MACHAKOS UNIVERSITY

University Examinations for 2016/2017 Academic Year

SCHOOL OF AGRICULTURE AND NATURAL RESOURCES MANAGEMENT

DEPARTMENT OF AGRIBUSINESS MANAGEMENT AND TRADE

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE AGRIBUSINESS MANAGEMENT

KBT 302: QUANTITATIVE TECHNIQUES IN AGRIBUSINESS

DATE: 3/8/2017 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS:

Answer **Question 1** and **ANY TWO** other questions. Question 1 carries 30 marks while the other questions carry 20 marks each. Clearly show all your workings.

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Given $S_1=\{0, 1,7\}$, $S_2=\{7,2,5\}$, $S_3=\{1, 0, 3\}$ and $S_4=\{2,7,3,1\}$, find:

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

b) Explain four assumptions of linear programming (4 marks)

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

i) $3(A^T)^{-1}$ (3 marks)

ii) $|B|$ (3 marks)

d) Given the demand function $Q_d = 30-4P$ and supply function $Q_s = -6+5P$, find the equilibrium quantity and price by elimination of variables. (2 marks)

e) Cookies Ltd makes 15 different snack brands. In an upcoming sports event, the firm intends to distribute free packages each containing three brands, to promote its products. What is the maximum number of people the firm can reach if each person gets only one unique package? (3 marks)

f) A project activity, A, has an estimated pessimistic completion time of 7weeks, optimistic completion time of 6 weeks and most likely completion time of 5.5 weeks. Find A's:

   i. Mean completion time (2 marks)

   ii. Standard deviation of completion time (2 marks)

g) The table below shows the probability distribution of milk sales at Maziwa Limited. Calculate the expected sales in the first half of a typical year (5 marks)

Sales in Thousands of Shillings (x)		0	300	600	900
Probability [P(x)]	Quarter 1	0.05	0.20	0.45	0.30
	Quarter 2	0.15	0.30	0.40	0.15

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

Decision alternative	**States of Nature**	
	Weak demand (s1)	Strong demand (s2)
Small scale production (d1)	10.5	12
Medium scale production (d2)	7.5	21
Large scale production (d3)	-13.5	30

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

i. The conservative approach (1 mark)

ii. The minimax regret approach (3 marks)

QUESTION TWO (20 MARKS)

a) The data below was extracted from records of Biashara Ltd to estimate the relationship between production costs and output for its product.

Production costs (Ksh '000)	50	100	250	300	350
Output (kg)	2050	2250	2500	2800	3100

i. Develop a linear squares regression equation for estimating output. (8 marks)

ii. Use the equation in (i) above to predict output if the firm spends KSh 520,000 in the production process. (2 marks)

b) Kemboi's farm produces potatoes and cabbages. In 2015, the farm earned Ksh 560,000 profit from 5 acres of potatoes and 3 acres of cabbages. In 2016, the farm invested in 6 acres of potatoes and 2 acres of cabbages, earning a profit of Ksh 600,000. Using Cramer's rule:

i. Find the returns per acre of crop. (8 marks)

ii. Establish whether the farm will be better off in 2017 by investing in 2.5 acres of potatoes and 5.5 acres of cabbages. (2 marks)

QUESTION THREE (20 MARKS)

a) The following table shows activities for a student research project.

Activity	A	B	C	D	E	F	G	H
Duration (days)	5	8	4	5	10	4	9	5
Predecessor	-	A	B	B	C,D	C	E,F	G

i. Draw the project network using the activity on arrow approach (5 marks)

ii. Determine the critical path, showing the total project duration (5 marks)

b) In June 2016, Pesa bank limited had 200 employees working in Kwale County and 250 employees working in Meru County. The probability that employees move from Kwale to Meru each year is 0.3 while the probability of moving from Meru to Kwale each year is 0.1. Estimate the number of employees working in each county in June 2018. (10 marks)

QUESTION FOUR (20 MARKS)

a) The following table shows wheat sales data from Ngano Ltd.

Month	1	2	3	4	5	6	7	8
Sales volume (tons)	34	42	38	46	36	32	40	36

i. Use a 4-week moving average to forecast monthly sales (5 marks)

ii. Calculate sales forecasts for weeks 2-5 using a smoothing constant of 0.2 (5 marks)

b) A milk producer has to make a decision on the marketing channel to use so as to maximize revenue from sale of 1000 litres of milk. The producer can sell to a farmers' cooperative or to a milk processing company, at high or low price. For farmer cooperative, high price is Ksh 45 per litre, and low price Ksh 40 per litre. For the milk processing company, the prices are Ksh 43 and 39 per litre, respectively. The table below shows the probabilities of buying at the different prices for each channel.

Channel	Probability of buying at:	
	High price	Low price
Farmers' Cooperative	0.2	0.8
Milk processing company	0.8	0.2

Showing all your workings where applicable:

i) Construct a decision tree for the above problem (5 marks)

ii) What is the recommended decision? (4 marks)

iii) What is the expected revenue of the decision? (1 mark)

QUESTION FIVE (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, 60 days of labor, while an acre of wheat requires 40 days of labor. Capital requirements per acre are Ksh 36,000 for rice and Ksh 14,400 for wheat. An acre of rice yields a profit of Ksh 60,000 while barley has a profit of Ksh 50,000 per acre. The firm has a total of 150 acres of land, 6,600 days labor, and capital amounting to Ksh 3,600,000.

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)