MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Estd. 2000

Department of Mathematics
Question Bank - Academic Year (2021-22)

Course Code & Course Name : 19BSS25 – Statistics and Queueing Models

Name of the Faculty : M.Saranya

Year/Sem/Sec : II / IV / ECE

Unit-I : TESTING OF HYPOTHESIS

Part-A (2 Marks)

1. Mention the various steps involved in testing of hypothesis.
2. Define Chi-square test for goodness of fit.
3. What are parameters and statistics in sampling?
4. What are Type – I error and Type – II error?
5. What are the applications of t – distribution?
6. What are the Null and Alternate hypothesis?
7. A Random sample of 200 tins of coconut oil gave an average weight of 4.95 kgs. With a standard deviation of 0.21 kg. Do we accept that the net weight is 5 kgs per tin at 5 % level?
8. State level of significance.
9. Write the conditions for applying χ^2 test.
10. Give the main use of χ^2 test.

Part-B (16 Marks)

1. The following the data gives the number of aircraft accidents that whether the during the various days of a week. Find whether the accidents are uniformly distributed over the week. (16)

Days:	Sun	Mon	Tue	Wed	Thu	Fri	Sat
No. of accidents:	14	16	8	12	11	9	14

2. The nine items of sample had the following 45, 47, 50, 52, 48, 47, 49, 53, 51. Does the mean of the nine items differ significantly from the assumed population mean 47.5? (16)

3. 10. Test whether there is any significant difference between the variance of the populations from which the following samples are taken: (16)

Sample I:	20	16	26	27	23	22	_

Sample II:	27	33	42	35	32	34	38

4. (i) Time taken by workers in performing a job are given below

Type I	21	17	27	28	24	23	-
Type II	28	34	43	36	33	35	39

Test whether there is any significant difference between the variances of time distribution. (8)

(ii) A sample of boys had the I.Q's: 70, 120, 110, 101, 88, 83, 95, 98, 100 and 107. Test whether the population mean I.Q may be 100. (8)

5.(i). 4 coins were tossed 260 times and the following results were obtained:

No. of heads	:	0	1	2	3	4
Observed frequencies	:	17	52	54	31	6

Under the assumption that the coins are unbiased, find the expected frequencies of getting 0, 1, 2, 3, 4 heads and test the goodness of fit. (8)

(ii) The heights of 10 males of a given locality are found to be 70, 67, 62, 68, 61, 68, 70, 64, 64, 66 inches. Is it reasonable to believe that the average height is greater than 64 inches? (8)

Unit-II: DESIGN OF EXPERIMENTS

Part-A (2 Marks)

1. What do you understand by " Design of an Experiment"?
2. What are the basic principles of design of Experiments.
3. Compare one-way classification model with two-way classification model.
4. Define Mean sum of squares?
5. Write one differences between RBD and LSD.
6. What is ANOVA ?
7. What are the assumptions involved in ANOVA.
8. Write down the assumptions in analysis of variable.
9. What are the advantages of a Latin square design?
10. Define RBD.

Part-B (16 Marks)

1. Four varities A, B, C, D of a fertilizer are tested in a RBD with 4 replications. The plot yields in pounds are as follows:

A12	D20	C16	B10
D18	A14	B11	C14
B12	C15	D19	A13
C16	B11	A15	D20

Analyse the experimental yield. (16)

2. A variable trial was conducted on wheat with 4 varienties in a Latin Square design. The plan of the experiment and per plot yield are given below: (16)

C25	B23	A20	D20
A19	D19	C21	B18
B19	A14	D17	C20
D17	C20	B21	A15

Analysis the data.

3. Three varieties A, B, C of a crop are tested in a randomized block design with 3 replications. The plot yields in pounds are as following.

A 6	C 5	A 8	B 9
C 8	A 4	B 6	C 9
B 7	B 6	C 10	A 6

(16)

Analyse the experimental yield.

4. Analyse the following of Latin square experiment.

A12	D20	C16	B10
D18	A14	B11	C14
B12	C15	D19	A13
C16	B11	A15	D20

(16)

5. The following is a Latin square a design when 4 Varieties of seed are being tested. Set up the analysis of variance table and state your conclusion. You can carry out the suitable charge of origin and scale.

A 110	B 100	C 130	D 120
C 120	D 130	A 110	B 110
D 120	C 100	B 110	A 120
B 100	A 140	D 100	C 120

(16)

Unit-III : STATISTICAL QUALITY CONTROL

Part-A (2 Marks)

1. Define Statistical quality control.
2. Define Process control
3. Define Control charts.
4. What are the types of control charts.
5. Explain control charts of Variables and Attributes.
6. Write the formula for control limits for mean and range.
7. What are the uses of following control charts
   (i) p-chart
   (ii) np-chart
   (iii) c-chart
8. Write the formula for p-chart and np-chart.
9. Find the lower control limits for $\overline{X}$ and R, when each sample is of size 4 and $\overline{\overline{X}} = 10.80$ and $\overline{R} = 0.46$
10. What is meant by tolerance limits?

Part-B (16 Marks)

1. Given below are the values of sample mean X and sample range R for 10 samples, each of size 5. Draw the appropriate mean and range charts and comment state of the control of the process.

Sample No.	1	2	3	4	5	6	7	8	9	10
Mean X	43	49	37	44	45	37	51	46	43	47
Range R	5	6	5	7	7	4	8	6	4	6

(16)

2. In a factory producing spark plugs, the number of defectives found in the inspection of 15 lots of 100 each is given below. Draw the control chart for the number of defectives and comment on the state of control.

Sample number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of defective(np)	5	10	12	8	6	4	6	3	4	5	4	7	9	3	4

(16)

3. 15 samples of 200 items each were drawn from the output of a process. The number of defective items in the samples are given below. Prepare a control chart for the fraction defective and comment on the state of control.

Sample number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of defective(np)	12	15	10	8	19	15	17	11	13	20	10	8	9	5	8

(16)

4. 15 tape-recorders were examined for quality control test.The number of defects in each tape – recorder is recorded below.Draw the appropriate control chart and comment on the state of control.

Unit no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of defects(c)	2	4	3	1	1	2	5	3	6	7	3	1	4	2	1

(16)

5. a.) 10 samples each of size 50 were inspected and the number of defectives in the inspection were: 2,1,1,2,3,5,5,1,2,3.Draw the appropriate control chart for defectives.

b.)A textile unit produces special cloths and packs them in rolls. The number of defects found in 20 rolls are given below. Find whether the process is under control.

Defects in 20 rolls : 12,14,7,6,10,10,11,12,5,18,12,4,4,9,21,14,8,9,13,21.

(16)

Unit- IV : QUEUEING MODELS

Part-A (2 Marks)

1. Define Markovian process.
2. What are the characteristics of queueing system.
3. Define Kendall's notation of queuing model.
4. Define a birth and death process.
5. Give the formula for average number of customers in the system in single server models.
6. In the usual notation of an M/M/1 queueing system, if λ=12/hour and μ=24/hour, find the average number of customers in the system.
7. For (M/M/1):(∞ /FIFO), write down the Little's formula. (or) Write the Little's formula for the infinite capacity queueing models. (or) Define Little's formula.
8. What is the formula for average waiting time of a customer in the system of the queuing model(M/M/c):(∞/FIFO)
9. If there are two servers in an infinite capacity Poisson queue system with λ=10 per hour and μ=15 per hour, what is the percentage of idle time for each server?
10. Define Balking and Reneging.

Part-B (16 Marks)

1. Customers arrive at a one-man barber shop according to a Poisson process with a mean Interarrival time of 12 min. Customers spend an average of 10min in the barber's chair.
   (a) What is the expected number of customers in the barber shop and in the queue?
   (b) How much time can a customer expect to spend in the barber's shop?
   (c) What is the average time customer spends in the queue?
   (d) What is the probability that more than 3 customers are in the system? (16)

2. A T.V. repairman finds that the time spent on his jobs follows exponential distribution with a mean of 30 minutes. If he repairs the sets in the order of their arrival according to Poisson distribution at an average rate of 10 per 8 hour-days, find his expected idle time on each day and also the total number of sets in his shop. (16)

3. The local one person barber shop can accommodate a maximum of 5 people at time (4waiting and 1 getting hair-cut) Customers arrive according to a Poisson distribution with mean 5 per hour. The barber cuts hair at an average rate of 4 per hour.
   (a) What percentage of time is the barber idle?
   (b) What fraction of the potential customers are turned away?
   (c) What is the expected number of customers waiting for a hair-cut?
   (d) How much time can a customer expect to spend in the barber shop? (16)

4. Patients arrive at clinic according to Poisson distribution at a rate of 30 patients per hour. The waiting room does not accommodate more than 14 patients. Examination time per patient is exponential with mean rate of 20 per hour.
   (a) Find the effective arrival rate at the clinic. (16)

(b) What is the probability that an arriving patient will not wait?
(c) What is the expected waiting time until a patients is discharged from the clinic?

5. There are three typists in an office. Each typist can type an average of 6 letters per hour. If letters arrive for being typed at the rate of 15 letters per hour.
(a) what fraction of the time all the typists will be busy?
(b) What is the average number of letters waiting to be typed? (16)
(c) What is the average time a letter has to spend for waiting and for being typed?
(d) What is the probability that a letter will take longer than 20 min. waiting to be typed and being typed?

Unit- V : Advanced Queueing Models

Part-A (2 Marks)

1. When M/G/1 queueing model will become a classic M/M/1 queueing model.
2. Write Pollaczek-Khintchine formula and explain the notations.
3. Define series queues with blocking.
4. Give any two examples for series queuing situations.
5. Give an example for a non Markovian queuing model
6. Write classification of queueing networks.
7. What do you mean by bottleneck of a network?
8. State Jackson's theorem for an open network.
9. Define open Jackson networks.
10. Write the traffic equations in open Jackson networks

Part-B (16 Marks)

1. Derive Pollaczek-Khinchine formula for the average number of customers in the M/G/1 queuing system**.** (16)

2. Automatic car wash facility operates with only one bay. Cars arrive according to a Poisson Process, with mean of 4 cars per hour and may wait in the facility's parking lot if the bay is busy. If the service time for all cars is constant and equal to 10 min, Determine
(1) Mean number of customers in the system. (16)
(2) Mean number of customers in the queue.
(3) Mean waiting time in the system.
(4) Mean waiting time in the queue.

3. A one man barber shop takes exactly 25 minutes to complete one hair-cut. If customers arrive at the barber shop in a Poisson fashion at an average rate of 1 every 40 minutes, how long on the average a customer spends in the shop? Also find the average time a customer must wait for service. (16)

4. An automatic car was facility operates with only one bay. Cars arrive according to a Poisson distribution with a mean of 4 cars/hour and may wait in the facility's parking lot if the bay is busy. Find the average number of customers in the system in the service time is (16)
(i) Constant and is equal to 10 minutes.
(ii) Uniformly distributed between 8 and 12 minutes.

5. A repair facility shared by a large number of machines has 2 sequential stations with respective service rates of 2 per hour and 3 per hour. The cumulative failure rate of all machines is 1 per hour. Assuming that the system behavior may be approximated by the 2 stage tandem queue, find (16)
(1) The average repair time including the waiting time
(2) The probability that both the service stations are idle and
(3) The bottleneck of the repair facility.

Course Faculty **HoD**

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Department of Mathematics
Question Bank - Academic Year (2020-21)

Course Code & Course Name : 19BSS28 – Statistics and Numerical methods

Name of the Faculty : **J. Dhamothiran**

Year/Sem/Sec : **II / IV / Civil**

Unit-I : TESTING OF HYPOTHESIS

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A 6	C 5	A 8	B 9
C 8	A 4	B 6	C 9
B 7	B 6	C 10	A 6

Analyse the experimental yield.

4. Analyse the following of Latin square experiment. (16)

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5. The following is a Latin square a design when 4 Varieties of seed are being tested. Set up the analysis of variance table and state your conclusion. You can carry out the suitable charge of origin and scale. (16)

A 110	B 100	C 130	D 120
C 120	D 130	A 110	B 110
D 120	C 100	B 110	A 120
B 100	A 140	D 100	C 120

Unit-III : SOLUTION OF EQUATIONS AND EIGEN VALUE POBLEMS

Part-A (2 Marks)

11. State the order of convergence and convergence condition for Newton-Raphson method.
12. What is the order of convergence for fixed point iteration?
13. Solve $x+y = 2$, $2x+3y = 5$ by Gauss Elimination method.
14. Distinguish Gauss Elimination method and Gauss Jordan method.
15. Write a sufficient condition for Gauss seidal method to converge?
16. Compare Gauss-Jacobi and Gauss seidal methods.
17. Write two iterative methods in solving a set of simultaneous equations.
18. State the basic principle involved for finding A^{-1} by Gauss – Jordan method?

19. Write down the procedure to find the numerically smallest Eigenvalue of a matrix by power method.
20. When do we use the power method?

Part-B (16 Marks)

6. Solve the following system of equations by Gauss-jacobi method and Gauss seidal method. (16)

$27x + 6y - z = 85; \quad x + y + 54z = 110; \quad 6x + 15y + 2z = 72$

7. Solve by Gauss seidal method: (16)

$$6x + 3y + 12z = 35; \quad 8x - 3y + 2z = 20; \quad 4x + 11y - z = 33$$

8. Find the inverse of the matrix $A = \begin{pmatrix} 4 & 1 & 2 \\ 2 & 3 & -1 \\ 1 & -2 & 2 \end{pmatrix}$ using Gauss Jordan method (16)

9. Find all the Eigen values of $A = \begin{pmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$ using power method, using (16)

$x_1 = [1, 0, 0]^T$ as the initial vector.

10. Find the numerically largest Eigen value of $\begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 5 \end{bmatrix}$ (16)

and the corresponding eigenvector by Power method.

Unit- IV : INTERPOLATION NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION

Part-A (2 Marks)

11. What is the Lagrange's formula to find y, if three sets of values (x_0 , y_0), (x_1 , y_1) and (x_2 , y_2) are given.
12. Write the Newton's divided difference interpolation formula
13. When will we use Newton's forward interpolation formula?
14. Write the formula for $\frac{dy}{dx}$ at $x = x_0$ using forward difference operator
15. Using Newton's backward difference formula, write the formulae for the first order derivatives at the end values $x = x_n$
16. What does Simpson's rule give exact result?
17. What is the order of error in Trapezoidal formula?

18. What is the order of error in Simpson's formula?

19. State the local error term in Simpson's one third rule.

20. State Trapezoidal rule to evaluate $\int_{x_0}^{x_n} f(x)dx$.

Part-B (16 Marks)

1. (i) Find the value of f(4) Using Lagrange's formula for the interpolation from the following table (8)

x :	0	2	3	6
y :	-4	2	14	158

(ii) Find the profit in the year 2000 by Lagrange's from the following table (8)

Year :	1997	1999	2001	2002
Profit in lakhs of Rs:	43	65	159	248

2. (i) Using Newton's divided difference formula, find u(3) given that u(1) = -26, (8)

u(2) = 12, u(4) = 256, u(6) = 844.

(ii) Find the polynomial from the following data using Newton's forward formula. (8)

x :	4	6	8	10
y :	1	3	8	16

3. (i) From the data given below find the number of students whose weight is between 60 to 70. (8)

Wt (x) :	0-40	40-60	60-80	80-100	100-120
No of students :	250	120	100	70	50

(ii) From the following data find y at x = 43 and x = 84 (8)

x :	40	50	60	70	80	90
y :	184	204	226	250	276	304

4. (i) Using Newton divided difference formula, find $f(6)$ from the following table: (8)

x :	1	2	7	8
$f(x)$:	1	5	5	4

(ii) Evaluate the following by Trapezoidal rule (8)

(i) $\int_0^1 \frac{dx}{1+x^2}$ with h=0.5

(ii) By dividing the range into 10 equal parts $\int_0^{\pi} \sin x dx$

5. Evaluate the following using by (i) Trapezoidal (ii) Simpson's rule. (16)

(i) $\int_{1}^{1.4}\int_{2}^{2.4} \frac{1}{xy}\,dxdy$ (ii) $\int_{1}^{2}\int_{1}^{2} \frac{xy}{x+y}\,dxdy$ with h=k= 0.25

Unit- V : NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Part-A (2 Marks)

11. Write down the fourth order Taylor's Algorithm.
12. State the disadvantage of Taylor's series method.
13. Write the merits and demerits of the Taylor method of solution.
14. What is the truncation error of Taylor's series method?
15. Write down Euler's algorithm to the differential equation $\frac{dy}{dx} = f(x, y)$.
16. State the special advantage of Runge-Kutta method over Taylor's series method.
17. What are the advantages of R-K method over Taylor's method.
18. How many prior values are required to predict the next value in Milne's method?
19. What is the error term in Milne's corrector formula?
20. Write down the finite difference formula for $y'(x)$ and $y''(x)$

Part-B (16 Marks)

1. (i) Solve $\frac{dy}{dx} = x^2 + y^2, y(0) = 1$ use Taylor's series method at x = 0.2 and x = 0.4. (8)

(ii) Find y(0.1), y(0.2) given $\frac{dy}{dx} - 2y = 3e^x, y(0) = 0$ using Taylor's series method. (8)

2. (i) Find y(0.1) given $y'' = y + xy', y(0) = 1, y'(0) = 0$ by Taylor's series method (8)

(ii) Find y at x=0.25 by Modified Euler's method given that $y' = 2xy, y(0) = 1$. (8)

3. (i) Find y(0.2), y(0.4) given $y' = y + e^x, y(0) = 0$,using Modified Euler's method. (8)

(ii) Solve $\frac{dy}{dx} = x^2 - y, y(0) = 1$ by Modified Euler's method for x=0.2 and x=0.4. (8)

4. (i) Find y(0.1) given $\frac{dy}{dx} = -y, y(0) = 1$ by using Runge kutta fourth order method. (8)

(ii) Find y(0.2) with h=0.1 from $\frac{dy}{dx} = x^2 + y^2, y(0) = 1$ by Runge kutta method . (8)

5. Given $y' = 1 - y, y(0) = 0$, find (i) y(0.1) , y(0.2) by Euler's method (ii) y(0.3) by Modified Euler's method (iii) y(0.4) by Milne's method. (16)

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