Benchmarking Airport Efficiency: An Application of Data Envelopment Analysis

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The call for airports to improve their resource utilization has become a necessity in an airline environment that has dramatically changed since September 11, 2001. Bankruptcies, terrorism and soaring oil prices have forced airlines to cut back on their schedules. As a result, airports have struggled to retain and expand air service. Moreover, the woes that had affected the National Airspace System (NAS) reappeared as the demand for air travel resumed: In 2005, delay and airport congestion returned to the year 2000’s level.

Data Envelopment Analysis was used to benchmark a sample of thirty-five airports based on the percent of on-time gate arrivals as the efficiency criterion. Then, regression analysis was performed to assess the impact of selected input variables on the likelihood that an airport is efficient. The study indicates that “airport efficiency” for the largest thirty-five airports in terms of operations has declined from 2004 onward as airport delays and congestion returned to the year 2000 levels.

An Algorithmic Approach for Airspace Flow Programs

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An Airspace Flow Program is a Traffic Flow Management (TFM) strategy for controlling the departure time and route selection of a set of aircraft constrained by en route airspace capacity constraints (e.g., weather). The concept extends current airport Ground Delay Program (GDP) and Flow Constrained Area (FCA) procedures. A routing and scheduling algorithm is presented that includes ground delay, route selection, and airborne holding as decision variables for departing and en route flights, and, like the current GDP resource allocation algorithm, aligns with a Collaborative Decision Making philosophy. A dynamic FCA capacity-estimation algorithm uses weather forecast information to produce time-varying entry and exit points as well as maximum flow rates through FCAs. Integration of these algorithms using a network representation of the National Airspace System enables assessment of the value of improved weather forecast accuracy and provides insights into the nature of robust TFM initiatives. Results are illustrated using an east coast severe weather scenario.
Comparison of Pilot and Automation Generated Lateral Conflict Resolutions

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This study compares and contrasts lateral conflict resolutions generated by pilots (with and without a set of decision support tools), with those generated by a fully automated conflict resolution tool that generates optimal (smallest path deviation) resolutions. The conflict geometries investigated were all factorial combinations of three levels of Intruder aircraft speed, three levels of initial Ownship distance to closest approach, and nine conflict angles. The resolution decision support tools included dynamic conflict alerting, which indicated whether a proposed path was conflict free, and a dynamic predictor system that showed a fast time depiction of the proposed resolution trajectories. The automation-generated resolutions, computed using a geometric optimization algorithm, served as a benchmark against which the pilot-generated resolutions were compared. Without decision support tools the pilot-generated resolutions were often ineffective in providing the necessary separation, particularly at smaller conflict angles. The resolutions tended to be effective when the decision support tools were used. Resolution cost, as measured by added path length, was greater for pilot-generated resolutions (averaging 2.7 nmi) compared to the automation-generated resolutions (averaging 1.3 nmi). When pilots had the decision support tools, their strategies, as indexed by whether they turned toward or away from the Intruder, and the mean locations at which they turned back to recapture their original route, tended to be the same as that of the automated system.