



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF BUSINESS AND ECONOMICS

DEPARTMENT OF BUSINESS ADMINISTRATION

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

MASTER OF BUSINESS ADMINISTRATION

BMS 840: QUANTITATIVE TECHNIQUES

DATE: 2/12/2019

TIME: 9.00-12.00 PM

INSTRUCTIONS:

Answer Question ONE and any other TWO questions

QUESTION ONE (40 MARKS)

- a) Statisticians always seek to use estimators that are likely to take on numeric values close to parameters of interest. Explain briefly four properties of good estimators (4 marks)
- b) The marks scored by ten students in two statistics courses, STA 211 and STA 212, were recorded as follows:

Contestants	A	B	C	D	E	F	G	H	I	J
STA 211	80	67	46	90	58	60	70	78	85	55
STA 212	72	57	53	80	60	65	78	79	82	52

Determine the Spearman's rank correlation coefficient and interpret it. (5 marks)

- c) A foreign investor wanted to investigate the financial performance of firms listed in Nairobi Securities Exchange. He sampled 40 firms out of the ones which were listed during a certain period and recorded their annual profits in millions of Kenya Shillings as follows.

200 400 760 100 700 350 450 650 780 880
690 900 400 400 100 300 300 440 840 100
560 200 100 900 900 820 500 220 800 400
790 500 500 900 700 900 290 300 500 260

Construct a 97.5 % confidence interval estimate for the mean of the sampled population. (5 marks)

- d) A manufacturing company uses labour and capital to make its product whose production function is expressed as follows:

$$Q = 24L + 36K - 6L^2 - 3K^2 + 6LK$$

Where, Q = units of output, L = the units of labour and K = the units of capital (the units are expressed in thousands)

- i) Find the optimal amount of capital and labour that would maximize the output (6 marks)
- ii) Find the optimum level of annual production (4 marks)
- e) Dr. Marcos, a statistics lecturer, found out that the mean score of many of his students followed a normal distribution with a mean of 60% and a standard deviation of 8 during a certain semester. He noted that a group of 63 of his students had a mean score of 63%. Perform the necessary hypothesis test at 5% level of significance to find out if this group had a higher mean score. (8 marks)
- f) Recently, a farmer bought a 110 Hectares piece of land with the objective of growing Wheat and Barley on the entire piece of land. Due to the quality of the sun and the region's excellent climate, the entire production of Wheat and Barley can be sold. He wants to know how to plant each variety in the 110 hectares, given the costs, labor requirements and net profits, as shown in the table below:

Variety	Cost (US\$/Hectare)	Labor requirements (Man-days/Hectare)	Net Profit (US\$/Hectare)
Wheat (W)	100	10	50
Barley (B)	200	30	120

The farmer has a budget of US\$10,000 and an availability of 1,200 man-days during the planning horizon.

- i) Formulate a linear program using the above information (2 marks)
- ii) Solve the program above using graphical methods to determine the acreage he should plant each variety in order to maximize the net profit. (6 marks)

SECTION B (40 MARKS): Answer any Two Questions from this section**QUESTION TWO (20 MARKS)**

- a) A household's daily utility function is given by

$$U = 6Q_1^2 + 4Q_2^2$$

where Q_1 and Q_2 are units of good 1 and 2 respectively whose price per unit are \$ 90 and \$ 30 respectively. The household has a daily budget of \$ 4200

- (i) Formulate a constrained optimization problem (3 marks)
 - (ii) Determine the number of units of good 1 and 2 that the household should consume in order to maximize its utility U (5 marks)
 - (iii) Determine the maximum utility (2 marks)
- b) A researcher wishes to determine whether there is a relationship between the gender of an individual and the amount of alcohol consumed. A sample of 1000 people is selected and the following data are obtained.

Gender	Alcohol	Moderate	High	Total
Male	200	200	200	600
Female	100	200	100	400
Total	300	400	300	1000

Perform a test of the hypothesis at the 5% level that alcohol consumption is independent of gender. (10 marks)

QUESTION THREE (20 MARKS)

- a) Three types of vegetables were tested to determine if the content of a certain type of vitamin was the same for each. Random sample data (milligrams of vitamin per 100 grams of vegetable) are given in the table below. Perform the Kruskal Wallis test at the 5% level to determine if mean vitamin contents for the three types of vegetables was the same

(10 marks)

Spinach	Kales	Cabbages
42	34	62
54	50	56
58	40	44
46	30	60
50	46	48
64	66	70

- b) Mr. Mambo was planning to vie for the position of the governor for his county during the general elections. He consulted political experts who advised him that he could only win if at least 35% of the electorate in the county would vote for him. He engaged some researchers to conduct an opinion poll to assess his chances of emerging victorious. Five hundred eligible voters were sampled out of whom 150 indicated that they would vote for him. Carry out a hypothesis test at 5% level of significance advise whether he should have contested. (10 marks)

QUESTION FOUR (20 MARKS)

- a) Four schools namely St Mary's Academy, Baraka Primary, Elite Junior and St Georges Primary participated in a regional Maths contest for class 8. Random samples of 5 pupils were selected from each of the four schools. The scores obtained by each of the pupil from each school are given below in the table below.

St Mary's Academy	Baraka Primary	Elite Junior	St Georges Primary
59	75	46	61
73	64	53	68
70	68	59	59
63	78	56	56
75	75	61	51

Perform an ANOVA test at 1% level to determine whether the mean scores for the schools were equal. (10 marks)

- b) Suppose that there are only two typed of detergent products in a given market. These are product A and B. At the beginning of this month, it is estimated that the proportion of the customers using product A and B are 40% and 60% respectively. After a series of aggressive advertising campaigns by the providers of these products in one month, it is estimated that 30% of customers using product A switched to product B and the others remained loyal. Of the customers who used product B, 25% used it again and the rest moved to product A. Assuming constant transition rate, determine:
- The transition Matrix (P) (2 marks)
 - The proportion of customers using products A and B after one month (2 marks)
 - The proportion of customers using products A and B in the long-run (6 marks)

QUESTION FIVE (20 MARKS)

- a) Give five reasons why researchers prefer to use samples rather than population while carrying out an inquiry (5 marks)

- b) A linear program is defined as follows:

Maximize

$$Z = 3X_1 + 2X_2 + X_3$$

Subject to

$$2X_1 + X_2 + X_3 \leq 150$$

$$2X_1 + 2X_2 + 8X_3 \leq 200$$

$$2X_1 + 3X_2 + X_3 \leq 320$$

$$X_1 \geq 0, X_2 \geq 0, X_3 \geq 0$$

Solve the linear program

(15 marks)