

Abstracts for INFORMS Aviation Sessions

WEDNESDAY, JUNE 4

2:00 PM – 3:45 PM

- Title:** Efficiency and Equity Tradeoffs in Rationing Airport Arrival Slots
- Authors:** T. Butler, Metron Aviation (Email: Hoffman@metronaviation.com)
- Abstract:** The success of greedy algorithms that have been deployed for rationing airport arrival slots is contingent upon a single server, single queue model of traffic flow. Now that the aviation community is ready to move toward a richer model of arrival flow, new algorithms need to be considered, especially for the case in which multiple resources are being allocated. Often, a tradeoff must be made between efficiency and equity in allocation. Through use of an optimization model, we test the tradeoff that would be necessary to continue use of current algorithms employed by traffic flow management in the multi-fix ground delay program setting.
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- Title:** Incorporating Weather Uncertainty in Airport Arrival Rate Decisions
- Authors:** J.W. Yen, Z.B. Zabinsky, and C. Serve, University of Washington, Seattle (Email: joyceyen@u.washington.edu)
- Abstract:** Weather uncertainty has a big impact on airport arrival rate decisions in the ground-holding problem. In a stochastic program, we investigate tradeoffs between the utility of flight arrival delays and the costs of ground and air delays, and sensitivities to weather forecast probabilities.
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- Title:** A Computational Study of Benders Decomposition for the Integrated Aircraft Routing and Crew Scheduling Problem
- Authors:** A. Mercier, J.F. Cordeau, and F. Soumis, GERAD and Ecole Polytechnique de Montreal (Email: Anne.Mercier@gerad.ca)
- Abstract:** We compare two Benders decomposition methods for the integrated crew scheduling and aircraft routing problem - one with the aircraft routing problem as the master problem and one with the crew pairing problem. We also study the impact of various computational refinements such as the generation of Pareto-optimal cuts and the use of a specialized branching scheme. Computational results are reported on data provided by two major airlines.

Title: Dominance and Indifference in Airline Planning Decisions

Authors: A.M. Cohn, University of Michigan (Email: amycohn@umich.edu)

Abstract: A key difficulty encountered when making airline planning decisions is the combinatorial explosion that occurs with even fairly small problem instances. The enormous number of feasible solutions greatly impacts tractability. This can be particularly problematic when developing real-time recovery plans, integrating planning steps, or seeking more robust solutions. In today's talk, we present for discussion some preliminary ideas about how to exploit properties of *dominance* and *indifference* when solving these difficult problems.

THURSDAY, JUNE 5

8:45 AM – 10:30 AM

Title: Degradable Airline Scheduling

Authors: Laura Kang and J.-P. Clarke (Email: lsmkang@mit.edu)

Abstract: We propose a methodology for deriving airline schedules that are robust to disruptions caused by bad weather. In this methodology, the existing schedule is partitioned into independent prioritized sub-schedules or layers. The resulting degradable airline schedule (1) is robust to disruptions due to weather at or around airports, (2) has itineraries with different reliabilities, (3) provides passengers with a mechanism to select flights based on their own preference for reliability, (4) provides airlines with a mechanism to increase customer satisfaction and (5) provides the flexibility required to more easily respond to changes imposed on the airline by air traffic control. We show through computation and simulation that this approach can significantly increase the number of passengers protected from capacity reductions due to weather.

Title: Robust Airline Crew Pairing Optimization

Authors: D. Klabjan, University of Illinois at Urbana-Champaign (Email: klabjan@uiuc.edu)

Abstract: Due to the flight disruptions in operations, the crew scheduling cost at the end of a month is substantially higher than the projected cost in planning. We present a model that yields more robust crew schedules in planning. Besides the objective of minimizing the cost, we introduce the objective of maximizing the number of crew that can be swapped in operations. We present a solution methodology for solving the resulting model. The

produced crew schedules are evaluated with a simulation. Several possible extensions and directions will be discussed.

Title: A Robust Fleet Assignment Model with Hub Isolation and Short Cycles

Authors: J. Rosenberger, American Airlines (Email: JayMRosenberger@aol.com)

Abstract: Airline decision makers cancel flights in operations because of disruptions. When canceling a flight, they usually cancel a cycle, a sequence of flights that begins and ends at the same airport. Consequently, a fleet assignment and aircraft rotation with many short cycles is frequently less sensitive to a flight cancellation than one with only a few short cycles. In this presentation, we determine a lower bound for the number of short cycles using the hub connectivity of a fleet assignment, and we present fleet assignment models that embed many short cycles and reduce hub connectivity within a solution. We show that solutions to such models perform better in operations than those of traditional fleet assignment models that minimize planned operating cost and passenger spill.

Title: Planning for Robust Airline Operations: Optimizing Aircraft Routings and Flight Departure Times to Achieve Minimum Passenger Disruptions

Authors: S. Lan, J.-P. Clarke and C. Barnhart (Email: slan@mit.edu)

Abstract: We propose methodologies for deriving aircraft maintenance routings that are robust to operational disruptions and for adjusting (retiming) flight schedules to minimize the number of passengers that are disrupted due to missed connections. In the first, flight segments are aggregated into aircraft maintenance routings that minimize the propagation of delays throughout the schedule. In the second, allocate “slack” optimal throughout the schedule. We show through computation that these approaches provide improvements in on-time performance and reductions in the number of disrupted passengers.

THURSDAY, JUNE 5

10:45 AM – 12:30 PM

Title: Optimization Models To Recover Aircraft Schedules and Minimize Passenger Schedule Disruptions

Authors: S. Bratu and C. Barnhart, MIT (Email: sbratu@mit.edu)

Abstract: We present a decision support portfolio to recover airline resource schedules and minimize passenger schedule disruptions. We demonstrate

through computational experiments, using passenger and flight information from a major U.S. airline, that our models allow real time decision making, while incorporating passenger considerations in the recovery process and not increasing operating costs.

Title: Virtual Hubs: An Airline Schedule Recovery Concept and Model

Authors: M. Karow and J.-P. Clarke, MIT (Email: karow@mit.edu)

Abstract: Inclement weather at hub airports can be devastating to airline operations. We propose a model that determines the flights to shift from a connecting complex at a hub airport during irregular operations to a strategically located, under-utilized airport. This “virtual hub” would, in addition to hosting selected connecting traffic that is shifted from the original hub in order to maximize passenger flow through the network, also reduce the demand on the nominal hub airport, thereby reducing delays at that airport. We show through computation that this approach reduces the total number of minutes of passenger delay.

Title: Evaluation of an Auction Mechanism for Allocating Airport Arrival Slots

Authors: E. Cholankiril, W. Hall and J.-P. Clarke, MIT (Email: superejc@mit.edu)

Abstract: A sequential, sealed-bid Vickery auction without package bidding is proposed as a mechanism for allocating arrival slots during Ground Delay Programs (GDPs). The auction was simulated on historical flight data and compared with two slot auction methods—Collaborative Decision Making (CDM) and a “global optimization” method where it is assumed that one airline owns all the flights. We show through computation that the proposed auction improves on the performance of CDM.

Title: Predicting NAS Performance

Authors: M. O. Ball, University of Maryland (Email: MBall@rhsmith.umd.edu)

Abstract: In the paper, we describe models and analysis whose objective is to predict the performance of the National Airspace System (NAS) from a small number of input parameters. This work was carried out in support of the development of the FAA “Strategy Simulator”. The goal of the strategy simulator is to model the manner in which the NAS reacts to major changes to FAA policy, industry structure, infrastructure,

technology and other factors. The outputs of the performance models we describe include average flight delay, flight cancellation probability and average passenger delay.