Uganda Martyrs University
Faculty of Science
Department of Natural Sciences

Quantitative Methods

End of Semester Exam, Date: July 20, 2022

Timing: 09:30am to 12:30 pm

Academic Year 2021/2022, Semester 1

Maximum mark: 100

Instructions:

1. *Carefully read through ALL the questions before attempting them.*
2. ***ANSWER ANY FOUR Questions*** *(Each question is 25 marks)*
3. *No* ***names*** *should be written anywhere on the examination book.*
4. *Ensure that your* ***Reg number*** *is indicated on all pages of the examination answer booklet.*
5. *Ensure your work is* ***clear*** *and* ***readable****. Untidy work shall be penalized*
6. *Any type of examination Malpractice will lead to automatic disqualification*
7. *Do not write anything on the questions paper.*

1. (a) Define the term "Quantitative data."

(b) State two advantages of Quantitative data over Qualitative data.

(c) Mr. Musoke, a manufacturer of grocery items wishes to carry out market research on the performance of his products. As a student of Quantitative methods, explain how he can generate quantitative data to meet his task.

(d) (i) Distinguish between Primary and Secondary data.

(ii) Explain the two types of interviews.

(iii) What are the advantages and disadvantages of interviewing, as a method of data collection.

2. (a) (i) Define a "Matrix".

(iii) Determine the order of each matrix below:

$$A = \begin{bmatrix} 2 & 0 & 1 \\ 8 & 3 & 5 \end{bmatrix} \qquad B = \begin{bmatrix} 1 & 3 & 2 & 7 \\ 0 & 8 & 1 & 6 \\ 4 & 5 & 2 & 3 \\ 1 & 1 & 8 & 3 \end{bmatrix}$$

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(b) Given matrices below;

$$D = \begin{bmatrix} 3 & 1 \\ 4 & 2 \end{bmatrix}, \qquad E = \begin{bmatrix} 4 & 3 \\ 1 & 1 \end{bmatrix}, \qquad \text{and} \qquad G = \begin{bmatrix} 0 & 11 & 1 \\ 10 & 14 & 8 \\ 7 & 9 & 2 \end{bmatrix}.$$

Determine;

(i) $3D - E^2$.

(ii) $|G|$. (0

(c) An automobile company uses three types of steel S_1, S_2 and S_3 for producing three types of cars C_1, C_2 and C_3. The steel requirement (in tons) for each type of car is given below:

	C_1	C_2	C_3
S_1	2	3	4
S_2	1	1	2
S_3	3	2	1

Determine the number of cars of each type which can be produced using 29, 13 and 16 tons of steel of the three types respectively. (0

(d) What is meant by the following as applied to Markov Processes :

(i) A state.

(ii) Transition probability. (0

(e) Coca cola company is considering using Markov theory to analyze brand switching between Coke, Fanta and Sprite. Survey data has been gathered and has been used to estimate the following transition matrix for the probability of moving between brands each month:

From	Corke	Fanta	Sprite
Corke	0.60	0.30	0.10
Fanta	0.20	0.50	0.30
Sprite	0.15	0.05	0.80

The current (month 1) market shares are 45%, 25% and 30% for brands Coke, Fanta and Sprite respectively.

(i) Identify the parameters in input analysis.

(ii) In the output analysis, determine the expected market shares after two months have elapsed (short run). **(05)**

3. (a) Distinguish between discrete and continuous quantitative data. **(02)**

(b) (i) Define the term "Problem" as used in Quantitative Methods.

(ii) Explain the different stages of decision making process. **(15)**

(c) Assuming you are a manager of a company that has many challenges.

(i) Identify one of the challenges.

(ii) Using the challenge identified above, briefly explain how you can carry out quantitative analysis.

(iii) Identify the difficulties you would meet in (ii) above.

(08)

4. (a) Draw the line $y = \frac{3}{2}x + 3$ on the x-y Cartesian plane and shade the region $y \leq \frac{3}{2}x + 3$. **(05)**

(b) Consider the planning and scheduling problem facing a manufacturer of microwave ovens with two models in its line i.e the standard and luxurious. Each oven is assembled from component parts and sub-assemblies that are produced in the mechanical and electronics departments. The following table shows the number of production hours per oven required in each department and the capacities of three production departments, in monthly hours.

	Standard (hours/ oven)	Luxurious (hours/ oven)	Capacity (hours/ oven)
Assembly Department	4	4	560
Mechanical Department	3	2	400
Electronics Department	2	4	400

The sales department believes that there will be demand for as many ovens as the company can produce. The accounting department has determined that the variable profit contributions are \$50 for each standard and \$40 for each luxurious. Using the graphical method, determine a production plan to maximize monthly profit contribution. **(10)**

(c) A company manufactures different electronic components for computers as follows:-

- Component A requires 2 hours of fabric and 1 hour of assembly.
- Component B requires 3 hours of fabric and 1 hour of assembly.
- Component C requires 2 hours of fabric and 2 hours of assembly

The company has up to 1,000 laboratory hours for fabrics and 800 laboratory hours for assembly. Each week profits for each unit of A, B and C are \$7, \$8 and \$10 respectively.

(i) Construct a Linear Programming Problem, LPP for this manufacturing company.

(ii) Determine how many of each should be produced to maximize the company profits using Simplex method. **(10)**

5. (a) With suitable examples, distinguish between Independent and mutually exclusive events. **(04)**

(b) Events A and B are such that; P(A) = 0.4, P(B) = 0.6 and P(AB) = 0.7. Determine:-
(i) $P(A \cap B)$ (ii) $P(A^1 \cap B)$ (iii) $P(A^1 \cap B^1)$ (iv) Test whether events A and B are independent or mutually exclusive. **(08)**

(c) A company is working on two independent projects P and Q. There is a 70% chance of finishing project P on time and a 60% chance of finishing project Q on time. Find the probability that:-

(i) Both projects will be finished in time.

(ii) At least one project will be finished in time.

(iii) At most one project will be finished in time. **(06)**

(d) State two importances of Expected Monetary value. **(02)**

(e) A company is in the process of introducing its newly developed shaving machine. Data on sales results has been obtained plus the corresponding probabilities as follows

Sales	50	100	150	200	250	300
Probability	0.1	0.3	0.3	0.15	0.10	0.05

The cost of introduction is $1,000,000/=$ and the unit selling price is $10,000/=$. Determine:

(i) The expected sales of this company.

(ii) The expected profit. **(05)**

Best wishes