ROWAN UNIVERSITY
Department of Mathematics Syllabus
STAT 02.371 – Design of Experiments: Analysis of Variance

CATALOGUE DESCRIPTION:

STAT 02.371 –Design of Experiments: Analysis of Variance

(Prerequisites: STAT 02.360 Probability and Random Variables, MATH 01.210 Linear Algebra, and one of STAT 02.261 Statistics II or STAT 02.361 Mathematical Statistics, or permission of instructor) Students will gain an understanding of the major theoretical and practical concepts in the design of experiments using the statistical technique called the analysis of variance (ANOVA). After a brief review of t-tests, the concept of power and the minimum number of experimental trials to achieve that power will be discussed. With this motivation for careful design as background, students will be introduced to the following aspects of the design of experiments: one-, two- and multi-way ANOVA, multiple comparisons and checking assumptions; blocking in designs including the Latin square; factorial designs with confounding and blocking; 2^k and 3^k designs, with fractions and blocking; random vs. fixed factors and expected mean squares; nesting, and "split-plots." Although the analysis of the designs will be presented in an applied manner using statistical software and examples from industry and science, the notions of estimability and the origin of the estimators will require knowledge of elementary matrix theory.

OBJECTIVES:

Students will:
a) Gain an understanding of the theoretical and practical aspects of the design of experiments using the statistical techniques known as the analysis of variance (ANOVA), and see its relevance in a wide range of applications.
b) Gain a strong foundation for the basics of statistical experimental designs using the ANOVA.
c) Work on problems of various degrees of complexity.
d) Use computer software to develop experimental designs and to perform the analyses of the designs using the techniques of ANOVA.
e) Be prepared to use statistics and ANOVA experimental design techniques in industrial and scientific applications.

CONTENT:

1. Preliminaries
    a) Introduction to comparative experiments
    b) Power in the one-sample z-test
    c) Power & finding the sample size in the two-sample t-test
2. One-way analysis of variance (ANOVA), and
    a) Analysis
    b) Checking model adequacy
    c) Power & sample size
3. Matrix theory
    a) Simple linear regression, least squares and the matrix solution
    b) One-way ANOVA and estimability
4. Blocking
    a) Randomized complete block design (including estimability)
    b) Latin squares (including estimability)

5. Factorial designs
    a) Two-factors and interaction
    b) General factorial
    c) 2^k designs
    d) Blocking and confounding in 2^k designs
    e) Fractional 2^k designs and resolution
    f) 3^k designs
    g) Blocking and fractions in 3^k designs
6. Experiments with random factors
    a) Rules for expected mean squares
    b) Approximate F-tests
    c) Restriction errors for blocking
    d) Nesting
7. Split-plot designs

POSSIBLE TEXTS:

Cobb, G.W.; Introduction to Design and Analysis of Experiments; Springer, 1998.

Kuehl, R. O.; Design of Experiments: Statistical Principles of Research Design and Analysis, 2nd edition; Duxbury/Thomson, 2000.

Lorenzen, T.J, and Anderson, V.L.; Design of Experiments: A No-Name Approach; Dekker, 1993.

Montgomery, D.C; Design and Analysis of Experiments, 7th edition; Wiley, 2009.

Oehlert, G.W.; A First Course in Design and Analysis of Experiments; Freeman, 2000.

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