Question 1a – Identify the Most and Least Trafficked Routes:

MOST TRAFFICKED ROUTES:

Sydney - Auckland: 2,961,212 passengers

Sydney - Singapore: 1,440,018 passengers

Sydney - Tokyo: 1,292,116 passengers

Sydney - Hong Kong: 1,151,900 passengers

Perth - Singapore: 952,926 passengers

Most trafficked: Sydney - Auckland (2,961,212 passengers)

LEAST TRAFFICKED ROUTES (non-zero only):

Hobart - Los Angeles: 2 passengers

Hobart - Tokyo: 1 passengers

Cairns - Honiara: 1 passengers

Townsville - San Francisco: 1 passengers

Darwin - Zagreb: 1 passengers

LEAST TRAFFICKED ROUTES:

Melbourne - Denver: 0 passengers

Perth - Bandar Seri Begawan: 0 passengers

Brisbane - Colombo: 0 passengers

Adelaide - Harare: 0 passengers

Brisbane - Chicago: 0 passengers

Least trafficked: Brisbane - Chicago (0 passengers)

Question 1b – Analyze Trends and/or Geographical Patterns:

YEARLY PASSENGER TRENDS

1985: 5,200,373 passengers

1986: 5,818,437 passengers

1987: 6,714,432 passengers

1988: 7,766,782 passengers

1989: 3,795,339 passengers

TOP 10 COUNTRIES BY PASSENGER TRAFFIC

New Zealand: 7,881,613 passengers

Singapore: 4,130,761 passengers

USA: 3,084,101 passengers

Hong Kong: 2,217,453 passengers

Japan: 1,773,146 passengers

UK: 1,729,405 passengers

Indonesia: 1,552,095 passengers

Fiji: 933,701 passengers

Thailand: 930,728 passengers

Malaysia: 835,317 passengers

TRAFFIC BY AUSTRALIAN PORT

Sydney: 15,499,688 passengers

Melbourne: 6,180,004 passengers

Brisbane: 3,153,897 passengers

Perth: 2,811,590 passengers

Adelaide: 604,937 passengers

Cairns: 474,393 passengers

Darwin: 277,604 passengers

Townsville: 110,539 passengers

Norfolk Island: 91,120 passengers

Hobart: 70,312 passengers

Port Hedland: 21,279 passengers

SEASONAL PATTERNS (AVERAGE BY MONTH)

Jan: 3,360 avg passengers

Feb: 2,699 avg passengers

Mar: 2,927 avg passengers

Apr: 2,764 avg passengers

May: 2,726 avg passengers

Jun: 2,709 avg passengers

Jul: 2,823 avg passengers

Aug: 3,048 avg passengers

Sep: 3,033 avg passengers

Oct: 2,982 avg passengers

Nov: 2,944 avg passengers

Dec: 3,237 avg passengers

DIRECTIONAL TRAFFIC ANALYSIS

Total Inbound: 14,898,445 passengers

Total Outbound: 14,396,918 passengers

Net Flow: 501,527 (positive = more arrivals)

Question 3a – Model Explanation:

I chose Exponential Smoothing and SARIMA models because I realized airline passenger traffic has specific patterns that needed specialized tools. Initially I considered using machine learning models like XGBoost or Random Forest, but that changed. I realized that I was trying to force general-purpose algorithms onto time-dependent data when these time series models were designed exactly for this type of problem. Halfway through building the model it became clear to me that passenger traffic follows predictable patterns - like holiday peaks and seasonal trends - those Exponential Smoothing captures well through its level, trend, and seasonal components. SARIMA adds another layer by learning that this January will probably look like last January, just adjusted for growth. Instead of picking one model upfront, I decided to test both and let the data decide - whichever had the lowest prediction error on test data won. Initially I had planned to build multiple complex models and ensemble them all together. However, I had to pivot and focus on these two core approaches that matched the structure of airline data. In terms of pure forecasting accuracy, I feel confident and believe that I was able to get good predictions with errors under 5% on major routes. I look forward to seeing how the model performs on future data.

Question 3b – Model Performance and Model Accuracy

I evaluated the model using a 6-month holdout test set. The model achieved a Mean Absolute Error of around 2,500 passengers per month on Sydney-Auckland, which is about 4.5% MAPE. Initially I tested both Exponential Smoothing and SARIMA, but Exponential Smoothing performed better on most high-traffic routes. The 95% confidence intervals captured actual values well during backtesting, though accuracy degraded slightly for 12-month forecasts versus 6-month ones. The model correctly identified seasonal patterns like December holiday peaks and summer increases. Performance was strongest on high-volume routes with consistent patterns - routes with sparse or irregular data had errors closer to 10% MAPE. In terms of limitations, the model assumes historical patterns continue and can't predict external disruptions. Overall, I feel confident the sub-5% error rate on major routes meets industry standards for airline forecasting.

Question 4a – Which routes AeroConnect invest more in or scale back from?

I would recommend AeroConnect to continue to invest into their current most trafficked routes which would be, Sydney-Auckland, Sydney-Singapore, Sydney-Tokyo, Sydney-HongKong, and Perth-Singapore. Additionally, I would recommend AeroConnect to invest more into the routes that fly to Singapore. For example, Perth which despite ranking 4th in traffic has one of the top 5 most flown routes, which is Perth to Singapore. Additionally, Singapore is the second most trafficked country. Outside from the data, Singapore is a major airplane hub that connects to every part of Asia, making it a very appealing place to fly to. Additionally on the east coast of Australia the only city that flies to Singapore would be Sydney, however there is probably a large population of Australians in Melbourne and Brisbane who would like to fly direct to Singapore but probably must first fly to Sydney or Perth first. Investing in direct flights in the 2nd and 3rd most trafficked airports could be good. In terms of scaling back I would recommend AeroConnect terminate the routes with little to no traffic. For instance, the least 5 trafficked routes as shown in my script should be terminated as paying the fees to maintain that route when you are only getting 2 trips is not profitable. The 5 least trafficked routes that are not 0 are:

Hobart - Los Angeles: 2 passengers

Hobart - Tokyo: 1 passengers

Cairns - Honiara: 1 passengers

Townsville - San Francisco: 1 passengers

Darwin - Zagreb: 1 passengers

Question 4b – How can AeroConnect use this model Going Forward?

A few ideas of how AeroConnect could use this model include:

- Using it monthly to run forecasts for major routes to generate predictions and adjust aircraft size and flight frequency based on predictions
- Help avoid under booking or overbooking
- Use the model to help price flights, In demand = higher price and vice versa
- Could modify and be used as a part of a greater dashboard
- Model maintenance whether it be re-training with data or just general tests
- Inform maintenance planning based on aircraft utilization
- Share with marketing for campaign timing
- Compare predictions vs actuals to identify model degradation