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**		
	A	*B*	*C*
I	8.5	7.0	7.5
II	12.0	9.5	10.0
III	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

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

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

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

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

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

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

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

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