

**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**Plot 91, Cadastral Zone, Nnamdi Azikiwe Expressway, Jabi, Abuja.**

**FACULTY OF SCIENCES**

**January\February Examination 2018**

**Course Code: MTH309**

**Course Title: Optimization Theory**

**Credit Unit: 3**

**Time Allowed: 3 HOURS**

**Instruction: ATTEMPT NUMBER ONE (1) AND ANY OTHER FOUR (4) QUESTIONS**

1. (a) Explain the following terms in the context of operations research
2. Network scheduling
3. Game theory
4. Decision theory
5. Queuing theory **(4 Marks)**
6. A firm manufactures products and, the profits are N3, N2 and N3 respectively. The firm has machines and given below is the required processing time in minutes for each machine on each product.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Product A | Product B | Product C |
| Machine M1 | 4 | 3 | 5 |
| Machine M2 | 3 | 2 | 4 |

Machine and have and machines minutes respectively. The firm must manufacture and but not more than Set up a linear programming problem to maximize the profit. **(8 Marks)**

(c) What is linear programming? **(2 Marks)**

(d) A paper mill produces two grades of paper namely and Due to raw materials restrictions,

it cannot produce more than Tonnes of grade and Tonnes of grade in a week. There are production hours in a week. It requires and hours to produce a Tonne of products and  respectively with the corresponding profits of N200 and N500 per tonne. Formulate the above as a linear programming problem to maximize profit and find the optimum product mix. **(8 Marks)**

1. (a) A company manufactures two products and Each unit of takes twice as long produce as

one unit of and if the company was to produce only it would have time to produce units per day. The availability of the raw material is sufficient to produce units per day of both and combined. Product  requires a special ingredient; only units can be made per day. If  fetches a profit of N2 per unit and a profit of N4 per unit. Find the optimum product mix. (6 Marks)

1. Consider the following linear programming problem.

Maximize 

Subject to :

 (6 Marks)

1. (a) Use sensitivity analysis simplex method to solve the following linear programming problem.

Maximize 

Subject to :

 (4 Marks)

(b) A manufacturer produces three types of plastic fixtures. The time required for molding,

trimming and packaging is given as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Process | Type A | Type B | Type C | Total time available |
| Molding | 1 | 2 |  | 12000 |
| Trimming |  |  | 1 | 4600 |
| Packaging |  |  |  | 2400 |
| Profit | N11 | N16 | N15 | - |

How many dozen of each type of fixture should be produced to obtain a maximum profit?

**(8 Marks)**

1. (a) Babies are born in a sparsely populates state at the rate of one birth every minutes. The time

between births follows an exponential distribution. Find the following:

1. The average number of births per year
2. The probability h=that no birth will occur in any one day
3. The probability of issuing birth certificates in hours given that certificates were issued the first hours of the -hour period. **(6 Marks)**

(b) List the phases or stages of operations research. **(3 Marks)**

(c) Mention five areas where operations research can be applied. **(3 Marks)**

1. A boy who sells newspaper, buys newspaper at 0.45 kobo each and sells them for 0.75 kobo each. The condition here is that the boy cannot return the unsold newspapers. The following table shows the distribution for the daily demand. If each day demand is independent of the previous day demand.

(a)Find the cumulative probability distribution **(4 Marks)**

(b)What is the value of x if the distribution is a valid probability mass function? **(2 Marks)**

(c) Hence or otherwise, show that the distribution is a valid probability mass function. **(6 Marks)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of Customers | 240 | 250 | 260 | 270 | 280 | 290 | 300 | 310 | 320 | 330 |
| Probability | 0.01 | 0.03 | 0.06 | 0.10 | 0.20 | 0.25 | 0.15 | 0.10 | 0.05 | x |

1. (a) Solve the game with the pay - off matrix. **(4 Marks)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Player B strategies** | | | | | |
| **Player A strategies** |  | **I** | **II** | **III** | **IV** | **V** |
| **1** | -2 | 5 | -3 | 6 | 7 |
| **2** | 4 | 6 | 8 | -1 | 6 |
| **3** | 8 | 2 | 3 | 5 | 4 |
| **4** | 15 | 14 | 18 | 12 | 20 |

1. According to the National Health and Nutrition Examination Survey USA. The prevalence of myopia varies by racial groups as follows. (4 Marks)

|  |  |
| --- | --- |
| Racial Group | Percentage Having Myopia |
| White | 26.4 |
| Black | 14.5 |
| Hispanic | 18.3 |
| Other | 20.7 |
| All | 23.9 |

Assume that one person is selected at random from each of the four racial groups .Find the probability that:

1. All the first four groups have myopia.
2. None of them has myopia.
3. Now assume that people are chosen at random from the whole population. Find the probability that, if people are chosen, at least  has myopia. **(4 Marks)**