**Answer ALL questions**

**Question 1 (10 marks)**

You are the President of Graduate Student Council in APU and is considering to sell fruits during Entrepreneur Week 2020. Because some of the fruits such as strawberries are already very ripe, you will need to sell them immediately and then discard any that remain unsold. You have estimated that you will be able to sell 15, 16, 17, 18, 19 or 20 cases in one day and the probability is shown in the table below. You purchase the fruits for $7 per case and sell them for $18 per case.

|  |  |
| --- | --- |
| **Demand** | **Probability** |
| 15 | 0.10 |
| 16 | 0.30 |
| 17 | 0.15 |
| 18 | 0.20 |
| 19 | 0.15 |
| 20 | 0.10 |

To decide how many fruit cases to purchase, you are required to construct a payoff table for this decision situation. Then use the following decision making methods (**A** and **B**) with and without probabilities to determine the best decision.

**Method (A)** Minimax regret approach

**Method (B)** Decision tree analysis (Hint: you are required to compute the expected value of perfect information.)

Comment the results if there is any discrepancy of decisions between **Method A** and **B**.

**Question 2 (10 marks)**

You will set up a booth to sell fruit case during Entrepreneur Week 2020. To properly plan for this booth, you are required to:

1. Develop a table with at least 8 different activities to show the requisite activities, their immediate predecessors and the estimated completion time (in days) since you are only given 2 weeks to prepare. Assume this is a new event that you never be worked before, you are required to provide the optimistic, most probable and pessimistic time estimates (in days) for each activities you are listed in the table.

(4 marks)

(b) Use R to determine the activity schedule for the event in part (a) and identify the critical path. Based on the analysis, can the event in part (a) be prepared in the time given? If not, provide suggestion to ensure the booth is ready in 2 weeks.

(6 marks)

**Question 3 (15 marks)**

1. To successfully set up the booth to sell the fruit cases, you are required to assign the tasks you described in Question 2 to your team members so that all the activities can be done in the time given. Assuming:

* only 10 of your team members are available and
* each of them can handle at most 2 tasks at the same time.

Formulate a model to determine how the tasks to be assigned to staff so that the booth can be prepared in the days you mentioned in **Question 2(b)**. To answer this question, you are required to consider all possible member-activity assignments and estimate the corresponding completion times.

(8 marks)

1. There is a Team B plans to sell fresh fruit juice during Entrepreneur Week 2020. Each of you is considering three possibilities to promote: (I) better packaging, (II) increase advertising, and (III) slight reduction in price. Each gain in your team will result in an identical loss in Team B. The table below shows the percentage of increase or decrease of sales for your team using the three possibilities:

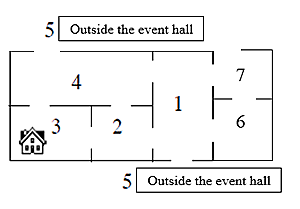
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Team B | | |
|  |  | I | II | III |
| Your Team | I | 9 | 7 | 2 |
| II | 11 | 8 | 4 |
| III | 4 | 1 | -7 |

Identify whether the above problem has a pure strategy solution. Then, determine the strategy both teams (including my team) should be used to promote the product.

(7 marks)

**Question 4 (15 marks)**

Suppose the following figure is the floor plan and your promotional booth is placed in Area **6** (marked as **X** in the figure). There are 7 areas including the area outside the event hall, and 11 openings between the areas (labelled as **A** to **K)**.



**K**

**I**

**J**

**H**

**G**

**F**

**E**

**D**

**C**

**B**

**A**

1. You are considering to have signage at the opening so that customers know where your booth is. For example if the signage at **A**, customers in Area 1 and 4 would see it and so on. Since the booth is at Area 6, no signage required at **F** and **H**. Formulate a model that will enable you to determine the locations of the signage.

(7 marks)

(b)Each time, a customer chooses at random one of the openings he/she is in and moves to another area. Set up the process as a Markov and assuming Area 5 and 6 are the absorbing states, formulate a transition matrix for the problem. Solve the matrix and determine the probability that a customer will come to Area 6. Comment your results.

(8 marks)

**Question 5 (15 marks)**

To have sufficient number of team members to help on the day of event, you are required to develop a work schedule to the team members you mentioned in **Question 3**. You have been suggested to use linear programming model to determine the optimal schedule for them.

Information related to the schedule are given as below:

* Event starts from 9am to 5pm.
* Since all the members are students in APU, none of them will be able in the booth from 9am to 5pm except you.
* No paid to the team members, they will only receive a certificate of participation.
* You are considering to request them to work either for 2-hour, 3-hour or 4-hour shift.

Formulate and determine an optimal schedule for the team members. To answer this, you are required to consider the minimum number of members required in each hour. Based on the output, is the number of team members in **Question 3** sufficient? If not, justify your answer. And what would be your preferred working shift?

**Question 6 (10 marks)**

You have contacted Company ABC in Kepong Village Mall to provide materials required for the booth. You have requested the company to send all the materials to APU in the shortest time (in minutes).

1. Construct a network to show at least 10 various areas/cities/landmarks/buildings that might pass from the company to APU.

(5 marks)

1. Of all possible routes available at the areas/cities/landmarks/buildings you mentioned in part (a) to APU, determine the shortest time (in minutes) using **TWO** of the following algorithms:
2. Transshipment modelling
3. Dijkstra shortest path algorithm.
4. Prims algorithm
5. Kruskal algorithm
6. Boruvka algorithm

(5 marks)

**Question 7 (25 marks)**

You are required to study a one-server waiting line system and observe for at least 2 hours. During your observation, you have to record the customer **arrival time**, **time the service begins** and **time the service ends**.

1. Based on data you collect, perform the following analysis:
2. Estimate the arrival and service rate.

(2 marks)

1. Compute the operating characteristics of the waiting line model by assuming Poisson arrivals and Exponential service times.

(5 marks)

1. To evaluate the performance of the waiting line system in part (a), you are required to run a simulation with at least 80 customers using Excel. Construct
2. bar chart to show the waiting and service time of customers

(3 marks)

1. histogram of waiting time

(3 marks)

1. histogram of service time

(3 marks)

1. Based on your result in part (b), perform the following:
2. Find the average waiting time.
3. Find the probability that a customer has to wait.
4. Find the average service time.
5. Find the average time a customer spends in the system.

(4 marks)

1. Based on the analysis in part (a) – (c), provide some suggestions to the observed server to improve their waiting line system.

(2 marks)

In your report, please include the original data, probability distribution for arrival and service time, and simulation results.

(3 marks)