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**CERTIFIED PUBLIC ACCOUNTANT**  
**FOUNDATION LEVEL 1 EXAMINATIONS**  
**F1.1: BUSINESS MATHEMATICS AND**  
**QUANTITATIVE METHODS**

**DATE: THURSDAY, 01 DECEMBER 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) The number of typing errors,  $x$ , on each of 200 pages of a given book was monitored. The findings showed that  $\sum x = 920$ ,  $\sum x^2 = 5032$ ,

**Required:**

- i) Calculate the mean and standard deviation (2 Marks)
- ii) 50 more pages were monitored and it was found that the mean was 4.4 errors, and the standard deviation was 2.2 errors.

**Required:**

Calculate the combined mean and the combined standard deviation of the number of errors per page for the 250 pages. (8 Marks)

b) In physics laboratory, 31 candidates tried to estimate the length of a cable. Actually, the line was 60 mm long. The estimates of those candidates were:

61	70	46	44	26	23	30	85	52	44	38
37	49	59	58	63	31	29	37	48	76	61
46	31	38	41	49	52	56	75	61		

**Required:**

Find the median and the quartiles of this distribution and use the quartiles to estimate the skewness. (4 Marks)

c) Group the frequency distribution from the table in b above into 7 equal continuous class intervals starting from class 20-30.

**Required:**

- i) Calculate Mode (2 Marks)
  - ii) Calculate Standard deviation (3 Marks)
  - iii) Calculate Coefficient of variation (1 Mark)
- (Total: 20 Marks)**

## QUESTION TWO

a) Since January 2020 at Gihozo supermarket, customers are encouraged to pay by credit card because of Covid-19 pandemic. A survey conducted in June 2021 showed that 60 % of customers pay by credit card. Assume that a sample of 10 customers was randomly selected.

**Required:**

- i) What is the probability that exactly two customers pay by credit card? (5 Marks)
- ii) What is the probability that more than seven customers pay by credit card? (3 Marks)
- iii) Find the mean and standard deviation of the distribution (2 Marks)

b) A company that produces vaccines for a pandemic stated that the vaccine had a 90 % success rate. A doctor questioned whether the vaccine would be as effective as the company claimed. He injected the vaccine to 15 patients. After six months, 11 of these patients reported that the vaccine had relieved their pandemic symptoms.

**Required:**

- i) Test the vaccine company's claim at the 5% level of significance. (8 Marks)
- ii) Should the doctor keep vaccinating? (2 Marks)

**(Total: 20 Marks)**

**QUESTION THREE**

a) Explain briefly what you understand by:

- i) A population (1 Mark)
- ii) A sampling frame (1 Mark)

b) A researcher wants to take a sample from the following:

- 1) Owners of Yego Carbs in Kigali city
- 2) Residents of Kigali who tested positive for Covid-19 during June 2021

**Required:**

**Suggest a suitable sampling frame in each case (2 Marks)**

c) Describe how to choose a systematic sample of eight numbers from a list of 300 (3 Marks)

d) A three-sector economy consists of the agriculture, construction, and manufacturing sectors, which produce three essential goods: food, housing, and clothing. The input coefficient matrix is described by:

$$A = \begin{pmatrix} 0.3 & 0.5 & 0.2 \\ 0.2 & 0.0 & 0.5 \\ 0.1 & 0.3 & 0.1 \end{pmatrix}$$

If the final demand from those essential goods is 100, 40, and 50 respectively;

**Required:**

- i) Find the Leontief matrix (3 Marks)
- ii) Determine the total output needed to satisfy demand and the economy. (10 Marks)

**(Total: 20 Marks)**

**QUESTION FOUR**

a) XYZ Hardware is considering introducing a new computer system in one of its branch offices so that employees can work remotely. The company has the option of leasing a small, medium, or large computer system. If the economy continues to grow, the company estimates that the profit for small, medium and large systems will be FRW 100,000, FRW 150,000, and FRW 200,000, respectively. If the economy slows, the profit will be FRW 60,000, FRW 20,000, and a loss of FRW 20,000, respectively. The probability of continued expansion is estimated to be 0.4, while the probability of a slowdown is estimated to be 0.6.

**Required:**

Using the expected value approach, construct a decision tree diagram to summarize the above information and decide which computer system the company can choose. (7 Marks)

b) Dakota Company operates three factories in three districts. The factory's products are available in four supermarkets. The factories x, y, and z have weekly production capacities of 1000, 700, and 900 kilograms, respectively. Supermarkets A, B, C, and D have a total demand of 900, 800, 500, and 400 Kilograms, respectively. The following table shows the transportation cost per kilogram:

	A	B	C	D
X	6	6	6	4
Y	4	2	4	5
Z	5	6	7	8

**Required:**

- i) Formulate a mathematical model that summarizes the above information (3 Marks)
- ii) Determine a suitable allocation to minimize the total cost, using North West Corner and Least Cost method, and comment on the results. (8.5 Marks)
- iii) State three characteristics of the transportation problem? (1.5 Marks)

**(Total: 20 Marks)**

**QUESTION FIVE**

XYZ Ltd has signed a contract of constructing a house with the following activities

Activity	Activity description	Immediate predecessor	Optimistic time	Most likely time	Pessimistic time
A	Excavate	-	1	2	3
B	Lay the foundation	A	2	3.5	8
C	Put the rough wall	B	6	9	18
D	Put up the roof	C	4	5.5	10
E	Install the exterior plumbing	C	1	4.5	5
F	Install the interior plumbing	I	4	4	10
G	Put up the exterior siding	D	5	6.5	11
H	Do the exterior painting	E, F	5	8	17
I	Do the electrical work	C	3	7.5	9
J	Put up the wallboard	I	3	9	9
K	Install the flooring	J	4	4	4
L	Do the interior painting	J	1	5.5	7
M	Install the exterior fixtures	H, G, K	1	2	3
N	Install the interior fixtures	M, L	5	5.5	9

**Required:**

- a) Construct a network diagram. (7 Marks)
  - b) Find the critical path. (4 Marks)
  - c) Calculate the mean and the variance of the project. (5 Marks)
  - d) Explain the concept of crashing of a project (2 Marks)
  - e) Explain the criteria for selecting an activity to be crashed (2 Marks)
- (Total:20 Marks)**

**QUESTION SIX**

a) A finalist at a particular university conducted research and found the data for person's age (x) and income (y) of 6 citizens in a country as follows:

Name	X	Y
James	42	143
Jane	50	179
Joy	47	197
Peter	58	335
Mary	57	384
Job	73	423

i) Find the regression line equation for Age(x) related to income(y) (9 Marks)

ii) Use the equation obtained in (i) to estimate the age of Mathew if his income is 582 (2 Marks)

b) A zero- sum game has the following pay-off table for player 1 and player 2

Strategy		Player Q			
		I	II	III	IV
Player P	A	0	-2	2	1
	B	5	4	-3	5
	C	2	3	-4	3

i) Use maximin/minimax criteria to find a saddle point of the game, if any (3 Marks)

ii) Use the dominance principle to eliminate rows and/ or columns, if possible (3 Marks)

iii) Use algebraic methods to determine the solution and the value of the game (3 Marks)

(Total: 20 Marks)

## QUESTION SEVEN

a) The demand for a product in each of the five months is shown below:

Month	1	2	3	4	5
Demand in Thousand (FRW)	13	17	19	23	24

**Required:**

- Use a two-month moving average to generate a forecast for demand of the 6<sup>th</sup> month. (2 Marks)
- Apply exponential smoothing with a smoothing constant of 0.9 to calculate the forecasted demand of the 6<sup>th</sup> month. (2.5 Marks)
- Which of these two forecasts do you prefer and explain why? (2 Marks)

b) To produce a monthly consumer price index report, the national institute of statistics collects commodity data from various markets across the country. The product data have been collected on a monthly basis. The table below summarizes the prices of products that were collected in December 2020 and December 2021, as well as the quantity demanded in one of the markets from Kamonyi District

Commodity	Prices in December 2020 in (FRW/Kg)		Prices in December 2021 in (FRW/Kg)	
	$P_0$	$Q_0$	$P_1$	$Q_1$
Irish potatoes Kinigi	450	5000	500	5400
casava	260	1000	300	1100
Sweet potato	230	15000	340	13000
yam	310	500	320	500
Matoke	200	7000	260	6800

**Required:**

- Calculate Laspeyres, Paasche and Fisher's ideal index number (7.5 Marks)
  - State and explain four desirable properties of the base period in index number (6 Marks)
- (Total: 20 Marks)**

**End of question paper**