CERTIFIED PUBLIC ACCOUNTANT

FOUNDATION LEVEL 1 EXAMINATIONS

F1.1: BUSINESS MATHEMATICS AND QUANTITATIVE METHODS

DATE: THURSDAY, 31 MARCH 2022

INSTRUCTIONS:

1. **Time Allowed: 3 hours 15 minutes** (15 minutes reading and 3 hours writing).
2. This examination has **seven** questions and only **five** questions **should** be attempted.
3. Marks allocated to each question are shown at the end of the question.
4. Show all your workings where applicable.
5. The question paper should not be taken out of the examination room.

QUESTION ONE

(a) Enumerate any two rules for drawing a network of a certain project. (2 Marks)

(b) Given the following Table representing a certain project the given time estimates in weeks

Activities of the project and duration in weeks

Activity	Optimistic time estimate (to)	Most likely time estimate ™	Pessimistic time estimate (tp)
1-2	3	6	9
1-6	2	5	8
2-3	6	12	18
2-4	4	5	6
3-5	8	11	14
4-5	3	7	11
6-7	3	9	15
5-8	2	4	6
7-8	8	16	18

Find out:

(i) The time estimate of activities (5 Marks)

(ii) The variance and standard deviation of the project (5 Marks)

(c) Project Manager of BC firm plan to complete project of building warehouse in 25 weeks. The project consist of nine activities (A, B. C, D, E, F, G, H and I). Table below summarize the activities, their preceding activities times and costs.

		Time (weeks)		Cost (FRW)	
Activity	**Preceding activities**	**Normal**	**Crash**	**Normal**	**Crash**
A	-	3	1	100,000	300,000
B	-	4	3	400,000	600,000
C	A	2	2	200,000	200,000
D	B	6	4	300,000	600,000
E	C	5	4	250,000	380,000
F	D	3	2	150,000	300,000
G	E	7	4	450,000	810,000
H	F	5	4	300,000	360,000
I	F,G,H	8	5	800,000	128,000

Required:

i) Find the total cost of performing the project in the normal time of 25 weeks. (2 Marks)

ii) Calculate the cost per week. (2 Marks)

iii) Find the critical path(s). (1 Mark)

iv) Find the saving that the consultancy realizes by reducing the project completion time to 16 weeks. (3 Marks)

(Total: 20 Marks)

QUESTION TWO

(a) Discuss the four components of Time Series (4 Marks)

(b) Output at a factory appears to vary with the day of the week. Output over the last three weeks has been as follows in the Table below:

Time series data

Details	Week 1 units "000"	Week 2 units "000"	Week 3 units "000"
Monday	80	82	84
Tuesday	104	110	116
Wednesday	94	97	100
Thursday	120	125	130
Friday	62	64	66

Required:

Find the trend (T) and seasonal variation (Y-T) using the moving averages of 5 days method and provide a suitable interpretation (8 Marks)

(c) Define the exponential smoothing method and mention its two limitations (3 Marks)

(d) Consider the sales captured in table below:

Two variables' data

Week	1	2	3	4	5	6
Sales (Y_t)	130	70	140	150	90	180

Required:

(i) Use the exponential smoothing model with $\alpha = 0.3$ to predict the volume of sales for the above time periods. (3 Marks)

(ii) Compute also the forecast error (2 Marks)

(Total: 20 Marks)

QUESTION THREE

(a) The small firm X Ltd likes to give all its workers a New Year party. The snacks are provided from X Ltd stock, but they have to buy their own drinks. They buy bottles of red and white wine (all at one price), packs of beer also all at one price and bottles of soft drinks which are also priced the same as each other. The first Christmas party was in 2010. It was a great success and so has been held every year since. We'll now look at how we can use index numbers to compare the cost for the base period of 2010 against the cost for a later period, taking the particular year of 2014.

Price index data

	Price (FRW "000"/unit)		Quantity in litre	
Drink	**2010**	**2014**	**2010**	**2014**
Wine	9.3	4.5	100	90
Beer	6.4	3.7	11	10
Soft drinks	5.1	2.7	5	3

Required:

Compute the quantity index by using Fisher's formula from the data given in the above table

(10 Marks)

b) A workshop contains four persons available for work on the four jobs. Only one person can work on any one job. The following table shows the cost of assigning each person to each job.

		Jobs			
		1	**2**	**3**	**4**
Persons	**A**	20	25	22	28
	B	15	18	23	17
	C	19	17	21	24
	D	25	23	24	24

Required:

Use the Hungarian algorithm to assign person to jobs such that the total assignment cost is a minimum

(10 Marks)

(Total: 20 Marks)

QUESTION FOUR

(a) Enumerate three properties of a Poisson distribution in probability (3 Marks)

(b) In a certain campus of University of Rwanda, the students engage in different sports in the following proportions:

- 60 % of all students play football
- 50 % of all students play handball
- 30 % of all students play football and handball

Required:

If a student is selected at random, what is the probability that he/she will:

(i) Play football or handball (2 Marks)

(ii) Play neither sport (2 Marks)

(c) The management of Kilino photograph record company has discovered that the number of defects in records appears to follow a Poisson distribution with a mean value equal to 0.4.

Required:

(i) What is the probability that a record selected at random will have three defects? (2 Marks)

(ii) If the management sets a policy that all photograph record sold to customers must not have any defect, **what percentage of its records production will not be made available for sales because of defects? ($e^{-4} = 0.01832$, $e^{-0.4} = 0.6703$)** (2 Marks)

(d) The following Table 7 gives distribution of wages (in thousands FRW):

Wages distribution

Wages per month	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70
No. of wages earners	9	108	488	230	112	30	16	7

An individual is selected at random from the above group.

Required:

Find the probability that:

(i) His wages are under 40 (2 Marks)

(ii) His wages are 55 or over (2 Marks)

(iii) His wages are either between 35-40 or 45-50 (2 Marks)

(e) Given the discrete probability distribution of the random variable X represented by the table below

Random numbers distribution

x_i	-2	-1	0	1	2
p_i	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{5}$	$\frac{1}{8}$	$\frac{3}{10}$

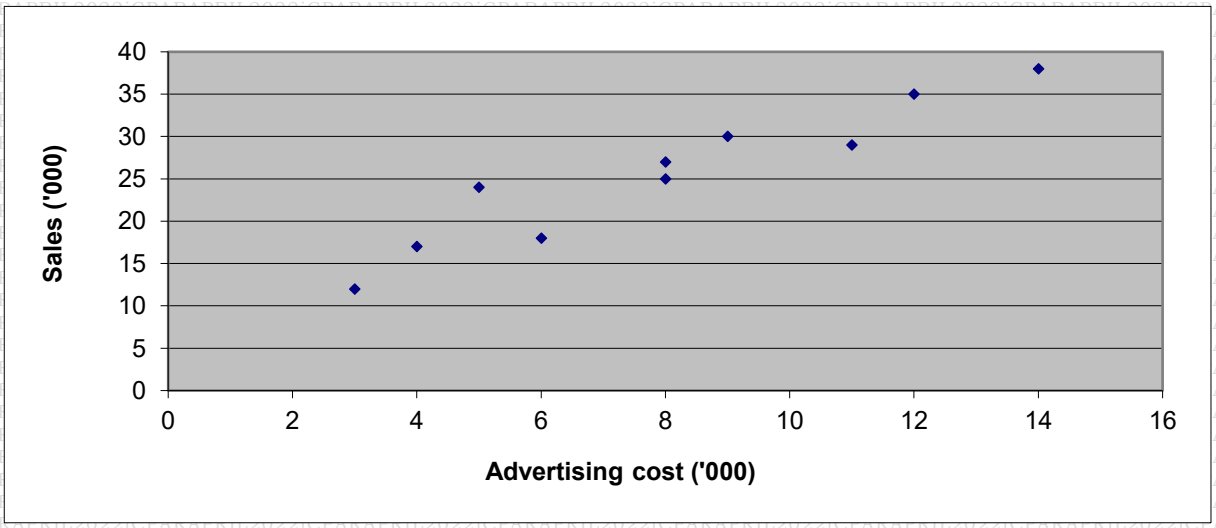
Required:

Calculate the mean and standard deviation of the random variable X. (3 Marks)

(Total: 20 Marks)

QUESTION FIVE

(a) Provide a suitable interpretation of the following scatter diagram in regression analysis (3 Marks)



(b) A game is represented by the following pay off matrix:

		Player B			
		I	II	III	IV
Player A	1	4	2	3	6
	2	3	4	7	5
	3	6	3	5	4

Required:

Compute the value of the game and optimal strategies. (8 Marks)

(c) Below are given the figures in Table 9 of production (in thousand quintals) of a sugar factory:

Sugar production data

Year	1992	1993	1994	1995	1996	1997	1998
Production	80	90	92	83	94	99	92

Required:

(i) Fit a straight line trend to these figures from the Table 9 (5 Marks)

(ii) Plot these figures on a graph and show the trend line (3 Marks)

(iii) Estimate the production in 2001 (1 Mark)

(Total: 20 Marks)

QUESTION SIX

(a) State two advantages of an arithmetic mean (2 Marks)

(b) To demonstrate that it is providing loans to small companies Bank of people provided the following data. These data summaries the number and level of loans to companies in both Rubavu and Karongi districts.

	Number of companies	
Loans (FRWS 000)	**Rubavu**	**Karongi**
24-28	8	19
28-32	41	36
32-36	77	47
36-40	90	58
40-44	58	27
44-48	26	13

(i) Compare the mean loan and standard deviation for both Rubavu and Karongi. (5 Marks)

(ii) Derive the coefficient of variation for both districts. (2 Marks)

(iii) Provide a suitable interpretation. (2 Marks)

(c) Given the following frequency distribution

Height (in inches)	60-62	63-65	66-68	69-71	72-74
Frequency	5	18	42	27	8

Required:

Coefficient of skewness (Sk = (Mean-Mode)/S.D) (3 Marks)

N.B: Use short formula or step deviation method to shorten your computations.

(d) Mr. Nsabimana, a retired public sector servant, is considering investing his money in two proposals. He wants to choose the one that has higher average net present value and lower standard deviation. The relevant data are given below.

	Net Present Value (NPV)	Chance of the possible outcome of NPV
Proposal A	1,559	0.30
	5,662	0.40
	9,175	0.30

and

	Net Present Value (NPV)	Chance of the possible outcome of NPV
Proposal B	-10,050	0.30
	5,812	0.40
	20,584	0.30

Required:

Help Mr. Nsabimana in choosing the appropriate proposal. (6 Marks)

(Total: 20 Marks)

QUESTION SEVEN

(a) A firm faces the demand schedule $p = 184 - 4q$ and the Total Cost (TC) function $TC = q^3 - 21q^2 + 160q + 40$ where q is the quantity produced.

Required:

What output will maximize the profit? (5 Marks)

(b) Assume that the demand for oil (in millions of barrels) can be explained by the model $q = \beta x$ and the vector of coefficients of the explanatory variables has been reliably estimated as $\beta = [\beta_0 \ \beta_1 \ \beta_2 \ \beta_3 \ \beta_4 \ \beta_5] = [4.2 - 0.1 \ 0.4 \ 0.2 - 0.1 \ 0.2]$

Required:

Calculate the demand for oil when the vector of explanatory variable is

$$x = \begin{pmatrix} \mathbf{1} \\ x_1^t \\ x_2^t \\ x_3^t \\ x_4^t \\ x_5^t \end{pmatrix} = \begin{pmatrix} \textbf{\textit{Constant}} \\ \textbf{\textit{Price}} \\ \textbf{\textit{Income}} \\ \textbf{\textit{Price of subsitute}} \\ \textbf{\textit{Price of complement}} \\ \textbf{\textit{Population}} \ (\textbf{\textit{in m.}}) \end{pmatrix} = \begin{pmatrix} \mathbf{1} \\ \mathbf{30} \\ \mathbf{18.5} \\ \mathbf{52} \\ \mathbf{12.8} \\ \mathbf{61} \end{pmatrix}$$ (3 Marks)

(c) A retailer sells two products, **Q** and **R**, in two shops **A** and **B**. The number of items sold for the last 4 weeks in each shop are shown in the two matrices **A** and **B** below, where the columns represent weeks and the rows correspond to products Q and R, respectively.

$$A = \begin{pmatrix} 5 & 4 & 12 & 7 \\ 10 & 12 & 9 & 14 \end{pmatrix} \text{ and } B = \begin{pmatrix} 8 & 9 & 3 & 4 \\ 8 & 18 & 21 & 5 \end{pmatrix}$$

Required:

Derive a matrix for total sales for this retailer for these two products over the last 4 weeks. (2 Marks)

(d) The report from JURU Ltd highlighted the fixed cost for the year February 2019 to be FRW 80,000. The estimated sales for the period are valued at FRW 200,000. The variable cost per unit for the single product made is FRW 4. if each unit sales at FRW 20 and the number of units involved coincides with the expected volume of output.

Required:

i) Construct the Break Even Chart (5 Marks)

ii) Determine the Break Even Point (1 Mark)

iii) Above how many units the company should produce in order to seek profit (1 Mark)

iv) Determine the profit earned at a turn of FRW160,000 (1 Mark)

v) Find the Margin of Safety (2 Marks)

(Total: 20 Marks)

End of Question Paper