****

**GARISSA UNIVERSITY**

**UNIVERSITY EXAMINATION 2019/2020 ACADEMIC YEAR TWO**

**SECOND SEMESTER EXAMINATION**

**SCHOOL OF SCHOOL OF PURE AND APPLIED SCIENCES**

**FOR THE DEGREE OF BACHELOR OF EDUCATION**

**COURSE CODE: ACS 204**

**COURSE TITLE: PRINCIPLES OF OPERATIONS RESEARCH**

**EXAMINATION DURATION: 2 HOURS**

**DATE: 17/12/2020 TIME: 03.00-05.00 PM**

**INSTRUCTION TO CANDIDATES**

* **The examination has FIVE (5) questions**
* **Question ONE (1) is COMPULSORY**
* **Choose any other TWO (2) questions from the remaining FOUR (4) questions**
* **Use sketch diagrams to illustrate your answer whenever necessary**
* **Do not carry mobile phones or any other written materials in examination room**
* **Do not write on this paper**

**This paper consists of FOUR (4) printed pages *please turn over***

**QUESTION ONE (COMPULSORY)**

1. Define the following term as used in operation research
2. Multi-channel facility
3. Optimal solution.
4. Service Mechanism
5. Jockeying
6. Service in random order **[5 Marks]**
7. There is a congestion of the platform of the railway station. The trains arrive at a rate of 30 train per day. The waiting time for any train to hump is exponentially distributed with an average of 36 minutes. Calculate
8. The mean queue size
9. The probability that the queue size exceed 9 **[6 Marks]**
10. The following is a payoff table for a particular venture.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | States of nature | | | | |
|  |  | θ1 | θ2 | θ3 | θ4 | θ5 |
|  | D1 | 150 | 225 | 180 | 210 | 250 |
| Decision | D2 | 180 | 140 | 200 | 160 | 225 |
| Alternatives | D3 | 220 | 185 | 195 | 190 | 180 |
|  | D4 | 190 | 210 | 230 | 200 | 160 |

Assume that the Table above, is a loss table rather than a payoff table. Determine the optimal decision using:

1. The min-max criterion,
2. The min-min criterion,
3. The min-max regret criterion, and
4. The minimum expected loss criterion (again assuming equal likelihood of states of nature)  **[8 Marks]**
5. Mr. Ombaka is the inventory Manager for office supplies Inc. of a large office supply warehouse. The annual demand for punches is 20, 000 units. The ordering cost is Ksh 100/= per order and the carrying cost is Ksh 5 unit per year. Determine EOQ (3 marks)
6. A branch of a Nationalized bank has only one typist, since typing work varies in length, the typing rate is randomly distributed approximating a Poisson distribution with a mean service rate of 8 letters per hour. The letter arrives a rate of 5 per hour during the entire 8 hour workday, the typist is valued at Ksh. 150 per hour. Determine
7. Equipment utilization
8. The percent time an arriving letter has to wait
9. Average system time
10. Average idle time cost of the typist per day. **[8 Marks]**

**QUESTION TWO**

1. A poultry farmer desires to purchase three specific feeds F1, F2 and F3 whose units cost per kg are 30, 15, and 40 respectively. The intention is to provide proper vitamin content while at the same time minimize the cost of feeding. The minimum vitamin content needed per feed mix are 35 and 50 units for vitamin A and B respectively; 1 kg of F1 contribute 3 units of A and a unit of B; 1 kg of F2 contribute one unit of A and 2 units of B; 1 kg of F3 contribute 4 units of A and four units of B. Formulate the underlined linear programming problem and solve it using simplex method. **[15 marks]**
2. Consider the following payoff table and obtain the best course of action using EOL criterion.

|  |  |  |  |
| --- | --- | --- | --- |
| State of nature | | | |
| Action | S | S | S |
| A | 60 | 100 | 120 |
| B | 90 | 60 | 110 |
| C | 80 | 110 | 90 |
| Prob | 0.5 | 0.3 | 0.2 |

**[5 marks]**

**QUESTION THREE**

1. A manufacturer makes two products  and. The first requires 5 hours for processing, 3 hours for assembling and 4 hours for packaging. The second requires 2 hours for processing, 12 hours for assembling and 8 hours for packaging. The plant has 40 hours available for processing, 60 hours for assembling and 48 hours for packaging. The profit margin for is $7 and for it is $21. Express the data in equations and inequalities necessary to determine the output mix that will maximize profits.  **[13 Marks]**
2. A company has 4 salesmen and 5 customers. The company has estimated the cost in dollars associated with assigning a particular salesman to a given specific client. These estimates are given in the table below

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Client | | | | | |
| Salesmen |  | 1 | 2 | 3 | 4 | 5 |
| A | 32 | 50 | 37 | 36 | 49 |
| B | 35 | 48 | 35 | 47 | 46 |
| C | 32 | 58 | 40 | 38 | 40 |
| D | 30 | 54 | 39 | 40 | 50 |

Determine who should be assigned which client and the minimum cost the company can incur **(7 marks)**

**QUESTION FOUR**

1. A transportation problem is specified by the supply, demand and shipping cost of a power company.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| From | City 1 | City 2 | City 3 | City 4 | Supply |
| Plant 1 | 8 | 6 | 10 | 9 | 35 |
| Plant 2 | 9 | 12 | 13 | 7 | 50 |
| Plant 3 | 14 | 9 | 16 | 5 | 40 |
| Demand | 45 | 20 | 20 | 30 |  |

Use the above data to determine minimize cost using

1. Northwest corner Method
2. Minimum cost Method
3. Vogel Method [**15 marks]**
4. A small group of Japanese Ladies gather together to make dolls. The dolls must be assembled A then clothed C before they are finally given some hair H. Being conscious of the competitive business climate the group knows that they must strive for efficiency. Which ladies should do which job in order to maximize their profit? **[5 marks]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| TASK | | | | |
| Individual |  | A | C | H |
| Lilo | 2 | 3 | 1 |
| Kumengo | 10 | 11 | 8 |
| Seesor | 9 | 5 | 3 |

**QUESTION FIVE**

1. Consider the following payoff table and obtain the best course of action using EMV criterion and the maximum likelihood criterion.  **[6 Marks]**

|  |  |  |  |
| --- | --- | --- | --- |
| State of nature | | | |
| Action | S1 | S2 | S3 |
| A | 60 | 100 | 120 |
| B | 90 | 60 | 110 |
| C | 80 | 110 | 90 |
| Probability | 0.5 | 0.3 | 0.2 |

1. Lillian Wambugu is the project manager of Jokete Construction Company. The company is bidding a contract to install telephone lines in a small town. It has identified the following activities along with their predecessor restrictions, expected times and worker requirements:

|  |  |  |  |
| --- | --- | --- | --- |
| Activity | Predecessors | Duration  Weeks | Crew Size  Workers |
| A  B  C  D  E  F  G  H | -  -  A  A  B  B  D, E  F, G | 4  7  3  3  2  2  2  3 | 4  2  2  4  6  3  3  4 |

Lillian Wambugu has agreed with the client that the project should be completed in the shortest duration.

1. Draw a network for the project. **[4 Marks]**
2. Determine the critical path and the shortest project duration.  **[4 Marks]**
3. Lillian Wambugu will assign a fixed number of workers to the project for its entire duration and so she would like to ensure that the minimum number of workers is assigned and that the project will be completed in 14 weeks. Draw a schedule showing how the project will be completed in 14 weeks  **[4 Marks]**
4. Comment on the schedule you have drawn in (iii) above.  **[2 Marks]**