WINONA STATE UNIVERSITY

COLLEGE OF SCIENCE AND ENGINEERING

DEPARTMENT OF MATHEMATICS AND STATISTICS

**Course Outline – STAT 365**

**Title:** Experimental Design and Analysis

**Number of Credits:** 3

**Catalog Description:** One-way Analysis of Variance, planned comparisons, post-hoc procedures, two- and three-way Analysis fo Variance, experimental design, Analysis of Covariance. Interpretation of computer output will be emphasized. Prerequisites: STAT 310 or ECON 322 – Intermediate Statistics for Business and Economics. Offered Yearly.

**Possible Textbooks:**

* *Design of Experiments: Statistical Principles of Research Design and Analysis*, 2nd Edition by Robert O. Kuehl.

**Topics Covered:**

1. Introduction to Designed Experiments
   1. Controlling variability
   2. Randomization
2. One-way ANOVA
   1. Completely randomized design
   2. Planned contrasts and post-hoc procedures
   3. Inference, diagnostics and remedial measures
   4. Power and sample size
3. Factorial Designs
   1. Simple and main effects
   2. Interaction effects and interaction plots
   3. ANOVA and F-test for balanced designs
   4. Model diagnostics
   5. Designs with three factors
4. Block Designs
   1. How blocks can provide increased power
   2. Choosing a blocking variable
   3. ANOVA
   4. Model diagnostics
5. Analysis of Covariance
   1. How ANCOVA can provide increased power
   2. Choosing the covariate
   3. Inference, diagnostics and remedial measures
   4. The statistical model for a 22 factorial experiment
   5. Multiple comparisons ( both when interaction is significant and is not significant)
6. Random Effects and Mixed Models
   1. Random vs. Fixed factors, One-way ANOVA
   2. Random vs. Fixed factors vs. Mixed factors, Two-way ANOVA
   3. Inference and variance component estimation
   4. Diagnostics and remedial measures
7. Nested Designs
   1. Crossed vs. nested factors
   2. Repeated measures
   3. Split-plot design and analysis
   4. Diagnostics and remedial measures

**Listing of Sections to be Covered:** Not applicable to this course, since there is no standard textbook. Chosen sections of any text should correspond to the topics outlined above.

**Remarks:** None.

**Approximate Pace of Coverage:** Not Applicable.

**Method of Instruction:** Methods may include lecture, case studies, discussion, group work, problem solving sessions, computer sessions, and discussion of computer output.

**Evaluation Procedure:** Assessments will vary in style and may include written exams, quizzes, homework assignments, labs, and group projects.

**Minnesota Transfer Curriculum:** None

**MnSCU Learning Outcomes:**

* This course will promote a student’s ability to correctly design and experiment applying the concepts of control, replication and randomization. A successful student will be able to decide what type of design is appropriate for a given study and work with researchers from other disciplines to develop a well-designed experiment.
* This course will promote a student’s ability to select appropriate statistical techniques for analysis of results. A successful student will be able to discuss the design of an experiment in detail and carry out an appropriate analysis. Moreover, a successful student will be able to distinguish well-designed experiments from poorly designed studies.
* This course will promote a student’s ability to record, process and critically analyze experimental data using statistical software. A successful student will be able to use the statistical software packages SAS and JMP to conduct appropriate data analyses.
* This course will promote a student’s ability to report and communicate conclusions effectively, and present findings in formats suitable for communicating to technical audiences. A successful student will be able to communicate the essential features of the data in a style that would be acceptable to a research journal. A successful student will also be able to provide appropriate interpretations and conclusions of experiments on almost all problems in class, on homework and on exams.

**Possible Computer Software:**

* JMP
* R
* SAS

**Last Revised:** Fall 2012 by the Statistics Subgroup.