WINONA STATE UNIVERSITY

COLLEGE OF SCIENCE AND ENGINEERING

DEPARTMENT OF MATHEMATICS AND STATISTICS

**Course Outline – STAT 321**

**Title:** Industrial Design of Experiments I

**Number of Credits:** 3

**Catalog Description:** An introduction to applications of statistical methods used by industrial researchers to aid in the solution of certain types of industrial problems. Methods to include analysis of means, analysis of variance, factorial designs, and fractional factorial (screening) designs. There will be industrial case studies and actual (hands on) experience at local industries (when available). Offered spring semester Prerequisite: An introductory statistics course, preferably STAT 303 Engineering Statistics or STAT 210 Statistics

**Possible Textbooks:**

* *Design of Experiments: Statistical Principles of Research Design and Analysis by R. O. Kuehl, 2nd Edition, 2000, Brooks/Cole*
* *Statistical Design and Analysis of Experiments, with Applications to Engineering and Science, by Mason, Gunst & Hess, 2nd Edition, 2003, Wiley*
* *Experiments Planning, Analysis, and Optimization, by Wu and Hamada, 2nd Edition, 2009, Wiley*

**Topics Covered:**

1. Introduction to Designed Experiments
   1. Basic definitions (e.g., response, factors, levels)
   2. Discussion of replication, randomization and controlling variability
2. Review of Statistical Inference ~ Simple Comparative Experiments
   1. Inference for comparing two population means
   2. Confidence intervals for a difference in two population means
3. Single Factor Experiments
   1. Idea behind ANOVA
   2. The statistical model for a single factor experiment
   3. Checking model assumptions
   4. Multiple comparison procedures and contrasts
   5. Power and sample size
4. Randomized Block Designs
   1. ANOVA
   2. The statistical model for an experiment with a blocking factor
   3. Checking model assumptions
5. 22 Factorial Designs
   1. The concept of main effects
   2. The concept of interaction
   3. ANOVA
   4. The statistical model for a 22 factorial experiment
   5. Multiple comparisons ( both when interaction is significant and is not significant)
6. 2k Factorial Designs
   1. ANOVA
   2. The statistical model for a 2k factorial experiment
   3. Multiple comparisons (both when higher-order interactions are and are not significant)
   4. Screening designs
   5. Making predictions with a fitted model for screening designs
   6. Randomized complete blocks with 2k designs
   7. Unreplicated 2k designs
7. Blocking and Confounding in 2k Designs
8. Fractional Factorial Designs
   1. Design Resolution
   2. Aliasing
9. Designs with Random Effects
   1. Random block effects
   2. Factorial designs with random factors
10. Nested Designs
11. Taguchi Designs (time permitting)

**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 an 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. In addition, a successful student will be able to develop a well-designed experiment to address industrial problems.
* 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 for several real-world experiments. Also, 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. Minitab will be used almost exclusively for data analysis in this course.
* 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 clear and concise manner. Also, a successful student will be able to provide appropriate interpretations and conclusions of experiments on almost all problems in class, on homework and on exams.

**Possible Computer Software:**

* Minitab
* Design Expert

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