



Strathmore
UNIVERSITY

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

DATE: 13th January, 2022

TIME: 2 Hours

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) Differentiate (4 marks)

$$y = \frac{1}{x^3 + 4x}$$

- (ii) 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)
- (iii) What is the difference between Laspeyres method and Paasche method? (2 marks)
- (iv) Differentiate between following as used in advanced quantitative methods (4 marks)
- (a) Upper triangular matrix and lower triangular matrix
 - (b) Symmetric Matrix and a Diagonal matrix
- (v) Discuss four components of a Time Series. (4 marks)
- (vi) Compute (4 marks)

$$\int \left(x^{-3} + 7e^{5x} + \frac{4}{x} \right) dx$$

(vii) Solve the following linear programming problem (LPP) by graphical method. (6 marks)

$$\begin{aligned} &\text{minimize} && 20x_1 + 10x_2 \\ &\text{subject to} && x_1 + 2x_2 \leq 40, \\ &&& 3x_1 + x_2 \geq 30, \\ &&& 4x_1 + 3x_2 \geq 60, \\ &&& x_1, x_2 \geq 0. \end{aligned}$$

Question Two (20 Marks)

- (i) What is regression analysis? (2 marks)
- (ii) Explain the importance of regression analysis in business. (3 marks)
- (iii) The following information relates to absences in a statistics course and the final exam grade, for some 7 students. Find the correlation coefficient and interpret your result. (3 marks)

$$\sum x = 19, \quad \sum y = 565, \quad \sum x^2 = 75, \quad \sum y^2 = 46,775, \quad \sum xy = 1,380.$$

(iv) The World Bank collected data on the percentage of GDP that a country spends on health expenditures (“Health expenditure,” 2013) and also the percentage of women receiving prenatal care (“Pregnant woman receiving,” 2013). The data for the countries where this information are available for the year 2011 is in the table below.

Health Exp. (% of GDP)	9.6	3.7	5.2	5.2	10.0	4.7	4.8	6.0	5.4	4.8	4.1	6.0	9.5	6.8	6.1
Prenatal Care (%)	47.9	54.6	93.7	84.7	100.0	42.5	96.4	77.1	58.3	95.4	78.0	93.3	93.3	93.7	89.8

- (a) Create a scatter plot of the data. (2 marks)
- (b) Find a regression equation between percentage spent on health expenditure and the percentage of women receiving prenatal care. (4 marks)
- (c) Then use the regression equation to find the percent of women receiving prenatal care for a country that spends 5.0% of GDP on health expenditure and for a country that spends 12.0% of GDP. (3 marks)
- (d) Find the correlation coefficient between percentage spent on health expenditure and the percentage of women receiving prenatal care then interpret. (3 marks)

Question Three (20 Marks)

- (i) If the total manufacturing cost ‘y’ (in Ksh.) of making x units of a product is : $y = 20x + 5000$,
 - (a) What is the variable cost per unit? (b) What is the fixed cost? (c) What is the total cost of manufacturing 4000 units? (d) What is the marginal cost of producing 2000 units? (6 marks)
- (ii) A motorist has to pay an annual road tax of \$50 and \$110 for his insurance. His car does 30 miles to the gallon which costs 75 Pence (per gallon). The car is serviced every 3000 miles at a cost of \$20, and depreciation is calculated in pence by multiplying the square of the mileage by

0.001. Obtain an expression for the total annual cost. Hence find an expression for the average total cost per mile and calculate the annual mileage which will minimize the average cost per mile. (5 marks)

(iii) The marginal cost function of firm is $MC = (\log x)^2$. Find the total cost of 100 units if the cost of producing one unit is Ksh. 22. (4 marks)

(iv) The additional cost (Ksh) of producing a motor car is given by $6 + 4x^2 + 1.5e^{-x}$, where x is the quantity produced. Determine the total cost producing 5 motor cars if the fixed cost is Ksh. 7. It is given that $e^{-5} = 0.006$. (5 marks)

Question Four (20 Marks)

(i) Let

$$B = \begin{bmatrix} 1 & 2 & 1 \\ -2 & -3 & -1 \\ 4 & 11 & -2 \end{bmatrix}$$

Find B^{-1} . (4 marks)

(ii) Consider the system of linear equations: $x_1 + x_2 + x_3 = 10$, $x_2 + x_3 = 3$, $2x_1 + 2x_2 + x_3 = 5$. Find all the solutions of this system. (8 marks)

(iii) Production scheduling Ace Novelty wishes to produce three types of souvenirs: Type A, B and C. To manufacture a Type A souvenir requires 2 minutes on Machine I, 1 minute on Machine II and 2 minutes on Machine III. A Type B souvenir requires 1 minute on Machine I, 3 minutes on Machine II and 1 minute on Machine III. A Type C souvenir requires 1 minute on Machine I and 2 minutes each on Machine II and Machine III. There are 3 hours available on Machine I, 5 hours available on Machine II and 4 hours available on Machine III for processing the order. How many souvenirs of each type should be Ace Novelty make in order to use all of the available time? Use matrix method. (8 marks)

Question Five (20 Marks)

(i) Explain three components for any decision-making situation. (3 marks)

(ii) The prices for the six food items are presented in the Table below. Also included is the number of units of each consumed by a typical family in 1995 and 2005.

Item	1995		2005	
	Price (\$)	Quantity	Price (\$)	Quantity
Bread white (loaf)	0.77	50	1.98	55
Eggs (dozen)	1.85	26	2.98	20
Milk (litre) white	0.88	102	1.98	130
Apples, red delicious (500 g)	1.46	30	1.75	40
Orange juice, (355 ml concentrate)	1.58	40	1.70	41
Coffee, 100% ground roast (400 g)	4.40	12	4.75	12

Determine a weighted price index using the Laspeyres method. Interpret the result. (7 marks)

- (iii) A food processor uses a moving average to forecast next month's demand. Past actual demand (in units) is shown below:

Month	43	44	45	46	47	48	49	50	51
Actual demand in units	105	106	110	110	114	121	130	128	137

- (a) Compute a simple five-month moving average to forecast demand for month 52. (4 marks)
- (b) Compute a weighted three-month moving average where the weights are highest for the latest months and descend in order of 3, 2, 1. (6 marks)

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