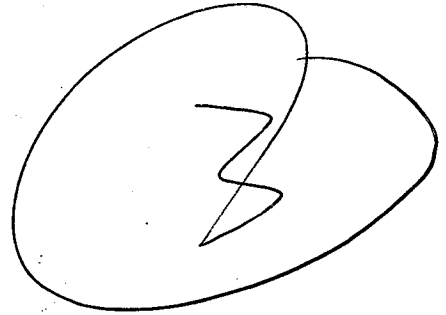




ZIMBABWE



MINISTRY OF HIGHER AND TERTIARY EDUCATION

**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

HIGHER NATIONAL DIPLOMA

IN

INFORMATION TECHNOLOGY

SUBJECT: Operations Research

PAPER NO: 710/S02

NOVEMBER 2011 EXAMINATION

REQUIREMENTS

1. Graph paper.
2. Non – programmable calculator.
3. Statistical formulae and tables.

INSTRUCTIONS TO CANDIDATE

Answer any four (4) questions.

This paper consists of 5 printed pages.

✓ QUESTION 1

- a) Evaluate $\int_0^2 \frac{1}{4+2x^2} dx$ by trapezium rule taking 5 ordinates. (10 marks)
- b) Find the Maclaurin series expansion of e^{-x} up to the term in x^4 . (6 marks)
- c) Explain the following project management terms.
 i) Backward pass rule.
 ii) Forward pass rule. (4 marks)
- d) Given that $\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5}$
 Evaluate $\ln(1,5)$ (5 marks)

QUESTION 2

- a) Explain the following terms as they are used in linear programming.
 i) Feasible region.
 ii) Dual price.
 iii) Dummy.
 iv) Binding constraints.
 v) Non binding constraints. (10 marks)
- b) Mr. Moyo is a branch manager of an office in Bulawayo, he decides to buy some new desks and chairs for his staff. He needs at least five (5) and at least ten (10) chairs and does not wish to have more than 25 items of furniture altogether. The prices of a desk and a chair are \$120 and \$80 respectively. Mr. Moyo has a maximum of \$2 400 to spend.
 Use the graphical method to obtain the maximum number of chairs and desks Mr. Moyo can buy. (10 marks)
- c) The following table gives data for a simple project xxx.

Activity	Preceding Activity	Duration (days)
A	—	3
B	—	3
C	—	7
D	A	1
E	D, J	2
F	B	2
G	C	1
H	E, F G	1
J	B	1

Draw a network diagram for the project indicating the earliest time and latest time. (5 marks)

✓ QUESTION 3

If x is a continuous random variable with a p.d.f $f(x) = kx$ for $0 \leq x \leq 5$

- a) i) Evaluate k
 ii) Find $P(2 \leq x \leq 4)$
 iii) Calculate $E(x)$

(7 marks)

- b) Independent continuous random variables x and y have respective p.d.f.

$$f(x) = \begin{cases} \frac{1}{4}x & 1 \leq x \leq 3 \\ 0 & \text{otherwise} \end{cases}$$

$$f(y) = \begin{cases} \frac{1}{2} & 2 \leq y \leq 4 \\ 0 & \text{otherwise} \end{cases}$$

- i) Calculate the expectation of $4y - 3x$.
 ii) Calculate the variance of $4y - 3x$.

(4 marks)

(6 marks)

- c) Given the following data.

x	2	5	4	6	3
y	60	100	70	90	80

Find the regression line y on x .

(8 marks)

✓ QUESTION 4

- a) Determine the saddle point solution and the value of the game whose pay off table given below is of player A. (9 marks)

	B ₁	B ₂	B ₃	B ₄
A ₁	4 000	3 000	1 000	4 000
A ₂	4 000	4 500	2 000	2 500
A ₃	3 500	2 500	1 500	2 500

$$x^n = \frac{x^{n+1}}{n+1}$$

- b) A company is introducing a new product x . The company will have to build a new plant to produce this product. Three different sized plants are under considerations, (small, moderate and large). It can be low, medium or high. The manager has used the best information available to estimate the profit associated with each plant sized alternative. The information is given below.

$$\frac{d}{dx} x^n = nx^{n-1}$$

Decision alternative	State of Nature		
	Low	Medium	High
Build a large plant	250 000	- 40 000	0
Build a moderate plant	- 50 000	350 000	60 000
Build a large plant	-100 000	80 000	400 000

NOTE: Negative values indicate as a loss.

Use Hurwicz criterion to determine the maximum profitable plant size.

Index of optimism $\alpha = 0.4$

(8 marks)

- c) In a simple queue an average rate of arrival of 18 items per hour has been observed. The service facility can only deal with an average of 20 items per same time frame. Find;

- The average number of items in the queue when there is a queue.
- The average time in a queue.
- The average time in the system.

(8 marks)

$$L_s = \frac{\lambda}{1 - \frac{\lambda}{\mu}}$$

$$L_q = \frac{\lambda}{\mu - \lambda}$$

QUESTION 5

- a) A company stocks an item that is sold at a rate of 50 units per day. It costs the company \$200 000 to place any order. A unit of the product costs the company \$3 500 to keep in storage.

$$w_s = \frac{1}{\mu - \lambda}$$

$$w_q = \frac{\lambda}{\mu(\mu - \lambda)}$$

Determine the Economic Order Quantity assuming a lead time of 7 days.

(4 marks)

- b) Explain the following inventory cost components.

- Purchasing cost.
- Set up cost.
- Holding cost.

(6 marks)

- c) The data given below illustrates the hours spent on training of employees and their contribution to production after training.

Training (hrs)	15	24	25	30	35	40	45	65	70	75
Production (tonnes)	60	45	50	35	42	46	28	20	22	15

- Identify the dependent and independent variable.
- Find the coefficient of correlation and give its interpretation.

(10 marks)

- d) Given the following p.d.f of a discrete random variable x .

x	0	1	2	3	4
$P(x = x)$	$\frac{1}{2}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$

Find $E(x)$.

(5 marks)

QUESTION 6

- a) Maximise $z = 3x_1 + 5x_2$

Subject to

$$\begin{aligned}x_1 &\leq 4 \\2x_2 &\leq 12 \\3x_1 + 2x_2 &\leq 18 \\x_1 &\geq 0 \text{ and } x_2 \geq 0\end{aligned}$$

(15 marks)

- b) Use Simpson's rule with eight ordinates to find an approximate value for.

$$\int_0^{10} \sqrt{1+x^2} \, dx$$

(10 marks)

.../wm

1
0 1.6 3.2 4.8 6.4 8 9.6 10