CERTIFIED PUBLIC ACCOUNTANT

FOUNDATION LEVEL 1 EXAMINATIONS

F1.1: BUSINESS MATHEMATICS AND QUANTITATIVE METHODS

DATE: THURSDAY 28, NOVEMBER 2024

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** are to be attempted.
3. Marks allocated to each question are shown at the end of the question.
4. Show all your workings and formulas, where applicable.
5. The question paper should not be taken out of the examination room.

QUESTION ONE

a) You work for a small manufacturing company that produces electronic components. Your task is to collect data related to number of customers visiting the company yearly.

The table below shows number of visitors in two consecutive years from January to August.

Months	Monthly visitors (2022)	Monthly visitors (2023)
January	150	100
February	160	120
March	155	110
April	165	130
May	170	140
June	175	150
July	180	160
August	185	190

Required:

i)   **Find the rolling moving totals from 2022 to 2023 and the cumulative total for 2023**

(8 Marks)

ii)   **Construct a Z-chart of the data above.**   (5 Marks)

b) Sweet Treats is a small bakery baking different types of bread, it tracks the daily sales (in FRW) over a week to analyze its performance. The sales data for the week is as follows: 150, 200, 180, 220, 250, 210, 190.

Required:

Using the daily sales data, **calculate the following:**
i)   **Range.**   (1 Mark)
ii)   **Variance.**   (2 Marks)
iii) **Coefficient of Variation.**   (1 Mark)
iv)   **Coefficient of Skewness.**   (3 Marks)
                                                                (Total: 20 Marks)

QUESTION TWO

a) **Explain four main functions of statistics**. (4 Marks)

b)   A local coffee shop wants to improve its customer satisfaction and is planning to conduct a survey. They decide to randomly sample customers who visit the shop over a week. The shop has an average of 200 customers per day. They want to survey 50 customers to gather their feedback on service quality, product variety, and pricing.

Required:

Explain six steps the coffee shop should take to ensure that the random sampling method is implemented correctly. (6 Marks)

c)   ICPAR wants to analyze the exam scores of its students in a Business Mathematics and Quantitative Method course. The scores are normally distributed with a mean (μ) of 75 and a standard deviation (σ) of 10.

Required:

Determine the percentage of students who scored below 85 on the exam. (4 Marks)

d)   The marketing team at a growing e-commerce website has been monitoring user engagement closely, particularly focusing on the frequency of page views. Over the past few months, they have gathered data indicating that the site averages about 4 page views per minute. Understanding this traffic pattern is crucial as they prepare for an upcoming promotional campaign, aiming to optimize their website's performance during peak times. The web manager wants to assess the likelihood of receiving a specific number of page views within a minute to better allocate resources and improve user experience. This information will help them understand the fluctuations in user activity and plan accordingly for customer support and server capacity.

Required:

i) **Calculate the probability of exactly 2 page views occurring per minute.**
   (Give your answer in 3 decimal places). (2 Marks)
ii) **Calculate the probability of at most 2 page views that occurred per minute.** *(Give your answer in 3 decimal places).* (3 Marks)
iii) **Calculate the probability of at least 2 page views that occurred per minute.** *(Give your answer in 3 decimal places).* (1 Mark)

(Total: 20 Marks)

QUESTION THREE

a) The marginal cost and marginal revenue with respect to a commodity of a firm are given by $C'(x) = 4 + 0.08x$ and $R'(x) = 12$.

Required:

Find the total profit function, given that the total cost at zero output is zero. (4 Marks)

b) The table below shows the sales variable cost and profit of a certain product produced in 2023.

	Sale	Variable cost	Profit
Year 2023	100,000	60,000	20,000

Required:

i) Determine the fixed cost. (1 Mark)

ii) Determine the break-even sales revenue. (2 Marks)

c) A company is analyzing the performance of three different products based on three criteria: sales, customer satisfaction, and production cost. The performance metrics are organized in the following 3x3 matrix:

$$P = \begin{pmatrix} 150 & 80 & 60 \\ 200 & 90 & 70 \\ 250 & 100 & 90 \end{pmatrix}$$

Here, each row represents a product, and each column represents a performance metric. The management wants to understand the overall performance by calculating the determinant of the matrix.

Required:

Calculate the determinant of the performance matrix P. (4 Marks)

d) A producer has the possibility of discriminating between the domestic and foreign markets for a product. The quantity of the product in the domestic market is $Q_1 = 21 - 0.1p_1$ while in the foreign market it is $Q_2 = 50 - 0.4p_2$. $Total\ cost = 2000 + 10Q$.

Required:

Calculate the price that the producer should charge in order to maximize profits with discrimination between markets and comment of the findings in both markets. (9 Marks)
(Total: 20 Marks)

QUESTION FOUR

a) A school is forming a committee to organize an annual science fair. The committee will consist of 4 teachers and 3 students. There are 6 teachers and 5 students available for selection.

Required:

Determine the number of different ways can the committee be formed.   (4 Marks)

b) A manager wants an estimate of sales of salesmen in his company. A random sample 200 out of 1000 salesmen is selected and average sales are found to be FRW 15,000 and the sample standard deviation is FRW 3,000.

Required:

Find out the population mean at 99% level of confidence.   (4 Marks)

c) In a post office, three boys are assigned to process incoming mails. The first boy, B1, processes 40 per cent, the second boy, B2, processes 35 per cent and the third boy, B3, processes 25 percent of the mail. The first boy has an error rate of 0.04, the second has an error rate of 0.06 and the third has an error rate of 0.03. A mail selected at random from a day's output is found to have an error.

Required:

The post master wishes to know the probability that the mail was processed by the first.
(6 Marks)

 d) Two companies A and B have recently conducted advertising campaigns to increase their respective shares of the market Car Spare parts. Before advertising campaigns begun, the market share of company A was 45% whereas company B had 40%. Other competitors accounted for the remaining 15%. A marketing analyst solicited the preferences of a random sample of 200 customers from whom the data below was collected.

	A	**B**	**C**	**Total**
Obtained frequency	102	82	16	200

Required:

Determine whether these market shares changed after the advertising campaign, using an appropriate statistical test.   (6 Marks)
(Total: 20 Marks)

QUESTION FIVE

a) The table below shows the prices (FRW) and quantities of 5 different commodities for the years 2021 and 2023 provided in different units. The year 2022 was considered to be the base year.

	2022		2023	
	Price (FRW)	**Quantity**	**Price (FRW)**	**Quantity**
Food	4	10	5	8
Medical care	6	8	9	9
Clothes	5	5	7	11
Fuel	3	12	6	8
Communication	5	7	8	5

Required:

i) Calculate Laspeyre's Price Number. (4 Marks)

ii) Explain what is meant by Consumer price index. (2 Marks)

iii) State two advantages and two disadvantages of Consumer price index numbers.

(4 Marks)

b) A school has a total of 200 students. Out of these, 120 are girls, and the rest are boys.

Required:

Determine the percentage of the students who are girls. (2 Marks)

c) Mr. Mugabo has an initial investment of $10,000. If he invests his money in a financial product that offers an annual return rate of 8% at simple interest rate.

Required:

Determine the period it will take to triple his investment. (4 Marks)

d) Fashion Trends is a seasonal clothing retailer, specialized in summer and winter apparel. They have collected sales data over the past five years, which shows distinct seasonal patterns.

Required:

Discuss two importances of time series analysis help Fashion Trends optimize their inventory management and marketing strategies? (4 Marks)

(Total: 20 Marks)

QUESTION SIX

a) The table below shows the data about the value of advertising expenditure (X) and sales (Y) in million Rwandan francs.

x	4	17	3	21	10	8	4	9	13	12	2	6	15	8	19
y	13	47	24	41	29	33	28	38	46	32	14	22	26	21	50

 Required:

i) **Calculate the coefficients of correlation and give an interpretation for your answer.**
(5 Marks)

ii) **Find the linear equation from the data given above?** (3 Marks)

iii) **What would be the value of sales (Y), if expenditure (X) were 45 million Rwandan francs?** (2 Marks)

b) Burger Prince Restaurant is contemplating opening a new restaurant. It has three different models (A, B and C) each with a different seating capacity (S1, S2 and S3). The payoff table (profits) for the three models is provided below.

	S1 (FRW)	S2 (FRW)	S3 (FRW)
Model A	10000	15000	12000
Model B	8000	18000	14000
Model C	6000	16000	21000
Probability	0.4	0.2	0.4

Required:

i) **By using expected monetary value which model is the best.** (6 Marks)
ii) **Calculate the Expected Value of Perfect Information**. (4 Marks)
(Total: 20 Marks)

QUESTION SEVEN

a) Your project is currently behind schedule, and you need to crash certain activities to meet the deadline. You analyze the project network diagram and identify that Activity B (which takes 4 days) and Activity C (which takes 5 days) are on the critical path.

Required:

Explain five steps that should be taken to determine which activity to crash, and what factors should you consider before making your decision. (5 Marks)

b) A factory manufactures two products A and B on three machines X, Y, and Z. Product A requires10 hours of machine X and 5 hours of machine Y and 1 hour of machine Z. The requirement of product B is 6 hours, 10 hours and 2 hours of machine X, Y and Z respectively. The profit contribution of products A and B are FRW 23 per unit and FRW 32 per unit respectively. In the coming planning period the available capacity of machines X, Y and Z are 2500 hours, 2000 hours and 500 hours respectively.

Required:

Determine the number products to be produced to maximize the profit using linear programming. (8 Marks)

c) Four factories, A, B, C and D produce sugar and the capacity of each factory is given below: Factory A produces 10 tons of sugar and B produces 8 tons of sugar, C produces 5 tons of sugar and that of D is 6 tons of sugar. The sugar has demand in three markets X, Y and Z. The demand of market X is 10 tons, that of market Y is 12 tons and the demand of market Z is 7 tons. The following matrix gives the transportation cost of 1 ton of sugar from each factory to the destinations.

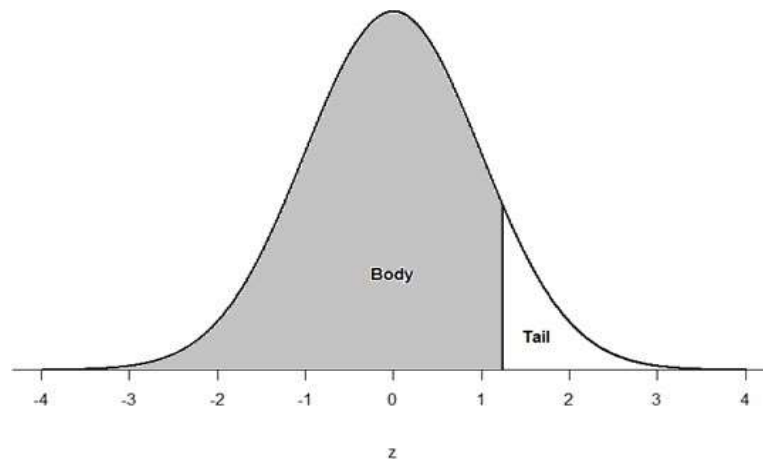|	**A**	**B**	**C**	**D**	**Capacity**
X	4	5	6	3	**10**
Y	3	6	4	5	**12**
Z	2	1	3	4	**7**
Requirement	**10**	**8**	**5**	**6**	

Required:

Find the Optimal Solution for least cost transportation cost. (7 Marks)
(Total: 20 Marks)

End of Question Paper

Standard Normal Distribution Table

Area in the Body to the Left of Z

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.10	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.20	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.30	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.40	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.50	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.60	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.70	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.80	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.90	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.00	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.10	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.20	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.30	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.40	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.50	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.60	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.70	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.80	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.90	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.00	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.10	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.20	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.30	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.40	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.50	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.60	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.70	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.80	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.90	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.00	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

Chi-square Distribution Table

d.f.	.995	.99	.975	.95	.9	.1	.05	.025	.01
1	0.00	0.00	0.00	0.00	0.02	2.71	3.84	5.02	6.63
2	0.01	0.02	0.05	0.10	0.21	4.61	5.99	7.38	9.21
3	0.07	0.11	0.22	0.35	0.58	6.25	7.81	9.35	11.34
4	0.21	0.30	0.48	0.71	1.06	7.78	9.49	11.14	13.28
5	0.41	0.55	0.83	1.15	1.61	9.24	11.07	12.83	15.09
6	0.68	0.87	1.24	1.64	2.20	10.64	12.59	14.45	16.81
7	0.99	1.24	1.69	2.17	2.83	12.02	14.07	16.01	18.48
8	1.34	1.65	2.18	2.73	3.49	13.36	15.51	17.53	20.09
9	1.73	2.09	2.70	3.33	4.17	14.68	16.92	19.02	21.67
10	2.16	2.56	3.25	3.94	4.87	15.99	18.31	20.48	23.21
11	2.60	3.05	3.82	4.57	5.58	17.28	19.68	21.92	24.72
12	3.07	3.57	4.40	5.23	6.30	18.55	21.03	23.34	26.22
13	3.57	4.11	5.01	5.89	7.04	19.81	22.36	24.74	27.69
14	4.07	4.66	5.63	6.57	7.79	21.06	23.68	26.12	29.14
15	4.60	5.23	6.26	7.26	8.55	22.31	25.00	27.49	30.58
16	5.14	5.81	6.91	7.96	9.31	23.54	26.30	28.85	32.00
17	5.70	6.41	7.56	8.67	10.09	24.77	27.59	30.19	33.41
18	6.26	7.01	8.23	9.39	10.86	25.99	28.87	31.53	34.81
19	6.84	7.63	8.91	10.12	11.65	27.20	30.14	32.85	36.19
20	7.43	8.26	9.59	10.85	12.44	28.41	31.41	34.17	37.57
22	8.64	9.54	10.98	12.34	14.04	30.81	33.92	36.78	40.29
24	9.89	10.86	12.40	13.85	15.66	33.20	36.42	39.36	42.98
26	11.16	12.20	13.84	15.38	17.29	35.56	38.89	41.92	45.64
28	12.46	13.56	15.31	16.93	18.94	37.92	41.34	44.46	48.28
30	13.79	14.95	16.79	18.49	20.60	40.26	43.77	46.98	50.89
32	15.13	16.36	18.29	20.07	22.27	42.58	46.19	49.48	53.49
34	16.50	17.79	19.81	21.66	23.95	44.90	48.60	51.97	56.06
38	19.29	20.69	22.88	24.88	27.34	49.51	53.38	56.90	61.16
42	22.14	23.65	26.00	28.14	30.77	54.09	58.12	61.78	66.21
46	25.04	26.66	29.16	31.44	34.22	58.64	62.83	66.62	71.20
50	27.99	29.71	32.36	34.76	37.69	63.17	67.50	71.42	76.15
55	31.73	33.57	36.40	38.96	42.06	68.80	73.31	77.38	82.29
60	35.53	37.48	40.48	43.19	46.46	74.40	79.08	83.30	88.38
65	39.38	41.44	44.60	47.45	50.88	79.97	84.82	89.18	94.42
70	43.28	45.44	48.76	51.74	55.33	85.53	90.53	95.02	100.43
75	47.21	49.48	52.94	56.05	59.79	91.06	96.22	100.84	106.39
80	51.17	53.54	57.15	60.39	64.28	96.58	101.88	106.63	112.33
85	55.17	57.63	61.39	64.75	68.78	102.08	107.52	112.39	118.24
90	59.20	61.75	65.65	69.13	73.29	107.57	113.15	118.14	124.12
95	63.25	65.90	69.92	73.52	77.82	113.04	118.75	123.86	129.97
100	67.33	70.06	74.22	77.93	82.36	118.50	124.34	129.56	135.81

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