Experimental Design

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Class hours:  Thursday 1:00-4:00pm
Office hours: Thursday 4:00-5:00pm

Description: Basic principles of design: randomization, treatment comparisons, estimations of variance components, intraclass correlation coefficient (ICC), RCBD, Latin square, split-plot experiments, mixed model, designs of clinical trials, design of cancer clinical trials, observational study and survey design. (3G credits)

No required text book

Student Evaluation
Student’s evaluation is based on the lectures
Class participation (10%)
4 assignments (40%)
1 project with presentation (50%)

1. Introduction (1 week: Aug. 27)
   1.1 Why we should care about design
   1.2 Define hypothesis
   1.3 Research design principles
2. Completely randomized design (CRD) and treatment comparisons (1 week: Sep. 3)
   2.1 Analysis of variance table
   2.2 Tests of hypotheses
   2.3 Advantages and disadvantages of CRD
   2.4 Family-wise Error rate (FWER)
   2.5 Comparison of all treatment with a control
   2.6 Pairwise comparison of all treatments
3. Experiments to study variance (1 week: Sep. 10)
   3.1 Random effects vs. fixed effects
   3.2 Estimates of variance components
   3.3 intraclass correlation coefficient
   Assignment 1 due on Sep. 17
4. Factorial treatment designs (1/2 week: Sep. 17)
   4.1 Why we need factorial designs
4.2 Three type of treatment factor effects
4.3 Statistical model

5. Block design (1 week: Sep. 17, 24)
   5.1 Advantages and disadvantages of blocking
   5.2 How to select blocks
   5.3 Latin square design
   5.4 In complete block design

6. Split-plot design (1/2 week: Sep. 24)
   Assignment 2 due on Oct. 1

7. Designs of clinical trials (2 week: Oct. 1, 8)
   7.1 Introduction (phase, blinding)
   7.2 Parallel group design
   7.3 Cluster randomized design
   7.4 Crossover design
   7.5 Group sequential design
   7.6 Adaptive design

8. Designs of cancer clinical trials (1 week: Oct. 22)
   8.1 Introduction
   8.2 3+3 design
   8.3 Continual reassessment method
   8.4 mTPI method
   Assignment 3 due on Oct. 29

9. Survey and Sampling Design (2 weeks: Oct. 29, Nov. 5)
   9.1 Sampling methods
   9.2 Questionaire and measurements
   9.3 Missing observations and imputation
   9.4 Survey analysis and computation

10. Design of Observational Studies (1 week: Nov. 12)
    10.1 Observational study vs. interventional study
    10.2 Types of observational studies
    10.3 Longitudinal setting in the observational studies
    10.4 Biasness, confounding, propensity score and multivariate matching
    Assignment 4 due on Nov. 19

11. Student Presentations (Nov. 19, Dec. 3)
    Project due on Dec. 10