Event-Driven Demand Modeling of European Private Aviation Travel

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Abstract

Accurately predicting the demand for aviation is a complex problem that is essential for the success of the private aviation industries. Factors such as seasonality and location affect the demand for private flights, but high-demand events and holidays introduce additional and often unexpected influences on these services. In European destinations, travel is heavily characterized by high-demand events and holidays. This research utilizes detailed characterization data centered around Europe containing over 1.1 million private flights between 2,016 locations from 2018 and 2019. Leveraging advanced data analysis techniques, this project constructs a spatio-temporal forecasting model to accurately predict the demand for private jet travel during high-demand events and holidays in European destinations. This research delivers valuable insights to providers of private aviation, enabling them to proactively respond to market fluctuations and optimize their operational strategies.

Research Scope

This research is interested in the interaction of demand factors for events that move across locations over time. Previous research has found factors that influence private aviation demand, but not during high demand events. Through an exploration of the private flight dataset and previous studies on luxury travel, this poster documents a normalization procedure. This methodology is then extended to forecasting future arrival counts.

Data Visualization

- 1,117,298 private jet flights from 2018 and 2019

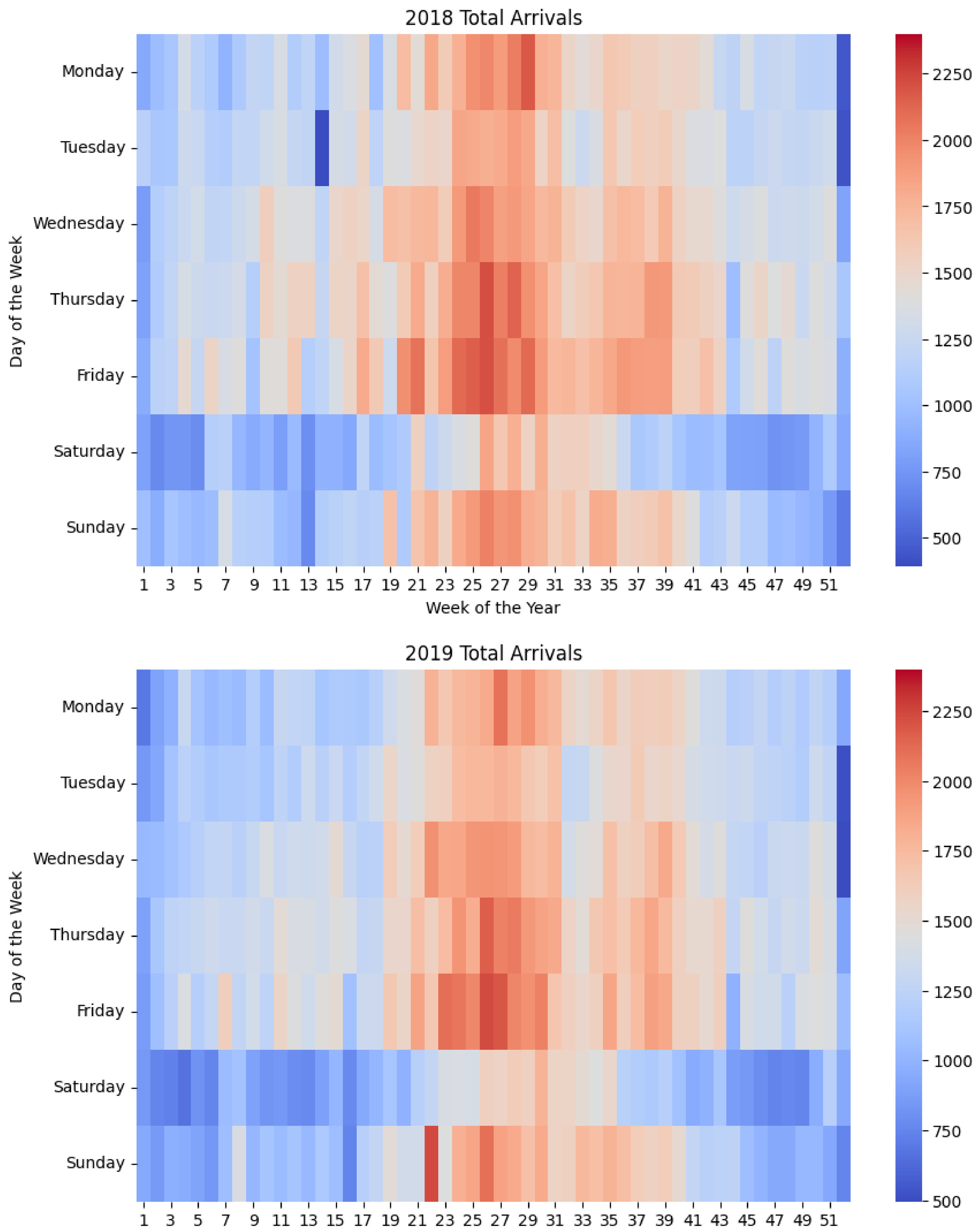

Figure 1: Heat Maps of Total Arrivals per Day of the Week and Week of the Year

Global Model

- A predictive model is built using the 2018 arrival data, with coefficients indicative of day of the week and month of the year.

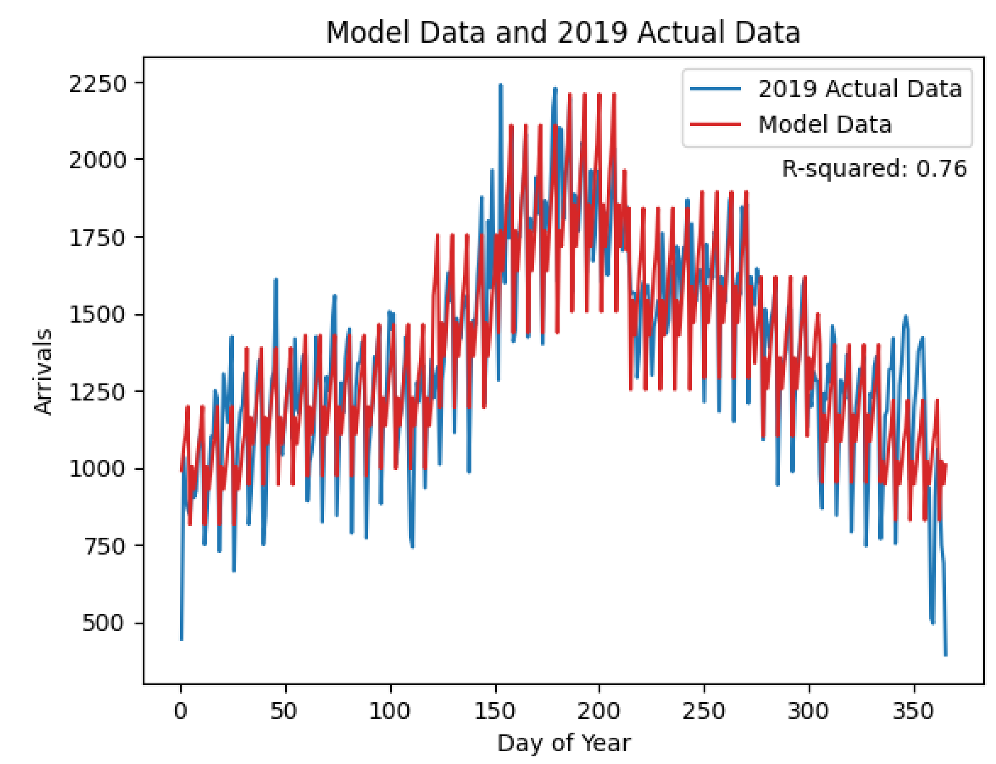

Figure 2: Line Plot of 2019 Flight Data and Model Data

Baseline	Coefficient
$\beta_{baseline}$	830
Month	**Coefficient**
January	0.983
February	1.138
March	1.172
April	1.201
May	1.439
June	1.731
July	1.814
August	1.529
September	1.554
October	1.328
November	1.147
December	1.0
Day of the Week	**Coefficient**
Monday	1.140
Tuesday	1.214
Wednesday	1.303
Thursday	1.359
Friday	1.468
Saturday	1.0
Sunday	1.230

Table 1: Model Coefficients for Month and Day of the Week

$$\text{Arrivals}(\partial, \mu) = \beta_{\text{baseline}} * \partial_{\text{day of week}} * \mu_{\text{month}}$$

Data Description and Methodology

- This method uses a base year to quantify events in context. For each 1,117,298 private jet flight arrival and departure records from 2018 and 2019
- The data set had several missing entry data that had to be discarded. This did not affect the subset used for this project.
- The arrival counts are given for each airport's ICAO identifier. Airports that receive majority private flights were chosen for analysis as more representative of dataset.
- After determining that time of year and day of week were relevant, a more sophisticated data normalization algorithm was created. This method uses a base year to quantify event demand in context. As a result, results from one event can be used to forecast similar, but distinct events. Such distinctions result from differences in location, time, economic conditions, and other idiosyncratic factors like event hype. For example, we used a soccer championship event in 2018 in Ukraine to forecast the demand spike for the 2019 championship in Madrid.

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Algorithmic Normalization Method

This method uses a base year to quantify events in context. For each day of week, it evaluates forward and backward-looking ratios of arrival counts to see if they fall within a threshold. This outlines unique trends in seasonality at a given airport for events normalization.

Event Characterization

UEFA Championship

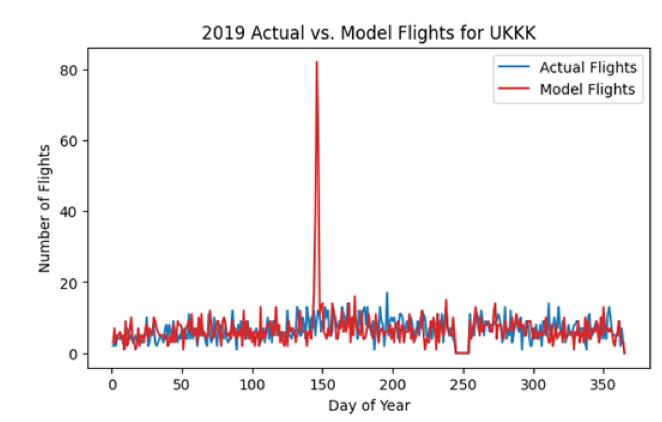

Figure 4: Spacio-Temporal Modeled Data and Actual 2019 Data of Sikorsky Airport (UKKK)

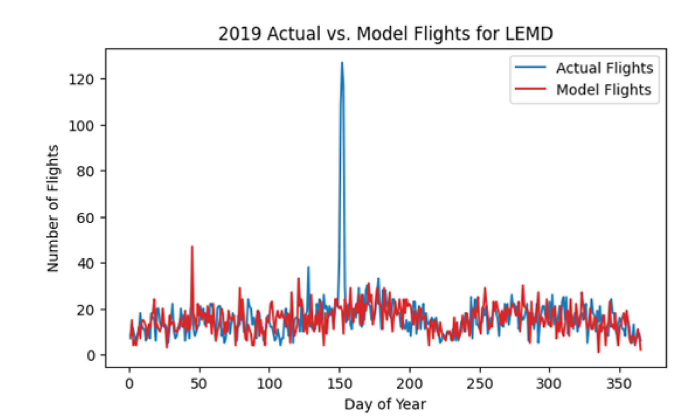

Figure 5: Spacio-Temporal Modeled Data and Actual 2019 Data of Adolfo Suárez Madrid–Barajas Airport (LEMD)

Locations	**2018:** Ukraine and Russia: • Boryspil International Airport • Sikorsky International Airport Kyiv • Pulkovo Airport **2019:** Spain: • Adolfo Suárez Madrid–Barajas Airport
Date	May 26, 2018 and June 1, 2019
Factor of Change	Model: • 2018: 13.50 • 2019: 6.90 Algorithm: 2018: 11.71

Table 1: UEFA Championship Characterization

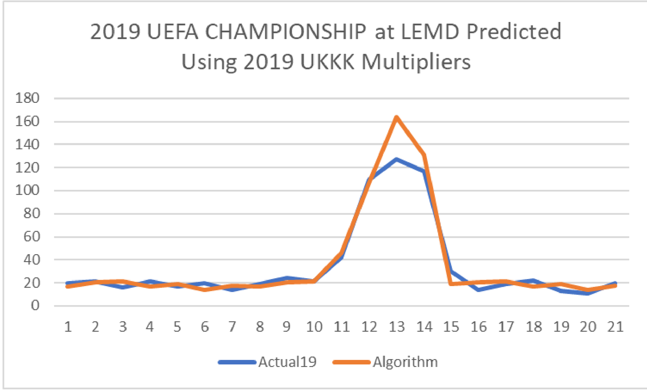

Figure 6: Algorithmically Modeled Data and Actual 2019 Data of Adolfo Suárez Madrid–Barajas Airport (LEMD)

Future Work

- Residual testing over more events with both methods to determine fit
- Sensitivity testing on algorithm's parameters
- Further break down and store the normalized event coefficients by days out from event, size of airport in yearly arrivals, and distance of airport from event center
- Create mapping algorithm for the correct application of coefficients in cases like an event being truncated or an event starting on different days of the week between years

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