PAPER NO-16: DESIGN OF EXPERIMENTS

1. Introduction
   - 1.1 Brief history of Statistical Design
   - 1.2 Terminology, Experimental Error and Basic Principles
   - 1.3 Uniformity trials and Fertility Contour Maps
   - 1.4 Choice of size and shape of plots and blocks
2. Completely Randomised Design (CRD)
   - 2.1 Structure and Model
   - 2.2 ANOVA
   - 2.3 Advantages, Disadvantages and Uses of CRD
3. Randomised Block Design (RBD)
   - 3.1 Structure and Model
   - 3.2 ANOVA
   - 3.3 Advantages, Disadvantages and Uses of RBD
4. Latin Square Design (LSD)
   - 4.1 Structure and Model
   - 4.2 ANOVA
   - 4.3 Advantages, Disadvantages and Uses of LSD
5. Relative efficiencies of basic designs
6. Analysis under a single missing observation
   - 6.1 Missing Plot technique
7. Balanced Incomplete Block Design
   - 7.1 Incidence Matrix
   - 7.2 Relationship among its Parameters
   - 7.3 Structure and Model
   - 7.4 Intra-Block Analysis
   - 7.5 Definitions and Properties of Symmetric BIBD, Resolvable BIBD and Affine Resolvable BIBD
   - 7.6 Complimentary BIBD, Dual BIBD, Derived BIBD and Residual BIBD
   - 7.7 Relative Efficiency of BIBD compared to RBD
8. Factorial Experiments
   - 8.1 Terminology
   - 8.2 Main effects and interactions
9. 2^n Factorial Designs
   - 9.1 Notation
   - 9.2 Standard order for treatment combinations
   - 9.3 Main Effects and interactions
   - 9.4 ANOVA
   - 9.5 Yates' Algorithm
10. Blocking and Confounding
    - 10.1 Introduction
    - 10.2 Confounding-Complete and Partial Confounding
    - 10.3 Confounding the 2^n (n=5) factorial designs in Two Blocks and Four Blocks
    - 10.4 ANOVA
    - 10.5 Analysis of a Single Replicate for two level factorial designs
11. Fractional Factorial Designs
    - 11.1 Two Level Fractional Factorial Designs (2^{n-k}; $n \leq 5$, $k \leq 2$)
    - 11.2 Concepts - Word, Defining Relation, Principal and Complimentary Fractions, Aliases and Alias Structure

11.3 Resolution of a design
11.4 Construction of Resolution III, IV and V designs

12 Split Plot Designs
12.1 Structure and Model
12.2 Comparison with Factorial designs
12.3 Partition of the total variation and ANOVA table
12.4 Expectations of various mean sum of squares

13 Response Surface Methodology
13.1 Experimental Designs for fitting Response Surfaces
13.2 Designs for First-Order Model-2^n factorial and its fractions
13.3 Designs for Second-Order Model-CCD

WEEK-WISE DETAILS

Week 1: Introduction

- Montgomery, D.C. (2007): *Design and Analysis of Experiments,* 5th Edition, John Wiley and Sons. pp 11-13
- Mukhopadhyay, P. (2011): *Applied Statistics*, Revised reprint, Books and Allied (P) Ltd. pp. 105-111
- Gomez, K.A. and Gomez, A.A. (1984): *Statistical Procedures for Agricultural Research*, Wiley. pp. 480-488

Week 2: CRD and RBD

- Montgomery, D.C. (2007): *Design and Analysis of Experiments*, 5th Edition, John Wiley and Sons. pp.63-70, 75-76, 126-131

Week 3: Latin Square Design

- Montgomery, D.C. (2007): *Design and Analysis of Experiments*, 5th Edition, John Wiley and Sons. pp.144-146
- Joshi, D.D. (1987): *Linear estimation and Design of Experiments*, reprint 2003, John Wiley and Sons. pp.115-118

Week 4: Relative efficiencies of the basic designs

- Joshi, D.D. (1987): *Linear estimation and Design of Experiments*, reprint 2003, John Wiley and Sons. pp.109-111, 125-126

Week 4-5: Analysis under single missing observations

- Montgomery, D.C. (2007): *Design and Analysis of Experiments,* 5th Edition, John Wiley and Sons. pp.139-140, 148

Week 6-7: Balanced Incomplete Block Designs

- Joshi, D.D. (1987): *Linear estimation and Design of Experiments*, reprint 2003, John Wiley and Sons. pp. 142-147, 167-170 (complements and Problems 1. 3.(a)-(c), 4., 5.)
- Das, M.N. and Giri, N.C. (1986): *Design and Analysis of Experiments*, 2nd Edition, New Age International (P) Ltd. pp. 204-206, 211-212, 224

Week 7-8: Factorial Experiments, 2^n Factorial Design

- Montgomery, D.C. (2007): *Design and Analysis of Experiments*, 5th Edition, John Wiley and Sons. pp 170-175,218-223

Week 9-10: Blocking and Confounding

- Montgomery, D.C. (2007): *Design and Analysis of Experiments*, 5th Edition, John Wiley and Sons. pp. 287-293, 296-297, 299-302

Week 10: Fractional Factorial Designs

- Montgomery, D.C. (2007): *Design and Analysis of Experiments,* 5th Edition, John Wiley and Sons. pp. 303-308, 317-319

Week 11: Split Plot Designs

- Dean, A. and Voss D. (1999): *Design and Analysis of Experiments,* Springer International Edition, Springer. pp.675-680

Week 12: Response Surface Methodology

- Montgomery, D.C. (2007): *Design and Analysis of Experiments*, 5th Edition, John Wiley and Sons. pp. 427-429 (till 11-2), 455-456

Practical/ Lab work

LIST OF PRACTICALS

1. Analysis of a CRD
2. Analysis of an RBD
3. Analysis of an LSD
4. Analysis of an RBD with one missing observation
5. Analysis of an LSD with one missing observation
6. Intra Block analysis of a BIBD
7. Analysis of 2^2 and2^3 factorial in CRD and RBD
8. Analysis of 2^2 and2^3 factorial in LSD
9. Analysis of a completely confounded two level factorial design in 2 blocks
10. Analysis of a completely confounded two level factorial design in 4 blocks
11. Analysis of a partially confounded two level factorial design
12. Analysis of a single replicate of a 2^n design
13. Analysis of a Split Plot design
14. Analysis of a fraction of 2^n factorial design