



Strathmore
UNIVERSITY

STRATHMORE BUSINESS SCHOOL
BACHELOR OF FINANCIAL SERVICES
END OF SEMESTER EXAMINATION
MAT 2201: ADVANCED QUANTITATIVE METHODS

DATE: 2nd December 2024

Time: 2 Hours

Instructions

1. This examination consists of **FIVE** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

Question One

- (a) Briefly explain the following terms as used in the concept of index numbers:
- (i) Single item index number. **(1 mark)**
 - (ii) Quantity relative index number. **(1 mark)**
 - (iii) Price relative index number. **(1 mark)**
 - (iv) The Laspeyre price index and Paasche price index. **(2 marks)**
- (b) The owner of Maumee Ford-Volvo wants to study the relationship between the age of a car and its selling price. Listed below is a random sample of 12 used cars sold at the dealership during the last year.

Car	Age (years)	Selling Price ("000")
1	9	8.1
2	7	6
3	11	3.6
4	12	4
5	8	5
6	7	10
7	8	7.6
8	11	8
9	10	8
10	12	6
11	6	8.6
12	6	8

- (i) Using the above data plot a scatter plot and interpret it. **(3 marks)**

- (ii) Develop the estimated regression equation by computing the values of β_0 (i. e. a) and β_1 (i. e. b) and write the estimated regression equation. **(8 marks)**
- (iii) Provide an interpretation for the y intercept (β_0) and slope (β_1) of the estimated regression equation. **(2 marks)**
- (iv) Estimate the expected selling price of a car whose number of age is 15 years. **(2 marks)**

(c) A company is considering investing in one of three investment opportunities A, B and C under 3 certain economic conditions. The payoff matrix for this situation is shown below:

Investment opportunities	1	2	3
A	5,000	7,000	3,000
B	-2,000	10,000	6,000
C	4,000	4,000	4,000

Determine the best investment opportunity using the following criteria:

- i. Maximin **(2 marks)**
- ii. Maximax **(2 marks)**
- iii. Minimax regret **(2 marks)**
- iv. Hurwicz (Alpha = 0.6) **(2 marks)**
- v. Laplace **(2 marks)**

(TOTAL: 30 MARKS)

Question Two

Ahadi Ltd. is in the process of analyzing its electricity expense and its relationship with the machine hours of operation. The following data is provided with respect to the year ended 31 December 2021:

Month	Number of machine hours "000"	Electricity expense Sh. "000"
January	72	1,020
February	55	820
March	39	720
April	60	900
May	49	870
June	39	720
July	53	825
August	81	1,365
September	63	870
October	59	890
November	45	790
December	50	940

Required:

- (a) The least squares regression line for the above data and interpret its meaning. **(10 marks)**
- (b) Estimate the amount of electricity expense assuming the expected machine hours are 78,000. **(2 marks)**

- (c) The product moment correlation coefficient between machine hours and electricity expense. Interpret your answer. **(6 marks)**
- (d) The standard error of estimate for the regression line. Interpret your answer. **(2 marks)**

(TOTAL: 20 MARKS)

Question Three

The table below shows the quarterly profits of Kahawa Ltd.

Year	Quarterly profits in Sh."Million"			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2019	23	32	27	21
2020	27	35	32	24
2021	31	43	40	29

Required:

- (i) The three-quarter moving average of the profits. **(6 marks)**
- (ii) The adjusted quarterly seasonal variations using the additive model. **(6 marks)**
- (iii) Forecast the adjusted profits for the year 2022 given that the actual profits (in Sh. "million") in the year 2022 are 35, 50, 47 and 33 for quarters 1, 2, 3 and 4 respectively. **(4 marks)**
- (iv) Derive the deseasonalised data for the profits using the additive model. **(4 marks)**

(TOTAL: 20 MARKS)

Question Four

A ticket agent has an arrangement with a concert hall that holds concerts on 60 nights a year whereby he receives discounts as follows per concert:

For purchases of	He receives a discount of
200 tickets	20%
300 tickets	25%
400 tickets	30%
500 tickets or more	40%

Purchases must be in full hundreds. The average price per ticket is Sh.30.

He must decide in advance each year the number of tickets he will purchase. If he has any tickets unsold by the afternoon of the concert he must return them to the box office. If the box office sells any of these he receives 60% of their price.

His sales records over a few years show that a concert with extremely popular artistes he can be confident of selling 500 tickets, for with lesser known artistes 350 tickets, and for one with relatively unknown artistes 200 tickets.

His records show that 10% of the tickets he returns are sold by the box office. (Note: these are in addition to any sales made by the ticket agent.)

His administration costs incurred in selling tickets are the same per concert irrespective of the popularity of the artistes.

There are two possible scenarios in which his sales records can be viewed:
 Scenario 1: that, on average, he can expect concerts with lesser known artistes.
 Scenario 2: that the frequency of a concert will be:

	%
With popular artistes	45
With lesser known artistes	30
With unknown artistes	<u>25</u>
	<u>100</u>

Required:

- a) Calculate separately for each of Scenarios 1 and 2:
 - (i) The expected demand for tickets per concert **(3 marks)**
 - (ii) The level of his purchases of tickets per concert that will give him the largest profit over a long period of time. **(8 marks)**
 - (iii) The profit per concert that this level of purchases of tickets will yield. **(2 marks)**

- b) Calculate for Scenario 2 only the number of tickets the agent should buy, based on the following criteria:
 - (i) Maximin **(1 mark)**
 - (ii) Maximax **(1 mark)**
 - (iii) Minimax regret **(3 marks)**

- c) Advise the ticket agent **(2 marks)**

(TOTAL: 20 MARKS)

Question Five

(a) The following exponential function represents the advertising cost of a certain small enterprise:

$$y = ab^x$$

Where y is the advertising cost in thousands of shillings.
 a, b are constants over a period of seven years.
 x is the period under consideration.

The actual advertising cost over a seven-year period is given as follows:

Year	1	2	3	4	5	6	7
Advertising cost (Sh.'000'	32	47	65	92	132	190	275

Required:

- (i) The advertising cost function of the enterprise, using the normal equation. **(12 marks)**
- (ii) The advertising cost of the enterprise in year 8. **(2 marks)**

- (b) Explain three limitations of the linear regression analysis. **(6 marks)**

(TOTAL: 20 MARKS)