



Avinashilingam Institute for Home Science and Higher Education for Women

Deemed to be University Estd. u/s 3 of UGC Act 1956, Category A by MHRD (now MoE)

Re-accredited with 'A++' Grade by NAAC. CGPA 3.65/4, Category I by UGC

Coimbatore - 641 043, Tamil Nadu, India

Master's Degree Examination – May 2025

II Semester

Class : I P.G.
Major : Mathematics

Time: 3 Hours
Max. Marks: 100

23MMAC10 Mathematical Statistics - II

Course Outcomes:

CO1: Demonstrate the concepts of Sampling theory.

CO2: Use ANOVA in agriculture field.

CO3: Apply the concept of classification of design of experiments.

CO4: Understand the methods of quality improvement.

CO5: Construct control charts.

Part A

10 x 1 = 10

Choose the Correct Answer

1. The drawback of purposive sampling is overcome in _____ sampling. CO1K1
a. purposive b. systematic c. stratified d. random
2. A _____ is a smaller group of members of a population selected to represent the population. CO1K1
a. sample b. parameter c. Small population d. Purposive sample
3. Analysis of variance is a statistical method of comparing the _____ of several populations. CO2K1
a. standard deviations b. variances c. means d. proportions
4. One of the assumptions of ANOVA test is that the observations are CO2K2
a. independent b. dependent c. not restricted d. same
5. The total number of possible latin squares of order $m \times m$ is CO3K2
a. $(m-1)!(m-2)! \times$ Number of standard squares b. $m!(m-1)! \times$ Number of standard squares
c. $(m-2)!(m-3)! \times$ Number of standard squares d. $(m-3)!(m-4)! \times$ Number of standard squares
6. _____ involves a method of permitting each unit of experimental material to be employed for every treatment under test. CO3K1
a. Replication b. Randomization
c. cross-classification d. experimentation with similar materials
7. All costs incurred in an effort to "make it right the first time" are _____ costs. CO4K2
a. prevention b. appraisal c. internal failure d. external failure
8. The _____ is a useful plot for identifying a potential relationship between two variables. CO4K2
a. defect concentration diagram b. fraction conforming c. scatter diagram d. correlation
9. The _____ is defined as the ratio of the number of nonconforming items in a population to the total number of items in that population. CO5K2
a. fraction conforming b. fraction nonconforming
c. sample fraction nonconforming d. sample bi-fraction nonconforming
10. The control chart for fraction non-conforming is _____ chart. CO5K2
a. np b. u c. c d. p

Part B**5 x 6 = 30****Answer ALL questions****Each answer should not exceed 400 words or two pages**11.a. Write note on population, parameter and statistic. CO1K2

(or)

11.b. Explain random sampling procedure with an example. CO1K212.a. Write differences between one-way and two-way ANOVA. CO2K3

(or)

12.b. The table shows quality rating of service stations by five professional raters: CO2K3

| RATER | SERVICE STATION | | | | | | | | | |
|-------|-----------------|----|----|----|----|----|----|----|----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| A | 99 | 70 | 90 | 99 | 65 | 85 | 75 | 70 | 85 | 92 |
| B | 96 | 65 | 80 | 95 | 70 | 88 | 70 | 51 | 84 | 91 |
| C | 95 | 60 | 48 | 87 | 48 | 75 | 71 | 93 | 80 | 93 |
| D | 98 | 65 | 70 | 95 | 67 | 82 | 73 | 94 | 86 | 80 |
| E | 97 | 65 | 62 | 99 | 60 | 80 | 76 | 92 | 90 | 89 |

Analyse the data and discuss whether there is any significant difference between raters or between service stations.

13.a. In a random block design, there are only two blocks. Let 'k' be the number of treatments and \bar{X}_1 and \bar{X}_2 be the average yield of the two blocks respectively. Show that thebetween-blocks sum of squares is given as $\frac{k}{2}(\bar{X}_1 - \bar{X}_2)^2$.CO3K2

(or)

13.b. Write short note on randomized block design. CO3K214.a. Describe how SPC methods are used to improve quality and productivity in a copper plating operation and give diagrammatic representation of cause and effect diagram for controller downtime. CO4K3

(or)

14.b. Write short note on defect concentration diagram. CO4K315.a. Write the formulae for constructing the control limits on the \bar{x} chart and R chart. CO5K2

(or)

15.b. What is standardized control chart and how the variable is plotted? CO5K2**Part C****5 x 12 = 60****Answer ALL questions****Each answer should not exceed 800 words or four pages**16.a. Prove that a systematic sample is more precise than a simple random sample without replacement if the mean square within the systematic sample is larger than the population mean square. CO1K4

(or)

16.b. What is sampling and describe its types? CO1K4

17.a. Draw ANOVA table for two-way classified data with M observations per cell.

CO2K4

(or)

17.b. The average number of days survived by mice with 5 strains of typhoid organisms along with their standard deviation and number of mice involved in each experiment is given below. On the basis of these data, what would be your conclusions regarding the strains of typhoid organisms?.

CO2K3

| Strains of typhoid | A | B | C | D | E |
|---------------------------|-------|------|------|------|------|
| No. of mice, n_i | 10 | 6 | 8 | 11 | 5 |
| Average, \bar{y}_i | 10.9 | 13.5 | 11.5 | 11.2 | 15.4 |
| Standard deviation, s_i | 12.72 | 5.96 | 3.24 | 5.65 | 3.64 |

18.a. Write note on Latin square design with an example.

CO3K3

(or)

18.b. The following table provides the yields of six varieties in a four replicate experiment for which one value is missing. Estimate the missing data and analyse the data.

CO3K3

| Blocks | Treatments | | | | | | Block Totals (B_j) |
|----------------------------|------------|------|------|------|------|------|------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| 1 | 18.5 | 15.7 | 16.2 | 14.1 | 13.0 | 13.6 | 91.1 |
| 2 | 11.7 | — | 12.9 | 14.4 | 16.9 | 12.5 | 68.4 |
| 3 | 15.4 | 16.6 | 15.5 | 20.3 | 18.4 | 21.5 | 107.8 |
| 4 | 16.5 | 18.6 | 12.7 | 15.7 | 16.5 | 18.0 | 98.0 |
| Treatment Totals (T_i) | 62.1 | 50.9 | 57.3 | 64.5 | 64.8 | 65.7 | 365.3 |

19.a. Explain the statistical basis of the control chart, in detail with suitable examples and diagrams wherever necessary.

CO4K4

(or)

19.b. Write note on Scatter Diagram.

CO4K4

20.a. A supply chain engineering group monitors shipments of materials through the company distribution network. Errors on either the delivered material or the accompanying documentation are tracked on a weekly basis. Fifty randomly selected shipments are examined and the errors recorded. Data for twenty weeks are shown in the following table. Set up a μ control chart to monitor this process.

CO5K4

Data on Number of Shipping Errors in a Supply Chain Network

| Sample Number (week), i | Sample Size, n | Total Number of Errors (Nonconformities), x_i | Average Number of Errors (Nonconformities per Unit), $u_i = x_i/n$ |
|---------------------------|------------------|---|--|
| 1 | 50 | 2 | 0.04 |
| 2 | 50 | 3 | 0.06 |
| 3 | 50 | 8 | 0.16 |
| 4 | 50 | 1 | 0.02 |
| 5 | 50 | 1 | 0.02 |
| 6 | 50 | 4 | 0.08 |
| 7 | 50 | 1 | 0.02 |
| 8 | 50 | 4 | 0.08 |
| 9 | 50 | 5 | 0.10 |
| 10 | 50 | 1 | 0.02 |
| 11 | 50 | 8 | 0.16 |
| 12 | 50 | 2 | 0.04 |
| 13 | 50 | 4 | 0.08 |
| 14 | 50 | 3 | 0.06 |
| 15 | 50 | 4 | 0.08 |
| 16 | 50 | 1 | 0.02 |
| 17 | 50 | 8 | 0.16 |
| 18 | 50 | 3 | 0.06 |
| 19 | 50 | 7 | 0.14 |
| 20 | 50 | 4 | 0.08 |

(or)

20.b. Write note on Attribute control chart and variable control chart.

CO5K5
