Question 1:

The wholesaler dealing in stationary items wants to determine the order size for the desk calendars. The demand and lead time are probabilistic and their distributions are given below:

Demand/week(thousand)	Probability	Lead time (weeks)	Probability
0	0.2	2	0.3
1	0.4	3	0.4
2	0.3	4	0.3
3	0.1		

The cost of placing an order is Rs 50 per order and the shortage cost is Rs. 10 per thousand. The inventory manager considers the policy whenever the inventory level is equal to or below 2000, an order is placed equal to the difference between the current inventory balance and the specified maximum replenishment level of 4000. Random digits for the demand/week are 31, 70, 53, 86, 32, 78, 26, 64, 45, 12, 99, 52, 43, 84, 38, 40, 19, 87, 83, 73. Random digits for lead time are: 29, 83, 58, 41, 13.

Make program to simulate the policy for 20 weeks period assuming that

(a) the beginning inventory is 3000 units, N no back orders are permitted

(b) each order is placed at the beginning of the week following the drop in inventory level to or below the order

(c) the replenishment orders are received at the beginning of the week.

Calculate the average ending inventory and total average weekly cost.

Total average weekly cost= Ordering cost + shortage cost

Question 2:

One hundred unemployed people were found to arrive at a one-person state unemployment office to obtain their unemployment compensation cheque according to the following inter-arrival time and service time.

Inter-arrival time (min)	Probability	Service time (min)	Probability
1	0.2	3	0.2
2	0.3	5	0.5
3	0.3	7	0.3
4	0.1		
5	0.1		

The state office is interested in predicting the operating characteristics of this one person state unemployment office during a typical operating day from 10:00 am to 11:00 am. Use the following random numbers to predict customers' inter-arrival and service times.

Customer	1	2	3	4	5	6	7	8	9	10	11	12
R.n. for Arrival		61	55	1	33	19	25	79	93	18	49	92
R.n. for service	28	1	61	85	67	53	62	79	66	63	33	77

Make a program to perform a simulation to determine the average waiting time and total time in the system and the maximum queue length. Further determine time spend by the 5th customer in the system, waiting time in the queue by the 6th customer, arrival time of the 7th customer and the service start time of 10th customer.

Question 3:

For a particular shop, the daily demand of an item with associated probabilities is given below:

Daily demand	0	10	20	30	40	50
Probability	0.01	0.20	0.15	0.5	0.12	0.02

If random number stream (X1, X2, ………..X10) is generated using linear congruential generator with X0=27, a=17,c=4 and m=100. Calculate

1. Average daily demand for the first four days
2. Average daily demand for the first ten days
3. Expected demand on 5th day

Question 4:

Apply linear Congruential Method to generate a series of random numbers.

Use $X_0 = 7$, $a = 5$, $c = 3$, and $m = 16$.

Change the value of $X_0 = 1, 2, 3, 4, 5, 6$. Make a table to show the values of i, X_i, R_i . Observe after how many random numbers cycle is repeated.

Question 5:

Apply the Kolmogorov-Smirnov test on the generated random numbers (with $X_0 = 3$, $a = 5$, $c = 3$, and $m = 16$) to check that the numbers following the uniformity property and null hypothesis can be accepted or rejected with α=0.05. Use the first ten random numbers and $D\alpha$ =0.41.

Question 6:

Apply chi-square test to check the uniformity of 100 generated random numbers between [0,1] with α=0.05 and $\chi^2_{0.05,9} = 16.9$

Interval	Upper limit	Observed Frequency	Expected frequency
1	0.1	8	10
2	0.2	11	10
3	0.3	9	10
4	0.4	7	10

5	0.5	6	10
6	0.6	14	10
7	0.7	10	10
8	0.8	10	10
9	0.9	12	10
10	1	13	10

Question 7:

Apply tests for autocorrelation for the following Hypothesis:

H_0: $\rho_{i,m} = 0$ *if numbers are independent*

H_1: $\rho_{i,m}$!= 0 *if numbers are dependent*

Use the following sequence of numbers:

1	2	3	4	5	6	7	8	9	10
0.63	0.28	0.30	0.42	0.97	0.05	0.71	0.63	0.17	0.86
0.61	0.19	0.94	0.64	0.84	0.54	0.56	0.57	0.09	0.99
0.01	0.10	0.69	0.38	0.93	0.85	0.68	0.14	0.18	0.84
0.19	0.71	0.44	0.72	0.95	0.28	0.96	0.51	0.50	0.89
0.66	0.31	0.50	0.33	0.89	0.54	0.73	0.76	0.62	0.92

Every number in the 5th, 10th, 15th, and 20th position is a larger value.

Use α=0.05, i=5, m=5, N=50, M=?

Question 8: Develop a program to simulate repairman problem. A factory possesses a total of M identical machines that are subject to breakdown. A certain minimum number of working machines $N < M$ is required for the factory to function correctly. When less than N of the machines are in working order, the factory is forced to stop production. The number of machines that are in working order at time t is denoted by n while the number that are broken is denoted by b. There are two different types of events—a machine breaks down, or a machine is repaired and returns to the spare category. Use this simulation to compute the length of time until the number of working machines first falls below N and the factory is forced to halt production. The model parameters are taken to be $M = 10$ and $N = 6$. Both repair time and breakdown times are taken to be normally distributed: mean repair times are 100-time units with standard deviation $\sigma = 50$ while times between breakdown have mean 300 time units and standard deviation $\sigma = 80$.

Question 9: Develop a program to simulate single server queueing system. The program should include the modules to handle arrival and departure events. The service time and interarrival time are exponentially distributed. Run the simulation until a total of N customers have been served and then compute the mean interarrival time, the mean service time and the mean time spent waiting in the queue. Use integer n to completely characterize a state of the system and t to denote the internal clock time. Use Integer variables n_a and n_d count the number of arrivals and departures, respectively. The variables t_a and t_d to denote the scheduled times of the next arrival and the next departure. Use t_λ and t_μ to denote generated interarrival times and service times, respectively. During the simulation run, tot_λ and tot_μ refer to running totals of arrival times and service times.

The model parameters are taken to be $N = 50$, $\lambda = 1.0$ and $\mu = 2.5$. Generate terminal statistics and print report.

Question 10: Develop a program simulate the following problem statement:

The lifetime, in years, of a satellite placed in orbit is given by the following pdf:

$$f(x) = \begin{cases} 0.4e^{-0.4x}, & x \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

(a) What is the probability that this satellite is still "alive" after 5 years?

(b) What is the probability that the satellite dies between 3 and 6 years from the time it is placed in orbit?

Question 11:

Develop a simulation table using event scheduling technique

Model components:

System state: (LQ(t), L(t), WQ(t), W(t))

Events:

- Arrival to the system (ALQ)
- Departure from loader servers (EL)
- Departure from weight (EW)
- Simulation end (E)

Event notices: **(EL, t, DT), (EW, t, DT), (ALQ, t, DT)**

Activities: See tables

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Loading time	5	10	10	5	5	10	10	5	10
Weighing time	12	12	12	16	16	16	12	16	12
Travel time	20	40	30	60	40	20	40	60	40

Question 12: A burger franchise planning a new outlet in Auckland wants to determine the probability the new outlet will have weekly sales of less than \$2000. If the weekly sales are less than this the outlet is unlikely to cover its costs. They use a triangular distribution to model the future weekly sales with a minimum value of a=\$1000, and maximum value of b=\$6000 and a peak value of c=\$3000. Develop a program to simulate the triangular distribution.

Question 13: 19SW must pass three theory subjects and two practicals in the 8th semester. Find the probability that they will pass more subjects and practical than they fail out of five. The binomial distribution uses an average pass rate of 70%. Evaluate the problem by developing a Java/Python program. Apply the binomial distribution to determine the probability that 19SW will pass more subjects than they fail out of five by developing a program.

Question 14: Develop a program simulate the following problem statement:

Joe Coledge is the third-string quarterback for the University of Lower Alatoona. The probability that Joe gets into any game is 0.40.

(a) What is the probability that the first game Joe enters is the fourth game of the season?
(b) What is the probability that Joe plays in no more than two of the first five games?

Question 15: Develop a program simulate the following problem statement:

The number of industrial injuries per working week in a particular factory is known to follow a Poisson distribution with mean 0.5.

Find the probability that

(a) in a particular week there will be:
  (i) less than 2 accidents,
  (ii) more than 2 accidents;
(b) in a three week period there will be no accidents.

Question 16:

Develop a program to simulate an inventory problem. A classical inventory problem concerns the purchase and sale of newspapers. The paper seller buys the papers for Rs. 20 each and sells them for Rs. 30 each. Newspapers not sold at the end of the day are sold as scrap for Rs. 5 each. Newspapers can be purchased in bundles of 10. Thus, the paper seller can buy 50, 60, and so on. Lost profit from excess demand is Rs. 10. There are three types of Newsday′s, good, fair, and poor, with probabilities of 0.35, 0.45, and 0.20, respectively. The distribution of papers demanded on each of these days is given in table 2.15. The problem is to determine the optimal number of papers the newspaper seller should purchase. This will be accomplished by simulating demands for 15 days and recording profits from sales each day. Assume the newsstand buy 60 newspapers each day. Simulate the total profit for 15 days.

Distribution of newspapers demanded on each of these days is:

Demand	Good	Fair	Poor
40	0.03	0.10	0.44
50	0.05	0.18	0.22
60	0.15	0.40	0.16
70	0.20	0.20	0.12
80	0.35	0.08	0.06
90	0.15	0.04	0.00
100	0.07	0.00	0.00

Question 17: Estimate, by simulation program, the average number of lost sales per week for an inventory system that functions as follows

(a) Whenever the inventory level falls to or below 10 units, an order is placed. Only one order can be outstanding at a time.

(b) The size of each order is equal to 20-I, where I is the inventory level when the order is placed.

(c) If a demand occurs during a period when the inventory level is zero, the sale is lost.

(d) Daily demand is normally distributed, with a mean of 5 units and a standard deviation of 1.5 units. (Round off demands to the closest integer during the simulation, and, if a negative value results, give it a demand of zero.)

(e) Lead time is distributed uniformly between zero and 5 days-integers only.

(f) The simulation will start with 18 units in inventory.

(g) For simplicity, assume that orders are placed at the close of the business day and received after the lead time has occurred. Thus, if the lead time is one day, the order is available for distribution on the morning of the second day of business following the placement of the order.

(h) Let the simulation run for 5 weeks.

Question 18: