# Question 6

**Steps to stimulate data:  
1) Set Parameters for Simulation**

You need the following key parameters:

Volatility of Jet Kerosene: **11.52% per month**

Volatility of AUD/USD: **3.16% per month**

Correlation between Jet Kerosene and AUD/USD: **0.30**

**2) Generate Random Numbers for Simulations**

Generate Random Variables from a bivariate normal distribution using Excel’s **=NORM.S.INV(RAND())**. To account for the correlation, we need to generate correlated random variables.

A square root of a mathematical equation

Description automatically generated**Correlate the Random Variables**:

Use the Cholesky decomposition of the correlation matrix to correlate your two random variables. The Cholesky decomposition for a 2x2 correlation matrix can be written as:

We can use: **=0.30 \* (Random value 1) + SQRT(1 - 0.30^2) \* (Random value 2)** to generate correlated value.

**3) Simulate Jet Kerosene and AUD/USD prices:**

Assuming a mean log return of zero, simulate the future prices as:

New Price=Previous Price×exp(σJet Kerosene​×Random Value)

New Rate=Previous Rate×exp(σAUD/USD​×Correlated Random Value)

**4) Generate 10 Simulations with 1000 Paths each**

First create a generator template by creating one path using above formulas dragging it to autofill 1000 paths. Next copy these 1000 paths and paste them **as values** separately so the values do not change for future calculations each time we refresh. Do this 10 time to get 10 Simulations.

**5) VBA Code to extract Earnings and Yearly Earnings**

**To Extract all earnings from Simulation:**

Sub ExtractData()

Dim wsSource As Worksheet

Dim wsDest As Worksheet

Dim i As Integer, j As Integer, k as Integer

Set wsSource = ThisWorkbook.Sheets("Simulations")

Set wsDest = ThisWorkbook.Sheets("Earnings")

For i = 1 To 10

For j = 1 To 1000

For k = 1 to 12

wsDest.Cells(j+1, i).Value = wsSource.Cells(3 + (i - 1) \* 16 + k , 9\*j).Value

Next k

Next j

Next i

End Sub

**To Find Yearly Earnings:**

Sub ExtractData()

Dim wsSource As Worksheet

Dim wsDest As Worksheet

Dim sum as Double

Dim i As Integer, j As Integer, k as Integer

Set wsSource = ThisWorkbook.Sheets("Earnings")

Set wsDest = ThisWorkbook.Sheets("Yearly Earnings")

For i = 1 To 10

For j = 1 To 1000

sum = 0

For k = 1 to 12

sum = sum + wsSource.Cells(12\*(j-1) + k +1 , i).Value

Next k

wsDest.Cells(j,i)=sum

Next j

Next i

End Sub

**ANSWERS:**

|  |  |  |
| --- | --- | --- |
|  | Earnings over next 12 months | Formulas |
| a) Maximum (of total earnings) | 176910160.4 | =MAX('Yearly Earnings'!A1:J1000) |
| b) 95th percentile | 137608095.8 | =PERCENTILE.INC('Yearly Earnings'!A1:J1000, 0.95) |
| c) Median or 50th percentile | 103763579.2 | =MEDIAN('Yearly Earnings'!A1:J1000) |
| d) 5th percentile | 63624071.53 | =PERCENTILE.INC('Yearly Earnings'!A1:J1000, 0.05) |
| e) Minimum | 2092077.155 | =MIN('Yearly Earnings'!A1:J1000) |
| f) Earnings at Risk (with 95% confidence) i.e. c. – d. | 40139507.65 | =B4-B5 |

# Question 7

**VBA Code to extract May data:**

**For Extracting May data for all (10 Simulation, 1000 paths):**

Sub ExtractData()

Dim wsSource As Worksheet

Dim wsDest As Worksheet

Dim i As Integer, j As Integer

Set wsSource = ThisWorkbook.Sheets("Simulations")

Set wsDest = ThisWorkbook.Sheets("May Data")

For i = 1 To 10

For j = 1 To 1000

wsDest.Cells(j + 2, 3 \* (i - 1) + 1).Value = wsSource.Cells(3 + (i - 1) \* 16 + 1, 9 + 9 \* (j - 1)).Value 'Earnings

wsDest.Cells(j + 2, 3 \* (i - 1) + 2).Value = wsSource.Cells(3 + (i - 1) \* 16 + 1, 6 + 9 \* (j - 1)).Value 'Jet Kerosene

wsDest.Cells(j + 2, 3 \* (i - 1) + 3).Value = wsSource.Cells(3 + (i - 1) \* 16 + 1, 7 + 9 \* (j - 1)).Value 'AUD/USD

Next j

Next i

End Sub

1. **Correlation between earnings and jet kerosene:**

Use **=** **CORREL('May Data'!A3:A1002,'May Data'!B3:B1002)** to get correlation for simulation 1. Repeat for all 10 simulations, adjusting the values of Columns.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Correlation: earnings and jet kerosene | | | | | | | | | |
| Simulation 1 | Simulation 2 | Simulation 3 | Simulation 4 | Simulation 5 | Simulation 6 | Simulation 7 | Simulation 8 | Simulation 9 | Simulation 10 |
| -0.81759 | -0.8033 | -0.78122 | -0.81003 | -0.79809 | -0.81725 | -0.81463 | -0.78516 | -0.80659 | -0.80717 |

1. **Correlation between earnings and AUD/USD:**

Use **=** **CORREL('May Data'!A3:A1002,'May Data'!C3:C1002)** to get correlation for simulation 1. Repeat for all 10 simulations, adjusting the values of Columns.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Correlation: earnings and AUD/USD | | | | | | | | | |
| Simulation 1 | Simulation 2 | Simulation 3 | Simulation 4 | Simulation 5 | Simulation 6 | Simulation 7 | Simulation 8 | Simulation 9 | Simulation 10 |
| -0.82169 | -0.8101 | -0.8122 | -0.80488 | -0.79603 | -0.81456 | -0.80759 | -0.81223 | -0.81261 | -0.79068 |