**KABARAK UNIVERSITY**

**UNIVERSITY EXAMINATIONS**

**MAIN CAMPUS**

**SECOND SEMESTER 2020/2021 ACADEMIC YEAR**

**EXAMINATION FOR THE DEGREE SCIENCE IN COMPUTER SCIENCE AND ACTUARIAL SCIENCE**

**COMP 315/MATH 316: OPERATION RESEARCH**

**STREAM: Y3/S21 - REGULAR TIME: 02:00-04:00PM**

**EXAMINATION SESSION: JANUARY - APRIL DATE: 24/5/2021**

**INSTRUCTIONS TO CANDIDATES**

1. **Attempt Question 1 and any other two questions in the answer booklet provided.**
2. **Do not write on your question papers. All rough work should be done in your answer booklet.**
3. **Clearly indicate which question you are answering.**
4. **Write neatly and legibly.**
5. **Edit your work for language and grammar errors.**
6. **Follow all the instructions in the answer booklet**

**SECTION A: (COMPULSORY) TOTAL MARKS FOR THIS SECTION IS 30.**

1. Briefly explain two phases of an operation research project. (4 Marks)
2. State three assumptions of operation research (3 Marks)
3. Given that *X0 = 23, a = 13, c = 27 and m = 64* generate the first 10 random numbers using linear congruential method (5 Marks)
4. Distinguish between
   1. Reneging and bulking (2 Marks)
   2. CPM and PERT (2 Marks)
5. A manufacturing company has acquired new machines for producing product Omega at a rate of 25 units per hour with a 98% rate of efficiency. The company requires to produce at least 1800 units of Omega per day. The 10 old machines that the company has, produce 15 units of Omega with a 95% efficiency. The cost of operating the new machine is Sh. 4 per hour and Sh. 3 per hour for the old ones. The cost incurred due to inefficiency is Sh. 2 per unit; Its government policy that at least 2 of the new machines must be indulged into production. The company wishes to optimally allocate the machines in order to minimize the total manufacturing cost if the total available hours for production in a day are 8 hours.

Obtain

* 1. Formulate the linear programming model (2 marks)
  2. Use graphical method of solution to find the optimum solution. (6 marks)
  3. State the dual problem (2 marks)

1. Grain Handlers Limited has three warehouses, W1, W2 and W3. The table below shows the inventories of rice in the three warehouses.

Warehouse **W1 W2 W3**

Inventory (bags) 260 168 172

The company is required to supply three of its companies **C1, C2,** and **C3** with rice. The requirements of the customers are as follows:

Customer **C1 C2 C3**

Requirement (bags) 280 120 200

The data below shows the cost of transporting one bag of rice from the warehouse to the customers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Transportation cost per bag (sh)** | | | |
|  |  | **Customer** | | |
|  |  | **C1** | **C2** | **C3** |
|  | **W1** | 100 | 80 | 120 |
| **Warehouse** | **W2** | 140 | 80 | 140 |
|  | **W3** | 160 | 120 | 140 |

**Required**

Using least cost method rule state the initial feasible solution (4 marks)

**SECTION B. TOTAL MARKS FOR THIS SECTION IS 40.**

**ANSWER ANY TWO QUESTIONS FROM THIS SECTION. EACH QUESTION IN THIS SECTION CARRIES 20 MARKS.**

1. A firm has a single channel service station with the following empirical data available to its management

The mean arrival rate is 6.3 minutes

The mean service time is 5.6 minutes

The arrival and service time probability distribution are as follows.

|  |  |  |  |
| --- | --- | --- | --- |
| Arrivals  (Minutes) | Probability | Service Time  (Minutes) | Probability |
| 3-4 | 0.05 | 3-4 | 0.10 |
| 4-5 | 0.2 | 4-5 | 0.25 |
| 5-6 | 0.35 | 5-6 | 0.35 |
| 6-7 | 0.25 | 6-7 | 0.20 |
| 7-8 | 0.1 | 7-8 | 0.10 |
| 8-9 | 0.05 |  |  |

The queuing process begins at 11:00 a.m. and proceeds for nearly 2 hours. An arrival goes to the facility immediately if it is empty otherwise it will wait in a queue. The queue discipline is FIFO. An attendant’s wages are shillings 500 per hour and customer’s waiting time cost is Shillings 562.50. Using Monte Carlo simulation technique show that it is not economical to engage a second attendant (10 Marks)

1. Amani Engineering Works Ltd has a network of branches all over Kenya. The branches are used to service repair and install equipment for their clients. Currently, the Nairobi branch has four clients who require installation of equipment .Each client requires the services of one engineer. There are four engineers who are not engaged at the moment and can be assigned any one of the tasks .However, these engineers have to travel form different locations and the Nairobi branch has to meet their travel and subsistence allowances. The allowances vary from one engineer to another and according to the client the engineer has been assigned to work for. The table below shows the costs (in thousands of shillings) associated with each engineer

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Client** | | | |
| **Engineers** | **1** | **2** | **3** | **4** |
| **A** | 37 | 27 | 34 | 21 |
| **B** | 57 | 22 | 79 | 34 |
| **C** | 22 | 25 | 61 | 45 |
| **D** | 39 | 42 | 54 | 43 |

Required

Assign engineers to clients order to minimize their total cost (4 Marks)

1. Determine the saddle point solution, the associated pure strategy and the value of the game for each of the following games. The payoffs are for playerA(6 Marks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Player B** | | | |
|  | 3 | – 1 | 4 | 2 |
| **Player A** | – 1 | – 3 | –7 | 0 |
|  | 4 | –7 | 3 | –9 |

1. Explain the difference between assignment and transportation problems

(4 Marks)

1. State the assumptions made in solving a transportation problem (3 Marks)
2. Formulate the dual problem of the following given model; (3 Marks)

Minimize,

Subject to

,

,

,

 ,



1. Use the Vogel’s Approximation method to solve the following transportation problem (10 Marks)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **W1** | **W2** | **W3** | **W4** | **SUPPLY** |
| **P1** | 58 | 55 | 60 | 62 | **250** |
| **P2** | 78 | 65 | 73 | 70 | **370** |
| **P3** | 66 | 63 | 70 | 58 | **380** |
| **P4** | 68 | 70 | 72 | 67 | **260** |
| **DEMAND** | **190** | **310** | **410** | **270** | **1180** |

1. Explain the importance of sensitivity analysis in linear programming problems

(2 Marks)

1. Describe the limitations of linear programming. (5 Marks)
2. A company makes two products 1 and 2, each product requires time on two machines A and B. The specifications for each product are as follows:

# Product 1 Product 2

Processing time on machine A (hrs/unit) 2 2

Processing time on machine B (hrs/unit) 1 2

Material and labour cost (sh/unit) 14 15

Selling price (sh/unit) 16 18

Maximum possible sale (units) 130 150

The amount of time available on machine A is 360 hrs and on machine B is 260 hrs.

**Required,**

1. List of the objective functions and constraints (5 Marks)
2. The optimum solution using simplex method. (8Marks)
3. state the major similarities between PERT and CPM. (5 Marks)
4. The School of Business Kabarak University is considering to have a faculty development programme and has planned the following activities:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ACTIVITY** | **Preceding activity** | **ESTIMATED TIME IN WEEKS** | | |
|  |  | **Optimistic** | **Most likely** | **Pessimistic** |
| A | – | 2 | 4 | 12 |
| B | – | 10 | 12 | 26 |
| C | A | 4 | 5 | 6 |
| D | A | 10 | 15 | 20 |
| E | A | 7 | 8 | 9 |
| F | B, C | 6 | 6 | 6 |
| G | D | 3 | 4 | 5 |
| H | E,F,G | 6 | 6 | 6 |

**Required**

1. Draw the network for the project. (3 Marks)
2. Determine the critical path, critical activities and project duration (5 Marks)
3. If 25 weeks deadline is imposed, what is the probability that the project will be finished within the time limit? (4 Marks)
4. If the project manager wants to be 99% sure that the project is completed on schedule date, how many weeks before the present date should he start the project work? (3 Marks)