# DEPARTMENT OF STATISTICS
## P – 302
## DESIGN AND ANALYSIS OF EXPERIMENT

**One-mark questions**

**Unit-I: Analysis of Variance and Experimental Design**

1. What is the purpose of analyzing variance in statistics?
2. Define variance components in the context of analysis of variance.
3. Differentiate between one-way and two-way fixed effect models in ANOVA.
4. Explain the concept of random effect models in ANOVA.
5. How do you estimate variance components in ANOVA?
6. Name some methods used for testing variance components.
7. What challenges are associated with analyzing unbalanced data in ANOVA?
8. What are the principles of experimental design?
9. Define experimental error in the context of designed experiments.
10. How do you interpret data from an experimental design?

**Unit-II: Block Designs and Missing Plot Techniques**

11. Explain the concept of a completely randomized design.
12. What is the purpose of a randomized block design?
13. Define a Latin square design.
14. How does a Graeco-Latin square design differ from a Latin square design?
15. What are cross-over designs used for in experimental design?
16. Describe the general theory behind missing plot techniques.
17. Provide an example application of missing plot techniques.

**Unit-III: Factorial Experiments and Confounding**

18. What is a factorial experiment?
19. Explain the concept of factorial effects in experimental design.
20. How do you estimate and test the significance of factorial effects?
21. Define a $2^n$ factorial experiment.
22. Describe the characteristics of a $3^2$ factorial experiment.
23. What is confounding in factorial experiments?
24. Differentiate between complete and partial confounding.
25. What are the advantages of partial confounding in factorial experiments?
26. How do you construct and analyze fractional replications for symmetric factorials?

**Unit-IV: Incomplete Block Designs and Split Plot Designs**

27. What is a balanced incomplete block design?
28. Explain the concept of parametric equality and inequality in incomplete block designs.
29. What is intra-block analysis in the context of incomplete block designs?

30. How do you analyze experimental data with the recovery of interblock information in incomplete block designs?
31. Define split plot and strip plot designs.
32. Describe the models used for split plot and strip plot designs.
33. Provide an example application of split plot designs.

## 1.5 mark Questions

### Unit-I: Analysis of Variance and Experimental Design

1.5 marks each:

1. Explain the components of variance in the context of analysis of variance.
2. Compare and contrast one-way and two-way fixed effect models in ANOVA.
3. Describe the process of estimating variance components in ANOVA.
4. Discuss various methods used for testing variance components.
5. How does the analysis of unbalanced data differ from balanced data in ANOVA?
6. Outline the principles that guide the design of experiments.
7. What role does experimental error play in designed experiments?
8. Elaborate on the steps involved in interpreting data from an experimental design.

### Unit-II: Block Designs and Missing Plot Techniques

1.5 marks each:

9. Provide examples of situations where a completely randomized design is appropriate.
10. Explain the key features of a randomized block design.
11. Define a Latin square design and its applications.
12. What distinguishes a Graeco-Latin square design from a Latin square design?
13. In what scenarios are cross-over designs commonly used?
14. What is the underlying theory behind missing plot techniques in experimental design?
15. Offer an application example of missing plot techniques.

### Unit-III: Factorial Experiments and Confounding

1.5 marks each:

16. Define a factorial experiment and its purpose.
17. Discuss the concept of factorial effects in experimental design.
18. How do you determine the best estimates of factorial effects?
19. Describe the steps involved in testing the significance of factorial effects.
20. Give an overview of a $2^n$ factorial experiment.
21. Explain the key characteristics of a $3^2$ factorial experiment.
22. What is confounding, and how does it impact $2^n$ factorial experiments?
23. Compare and contrast complete and partial confounding.
24. Enumerate the advantages and disadvantages of partial confounding.
25. Describe the construction and analysis of fractional replications for symmetric factorials.

**Unit-IV: Incomplete Block Designs and Split Plot Designs**

1.5 marks each:

26. Discuss the concept of a balanced incomplete block design.
27. Explain parametric equality and inequality in incomplete block designs.
28. What is intra-block analysis, and why is it important in incomplete block designs?
29. How do you analyze experimental data while recovering interblock information in incomplete block designs?
30. Outline the models used for split plot and strip plot designs.
31. Elaborate on the process of analyzing split plot and strip plot experimental data.
32. Provide an application example of split plot designs.

## 2 mark Questions

**Unit-I: Analysis of Variance and Experimental Design**

1. What are the main components of variance in analysis of variance (ANOVA)?
2. Explain the differences between one-way and two-way fixed effect models in ANOVA.
3. How do you estimate variance components in ANOVA, and why is this important?
4. Discuss various methods used for testing variance components, such as Bartlett's test.
5. What challenges and issues arise when dealing with unbalanced data in ANOVA?
6. Explain the fundamental principles that guide the design of experiments.
7. How is experimental error quantified, and why is it important in designed experiments?
8. Walk through the steps involved in interpreting and drawing conclusions from experimental data.

**Unit-II: Block Designs and Missing Plot Techniques**

9. Define and provide an example of a completely randomized design.
10. What is the purpose of a randomized block design, and how does it work?
11. Describe the characteristics and applications of Latin square designs.
12. How does a Graeco-Latin square design differ from a Latin square design?
13. In what situations are cross-over designs commonly used, and why?
14. Explain the general theory behind missing plot techniques in experimental design.
15. Provide a real-world application of missing plot techniques.

**Unit-III: Factorial Experiments and Confounding**

16. Define a factorial experiment and its essential components.
17. What are factorial effects in the context of experimental design?
18. How do you determine the best estimates of factorial effects in factorial experiments?
19. Describe the steps involved in testing the significance of factorial effects.
20. Give an overview of a $2^n$ factorial experiment and its applications.
21. What are the key characteristics of a $3^2$ factorial experiment?
22. Explain the concept of confounding in $2^n$, $3^2$, and $3^3$ factorial experiments.
23. Compare complete and partial confounding, highlighting their advantages and disadvantages.

24. How are fractional replications constructed and analyzed for symmetric factorials?

## Unit-IV: Incomplete Block Designs and Split Plot Designs

25. Discuss the concept of a balanced incomplete block design and its use.
26. Explain the significance of parametric equality and inequality in incomplete block designs.
27. What is intra-block analysis, and why is it important in incomplete block designs?
28. How is experimental data analyzed while recovering interblock information in incomplete block designs?
29. Describe the models commonly used for split plot designs.
30. Explain the analytical process involved in split plot experimental data.
31. Offer a practical example of the application of split plot designs

**6 Mark Question**

## Unit-I: Analysis of Variance and Experimental Design

1. Explain the components of variance in the context of analysis of variance (ANOVA) in detail. How are they calculated?
2. Discuss the differences between one-way and two-way fixed effect models in ANOVA. Provide examples for each.
3. Describe the process of estimating variance components in ANOVA. How do you choose an appropriate method for estimation?
4. Compare and contrast various methods for testing variance components, including their strengths and limitations.
5. Analyze the challenges posed by unbalanced data in ANOVA. How can you address these challenges effectively?
6. Elaborate on the fundamental principles that underlie the design of experiments. Provide real-world examples to illustrate these principles.
7. Define experimental error and explain its significance in designed experiments. How does it affect the interpretation of results?
8. Walk through the steps involved in interpreting and drawing meaningful conclusions from experimental data, emphasizing best practices.

## Unit-II: Block Designs and Missing Plot Techniques

9. Provide a detailed explanation of completely randomized designs, emphasizing their advantages and disadvantages.
10. How does a randomized block design work? Explain its applications and situations where it is suitable.
11. Describe the key characteristics of Latin square designs and provide examples of their applications.
12. Differentiate between Latin square and Graeco-Latin square designs. When would you choose one over the other?
13. Discuss the significance of cross-over designs in experimental design. Provide a step-by-step explanation of how they are implemented.

14. Explain the general theory behind missing plot techniques in experimental design, including the rationale and benefits.
15. Offer a comprehensive overview of the practical applications of missing plot techniques, considering their role in addressing real-world challenges.

## Unit-III: Factorial Experiments and Confounding

16. Define a factorial experiment, and provide a thorough description of its elements, including factors and levels.
17. How do you identify factorial effects in experimental design? Discuss the mathematical principles involved in their determination.
18. Explain the process of determining the best estimates of factorial effects in factorial experiments. What statistical techniques are involved?
19. Describe the steps required to rigorously test the significance of factorial effects, considering both practical and statistical aspects.
20. Provide an in-depth exploration of a $2^n$ factorial experiment, highlighting its structure, applications, and key considerations.
21. Analyze the characteristics and advantages of a $3^2$ factorial experiment. Explain its role in experimental design.
22. Discuss the concept of confounding in $2^n$, $3^2$, and $3^3$ factorial experiments. How does it impact the results, and how can it be managed?
23. Compare complete and partial confounding, including their respective advantages and disadvantages in experimental design.
24. Explain the construction and analysis of fractional replications for symmetric factorials. Why might you choose this approach, and what are the implications?

## Unit-IV: Incomplete Block Designs and Split Plot Designs

25. Provide an extensive overview of the balanced incomplete block design (BIBD), including its construction, applications, and advantages.
26. Explain the significance of parametric equality and inequality in the context of incomplete block designs. How do these concepts affect the design?
27. What is intra-block analysis, and how does it contribute to a better understanding of experimental data in incomplete block designs?
28. Describe the analytical methods used to recover interblock information in incomplete block designs. Why is this information valuable?
29. Present the models commonly used for split plot designs. How do these models help analyze complex experimental setups?
30. Walk through the analytical process of split plot experimental data, emphasizing the key steps and statistical techniques involved.
31. Offer a practical example of the application of split plot designs, showcasing how they can address specific experimental challenges.