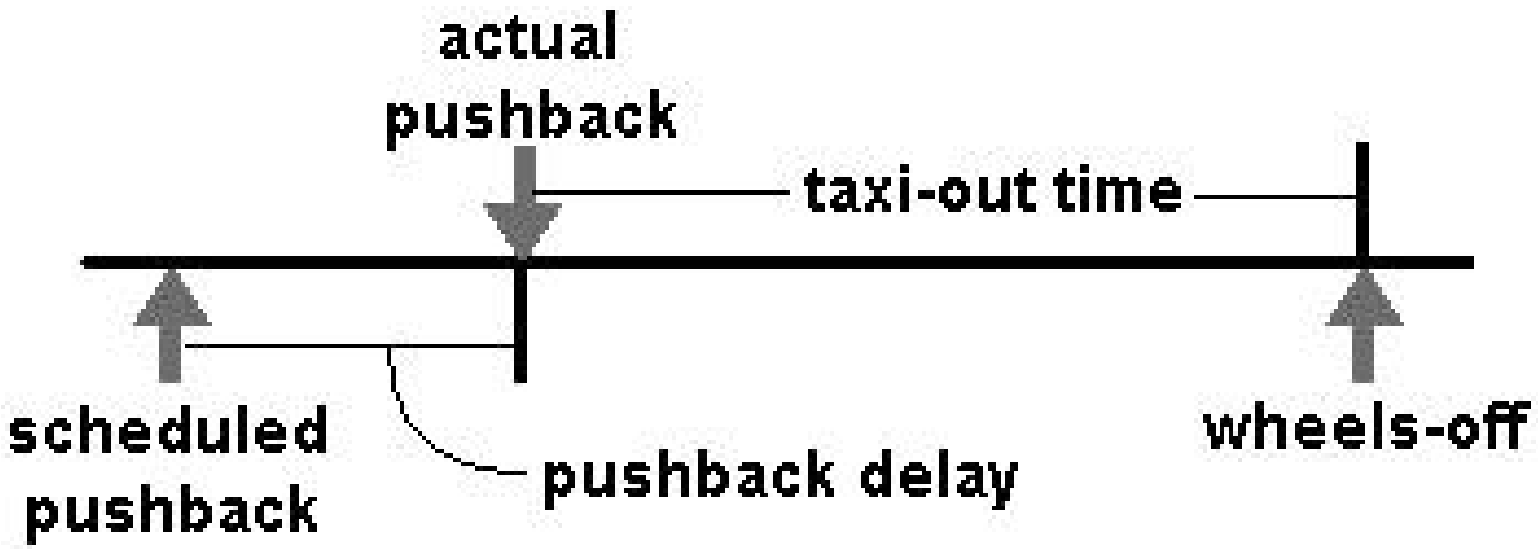
Taxi Time Prediction for CDM

Laura Kang
John-Paul Clarke
Massachusetts Institute of Technology
International Center for Air Transportation

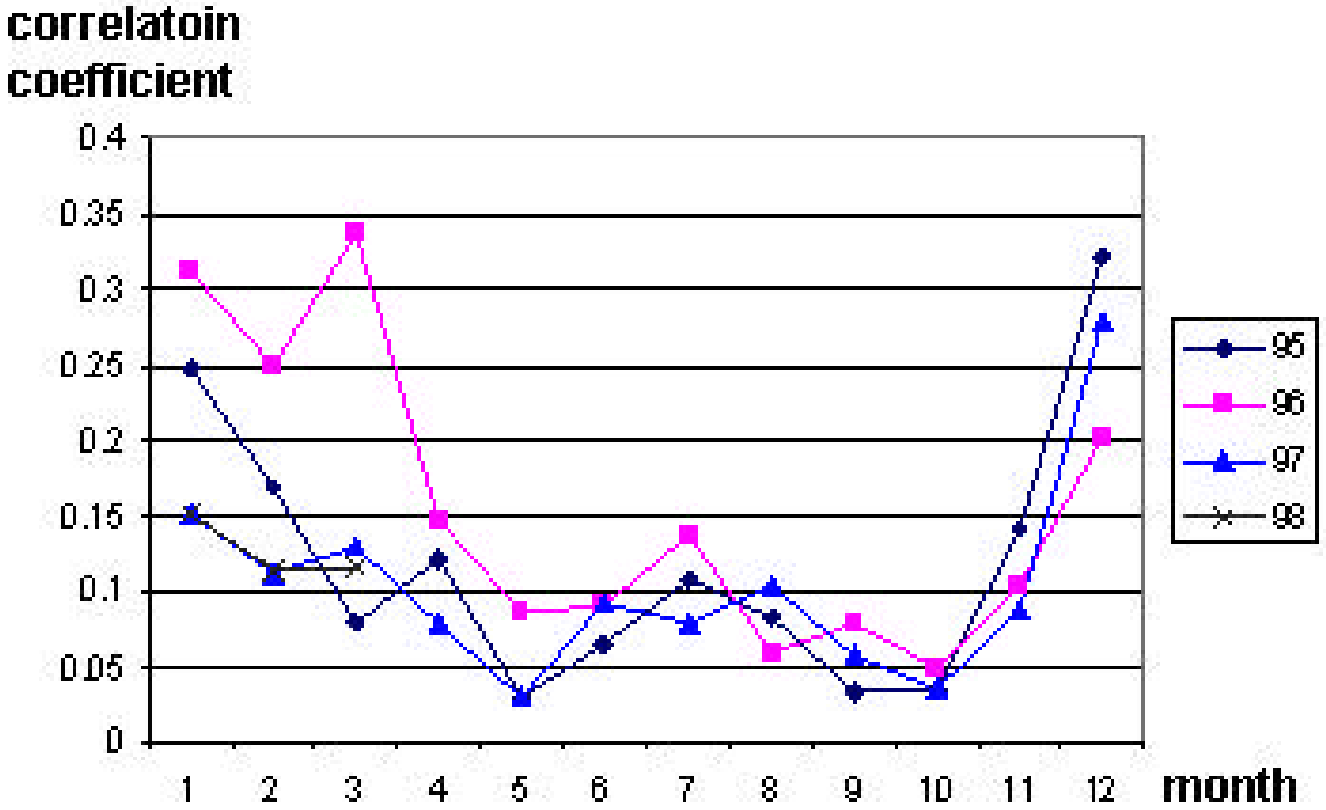
Introduction

- **Airline operations contribute to taxi delays**
  - **Hub complexes create peaks in the demand for ATC services**
  - **Congestion impacts surface operations**
  - **Significant variation in taxi time**
- **Taxi out time uncertainty creates uncertainty in arrival time estimates**
- **Results in inaccurate estimates of arrival demand**
  - **Unused capacity**
- **Need to improve taxi time estimates at congested airports**

Definitions



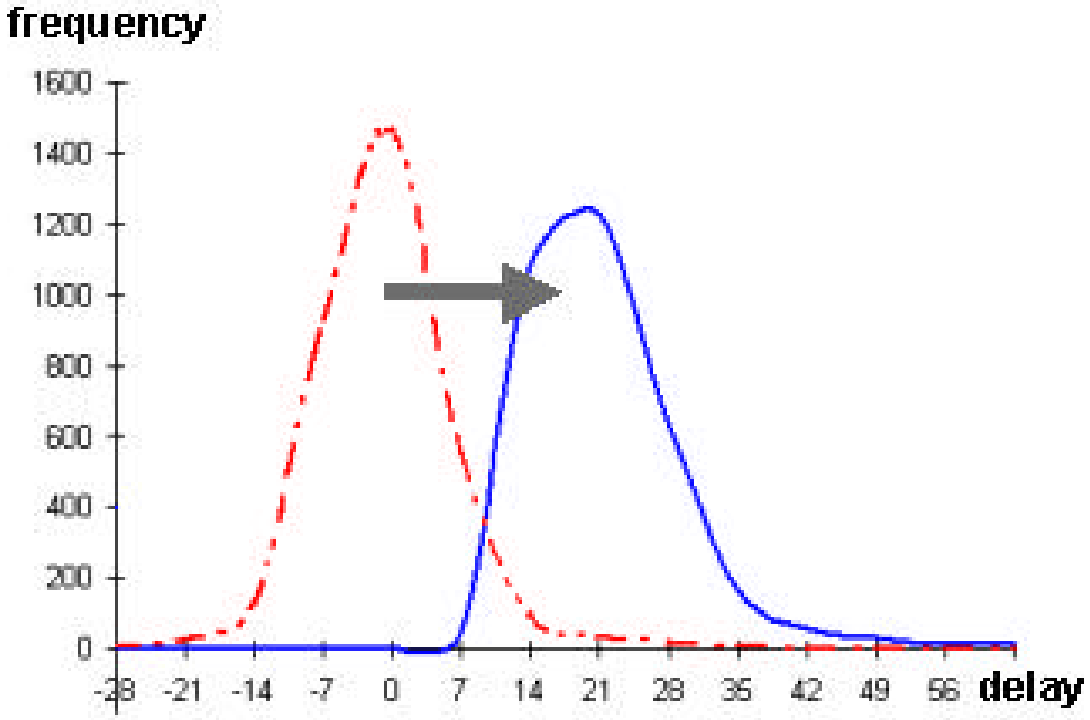
Pushback-Taxi Time Correlation



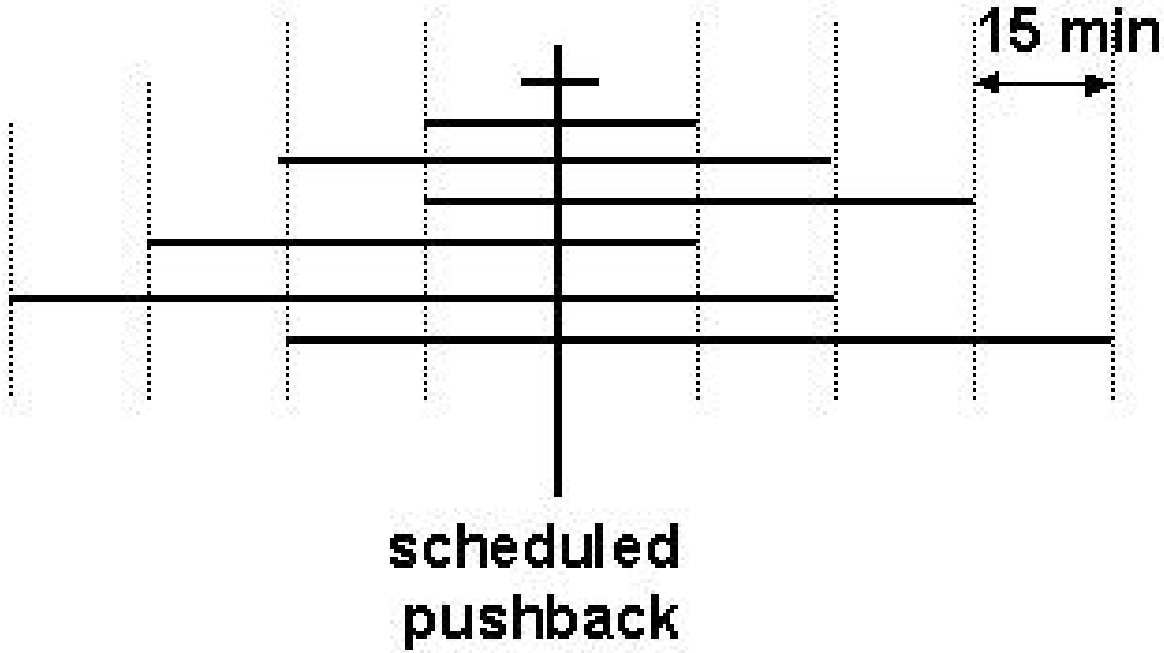
Factor Analysis

- **Approach**
  - Stepwise selection
- **Factors**
  - Airline
  - Terminal
  - Time of day
  - Day of week
  - Fleet information
  - Departure and arrival traffic
    - 10, 30, 60 and 90 minutes time windows which can represent all traffic at, before and after the scheduled pushback time
  - Weather
    - 7 categories of weather reported in the Boston Globe

Model


frequency
1600
1400
1200
1000
800
600
400
200
0
-28
-21
-14
-7
0
7
14
21
28
35
42
49
56
delay

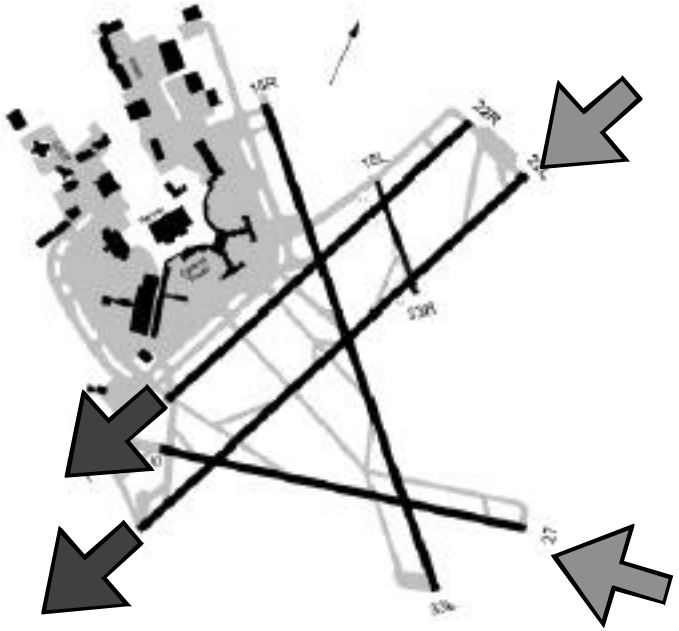
Time Windows



BOS Case Study

- **Airport with significant taxi out times**
- **Distinct configuration characteristics**
- **Convenient**
  - **Close**
  - **Data available**
- **Impacted by weather**
  - **Time of year effects**

Case 1: July 1998; 27-22L/22L-22R



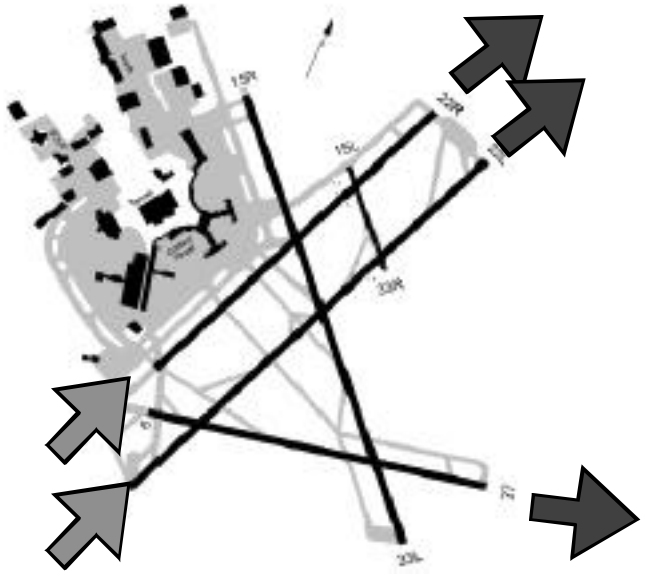
Arrival

Departure

Case 1: Key Factors

- Terminal
- Weather
- Number of airplanes scheduled to be pushed back in 10 minute time window
- Traffic at the other terminal in larger time windows

Case 2: July 1998; 4L-4R-9/4L-4R



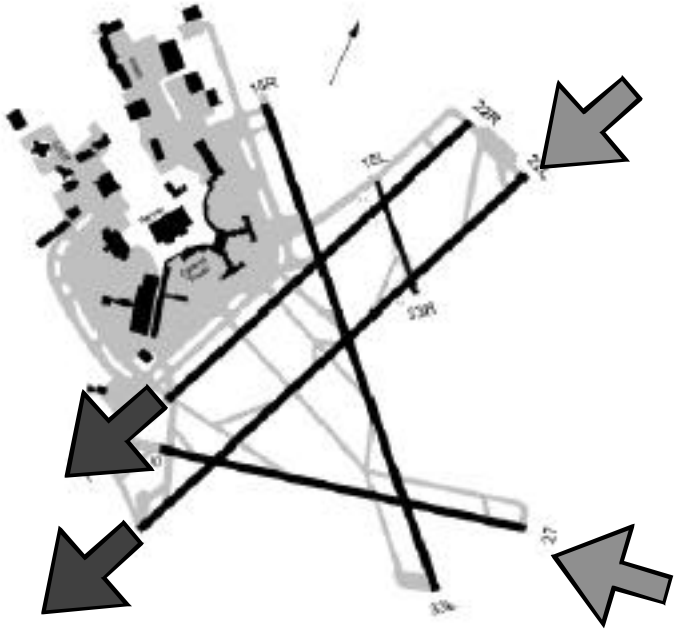
Arrival

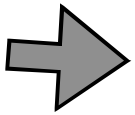
Departure

Case 2: Key Factors

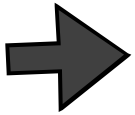
- Airline
- Terminal
- Day of week.
- Traffic at terminal C
  - Terminal C (at the center of the primary taxiways) could create bottleneck for other terminals
  - Aircraft scheduled to be pushed back from terminal E take longer to taxi out because terminal E is the farthest terminal from the departure runways and because these aircraft must taxi past terminal C

Case 3: January 1998; 27-22L/22L-22R





Arrival

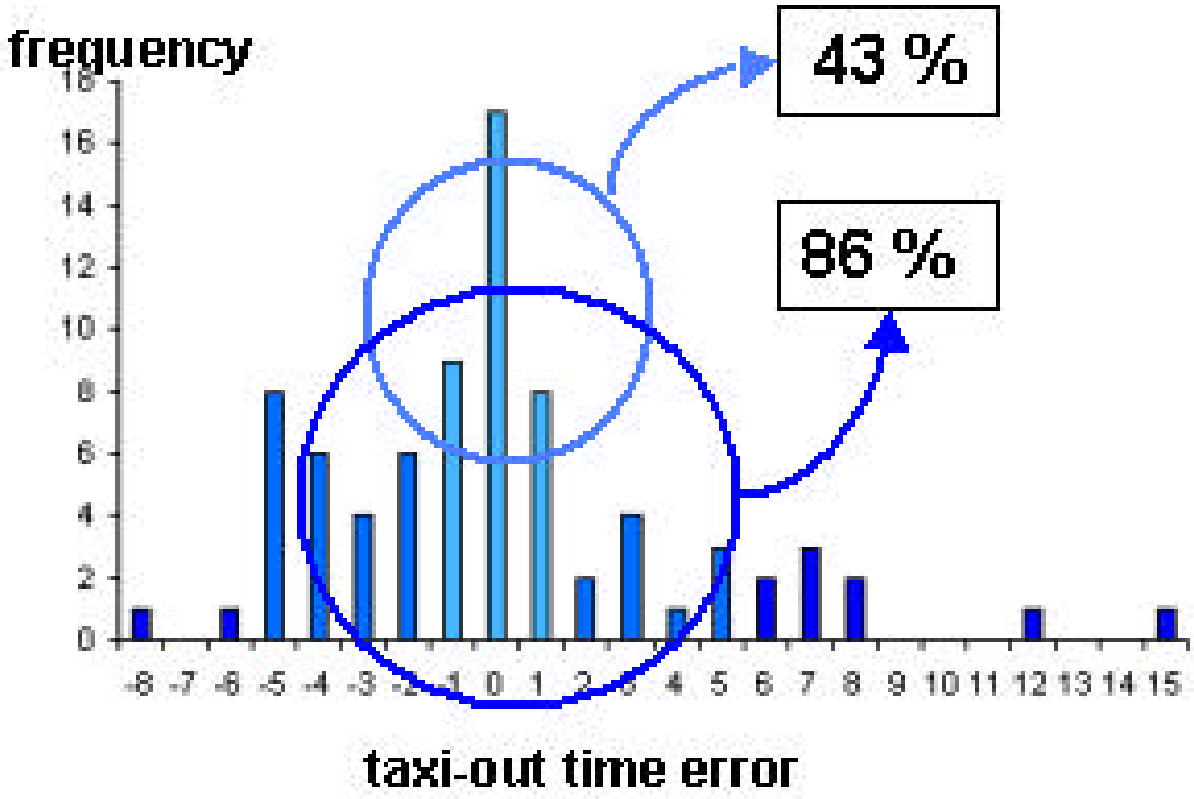


Departure

Case 3: Key Factors

- Fleet type
- Weather
- Long-term traffic demand
  - Traffic demand at terminal C is the most important
  - Traffic demand at terminal A is the least important

Comparison of Model to Actual Data



Summary

- Taxi out time uncertainty creates uncertainty in arrival time estimates
- Results in inaccurate estimates of arrival demand
- Need to improve taxi time estimates at congested airports
- Factor analysis model used to determine key factors that affect taxi out time
- Favorable comparison of model to actual data
  - 43% less than or equal to 1 min error
  - 86% less than or equal to 5 min error