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## Stochastic Models for the Estimation of Airport Arrival Capacity Distributions

In this dissertation, statistical and integer programming methods are used to calibrate models to estimate airport arrival capacity distributions. These distributions are an essential input to decision models used to regulate flow into congested airports when demand for arrival resources exceeds the available capacity. The techniques developed make contributions to the body of knowledge on air traffic flow management. On a more general level, the approach developed can be viewed as a clustering technique that maintains the time order of imbedded time series data.

During instances of capacity-demand imbalances, efficient planning and decision-making is contingent upon the “goodness” of the models that estimate airport capacity over time. Airport capacities are subject to substantial uncertainty as they depend on stochastic weather conditions. The models developed in this thesis are required inputs into a class of stochastic ground holding models that determine the amount of ground delay to assign to incoming flights to balance assigned ground delay and expected airborne delay optimally while minimizing total delay. The models are judged by the amount of total weighted delay incurred in comparison to the amount of total weighted delay that would have been realized under current operational procedures. (Airborne delay is weighted more heavily than ground delay). Based on comparisons between the decision models that employ the estimates developed in this thesis and current models, the results of this thesis reduce the total amount of weighted delay. Another contribution is the development of a new, simple decision model that more accurately estimates the amount of delay incurred in a ground delay program as it dynamically changes.

The statistical models calibrated in this thesis use empirical historical data to generate (arrival capacity) probability distribution functions (vectors of capacity scenarios). In the case considered in this thesis, the capacity scenarios (one-parameter arrival capacity distributions) are used to model morning fog at San Francisco’s International Airport. To determine seasonal capacity probabilistic distribution functions (distributions that vary in time), a set partitioning integer programming model is utilized.