



**NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY**

FACULTY OF HEALTH AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

QUALIFICATION: BACHELOR OF ECONOMICS	
QUALIFICATION CODE: 07BECO	LEVEL: 5
COURSE CODE: MFE512S	COURSE NAME: MATHEMATICS FOR ECONOMISTS 1B
SESSION: November 2022	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
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INSTRUCTIONS
<ol style="list-style-type: none">1. Answer ALL the questions in the booklet provided.2. For section A, write True for statements that are true and False for statements that are false. For section B, write down the correct letter of your choice. Show clearly all the steps used in the calculations when answering section C questions.3. All written work must be done in blue or black ink and sketches must be done in pencil.

PERMISSIBLE MATERIALS

1. Non-programmable calculator without a cover.

ATTACHMENT: Graph paper

THIS QUESTION PAPER CONSISTS OF 5 PAGES (Including this front page)

SECTION A (True or false Questions)

QUESTION 1

[15 marks]

State whether each of the following statement is **true** or **false**.

- 1.1 A 4×5 matrix has 4 columns and 5 rows. [1]
- 1.2 The following system of linear equations is homogeneous.
 $x + y - z = 0$
 $2x + y + 2z - 1 = 0$ [1]
 $3x + 2y - z = 0$
- 1.3 If A is a 3×4 matrix and B is a 4×3 matrix, then the product BA is a 4×4 matrix. [1]
- 1.4 Every square matrix has an inverse. [1]
- 1.5 The following system of linear equations has only one solution.
 $x + 2y = 0$ [1]
 $2x = y$
- 1.6 For any matrix M , $M^T M$ is always possible. [1]
- 1.7 A unit or identity matrix is a square matrix whose every entry which is not in the main diagonal is a 0. [1]
- 1.8 Two matrices may only be multiplied if they have the same order. [1]
- 1.9 If matrix M is a singular matrix, then $M = M^T$. [1]
- 1.10 Any matrix of any order may be multiplied by a scalar. [1]
- 1.11 $\begin{pmatrix} a & a \\ a & a \end{pmatrix}$ is singular. [1]
- 1.12 Every homogeneous system of equations is consistent. [1]
- 1.13 Elementary row operations can be used to solve any system of linear equations. [1]
- 1.14 Jacobians are used to test for second order conditions of the stationary points. [1]
- 1.15 Hessian determinants are used to test if a matrix has an inverse. [1]

SECTION B (Multiple choice Questions)

Question 2

[10 marks]

Write down the letter that corresponds to the right answer **only**.

- 2.1 The order of $A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ a_{31} & a_{32} & \dots & a_{3n} \end{bmatrix}$ is [2]

A. 3×3 B. 3×4 C. $n \times 3$ D. $3 \times n$ E. None of these answers

2.2 Which of the following matrix is a diagonal matrix? [2]

A. $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$ B. $\begin{pmatrix} 0 & 0 & 1 \\ 0 & 2 & 0 \\ 3 & 0 & 0 \end{pmatrix}$ C. $\begin{pmatrix} 1 & 2 \\ 0 & 0 \end{pmatrix}$ D. $\begin{pmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 2 \end{pmatrix}$ E. None of these

2.3 Which of the following linear programming problem is a standard maximizing problem? [2]

A. $\begin{array}{l} \text{Maximize } P = 3x - 2y \\ \text{Subject to } 2x + 3y \leq 6 \\ x + 2 \leq 1 - y \\ x, y \geq 0 \end{array}$ B. $\begin{array}{l} \text{Maximize } P = 3x - 2y \\ \text{Subject to } 2x + 3y \leq 6 \\ x - y \leq 1 \\ x \leq 0, y \geq 0 \end{array}$

C. $\begin{array}{l} \text{Maximize } P = 3x - 2y \\ \text{Subject to } 2x + 3y \leq 6 \\ x - y \leq 1 \\ x, y \geq 0 \end{array}$ D. $\begin{array}{l} \text{Minimize } P = 3x - 2y \\ \text{Subject to } 2x + 3y \leq 6 \\ x - y \leq 1 \\ x, y \geq 0 \end{array}$

E. None of these

2.4 The solution for the inequality: $3 \leq 5 - 2x \leq 11$ is [2]

A. $1 \leq x \leq -3$ B. $-3 \leq x \leq 1$ C. $x \geq 1$ or $x \leq -3$

D. No solution

2.5 Use the Hessian to test for the nature **critical point (2, 1)** of the function

$f(x, y) = -\frac{1}{2}x^2 + 2xy + y^2 + 6x - 6y - 10.$ [2]

- A. It is a local maximum B. It is a local minimum
C. It is a saddle point D. Undetermined (test fails)

SECTION C (Structured questions)

Question 3

[75 marks]

3.1 If $B = \begin{pmatrix} 2 \\ -1 \\ 1 \end{pmatrix}$ and $A = (1 \quad -2 \quad -3)$ determine the products AB and BA if they exist. [5]

3.2 Use Cramer's rule to solve each of the following systems of linear equations.

3.2.1 $x + 3y + 3z = -2$
 $4y + x + 4z = -2 + y$
 $x + z + 4y + 2 = -1 - 2z$ for **y only.** [5]

3.2.2 $x + 2y = 3$ [2]
 $3x + 6y = 9$

3.3 Find the inverse of $A = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{pmatrix}$ if it exists and use matrix inverse method to solve the following system of linear equations.

$$\begin{aligned} x + 2y + 3z &= 2 \\ 2x + 4y + 5z &= 3. \\ 3x + 5y + 6z &= 4 \end{aligned} \quad [15]$$

3.4 A fruit juice company makes two special drinks by blending apple and pineapple juices. The first drink uses 30% apple juice and 70% pineapple juice, while the second drink uses 60% apple juice and 40% pineapple juice. There are 1000 liters of apple juice and 1500 liters of pineapple juice available. If the profit for the first drink is N\$.60 per liter and that for the second drink is N\$.50, use the simplex method to find the number of liters of each drink that should be produced in order to maximize the profit. [15]

3.5 Sky Aviation Industries has two plants, I and II, which produce the "Venag" jet engines used in their light commercial airplanes. The maximum capacities of these two plants are 110 units and 100 units per month, respectively. The engines are shipped to two of the company's main assembly plants, A and B. The shipping costs (in dollars) per engine from plants I and II to the main assembly plants A and B are as follows:

	<i>To</i>	
	<i>A</i>	<i>B</i>
<i>From</i>	<i>I</i>	<i>II</i>
	$\begin{bmatrix} 120 & 70 \end{bmatrix}$	$\begin{bmatrix} 100 & 60 \end{bmatrix}$

In a certain month, assembly plant A needs 70 engines while assembly plant B needs 80 engines. Set up a linear programming model that will determine the number of engines to be shipped from each plant to each main assembly plant that will minimise the total cost and use the graphical method to solve this model. Use the scale 5 small squares: 10 units on both axes. [15]

3.6 A motor company manufacture and sell cars and motorbikes. The cost of manufacturing x motorbikes and y cars is given by $C(x, y) = 800x^2 + 400xy + 2900y^2$. Each motorbike is sold for N\$36 000-00 and each car is sold for N\$180 000-00.

3.6.1 Use Gaussian elimination to determine the number of motorbikes and the number of cars that should be manufactured and sold for a maximum profit P and determine the maximum profit P_{\max} . [8]

- 3.6.2 Use the Hessian to confirm that the amounts in 3.6.1 will produce maximum profit. [5]
- 3.6.3 Use the Jacobian to test for functional dependence between the cost function and the revenue function. [5]

*****END OF EXAMINATION*****

GOODLUCK!!!!!!!!!!