DIRE DAWA UNIVERSITY

COLLEGE OF NATURAN AND COMPUTATIONAL SCIENCE

DEPARTMENT OF STATISTICS

COURSE OUTLINE

Design and Analysis of Experiments (Stat3042)

Course Guide Book

Course Titles/Code: Design and Analysis of Experiments

(Stat3042) Credit: 7 ECTS

Credit hours: 4hrs (4hrs lecture +1hrs tutorial+2hrs Lab)

Module title/code: Statistical Modeling I (Stat-M3041)

Course Type: Core Prerequisite(s):

Academic **Year:2017**

Semester: **I**

Instructor Name: **Mr Ahmed A(M.sc)**

Length of time to complete the course: 16 Weeks

Student's workload					
Lecture	Tutorial	Assessment	Lab	Home Study	Total
64	16	15	32	35	162

Course description

Introduction; Simple comparative experiments; Single factor ANOVA; More about single factor experiment; Randomized blocks, Latin squares, and Related designs; Factorial designs; The 2^K factorial design; More on 2^K factorial designs: Blocking, confounding and fractional designs; Nested and Split plot designs; Analysis of covariance.

Objective

The objective of this course is to present the theoretical foundation of several experimental designs along with respective statistical analysis as applied in several scientific studies.

Learning outcomes

At the end of the course students are expected to:

- define basic concepts of experimental design including experimental units, randomization, replication, control, factor, treatments etc.,
- identify the principles for the application of different experimental designs including Complete Randomization, Randomized Block, Latin Square, Split Plot, Nested, Factorial, Fractional Factorial designs etc.,
- define the statistical models and hypothesis tests for different experimental designs,
- derive test procedures and computational formulas for hypothesis tests in experimental studies, perform statistical analysis (including multiple comparison test) and construct ANOVA/ ANCOVA tables for different experimental designs, apply blocking and confounding design techniques in the 2^K factorial design,
- use appropriate statistical software for the statistical analysis,

Course outline:

1. Introduction (4 lecture hours)
   1.1 Strategy of experimentation
   1.2 Some typical Applications of Experimental Designs
   1.3 Guidelines for Designing Experiments
   1.4 Basic principles
2. Review of Simple Comparative Experiments (4 lecture hours)
   2.1 Inference about the difference in means
   2.2 Inferences about the variances of normal distribution

3. Completely randomized design: Single factor Analysis of Variance (14 lecture hours)
    3.1 Introduction
    3.2 The analysis of variance
        3.2.1 Decomposition of the total sum of squares
        3.2.2 Statistical analysis
        3.2.3 Estimation of the model parameters
        3.2.4 Unbalanced data
        3.2.5 Model adequacy checking
    3.3 Interpretation of results
        3.3.1 Comparison among treatment means
        3.3.2 Graphical comparison of means
        3.3.3 Contrasts
        3.3.4 Orthogonal contrasts
        3.3.5 Comparing pairs of treatment means
        3.3.6 Comparing treatment means with control
    3.4 Distribution property of the components of the total variation.
    3.5 More about single factor experiment
        3.5.1 Choice of sample size: Operating characteristic curves
        3.5.2 Fitting response curves
        3.5.3 Least square estimation of the model parameters
        3.5.4 Repeated measures
    3.6 Regression approach to ANOVA
4. Block Designs (8 lecture hours)
    4.1 Randomized Block Design
        4.1.1 Why Blocking?
        4.1.2 Statistical analysis (Model, Test procedures, Computational formulas, ANOVA table, and multiple comparisons)
        4.1.3 Missing Data
        4.1.4 Model adequacy checking
    4.2 Latin squares, and Related Designs
        4.2.1 The Latin square design (design, statistical analysis)
        4.2.2 The Graeco-Latin square design (design, statistical analysis)

4.2.3 Balanced incomplete block design (design, statistical analysis)

5. Factorial Designs (20 lecture hours)
   - 5.1 Basic definitions and principles
   - 5.2 The advantage of factorial designs
   - 5.3 The two factor factorial design (with and without interaction)
     - 5.3.1 Two factor design without interaction
     - 5.3.2 Two factor design with interaction
   - 5.4 The three factor factorial design
   - 5.5 Blocking in a factorial design
   - 5.6 Unbalanced data in a factorial design
   - 5.7 The 2^k factorial design
     - 5.7.1 Introduction
     - 5.7.2 The 2^2 design
     - 5.7.3 The 2^3 design
   - 5.8 Blocking and confounding in 2^2 and 2^3 designs
6. Nested and Split Plot Designs (6 lecture hours)
   - 6.1 The two-stage nested designs
   - 6.2 The split plot design
   - 6.3 The split-split plot design
7. Analysis of Covariance (ANCOVA) (8 lecture hours)
   - 7.1 Introduction
   - 7.2 ANCOVA for completely randomized design
   - 7.3 ANCOVA for blocked randomized design

Textbook

Montogomery, D.C. (2013). Design and Analysis of Experiments (8^{th} Edition).

John Wiley & Sons Inc

References

1. Montogomery, D.C. (1997). Design and Analysis of Experiments (5^{th} Edition). John Wiley & Sons Inc.
2. Kuehl R. O. (2000). Design of Experiments: Statistical Principles of Research Design and Analysis, 2nd Ed. Duxbury press.

3. Winner B. J (1971). Statistical Principles in Experimental Design (2nd Edition).
4. Hicks C. R. and Turner K. V. (1999). Fundamental Concepts in the Design of Experiment (5th Edition).
5. Anderson, V. L., and McLean, R. A. (1974). Design of Experiments. Marcel Dekker, New York.
6. . Gill, J. L. (1978). Design and Analysis of Experiments in the Animal and Medical Sciences. Vol 1. Iowa State University Press, Iowa.
7. Lindeman, H. R. (1974). Analysis of Variance in Complex Experimental Designs. W. H. Freeman, San Francisco.
8. Ogawa, J. (1974). Statistical Theory in the Analysis of Experimental Design. Marcel Dekker, New York.
9. Raktoe, B. L., Hedayat A. and Federer W. T. (1981). Factorial Designs. Wiley, NewYork.

Teaching and Learning Methods

Lectures, assignments and computer labs

Modes of Assessment

Continuous Assessment	50%
Final Exam	50%
Total	100%

Method	Assignment	Test	Quiz	Final
Percent	20	20	10	50
Frequency	2	2	2	1