# THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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## A. M. E. C. E. A

### MAIN EXAMINATION

### AUGUST - DECEMBER 2018 TRIMESTER

### FACULTY OF COMMERCE

### DEPARTMENT OF ACCOUNTING AND FINANCE

### REGULAR PROGRAMME

### CMS 321: ANALYTICAL DECISION MAKING

| Date: DECEMBER 2018 | Duration: 2 Hours |
|---|---|
| INSTRUCTIONS: Answer Question ONE and ANY OTHER TWO Questions | |

Q1. a) Read through the following information relating to a firm offering financial investment services and answer the question that follows:
Pfeiffer Inc. is an investment advisory firm that manages more than Kshs 120 million in funds for numerous clients. The company uses an asset allocation model that recommends the portion of each client's portfolio to be invested in a growth fund, an income fund, and a money market fund. To maintain diversity in each client's portfolio, the firm places limits on the percentage of each portfolio that may be invested in each of the three funds. General guidelines indicate that the amount invested in the growth fund must be between 20% and 40% of the total portfolio value. Similar percentages of the other two funds stipulate that between 20% and 50% of the total portfolio value must be in the income fund and at least 30% of the total portfolio value must be in the money market fund. Additionally, Pfeiffer is currently forecasting annual yields of 18% for the growth fund, 12.5% for the income fund and 7.5% for the money market fund. Pfeiffer has just contracted with a new client who has Kshs 800,000 to invest.

**Required:**
Develop a linear programming model that is appropriate for advising the new client on how to allocate the Kshs 800,000 among the growth, income, and money market funds, with an objective of maximizing yield from the investment? (NB. DO NOT SOLVE FOR THE LP MODEL)

**(14 marks)**

b) Consider the following transportation table:

| Origin | $D_1$ | $D_2$ | $D_3$ | $D_4$ | Supply |
|---|---|---|---|---|---|
| $O_1$ | 5 | 7 | 10 | 5 | 75 |
| $O_2$ | 6 | 5 | 8 | 2 | 175 |
| $O_3$ | 6 | 6 | 12 | 7 | 100 |
| $O_4$ | 8 | 5 | 14 | 4 | 150 |
| Demand | 125 | 100 | 150 | 125 | |

eg. Transportation cost per unit on $O_4$- $D_1$ route

**Required:**

(i) Provide the initial feasible transportation solution using the MCM and determine whether the solution is degenerate or not. (**NB.** Do not proceed to solve for the optimal solution) **(4 marks)**

(ii) Suppose you were to formulate a linear programming model for solving the transportation problem, indicate the adjustments you would make to the model formulation, where;

(I) The route $O_3$- $D_3$ is to carry at least 50 units (**NB**. Provide the required constraint). **(2 marks)**

(II) The route $O_4$ - $D_4$ is unacceptable (**NB.** Provide an explanation of the adjustment needed). **(2marks)**

c) The Reliable Construction Company has just made a winning bid of K£5.4 million to construct a new plant for a major manufacturer. The manufacturer needs the plant to go into operation within a year (47 weeks). Below is the least of the various activities and other relevant information which Mr. Perty, the company's construction manager looks forward to performing in the challenge of bringing the project in on schedule.

| **Activity** | **Activity description** | **Immediate predecessor** | **Estimated duration (weeks)** |
|---|---|---|---|
| A | Excavate | - | 2 |
| B | Lay foundation | A | 4 |
| C | Put up the rough wall | B | 10 |

| | | | |
|---|---|---|---|
| D | Put up the roof | C | 6 |
| E | Install the exterior plumbing | C | 4 |
| F | Install the interior plumbing | E | 5 |
| G | Put up the exterior siding | D | 7 |
| H | Do the exterior painting | E, G | 9 |
| I | Do the electrical work | C | 7 |
| J | Put up the wallboard | F, I | 8 |
| K | Install the flooring | J | 4 |
| L | Do the interior painting | J | 5 |
| M | Install the exterior fixtures | H | 2 |
| N | Install the interior fixtures | K, L | 6 |

**Required:**
Will Mr. Perty be able to complete the project in the required time if the activities are performed according to the estimated durations above? **(8 marks)**

Q2. Consider the following transportation problem for a company with four origins and four destinations:

| Origin | $D_1$ | $D_2$ | $D_3$ | $D_4$ | Supply |
|---|---|---|---|---|---|
| $O_1$ | 5 | 7 | 10 | 5 | 75 |
| $O_2$ | 6 | 5 | 8 | 2 | 175 |
| $O_3$ | 6 | 6 | 12 | 7 | 100 |
| $O_4$ | 8 | 5 | 14 | 4 | 150 |
| Demand | 125 | 100 | 150 | 125 | |

eg. Transportation cost per unit on $O_4$- $D_1$ route

**Required:**

a) Assuming the company's objective is a cost minimization one, determine the optimal transportation plan. What is the total cost of the transportation plan? **(10 marks)**

b) Assuming the company's objective is a profit minimization one, determine the optimal transportation plan. What is the total prof of the transportation plan? (**10 marks)**

Q3. a) Dr. Paul Ngula is the manager of the research division of Better Health

Care Inc., a large pharmaceutical company. His important project coming up is the development of a new drug to combat the AIDS virus. He has identified 10 groups in his division that will need to carry out different phases (activities) of this research and development (R & D) project. To beat the competition, the managing director of Better Health Care has informed Dr. Paul that he wants the drug ready within 22 months.
Dr. Paul knows very well that there is considerable uncertainty about how long each group will need to do its work. Designating the work to be carried out by the respective groups by letters A, B, …., J, and using the PERT three-time estimate approach, the manager of each group has produced a most likely estimate, an optimistic estimate, and a pessimistic estimate, of the duration of the group's activity, and using appropriate PERT formulas, these estimates have been converted into estimates of the mean (i.e expected time) and variance of each activity, as provided by the data in the following table. The immediate precedence relationship (i.e immediate predecessor) information for the activities is also provided.

| Activity | Estimated mean (months) | Estimated variance (months) | Immediate predecessor |
|---|---|---|---|
| A | 4 | 5 | - |
| B | 6 | 10 | - |
| C | 4 | 8 | A |
| D | 3 | 6 | B |
| E | 8 | 12 | A |
| F | 4 | 6 | C |
| G | 3 | 5 | D |
| H | 7 | 14 | B |
| I | 5 | 8 | E,F |
| J | 5 | 7 | G,H |

**Required:**

(i) Determine the project completion time. **(6 marks)**

(ii) What should Dr. Paul tell the managing director about the likelihood of having the drug ready within 22 months, if the project completion times are determined to follow a normal distribution? Support your answer. **(5 marks)**

c) Mary wants to operate a cafeteria in the City of Kisumu (Kenya). A small business enterprise advisor whom she approached, listed for her, six major activities to carry out. The table below gives a summary of relevant data for the project comprising of the normal time estimate, crash time and cost reduction per day, for each activity, for each activity. Information on the the precedence relationship among the activities is also provided.

| Activity/description | Predecessor | Normal time (weeks) | Crash time (weeks) | Cost slope/cost reduction (shs) |
|---|---|---|---|---|
| A: Procurement of materials | - | 3 | 3 | - |
| Plumbing | A | 6 | 4 | 45,000 |
| Masonry | - | 5 | 3 | 30,000 |
| Electrical works | C | 8 | 7 | 60,000 |
| Carpentry | C | 6 | 4 | 22,000 |
| Finishing | B,D, E | 4 | 2 | 75,000 |

**Required:**

(i) Determine the shortest time in which the project can be completed using relevant data on the project provided above, if crash cost is not a barrier to crashing. **(4 marks)**

(ii) Compute the additional cost to be incurred for the shortest time in which the project can be completed. **( 3 marks)**

(iii) Explain the meaning of the cost slope and provide an illustration of how a cost slope of any given activity in the project can be computed. **(2 marks)**

Q4. Yana Tyre Company has decided to hire a new mechanic to handle all tyre changes for customers ordering a new set of tyres. Two mechanics have applied for the job. One mechanic has limited experience and can be hired for £7 per hour. It is expected that this mechanic can service an average of 3 customers per hour. The other mechanic has several years of experience. This mechanic can service an average of 4 customers per hour, but must be paid £10 per hour. Assume that the customers arrive at the Yana garage at the rate of 2 customers per hour.

**Required:**

a) Compute the following waiting line characteristics for *each mechanic*, assuming Poisson arrival times and exponential service times:

(i) $L_q$ (the average number of customers in the waiting line) **(4 marks)**

(ii) $L$ (the average number of customers in the system) **(4 marks)**

(iii) $W_q$ (the average time a customer spends in the waiting line) **(4 marks)**

(iv) $W$ (the average time a unit spends in the system) **(4 marks)**

b) If the company assigns a customer waiting cost of £15 per hour, which mechanic provides the lower operating cost per hour? Support your answer. **(4 marks)**

***END***