KENYA METHODIST UNIVERSITY

NAKURU CAMPUS

DLM ASSIGNMENT        1ST TRIMESTER 2014

*Answer All Questions*

**BUSS 320**
**Quantitive Methods**

**Question one: matrices and input –output analysis**
In an economy there are three sectors; agriculture, industry and fishing, the following table gives the supply and demand positions of the sectors in shillings.

| PRODUCER | AGRICULTURE | INDUSTRY | FISHING | FINAL DEMAND | TOTAL OUTPUT |
|---|---|---|---|---|---|
| AGRICULTURE | 400 | 600 | 500 | 1000 | 2500 |
| INDUSTRY | 1200 | 600 | 600 | 1200 | 3600 |
| FISHING | 200 | 400 | 500 | 300 | 1400 |

Determine the total output given that final demand increases to 4800, 1600 and 600 respectively   **8mks**

**Question two:markovian processes**
(a)At the end of each fiscal year the student loans board gathers information on the payment status of the loans. The loans are divided into 3 categories: early payments (E), current payments(C) and late payments (L).Each year some of the students lag behind in payments or catch up. The information is given by the matrix below

$$\begin{array}{c} \\ C \end{array} \begin{bmatrix} \overset{E}{0.86} & \overset{C}{0.08} & \overset{L}{0.06} \\ 0.62 & 0.29 & 0.09 \\ 0.17 & 0.37 & 0.46 \end{bmatrix}$$

In one year the percentage in each category was:
E→ 80%     c→ 11%  and L→9%.Find the percent in each category three years later.                    **(5mks)**

**Question three ;calculus**
Given that a firm has total cost function given by the equation $c(x) = \frac{1}{3}x^3 - 7x^2 + 111x + 50$ and the corresponding revenue function given by $R(x) = 100x - x^2$, determine the profit function and hence find the marginal profit when 20 units of product are produced and sold.                    ( **6 mks)**

**Question four;network analysis**
A project has 11 activities whose optimistic, most likely and pessimistic times (weeks) are shown below:

| Activity | predecessor | Optimistic  time (weeks) | Most likely time (weeks) | Pessimistic time (weeks) |
|---|---|---|---|---|
| A | - | 2 | 5 | 8 |
| B | - | 1 | 4 | 7 |
| C | - | 4 | 7 | 10 |

| D | A | 7 | 11 | 15 |
|---|---|---|---|---|
| E | A,B | 3 | 4 | 5 |
| F | A,B | 6 | 9 | 12 |
| G | C | 4 | 6 | 8 |
| H | C | 3 | 6 | 9 |
| I | E,F,G | 3 | 8 | 13 |
| J | H | 12 | 13 | 14 |
| K | I,J,D | 1 | 3 | 5 |

Required:
(i) The variance of each activity
(ii)Draw a project network for the above problem
(iii) The critical path
(iv)The expected project time and standard deviation
(v) The probability of completing activity K within 5 weeks                                    (**12 mks**)

## QUESTION FIVE;LINEAR PROGRAMMING

Quick Ltd manufactures two products: B1.and.B2 using two machines, X1 and $X_2$ For each machine there is a maximum of 200 machine hours available each week and a maximum of 400 labour hours are dedicated to the production of products $B_1$ and $B_2$ each week.
The resource usage per unit of each product is shown in the table below;

**Resource usage per unit**

| Resource | Product $B_1$ | Product $B_2$ |
|---|---|---|
| Machine $X_1$(HOURS) | 2 | 3 |
| Machine $X_2$(hours) | 4 | 2 |
| Labours hours | 5 | 3 |
| Contribution per unit (sh) | 3,000 | 2,000 |

**Required:**
(i)Formulate a linear programming model to solve the above problem.
(ii) Graphically solve the linear programming model formulated above            (4 marks)

## QUESTION SIX:QUEUING THEORY

Dr.Rosemary Meno, a renowned dentist operates a dental clinic at the city centre. Patients arrive at the clinic at a mean rate of 20 patients per hour. The consultation period taken by Dr.Rosemary Meno per patient is an average of 2 minutes. Each patient is allowed only one consultation per day.
Required
(i)The average number of patients in the queue system
(ii) The average number of patients in the queue
(iii) The probability that there is no patient in the queue system            (9marks)

## Question seven: simulation

ABC ltd. recently acquired a threshing machine with a useful life of 15 years. Over the useful life, the machine is likely to have periodic failures and breakdown .past data for similar machines indicate a probability distribution of failures as follows.

| Number of failures | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| probability | 0.80 | 0.15 | 0.04 | 0.01 |

Required

(i) Using the random numbers provided below, simulate the number of failures that will occur over the useful life of the machine.

Random numbers 70,88,37,12,45,99,54,71,64,93,67,80,55,34,22

(ii) Determine the average annual failure rate (8 marks)

### Question eight: assignment problem

A company makes profit (shs.million) while processing different jobs on different machines (one machine one job only).Now the company is facing a problem of assigning 4 machines to five jobs. The profits are estimated as given below

|  |  | Job | | | | |
|--|--|-----|--|--|--|--|
|  |  | J1 | J2 | J3 | J4 | J5 |
|  | A | 21 | 16 | 35 | 42 | 16 |
| Machine | B | 1 | 20 | 30 | 35 | 15 |
|  | C | 20 | 16 | 30 | 27 | 18 |
|  | D | 15 | 18 | 32 | 27 | 15 |

Determine the optimal assignment for maximum total profits (8 marks)