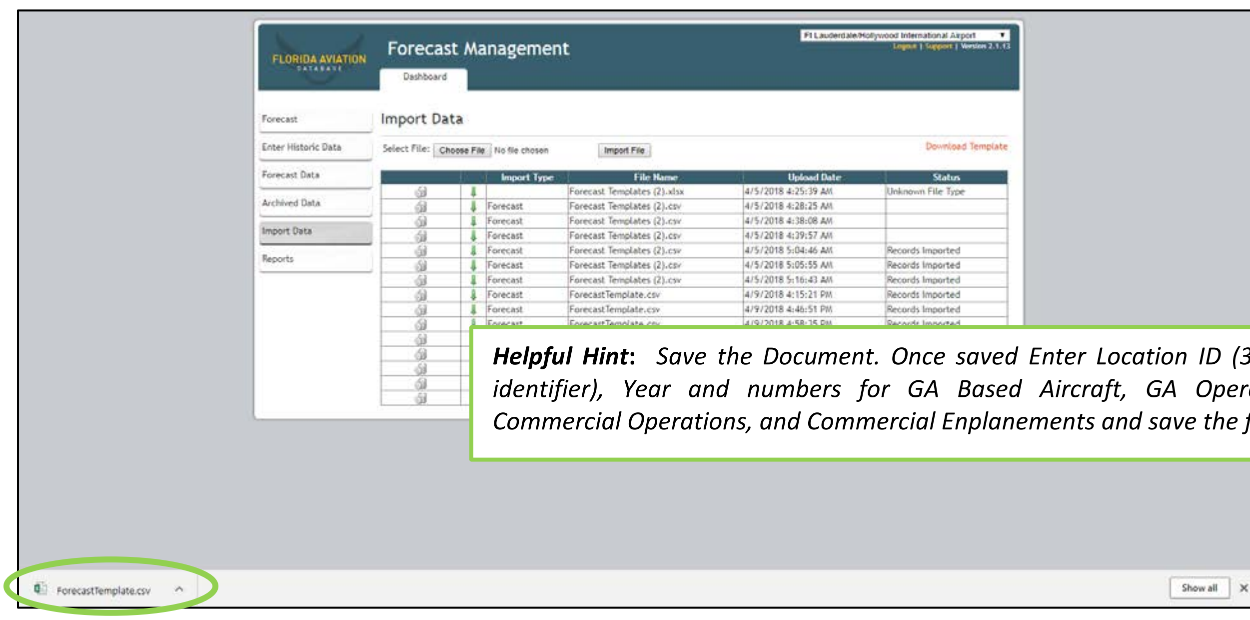
Bulk Import Data for Multiple Facilities

a) Select Download Template



		Import Type	File Name	Upload Date	Status
			Forecast Templates (2).xlsx	4/5/2018 4:25:39 AM	Unknown File Type
		Forecast	Forecast Templates (2).csv	4/5/2018 4:28:25 AM	
		Forecast	Forecast Templates (2).csv	4/5/2018 4:38:08 AM	
		Forecast	Forecast Templates (2).csv	4/5/2018 4:39:57 AM	
		Forecast	Forecast Templates (2).csv	4/5/2018 5:04:46 AM	Records Imported
		Forecast	Forecast Templates (2).csv	4/5/2018 5:05:55 AM	Records Imported
		Forecast	Forecast Templates (2).csv	4/5/2018 5:16:43 AM	Records Imported
		Forecast	ForecastTemplate.csv	4/9/2018 4:15:21 PM	Records Imported
		Forecast	ForecastTemplate.csv	4/9/2018 4:46:51 PM	Records Imported
		Forecast	ForecastTemplate.csv	4/9/2018 4:58:35 PM	Records Imported
		Forecast	ForecastTemplate.csv	4/10/2018 2:46:48 AM	Records Imported
		Forecast	ForecastTemplate.csv	4/10/2018 2:08:24 PM	Records Imported
		Forecast	ForecastTemplate.csv	4/17/2018 2:54:40 PM	Records Imported
		Forecast	ForecastTemplate.csv	4/17/2018 4:04:55 PM	Records Imported
		Forecast	Becky Test.csv	5/4/2018 1:43:42 PM	Records Imported

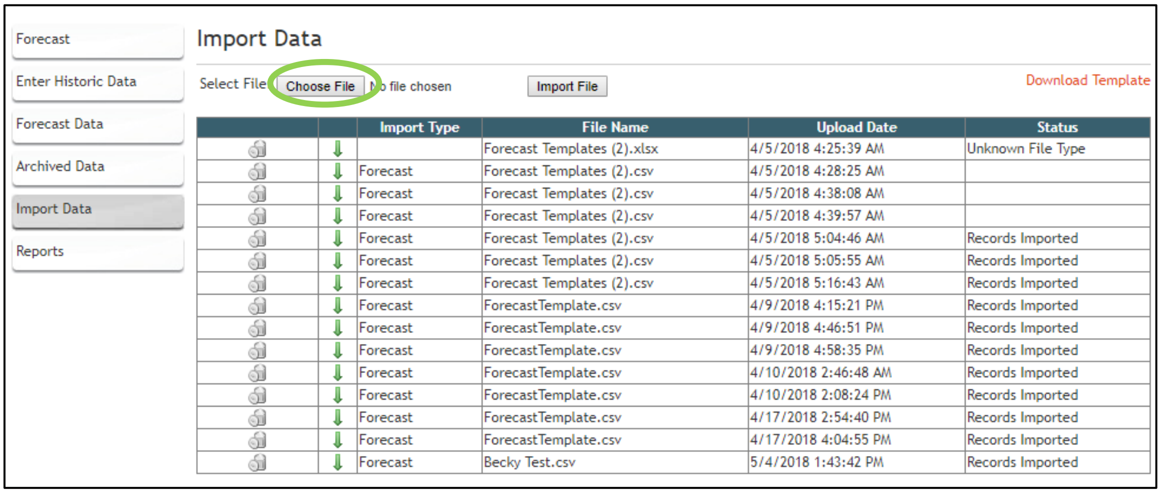
b) The Download Template will display where your computer is set to download



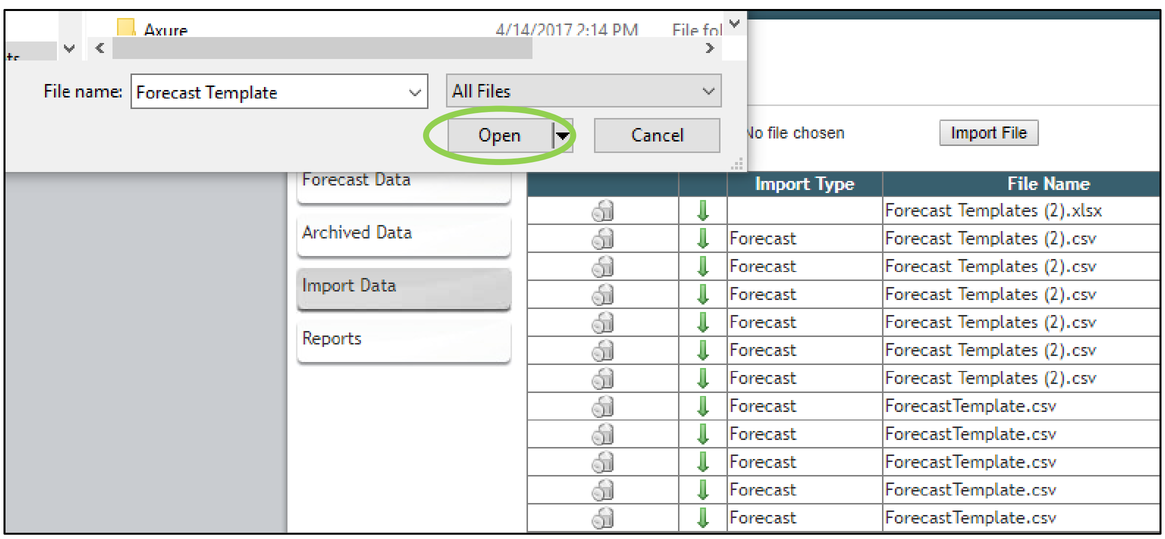
***Helpful Hint**: Save the Document. Once saved Enter Location ID (3 letter identifier), Year and numbers for GA Based Aircraft, GA Operations, Commercial Operations, and Commercial Enplanements and save the file.*

Import the Completed Download Template

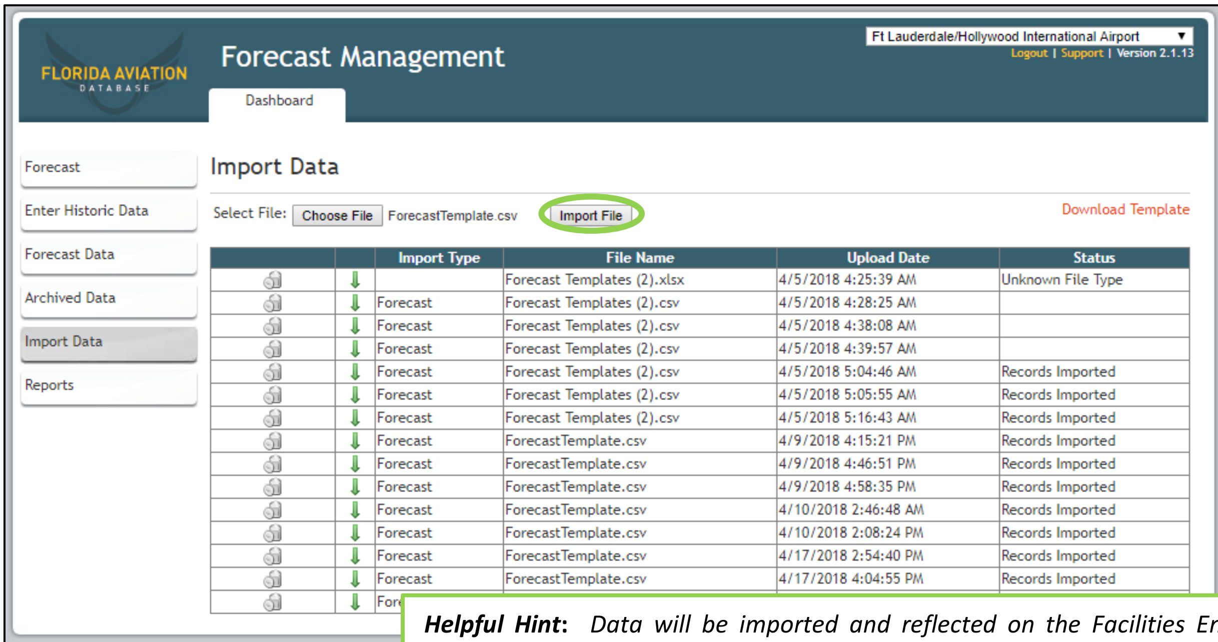
a) Choose File



b) Select the File that needs to be imported and Select **Open**



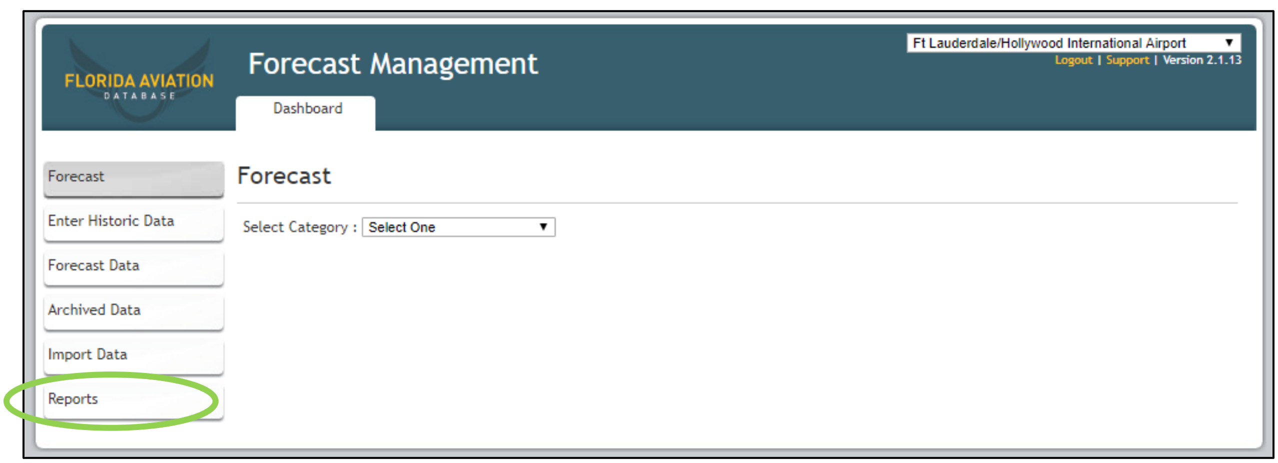
c) Select **Import File**



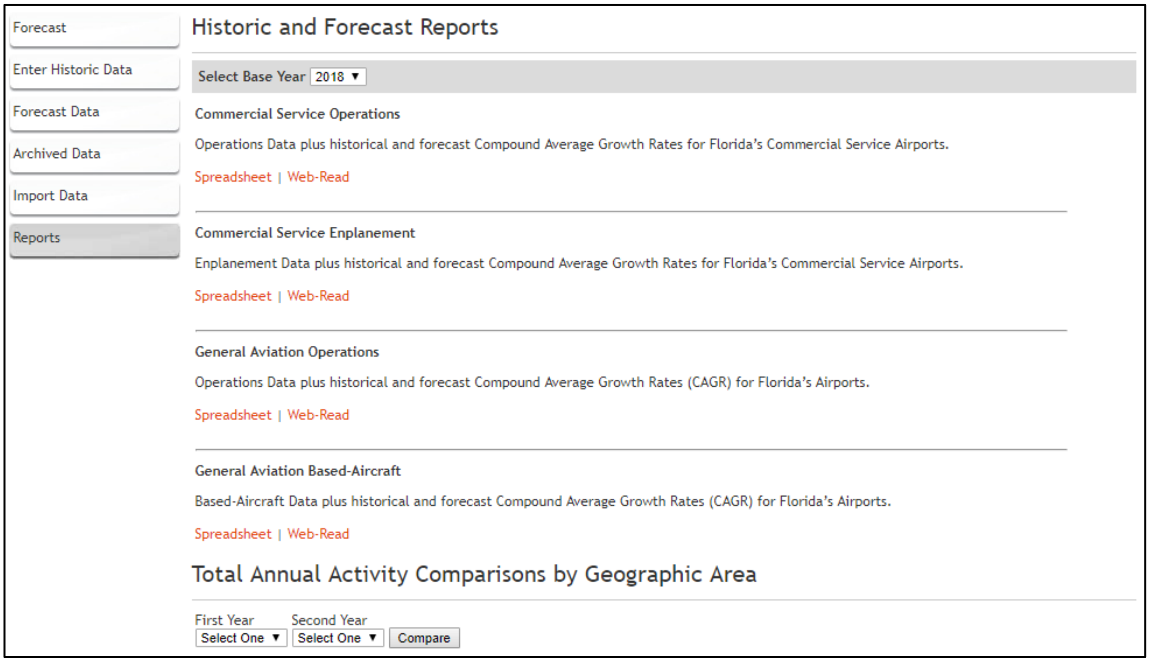
Helpful Hint: *Data will be imported and reflected on the Facilities Enter Historic Data tab.*

View Reports

a) Select the **Reports** tab

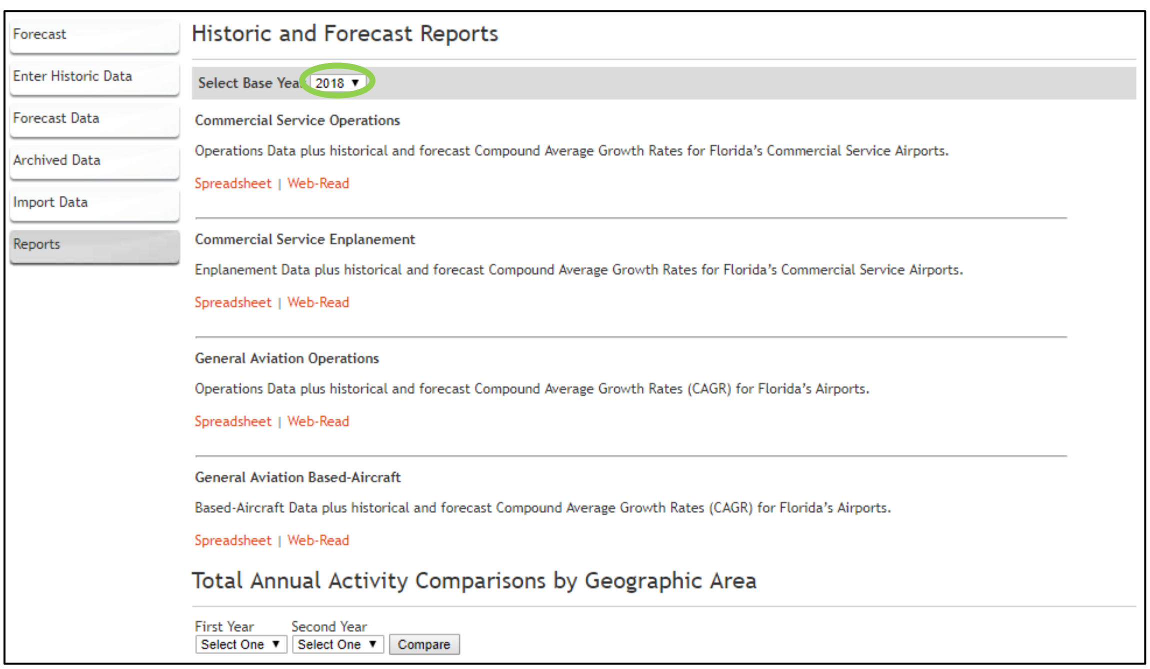


b) Historic and Forecast Reports will display

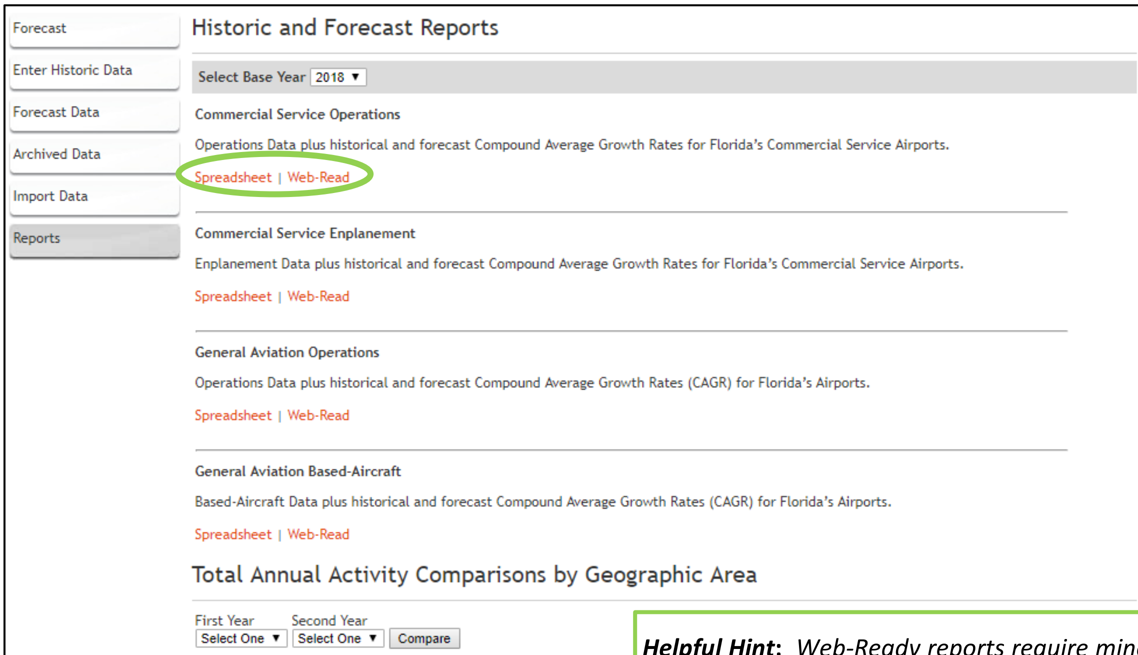


Run Report

a) Select Base Year



b) Then Spreadsheet or Web Ready



Helpful Hint: *Web-Ready reports require minor formatting before being converted to pdf.*

6. Project Summary

Forecasts of future levels of aviation activity are critical in making effective decisions related to airport grant funding and aviation project planning. Forecast projections assist in determining the need for new or expanded facilities. The objectives of the project was to develop new methodologies for airport aviation activity forecast and update the existing Florida Aviation Database (FAD) aviation activity forecast tool with the new advanced forecast methodologies. Based on the review of existing methodologies and analysis of their advantages and disadvantages, the autoregressive integrated moving average model (ARIMA) and the Monte Carlo simulation-based method were used, and corresponding automatic forecasting algorithms were developed.

Forecasting results using both the existing user growth rate method and two new methods were presented on passenger enplanements and aircraft operations at two commercial service airports, Orlando-Melbourne International Airport (MLB) and Jacksonville International Airport (JAX), and aircraft operations and based aircraft at two general aviation airports, Ormond Beach Municipal Airport (OMN) and Flagler Executive Airport (FIN).

The forecasting methods have been included in the Florida Aviation Database Forecasting Module. The module has also been updated to make the data input more automatic and interfaces more user friendly. A comprehensive user manual was prepared and included in the report to provide a step-by-step guide of how to use the module. With the updated forecast methodologies, it is expected that the tool can provide greater insights to support FDOT personnel when making financial and resource allocation decisions.

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