

Simulation and Analysis - Previous Year Questions Analysis

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Mahbub Sir

Book = Concepts of Simulation - DS Hira

Chapter 1: Concepts Of Simulation

- Define computer simulation models. Describe the steps in simulation study. (02) [20-21 Final] [18-19 Final] [17-18 Final] [16-17 Final] [Jul-Dec-18 Final] [19-20 Final]
- Define system simulation. Describe different types of simulation models. (03) [17-18 Mid] [15-16 Mid] [Jul-Dec-18 Final]
- What are the advantages of simulation? Describe about the applied area of simulation. (02) [17-18 Mid] [15-16 Mid] [16-17 Final]
- What is real time simulation? [16-17 Final]
- Describe the iterative process of verification and validation of simulation models. [Jul-Dec-18 Final]
- Define critical path. Describe the benefits of using simulation of PERT and CPM for planning, scheduling and controlling of a large and complex software project. (3) [Jul-Dec-18 Final]

Chapter 2: Monte Carlo Method

- Define distributed simulation. [17-18 Final] [Jul-Dec-18 Final]
- Write down the difference between monte-carlo and stochastic simulation. (02) [19-20 Mid] [17-18 Final] [Jul-Dec-18 Final] [2018-19 Final]
- Define Monte-Carlo method. Solve the integrals $I = \int_1^5 \frac{x^4}{3} dx$ by monte-carlo method. [USE Random Number 48, 36, 44, 41, 46, 18, 32, 41, 23, 23 for X coordinate and Random Number .52, .18, .30, .88, .21, .25, .57, .82, .9, .63 for Y coordinate, you have a right to do scaling, if required] (04) [20-21 Mid]

- Define Monte-Carlo method. Solve the integrals $I = \int_1^5 \frac{x^4}{3} dx$ by monte-carlo method. [USE Random Number 48, 36, 44, 41, 46, 18, 32, 41, 23, 23 for X coordinate and Random Number .52, .18, .30, .88, .21, .25, .57, .82, .9, .63 for Y coordinate, you have a right to do scaling, if required] (04) [20-21 Final]
- Define Monte-Carlo method. Solve the integrals $I = \int_2^5 x^3 dx$ by monte-carlo method. [USE Random Number 61 to 70 for X coordinate and Random Number 71 to 80 for Y coordinate, from table] (05) [18-19 Mid] [Jul-Dec-18 Final]
- Define Monte-Carlo method. Solve the integrals $I = \int_2^5 x^3 dx$ by monte-carlo method. [USE Random Number 22, 25, 18, 45, 15, 27, 48, 43, 40, 47 for X coordinate and Random Number .57, .18, .00, .90, .05, .77, .66, .10, .76, .42 for Y coordinate, from table] (05) [17-18 Mid]
- Define Monte-Carlo method. Solve the integrals $I = \int_1^5 \frac{x^4}{3} dx$ by monte-carlo method. [USE Random Numbers...] (05) [2018-19 Final]
- A drunkard moved from a point to a destination and takes step in four directions, backward, forward, right, and left. The probabilities associated with these are 15%, 40%, 20% and 25% respectively. The distances covered to backward, forward, right, and left are 50 cm, 90 cm, 60 cm and 40 cm respectively. Simulate the walk for 20 steps and find the location at end of 20 steps while starting point is (0, 0) on the X-Y scales. [USE Random Number 67, 23, 01, 95, 84, 56, 77, 76, 18, 82, 45, 29, 68, 21, 15, 86, 00, 89, 45] (04) [20-21 Mid]
- A drunkard moved from a point to a destination and takes step in four directions, backward, forward, right, and left. The probabilities associated with these are 10%, 50%, 15% and 25% respectively. The distances covered to backward, forward, right, and left are 30 cm, 80 cm, 60 cm and 40 cm respectively. Simulate the walk for 20 steps and find the location at end of 20 steps while starting point is (0, 0) on the X-Y scales. [USE Random Number 67, 23, 01, 95, 84, 56, 77, 76, 18, 82, 45, 55, 29, 68, 21, 15, 86, 00, 89, 43] (05) [19-20 Mid] [18-19 Mid] [17-18 Final] [Jul-Dec-18 Final]
- A drunkard moved from a point to a destination and takes step in four directions, forward, backward, left and right. The probabilities associated with these are 40%, 15%, 22% and 23% respectively. The distances covered to forward, left and right are 75 cm, 45 cm, 60 cm and 60 cm respectively. Simulate the walk for 25 steps and find the location at end of 25 steps while starting point is (0, 0) on the X-Y scales. [USE RN 67, 23, 01, 62, 84, 56, 77, 76, 98, 82, 45, 87, 29, 68, 21, 15, 36, 00, 89, 43, 32] (05) [15-16 Mid] [17-18 Mid] [16-17 Final]
- A machine center has three identical bearings, which fail according to the following probability distribution in table A. The present maintenance policy is to change a bearing as and when it fails. When bearing fails machine center stops, a technician is called to replace the failed bearing with a new one. The time between the failure of the bearing and reporting of the technician (delay time) is random and is distributed as table B. [20-21 Final]

Bearing Life(Hours)	Probability
1200	0.10
1400	0.25
1600	0.30
1800	0.25
2000	0.10

Delay Time(Minutes)	Probability
2	0.3
5	0.5

Delay Time(Minutes)	Probability
8	0.2

It takes 15 minutes to change one bearing, 25 minutes to change two bearing and 35 minutes to change all three bearings. Downtime of the system costs \$5 per minutes, direct on job costs of the technician is \$30 per hour and the cost of bearing is \$30. The maintenance department is interested in evaluating an alternative policy of replacing all the three bearings, whenever a bearing fails. Simulate the present and proposed policy for 10000 hours and choose the better policy. (10) [20-21 Final] [18-19 Final]

- An ammunition depot, of rectangular shape measuring 500 m of length and 350m of width is under attack by a squadron of bombers. In each sortie 10 bombers drop bombs, one each, on the ammunition depot. If the bomb lands anywhere in the marked area, it is a hit, otherwise it is a miss. All the bombers aim at the center of the area. The point of strike is assumed to be normally distributed around the aiming point with a standard deviation of 500 m in x-direction and 350m in the y-direction. Simulate operation of bombing operation for 20 strikes and determine the percentage number of strikes, which are on the target.

Use Normal Random Number:

For X direction - [.23, -1.16, 0.39, -1.90, -0.78, -0.02, -0.40, -0.66, 1.14, 0.07, 0.53, 0.03, 1.19, 0.11, 0.16, -0.82, 0.42, -0.89, 0.49, -0.21]

For Y direction- [0.24, -0.02, 0.64, -1.04, 0.68, -0.47, -0.75, -0.44, 1.21, -0.08, -1.56, 1.49, -1.19, -1.86, 1.21, 0.75, -1.50, 0.19, -1.44, 0.65] (06) [20-21 Final] [17-18 Final] [16-17 Final]

- An ammunition depot, of rectangular shape measuring 500 m of length and 350m of width is under attack by a squadron of bombers. In each sortie 10 bombers drop bombs, one each, on the ammunition depot. If the bomb lands anywhere in the marked area, it is a hit, otherwise it is a miss. All the bombers aim at the center of the area. The point of strike is assumed to be normally distributed around the aiming point with a standard deviation of 500 m in x-direction and 350m in the y-direction. Simulate operation of bombing operation for 20 strikes and determine the percentage number of strikes, Which are on the target. [USE Random Number 21 to 40 for X coordinate and Random Number 41 to 60 for Y coordinate, from table] (05) [18-19 Mid] [Jul-Dec-18 Final]
- What is normally distributed random numbers? Describe the properties and applications of normally distributed random numbers. (02) [20-21 Final] [18-19 Final] [17-18 Final]

Chapter 3: Simulation Of Continuous Systems

- Define the simulation of continuous system. Describe the disadvantages of analog simulation. [18-19 Final] [19-20 Final]
- Define analog simulation. Describe the simulation of an exterior ballistics with an example. (6) [17-18 Final]
- Consider a chemical reaction of two gas H_2 and O_2 react to produce H_2O . The rate of the reaction is depending upon the ratio in which H_2 and O_2 are mixed and some other factor like temperature, pressure and humidity which remains constant during the reaction. There will also happen backward reaction where H_2O decomposes back into H_2 and O_2 . If C_1 , C_2 and C_3 are the amount of H_2 , O_2 and H_2O at any instant of time t, the rate of increase of H_2 , O_2 and H_2O are given by the following differential equations:

$$\begin{aligned}\frac{dC_1}{dt} &= K_2C_3 - K_1C_1C_2 \\ \frac{dC_2}{dt} &= K_2C_3 - K_1C_1C_2 \\ \frac{dC_3}{dt} &= 2K_1C_1C_2 - 2K_2C_3\end{aligned}$$

Where K_1 and K_2 are constants. If $K_1 = 0.025$; $K_2 = 0.01$ and at time $t = 0$, $C_1 = 50.00m^3$, $C_2 = 25.00m^3$, $C_3 = 0.00m^3$, $\Delta t = 0.2$ minute. Simulate the experiment for 3 minute to determine the amount of H_2 , O_2 and H_2O . (05) [15-16 Mid] [17-18 Final] [Jul-Dec-18 Final] [19-20 Final]

- Let us consider a case where two chemicals ch_1 and ch_2 react to produce a third chemical ch_3 . The rate of reaction will depend upon a large number of factors like the ratio in which ch_1 and ch_2 are mixed, the temperature, the pressure and the humidity etc. In addition to the forward reaction where ch_1 and ch_2 react to produce ch_3 , there may also be backward reaction, where the ch_3 decomposes back into ch_1 and ch_2 . Let the rate of formation of ch_3 be proportional to the product of the amount of ch_1 and ch_2 present in the mixture and let the rate of decomposition of ch_3 be proportional to its amount in the mixture. If c_1 , c_2 and c_3 are the amount of ch_1 , ch_2 and ch_3 at any instant of time t , the rate of change of c_1 , c_2 and c_3 are given by the following differential equations:

$$\begin{aligned}\frac{dc_1}{dt} &= k_2 c_3 - k_1 c_1 c_2 \\ \frac{dc_2}{dt} &= k_2 c_3 - k_1 c_1 c_2 \\ \frac{dc_3}{dt} &= 2k_1 c_1 c_2 - 2k_2 c_3\end{aligned}$$

Where k_1 and k_2 are constants. If the temperature, pressure and humidity are constant and have no effect on the rate of reaction and $k_1 = 0.025$, $k_2 = 0.01$, $c_1 = 50.00$, $c_2 = 25.00$, $c_3 = 0.00$ and $\Delta t = 1$ sec simulate the chemical reaction for 20 sec. (07) [16-17 Final]

- In a pure pursuit, there is a target bomber which moves along a predetermine path (given on table below) and there is a pursuer aircraft who follows the target bombers, redirecting itself towards the target bombers at fixed intervals of time.

Target bombers moving path:

Time, t	0	1	2	3	4	5	6	7	8
xb(t)	100	100	120	129	140	149	158	168	179
yb(t)	0	3	6	10	15	20	26	32	37

Time, t	9	10	11	12	13	14	15
xb(t)	188	198	209	219	226	234	240
yb(t)	34	30	27	23	19	16	14

The fighter aircraft following the enemy bombers with speed at 25KM/min to destroy it. The fighter aircraft is at position x_f , y_f (0, 60) when it sights the bomber that is at time $t=0$, the time at which the pursuit begins. The fighter corrects its direction after a fixed interval of one minute, so as to point towards a bomber and shoots the bomber by firing a missile as soon as it is within a distance of 12 KM. The pursuit ends. In case the bomber is not shot within 15 minutes of the pursuit, the pursuit is abandoned. Simulate the problem to determine the pursuit is end/abandoned. [16-17 Final] [2017-18 Final]

- In a pure pursuit, there is a target bombers which moves along a predetermine path (given on table below) and there is a pursuer aircraft who follows the target bombers, redirecting itself towards the target bombers at fixed intervals of time.

Target bombers moving path:

Time,t	0	1	2	3	4	5	6	7	8
xb(t)	160	161	167	172	181	189	199	215	239

Time,t	0	1	2	3	4	5	6	7	8
y _b (t)	0	4	9	11	14	24	34	41	52

Time,t	9	10	11	12	13	14	15
x _b (t)	245	254	265	271	289	293	300
y _b (t)	45	41	36	39	34	28	12

The fighter aircraft following the enemy bombers with speed at 30KM/min to destroy it. The fighter aircraft is at position x_f, y_f (50, 50) when it sights the bomber that is at time $t=0$, the time at which the pursuit begins. The fighter corrects its direction after a fixed interval of one minute, so as to point towards a bomber and shoots the bomber by firing a missile as soon as it is within a distance of 10 KM. The pursuit ends. In case the bomber is not shot within 15 minutes of the pursuit, the pursuit is abandoned. Simulate the problem to determine the pursuit is end/abandoned. (12) [19-20 Final] [Jul-Dec-18 Final]

- There are a number of moving objects, which chase each other in a serial order like A chases B, B chases C, and C chases D etc. Each object moves towards its target unmindful of the fact that it itself is being targeted by some other object. Depending upon the original location, and speed of motion of the object, each object will take its own time to hit its target. As soon as hit occurs, the chase ends. The initial location of the objects A, B, C, and D are (0,0), (0,10), (0,20), (0,30) respectively and their velocities are 30km/hr, 25km/hr, 20 km/hr and 15km/hr respectively. Object D moves towards a fixed at (30,50), while C moves always in a direction pointing towards D, the object B moves always pointing towards C and object A always pointing towards B. It can be assumed that when the distance between two objects less than 0.005 hit is taken to occur. Identify, which object will hit the target at first and in what time? (07) [19-20 Final] [18-19 Final]

Chapter 4: Random Numbers

- Why the random numbers generated by computer are called pseudo random numbers? Discuss the pitfalls of congruence method of generating random numbers. (02) [18-19 Final] [19-20 Final]
- Write down the properties of random numbers. [Jul-Dec-18 Final]
- When the mid square random number generators produce unexpected result? Write down the qualities of an efficient random number generator. (04) [2016-17 Final]
- The following sequence of random numbers have been generated 0.037, 0.55, 0.71, 0.97, 0.65, 0.29, 0.84, 0.78, 0.23, 0.17; Use Kolmogorov-Smirnov test with $\alpha = 0.05$ to determine, If these numbers are uniformly distributed over the interval 0 to 1. Note that for $\alpha = 0.05$ and $N=10$ the critical value is 0.410. (05) [2016-17 Final]
- Write down the qualities of an efficient random number generator. Use the multiplicative congruential method to generate a sequence of 10 three-digit random numbers. Let, $r_0 = 117, a = 3, m = 1000$. (05) [2016-17 Final]
- Write down the qualities of an efficient random number generator. [20-21 Final] [18-19 Final]
- Define random variables. What are the purposes of testing the uniformity and independence of random values? (02) [18-19 Final] [19-20 Final]
- What are the differences between true and pseudo random numbers? Describe the procedure to physically generate random number at the interval with two-digit accuracy. (02) [20-21 Final]
- Why it is needed to test the randomness of pseudo random numbers? Write down the different types of testing system of randomness. (02) [16-17 Final]
- Use mixed congruential method to generate the following sequence of random numbers, A sequence of 10 two digit random numbers such that $r_{n+1} = (19r_n + 1)$ modulo 23 Take $r_0 = 1$. [Take seed values yourself] (03) [20-21 Final]

- The following sequence of random numbers have been generated 0.037, 0.55, 0.71, 0.97, 0.65, 0.29, 0.84, 0.78, 0.23, 0.17; Use Kolmogorov-Smirnov test with $\alpha = 0.05$ to determine, If these numbers are uniformly distributed over the interval 0 to 1. Note that for $\alpha = 0.05$ and $N=10$ the critical value is 0.410. (5) [17-18 Final] [Jul-Dec-18 Final]
- Generate two digit 40 random numbers between 0 to 50 by a multiplicative congruential method. Apply Chi-Squared test to verify the randomness. Where, the accepted value of Chi-square for four degree of freedom at 95% confidence level is 9.448. (6) [Jul-Dec-18 Final]
- Perform the Kolmogorov-Smirnov test to testify the uniformity of following random numbers at 95% level of significance. 0.37, 0.1, 0.5, 0.88, 0.37, 0.29, 0.84, 0.78, 0.08, 0.46 at $\alpha = 0.01$ and $N = 10$, critical values is 0.368; At $\alpha = 0.05$ and $N = 10$, critical values is 0.410. (05)

Table: Chi-square Distribution

d.f.	.995	.99	.975	.95	.9	.1	.05	.025	.01
1	0.00	0.00	0.00	0.00	0.02	2.71	3.84	5.02	6.63
2	0.01	0.02	0.05	0.10	0.21	4.61	5.99	7.38	9.21
3	0.07	0.11	0.22	0.35	0.58	6.25	7.81	9.35	11.34
4	0.21	0.30	0.48	0.71	1.06	7.78	9.49	11.14	13.28
5	0.41	0.55	0.83	1.15	1.61	9.24	11.07	12.83	15.09
6	0.68	0.87	1.24	1.64	2.20	10.64	12.59	14.45	16.81
7	0.99	1.24	1.69	2.17	2.83	12.02	14.07	16.01	18.48
8	1.34	1.65	2.18	2.73	3.49	13.36	15.51	17.53	20.09
9	1.73	2.09	2.70	3.33	4.17	14.68	16.92	19.02	21.67
10	2.16	2.56	3.25	3.94	4.87	15.99	18.31	20.48	23.21
11	2.60	3.05	3.82	4.57	5.58	17.28	19.68	21.92	24.72
12	3.07	3.57	4.40	5.23	6.30	18.55	21.03	23.34	26.22
13	3.57	4.11	5.01	5.89	7.04	19.81	22.36	24.74	27.69
14	4.07	4.66	5.63	6.57	7.79	21.06	23.68	26.12	29.14
15	4.60	5.23	6.26	7.26	8.55	22.31	25.00	27.49	30.58
16	5.14	5.81	6.91	7.96	9.31	23.54	26.30	28.85	32.00
17	5.70	6.41	7.56	8.67	10.09	24.77	27.59	30.19	33.41
18	6.26	7.01	8.23	9.39	10.86	25.99	28.87	31.53	34.81
19	6.84	7.63	8.91	10.12	11.65	27.20	30.14	32.85	36.19
20	7.43	8.26	9.59	10.85	12.44	28.41	31.41	34.17	37.57
[19-20 Final]									

- A sequence of 100 random numbers is given below. Use Chi-Square test with $\alpha = 0.05$ to test these numbers are uniformly distributed. (12)

21	81	92	28	96	20	68	52	79	84
82	62	12	08	92	83	74	85	60	49
48	37	65	74	22	11	28	10	55	82
72	95	08	85	79	95	86	11	16	52
70	55	50	87	67	51	72	38	29	62

71	12	07	75	56	34	40	67	24	86
18	82	41	29	63	06	84	01	20	06
06	33	14	79	25	65	57	47	74	68
54	35	81	07	88	96	70	85	29	13
12	91	26	57	30	22	90	03	13	31

[18-19 Final] [16-17 Final]

- Define autocorrelation. Test the autocorrelation of the given numbers (above question) by employing the chi-squared test with 99% confidence level.

21	81	92	23	96	20	68	57	79	84
82	62	12	08	92	83	74	85	60	49
48	37	65	74	22	11	28	10	55	82
72	95	08	85	79	95	86	11	16	52
70	55	50	87	67	51	72	38	29	62
71	12	07	75	56	34	40	67	24	86
18	82	41	29	63	06	84	01	20	06
06	33	14	79	25	65	57	47	74	68
54	35	81	07	88	96	70	85	29	13
12	91	26	57	30	22	90	03	13	31

N.B: You can use chi-squared table below as required. [18-19 Final] [19-20 Final]

- A sequence of 10,000 five digit random numbers has been generated, and an analysis of numbers indicate that there 3075 numbers having five different digits, 4935 having a pair, 1135 having two pairs, 695 having three of a kind, 105 having full house, 54 having four of a kind and one having all five of a kind. Use Poker test to determine if these random numbers are independent at $\alpha = 0.01$. Note that for $\alpha = 0.01$ and $N=06$ the critical value is 16.8. (06) [20-21 Final] [17-18 Final] [16-17 Final]

Masud SirBook

Simulation Modeling and Analysis (Averill M. Law)

Chapter 1: Basic Simulation Modeling

- Distinguish between analytical solution and simulation. (02) [2020-21 Mid]
- Explain the problem statement of simulation of a single server queuing system. (05) [2020-21 Mid]
- Define simulation with example. Demonstrate different ways in which a system might be studied. Explain the next-event time-advance approach illustrated for the single-server queueing system. (05) [2020-21 Final]
- Consider a single-server queuing system, there are several IID random variables interarrival times, service times, and customer delays. Describe the problem statement of the single-server queuing system. (05) [2020-21 Final]
- What is an inventory system? Formulate a simulation of an inventory system in which many of the elements are representative of those found in the actual inventory system. (04) [2020-21 Final]
- Define the following terminologies: i) System ii) Model iii) Simulation iv) Analytical solution. Demonstrate different ways in which a system might be studied. (03) [2019-20 Mid][2018-19 Final]

- What are the steps of simulation for a single-server queueing system? Describe the problem statement and intuitive explanation of a single-server queueing system. (05) [2019-20 Mid][2018-19 Final]
- Define the following terminologies: (i) Arrival rate (ii) Service rate (02) [2017-18 Final]
- What is the application of SIR model? Illustrate and state the general SIR schematic. Show and explain the maximum number of infected, I_{max} and solution curves. (7) [2017-18 Final]
- Define the following terminologies: (i) Arrival rate (ii) Service rate (iii) Reneging. (06) [2016-17 Final] Explain and illustrate the cost of customer waiting time and the idle capacity. (03) [2016-17 Final]
- A factory has a large number of semiautomatic machines. On 50% of the working days none of the machine fail. On 30% of the days one machine fails and on 20% of the days two machines fail. The maintenance staff on the average puts 65% of the machines in order in one day, 30% in two days, and the remaining 5% in three days. Estimate the average length of queue, average waiting time, and the server loading that is the fraction of time for which server is busy. (03) [2016-17 Final]
- According to two servers in parallel queueing system, illustrate a mixture of components A and B pass through workstation I. (02) [2016-17 Final]
- Discuss about the component used in next event time-advance approach. (4) [2018 Final]
- Show the comparison between i) analytical solution and simulation ii) static simulation and dynamic simulation. (4) [2018 Final]
- For a single server queueing system, inter-arrival times of customer are 0.2, 0.8, 0.4, 2.0, 1.0, 0.2, 0.5, 1.0 and service times are 1.5, 1.0, 0.6, 1.2, and 0.6. Show the snapshot of computer representation at time 0 and at each of the 6 succeeding event times. (6) [2018 Final]
- What are differences between next event time advance approach and fixed increment time advance approach? (3) [2018 Final]
- Define system with example. Distinguish analytical solution versus simulation. Demonstrate different ways in which a system might be studied. (05) [2019-20 Final]
- Explain the next-event time-advance approach illustrated for the single-server queueing system. (04) [2019-20 Final]
- List the steps of simulation for a single-server queueing system? Consider a single-server queueing system, there are several IID random variables interarrival times, service times, and customer delays. Describe the problem statement of the single-server queueing system. (05) [2019-20 Final]

Chapter 4: Review of Basic Probability and Statistics

- Define random variable. How to compute variance, covariance, and correlation for simulation study? Why stochastic process is used to simulate the output data. Illustrate correlation function of the process of delays in queue D1, D2,for the M/M/1 queue. (05) [2020-21 Final]
- What is the necessity of statistical analysis with simulation output data? Describe and illustrate the transient and steady-state behaviors of a stochastic process. (03) [2020-21 Final][2019-20 Final]
- What is random variable? Compute variance and covariance based on a set of random variates. Why stochastic process is used to simulate the output data? Illustrate correlation function... (07) [2018-19 Final]
- Explain hypothesis testing including null and alternative hypothesis for mean. What is the difference type I error and type II error? Explain and illustrate the strong law of large number. (07) [2018-19 Final]
- What is a stochastic process? Write the probability mass function of Poisson distribution. List several applications of Poisson distribution. (7) [2017-18 Final]
- What is stochastic process? (02) [2016-17 Final]

- A pair of dice is rolled once. The sum of the two numbers on the dice represents the outcome for a random variable x . Determine the probability distribution of x . What is the probability that x is even? (04) [2016-17 Final]
- How to compute variance, covariance, and correlation for simulation study. Why stochastic process is used to simulate the output data. Illustrate correlation function of the process of delays in queue D1, D2,for the M/M/1 queue. (05) [2019-20 Final]

Chapter 5: Building Valid, Credible, and Appropriately Detailed Models

- Define verification, validation, and credibility in simulation model. Illustrate the timing relationship of validation, verification, and establishing credibility. (05) [2020-21 Final]
- Describe the eight methods for debugging a simulation model's computer program. (04) [2020-21 Final]
- Describe the iterative process of verification and validation of simulation models. (02) [2017-18 Final]
- Define verification, validation, and credibility in simulation model. Mention the issues in an accreditation decision. Show the timing relationship of validation, verification, and establishing credibility. Derive the mathematical formulation... (06) [2019-20 Final]
- Explain the inspection approach of statistical procedure for comparing real-world observation and simulation output data. (03) [2019-20 Final]

Chapter 6: Selecting Input Probability Distributions

- Write down the properties of the location, scale, and shape parameters of continuous distributions. State the relevant information (application, density function, parameters, and density curve) for the simulation modeling application of the normal continuous distribution. (05) [2020-21 Final]
- Write the properties of location, scale, and shape parameters of continuous distributions. [Part 1] (07) [2018-19 Final]
- How to address the COVID-19 scenario using Exponential distribution. Illustrate the Exponential curves on the following scenarios: (i) Exponential growth and Exponential decay. (ii) Infection begins to taper off when herd immunity is reached. (iii) Confirmed cases will rise again if restrictions are lifted too soon. (7) [2017-18 Final]
- Why is Gaussian distribution called bell curve? (02) [2016-17 Final]
- Give some applications of Poisson distribution. (02) [2016-17 Final]
- List some sources of randomness for common simulation applications. Write the properties of location, scale, and shape parameters of continuous distributions (04) [2019-20 Final]

Chapter 7: Random-Number Generators

- What are the limitations of mid-square method? Evaluate the performance of Mid-square method if seeds are 6785, 1379, 1357. (4) [2018 Final]
- Generate a sequence of 15 random numbers between 20 to 30 such that $r_{n+1} = (7r_n + 15) \bmod m$, where $r_0 = 11$, $m =$ prime number. (4) [2018 Final]

Chapter 8: Generating Random Variates

- Many random number generators in use today are linear congruential generators, LCGs. Discuss how to obtain the desired random numbers from LCGs? What is the inverse transform function? Let X have an exponential distribution with a mean β . Generate the desired random variate using the inverse transform function. (06) [2020-21 Final][2019-20 Final]
- What is inverse transform function? Let X have the exponential distribution with mean β . Generate the desired random variate using the inverse transform function. [Part 2] (07) [2018-19 Final]

- Write the density function of the normal curve. Generate ten random observations from Normal distribution with a mean 15 and standard deviation 5. (7) [2017-18 Final]
- Generate five random observations from Normal distribution with mean = 5 and standard deviation 4. (04) [2016-17 Final]

Chapter 9: Output Data Analysis for a Single System

- Describe and illustrate the transient and steady-state behaviors of a stochastic process. (03) [2023 Final]
- Describe and illustrate transient and steady-state behavior of a stochastic process. (04) [2022 Final (Session 19-20)]
- What is the necessity of statistical analysis with simulation output data? (03) [2023 Final]
- What is the necessity of statistical analysis on simulation output data? (04) [2022 Final (Session 19-20)]
- Why stochastic process is used to simulate the output data? (07/05) [2021 Final][2022 Final (Session 19-20)]
- Derive the mathematical formulation in a good estimate of the mean of the system using both validation and output analysis. (06) [2022 Final (Session 19-20)]
- Compute variance and covariance based on a set of random variates. (07) [2021 Final]
- How to compute variance, covariance, and correlation for simulation study? (05) [2023 Final][2022 Final (Session 19-20)]
- Illustrate correlation function of the process of delays in queue $D_1, D_2, \dots$ for the M/M/1 queue. (05) [2023 Final][2022 Final (Session 19-20)][2021 Final]

“Maybe you are searching among the branches,
for what only appears in the roots.”

— **Jalaluddin Rumi**

Persian poet and Sufi Mystic