



# **MACHAKOS UNIVERSITY**

**University Examinations for 2019/2020 Academic Year**

**SCHOOL OF BUSINESS AND ECONOMICS**

**DEPARTMENT OF ECONOMICS**

**THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR**

**BACHELOR OF ECONOMICS AND STATISTICS**

**BACHELOR OF ECONOMICS**

**EES 302: OPERATIONS RESEARCH I**

**DATE:**

**TIME:**

---

## **INSTRUCTIONS:**

- 1. ATTEMPT QUESTION ONE AND ANY OTHER TWO QUESTIONS**
- 2. CLEARLY SHOW ALL YOUR WORKINGS**

### **QUESTION ONE (COMPULSORY) (30 MARKS)**

a) A firm produces three products X1, X2 and X3. It uses two resources; man hours and raw materials

- To produce a unit of X, the firm requires 6 hours and 2 units of raw materials.
- To produce a unit of X2, the firm requires 3 hours and 2 units of raw materials.
- To produce a unit of X3, the firm requires 5 hours and 10 units of raw materials.

On 30 man hours and 50 units of raw materials are available. If profits per unit of product X1, X2 and X3 are 30, 24 and 60 respectively;

- Formulate the linear programming problem for the firm and solve the optimal solution (10 marks)
- Interpret the above solution as thoroughly as possible. Be sure to interpret the shadow prices/marginal values for the resources (5 marks)

- iii. Formulate the dual problem corresponding to the problem in (a) above. Using the dual theorems, determine the optimal solution to the dual problem (10 marks)

**QUESTION TWO (20 MARKS)**

Given the following payoff information of a investor who wishes to process sin different types of housing considering the demand in the market

| Type of investment | Low demand | Medium demand | High demand | Extreme high demand |
|--------------------|------------|---------------|-------------|---------------------|
| Mansionnates       | 100        | 50            | 150         | 50                  |
| Apartments         | 200        | 100           | 0           | 50                  |
| Town houses        | 100        | 100           | 200         | 150                 |
| Bungalow           | 0          | 50            | 600         | 250                 |
| Probability        | 0.5        | 0.25          | 0.15        | 0.1                 |

Identify the best form of investment. Proof your answer (20 marks)

**QUESTION THREE (20 MARKS)**

- a) A book binder has one printing press, one binding machine and the manuscripts of a number of different books. The times required to perform the printing and binding operation for each of the five books are known and shown in the table below

| Book          | Processing time in minutes |    |    |    |    |
|---------------|----------------------------|----|----|----|----|
|               | 1                          | 2  | 3  | 4  | 5  |
| Printing time | 40                         | 90 | 80 | 60 | 50 |
| Binding time  | 50                         | 60 | 20 | 30 | 60 |

Determine the order in which the books should be processed in order to minimize the total time required to process all the books. What is the total time required (8 marks)

- b) Suppose that an individual operation is added to the process described in |a( namely, finishing. The time required for the operations are given below

|                |    |     |    |    |     |
|----------------|----|-----|----|----|-----|
|                |    |     |    |    |     |
| Book           | 1  | 2   | 3  | 4  | 5   |
| Finishing time | 80 | 100 | 60 | 70 | 100 |

What is the order in which the five books should be processed from printing to the press.  
Find the minimal total elapsed time (12 marks)

#### QUESTION FOUR (20 MARKS)

A company has developed a new produce and has identified the activities necessary for the product promotion campaign as follows.

| Activity | Description                     | Preceding activity | Duration |
|----------|---------------------------------|--------------------|----------|
| A        | Approval of training budget     | -                  | 1        |
| B        | Training of service people      | A                  | 8        |
| C        | Training of sales people        | A                  | 4        |
| D        | Sales promotion to distributors | C                  | 4        |
| E        | Distribution to distributor     | D                  | 2        |
| F        | Distribution to retailers       | E                  | 4        |
| G        | Advertising proof               | A                  | 2        |
| H        | Advertising contact             | G                  | 1        |
| I        | Illustration and text           | H                  | 4        |
| J        | Printing                        | I                  | 4        |
| K        | Product launch                  | B,F,J              | 1        |

#### Required

- Briefly explain three functions of project management (3 marks)
- Construct a network diagram for the above project (5 marks)
- Determine the critical path of the project. How long is the project expected to take (12 marks)

**QUESTION FIVE (20 MARKS)**

a) Define the following terms (10 marks)

- i. Dominant strategy
- ii. Nash equilibrium
- iii. Saddle point
- iv. Minimax theorem
- v. Expected value of perfect information

b) Two competing mobile firms must decide on the size of the screen on their new models. They may adopt a wide screen or a slim screen strategy. The following matrix shows their respective payoffs.

|                |             |                |             |
|----------------|-------------|----------------|-------------|
| A's strategies |             | B'S strategies |             |
|                |             | Wide screen    | Slim screen |
|                | Wide screen | 200, 100       | 100, 90     |
|                | Slim screen | 80, 70         | 180, 60     |

a) Use the information to identify the dominant strategy for each player and the Nash equilibrium of the game (5 marks)

b) The following matrix shows the alternative sizes of a minibus a company could buy and the respective payoffs. Use the information to obtain the saddle pint for the company. (5 marks)

|                         |                       |                         |
|-------------------------|-----------------------|-------------------------|
|                         | Buy 14 seater minibus | Buy a 36 seater minibus |
| Buy a 14 seater minibus | (3, -3)               | (3,-3)                  |
| Buy a 36 seater minibus | (2, -2)               | (4, -4)                 |