TECHNICAL UNIVERSITY OF MOMBASA

A Centre of Excellence

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS AND PHYSICS

SERIES: September 2018

SMA 2472 : OPERATION RESEARCH

TIME ALLOWED: 2HOURS

INSTRUCTIONTO CANDIDATES:

You should have the following for this examination

- Mathematical tables
- Scientific Calculator

This paper consists of **FIVE** questions

Answer question **ONE (COMPULSORY)** and any other **TWO** questions

Maximum marks for each part of a question are as shown

QUESTION ONE (30 MARKS COMPULSORY)

a. Define the following terms as used in network analysis

i. Dummy activity (1 mark)

ii. Event (1 mark)

iii. Network (1 mark)

b. Use simplex method to

Maximize p= $2x + 6y + 4z$

Subject to $2x + 5y + 2z \leq 38$

$4x + 2y + 3z \leq 57$

$x + 3y + 5z \leq 57$

$x, y, z \geq 0$ (8 marks)

c. A manufacturer produces two products, klunk and klick. Klunck has a contribution of £ 3 per unit and klick has £ 4 per unit. The manufacturer wishes to establish the weekly production plan which maximizes contribution. Production data are as follows

	Per unit		
	Machining (Hours)	Lab our (Hours)	Material (kgs)
Klunck	4	4	1
Klick	2	6	1
Total available per week	100	180	40

Because of a trade agreement, sales of klunck are limited to a weekly maximum of 20 units and to honour an agreement with an old established customer at least 10 units of klick must be sold per week

I. Formulate a linear programming problem 6 marks
II. Represent the LP on a graph 4 marks
III. Maximize the objective funct ion 2marks

d. Distinguish between a slack and pivot variable 2 marks
e. State two applications of linear programming 2 marks
f. Outline two contemporaries in operation research 2 marks
g. State one structure of mathematical models 1mark

QUESTION TWO (20 MARKS)

a. Define the following terms
   I. Decision tree 2 marks
   II. Forward pass 2 marks
   III. Nodes (2 marks)

b. A firm has developed a new product X . They can either test the market or abandon the project. The details are set out below.
   Test market cost £50,000; likely outcomes are favorable (P=0.7) or failure (P=0.3). If favorable, they could either abandon or produce it when demand is anticipated to be
   Low P=0.25 Loss £100,000
   Medium P=0.6 Profit £150,000
   High P=0.15 Profit £450,000
   If the test market indicates failure, the project would be abandoned. Abandonment at any stage results in a gain of £30,000 from the special machinery used. Draw the decision tree showing the nodes and probabilities 6 marks

c. A firm produces two products X and Y with contributions of $8 and $10 per unit respectively. Solve by graphical method and L.P model associated with the data above. (8 marks)

	Labour hours	Material A	Material B
X	3	4	6
Y	5	2	8
Total available	500	350	800

QUESTION THREE (20 MARKS)

a. A filling station is being planned and it is required to know how many attendants will be needed to maximize earnings. From traffic studies is has been forecasted that the customers will arrive in accordance with the following table.

Customers	probability
0	0.72
1	0.24
2	0.03
3	0.01

From past experience it has been estimated that service times vary according to the following table.

Service time in minutes	1	2	3	4	5	6	7	8	9	10	11	12
probablity	0.16	0.13	0.12	0.1	0.09	0.08	0.07	0.06	0.05	0.05	0.05	0.04

If there are more than two customers waiting, in addition to those being serviced, new arrivals drive on and the sales is lost. A petrol pump attendant is paid $40 per 8 hour day, and the average contribution per customer is estimated to be $4. How many attendants are needed? (6 marks)

b. Draw an activity on node diagram for the following project

Activity	Preceding activity	Duration (days)
1	-	4
2	1	7

3	1	5
4	1	6
5	2	2
6	3	3
7	5	5
8	2,6	11
9	7,8	7
10	3	4
11	4	3
12	9,10, 11	4

Calculate the EST/LST and LFT values for each box 14 marks

QUESTION FOUR (20 MARKS)

a. Define the following terminologies
   I. Economic order quantity 2 marks
   II. Sensitivity analysis 2 marks
   III. Re-order level 2 marks

Player Y

Player x $\begin{pmatrix} 1 & 4 \\ 5 & 3 \end{pmatrix}$

b. A company uses 2000 components per annum and the stock is £6 per component. Holding costs are £2 per component p.a and stock costs are £3 per component per item unavailable. The EOQ is 500 and demand is available as follows

Usage in lead time	**Probability**
80	0.2
90	0.5
100	0.3

What is the most economical re-order level: 90, 95 or 100?
(8 marks)

QUESTION FIVE (20 MARKS)

I. Define the following terminologies
   a. Linear programming 2marks
   b. Objective function 2 marks
   c. Operation research 2 marks
   d. Simplex method 3 marks
   e. Model 2 marks

II. Outline three factors that facilitated growth of operation research 3marks

III. Discuss the stages in OR study 6marks

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