Forecasting for Airport Planning

Linda Perry
Associate Director, Jacobs Consultancy
linda.perry@jacobs-consultancy.com
Agenda Outline

- The Aviation Forecasting Process
- Forecast Uncertainty
- Derivative Forecasts
Top 10 Forecasting Tips

1. Transparency rules.
2. Uncertainty is for wimps.
3. Optimism bias is highly over-rated.
4. My other analytical tool is a hammer.
5. The window to the future is clouded by the past, seriously.
6. The details are the devil.
7. Scenario me this…
8. Unpredictability = job security for forecasters
9. An econometric model is like a wedding dress…it can only be used once.
10. There are no facts about the future.
The Aviation Forecasting Process

The key elements, decisions and input for preparing forecasts for planning

1. Data Collection
   - Review of existing forecasts
   - Collect aviation and socioeconomic data
   - Identify key issues/trends
   - Obtain input from key stakeholders on key issues/trends

2. Use of Analytical Tools
   - Trend analysis
   - Market share forecasting
   - Econometric analysis
   - Probability (risk) analysis
   - Choice analysis

3. Supplemental Analyses
   - Airport Role
   - Market-Level Analysis
   - Connecting hub
   - International gateway

4. Select Final Model

5. Define Forecast Scenarios

6. Annual Demand Forecasts
   - Enplaned passengers
   - Air cargo

7. Translate Annual Demand Forecasts into Aircraft Operations
   - Enplaned passenger load factor
   - Average seats per departure
   - Enplaned cargo per departure
   - Aircraft fleet mix

8. Finalize Forecast Scenarios for Airport and FAA Approval

9. Prepare Derivative Forecasts
Data Collection

Where do you start?

• **Review of Existing Forecasts**
  – Planning forecasts from the last Master Plan, other planning efforts, and/or financial studies
  – Current FAA TAF

• **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 (Partial List)**
  – Aircraft capacity (seats)
  – Aircraft technology
  – Airline consolidation/merger
  – Airline travel substitutes (e.g., 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
Use of Analytical Tools

What tools do you use?

- **Trend Analysis**
  - Average annual growth rates calculated for aviation activity and related factors
  - Historical relationships assumed to continue in the future
  - No modeling of causal relationships

- **Market Share Forecasting**
  - Aviation activity is calculated as a share of state, regional, or national activity
  - Independent forecasts of aggregate activity needed

- **Econometric Models**
  - Equation defines causal relationships between aviation activity and socioeconomic, airline travel cost, service, and other factors
  - Independent forecasts of causal factors needed

- **Probability (Risk) Analysis**
  - Expresses the probability that a certain level of aviation activity will occur

- **Choice Analysis**
  - Models to generate trip generation and distributions and mode choice

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**TREND ANALYSIS**

Average annual growth rate = 3.0%

**REgression Analysis**

\[ y = 1.08 \ln(\text{Income, 2008 dollars}) - 0.55 \ln(\text{Yield, 2008 dollars}) - 0.30 \text{Dummy variable for post 2001 period} - 2.95 \]
Supplemental Analyses

*What else do you consider?*

- **Airport Role**
  - Primary airport in region or state
  - Part of a multi-airport region
  - Origin-destination airport vs. connecting hub
  - International gateway
  - Recent service changes
- **Market-Level Analysis**
  - Bottom-up analysis of passengers, service, and yield
  - Implications of mature and dominant markets
  - Potential for new markets
- **Connecting hub**
  - Share of connecting passengers
  - Airport role in hubbing airline network
  - Flow of connecting passengers
- **International Gateway**
  - Share of international passengers and airline service by world region
  - Industry forecasts of aviation activity by world region (e.g., Airbus, Boeing, FAA)
  - Mix of U.S. and foreign-flag airlines
Select Final Model

What criteria do you use to select the final model or forecast method?

Decisions are inter-related

4. Select Final Model

Potential Criteria for Evaluating Alternative Models
- Reflects relevant aviation and socioeconomic variables
- Based on appropriate historical period
- Model demand elasticity values are consistent with accepted values
- Statistical significance of model coefficients
- Model structure allows for flexibility in testing scenarios

5. Define Forecast Scenarios

Key Inputs (Examples)
- Expected range of socioeconomic values
- Expected range of the price of oil
- Expected range of the cost of travel
- Expected range of additional travel costs associated with climate change
How do you define a forecast scenario?

- Selected forecast method or model may drive how forecast scenarios are defined
- Potential forecast scenario definitions
  - Variations in average annual forecast growth rates
  - Percent difference from a baseline or most likely forecast
  - Variations in the forecast values of the causal variables such as income, yield, or fuel costs
  - Probability distributions of the causal variables to quantify the likelihood of future values
  - Airline service related scenarios
  - Connecting hub scenarios
Prepare Annual Demand Forecasts

How do you present the forecasts?

• Planning period
  – Typically 20-year forecast in 5 year increments
  – Forecasts extending beyond 20 years may be needed for long-range planning

• Disaggregate aviation demand
  – Domestic and international
  – Mainline and regional affiliate
  – U.S. flag and foreign-flag airlines
  – Originating and connecting
  – Enplaned and deplaned cargo
  – Freight and mail
  – All-cargo, integrated, combination, and passenger airlines (belly-cargo)

• Calculate average annual forecast growth rates

• Graph the forecast results

• Compare with other forecasts (e.g., previous planning forecasts, FAA TAF)
Translating Passenger Forecasts into Operations

1. Enplaned Passenger Forecasts
   (Domestic and international, mainline and regional affiliate)

2. Forecast Assumptions
   - Average seats per departure
   - Enplaned passenger load factor

3. Calculate Enplaned Passengers per Departure
   (Seats per departure x load factor)

4. Derive Passenger Airline Aircraft Departures
   (Enplaned passengers / Enplaned passengers per departure)
Total Aircraft Operations Forecasts

1. Aviation Demand Forecasts

2. Passengers
- Disaggregate total passenger demand into components (domestic and international, air carrier and regional affiliate)
- Evaluate and make future assumptions about average aircraft size by type
- Evaluate and make future assumptions about load factors (percent of occupied seats, on average)

3. Cargo
- Disaggregate total cargo demand into components (domestic and international, freight and mail, passenger and all-cargo aircraft)
- Evaluate and make future assumptions about average aircraft size by type
- Evaluate and make future assumptions about average cargo per operation by type

4. General Aviation Aircraft Operations
- Assessment of general aviation aircraft fleet (present and future)
- Evaluation of local and itinerant activity
- Consideration of other general aviation airports in region

5. Military Aircraft Operations
- Identification of military fleet (present and future)
- Understanding of daily operations (sorties)
- Input on range of potential future activity

6. Total Aircraft Operations Forecasts

7. Future Planning Schedules
How do you obtain FAA approval of the forecasts?

FAA Forecast Guidance*

- For large, medium, and small hub airports, locally developed forecasts for operations, based aircraft, and enplaned passengers are considered consistent with FAA’s Terminal Area Forecasts (TAF) if they meet the following criteria:
  - Forecast differs by less than 10 percent in the 5-year forecast period and 15 percent in the 10-year period, or
  - Forecast activity levels do not affect the timing or scale of an airport project.
- In order to facilitate the process of approving a forecast, the FAA also suggests completion of a template which covers the key forecast elements and calculates the percentage differences between the airport planning forecast and the TAF.
- Allow time (30 to 45 days) in the project schedule for FAA approval of the forecasts.

There are no facts about the future

- Historical data may not fully reflect all the relevant factors that will influence demand in the future.
- Independent forecasts of causal variables such as population and income are uncertain.
- Unpredictability of external events (e.g., wars, biological events, economic crises)
- Consider uncertainty in preparing forecasts
  - High, Low, and Baseline Range
  - Scenario-based Methods
  - Probabilistic forecasts
A derivative forecast relates to the annual forecasts

- Peak Month (percent of annual)
- Average Day Peak Month (ADPM)
- Average Annual Day (AAD)
- Future Schedules (starting with base year matched schedule)
- Aircraft Fleet Mix
- Day/Night Operations By Stage Length (profile)

1. Annual Passenger Airline Operations Forecasts
2. Peak Month (Percent of annual operations)
3. Average Day Peak Month (ADPM) (Peak Month / # Peak Month Days)
4. Design Day Schedule Operations (Control total for future schedule)
Future Schedules for Planning

What is an airline schedule?

• A Market Assessment
  – Airline service by region reflects market size, communities of interest, and flow of passengers

• An Airline Business Plan
  – Service to markets reflects airline hubs or focus cities, the role of an airport in an airline’s system, and how an airline moves passengers through its system to their destination

• An Airport Facility Tool
  – Provides the day-to-day mechanism for planning time of day and level of activity considerations that relate to gate, terminal, runway, roadway and other airport usages.
Future Schedules

An illustration of future schedule activity levels over the course of a day

TOTAL AIRPORT ROLLING HOUR COUNTS

Rolling Hourly Operations (60 minute look ahead)

0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00

700 Ops 750 Ops 800 Ops

Arrivals

Departures
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Thank you for your attention