

THE OPEN UNIVERSITY OF SRI LANKA

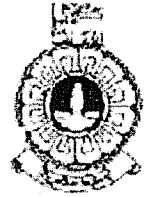
B.Sc. /B.Ed. Degree Programme

APPLIED MATHEMATICS-LEVEL 05

APU3146/APE5146 - Operations Research

OPEN BOOK TEST 2016/2017

Duration: One Hour



Date: 07.10.2017

Time: 04.00 p.m- 05.00 p.m

Answer all questions

Question 1

The manager of a multinational company and the Union of workers are preparing to sit down at the bargaining table to work out the details of a new contract for the workers. Each side has developed certain proposals for the contents of the new contract. Union proposals are called "Proposal *I*", "Proposal *II*" and "Proposal *III*". Manager's proposals are called "Contract *A*", "Contract *B*" and "Contract *C*". Both parties are aware of the financial aspects of each proposal-contract combination. The reward matrix is:

Proposal	Contract		
	<i>A</i>	<i>B</i>	<i>C</i>
<i>I</i>	8.5	7.0	7.5
<i>II</i>	12.0	9.5	10.0
<i>III</i>	9.0	11.0	8.0

- (i) Is there a saddle point? Justify your answer.
- (ii) Find the strategies which are dominated by other strategies, and reduce the size of the reward matrix.
- (iii) Formulate a Linear Programming model to determine the optimum strategy of the Union and the optimum strategy of the Manager (No need to solve).

Question 2

Patients arrive at the Government hospital for emergency service at the rate of one every hour. Currently, only one emergency case can be handled at a time. Patients spend on average of 20 minutes receiving emergency care.

- (i) What is the probability that a patient arriving at the hospital will have to wait?
- (ii) Find the average length of the queue that forms.
- (iii) Find the average time a patient spends in the system.
- (iv) What is the probability that there will be five or more patients waiting for the service?
- (v) Determine the fraction of the time that there are no patients.

Formulas (in the usual notation)**(M/M/1):(∞/FIFO) & (M/M/1):(∞/SIRO) Queuing Systems**

$$P_n = \left(\frac{\lambda}{\mu}\right)^n \left(1 - \frac{\lambda}{\mu}\right)$$

$$P(\text{queue size} \geq n) = \rho^n$$

$$E(n) = \frac{\lambda}{\mu - \lambda}$$

$$E(m) = \frac{\lambda^2}{\mu(\mu - \lambda)}$$

$$V(n) = \frac{\lambda\mu}{(\mu - \lambda)^2}$$

$$E(w) = \frac{\lambda}{\mu(\mu - \lambda)}$$

$$E(v) = \frac{1}{\mu - \lambda}$$
