UNIVERSITY OF JOHANNESBURG

Department of Finance and Investment Management

Applied Financial Markets Analysis

FINAL ASSESSMENT OPPORTUNITY

2021

Time: 3 hours **Marks: 50**

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INSTRUCTIONS:

- This paper consists of 8 pages and an excel workbook with 4 sheets.
- Answer ALL questions.
- Silent, non-programmable calculators may be used, unless otherwise instructed.
- Show all calculations clearly.
- Answers with Tippex and in pencil will not be marked.
- Scratch out open spaces and empty pages.
- Round answers to 4 decimal places where necessary.

PART 1:

1. An analyst is evaluating two shares A and B to determine the viability of a two-asset portfolio consisting of them. There is a 0.65 correlation between these shares currently.

Cell Reference	Parameter	Value
D2	Variance of A	25%
E2	Variance of B	20%
D3	Weight of A	0.35
E3	Weight of B	0.65

To compute the portfolio volatility the correct formula in excel is:

a. =SQRT((25%^2)*(0.35)^2+(20%)*(0.65)^2+2*25%*20%*0.35*0.65)
b. =SQRT(D2^2*D3^2+E2^2*E3^2+2cov(A,B))
c. =SQRT(D2^2*D3^2+E2^2*E3^2+2*D2*E2*D3*E3)
d. =(D2*D3^2+E2*E3^2+2*COVAR(A,B)*CORREL(A,B))

2. Cell **F15** contains a portfolio volatility which was derived from weekly returns data that were computed from the Friday closing prices of the past 48 months. Using the square root rule to annualise the volatility, considering different time horizons; 250 trading days, 52 weeks and 12 months,

Hint: J-period volatility =$\sqrt{J}$ Multiplied by 1 period volatility.

Which one of the following answers is correct?

a. =SQRT(250)*F15
b. =SQRT(F15)*250
c. =SQRT(52)*F15
d. =F15*250

3. The table below is a summary for a two-asset portfolio consisting of monthly return data with closing prices at the end of each month for a period of three years. The file consists of about 72 rows with returns calculations ranging from **C2:D73**.

Parameter	Cell Reference
Variance of A	F2
Variance of B	G2
Weight A	F3
Weight B	G3
Correlation(A,B)	H5

Which one of the following is the correct syntax for calculating the correlation in excel?

a. =Cov(A,B)/(SigmaA*SigmaB)
b. =COVARIANCE(F2:F73;G2,G73)/(STD(F2)*STD(G2))
c. =COVARIANCE.P(F2:F3;G2:G73)/(F2*G2)
d. =COVAR(FS:F73,G2:G73)/(SQRT(F2)*SQRT(G2))

4. Using the same data from the previous question what is the syntax for volatility of the portfolio, given that the portfolio consist of a long position in share A and a short position in share B;

    a. =SQRT((F2)^2*(F3)^2+(G2)^2*(G3)^2+2*F2*G2*F3*G3)
    b. = SQRT((F2)^2*(F3)^2+(G2)^2*(G3)^2+2*F2*G2*F3*G3*H5)
    c. = SQRT((F2)^2*(F3)^2+(G2)^2*(G3)^2+2* COVARIANCE.P(F2:F3,G2:G73))
    d. = SQRT((F2)^2*(F3)^2+(G2)^2*(G3)^2-2*F2*G2*F3*G3*H5)

5. Multiplying an N row **Matrix A**, by an M columns **Matrix B**, result in an N X M matrix; **Matrix A** ranges from area **B2:D3** while **Matrix B** ranges from **F2:G4**.
   Which one of the following is the correct syntax for multiplying **Matrix A** by **Matrix B** in excel, without realising the error message after hitting enter.

    a. =MMULT(B2:D3 F2:G4) then press Ctrl+Shift+Enter
    b. =MMULT(B2:D3; F2:G4) then press Ctrl+Shift+Enter
    c. =MMULT(B2:D3;F2:G4) then press Ctrl+Shift+Enter
    d. =MMULT(B2:D3 , F2:G4) then press Ctrl+Shift+Enter

6. The following is a portfolio variance matrix with N rows.

$$\sigma_p^2$$

$$\sigma_p^2 = [w_1 \ \ldots \ w_N] \begin{bmatrix} \sigma_i^2 & \sigma_{12} & \sigma_{13} \cdots & \sigma_{1N} \\ \vdots & & \ddots & \vdots \\ \sigma_{N1} & \sigma_{N2} & \sigma_{N3} \cdots & \sigma_N^2 \end{bmatrix} \begin{bmatrix} w_1 \\ \vdots \\ w_N \end{bmatrix}$$

   Which one of the following is the correct number of individual variances?

    a. N(N-1)/2
    b. N(M)
    c. N^2
    d. N

7. Which one of the following methods for calculating returns is time consistent?

    a. Absolute return
    b. Simple return
    c. Continuously compounded
    d. None of the above

8. A file consists of daily exchange rate data for the USD to ZAR from which we are required to calculate the daily returns. The first two exchange rate values are in cells **A2** and **A3**, and your first return calculation should be in cell **B3**.
   We are concerned about the stationarity of our financial time series and therefore the preferred method for calculating returns taking into account your answer in the previous question should be:
    a. =(A3-A2)/A2
    b. =(1+R)*A2
    c. =(A3/A2-1)
    d. =LN(A3/A2)

9. Considering the optimization statement;

Find the minimum variance

$$\sigma_p^2 = w'\Sigma w$$

Subject to constraints

$$E(R_p) = \mu_p = \mu w'$$

$$w' = 1$$

Which one of the following entries about Solver parameters is incorrect?

a. Set objective to minimum
b. Weights should be changed by optimisation algorithm
c. Sum of weights should never exceed one
d. None of the above

10. In excel the multi-asset portfolio variance syntax is:
=MMULT(MMULT(covarmatrix,weightvector),TRANSPOSE(weightvector))

a. True
b. False

11. Given the following covariance matrix that was produced using Data Analysis Add-in;

	Column 1	*Column 2*	*Column 3*	*Column 4*	*Column 5*
Column 1	140.3125000	C2	C3	C4	
Column 2	21.1093750	436.2460938			F3
Column 3	-13.4843750	78.6132813	32.5898438		
Column 4	16.1875000	41.0937500	7.6562500	9.3750000	
Column 5	-177.6875000	-583.9062500	-173.7812500	-115.0625000	1916.1250000

The correct entries for cell C4 and F3 are:

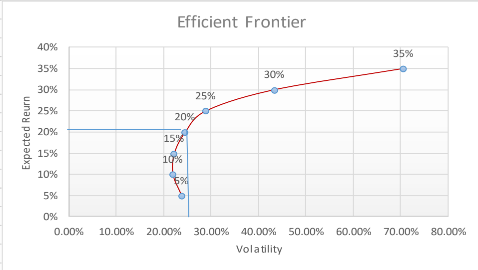
a. 16.1875000 and 41.0937500
b. 41.09397500 and -583.9062500
c. -177.687500 and 78.6132813
d. 16.1875000 and -583.9062500

12. Given the portfolio variance as $\sigma_p^2 = w'\Sigma w$ for daily returns data, which of the following is the correct syntax for the volatility

a. =MMULT(MMULT(N5:R5,O18:S22),TRANSPOSE(N5:R5))
b. =MMULT(MMULT(N5:R5,O18:S22),TRANSPOSE(N5:R5))*250
c. =MMULT(MMULT(N5:R5,O18:S22),TRANSPOSE(N5:R5))*SQRT(250)
d. None of the above

13. The following set of points and the corresponding graph were derived from Solver iterations:

Target Return $E(R_p)$	Volatility (σ)
-7%	N/A
-6.50%	N/A
5%	23.76%
10%	21.93%
15%	22.21%
20%	24.51%
25%	28.88%
30%	43.35%
35%	70.52%
40%	N/A



Beyond which point (co-ordinates) of the curve in the above picture is the efficient frontier formed?

a. (22.21%; 15%)
b. (25.51%; 20%)
c. (28.88%; 25%)
d. (23.76%; 5%)

14. The following worksheet is used to calculate the bond price and the bond yield:

			Maturity	Zero Rate	PV	Coupon	Cash Flow
c	10.00%	coupon					
y	0.00%	yield	0.5	2.50%	0.98758	5.00	4.94
m	2	conversions	1	2.75%	0.97287	5.00	4.86
FV	100	Face value	1.5	3.00%	0.95600	5.00	4.78
			2	3.15%	0.93894	5.00	4.69
			2.5	3.75%	0.91051	5.00	4.55
			3	4.00%	0.88692	5.00	93.13
							116.96

Goal Seek ? ×
Set cell: H18
To value: 116.96
By changing cell: B3
OK Cancel

Maturity	Yield	PV	Coupon	Cash Flow
0.5		1.00000	5.00	5.00
1		1.00000	5.00	5.00
1.5		1.00000	5.00	5.00
2		1.00000	5.00	5.00
2.5		1.00000	5.00	5.00
3		1.00000	5.00	105.00
				130.00

We used excel ***Use from selection*** to rename cells in the range **A2:B5** seeing that all inputs in the range are constants. The following is the formula in excel for calculating the semi-annual coupon value:

a. =B2
b. =B2/2
c. =c_*100
d. =c_/m*FV

15. Using the same data from the previous question what is the formula for the last entry comprising both coupon and face value.
    a. =c_*100
    b. =c_/2*100
    c. =FV*(1+c_/Fv)
    d. =FV*(1+c_/m)

16. For a ten year zero coupon bond with the price of R96.65 and a yield of 6.5% what is the duration.
    a. 9.65 years
    b. 9.50 years
    c. 10 years
    d. None of the above

17. Price has a direct relationship with yield as evidenced by the increasing prices with an increase in interest rates.

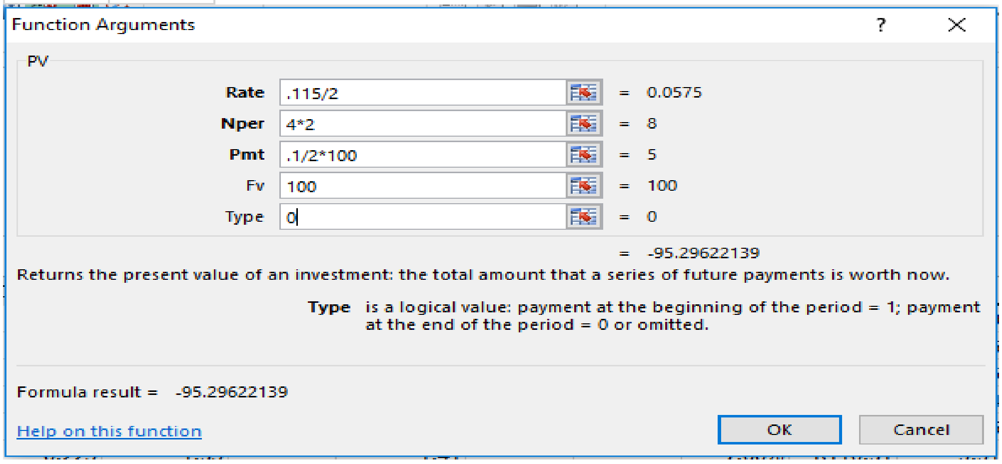
    a. True
    b. False

18. Unlike duration which measures small changes in the price/yield relationship, convexity is a measure of curvature associated with small movements, and it can also be used for hedging.

    a. True
    b. False

19. Using the entry form below to calculate the price for a four year 10% coupon bond with a face value of R 100 and 11.5% yield, coupon is paid semi-annually.

c	10.000%
n	4
m	2
y	11.500%
FV	100



Highlighting **A2:B6** and from the Excel ribbon selecting **Formulas**, we used **Define Names** and select **Create from Selection**, to define inputs as constants; If the cell **E5** uses the excel build-in formula what is the correct syntax for calculating the price of the bond.

a. =PV(0.115/2,4*2,0.1*100)
b. =PV(y,n,c,100)
c. =PV(y/2,n*m,0.10/2,100)
d. =PV(y/m,n*m,c/2*FV,FV,0)

20. Given the extract from the worksheet below about the same bond as per the previous question where rates are semi-annually compounded:

	A	B	C	D	E	F	G	H	I
1				Periods	Payment	PV	Weights	Duration	Convexity
2	c	10.000%		1	5.00	4.73	0.050	0.050	0.05
3	n	4	Years	2	5.00	4.47	0.047	0.094	0.19
4	m	2		3	5.00	4.23	0.044	0.133	0.40
5	y	11.500%		4	5.00	4.00	0.042	0.168	0.67
6	FV	100		5	5.00	3.78	0.040	0.198	0.99
7	Price			6	5.00	3.58	0.038	0.225	1.35
8				7	5.00	3.38	0.035	0.248	1.74
9				8	105.00	67.13	0.704	5.636	45.09
10						95.30		6.752	50.48

Which one of the following is the correct syntax for the entry in **F2** under PV column?

a. =E2/(1+y_/m)^D2
b. =E2*EXP(-y_*2)
c. =E2/(1+c_/m)^D2
d. None of the above

PART 2:

Question 2

You have been provided with daily closing prices for Gold and the USD to ZAR rates for the period 18/10/2019 to 19/10/2021. A summary of statistics for both time series based on their log-returns, has also been provided. A hedge ratio is computed according to the equation

$$h = \rho_{12} \frac{\sigma_1}{\sigma_2}$$

We assume that asset 1 is gold and asset 2 is USDZAR, so that σ_1 and σ_2 are volatilities for gold and USDZAR respectively, and that their correlation is ρ_{12}.

You are required to compute the following.

a) Strictly using the **Add-Trendline** technique in Excel, calculate the correlation between gold and USD returns. (Do not confuse the coefficient of determination with regression). 4 Marks.

b) Compute the hedge ratio using the equation provided. 2 Marks

c) Using the third moment from the summary provided, one of the assets has a frequency of more negative returns, which one is it.? 2 Marks

d) What is the value of that moment? 1 Mark

10 Marks.

Question 3

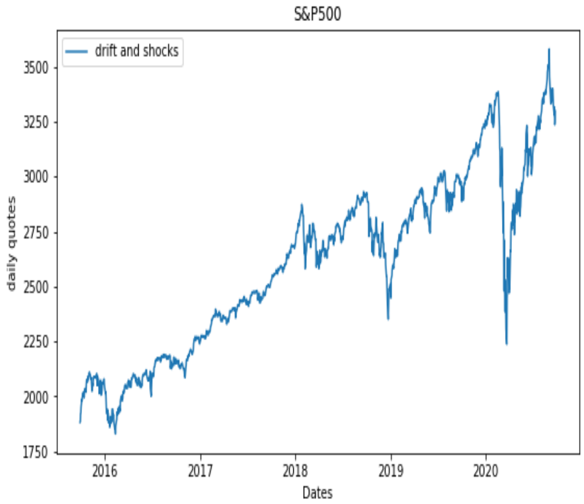
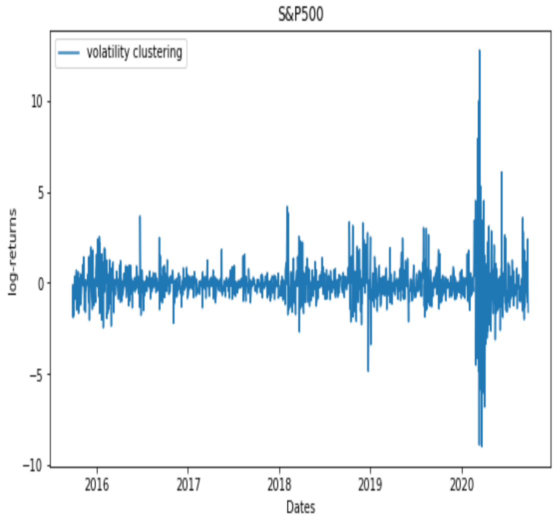


Figure3(a)

Figure`3(b)



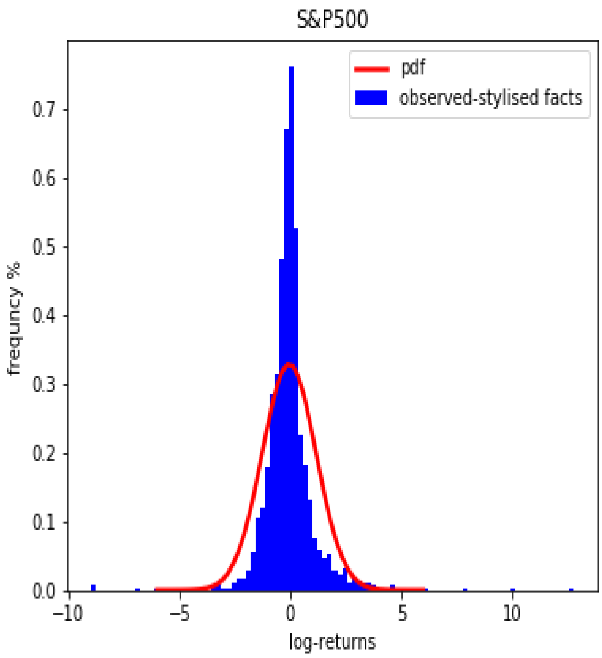


Figure3(c)

The above plots are based on daily adjusted closing prices of the S&P500 for the 5 years period between 2015 to 2020. Each plot has a topic labelled as a legend such as “drift and shocks”, “volatility clustering” and “stylized facts”.

You are required to analyse and discuss each plot in terms of topics provided.

3.1 Figure 3(a): drift and shocks, 3 Marks

3.2 Figure 3(b) volatility clustering. 3 Marks

3.3 Figure 3(c): Stylized facts and characteristics of the return distribution. 4 Marks.

Question 4

Using the same time series for USDZAR from Question2, some Investment Analyst from a Consulting firm that advice your asset management firm is arguing that Rand dollar does not mean-revert. The only tool at our disposal is the Vasicek model which is represented as:

$$\boldsymbol{dt = \kappa(\mu - r_t)dt + \sigma dZ}$$

You are required to perform the following**:**

a) Test for mean-reversion using data provided. 5 Marks

b) Estimate the long-run mean is $\boldsymbol{\hat{\mu}} = \frac{\boldsymbol{\kappa\mu}}{\boldsymbol{k}}$ 2 Marks

c) Compute the estimate of volatility $\boldsymbol{\hat{\sigma}}$ 3 Marks

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