RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (Four year) Degree in Industrial Mathematics
Fourth Year– Semester II Examination – July/August 2018

MAT 4304– OPERATIONAL RESEARCH II

INSTRUCTIONS:
- Answer **ALL** questions
- Time Allowed: **THREE** hours

1. Consider a project having the following activities and their time estimates in days:

Activity	Predecessor	t_o	t_m	t_p
A	-	2	4	6
B	A	8	12	16
C	A	14	16	30
D	B	4	10	16
E	C, B	6	12	18
F	E	6	8	22
G	D	18	18	30
H	F, G	8	14	32

t_o: Optimistic time t_m : Most likely time t_p : Pessimistic time

Draw a network for the above project.

Using the above data, construct an Excel spreadsheet model and using simtools Microsoft Excel Add-In simulate it with 25 runs, and hence, determine

(i)   the average project completion time and

(ii)   percentage of each activity being critical.

Assume that the duration time of each activity follows a Triangular distribution.

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2. At a toll office a sample of 100 arrivals of vehicles gives the following frequency distribution of the inter arrival and service time:

Inter arrival time (minutes)	Frequency	Service time	Frequency
1.0	2	1.5	10
1.5	5	-	-
2.0	9	2	22
2.5	25	-	-
3.0	22	2.5	40
3.5	11	-	-
4.0	10	3.0	20
4.5	6	-	-
5.0	3	3.5	8
5.5	2	-	-

There is a clerk in the office. Using simtools Microsoft Excel Add-In simulate the process for 20 arrivals and estimate the average vehicle waiting time and average percent idle time of the clerk.

3. 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 a ship. If the ship has space only for 101 cars, simulate the process using simtools Microsoft Excel Add-In 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.

4. A student has to take three courses Chemistry, Physics and Combined Mathematics. He has three days available for study. He feels it would be better to devote a whole day to study the same course, so that he may study a course for one day, two days or three days or not at all. His estimates of grades, measured numerically, he may get by studying are as follows:

Study days/Course	Chemistry	Physics	Combined Mathematics
0	1	2	1
1	2	2	2
2	2	4	4
3	4	5	4

Using Dynamic programming, find how he should plan to study so that he maximizes the sum of his grades.

5. A manufacturer has order to supply goods at a uniform rate of R per unit time. 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 and C_2 is the shortage cost per item per unit time.
Determine the optimum

(i)   production run,

(ii)   production quantity.

The demand for an item is 18,000 units per year. The holding cost for one unit per unit time is Rs. 12.00, the cost of shortage for one unit per unit time is Rs. 50.00 and the production cost per unit is Rs. 400.00. Assuming that the replenishment rate is instantaneous, determine the optimum order quantity and optimum production run.

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