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Faculty of Applied Science  
Rajarata University of Sri Lanka  
Mihintale

RAJARATA UNIVERSITY OF SRI LANKA, MIHINTALE

B.Sc. (Four Year Degree) in Industrial Mathematics

Fourth Year Semester II Examination – October/November 2014

MAT4304 – OPERATIONAL RESEARCH II

Time Allowed: 3 hours

Answer all questions

Calculators will be allowed

1. (a) Linda Madison owns Creations, a business that provides hair and nail care services in a small, college town. Recently, Linda has decided to expand her business to include tanning and massage services for her clients. In order to accommodate these new services and the additional clients they are expected to attract, Linda is relocating her business to a large facility. However, the new location will require some renovation before she relocate there. Linda has identified the following activities that must be performed before she can open at her new location.

Activity	Description	Days Required	Predecessor Activities
A	Install new plumbing	10	---
B	Order and receive furniture	20	---
C	Order and receive flooring	15	---
D	Construct partitions	5	---
E	Paint and wallpaper	5	A,D
F	Install furniture	3	E,B
G	Install flooring	4	E,C
H	Move inventory and record	2	F,G
I	Clean old shop	2	H

- Draw a Critical Path Method network for this problem.
- Use linear programming to identify the earliest start time for each activity.
- What is earliest time the audit can be completed?
- Use linear programming to identify the latest start time for each activity.
- Create a spreadsheet to summarize the earliest and latest start and finish times, the slack for each activity, and the critical activities.

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- (b) Refer to the part (a). Suppose that Linda's lease on her current facility expires in 20 days. The normal and crash times and costs for each activity in her moving project are summarized below. By what amount should each activity be crashed in order for her to complete the move within 20 days?

Activity	Normal		Crash	
	Time	Cost(\$)	Time	Cost
A	10	11,000	7	15,000
B	20	5,000	18	6,000
C	15	3,000	12	3,500
D	5	1,500	3	2,000
E	5	750	2	1,200
F	3	600	1	1,200
G	4	1,000	2	1,500
H	2	250	1	450
I	2	200	1	300

2. A manufacturing company keeps stock of a special product. Previous experience indicates the daily demand as given below:

Daily Demand	5	10	15	20	25	30
Probability	0.01	0.20	0.15	0.50	0.12	0.02

- (i) Simulate the demand for the next 10 days.
- (ii) Find the average demand for that product on the basis of simulated data.
3. Suppose that a decision maker, faced with four decision alternatives and four states of nature, develops the following profit payoff table:

	<b>State of Nature</b>
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Decision Alternative	$S_1$	$S_2$	$S_3$	$S_4$
$D_1$	14	9	10	5
$D_2$	11	10	8	7
$D_3$	9	10	10	11
$D_4$	8	10	11	13

- (i) If the decision maker knows nothing about the probabilities of the four states of nature, what is the recommended decision using the maximax payoff, maximin payoff and minimax regret approaches?
- (ii) Suppose that the decision maker obtains information that enables the probability estimates to be made:  $P(S_1) = 0.5$ ,  $P(S_2) = 0.2$ ,  $P(S_3) = 0.2$ , and  $P(S_4) = 0.1$ .
- (a) Find the decision corresponding to the maximum Expected Monetary Value (EMV). Construct the decision tree using **TreePlan** Add-in and use it to verify the answer. Also, using the decision tree and Solver find the least possible  $P(S_1)$  such that the maximum EMV corresponds to decision  $D_1$ .
- (b) Find the decision corresponding to the minimum Expected Opportunity Loss (EOL).
- (c) Construct a data table to summarize the EMVs for each decision by varying  $P(S_1)$ : 0.0, 0.1, 0.2, 0.3, 0.4 and 0.5 .
4. The demand rate of a particular item is 12,000 units per year. The set-up cost per run is Rs. 350 and the holding cost is Rs. 0.20 per unit per month. If no shortages are allowed and the replacement is instantaneous, determine
- (i) The optimum run size
- (ii) The optimum scheduling period
- (iii) Minimum total expected annual cost.

5. A contractor has to supply 10,000 bearings per month to an automobile manufacturer. He finds that when he starts a production run he can produce 25,000 bearings per month. The cost of holding a bearing in stock for one year is Rs. 2 and the set-up cost of a production run is Rs. 180. How frequently should the production run be made?