

RESEARCH BRIEF

AN OPTIMIZATION MODEL FOR MITIGATING EXEMPTION BIAS IN AIR TRAFFIC GROUND DELAY PROGRAMS

The potential

The Federal Aviation Administration (FAA) strives to provide fair and equitable access to the National Airspace System. The task of monitoring traffic demand-capacity imbalances falls to FAA air traffic flow management (TFM) specialists.

Each demand-capacity imbalance places TFM in a decision-making environment in which the specialists must allocate scarce resources. Which aircraft should receive priority? What is the basis for equity? How can the decision maker be certain that resources are being used wisely?

GDPs are currently the most sophisticated resource allocation mechanisms: delays are applied to flights at their origin airports when they are bound for a common destination airport with reduced capacity or excessive demand.

The Collaborative Decision Making (CDM) program has established a highly successful paradigm for allocation of airport arrival slots. The essence is “first-scheduled, first-served,” meaning that earlier arrival slots are generally awarded to the flights that are scheduled to arrive earlier. This is preferable to the FAA’s older “first-come, first served model.”

Yet the concept of fairness under CDM is largely implicit, and the achievement of equitable allocations is often complicated by practical considerations.

The challenge is to build on the CDM model of air traffic management to provide an optimization model that will be more equitable to air carriers, reducing delay during GDPs and also lessening the impact of exemption biases for air carriers.

The exemption challenge

From an equity standpoint, it would be most desirable to spread total necessary delay out over as many flights, or types of flights, as possible. But important, valid considerations motivate both limiting

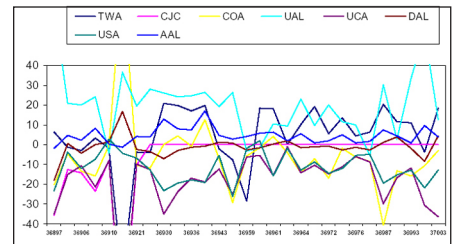
the scope of programs and also exempting certain flights within the scope of FAA-assigned delay.

Flights that are already in the air when the program is filed cannot be assigned ground delay and, by necessity, are exempt. The geographical exemption excludes flights originating at distant airports.

The price paid for exempting large numbers of flights is that the total necessary delay in a GDP is distributed over a smaller collection of flights, thus driving up the maximum delay and average delay per (non-exempted) flight. Carriers with predominantly shorter duration flights may be receiving an undue amount of delay. Efficiency and equity are at odds with each other.

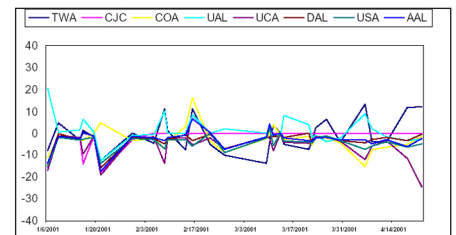
The research

ISR researchers have characterized ideal allocations relative to fairness and have constructed an optimization model that creates an actual allocation that takes into account the ideal but also considers other objectives and constraints. This framework succeeds in reducing the exemption biases that exist under current procedures.



Historical GDP allocation at Logan Airport

Exempted flights are assigned slots first, which can have a significant impact on the distribution of delays among airlines. This figure shows the difference between an airline’s actual pre-flight delay allocation and the ideal allocation with respect to fairness. Exemptions introduce a systematic bias against certain airlines where short-haul flights predominate.



Impact of the optimization model at Logan Airport

With the optimization model in use, there is a significant impact in delay and a substantial reduction in biases. The reductions are very significant and would have a major impact on the performance of the airlines involved.

Status

There is a substantial reduction in exemption biases when the optimization model is used. The reductions are very significant and would have a major impact on the performance of the airlines involved.

Research team

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