CERTIFIED PUBLIC ACCOUNTANT

FOUNDATION LEVEL 1 EXAMINATION

F1.1: BUSINESS MATHEMATICS AND

QUANTITATIVE METHODS

DATE: THURSDAY 24, AUGUST 2023

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) Discuss the steps of computing trend line values by semi-average method as applied in time series analysis. (3 Marks)

(b) Ganza consultant Ltd estimates its sales for a particular year to be FRW 24,000,000. The seasonal indexes for sales are as follows:

Month	Seasonal index	Month	Seasonal index
January	75	July	102
February	80	August	104
March	98	September	100
April	128	October	102
May	137	November	82
June	119	December	73

Required:

Using this information above, **calculate the estimates of monthly sales of the company. (Assume that there is no trend).**

(Hint: $Estimated\ sales = \dfrac{Annual\ sales}{12} \times seasonal\ effect$) (4 Marks)

(c) Given the following table representing data of commodities for two years.

Commodity	2021		2022	
	Price (FRW/unit)	Total value	Price (FRW/unit)	Total value
A	5	50	4	48
B	8	48	7	49
C	6	18	5	20

Required:

Compute the quantity index by using Fisher's formula from the data given in the above table (13 Marks)

(Total: 20 Marks)

QUESTION TWO

(a) As a result of network diagram analysis, project teams may identify a need to compress the schedule. Schedule compression shortens the project duration in order to meet schedule deadlines without reducing the project scope. Schedule compression techniques include crashing and fast tracking. If utilized, project teams should recreate and reassess the network diagram to ensure that no new schedule issues have emerged.

Required:

In reference to network analysis, **differentiate crashing and fast tracking**.   (4 Marks)

(b) Table below gives the time and cost data in respect to normal and crash periods of a project.

Activity	Normal time (days)	Normal cost (FRW000)	Crash time (days)	Crash cost (FRW000)
1-2	3	360	2	400
2-3	6	1400	4	1600
2-4	9	2000	5	2600
2-5	7	1000	5	1500
3-4	8	400	4	600
4-5	5	1600	3	2000
5-6	3	500	2	750

Required:

i. Draw the network diagram of the project and identify the critical path   (4 Marks)

ii. What is the normal duration and cost of the project?   (4 Marks)

iii. Determine the optimum project duration, if the indirect cost is   FRW150,000/day

(8 Marks)

(Total: 20 Marks)

QUESTION THREE

(a) The linear programming method is applicable in problems characterized by the presence of decision variables.

Required:

Explain in brief what Linear Programming is. (4 Marks)

(b) A woodworker builds and sells band-saw boxes. He manufactures two types of boxes using a combination of three types of wood: maple, walnut and cherry. To construct the Type I box, the carpenter requires 2 board foot (bf) of maple and 1 bf of walnut. To construct the Type II box, he requires 1 bf of walnut and 3 bf of cherry. Given that he has 10 bf of maple, 5 bf of walnut and 11 bf of cherry and he can sell Type I of box for FRW 120,000 and Type II box for FRW 160,000.

Required:

Use the Simplex method to advise the woodworker on how many of each box type should he make to maximize his revenue? Assume that the woodworker can build the boxes in any size, therefore fractional solutions are acceptable. (10 Marks)

(c) A manufacturing company owns three factories (A, B and C) and distribute his products to five different retail agencies (destinations). The following table shows the capacities of the three factories, the quantity of products required by the various retail agencies and the cost of shipping one unit of the product from each of the three factories to each of the five retail agencies.

Factories	Retail Agency					Capacity
	1	2	3	4	5	
A	1	9	13	36	51	50
B	24	12	16	20	1	100
C	14	33	1	23	26	150
Requirement	100	60	50	50	40	300

Required:

Use the North West Corner Method to determine the initial basic feasible solution of the above transportation problem. (6 Marks)

(Total: 20 Marks)

(a) To build any model, certain reasonable assumptions are quite necessary. **List three assumptions for building a model of two-person zero sum game** (3 Marks)

(b) Given a game represented by the following pay-off matrix:

		Player B				
		I	II	III	IV	V
	1	-2	5	-3	6	7
Player A	2	4	6	8	-1	6
	3	8	2	3	5	4
	4	15	14	18	12	20

Required:

Compute the value of the game and provide a suitable interpretation. (7 Marks)

(c) The probability of demand for hiring cars on any day in Kigali City is as follows

Number of cars demanded:	0	1	2	3	4
Probability :	0.1	0.2	0.3	0.2	0.20

Cars have a fixed cost of FRW 90,000 each day to keep the daily hire charges (variable costs of running FRW 200)

Required:

i. If the car-hire company owns 4 cars, calculate the daily expectation (2 Marks)

ii. If the company is about to go into business and currently has no car, estimate the number of cars it should buy. (8 Marks)

(Total: 20 Marks)

QUESTION FIVE

(a) Explain the following by giving a suitable example:
i. **Mutually exclusive events** (1 Mark)
ii. **Impossible events** (1 Mark)

(b) The probability that a student doing CPA passes a test in Law is 2/3, and the probability that he passes both a test in Law and a test in Business Mathematics is 14/25. The probability that he passes at least one test is 4/5.

Required:

Compute the probability that he passes the test in Business Mathematics (3 Marks)

(c) A Masters of Business Administration graduate applies for a job in two firms X and Y. The probability of his being selected in firm X is 0.7 and being rejected at Y is 0.5. The probability of at least one of his applications being rejected is 0.6.

Required:

Calculate the probability that he will be selected by one of the firms (5 Marks)

(d) A telephone exchange receives on an average 4 calls per minute.

Required:

Find the probability on the basis of Poisson distribution, if
  i. **2 or less calls per minute.** (2 Marks)
  ii. **up to 4 calls per minute and.** (2 Marks)
  iii. **More than 4 calls per minute are received**. (1 Mark)

(Given $e^{-4} = 0.0183$

(e) A market researcher at a major automobile company classified households by car ownership. The relative frequencies of households for each category ownership are shown below:

Number of cars per household	Relative frequency
0	0.10
1	0.30
2	0.40
3	0.12
4	0.06
5	0.02

Required:

Calculate the expected value and standard deviation of the random variable (5 Marks)

(Total: 20 Marks)

QUESTION SIX

(a) State three advantages of stratified random sampling. (3 Marks)

(b) The weighted geometric mean of four numbers 8, 25, 17 and 30 is 15.3. If the weights of the first three numbers are 5, 3 and 4, respectively.

Required:

Find the weight of fourth number. (7 Marks)

(c) From the analysis of monthly wages paid to employees in two service organizations X and Y, the following results were obtained:

	Organization X	Organisation Y
Number of wage-earners	550	650
Average monthly wages (FRW)	5000	4500
Variance of the distribution of wages (FRW)	900	1600

Required:

i. Identify the organization that pays a larger amount as monthly wages. (5 Marks)

ii. In which organization is there greater variability in individual wages of all wage earners taken together? (5 Marks)

(Total: 20 Marks)

QUESTION SEVEN

(a) Define scatter diagram? How does it help in ascertaining the nature and degree of linear correlation between two variables? (2 Marks)

(b) A researcher wants to find out if there is any relationship between the heights of the sons and the heights of the fathers. He took a random sample of six fathers and their six sons. Their heights in inches are given below in an ordered array:

Height of father in inches (X)	Height of son in inches (Y)
63	66
65	68
66	65
67	67
67	69
68	70

Required:

Using the short method
i.   **Fit a regression line of Y on X, and hence predict the height of the son if father's height is 70 inches.** (12 Marks)
ii. **Fit a regression line of X on Y, and hence predict the height of the father if son's height is 65 inches.** (4 Marks)
iii. **Calculate Karl Pearson's coefficient of correlation.** (2 Marks)

(Total: 20 Marks)

End of question Paper