Business Mathematics Examination

Instructions

a. The paper contains two sections: Section A and Section
b. Attempt all questions in Section A
c. Attempt ANY two Questions in section B
d. Total marks: 50 marks
e. Time allowed: 2 hours

Section A – 20 marks (Attempt All Questions)

1. Solve for x in the equation $3x + 5 = 14$ (1 mark)
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
2. Find the value of x in the linear system $\begin{matrix} 2x + y = 10 \\ x - y = 5 \end{matrix}$ (1 mark)
   a. 2
   b. 3
   c. 4
   d. 5
   e. 6
3. Solve the following quadratic equation $x^2 - 5x + 6 = 0$ (1 mark)
   a. $\{x, y\} = \{3,2\}$
   b. $\{x, y\} = \{-2, -3\}$
   c. $\{x, y\} = \{-2,3\}$
   d. $\{x, y\} = \{2, -3\}$
   e. $\{x, y\} = \{2,3\}$
4. Which of the following is a feasible solution for the linear programming problem that maximize $Z = 3x + 4y$ subject to $\begin{matrix} x + 2y \leq 10 \\ 2x + y \geq 10 \\ x, y > 0 \end{matrix}$ (1 mark)
   a. (5, 0)
   b. (0,10)
   c. (20, 0)
   d. (10, 5)
   e. (0,0)
5. What does the term 'feasible region' mean in linear programming? (1 mark)
   a. The are that maximizes the objective function.
   b. The area that satisfies all constraints.
   c. The area outside the constraints.
   d. The area that minimizes the objective function
   e. The right area
6. If 1000 KES is invested at annual interest rate of 5% compounded annually, what will be the amount after 3 years? (1 mark)
   a. 1050
   b. 1100
   c. 1150
   d. 1157.63
   e. 1158

7. Calculate the present value of 2000 KES to be received after 5 years at an annual discount rate of 6%. (1 mark)
    a. 1494.52
    b. 1500
    c. 1495
    d. 1700
    e. 1800
8. Integrate with respect to x; $\int 5x^3 dx$ (1 mark)
    a. $15x^2 + c$
    b. $\frac{5}{3}x^3 + c$
    c. $\frac{5}{4}x^4$
    d. $\frac{5}{4}x^4 + c$
    e. $\frac{5}{3}x^4 + c$
9. Find $\frac{\partial f}{\partial x}$ given $f(x,y) = x^2y + 4y^3 + x$ (1 mark)
    a. $2xy + 12y^2 + 1$
    b. $-(2xy + 1)(x^2 + 12y^2)^{-1}$
    c. $2xy + 1$
    d. $2xy + 12y^2$
10. Find $\frac{dy}{dx}$ given $3xy^2 + y^3 + 2xy$ (1 mark)
    a. $3y^2 + 3y^2 + 2y$
    b. $3y^2 + 6xy + 3y^2 + 2y + 2x$
    c. $-y(3y + 2)(6xy + 3y^2 + 2x)^{-1}$
    d. $3xy + 3y^2 + 2y$
11. In decision analysis, what does the term 'expected value' mean? (1 mark)
    a. The value of the best outcome
    b. The average value of all possible outcomes
    c. The value of the worst outcome
    d. The value of the most probable outcome
12. Which of the following is a criterion for decision making under uncertainty? (1 mark)
    a. Expected value criterion
    b. Minimax criterion
    c. Linear programming
    d. Cost-benefit analysis
    e. Differential analysis
13. Explain the difference between closed and open input-output models. (2 marks)
14. Explain three assumptions of the static output model (6 marks)

Section B: 30 Marks (Attempt ANY two questions)

Question One (15 marks)

(a) A certain company produces and sells TVs. The total weekly revenue and cost in KES is given by $R(x,y) = -0.2x^2 - 0.25y^2 - 0.2xy + 225x + 135y + 100$ and $C(x,y) = 125x + 45y + 5500$ respectively, where x denotes the number of Plasma screen units and y the number of Curved screen units produced and sold each week. Find the company's maximum profit per week, and the number of Plasma and Curved screen units that must be produced and sold to achieve this profit. (6 marks)

(b) Given the following two matrices evaluate;

$A=\begin{bmatrix} 0 & 5 & -4 \\ -2 & 3 & 4 \end{bmatrix}$ and $B=\begin{bmatrix} 8 & 4 \\ 3 & -2 \\ 1 & 6 \end{bmatrix}$.

(i) $A + BT$ (2 marks)

(ii) AB (2 marks)

c) A two-sector economy of agriculture and mining. Its input - output matrix is given as

$$\begin{matrix} & \begin{matrix} A & M \end{matrix} \\ \begin{matrix} A \\ M \end{matrix} & \begin{bmatrix} 0.2 & 0.3 \\ 0.4 & 0.1 \end{bmatrix} \end{matrix}$$

(i) If the total production is 300 billion and 500 billion shillings worth of agriculture and mining respectively, calculate the amount of both consumed internally.(1 mark)

(ii) If the external demand is 120 billion and 180 billion shillings worth of agriculture and mining respectively, what would be the total production? (4 marks)

Question Two (15 marks)

(a) A company has three modes of paying their namely; cash payment, credit card, MPESA. The matrix below represents probabilities for switching between modes.

	Cash	credit card	MPESA
Cash	0.85	0.10	0.05
Credit card	0.04	0.90	0.06
MPESA	0.05	0.25	0.70

If 70% currently pay by cash, 20% by credit card and 10% by MPESA what will be the corresponding percentages after?

(i) two payments (4 marks)

(ii) in the long run. (6 marks)

(b) A farmer intends to feed his calves a daily diet containing a minimum of 24 g of fat, 36 g of carbohydrates, and 4 g of protein. He notes it is cheaper to order ration X and ration Y and blend them for an optimal mix. Ration X contains 8 g of fat, 12 g of carbohydrates, and 2 g of protein per ounce, and costs shillings 2 per ounce. Ration Y contains 12 g of fat, 12 g of

carbohydrates, and 1 g of protein per ounce, at a cost of shillings 3 per ounce. Formulate a linear program for this problem (5 marks)

Question Three (15 marks)

Suppose that a decision maker faced with four decision alternatives and four states of nature has developed the following payoff table:

	S_1	S_2	S_3	S_4
D_1	140	90	120	50
D_2	110	100	80	90
D_3	90	150	120	110
D_4	80	60	110	130

(a) If the decision maker knows nothing about the probabilities of the four states of nature, what would be the best decision using;

(i) Optimistic approach (1 mark)

(ii) Pessimistic approach (1 mark)

(iii) Laplace approach (2 marks)

(iv) Opportunity loss approach (3 marks)

(b) Suppose the decision maker obtain information that enables the computation of the following probabilities $P(S_1)=0.4$, $P(S_2)=0.2$, $P(S_3)=0.1$, $P(S_4)=0.3$

(i) Which would be the best decision using expected value approach? (3 marks)

(ii) Calculate the value of perfect information (3 marks)

(c) Explain two main differences between payback period and net present value methods of investment appraisal.

(i) Unlike NPV, Payback period does not consider the time value of money

(ii) Payback period does not consider the cash inflow after payback period where as NPV considers all the cash inflow. (2 marks)

Source: *Adopted from Africa Nazarene University Examinations, 2024.*