



ZIMBABWE EZEKIEL GUTI UNIVERSITY

FACULTY OF LAW, BUSINESS INTELLIGENCE AND ECONOMICS

DEPARTMENT OF ECONOMICS, MARKETING AND ENTREPRENEURSHIP

EXAMINATION PAPER

COURSE CODE : MSTM511
COURSE TITLE : QUANTITATIVE MANAGEMENT
DURATION : 3 Hours
LEVEL : 1.1
DATE : November 2024

10 FEB 2025

INSTRUCTIONS TO CANDIDATES:

1. No cell phones are allowed in the examination venue.
2. Use of silent, non-programmable calculators is allowed
3. Answer question number **one (1)** in Section A (Compulsory) and any other **three (3)** questions in Section B.
4. Begin each question on a new page.
5. The number of marks for each question or part question is shown in brackets []
6. Show all workings, where applicable.

Section A (Compulsory)

Question 1:

a) Mrs Q of XYZ Ltd. wants to introduce a new product in the market. She has a choice of two different research and development plans *A* and *B*. *Plan A* costs US\$10 and has 40 per cent chance of success, whereas *Plan B* costs US\$5 with 30 per cent chance of success. In the event of success, Mrs Q has to decide whether or not to advertise the product heavily or lightly. Heavy advertising will cost US\$4 but gives a 90 percent probability of full acceptance and 30 percent probability of partial acceptance by the market. Light advertising will cost US\$1 with a 50 percent probability of full acceptance. Full market acceptance of the product developed as per plan *A* would be worth US\$40 and as per plan *B* would be worth US\$30. Partial acceptance in both the cases will be worth US\$20.

Required:

- i. With the aid of a decision tree, outline the plan Mrs Q *should* adopt [10 marks]
- ii. Justify the advertising approach to be adopted for marketing the product? [5 marks]
- iii. Outline the advantages of a decision tree approach of decisions making [10 marks]

b) Arrivals at a telephone booth are considered to be Poisson with an average time of 10 minutes between one arrival and the next. The length of a phone call is assumed to be distributed exponentially with mean three minutes.

Required:

- (i) What is the probability that a person arriving at the booth will have to wait? [5 marks]
- (ii) What is the average length of the queue that forms from time to time? [5 marks]
- (iii) The telephone department will install a second booth when convinced that an arrival would have to wait at least three minutes for the phone. By how much must the flow of arrivals be increased in order to justify a second booth? [5 marks]

Section B

Question 2:

A firm has a single channel service station with the following empirical data available to its management:

- (i) The mean arrival rate is 6.2 minutes.
- (ii) The mean service time is 5.5 minutes.
- (iii) The arrival and service time probability distributions are as follows:

Arrivals	Probability (Minutes)	Service Time	Probability (Minutes)
3-4	0.05	3-4	0.10
4-5	0.20	4-5	0.20
5-6	0.35	5-6	0.40
6-7	0.25	6-7	0.20
7-8	0.10	7-8	0.10
8-9	0.05	8-9	0.00
	1.00		1.00

The queuing process begins at 10.00 a.m. and proceeds for nearly 2 hours. An arrival goes to the service facility immediately if it is empty; otherwise, it will wait in a queue. The queue discipline is, first come first served. If the attendant's wage is US\$8 per hour and the customer's waiting time cost US\$9 per hour. The random numbers generated for arrivals are 44; 84; 82; 50; 83; 40; 96; 88; 16; 16; 97; 92; 39; 33; 83; 42; 16; 07; 77 and 66.

The random numbers generated for services time are 50; 95; 58; 44; 77; 11; 08; 38; 87; 45; 09; 99; 81; 97; 30; 36; 75; 72; 79 and 83.

Required:

Using the Monte Carlo simulation technique, outline whether it would be an economical proposition to engage a second attendant based upon a simulated period for 2 hours.

[20 marks]

Question 3:

A company manufactures 3 products A, B and C. The profits are: \$ 3, \$ 2 and \$ 4 respectively. The company has two machines and given below is the required processing time in minutes for each machine on each product. Machines I and II have 2000 and 2500 minutes, respectively. The company must manufacturer, 100 A's, 200 B's and 50 C's but no more than 150 A's.

	Products		
Machines	A	B	C
I	4	3	5
II	2	2	4

Required:

Find the number of units of each product to be manufactured by the company to maximize the profit using the Linear Programming Model.

[20 marks]

Question 4

With the aid of illustrations, explain how a manager can use the concept of elasticity of demand for strategic decision makings.

[20 marks]

Question 5

Using a company of choice, discuss the model building process.

[20 marks]

List of Formulas

- 1) Price Elasticity of Demand = $-(P/Q) \times \text{slope}$.
- 2) Income Elasticity of Demand = $(I/Q) \times \text{slope}$
- 3) Advertisement and Promotion Elasticity of demand = $[(\Delta/Q) \times (\Delta Q/\Delta A)]$
- 4) Coefficient of Correlation using Method of Least Squares

$$r = \frac{a\sum Y + b\sum XY - n\bar{Y}^2}{\sum Y^2 - n\bar{Y}^2}$$

a = Y-intercept

b = Slope of the estimating equation

X = Values of the independent variable

Y = Values of dependent variable

\bar{Y} = Mean of the observed values of Y

n = Number of items in the sample
(i.e., pairs of observed data)

- 5) Coefficient of Correlation using Karl Pearson Method

$$r = \frac{\sum XY}{n\sigma_x\sigma_y}$$

where

$$X = (X - \bar{X})$$

$$Y = (Y - \bar{Y})$$

σ_x = Standard deviation of

X series and is equal to $\sqrt{\frac{\sum X^2}{n}}$

σ_y = Standard deviation of

Y series and is equal to $\sqrt{\frac{\sum Y^2}{n}}$

n = Number of pairs of X and Y observed.

- 6) Coefficient of Correlation using Regression

$$\beta = \frac{\sum XY - (\sum X \sum Y)/n}{\sum X^2 - (\sum X^2)/n}$$