



RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

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

Fourth Year – Semester II Examination – Oct / Nov 2015

MAT 4304 - Operational Research II

Answer all questions

Time Allowed: 3 hours

1. A manufacturer has order to supply goods at a uniform rate of R per unit time. No shortages are allowed. He starts a production run every t time units, where t is fixed and the set up cost per production run is C_3 . Replacement is instantaneous. C_1 is the cost of holding one unit in inventory for a unit time.

Determine the optimum

- (i) production run
- (ii) production quantity.

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The annual demand for an item is 3200 units. The unit cost is Rs. 6.00 and inventory carrying charges 25% per annum. If the cost of one procurement is Rs. 150.00, then determine

- (iii) economic order quantity
- (iv) the time between two consecutive orders
- (v) number of orders per year
- (vi) the optimal total cost.

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2. Consider the manufacturing model with no shortages. It is assumed that the run sizes are constant and that a new run will be started whenever inventory is zero. Let

R = number of items required per unit time

K = number of items produced per unit time

C_1 = cost of holding per item per unit time

C_3 = cost of setting up a production run

q = number of items produced per run

t = time interval between runs

Determine the optimum

- (i) lot size
- (ii) time interval

An item is produced at the rate of 50 items per day. The demand occurs at the rate of 25 items per day. If the set up cost is Rs. 100.00 per set up and holding cost is Rs. 0.01 per unit of item per day, then find the economic lot size for one run, assuming that shortages are not permitted. Also, find the time of cycle and minimum total cost per run.

3. An investment firm desires to study the investment proposals based on following three factors:

- (a) Market demand (in units)
- (b) Profit per unit, and
- (c) Investment required.

The above factors are considered to be independent of each other. In the analysis of a new product, the firm estimates the following probability distribution.

<i>Market Demand (Annual)</i>		<i>Profit per unit (Price-Cost)</i>		<i>Investment required</i>	
<i>Units '000</i>	<i>Probability</i>	<i>Rs.</i>	<i>Probability</i>	<i>Rs. '000</i>	<i>Probability</i>
10	0.10	10	0.10	2000	0.3
15	0.15	12	0.30	2500	0.5
20	0.20	14	0.25	3000	0.2
25	0.25	16	0.25		
30	0.15	20	0.10		
35	0.10				
40	0.05				

Employ the simulation technique and repeat the trial 10 times. Determine the return on investment for each trial considering the above given three factors. Also compute the most likely return.

4. An automobile production line turns out about 100 cars a day but deviations occur owing to many causes. The production is more accurately described by the probability distribution given below:

Production/Day	95	96	97	98	99	100	101	102	103	104	105
Probability	0.03	0.05	0.07	0.10	0.15	0.20	0.15	0.10	0.07	0.05	0.03

Finished cars are transported across the bay at the end of each day by ferry. If the ferry has space only for 101 cars, simulate the process using Microsoft Excel for 15 days to determine the average number of cars waiting to be shipped and the average number of empty space on the ship.

Hint: Create an Excel spreadsheet consisting of columns to calculate number of cars waiting and number of empty space in the ship each day.

5. (a) A national accounting firm has identified the following set of activities that must occur to carry out an audit for one of their major clients.

Activity	Days Required	Predecessor
A	12	-
B	16	-
C	13	A
D	14	A
E	9	A
F	12	C
G	6	B, E
H	4	C, D, E
I	24	C, D, E
J	12	F, H
K	22	F, H
L	8	I, J

- (i) Draw the CPM network for this problem.
- (ii) Manually determine the earliest and latest start and finish times for each activity and the amount of slack for each activity. What is the critical path and earliest time the audit can be completed?
- (iii) Formulate linear programming models to determine the earliest and latest start and finish times for each activity and the amount of slack for each activity. Implement the models in MS Excel and hence solve.

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- (b) The activities summarized below must be performed by the promoter of a country music concert in Dallas:

Activity	Description	Predecessor	Days Required		
			Minimum	Average	Maximum
A	Find location	-	2	4	7
B	Hire opening act	A	3	6	10
C	Hire technicians	A	1	2	3
D	Set up radio ads	B	2	4	6
E	Distribute tickets	B	2	3	5
F	Rent sound and light	B, C	3	4	6
G	Set up news paper ads	B	1	2	4
H	Hire security	F	2	3	4
I	Conduct rehearsal	F, H	1	1.5	2
J	Final details	I	2	3	4

- (i) Draw the activity network for this problem.
- (ii) According to PERT, what is the expected length of time required to accomplish these activities?

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