

INDIAN STATISTICAL INSTITUTE

MS QMS

Semester II Final Exam: Operations Research 2

Date: 09 July 2021

Time: 3 hours

Maximum Marks: 50

Answer as many questions as you can. The maximum you can score is 50 marks.

1. A young widow in Kerala started a small chip manufacturing unit namely four-o'clock chips at her house premise. The money needed for setting up the unit is given by the state government as an interest-free loan under its women entrepreneur development scheme. The four-o'clock chips have two types of products namely tapioca chips and jackfruit chips available in 500-gram packets. The company sells its products through bakeries and other food outlets. Since the four-o'clock chips have huge demand, whatever the company produces will be purchased by the retail food outlets. The profit per packet, the resources required & the frying equipment time required per packet are given in the table below. The maximum availability of resources and equipment time is given in the right-hand side column.

	Tapioca chips	Jackfruit chips	Availability
Resources	2	1	k1
Equipment Time	5	9	k2
Profit	5	7	

Formulate the problem as an integer linear programming (ILP) problem. Solve the problem and identify the optimum number of 500-gram packets of tapioca and jackfruit chips to be produced to maximize the profit. Choose k1 as a random integer between 10 & 15 and k2 as a random integer between 40 and 45.

[12]

2. The inter-arrival times of customers at the KBank atm at St. Francis of Assisi Church bus stop, KS Town is exponentially distributed with a mean ($1/\lambda$) of 30 minutes and the cash withdrawals follow an exponential distribution with mean ($1/\lambda$) Rs. 5000. The upper limit on the money the atm can hold is limited to Rs.2,00,000 due to security and other operational reasons. Whenever the bank replenishes the atm, it ensures that the amount in the atm is equal to the maximum capacity. The experts suggested that the bank needs to replenish the atm every 24 hours to ensure that the amount in the atm will never be less than Rs. 25,000. Simulate the atm cash withdrawal process with 5 replications and comment on the expert opinion. On average how much is the amount available in the atm 24 hours after replenishment? On average how much time it will take the amount in the atm to drop below Rs. 25,000 after replenishment?

[12]

3. a) Give an example for the $M/M/1/$ queue system with 2 stages of service.
- b) Arrivals at a telephone booth are considered to be Poisson at an average time of 8 min between an arrival and the next. The length of the phone call is distributed exponentially, with a mean of 4 min.

Determine

- (a) Expected fraction of the day that the phone will be in use.
- (b) Expected number of units in the queue
- (c) Expected waiting time in the queue.
- (d) What is the probability that more than 5 units in the system?
- (e) Telephone company will install a second booth when convinced that an arrival would have to wait for at least 6 min in queue for phone. By how much the flow of arrival is increased in order to justify a second booth.

[2+10]

4. Write short notes on any three:

- a) Service disciplines in queues
- b) (Q, r) model of inventory control
- c) Critical path method
- d) Multi criteria optimization approach

[4x3]

5. A manufacturer uses Rs 10000/ worth of an item during the year. He has estimated an ordering cost of Rs 25 per order and carrying cost as 12.5% of average inventory value. Find the optimal order size, no of orders per year, and time period between orders.

[2x3]
