

UNIVERSITY OF SWAZILAND

FINAL EXAMINATIONS 2006/7

Dip.Comm II, IDE-Dip.Comm III

TITLE OF PAPER : QUANTITATIVE TECHNIQUES

COURSE NUMBER : MS 202

TIME ALLOWED : THREE (3) HOURS

INSTRUCTIONS : 1. THIS PAPER CONSISTS OF
SEVEN QUESTIONS.
2. ANSWER ANY FIVE QUESTIONS

SPECIAL REQUIREMENTS : NONE

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QUESTION 1

1. (a) Use Gauss-Jordan reduction method to find the inverse of the following matrix

$$\begin{pmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 2 & 7 & 7 \end{pmatrix}$$

[7 marks]

- (b) Use the method of Lagrange multipliers to optimize

$$z = 80x - 2x^2 - xy - 3y^2 + 100y$$

subject to $x + y = 12$.

[7 marks]

- (c) The technological matrix of a three sector economy and the total output for each sector for a particular year are given by

$$A = \begin{bmatrix} 0.3 & 0.4 & 0.1 \\ 0.5 & 0.2 & 0.6 \\ 0.1 & 0.3 & 0.1 \end{bmatrix} \quad X = \begin{bmatrix} 100 \\ 250 \\ 175 \end{bmatrix}$$

[6 marks]

QUESTION 2

2. (a) A department store sells two brands of inexpensive calculators. The store pays E6 for each brand A calculator and E8 for each brand B calculator. The research department has estimated the following weekly demand equations for these two competitive products:

$$x = 116 - 30p + 20q \quad \text{Demand equation for brand A}$$

$$y = 144 + 16p - 24q \quad \text{Demand equation for brand B}$$

where p is the selling price for brand A and q is the selling price for brand B. How much should the store price each calculator to maximize weekly profits? What is the maximum weekly profit? [12 marks]

- (b) A manufacturing company produces two models of a television set, x units of model A and y units of model B per week, at a cost of

$$C(x, y) = 6x^2 + 12y^2$$

If it is necessary (because of shipping considerations) that

$$x + y = 90$$

how many of each type of set should be manufactured per week to minimize cost? What is the minimum cost? [8 marks]

QUESTION 3

3. (a) Suppose that you deposit E2500 on your 25th birthday. What rate r compounded quarterly must your deposit earn in order to grow to one million Emalangi by your 75th birthday? [7 marks]
- (b) What value would an investment be if R1500 is invested at the beginning of the period followed by 10 annual payments of R150 at a rate of 12% compound interest? [7 marks]
- (c) A debt of E2000 is to be paid off by payments of E500 in two months, E200 in four months and a final payment of E1435. Interest at 12% under the merchant's rule was used to calculate the final payment. In how many months should the final payment be made? [6 marks]

QUESTION 4

4. (a) Find the 20th term of a geometric progression whose 2nd term is 12 and 8th term is 4. [7 marks]
- (b) A loan of E1000 is due in one year with interest at 14.25%. The debtor pays E200 in 3 months and E400 in 7 months. Find the balance due in one year under the Merchant's rule. [7 marks]
- (c) A subscription share at a workers' union pays an annual interest rate of 8% compounded monthly. To what amount will payments of E30 made at the end of each month accumulate at the end of 3 years? [6 marks]

QUESTION 5

5. (a) A company produces chairs and tables. Each table takes four hours of labour from the carpentry department and two hours of labour from the finishing department. Each chair requires three hours of carpentry and one hour of finishing. During the current week, 240 hours of carpentry time are available and 100 hours of finishing time. Each table produced gives a profit of E70 and each chair a profit of E50. Use the **graphical method** to find the number of chairs and tables that should be made in order to maximize profit? [10 marks]
- (b) Solve the following Linear Programming problem using the Simplex Method

$$\begin{aligned} \text{maximize } P &= -x_1 + 2x_2 \\ \text{subject to } -x_1 + x_2 &\leq 2 \\ -x_1 + 3x_2 &\leq 12 \\ x_1 - 4x_2 &\leq 4 \\ x_1, x_2 &\geq 0 \end{aligned}$$

[10 marks]

QUESTION 6

6. (a) Solve the following minimization Linear Programming problem by maximizing the Dual.

$$\begin{aligned} \text{minimize } C &= 40x_1 + 12x_2 + 40x_3 \\ \text{subject to } 2x_1 + x_2 + 5x_3 &\geq 20 \\ 4x_1 + x_2 + x_3 &\geq 30 \\ x_1, x_2, x_3 &\geq 0 \end{aligned}$$

[10 marks]

- (b) Suppose a manufacturer of printed circuits has a stock of 200 resistors, 120 transistors and 150 capacitors and is required to produce two types of circuits.

Type A requires 20 resistors, 10 transistors and 10 capacitors.

Type B requires 10 resistors, 20 transistors and 30 capacitors. [10 marks]

If the profit on type A circuits is E5 and that on type B circuits is E12, how many of each circuit should be produced in order to maximize profit?

QUESTION 7

7. (a) Consider a transportation problem in which the cost, supply and demand values are presented in the following table. The sources are the factories A, B and C and the destination are the warehouses 1, 2, 3 and 4.

	1	2	3	4	Supply
A	12	13	4	6	500
B	6	4	10	11	700
C	10	9	12	4	800
Demand	400	900	200	500	

- i. Is this a balanced transportation problem ? [2 marks]
- ii. Find the initial basic feasible solution using the North-West Corner rule. [6 marks]
- (b) A shop sells 700 CDs, 400 cassettes and 200 CD-Players each week. The selling price of each CD is E4, cassettes E6, and CD-Players E150. The cost to the shop is E3.25 for a CD, E4.75 for a cassette and E125 for a CD player. Find the weekly profit using a Matrix approach. [4 marks]
- (c) Solve the following matrix system

$$\begin{aligned}2x + 4y + 6z &= 2 \\4x + 5y + 6z &= 1 \\3x + y - 2z &= 1\end{aligned}$$

[8 marks]