



MASENO UNIVERSITY
UNIVERSITY EXAMINATIONS 2015/2016

**FOURTH YEAR SECOND SEMESTER EXAMINATIONS FOR THE
DEGREE OF BACHELOR OF SCIENCE AND BACHELOR OF
EDUCATION WITH INFORMATION TECHNOLOGY**

MAIN CAMPUS

SMA 429: OPERATION RESEARCH III

Date: 26th April, 2016

Time: 11.00 - 1.00 pm

INSTRUCTIONS:

- Answer question ONE and any other TWO questions.



2016/17 - OPERATION RESEARCH III (APRIL, 2016 EXAMS)

Instructions: Answer question ONE and any other TWO questions.

Question One Compulsory (30 Marks)

- a) Differentiate between Linear and Non-Linear Programming. (4 Marks)
- b) The Cam-Con Co. owns a tract of land that may contain oil. A consulting Geologist has reported to management that he believes there is 1 chance in 4 of oil. Because of this prospect, another oil company has offered to purchase the land for \$90,000. However, the Company is considering holding the land in order to drill for oil itself. The cost of drilling is \$100,000. If oil is found, the resulting expected revenue will be \$800,000, so the company's expected profit (after deducting the cost of drilling) will be \$700,000. A loss of \$100,000 (the drilling cost) will be incurred if the land is dry (no oil). Advice the Co. whether to drill or sell based just on these data using Bayes' Decision Rule without experimentation. (5 marks)
- c) Illustrate the quadratic programming notation for the problem given below.

$$\text{Maximize } f(x_1, x_2) = 15x_1 + 30x_2 + 4x_1x_2 - 2x_1^2 + 6x_2^2$$

$$\text{Subject to } 4x_2 + x_1 \leq 30$$

$$x_1, x_2, \geq 0$$

(3 Marks)

- d) i) State when a stochastic process $\{x_t\}$ is said to have the Markovian property. (2 Marks)
- ii) There are three categories of income tax filers in Kenya. Those who never evade taxes, those who sometimes do it and those who always do it. An examination of audited tax return from one year to the next shows that of those who did not evade taxes last year, 95% continue in the same category this year, 4% move to the "sometimes" category and the remainder moves to the "always" category. For those who sometimes evade taxes, 6% move to the "never", 90% stay the same, and 4% move to "always". As for the always evaders the respective percentages are 0%, 10% and 90% respectively. Express the problem as a Markov chain. (4 Marks)
- e) i) In a certain market, the demand function for a certain commodity is given by $f(p) = pe^p$. If the current selling price is E_p and the quantity demanded is E_d . Write down the formula for finding the consumer surplus for the commodity. (2 Marks)
- ii) State any **three** advantages of manpower planning. (3 Marks)
- f) Illustrate the formulation and application of Karush-Kuhn-Tucker (KKT) conditions using the problem
- $$\text{Maximize } f(x) = \ln(x_1 + 1) + x_2$$
- $$\text{Subject to } 2x_1 + x_2 \leq 3$$
- $$x_1, x_2, \geq 0$$

(7 Marks)

Question Two (20 Marks)

Solve the following programming problem by the branch and bound algorithm.

Maximize $x_1 + x_2$

Subject to $2x_1 + 5x_2 \leq 16$

$6x_1 + 5x_2 \leq 30$

$x_1, x_2, \geq 0$ and integer

(20 Marks)

Question Three (20 Marks)

- a) Write down the algorithm of one-dimensional search procedure for solving unconstrained optimization programming problem. (9 Marks)

- b) Consider the following goal programming model

Maximize $A = 4x + 8y$

Minimize $B = 8x + 24y$

Subject to $x + 2y \leq 10$

$x \leq 6$

$x, y, \geq 0$

Solve the programming problem using preemptive method given that first priority is given to goal A. (11 Marks)

Question Four (20 Marks)

- a) Explain what is meant by the following terms:

- i) Consumer Surplus
- ii) Pareto Optimality
- iii) Utility theory

(6 marks)

- b) As a leader of an oil exploration drilling venture, you must determine the best selection of 5 out of 10 possible sites. Label the sites S_1, S_2, \dots, S_{10} and the expected profits associated with each as P_1, P_2, \dots, P_{10} .

i) If site S_2 is explored, then site S_3 must be explored. Furthermore, Regional development restrictions are such that:

ii) Exploring sites S_1 and S_7 will prevent you from exploring site S_4 .

iii) Exploring sites S_3 or S_4 will prevent you from exploring site S_5

Formulate an integer program to determine the best exploration scheme. (5 Marks)

- c) Find an optimal solution to the following unconstrained non-linear program using one dimensional search method. Take error tolerance for the solution to be 1.0%.

$P = -3x^4 + 12x - 2x^6$

(9 Marks)

Question Five (20 Marks)

- a) Consider the following transition matrix P for a second year student at Egerton University.

$$P = \begin{bmatrix} 0.3 & 0.2 & 0.5 \\ 0.1 & 0.7 & 0.2 \\ 0.0 & 0.1 & 0.9 \end{bmatrix}$$

The performance of the student is such that state 1 represents scoring an **A**, state 2 represents scoring a **B** and state 3 represents scoring a **C**.

- i) If this semester she scores a **C** what is the probability that next semester she will score an **A**?
- ii) The initial condition for the Student to score grade **A** i.e. $\mathbf{a}^{(0)} = (1,0,0)$. Determine the absolute probabilities of the three states of the system after 8 exams sittings. (5 Marks)
- b) The Broker Company owns a piece of land that may contain oil. A consulting geologist has reported to management that she believes there is 1 chance in 4 of oil. Because of this prospect, another oil company has offered to purchase the land for \$90,000. However, Broker is considering holding the land in order to drill for oil itself. The cost of drilling is \$100,000. If oil is found, the resulting expected revenue will be \$800,000, so the company's expected profit (after deducting the cost of drilling) will be \$700,000. A loss of \$100,000 (the drilling cost) will be incurred if the land is dry (no oil). Suppose a seismic survey to obtain a seismic sounding was carried out at a cost of \$30,000. Based on experience, if there is oil, then the probability of unfavorable seismic sounding (USS) is 0.4 and if there no oil, probability of USS is 0.8. Based on Bayes' theorem, use probability tree diagram to find the best alternative action to be taken by the company. (15 Marks)

THE END