# Philadelphia University

## Experimental Design

Faculty: Science

Department: Mathematics

Module Name: Experimental Design

Module Number: 250331

Level: 3

Credit Hours: 3 credit hours

Prerequisite /Co-Requisite: math 210231

Lecturer: Associate Professor Dr. Jaffar Almousawi

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Module Coordinator: Dr. Jaffar Almousawi

Aims (Module Purpose)

This course is designed to introduce the student to the basic ideas of experimental design and accompanying analysis. It also enriches student's knowledge and understanding of the statistical methods as it pertains to the design and analysis of experiments. Emphasis will be on conceptual understanding and application to practical problems. Students completing the course are expected to be knowledgeable in the basic experimental designs. Materials covered in the course include Introduction to Statistics and Data Analysis, Inferential Data Analysis for Simple Experiments, One Factor Designs, One Factor Blocking Designs, Latin Square Designs, Two- and General Factor Factorial Experimental Designs, $2^K$ Factorial Designs.

Learning Objectives

Upon completion of this course, the student will

1. save resources by eliminating unnecessary factors
2. know the components of an experiment, including treatments, controls, replication, experimental units, and blocking.
3. understand statistical principles important in the design and interpretation of experiments.
4. be familiar with fundamental experimental designs such as completely randomized, randomized blocks, factorial, Latin squares and other designs.
5. be able to design experiments of sufficient power that uses resources efficiently

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Faculty: Science

Department: Basic Sciences

Module Name: Experimental Design

Module Outlines

| Week | Day | Subject |
|---|---|---|
| (1) | | Introduction to statistics and data analysis: Introduction, How statistical reasoning works, What is Statistics? Simple Random Sample, Sample Mean, Median, Rang, Variance, Coefficient of Variation, Standard Error, Graphical Representation of Data, Dotplot, Boxplot, Getting a Summary Using MINITAB The Normal Distribution Within Data Analysis, Outliers in Data |
| (2)–(3) | | Inferential Data Analysis for Simple Experiments: Basic Concepts, Statistical Inference, Point and Interval Estimations, Hypotheses Test, Test Statistic, Rejection and Nonrejection Regions, Significance Level, The p value Approach, Inference Methods for the Two Sample Studies, Getting Descriptive Statistics and Plots Using MINITAB, Test for Means and Variability |
| (4)–(5) | | The Paired Comparison Testing, t test for mean difference, Confidence Interval for Mean Difference, Sample Size Estimation In Design Planning Sample Size Estimation for Two Sample Studies, Sample Size Estimation for Paired Sample Studies |
| (6)–(7) | | One Factor Designs, Introduction, Randomization, replication, and blocking, ANOVA METHODS, Completely Randomized Design (CRD), Design Structure, Model for the Measured Response, Assumptions, Exploratory Data Analysis (EDA), CRD Using MINITAB |
| (8) | | ANOVA for CRD, Hypotheses, The Sum of Squares Identity, The ANOVA Table, Graphical Checks to Assess Model Assumption |
| (9)–(10) | | One Factor Blocking Designs, Introduction, Completely Randomized Block Design (CRBD), Design Structure, Model for Measured Response, Assumptions, Exploratory Data Analysis (EDA) , ANOVA Principle for CRBD, The Sum of Square Identity, The ANOVA Table, ANOVA Table Using MINITAB, Tests on Individual Treatment Means, Residual Analysis and Model Checking |
| (11) | | Latin –Square Designs, Model for the Measured Response, Hypotheses, EDA ANOVA Principle for LS Designs, The ANOVA Table, Latin Square Design Using MINITAB |
| (12)–(13) | | Factorial Experimental Designs, Introduction, Main Effects and Interaction, Two–Factor Factorial Experiments, Design Structure, Model for Measured Response, Hypotheses, The Sum of Squares Identity for a Two–Factor Factorial |
| (14) | | Factorial Experimental Designs, The ANOVA Table, Diagnostic Checking, the General Factorial Experiment |
| (15)–(16) | | $2^K$ Factorial Design for $K \geq 2$: Introduction, The $2^2$ Design, Main Effects and Interaction, Contrasts, Sums of Squares, The ANOVA table, Residual Analysis, The $2^3$ Design, Main Effects and Interactions, Sums of Squares, The ANOVA Table, Residual Analysis |

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## Modes of Assessment

| Mode of Assessment | Weight | Date |
|---|---|---|
| First test | 20% | |
| Second Test | 20% | |
| Homework assignments | 10% | |
| Final (Comprehensive; written) | 50% | |

- Make-up exams will be offered only for valid reasons with consent of the dean.
- Make-up exams may be different from regular exams in content and format.

## Attendance Policy

Lecture attendance is expected. The course notes and textbook are not comprehensive. Additional materials will be covered in lecture. Students are responsible for all materials covered in lectures.

## Expected Workload

On average, you should expect to spend at least (9) hours per week on this module.

## Textbook(s) and Supporting Materials

Textbook:

Title: Experimental Design Techniques in Statistical Practice (1998)
Author: Gardiner and Gettinby
Publisher: Horwood
ISBN: 1-898563-35-7

Reference (1):

Title: Applied Statistics and Probability for Engineers
Author: Montgomery and Runger
Publisher: John Wiley & Sons
ISBN: 0-471-17027-5

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Reference (2):

Title: A MINITAB GUIDE TO STATISTICS
Author: Meyer and Krueger
Publisher: Prentice Hall
ISBN: 0-13-784232-5

Website of Interest: