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In This Issue

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FOCUS SECTION—THE AIRLINE INDUSTRY

The air transportation industry continues to provide fertile ground for innovative and exciting contributions to the transportation science. The first six of the seven papers in this issue deal with aspects of air transportation.

Landings at Logan Airport: Describing and Increasing Airport Capacity

Airports are the critical bottleneck in the nation's air aviation network. It is therefore important to understand what factors affect the landing capacity of airports and how this capacity might be increased. In this paper, the authors develop a statistical model for the Landing Time Intervals (LTIs) between successive aircraft using data from Logan Airport, Boston. The model indicates that reordering the sequence of landing aircraft can substantially reduce the LTIs and thereby increase runway capacity. The paper also uses actual landing data to investigate the potential benefit of using sequencing algorithms to expedite aircraft landings. While better sequencing can sizably reduce aircraft delays in the near-terminal area, this improvement must be balanced against numerous operational constraints related to the air traffic control environment and controller and pilot workload.

Solving Optimally The Static Ground-Holding Policy Problem in Air Traffic Control

Ground-holding is the practice of delaying the departure of a flight due to anticipated congestion at destination airport because it is both less expensive and safer for aircraft to wait on the ground, prior to take-off, than in the air. It has been estimated that approximately 200 to 250 aircraft-years may be spent each year on ground delays. This paper presents a model for the general, multiperiod ground holding problem which can be used to obtain optimal solutions to practical instances of the problem of determining which aircraft to hold and for how long. The model results in linear programs of a size solvable on a personal computer for even the largest airports in the U.S. air traffic control network. The formulation allows for classification of aircraft into several cost classes and for probabilistic airport capacity forecasts that are in line with current weather forecasting technology. Results indicate that the model proposes strategies which could result in significant cost advantages.

Modeling the Customer Arrival Process And Comparing Decision Rules in Perishable Asset Revenue Management Situations

Perishable-asset revenue management (PARM) combines the traditional areas of yield management, overbooking, and pricing into one macro problem. Such problems include a perishable good or service, a fixed number of units, and the possibility of segmenting price-sensitive customers. This paper presents a model that allows for the evaluation of different decision rules in PARM situations. The paper shows that suboptimal rules can decrease the expected contribution by 10% or more for errors in the allocation decision on the order of 20 units and that simple static decision rules provide an excellent approximation to the optimal rule in three important situations.

A Model for Dynamic Airline Seat Inventory Control with Multiple Bookings

Following deregulation, the U.S. airline industry has witnessed a period of intense competition. To remain profitable, most airlines have adopted some form of yield management system whereby an attempt is made to increase revenues by controlling the availability of seats in different fare classes. This paper describes a method by which an airline reservation system can allocate seats to fare classes to maximize revenue from a flight. The paper specifically addresses issues such as the timing of requests for seats and multiple seat requests. Past customer demand history is used to help the airline avoid selling too many low fare seats when higher fare passengers are expected to arrive at a later time.

A Real Time Decision Support System for Airline Flight Cancellations and Delays

Perturbations in an airline's flight schedule occur daily due to unplanned events such as inclement weather, crew delays or mechanical problems. Traditionally, airlines have relied on flight controllers with access to on-line operational data to manage the day-to-day situation as it unfolds. The task is

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complex because of the multitude of responses that can be taken, the importance of evaluating the network effects, and the need to develop good solutions in real-time. This paper formulates some of the problems faced by flight controllers as network models. Decision support tools are under development at United Airlines using the framework presented in the paper.

Airline Scheduling and Routing in a Hub-and-Spoke System

An airline chooses its schedule and prices to maximize profit. Schedules determine costs, while schedules and route prices affect demand in a competitive arena. This paper attacks the problem of integrating these decisions within the context of hub-and-spoke systems. The procedure presented in the paper computes airline demand using an empirically defined model of customer choice and, with fixed flight schedules, finds the profit maximizing prices. Then it improves flight schedules considering the effect of schedules on prices and profits. Several heuristics are used to determine routes and to construct flight schedules. The paper explores competitive issues through examples in which airlines compete by setting profit maximizing schedules and prices. The examples suggest that: airlines have an incentive to cut prices to fill planes, several equilibria exist with different numbers of competitors, fares drop with increased competition, and "flight bunching" occurs only at peak demand times.

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A Variable Depth Approach for The Single Vehicle Pickup and Delivery Problem with Time Windows

The single vehicle pickup and delivery problem with time windows is a variant of the traveling salesman problem in which a salesman must not only find the shortest route through a number of cities, but must also satisfy three side constraints: capacity constraints on the amount carried at any point on the route, precedence constraints on the order in which two corresponding pickup and delivery points are visited, and scheduling constraints set by the time windows. This paper attacks the problem by applying two types of local search techniques: variable depth search and simulated annealing. Variable depth search produces good solutions in a short time but can be fooled by certain perverse problem instances. Simulated annealing can handle these instances but demands much more time. The paper shows that local search gives reasonable solutions to complicated combinatorial optimization problems with a modest amount of implementation effort, even when deep insights into the mathematical structure of the problem are lacking.