Air Travel Itinerary and Booking Choice Models

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Outline

- Introduction: Airline industry
- Motivation: Understanding air travel behavior
- Sample research Issues
- Sample Methods
- Outcomes
Introduction

Airline industry: A changing phase

- Increased fuel costs
- Government regulations and security issues
- Changing consumer behavior and expectations
- Focus on passengers and their travel experience
- Stiffening competition
  - Among the larger airlines
  - Due to low cost carriers
Focus on profitability through appropriate service-enhancement, marketing, scheduling, operation, and revenue management strategies, including decisions on:

- Itinerary scheduling
- Route allocation
- Number of over bookings
- Marketing strategy
  - Increasing loyalty among existing customers
  - Attracting new customers
  - Improving overall travel experience (from booking and boarding to baggage handling and arrival) through service enhancements
- Fleet size

Means: Understand air travel behavior
Why Understand Air Travel Behavior?

- Understand consumer preferences
- Understand the increasingly competitive airline market
- Better predict air travel demand
- Design appropriate marketing strategies and pricing schemes
- Formulate cost effective service-enhancement strategies
- Evaluate and design new services, schedules, route plans, and pricing schemes
- Make appropriate revenue management decisions to increase the yield
- In all, most marketing, scheduling, operation, and revenue management decisions involve a clear understanding of air travel behavior.

(See next page)
Pricing and marketing
- Fare level, fare policies and restrictions, and promotional offers
- Market targeting and service positioning strategies

Booking revenue management
- No of seats to be made available by fare class
- Overbooking decisions

Schedule planning
- Time table planning
- Decisions on frequency of flights, departure/arrival times

Route allocation and fleet assignment
- Decisions on number of stops and connections
- Network level route decisions

Fleet size decisions
- Number and types of aircrafts to operate, acquire, and decommission

Short term

Long term
What is Air Travel Behavior?

- Marked by passengers’ *choices* pertaining to air travel

- A multitude of choice dimensions
  - Whether to fly or not?
  - Where to fly from and where to fly to?
  - Which airline to fly with?
  - How, when, and where to make the air ticket purchase?
  - When to fly? Which itinerary to choose? and what route to take?
  - The decisions to reschedule, cancel, stand-by, or no-show
  - and so on...

- Complex inter-dependencies among the choice dimensions
Dimensions of Air Travel Choice

Dimensions of Choice
- Origin city and/or airport choice
- Destination city and/or airport choice
- Airline/carrier choice
- Fare class choice
- Frequent flyer membership choice
- Booking mode (travel agent, online) and timing
- Itinerary choice (stops/connections/route, departure time/arrival time)
- Cancellation/re-scheduling behavior
- Standby and no-show behavior
- Ground access/egress mode choice, parking choice

Each of these dimensions can be modeled as a choice
Models of Air Travel Choice Behavior

Models of potential use for airlines: Itinerary choice models and booking models

**Itinerary choice models**

- Origin/destination city/airport choice models
  - To determine which cities and airports to operate from
  - To determine the extent of presence in each airport
  - To assess the importance of flight availability, flight frequency, and accessibility to the airport, and the potential market share for new airports

- Airline/carrier choice models
  - To understand the nature of competition from other airlines, and the importance of the market presence, price structure, schedule convenience, and customer loyalty to the airline.

- Models of itinerary choice
  - To assess the importance customers attach to flight level of service, number of stops, connection quality, departure/arrival time, price, travel time, and many other in-flight service attributes
  - To predict the demand on each itinerary, that can be used in schedule planning, and route allocation
  - To identify, prioritize, and evaluate service-enhancements, and to formulate
Booking Models

- Models of fare class choice and frequent flyer membership
  - Useful to design strategies for market positioning strategies, new customer attraction, and customer retention.

- Models of booking mode and timing
  - Useful in decisions on seat allocation (by fare class), and timing of seat availability and price changes at various booking channels, and in formulating marketing strategies

- Models of cancellation, rescheduling, no-show and stand-by behavior
  - Useful to update the predicted travel demand, and update the seat allocation decisions
  - To determine the number of over bookings

Overall, help the airline sell the *optimum number of seats at appropriate timing*
Westerhof’s (1998) Cancellation Model

- **T** (Departure date)
- **T-1**
- **1**
- **0** (No-shows)

- **New bookings**
- **Surviving bookings**
- **Cancellations** $XX_T$
- **Cancellations** $XX_{T-1}$
- **Cancellations** $XX_1$

- **Total flown**
Predict new bookings (for each point in time) by fare class

Predict new cancellations (for each point in time) by fare class

Update predictions on the number of no-shows

• Apply models of cancellation timing and no-show behavior to each of the existing bookings to predict new cancellations and no-shows

• Wrong cancellation and no-show forecasts may lead to unsold seats or denied boardings

at each check point in time

use current bookings & cancellations data to:

and update seat availability decisions
Research Issues

Formulate and estimate discrete choice models of *itinerary choice* to:

- Examine customers’ sensitivity and response to different services and amenities
- Evaluate currently available travel packages and service characteristics
- Better predict passenger demand for new routes, and/or services
- Predict the effectiveness of, and design the best of, new travel and service packages
- Prioritize service enhancements under budget constraints
- Design targeting and positioning strategies to promote market share
Objectives...

- Formulate and estimate models of **booking behavior** (including booking class, frequent flyer membership, rescheduling, cancellation, and no-show behavior) to:
  - Design customer attraction and retention strategies
  - Assist in predicting the demand for each itinerary and fare class
  - Predict how many cancellations and refund exchanges at each point in time, for each flight
  - Predict the number of no-shows for each flight
  - Predict the temporal trend in the demand for each flight
  - Assist the revenue management decisions pertaining to seat allocation (and corresponding timing), and number of over bookings
Objectives...

- Augment the air travel data available with airlines with data from other sources
- Provide specifications of air travel behavior models for use by Airlines
- Undertake trade-off analysis and willingness to pay (WTP) analysis for various service enhancements
- Formulate forecasting procedures
- Demonstrate the use of forecasting results for use in service enhancement prioritization, pricing policy analysis, scheduling, and seat allocation timing decisions
Methods

- Traditionally used models
  - Simple probability and time series models using aggregate data
  - Highly simplistic, heavily aggregated, strong assumptions, lack of behavioral realism

- Use of **discrete choice and other econometric models**
  - Potentially large number of applications, with potentially high returns, in:
    - Air travel demand prediction
    - Airline revenue management
    - Air pricing policy evaluation and fare structure design
    - Marketing strategy development
    - Airline schedule planning, fleet assignment and route allocation
  - Advantages: Behavioral foundation and the disaggregate nature of analysis
Methods that may be Used

- Econometric models of air travel behavior
  - Standard and advanced discrete choice models, including the Mixed Logit model, Generalized Extreme Value (GEV) model, and Multiple Discrete-Continuous Extreme Value (MDCEV) model
  - Hazard-based duration models

- Methodological issues to be considered
  - Variations in behavior across different customers due to observed and unobserved factors
  - Interdependencies among various choice dimensions
  - Endogeneity of fare class choice and frequent flyer choice
  - Choice set considerations

- Trade-off analysis, and willingness to pay (WTP) analysis

- Forecasting and microsimulation methods to be used for service-enhancement prioritization, seat allocation, and pricing strategy analyses
Outcomes: Address the Following Questions

- What are the most important travel and service characteristics that customers associate with?

- How much are customers willing to pay for improvements in:
  - Flight level of service (total travel time, number of stops)
  - Connection quality (reduction in connection delays, waiting time etc.)
  - Reduction in departure/arrival time delays and other schedule delays
  - Flight frequency
  - In-flight services
  - Aircraft attributes (air craft type, seating configurations, and equipment)

- How much are customers willing to trade-off one service enhancement to the other?

- How many seats to make available for each booking class, and when to make them available?

- How many over bookings are to be made?

- What is the revenue impact of: (1) a service enhancement, and (2) a seat allocation plan?
Thank You!

Questions/Comments Most Welcome
Other Data Sources

- Official Airline Guide (OAG)
  - Average fares by carrier across all itineraries for each airport pair

- US DOT Data (OD Data bank)
  - Based on 10% sample of flown tickets
  - Passenger counts and quarterly average price by each itinerary between OD pairs

- “Superset” data - Data Base Products Inc.
  - Cleaned version of the OD data bank

- Airlines Reporting Corporation (ARC) Data
  - Individual-level ticket transaction (purchase, refund etc.) information