

Update: Robust Scheduling and Modeling of Airline Capacity Reductions

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MIT IAB November 2008



Overview

- Review of robustness in airline planning
 - Problem motivation
 - What we'd done before
 - Your feedback
 - Our revised results
 - New ideas?
- Introduction to new research analyzing impact of capacity reduction
 - What role should we be playing in policy discussions? Who should the collaborators be?

Motivation for Robust Scheduling

- Delays are bad. And frequent.
- Lots of causes that are difficult to control (e.g. weather, air traffic control, mechanical)
- But many delays are caused by other delays – propagation from upstream delays, due to network effects
- Fundamental conflict – planning metrics discourage slack but slack is essential to stop delay propagation

Challenges

- How much extra *planned* cost should we incur to reduce *potential* delay costs in operations?
- How do we *measure* robustness?
- How do we *value* robustness?
- How do we *achieve* robustness?

Our Initial Approach

- Can we side step some of these challenges, at least for now?
- Try to improve operational robustness without increasing planned costs
- How? Redistribute existing slack to places where it has greatest benefit
- Keep crew, routing assignments unchanged
- Limit time windows to maintain demand

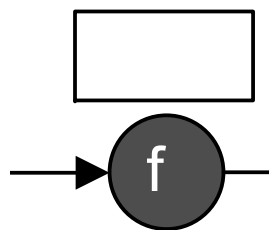
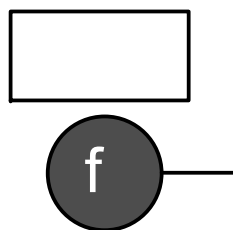
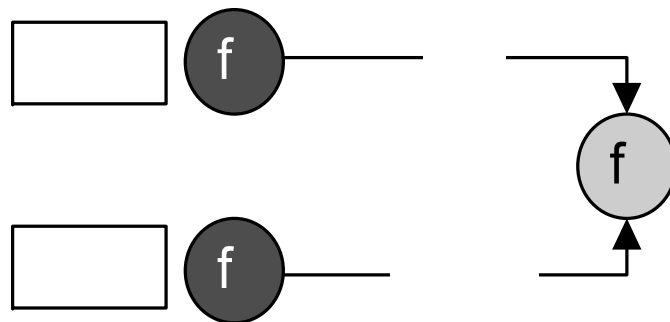
Results

Data Set	Duty Restrictions	Single-Layer Model	Multi-Layer Model
1	0	6.3%	7.2%
1	5	23.0%	27.4%
1	10	33.6%	40.9%
1	15	41.5%	51.0%
2	0	5.3%	5.8%
2	5	23.5%	27.3%
2	10	34.4%	41.5%
2	15	43.1%	52.2%

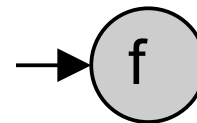
Your Concerns

- Our surrogate metric for robustness is the sum of expected delay minutes across all *independent* root delays, viewed individually
- Of course, delays don't happen one-at-a-time
- We sometimes over-count (both in the original and “optimized” schedule)
- We sometimes under-count (both in the original and “optimized” schedule)

Simultaneous Disruptions



Root delay:
25 minutes



Root delay:
30 minutes

New Results -- Simulation

Data Set	Duty Restrictions	Single-Layer Model	Multi-Layer Model
1	0	(5.7%,6.1%)	(7.2%,7.6%)
1	5	(19.7%,20.4%)	(25.6%,26.2%)
1	10	(32.7%,33.5%)	(38.0%,38.6%)
1	15	(42.3%,43.1%)	(47.5%,48.2%)
2	0	(4.9%,5.3%)	(5.8%,6.2%)
2	5	(25.2%,25.7%)	(27.1%,27.6%)
2	10	(39.3%,39.9%)	(41.3%,42.0%)
2	15	(50.0%,50.7%)	(52.0%,52.6%)

What's Next?

- Correlated delays within optimization model?
- Itinerary protection?
- Recovery interventions?
- Permitting crew, tail modifications?
- ???

Something Entirely Different

- Lots of discussions in the press, in the government, in other academic circles about the airline industry
- Many of those participating in these discussions don't have a good appreciation of network impacts – critical to understanding, measuring airline decisions
- What role should we play in policy discussions?

Capacity Reduction Impacts

- ATA estimates as many as 100 communities could lose service this year, 200 next year
- Small airports are halting expansions, reducing headcount, freezing hiring
- Large airports also impacted by reduction, even if not elimination

Capacity Reduction Impacts

- Many other airports maintain some service but limited routes
- 400 routes eliminated between March and September of 2008

Capacity Reduction Impacts

- Leisure markets
- Secondary airports (e.g. Midway, Islip, Oakland)
- Regional jet non-stops

Impact on Leisure

- Fort Lauderdale will have almost 10% fewer seats this fall than last year
- United pulling out altogether
- JetBlue flying same number of flights but some with smaller aircraft; fares are going up
- Impact on hotel bookings is clearly visible
 - Rely on vacation travelers
 - As fares go up, trips become discretionary

Impact on Leisure

- Hawaii likewise heavily affected
- 25% less scheduled air service than a year ago
- Honolulu to mainland down by 10%
- Estimated impact: 1 million tourists per year

Not Just the U.S.

- ANA may halt service to Guam and Taipei
- XL Airways cancels service from Great Britain to the Caribbean
- Delays of service to China (American, USAir, Northwest, United...)

Secondary Airports

- San Francisco not seeing much change, but Oakland losing about 20% of seats
- Continental pulling out of Midway
- Delta leaving Islip
- In total, Islip and Manchester (NH) each losing more than 10%

Cuts in Non-Stops/Fewer Regional Jet Flights

- Austin losing 8 – 9 out of fifty nonstops
- Embraer predicts 250 – 350 fifty-seat RJs to shed over the next five years in North America
- Eg. Delta eliminating 20 – 25 RJs

What We Do Know

- Many communities have seen dramatic reduction in service
- Often, not the congested areas
- Lots of invested constituents

What We Also Know

- Things aren't as simple as they look from the outside
- Network effects play a major role in these issues
- Example – Carey Treado, U. Pitt.

Research Goals

- To develop models needed to accurately capture impacts of capacity reduction, integrating both airline and community impacts
- To develop models needed to better understand passenger behavior as a result of changes in service
- To develop models of environmental impact
- To communicate the results with broader visibility

Questions for Discussion

- What role should the Global Airline Industry Program be playing in policy-making?
- What is the relationship between industry/academia/government in these areas? How do we effectively work together? What are the potential conflicts?
- What are the key policy questions we should be focusing on?