

UNIVERSITY OF SWAZILAND

MS 202

MAIN EXAMINATION 2014/2015

BComm. /BEd.

TITLE OF PAPER : Quantitative Techniques

COURSE NUMBER : MS 202

TIME ALLOWED : 3 HOURS

SPECIAL REQUIREMENTS : NONE; NOT EVEN GRAPH PAPER.

Instructions

- (a) Candidates may attempt:
 - (i) ALL questions in Section A and
 - (ii) At most THREE questions in Section B.
- (b) Each question should start on a fresh page.

SECTION A (40 marks)

Candidates may attempt ALL questions being careful to number them A1 to A5.

A1. Find and classify all stationary points of the function $x^3 + y^2 - 3x - 6y - 1$. [10]

A2. Solve the linear system

$$\begin{array}{rcl} & 4x_2 + x_3 & = 2 \\ x_1 - 2x_2 & & = 4 \\ 2x_1 + 6x_2 + 4x_3 & & = -2 \end{array}$$

using Gauss-Jordan elimination. [10]

A3. Solve the Linear programming problem:

$$\begin{array}{l} \text{Min } C(x, y) = 21x + 50y \\ \text{subject to } 2x + 5y \geq 12 \\ \quad \quad \quad 3x + 7y \geq 17 \\ \quad \quad \quad x, y \geq 0 \end{array}$$

using the Graphical Method. [10]

A4. A company wishes to assign its employees A, B, C to 3 different training courses 1, 2, 3 based on their skills. The assignment costs are given as follows:

Cost	1	2	3
A	15	9	12
B	7	5	10
C	13	4	6

Determine the assignment schedule that minimizes the total assignment cost. [6]

A5. A student has just been offered a place at a local university to study Law for 4 years. How much should her parents set aside to provide an income of £650 every month for the duration of the entire degree programme if the money earns interest at rate 4.6% compounded monthly? [4]

SECTION B (60 marks)

Candidates may attempt THREE questions being careful to number them B6 to B10.

- B6.** A furniture shop sells x desks and y chairs in a week at prices p Emalangeni per kg and q Emalangeni per kg respectively. The demand equations for the company are

$$x = 52 - p + q, \quad y = 101 + p - 2q,$$

and its cost function is $5x + 3y + 5000$.

- (a) Determine the weekly profit function $P(x, y)$ for the company. [10]
- (b) Find the number of desks and chairs the company must sell in order to maximize weekly profit. Show that this is indeed the maximum profit. [10]
- B7.** (a) A restaurant sells 370 cheeseburgers, 350 hamburgers and 280 milk shakes in a week. The price of a cheeseburger is E20, that of a hamburger is E17 and that of a milk shake is E8. The cost to the restaurant of a cheeseburger is E14.50, that of a hamburger is E12 and that of a milk shake is 4.50. Determine the restaurant's weekly profit using **matrix multiplication**. [8]
- (b) An economy is made up of 3 industries: Agriculture, Health and Services. E1 worth of output from Agriculture requires 40c of output from Health and 20c of output from Services. E1 worth of output from Health requires 50c of output from Agriculture and 30c of output from Health. E1 worth of output from Services requires 50c of output from Agriculture, 5c of output from Health and 35c of output from Services.
- The external demand for the current production period is E1 billion, E2 million and E1.5 billion. Determine the production schedule for this economy. [12]
- B8.** A small brewery produces beer and ale. To make a litre of beer the brewery requires 2 kg of corn, 1 kg of hops and 1 kg of malt. To make a litre of ale 1 kg of corn, 1 kg of hops and 2 kg of malt are required. Suppose that only 10 kg of corn, 7 kg of hops and 12 kg of malt are available. Also, suppose that the brewery makes a profit of E30 for each litre of beer and E40 for each litre of ale produced.
- (a) The problem is to determine the number of litres of beer and ale that should be produced in order to maximize profit. Formulate this as a linear programming problem. [8]
- (b) Solve the resultant linear programming problem using the **Simplex Method**. [12]

B9. A trucking company has a contract to move 120 truckloads of timber from 3 plantations: A, B, C to 3 factories D, E, F for processing. The cost of moving 1 vehicle from A to each of D, E, F is E8, E6, E9 respectively. Similarly, the respective costs of moving 1 vehicle from B are E6, E3, E8, and those from C are E10, E7, E9. Timber available for distribution from A, B, C is enough for 20, 30, 70 truckloads respectively. Timber required at D, E, F should be enough for 90, 20, 10 truckloads respectively.

Determine the optimal distribution strategy required for this company to minimize total transportation cost. Evaluate the minimum total transportation cost. [20]

B10. (a) A loan of E4200 is due in 12 months with interest charged at 5.5% per annum. The debtor makes a first payment of E1250 in 6 months, followed by a payment of E830 in 10 months. Find the balance payable on due date under the Merchant's rule. [6]

(b) A woman wishes to set up a fund to provide E120,000 for the purchase of a brand new taxi at the end of 7 years when she retires. If equal deposits are made at the end of every 3 months in a fund earning 5.4% interest converted quarterly, determine the value of each deposit. [4]

(c) A company wishes to assign its employees A, B, C to 3 different tasks 1, 2, 3 based on their past % performance rates as shown in the following table.

	1	2	3	4
A	65	90	40	95
B	60	70	75	80
C	40	85	60	80
D	80	55	55	65

Determine assignment schedule that maximizes average performance rate. [10]

END OF QUESTION PAPER