



# THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

**A. M. E. C. E. A**

**MAIN EXAMINATION**

**SEPTEMBER - DECEMBER 2022**

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**FACULTY OF SCIENCE**

**DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE**

**REGULAR PROGRAMME**

**MAT 362: OPERATIONS RESEARCH I**

<b>DATE: DECEMBER 2022</b>	<b>Duration: 2 Hours</b>
<b>INSTRUCTIONS: Answer Question ONE and any other TWO Questions</b>	

**Q1.**

- a) Explain the term Operations research? **(2 Marks)**
- b) Give a brief history of operation research **(3 Marks)**
- c) Draw a flow chart showing the different stages in operation research **(3 Marks)**
- d) Describe the role, methodology and limitations of Operations Research. **(4 Marks)**
- e) Enumerate the types of models used in operations research. **(3 Marks)**
  
- f) In the context of two person game theory, explain the following
  - i) zero-sum and non zero-sum games **(2 Marks)**
  - ii) saddle point **(2 Marks)**
  - iii) the pure and the mixed strategy **(2 Marks)**
  - iv) The value of the game **(1 Mark)**
  
- g) Two participants husband and wife wish to go to an event together but may disagree whether to go to a football game or a variety show. Each participant gets a utility of 10 if he/she goes to his/her preferred event, a utility of 5 if they agree to go to the other's preferred event. A utility of 2 if both are unable that is, they either stay at home or go out individually to their preferred choice, zero otherwise.  
  
Express their phenomenon as a two person non-zero sum game matrix. Comment with reasons on your preferred decision. **(6 Marks)**
  
- h) What are the assumptions and limitations of a game theory? **(2 Marks)**

**Q2**

- a) Explain the term simulation **(2 Marks)**  
 b) Explain the advantages and disadvantages of simulation **(5 Marks)**  
 c) Give the steps in Monte Carlo simulation **(3 Marks)**  
 d) You are provided with the following data .

## Inter Arrival

Inter arrival Time(Minutes)	Pr Probability	C Cumulative probability	R. Random numbers range
3 3	0. 0.17	0. 0.17	00 00-16
4 4	0.25	0. 0.42	17 17-41
5 5	0. 0.25	00 0.67	42 42-66
6 6	0. 0.20	0. 0.87	67 67-86
7 7	0 0.13	1 1.00	87 87-99
Service time(minutes)	P Probability	C Cumulative probability	R Random Numbers range
3 3	0.10	0 0.10	00-09
4 4	0 0.30	0.40	10-39
5 5	0 0.40	0.80	4 40-79
6 6	0 0.15	0.95	80-94
7 7	0.05	1. 1.00	95-99

The management of Nyundo service station plans to install only one dispensing plum of the new station. You are provided with the following Random numbers 2439574577276824643588689851489393618402

Required

Simulate the arrival time of a sample of to vehicles and determine the number of vehicles waiting for service at any time. Assume the station opens at 6pm. **(10 Marks)**

**Q3**

- a) Explain the following terms as used in network analysis
- i) Backward pass **(2 Marks)**  
 ii) Crashing **(2 Marks)**  
 iii) Slack **(2 Marks)**  
 iv) Earliest start time **(2 Marks)**  
 v) Critical path activities **(2 Marks)**

b) consider the following network and activity times (in weeks)

Activity	Activity Times (weeks)
A	5
B	3
C	7
D	6
E	7
F	3
G	10
H	8

Required

- i) How long will it take to finish this project **(4 Marks)**
- ii) Can activity D be delayed without delaying the entire project? If so, by how many weeks **(4 Marks)**
- iii) What is the schedule for activity E? **(2 Marks)**

**Q4**

- a) Name the methods used to find the basic feasible solutions for a balanced transportation problem **(3 Marks)**
- b) What is holding cost in the context of EOQ **(2 Marks)**
- c) A firm has three factories in Lagos, Ibadan and Benin which make weekly dispatches to four depots located at Kaduna, Kano, Kebbi and Katsina. The transport cost per cost of goods dispatch along route is shown in the table below as well as the weekly quantities available from each factory and the requirement of each depot.

Storage	Demand point				Supply capacity
	Kaduna	Kano	Kebbi	Katsina	
Lagos	5	4	5	6	100
Ibadan	3	3	6	6	200
Benin	2	5	7	8	400
Demand	200	100	150	250	

How should the product be allocated to the depots? Use the North-west corner method for the initial allocation.

d) Define economic order quantity (EOQ) **(2 Marks)**

ii) Paul Peterson is the inventory manager for Office Supplies, Inc., a large office supply

warehouse. The annual demand for paper punches is 20,000 units. The ordering cost is \$100 per order, and the carrying (holding) cost is \$5 per unit per year.

Determine the EOQ

**(3 Marks)**

**Q5**

- a) Explain integer programming and dynamic programming in Operations research giving its limitations **(5 Marks)**
- b) State applications of integer and dynamic programming to business **(5 Marks)**
- c) An investment consultant has four projects with different investments and present value of expected returns. Funds available for investment during the three proposals are also available. The detailed information regarding the project is as follows.

Project	Investment during the year			PV of expected return
	1	2	3	
P-1	1,000,000	600,000	500,000	800,000
P-2	500,000	200,000	400,000	700,000
P-3	300,000	250,000	350,000	400,000
P-4	400,000	300,000	260,000	300,000
Funds for investment	1,800,000	1,000,000	800,000	

Formulate an integer programming model for the consultant to make a decision as to which project should be accepted in order to maximize present value of expected return. **(10 Marks)**

**\*END\***