MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF AGRIBUSINESS MANAGEMENT AND TRADE

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN AGRIBUSINESS MANAGEMENT

AGB 302: QUANTITATIVE TECHNIQUES IN AGRIBUSINESS

DATE: 11/11/2020   **TIME: 8.30-10.30 AM**

INSTRUCTIONS;

Answer **Question 1** and **ANY TWO** other questions. Show all your workings.

QUESTION ONE (30 MARKS)

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

b)   Given $S_1=\{0,1,7\}$, $S_2=\{7,2,5\}$, $S_3= \{1, 0, 3\}$ and $S_4= \{4,6,8,9,0\}$, find:

   i) $S_2 \cap S_3$ (1 mark)

   ii) $S_2 \cup S_3 \cap S_4 \cap S_1$ (2 marks)

c)   Mbegu Ltd makes 12 different maize seed varieties. In an upcoming farmers field day, the firm intends to distribute free seed packages each containing five varieties, to promote them. If 895 farmers attend the event, and each farmer can get only one unique package, will the packages be enough for all the farmers?   (3 marks)

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

Decision alternative	States of Nature	
	Weak demand (s1)	Strong demand (s2)
Maize production (d1)	15.8	17.2
Wheat production (d2)	18.3	21.5
Barley production (d3)	-10.5	42.0

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

i.   The pessimistic approach   (2 marks)

ii.   The opportunist approach   (3 marks)

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

f)   The table below shows the probability distribution of sales revenues at Matunda Ltd.

Calculate the:

i.   Expected revenue   (2 marks)

ii.   Standard deviation of the revenue   (4 marks)

Sales revenue in Millions of Shillings (x)	100	250	350	450
Probability [P(x)]	0.04	0.15	0.31	0.23

g)   Given $A = \begin{bmatrix} 5 & 1 & 2 \\ 4 & 0 & -2 \\ 1 & -2 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 2 & -1 & 3 \\ -1 & 4 & -1 \\ 0 & -3 & 1 \end{bmatrix}$, find the determinant of:

$2(A + B)^T$ (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)   A poultry farmer has to make a decision on the marketing channel to use so as to maximize revenue from sale of 2000 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)

QUESTION THREE (20 MARKS)

a) Maziwa Dairy farm experimented milk production from two cow breeds, Crown and Zebu. In the first trial, the farm produced 2000 litres of milk from 30 Crown cows and 50 Zebu cows. In the second trial, the farm produced 4200 litres of milk from 60 Crown cows and 120 Zebu cows. Using Cramer's rule, find the milk production per cow for each breed

(8 marks)

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

Activity Code	E	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, 30 days of labor, while an acre of wheat requires 20 days of labor. Capital requirements per acre are Ksh 18,000 for rice and Ksh 12,200 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 75 acres of land, 3,300 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) 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 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)