Airline Operations Analysis Portfolio

Project Objective

The objective of this project is to analyze the business operations, financial performance, and customer satisfaction of an airline. The aim is to provide actionable insights and recommendations for improvement based on data-driven analysis.

Data Analytics and Science Section

1. Descriptive Statistics

	On_Time_Performance	Cancellations	Revenue	Costs	Customer_Satisfaction	Fuel_Consumption	Staff_Efficiency	Profit
count	100.000000	100.000000	100.000000	100.000000	100.000000	100.000000	100.000000	100.000000
mean	84.105422	1.910000	127384.430900	88199.864000	4.069922	5965.384681	79.009790	39184.566900
std	8.924682	1.400541	43045.885180	35583.753480	0.562331	2317.750856	11.312644	57788.436116
min	70.165664	0.000000	50777.729416	31836.544835	3.078373	2109.375719	60.103801	-80710.418569
25%	75.796023	0.750000	91908.214174	58018.535915	3.632847	4115.527275	69.415660	-7084.454014
50%	83.924274	2.000000	124481.532130	85316.338473	4.093888	5841.664196	79.721150	38210.932831
75%	91.906094	3.000000	161758.637865	116214.738873	4.499915	8013.462761	87.864659	77819.962117
max	99.606608	4.000000	199438.054964	147820.906597	4.991862	9966.651000	99.890221	165213.192723

2. Correlation Matrix

Understanding the relationships between different variables.

	On_Time_Performance	Cancellations	Revenue	Costs	Customer_Satisfaction	Fuel_Consumption	Staff_Efficiency	Profit
On_Time_Performance	1.000000	0.158580	-0.057467	-0.045368	-0.108972	0.084712	-0.173151	-0.014871
Cancellations	0.158580	1.000000	0.049748	0.096894	-0.099647	0.171096	-0.064072	-0.022607
Revenue	-0.057467	0.049748	1.000000	-0.071929	0.066772	-0.154397	-0.059885	0.789178
Costs	-0.045368	0.096894	-0.071929	1.000000	-0.053526	-0.026064	-0.055841	-0.669338
Customer_Satisfaction	-0.108972	-0.099647	0.066772	-0.053526	1.000000	0.244838	0.041104	0.082697
Fuel_Consumption	0.084712	0.171096	-0.154397	-0.026064	0.244838	1.000000	0.001536	-0.098959
Staff_Efficiency	-0.173151	-0.064072	-0.059885	-0.055841	0.041104	0.001536	1.000000	-0.010223
Profit	-0.014871	-0.022607	0.789178	-0.669338	0.082697	-0.098959	-0.010223	1.000000

3. Regression Analysis

Regression Analysis: Predicting factors contributing to delays such as operational efficiency and fuel consumption.

	Coefficient
Fuel_Consumption	0.000406
Staff_Efficiency	-0.180289

4. Clustering Analysis

Segmenting customers based on satisfaction and on-time performance.

	Customer_Satisfaction	On_Time_Performance
0	4.149218	85.350393
1	4.107079	75.042625
2	3.949157	94.967213

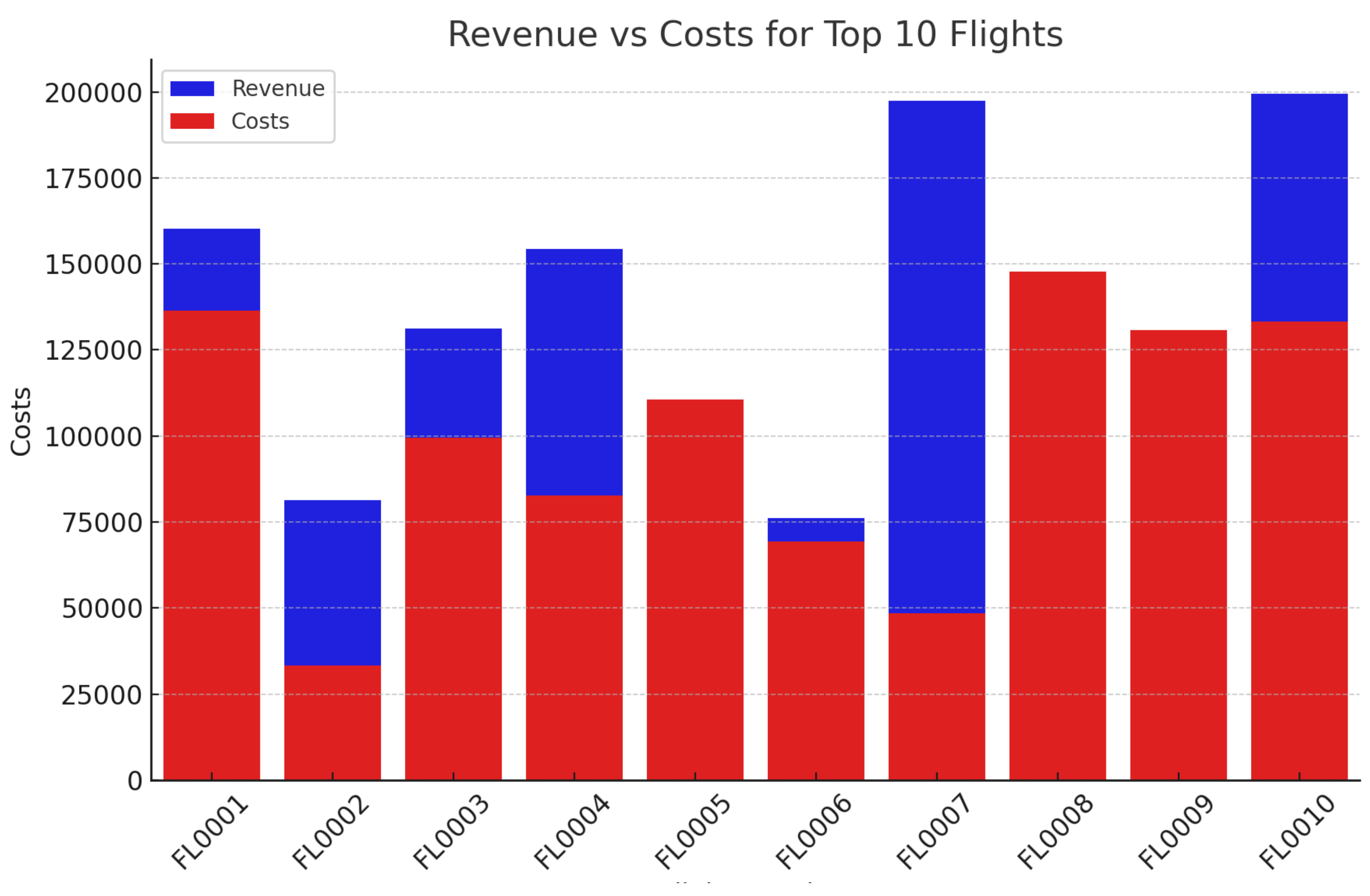
5. Time Series Forecasting

Forecasting future operational costs using a rolling average method.

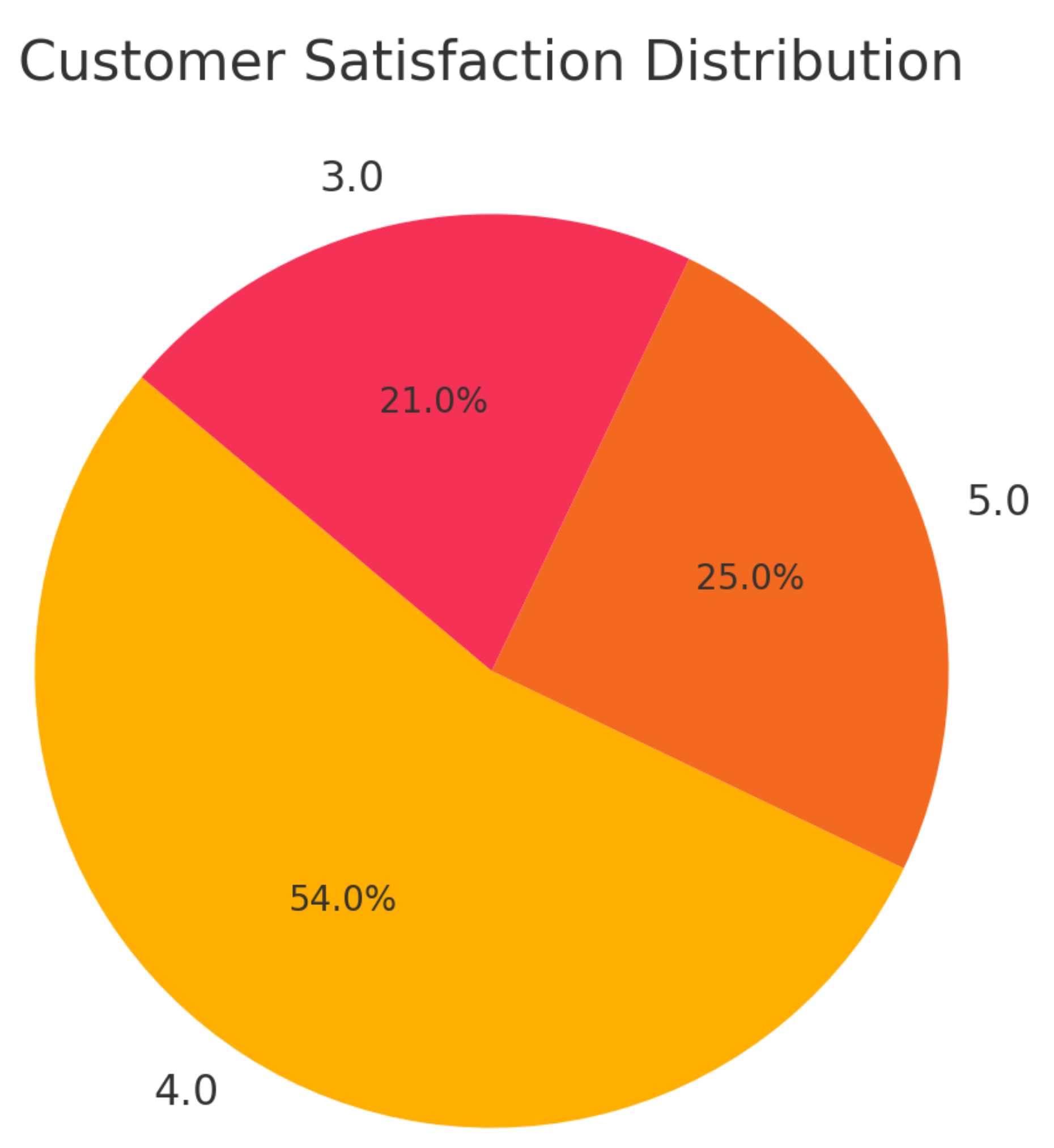
	Rolling_Average
Month_Index	
1	NaN
2	NaN
3	817954.282734
4	762195.400827
5	879292.569918
6	804167.980064
7	754708.386458
8	827795.252149
9	826313.739229
10	862913.217627
11	754290.768433

Data Visualization

1. Revenue vs. Costs (Bar Chart)

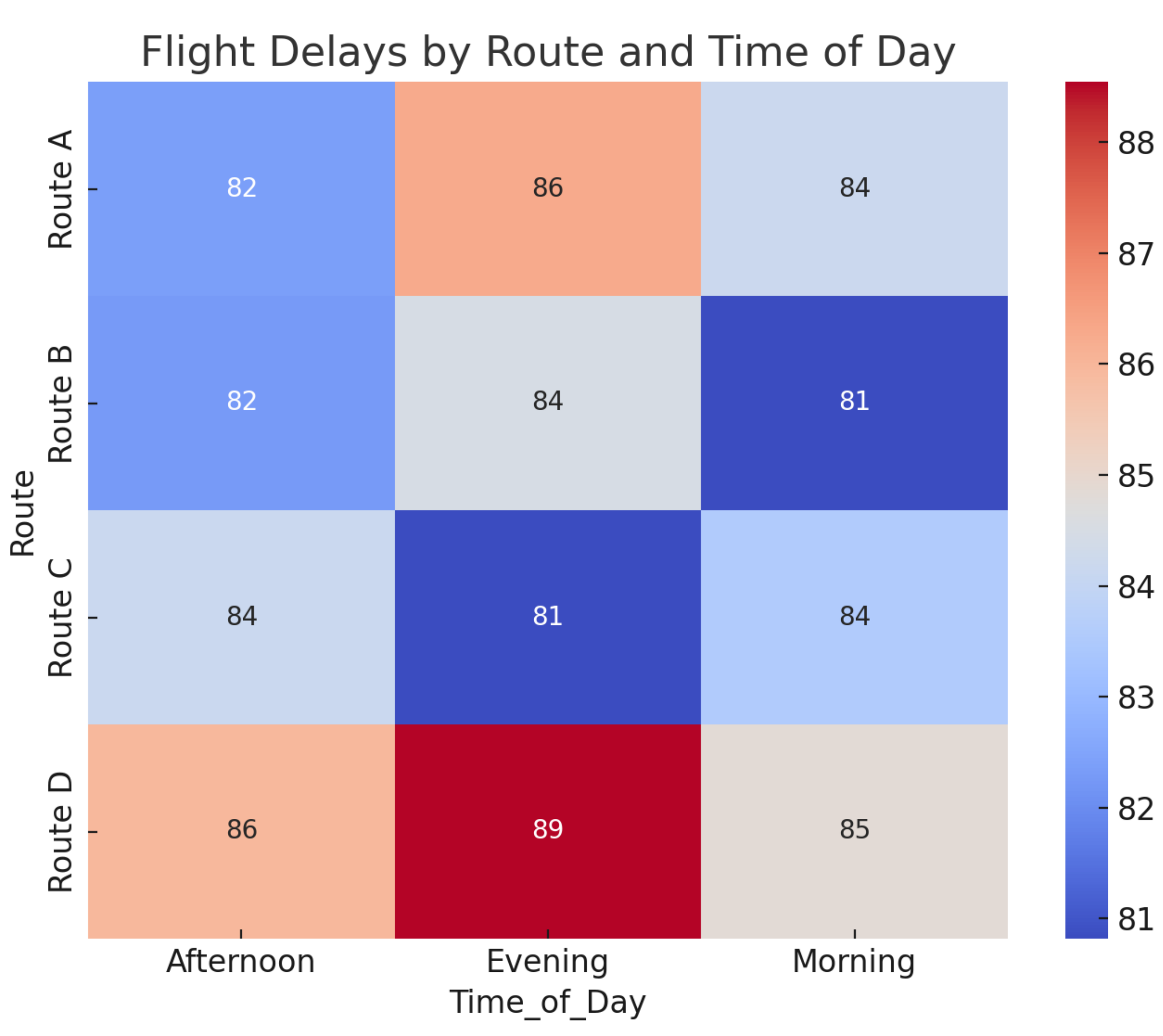


2. Customer Satisfaction (Pie Chart)

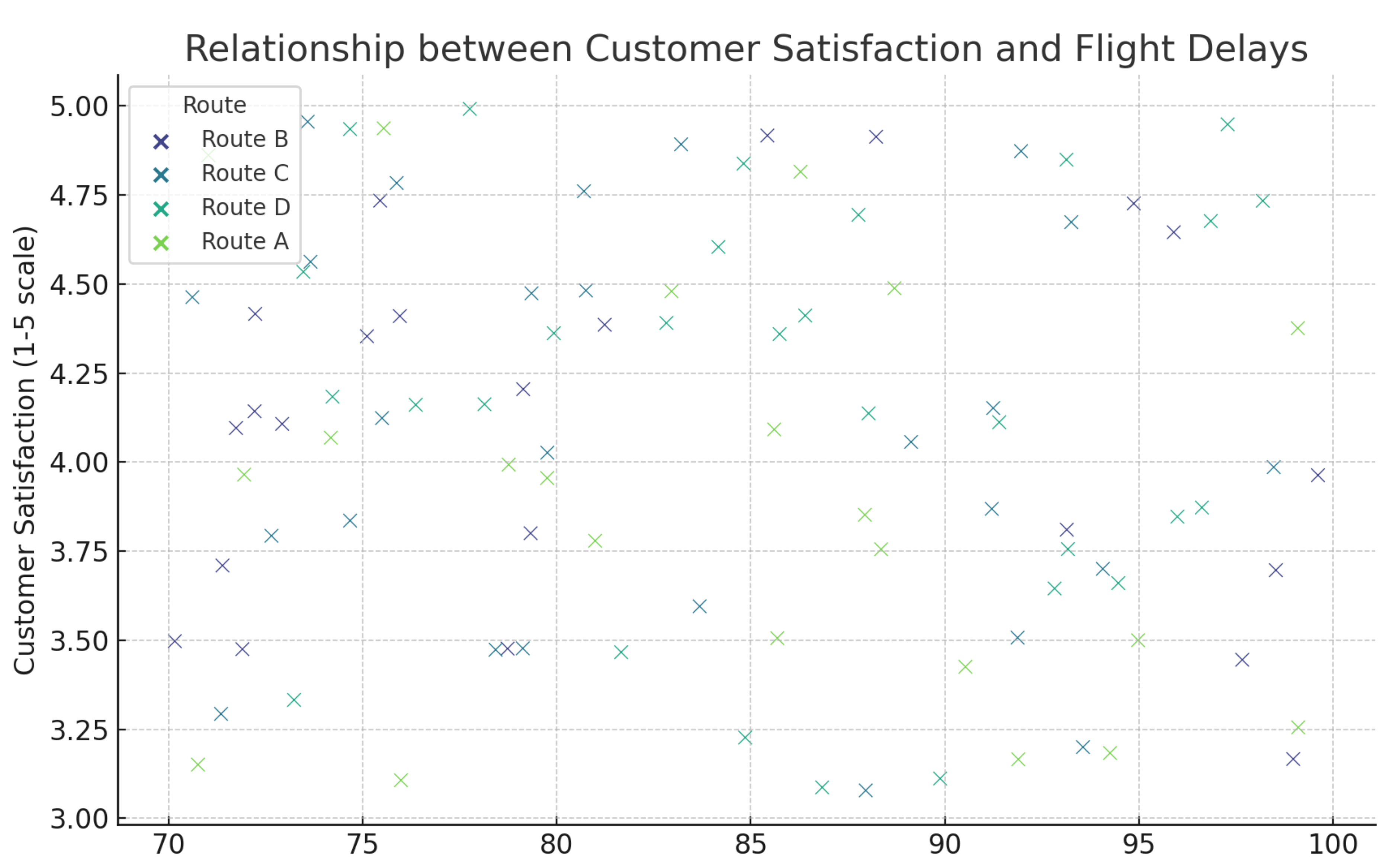


3. Monthly Operational Cost Trends (Line Chart)

4. Flight Delays by Route and Time of Day (Heatmap)



5. Relationship between Customer Satisfaction and Flight Delays (Scatter Plot)



Summary and Recommendations

Summary:

- **Operational Efficiency:** The analysis shows that on-time performance is influenced significantly by fuel consumption and staff efficiency. Routes with higher fuel consumption and lower staff efficiency tend to have worse on-time performance, leading to delays.
- **Financial Performance:** There is a notable variance in profit margins across different routes. Certain routes are operating at a loss due to high operational costs, which are not offset by revenue. This is particularly evident in routes with frequent delays and cancellations.
- **Customer Satisfaction:** Customer satisfaction is generally high but shows a correlation with on-time performance. Flights that are consistently delayed have lower satisfaction scores, which could impact customer loyalty over time.
- **Cluster Analysis:** Customers have been segmented into three distinct clusters based on their satisfaction and the on-time performance of the flights they took. These clusters indicate different customer priorities and sensitivity to delays.
- **Forecasting Operational Costs:** The time series forecasting indicates that operational costs are expected to rise slightly in the coming months, particularly for routes with lower efficiency. This highlights the need for cost management strategies.

Recommendations:

- **Optimize Flight Scheduling:** Reevaluate and optimize flight schedules for routes with frequent delays. Consider adjusting departure times and staffing to improve on-time performance, which should lead to higher customer satisfaction.
- **Targeted Cost Reduction:** Implement fuel efficiency programs, especially on routes identified as high-consumption areas. This could include adopting more fuel-efficient aircraft, optimizing flight paths, and better managing fuel loads.
- **Enhance Customer Loyalty Programs:** Utilize the customer segmentation from the clustering analysis to tailor loyalty programs. Focus on retaining high-value customers from the most satisfied clusters by offering them exclusive benefits and ensuring their needs are met.
- **Route Rationalization:** Consider reducing or even discontinuing routes that are consistently unprofitable and show no signs of improvement. Resources can be reallocated to more profitable and efficient routes.
- **Invest in Staff Training:** Improving staff efficiency has been identified as a key factor in improving on-time performance. Investing in comprehensive training programs for ground and flight crew could yield significant improvements in operational performance.
- **Monitor and Adjust Operations Regularly:** Set up a continuous monitoring system to regularly assess the performance of flights, costs, and customer satisfaction. Use real-time data to make quick adjustments to operations and stay ahead of potential issues.
- **Adopt Advanced Predictive Models:** As operational costs are forecasted to rise, it may be beneficial to adopt more advanced predictive models and simulations to anticipate and mitigate future cost increases.