New scheduling model puts airlines on equal plane while easing congestion

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Air traffic congestion that causes frustrating delays and cancellations can be reduced through flight schedules that don't systematically favor certain airlines over others, according to a new study from Dartmouth College and Carnegie Mellon University.

The study proposes the first-ever scheduling plan to manage snarled flight traffic without prioritizing landing and takeoff positions for individual carriers - known as "equity" among researchers.

The research, published in the journal *Transportation Science*, uses game theory to explain the trade-offs between efficiency and fairness when airport authorities make scheduling changes. The study results are also simulated at one of the country's largest airports to see how well it performs.

"Equity in scheduling is important to the airlines as well as to the everyday flying public," said Vikrant Vaze, an assistant professor of engineering at Dartmouth's Thayer School of Engineering. "An equitable scheduling approach ensures that passengers are treated fairly regardless of what carrier issues the boarding pass."

While weather, technical issues and crew schedules all cause operational problems, most delays in the U.S. are the result of high demand and low capacity at the busiest airports. This combination of limited infrastructure and heavy air traffic results in flight changes that cost airlines and consumers in the U.S. over $30 billion annually, according

to a 2007 figure cited in the research.

According to the paper, existing solutions to ease congestion do not account for the impact of the schedule changes on specific airlines, resulting in the potential to benefit some airlines at the expense of others. The new research addresses this concern by integrating inter-airline equity considerations into the decision making around airport scheduling.

"Many airlines have argued that any scheduling interventions at busy airports may hinder their ability to compete in key markets," said Alexandre Jacquillat, assistant professor of operations research and public policy at Carnegie Mellon's Heinz College of Information Systems and Public Policy. "This paper essentially shows that scheduling technologies and scheduling policies can be developed to mitigate these concerns."

The study suggests that the only long-term solution is to create timetables that limit over-capacity scheduling at peak hours. This practice, while common outside the United States, is only applied at a handful of the busiest U.S. airports.

The approach developed for this study, named the Integrated Capacity Utilization and Scheduling Model with Equity Considerations (ICUSM-E), builds on an earlier model that optimizes scheduling through shifts in demand, but extends it in a way that balances such adjustments equitably among the airlines.

In developing the model, researchers compared airport capacity estimates alongside the preferred schedule of flights requested by airlines. The team focused primarily on adjustments that involve shifting demand through scheduling controls, but also considered demand reductions like the elimination of some flights.

In addition, the researchers also considered the general case where each flight is assigned a weight characterizing the cost - or the inconvenience - of a flight being rescheduled or cancelled, as well as mechanisms in which the airlines can signal the relative rescheduling costs of different flights through non-monetary credit allocation or a monetary auction-based mechanism.

According to the authors in the paper, the study "proposes and evaluates a quantitative approach to optimize such interventions in a way that achieves on-time performance objectives, while minimizing interference with airlines' competitive scheduling and, for the first time, balancing the impact of such interventions equitably among the airlines."

In a demonstration of the results, researchers generated and solved real-world, full-scale computational scenarios at New York's John F. Kennedy Airport.

"Testing and validating the research model at an airport like JFK allows us to confirm that the theory of trade-offs between equity and efficiency matches the ground reality of busy airports in the U.S.," said Vaze.

The research showed that, under a wide range of conditions, inter-airline equity can be achieved at JFK with no - or minimal - efficiency losses. This suggests that existing approaches for scheduling interventions can be extended to include inter-airline equity considerations.

"A single study can't eliminate all congestion challenges at airports like JFK, but this paper suggests that important opportunities exist to make the resulting processes and policies more equitable - at virtually no cost," said Jacquillat.

While models that equitably allocate aviation capacity on the day of operations exist, the current research focuses on more typical scheduling

interventions that take place months in advance of a flight. These interventions are meant to manage the number of flights at an airport even before schedules get published or tickets get marketed.

The research comes as significant efforts are being made globally to review industry guidelines and scheduling policies at major airports.

More information: Alexandre Jacquillat et al, Interairline Equity in Airport Scheduling Interventions, *Transportation Science* (2018). DOI: 10.1287/trsc.2017.0817

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