

BOTSWANA COLLEGE OF DISTANCE AND OPEN LEARNING

In collaboration with

THE COMMONWEALTH OF LEARNING

Commonwealth Executive Masters in Business Administration

Commonwealth Executive Masters in Public Administration

QUANTITATIVE TECHNIQUES

QT312

Special Examination

Marks: 100

Time allowed: 3 hours

Instructions

1. This paper consists of Part A and Part B. Answer **ALL** questions in Part A and any **THREE** (3) questions in Part B.
2. Answer questions according to instructions given in each section
3. Write answers in the answer booklet provided
4. Answer **ALL** questions, in grammatical **English**.

Part A (40 marks)**ANSWER ALL QUESTIONS IN THIS PART****Question 1****(8 marks)**

a. Simplify $3\frac{3}{4} - \left(5\frac{3}{16} - 3\frac{7}{8}\right) + 2\frac{1}{2}$

(5 marks)

- b. A patient is given $1\frac{1}{2}$ teaspoons of medicine in the morning and $2\frac{1}{4}$ teaspoons at night. How many teaspoons total does the patient receive daily? **(3 marks)**

Question 2**(13 marks)**

Consider the equation $y = -x^2 + 2x - 3$.

- Draw up a table of x and y values for x -values from -3 to +3. **(3 marks)**
- Find the y -intercept. **(1 mark)**
- Calculate the value of the determinant and comment on its value. **(2 marks)**
- Draw the graph of the quadratic. **(3 marks)**
- Give the values of x and y where the quadratic reaches its maximum. **(4 marks)**

Question 3**(9 marks)**

- a. Determine the equation of a straight line passing through the point (-1, 4) and parallel to the line $3y + 6x = 3$. **(6 marks)**

- b. Solve the following simultaneous equations algebraically:

$$3x - 7y = -24$$

$$2x + 5y = 13$$

(6 marks)**Question 4****(10 marks)**

- a. Find the derivative of the following function:

$$f(x) = 3x^{15} + \frac{1}{17}x^2 + \frac{2}{\sqrt{x}}$$

(3 marks)

- b. Integrate the following with respect to x .

$$\int_{-2}^4 (2x - 3x^2 + 1) dx$$

(4 marks)

PART B**[60 MARKS]**

Answer any **THREE (3)** of the questions below.

QUESTION 1 (20 marks)

A production processes requires steel and plank to produce two products X and Y. Product X requires 4 m of steel and 6 m of plank while product Y uses 9 m of steel and 5 m of plank. At least 180 m and 150 m are available for steel and plank respectively. At least 10 of each type should be produced for efficiency of the production process. Type X product costs P300 while each type of Y costs P290. Let x =number of X and y =number of Y.

Required:

- Formulate a linear programming model for this problem. **(5 marks)**
- Present a graphical solution of this problem. **(8 marks)**
- Identify and explain the special case in the graphical representation. **(3 marks)**
- In order for company to minimize its costs, how many products of each type should it produce? **(4 marks)**

(Total 20 marks)**QUESTION 2****(20 marks)**

Four investment alternatives A, B, C and D are available under three states of nature S1, S2 and S3. The payoff table is shown below with the probabilities.

	S1	S2	S3
A	45	20	90
B	-8	60	60
C	100	-10	75
D	70	80	-5
Probabilities	0.25	0.35	0.4

- a. What decision is the investor going to make if he is:
- i. Pessimistic (4 marks)
 - ii. Optimistic (4 marks)
 - iii. Risk averse (4 marks)
 - iv. A person who like the expected value (EV) approach (4 marks)
- b. How much is the expected value for perfect information? (4 marks)

QUESTION 3

[20 marks]

The demand for a 5kg super gas tank over a period of several weeks has been studied. A probability table below shows the results.

Demand	Probability
2	0.13
4	0.21
5	0.10
6	0.20
7	0.15
8	0.05
9	0.16

- a. Apply the Monte Carlo method to generate the random number ranges for this data.

(10 marks)

- b. Simulate for 15 weeks using the random numbers:

42	15	14	51	69	12	89	79	15	97	37	2	39	94
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(3 marks)

- c. Calculate the average demand for the simulated data. (3 marks)
- d. Use probability to calculate the expected demand. (4 marks)

QUESTION 4

(20 marks)

The following data was collected from an experiment measuring two values X and Y.

X	Y
4	16
9	40
7	21
4	32
5	15
6	20
10	18
8	18
3	15
2	30

- Portray the data in the form of a scatter plot and comment on the general trend. **(5 marks)**
- Determine the linear regression equation and use it to estimate the value of Y when X=25. **(10 marks)**
- Determine the Pearson's correlation coefficient corresponding to the data and comment. **(5 marks)**

END OF EXAMINATION

FORMULAE

$P(A/B) = \frac{P(A \cap B)}{P(B)}$	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$	$P(A \cup B) = P(A) + P(B)$
${}^n P_r = \frac{n!}{r!(n-r)!}$	${}^n P_r = \frac{n!}{(n-r)!}$	$\bar{x} = \frac{\sum x_i}{n}$
$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1}$	$MAD = \frac{\sum x_i - \bar{x} }{n}$	$\bar{x} = \frac{\sum f_i x_i}{n}$
$Median = O_{me} + \frac{c(\frac{n}{2} - f(<))}{f_{me}}$	$Mode = O_{mo} + \frac{c(f_m - f_{m-1})}{2f_m - f_{m-1} - f_{m+1}}$	$Q_1 = O_{q1} + \frac{c(\frac{n}{4} - f(<))}{f_{q1}}$
$Q_3 = O_{q3} + \frac{c(\frac{3n}{4} - f(<))}{f_{q3}}$	$Variance = \frac{\sum f_i x_i^2 - n\bar{x}^2}{n-1}$	$Z = \frac{X - \mu}{\sigma}$
$P(x) = \frac{n! \cdot p^x \cdot q^{n-x}}{x!(n-x)!}$	$P(x) = \frac{e^{-a} \cdot a^x}{x!}$	