MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF AGRIBUSINESS MANAGEMENT AND TRADE

THIRD YEAR SPECIAL/ SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE AGRIBUSINESS MANAGEMENT AND TRADE

AGB 302: QUANTITATIVE TECHNIQUES IN AGRIBUSINESS

DATE: 24/03/2021   **TIME: 8.30-10.30 AM**

INSTRUCTIONS;

Answer **Question ONE** and **ANY TWO** other questions. Show all your workings.

QUESTION ONE (30 MARKS)

a) Given the supply function $Q_s = -21+10P$ and demand function $Q_d = 15-2P$, find the equilibrium price and quantity   (2 marks)

b) Given A={0,1,7},   B={7,2,5},   C= {1, 0, 3}   and   D= {4,6,8,9,0}, find:

     i. $B \cap C$ (1 mark)

     ii. $B \cup C \cap D \cap A$ (2 marks)

c) Matunda Ltd produces 9 different fruits. In an upcoming event, the firm intends to distribute free fruit packages each containing four fruits, to promote them. If 148 people attend the event, and each person can get only one unique package, will the packages be enough for all the people at the event?   (3 marks)

d) The probability distribution of customers at Farm Ltd is shown in the table below. Calculate the:

     i.   Expected number of customers   (2 marks)

     ii.   Standard deviation of the number of customers   (4 marks)

Number of customers (x)	50	100	150	200
Probability [P(x)]	0.04	0.15	0.31	0.23

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e)   An investor constructed the following payoff table for investment in horticultural production. The figures are profits in millions of Kenya Shillings.

Decision alternative	States of Nature	
	Weak demand (s1)	Strong demand (s2)
Sukumawiki production (d1)	13.8	22.5
Spinach production (d2)	18.3	27.5
Tomato production (d3)	-9.5	45.0

Justifying your answer, advise the investor on the best decision using:

i.   The pessimistic approach (2 marks).

ii. The opportunist approach (3 marks).

f)   Outline five limitations of linear programming   (5 marks)

g)   Given $B = \begin{bmatrix} 5 & 1 & 2 \\ 4 & 0 & -2 \\ 1 & -2 & 0 \end{bmatrix}$, $D = \begin{bmatrix} 2 & -1 & 3 \\ -1 & 4 & -1 \\ 0 & -1 & 1 \end{bmatrix}$

find the determinant of: $2(D - B)^T$ (6 marks)

QUESTION TWO (20 MARKS)

a)   The following table shows crop production from a French beans farm.

Month	1	2	3	4	5	6	7	8
Production (tons)	18	22	20	24	19	17	21	19

i.   Use a 3-month moving average to forecast monthly sales   (3 marks)

ii.   Calculate sales forecasts for weeks 2-6 using a smoothing constant of 0.15 (5 marks)

b)   The data below was extracted from production records of five farms.

Production costs (Ksh '000)	4	5	6	7	8
Output (tons)	1.0	1.5	2.5	3.0	4.5

i.   Develop a linear regression equation expressing output as a function of costs

(10 marks)

ii.   Use the equation in (i) above to predict output for a farm that spends KSh 12,000 in the production process   (2 marks)

QUESTION THREE (20 MARKS)

a) In March 2017, the numbers of farmers cultivating maize and wheat in Trans Nzoia were 20,000 and 2,500 respectively. The probability that a farmer switches from maize to wheat farming each year is 0.12 while the probability of moving from wheat to maize farming each year is 0.05. How many farmers can be expected produce each crop in March 2020?

(8 marks)

b) The following table shows activities for an agricultural project.

Activity Code	A	F	G	H	I	J	K	L	M	N
Predecessor	-	-	F	E,G	H	F,I	J	J	H	K,L
Estimated duration (weeks)	4	5	7	9	7	8	4	5	2	6

   i.   Draw the project network diagram   (5 marks)

   ii. Determine the total project duration   (5 marks)

   iii. Determine the slack for activity "**J**"   (2 marks)

QUESTION FOUR (20 MARKS)

Farm Ltd grows rice and wheat for the market and is interested in maximizing profits. The firm uses only land, labor and capital to produce the crops. One acre of rice requires, 40 days of labor, while an acre of wheat requires 16 days of labor. Capital requirements per acre are Ksh 15,000 for rice and Ksh 22,500 for wheat. An acre of rice yields a profit of Ksh 30,000 while wheat has a profit of Ksh 25,000 per acre. The firm has a total of 100 acres of land, 3,200 days labor, and capital amounting to Ksh 1,800,000.

a) Formulate the linear programming problem   (5 marks)

b) Using the graphical method, find the optimal solution   (9 marks)

c) What is the total maximum profit?   (3 marks)

d) Calculate the levels of inputs required   (3 marks)

QUESTION FIVE (20 MARKS)

a) Mbegu Ltd experimented grain production from two crop varieties, Crown and Hela. In the first trial, the company produced 2000 kg of grain from 30 kg of Crown seeds and 50kg of Hela seeds. In the second trial, the company produced 4200 kg of grain from 60 kg of Crown seeds and 120kg of Hela seeds. Using Cramer's rule, find the grain production per kg for each crop variety   (8 marks)

b) A poultry farmer has to make a decision on the marketing channel to use so as to maximize revenue from sale of 1000 birds. The producer can sell to a restaurant, a hospital or a supermarket, at high or low price. For farmer restaurant, high price is Ksh 550 per bird, and low price Ksh 325 per bird. For the hospital, high and low prices are Ksh 500 and 390 per bird, respectively; while supermarket will buy at a low price of Ksh 410 and high price of 490. The probabilities of buying at high prices are 0.25, 0.46 and 0.58 for the restaurant, hospital and supermarket, respectively.

    i.   Construct a decision tree for the above problem   (8 marks)

    ii.   With justification, state the recommended decision   (4 marks)