Southern Connecticut State University
School of Arts and Science
Department of Mathematics

Mathematics 527 – Design of Experiments

I. Description.

Catalog Description: The course introduces the fundamental concepts in the design of experiments and categorical data analysis: review of statistical inference, completely randomized designs, randomized block designs, Latin Square designs, factorial experiments, confounding and fractional replications, analysis of contingency tables, and tests for independence.

Departmental Description: The course is meant to be a continuation of a statistical class, which covered statistical inference. Some theory will be presented, but the class should focus on applying statistical techniques to designing and analyzing experiments. A statistical software package is required.

II. Credit.

Mathematics 527 carries 3 semester-hours of University credit.

III. Prerequisites.

Mathematics 527 has a prerequisite of a grade of C- or better in MAT 525 (Probability and Statistics I) or equivalent.

IV. Purpose.

To introduce students to the essential ideas of planning, designing, analyzing and interpreting the results of experimental data, including underlying assumptions, strengths and limitations of these procedures.

V. Format.

Mathematics 527 may follow a lecture format with homework assignments. Use of a computer package is required. A computer lab session is recommended. The course may also be offered as a hybrid course, where some sessions meet virtually.

VI. Outline. (Assuming 42 hours less 6 hours for exams/review in addition to the Final exam for a total of 36 hours)

A. Review of Basic Probability and Statistics: (2 Hours 6%)

1. Treatment of Data Frequency Distributions, Histograms
2. Descriptive Measures: Central Tendency, Variation, Percentiles.
3. Conditional Probability
4. Confidence Intervals for one sample
5. Hypothesis Testing for one sample

B. Statistical Inference of Two Samples (4 Hours 11%)

1. Populations means
2. Matched Paired Inferences
3. Population Proportions
4. Population Variances

C. Planning Experiments (3 hours 8%)

1. Principles of planning
2. Experimental Error
3. Plot techniques
4. Classifying experimental designs

D. Analysis of Variance (ANOVA): (10 hours 28%)

1. ANOVA tables
2. Multiple Comparisons in ANOVA
3. ANOVA as a model
4. Random Effects
5. Power and sample size calculations

E. Multifactor Analysis of Variance: (13 hours = 36%)

1. Randomized Block Designs
2. Two-Factor Designs without replication
3. Two-Factor Designs with replication
4. Multiple Comparisons
5. Factorial Designs
6. Analysis of Covariance
7. Latin Squares Designs
8. Graeco-Latin Squares Designs

F. Categorical Data Analysis: (4 hours = 11%)

1. Contingency Tables
2. Tests of Independence

VII. Objectives.

Students in MAT 527 should achieve several objectives. These objectives, provided by the Mathematics Department are listed below. Also listed are the topics from Section VI which satisfy the objectives.

Mathematics Department Objectives

1. Demonstrate that they can model and solve problems that represent a wide variety of realistic applications. (Applied Math Goal 1, Topics D and E)
2. Appreciate the beauty, joy, and challenge in mathematics and experience mathematics as an engaging field with contemporary open questions. (Department Goal 8, Topics D, E and F)
3. Think analytically and critically and be able to formulate problems, solve them, and interpret their solutions. (Department Goal 9, Topics D, E and F)

Students successfully completing MAT 527 will be able:

To recognize and understand the difference between designed experiments and observational studies
To create, utilize, analyze and interpret ANOVA tables for one-factor designs
To utilize and interpret multiple-comparison techniques for one-way ANOVA
To create, utilize, analyze and interpret ANOVA tables for randomized block designs
To create, utilize, analyze and interpret ANOVA tables for two-factor completely randomized designs (with and without replication)
To design, analyze and interpret experiments for the difference between means, using Analysis of Covariance
To calculate and interpret categorical data analysis, such as Test for Independence
To identify and explain the limitations of the statistical procedures they use.

VIII. Sample Texts.

Devore Jay L., Probability and Statistics for Engineering and the Sciences, Eighth Edition, Thomson, USA, 2010

IX. Waiver Policy.

Mathematics 527 cannot be waived.

X. Bibliography.

Box George, Hunter William and Hunter J. Stuart, Statistics for Experimenters, John Wiley and Sons, New York, 1978

Montgomery Douglas C, Design and Analysis of Experiments, John Wiley and Sons, New York, 1997

Ott R. Lyman and Longnecker Michael, An Introduction to Statistical Methods and Data Analysis. Duxbury Press, Albany, NY 2001.

Wu Jeff and Hamada Michael, Experiments, John Wiley and Sons, New York, 2000

XI. Prepared.

January 2014

XII. Preparer.

Raymond Mugno