LITERATURE SURVEY

1. Study of Flight Departure Delay and Causal Factor Using Spatial Analysis

ABSTRACT: Analysis of flight delay and causal factors is crucial in maintaining airspace efficiency and safety. However, delay samples are not independent since they always show a certain aggregation pattern. Therefore, this study develops a novel spatial analysis approach to explore the delay and causal factors which is able to take dependence and the possible problem involved including error correlation and variable lag effect of causal factors on delay into account. The study first explores the delay aggregation pattern by measuring and quantifying the spatial dependence of delay. The spatial error model (SEM) and spatial lag model (SLM) are then established to solve the error correlation and the variable lag effect, respectively. Results show that the SEM and SLM achieve better fit than ordinary least square (OLS) regression, which indicates the effectiveness of considering dependence by employing spatial analysis. Moreover, the outcomes suggest that, aside from the well-known weather and flow control factors, delay-reduction strategies also need to pay more attention to reducing the impact of delay at the previous airport.

REFERENCE:
https://go.gale.com/ps/i.do?p=AONE&u=googlescholar&id=GALE|A610927245&v=2.1&it=r&sid=AONE&asid=8b2120b0

2. ANALYSIS OF AIRCRAFT ARRIVAL AND DEPARTURE DELAY CHARACTERISTICS

ABSTRACT: The increase in delays in the National Airspace System (NAS) has been the subject of several studies in recent years. These reports contain delay statistics over the entire NAS, along with some data specific to individual airports, however, a comprehensive characterization and comparison of the delay distributions is absent. Historical delay data for these airports are summarized. The various causal factors related to aircraft, airline operations, change of procedures and traffic volume are also discussed. Motivated by the desire to improve the accuracy of demand prediction in enroute sectors and at airports through probabilistic delay forecasting, this paper analyzes departure and arrival data for ten major airports in the United States that experience large volumes of traffic and significant delays. To enable such an analysis, several data fields for every aircraft departing from or arriving at these ten airports in a 21- day period were extracted from the Post Operations Evaluation Tool (POET) database. Distributions that show the probability of a certain delay time for a given aircraft were created. These delay-time probability density functions were modeled using Normal and Poisson distributions with the mean and standard deviations derived from the raw data. The models were then improved by adjusting the mean and standard deviation values via a least squares method designed to minimize the fit error between the raw distribution and the model. It is shown that departure delay is better modeled using a Poisson distribution, while the enroute and arrival delays fit the Normal distribution better. Finally, correlation between the number of departures, number of arrivals and departure delays is examined from a time-series modeling perspective.

REFERENCE:
https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.81.9924&rep=rep1&type=pdf

3. Flight delay causality: Machine learning technique in conjunction with random parameter statistical analysis

ABSTRACT: The consequences of flight delay can significantly impact airports' on-time performance and airline operations, which have a strong positive correlation with passenger satisfaction. Thus, an accurate investigation of the variables that cause delays is of main importance in decision-making processes. Although statistical models have been traditionally used in flight delay analysis, the presence of unobserved heterogeneity in flight data has been less discussed. This study carried out an empirical analysis to investigate the potential unobserved heterogeneity and the impact of significant variables on flight delay using two modeling approaches. First, preliminary insight into potential significant variables was obtained through a random parameter logit model (also known as the mixed logit model). Then, a Support Vector Machines (SVM) model trained by the Artificial Bee Colony (ABC) algorithm, was employed to explore the non-linear relationship between flight delay outcomes and causal factors. The data-driven analysis was conducted using three-month flight arrival data from Miami International Airport (MIA). A variable impact analysis was also conducted considering the black-box characteristic of the SVM and compared to the effects of variables indented through the random parameter logit modeling framework. While a large unobserved heterogeneity was observed, the impacts of various explanatory variables were examined in terms of flight departure performance, geographical specification of the origin airport, day of month and day of week of the flight, cause of delay, and gate information. The comprehensive assessment of the contributing factors proposed in this study provides invaluable insights into flight delay modeling and analysis.

REFERENCE: https://www.sciencedirect.com/science/article/pii/S2046043022000119

4. Competing Networks, Spatial and Industrial Concentration in the US Airline Industry

ABSTRACT: The paper uses Gini decomposition analysis to evaluate changes in the spatial distribution and industry shares of total US air traffic, as well as analysing the decomposition components for individual airlines and airports for the period 1990–2002. The paper develops explicit relationships between two of the main decomposition schemes used in the income inequality literature and shows the insights that such analysis may provide for evaluation and examination of air transport networks and traffic distributions. A multi-dimensional Gini and its decomposition are derived using an adjustment method derived from the relationship between the two Gini decomposition schemes.

REFERENCE:
https://www.researchgate.net/publication/24089448_Competing_Networks_Spatial_and_Industrial_Concentration_in_the_US_Airline_Industry

5. Air Traffic Flow Management slot allocation to minimize propagated delay and improve airport slot adherence.

ABSTRACT: In Europe, one of the instruments at the Network Manager's (NM) disposal to tackle demand-capacity imbalance is to impose ground, i.e. Air Traffic Flow Management (ATFM), delays to flights. To compensate for anticipated delays and improve on-time performance, Aircraft Operators usually embed a buffer time in their schedules. The current practice for allocating ATFM delays does not take into account if flights have any remaining schedule buffer to absorb ATFM delay and reduce delay propagation to subsequent flights. Furthermore, the policy presently employed is to minimize ATFM delays, an order of magnitude of half a minute per flight, while propagated delays are approximately ten times higher. In this paper, we explore the possibility to control ATFM delay distribution in a way

so as to minimize delay propagated to subsequent flights, but also to increase flights' adherence to airport slots at coordinated airports. To this aim, we propose a two-level mixed-integer optimization model to solve en-route demand-capacity imbalance problem and further improve airport slot adherence. The rationales behind the research are drawn from practical experience, while the model proposed is compatible with the one currently being used by the NM, making it easy to implement. We test the model on two real-world case studies and conduct ex post analysis to test the effects of violation of model assumptions on results. The results show that it is possible to use the proposed methodology to lower delay propagated to subsequent flights and at the same time to improve airport slot adherence. In addition, they suggest that the current regulatory settings aiming to minimize ATFM delay minutes, as well as operational implementation thereof, are neither necessarily fully aligned with the desires and operating goals of Aircraft Operators, nor they improve the predictability of operations in the network.

REFERENCE: https://www.sciencedirect.com/science/article/pii/S0965856416300052

6. Comparative Analysis on Propagation Effects of Flight Delays: A Case Study of China Airlines.

ABSTRACT: This paper aims to capture the interdependency among the sequence of flight delays due to airline operations in airports, weather, and air traffic control conditions. A copula function is used to determine the distribution of delay sequence and examine the propagation effects. Using the actual data sourced from an airline in Asia Pacific region, it is found that flight delays could propagate to downstream airports/airlines, where the strength of delays was decreased, passed on, or increased. Considering the possible effects of increased delays under air traffic control or airline factors, scenarios that adjust flight schedules with additional buffer time were created and analyzed. Results show that, by adding buffer time efficiently, flight schedules can become more reliable.

REFERENCE:
https://www.researchgate.net/publication/322796669_Comparative_Analysis_on_Propagation_Effects_of_Flight_Delays_A_Case_Study_of_China_Airlines

7. Modeling flight delay propagation in airport and airspace network.

ABSTRACT: An Airport-Sector Network Delays model is developed in this paper for flight delay estimation within air transport network. This model takes both airports and airspace capacities into account by iterating among its three main components: a queuing engine, which treats each airport in the network as a queuing system and is used to compute delays at individual airport, a Link Transmission Model, which computes delays at individual sector and transmits all air delays into ground delays, and a delay propagation algorithm that updates flight itineraries and demand rates at each airport on the basis of the local delays computed by the queuing engine and flow control delays computed by the Link Transmission Model. The model has been implemented to a network consisting of the 21 busiest airports in China and 2962 links that represent to 151 enroute control sectors in mainland China, and its performance is evaluated by comparing with the actual delay data and results of Airport Network Delays model. It is found that the proposed model is well-suited for simulating delays in air transport system where either airports or airspace could be the bottleneck of the system.

REFERENCE: https://hal-enac.archives-ouvertes.fr/hal-01897108/document

8. Propagation Index on Airport Delays

ABSTRACT: This paper explores the propagation effect of flight delays among airports in the aviation system and proposes a new measure, the propagation index, to effectively analyze the interrelationship among airports in relation to flight delays. This index quantifies the effect of delay propagation by measuring the causality among delay time series. To assess the effectiveness of the proposed index on airport delays, three neural network-based regression models are built. The comparative experiments demonstrate that the propagation index proposed is highly correlated with observed airport delays.

REFERENCE: https://journals.sagepub.com/doi/abs/10.1177/0361198119844240

9. Modeling Congestion Propagation in Multistage Schedule within an Airport Network

ABSTRACT: In order to alleviate flight delay it is important to understand how air traffic congestion evolves or propagates. In this context, this paper focusses on the aggravation of airport congestion by the accumulation of delayed departure flights. We start by applying a heterogeneous network model that takes congestion connection/degree into consideration to predict departure congestion clusters. This is on the basis of the fact that, from a micro perspective, the connection between congestion and discrete clusters can be embodied in models. However, the results show prediction to be of high accuracy and time consuming due to the complexities in capturing the connection in congested flights. The problem of being highly time consuming is resolved in this paper by improving the models by stages. Stage partitioning based on the variation of delay clusters is similar to the typical infectious cycle. For heterogeneous networks the model can describe the congestion propagation and its causes at the different stages of operation. If the connection between flights is homogeneous, the model can describe a more indicative process or trend of congestion propagation. In particular, for single source congestion, the simplified multistage models enable short-term prediction to be fast. Furthermore, for the controllers, the accuracy of prediction using simplified models can be acceptable and the speed on the prediction is significantly increased. The simplified models can help controllers to understand congestion propagation characteristics at different stages of operation, make a fast and short-term prediction of congestion clusters.

REFERENCE:
https://www.researchgate.net/publication/327056786_Modeling_Congestion_Propagation_in_Multistage_Schedule_within_an_Airport_Network