



Strathmore  
UNIVERSITY

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

DATE: 5th December, 2022

TIME: 2 Hours

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**INSTRUCTIONS**

1. This examination consists of **FIVE** questions.
  2. Answer Question **ONE (COMPULSORY)** and any other **TWO** questions.
  3. You may use a **SIMPLE CALCULATOR**. No **MOBILE PHONES** in the exams room.
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**Question One (30 Marks)**

- (i) List and explain steps involved in formulating a linear programming problem (LPP). (3 marks)
- (ii) Explain three uses of correlation. (3 marks)
- (iii) Differentiate the following functions from first principles (3 marks)

$$f(x) = \frac{1}{\sqrt{3x}}$$

- (iv) Find the derivatives of the following and simplify your answer. (2 marks)

$$f(x) = (x + 3)^7(x + 5)^{10}.$$

- (v) The demand for the product of a firm varies with the price that the firm charges for the product. The firm estimates that annual total revenue  $R$  as a function of the price  $P$  is given by  $R(p) = -50p^2 + 500p$ .
  - (a) Determine the price, which should be charged in order to maximize total revenue. (2 marks)
  - (b) What is the maximum value of total revenue? (2 marks)
- (vi) Explain three components for any decision-making situation. (6 marks)
- (vii) Given that  $\sum p_1q_1 = 250$ ,  $\sum p_0q_0 = 150$ , Paasche's index number =150 and Dorbish and Bowley's index number =145. Find out

(a) Fishers ideal index number (3 marks)

(b) Marshal Edgeworth index number (3 marks)

(viii) The number of cars sold by a car dealer during just 6 months in 2022 was as follows:

| January | February | March | April | May | June |
|---------|----------|-------|-------|-----|------|
| 18      | 16       | 28    | 51    | 47  | 55   |

Find 3 monthly moving average. (3 marks)

### Question Two (20 Marks)

(i) The Denver advertising agency promoting the new Breem dish washing detergent wants to get the best exposure possible for the product within the \$100,000 advertising budget ceiling placed on it. To do so, the agency needs to decide how much of the budget to spend on each of its two most effective media: (1) television spots during the afternoon hours and (2) large ads in the city's Sunday newspaper. Each television spot costs \$3,000; each Sunday newspaper ad costs \$1,250. The expected exposure, based on industry ratings, is 35,000 viewers for each TV commercial and 20,000 readers for each newspaper advertisement. The agency director, Deborah Kellogg, knows from experience that it is important to use both media in order to reach the broadest spectrum of potential Breem customers. She decides that at least 5 but no more than 25 television spots should be ordered, and that at least 10 newspaper ads should be contracted. How many times should each of the two media be used to obtain maximum exposure while staying within the budget? Use the graphical method to solve. (5 marks)

(ii) A manufacturer of bags makes three types of bags P, Q and R which are processed on three machines M1, M2 and M3. Bag P requires 2 hours on machine M1 and 3 hours on machine M2 and 2 hours on machine M3. bag Q requires 3 hours on machine M1, 2 hours on machine M2 and 2 hours on machine M3 and Bag R requires 5 hours on machine M2 and 4 hours on machine M3. There are 8 hours of time per day available on machine M1, 10 hours of time per day available on machine M2 and 15 hours of time per day available on machine M3. The profit gained from bag P is Ksh 3.00 per unit, from bag Q is Ksh 5.00 per unit and from bag R is Ksh 4.00 per unit. What should be the daily production of each type of bag so that the products yield the maximum profit ? Use the simplex method to solve this problem. (8 marks)

(iii) A steel company has two mills. Mill 1 costs \$70,000 per day to operate, and it can produce 400 tons of high-grade steel, 500 tons of medium-grade steel, and 450 tons of low-grade steel each day. Mill 2 costs \$60,000 per day to operate, and it can produce 350 tons of high-grade steel, 600 tons of medium-grade steel, and 400 tons of low-grade steel each day. The company has orders totaling 100,000 tons of high-grade steel, 150,000 tons of medium-grade steel, and 124,500 tons of low-grade steel. How many days should the company run each mill to minimize its costs and still fill the orders? Use the dual simplex method to solve this problem. (7 marks)

### Question Three (20 Marks)

(i) Gatheru and Kabiru Public Accountants have recently started to give advice to their clients. Acting as consultants, they have estimated the demand curve of a client's firm to be  $AR = 200 - 8Q$  where  $AR$  is the average revenue in shillings and  $Q$  is the output in units. Investigators have shown that the firm's cost profile shows that marginal cost  $MC$  is given by  $MC = Q^2 - 28Q + 211$  (in millions of shillings). Investigations have shown that the firm's cost when not producing output is Ksh 10 million. Required:

- (a) The total cost function (2 marks)
- (b) The total revenue function (2 marks)
- (c) The level of output that maximize profit (3 marks)

(ii) A market trader sells ball-point pens on his stall. He sells the pens for a different fixed price,  $x$  pence, in each of six weeks. He notes that the number of pens,  $y$ , that he sells in each of these six weeks. The results are shown in the following table.

|   |    |    |    |    |    |    |
|---|----|----|----|----|----|----|
| x | 10 | 15 | 20 | 25 | 30 | 35 |
| y | 68 | 60 | 55 | 48 | 38 | 32 |

- (a) Draw a scatter diagram to illustrate the above information. (2 marks)
- (b) From your scatter diagram comment on the nature of correlation. (2 marks)
- (c) Compute Karl Pearson's coefficient of correlation and interpret. (3 marks)
- (d) Fit a relevant regression equation to the data and interpret its slope. (4 marks)
- (e) Estimate the number of pens sold when the price is 49 pence. (2 marks)

**Question Four (20 Marks)**

(i) Compute price index by applying weighted average price relatives: (4 marks)

| Commodities | $p_0$ | $q_0$ | $p_1$ |
|-------------|-------|-------|-------|
| Sugar       | 10    | 6kg   | 15    |
| Rice        | 20    | 10kg  | 25    |
| Milk        | 10    | 8lt   | 14    |

(ii) Use the results in the table below to compute:

- (a) Laspeyre's index number (3 marks)
- (b) Paasche's index number (3 marks)
- (c) Fisher's index number (3 marks)
- (d) Bowley's index number (3 marks)

| Commodity | Base year |          | Current year |          |
|-----------|-----------|----------|--------------|----------|
|           | Price     | Quantity | Price        | Quantity |
| A         | 10        | 12       | 12           | 15       |
| B         | 7         | 15       | 5            | 20       |
| C         | 5         | 24       | 9            | 20       |
| D         | 16        | 5        | 14           | 5        |

- (iii) If the ration between Laspeyre's (L) and paasche's (P) index numbers is 28.27, find the missing figure in the following table. (4 marks)

| Commodity | Base year |          | Current year |          |
|-----------|-----------|----------|--------------|----------|
|           | Price     | Quantity | Price        | Quantity |
| A         | 1         | 10       | 2            | 5        |
| B         | 1         | 5        | $x$          | 2        |

**Question Five (20 Marks)**

- (i) Explain how the method of semi-average is used to do forecasting. (4 marks)
- (ii) Fit a trend line to the following data by the method of semi-average and forecast the production for the year 2024. (5 marks)

| Year       | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|------------|------|------|------|------|------|------|------|------|
| Production | 40   | 45   | 40   | 42   | 46   | 52   | 56   | 61   |

- (iii) Below are given figures of production of a sugar factory.

| Year       | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|------------|------|------|------|------|------|------|------|
| Production | 80   | 90   | 92   | 83   | 94   | 99   | 92   |

Fit a trend-line using the method of least squares and estimate the production of sugar in the year 2021. (5 marks)

- (iv) Company A owns a track of land that contains oil. A consulting geologist has reported to the company management that she believes that there is one chance in four of land having oil. Due to this prospect another company B has offered to purchase the land for \$90,000. However company A can hold the land and drill for oil itself. If oil is found the company's expected profit is \$700,000. A loss of \$100,000 will be incurred if the land is dry. Prepare Pay-off table for the two possible actions. (6 marks)

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