D214 Data Analytics Graduate Capstone Project Assessment 3:

Univariate Time Series Analysis of Airline Arrival Delays: Executive Summary

Nathanael Ellis

Western Governors University

D214: Data Analytics Graduate Capstone

Dr. Daniel Smith

September 16, 2022

Attn: Data Analytics Team

Recent airline travel delays have caused many issues for travelers (Josephs, 2022). These delays create an opportunity for our group to assist multiple potential stakeholders including airlines, airport managers, and travelers. This research project attempted to create an ARIMA based timeseries model to predict the number of cumulative airline flight arrival delays each day across all major U.S. airports. Our alternative hypothesis was that we could create an ARIMA model of airline flight arrival delays within a 95% confidence interval.

To test our hypothesis, we gathered flight on-time data from the Bureau of Transportation Statistics (“Airline On-Time,” 2022) for the time period of January 2017 through May 2022. This data included all individual flights during this time as well as both planned and actual arrival times. The data was cleaned and aggregated to create a time series with delay counts for all the flights for all airlines each day. This information was used to create an ARIMA model as well as a Prophet model and a baseline model using the median count of daily delays. Comparisons between models were accomplished using Mean Absolute Error.

We found that the ARIMA model did perform better than the baseline model with MAEs of 976 and 1424 respectively. Unfortunately, the ARIMA model did not capture 9% of the test values within the 95% confidence interval bounds. Also, the Prophet model outperformed the ARIMA model with an MAE of 866.

Hardware limited the complexity of the model due to RAM and processor limitations. Alternative analysis of this large dataset will necessitate the use of a separate relational database to store the information. Other timeseries modeling techniques, such as Prophet, may be able to create better performing models than the ARIMA model that was the focus of this project.

The proposed actions are the following:

1. Attempt more complicated ARIMA models using more powerful hardware.
2. Test other time series models such as neural networks using LSTM layers.
3. Explore other aspects of this extensive dataset including delay category trends.

In summary, this study has allowed us to explore the efficacy of ARIMA models on airline arrival delay data. While the ARIMA model we created did not perform well enough for production use, we can use this as a steppingstone towards alternatives. With an MAE 40% better than the baseline, the Prophet model shows that we may still be able to create a useful model to for tracking airline arrival delays.

**References**

*Airline On-Time Performance Data*. (2022, May). BTS. Retrieved August 14, 2022, from https://www.transtats.bts.gov/Tables.asp?QO\_VQ=EFD&QO\_anzr=Nv4yv0r%FDb0-gvzr%FDcr4s14zn0pr%FDQn6n&QO\_fu146\_anzr=b0-gvzr

Josephs, L. (2022, July 1). More than 12,000 flights delayed, hundred canceled during busy July Fourth weekend. CNBC. Retrieved August 14, 2022, from <https://www.cnbc.com/2022/07/01/airline-travel-of-july-weekend-puts-airlines-and-travelers-to-the-test-after-difficult-spring.html>