

# Assignment 3

**Topic: Measuring the Risks for Domestic Airlines**

**Total: 40 points**

**Deadline: September 2, 2024 (before midnight)**

1. The core criteria used to assess this assignment are:
  - a. **Knowledge and understanding:** Understanding of key ideas in Financial Modelling
  - b. **Application:** Ability to apply theoretical ideas, frameworks and quantitative risk models in practice and in a critically reflective way.
  - c. **Reasoning and analysis:** Ability to analyse, use critical reasoning and principles to formulate a position, balancing theory and personal reflection.
  - d. **Professional literacy:** Understanding of the risk management profession including recent issues, trends, cases and special terminology
  - e. **Communication and presentation:** Ability of communicate complex technical concepts clearly and effectively in writing
  - f. **Research:** Ability to explore a complex issue by finding and absorbing relevant documents suitable.

Suggested information sources

You may make use of academic sources such as

2. Berghöfer, B., & Lucey, B. (2014). Fuel hedging, operational hedging and risk exposure—Evidence from the global airline industry. *International Review of Financial Analysis*, 34, 124-139. along with some of the papers cited by Berghofer and Lucey
3. De Mello, L., Sheedy, E., & Storck, S. (2015). A Practical Guide for Non-Financial Companies When Modeling Longer-Term Currency and Commodity Exposures. *Journal of Applied Corporate Finance*, 27(1), 89-100.
4. Annual reports of domestic airlines may be a good source of information
5. Bodie, Z., Kane, A., & Marcus, A. (2018). Investments (11th global ed.). *Berkshire: McGraw-Hill Education*.

## Risk for Domestic Airlines

Australian airline: Qantas

- In March 2021, Qantas Airline generated revenues of \$35 million i.e., 700 flights producing (on average) \$50,000 each. Revenues are partly determined by demand from international visitors to Australia who are sensitive to currency movements. Assume that percent change in flights in the current month has a delta ( $\Delta$ ) of -0.70 with respect to returns in AUD exchange rate (expressed in US dollars) in the previous month. For example, the AUD appreciated by 1.70 in April so flights in May will be 1.29% lower at 690 (after rounding). We assume that there is currently plenty of capacity to meet any increase in the demand for flights.
- Every month Qantas has fixed costs of \$15 million (this includes debt servicing with interest costs fixed).
- The most significant variable cost is jet kerosene. Each flight requires (on average) 13 metric tonnes of jet kerosene. We assume that the USD price of jet kerosene at the start of the month will apply to all usage of jet kerosene during the month (USD 510.75 per metric tonnes as of 12<sup>th</sup> April 2021 will apply for the entire month of April). To convert to AUD, we convert at the spot exchange rate applying at the start of the month (0.76225 USD per AUD 12 April 2021 rate will apply for April).
- Other variable costs are \$9000 per flight.

	USD price of jet kerosene per metric tonne	USD per AUD
12 <sup>th</sup> April 2021	510.75	0.76225

1. Calculate the earnings before tax for Qantas Airline for the month of April 2021 expressed in AUD. **4 Points**
2. Compute the following table:

	Jet kerosene returns in USD	AUD/USD returns
Volatility per month (using all available data)		
Volatility per annum (using all available data)		
Mean per month (using all available data)		
Mean per annum (using all available data)		

**4 Points**

3. Assuming normality of returns and using the data from question 2, what is the probability that in any given month jet kerosene returns in USD will be lower than -23%? **4 Points**

4. Based on the empirical data, what is the actual probability that in any given month jet kerosene returns in USD will be lower than -23%? Compare with your answer in question 3 and discuss the implications. **4 Points**
5. Calculate the correlation between jet kerosene returns and AUD/USD returns using all available data and discuss the implications for Qantas Airline. **4 Points**
6. Simulate 1000 paths of monthly prices for the next 12 months (i.e., May 2020 to April 2021) for jet fuel and the AUD/USD assuming that:
  - a. The mean of log returns for both series is zero
  - b. The two series have a bivariate normal distribution
  - c. The volatility of jet fuel (in USD) is 11.52% per month
  - d. The volatility of AUD in USD is 3.16% per month.
  - e. The correlation between these two prices is 0.30

For each path calculate the earnings each month. For the first path you should show all your workings (no other calculations to be presented). Provide sufficient workings so the marker can follow your calculations.

Each time you hit the F9 button, Excel will recalculate everything with a new set of random numbers. Try doing this at least ten times and see how the EaR changes for different samples/ To reduce sampling error, take an average across the then different samples i.e. you now have a total of 10,000 Monte Carlo Simulations.

Complete the following table using the average across the ten samples. Discuss the effect of sampling error on the distribution of outcomes:

	Earnings over next 12 months
a) Maximum (of total earnings)	
b) 95 <sup>th</sup> percentile	
c) Median or 50 <sup>th</sup> percentile	
d) 5 <sup>th</sup> percentile	
e) Minimum	
f) Earnings at Risk (with 95% confidence) i.e. c. – d.	

**10 points**

7. You consider hedging the fuel price risk and /or the currency risk. To analyse this issue, copy the simulated earnings, jet kerosene and AUD for May 2020 to a new sheet i.e., you will have 1000 simulated values for each of earnings, jet kerosene and AUD.
  - a. Calculate the correlation between earnings and jet kerosene from these simulated values.
  - b. Calculate the correlation between earnings and AUD/USD from these simulated values.

- c. Calculate the minimum variance hedge for jet kerosene (assuming no currency hedge).
- d. Calculate the minimum variance hedge for currency (assuming no fuel hedge).
- e. Now perform a regression analysis where your dependent variable is simulated earnings; your independent variables are simulated jet kerosene and simulated AUD/USD.

If Qantas Airline was motivated to hedge market risk, what would be the most efficient way of achieving this based on the analysis in a) to e)? Justify your answer. (*Hint: please refer to slides for hedging*) You can download, monthly futures and monthly spot of exchange rate from the following sources:

<https://www.ofx.com/>    <https://www.investing.com/>

- f. Calculate the time-varying volatility using univariate GARCH models and explain the major features of all these models. You have to explain the results and plot the time-varying conditional volatility. Calculate for Jet Kerosene and USD/AUD
- g. Calculate the time-varying conditional correlation using DCC model and plot the time-varying hedge ratio. Please form the pairs of Jet/Kerosene AUD/USD.

**10 points**