Experimental Design

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Class hours: Thursday 1:00-3:30pm
Office hours: Thursday 3:30-4:30pm

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, precision medicine, multiple testing for multiple endpoints, 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. 30)
   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. 6)
   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. 13)
   3.1 Random effects vs. fixed effects
   3.2 Estimates of variance components
   3.3 Intraclass correlation coefficients
   Assignment 1 due on Sep. 21
4. Factorial treatment designs (1/2 week: Sep. 20)
   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. 20, 27)
   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. 27)
   Assignment 2 due on Oct. 4
   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
   8.1 Introduction
   8.2 3+3 design
   8.3 Continual reassessment method
   8.4 mTPI method
9. Precision medicine (1 week: Nov. 1)
   9.1 Introduction
   9.2 Subgroup analyses
   Assignment 3 due on Nov. 8
10. Multiple testing for multiple endpoints in clinical trials (1 week: Nov. 8)
    10.1 Introduction of Multiple Testing Problem
    10.2 Classic Multiple Testing Methods Based on Family-wise Error Control
    10.3 Weighted Parametric Multiple Testing Methods
    10.4 Comparison of Weighted Parametric Multiple Testing Methods
11. Survey and sampling design (1 weeks: Nov. 15)
    11.1 Sampling methods
    11.2 Questionaire and measurements
    11.3 Missing observations and imputation
    11.4 Survey analysis and computation
12. Design of observational studies (1 week: Nov. 29)
    12.1 Observational study vs. interventional study
    12.2 Types of observational studies
    12.3 Longitudinal setting in the observational studies
    12.4 Biasness, confounding, propensity score and multivariate matching
    Assignment 4 due on Dec. 6
13. Student Presentations (Dec. 6, 13)
Project due on Dec. 13