Program Cover Document --- STA 303: Design of Experiments

I. Basic Course Information

STA 303 is an upper level statistics option, both for BS statistics majors and statistics minors. It is a required course for the BA Applied Statistics program. It will be scheduled for two 80-minute lecture periods per week. It has STA 115 or STA 215, and MAT 125 or MAT 127 as prerequisites.

II. Learning Goals

The American Statistical Association's guidelines for undergraduate programs in statistical science state that such programs should "emphasize concepts and tools for working with data and provide experience in designing data collection and in analyzing real data that goes beyond the content of a first course in statistical methods." More specifically, they recommend that programs should provide statistical topics that include the design of studies such as random assignment, replication, blocking, analysis of variance, fixed and random effects, and diagnostics in experiments. They emphasize that programs should require familiarity with a standard statistical software package.

Experiments are performed by investigators in virtually all fields of inquiry, usually to discover something about a particular process or system. An experiment can be defined as a series of tests in which purposeful changes are made to input variables of a process or system so that we may observe and identify the reasons for any changes that may be witnessed in the output response. Statistical design of experiments refers to the process of planning the experiment so that appropriate data that can be analyzed by statistical methods will be collected, resulting in valid and objective conclusions. The statistical approach to experimental design is necessary if we wish to draw meaningful conclusions from the data. Indeed, when the problem involves data that are subject to experimental errors, statistical methodology is the only objective approach to analysis. This course will cover the two primary aspects to any experimental problem: the design of the experiment itself and the statistical analysis of the resulting data.

STA 303 will equip students with skills in designing and analyzing experiments that they can utilize and build on in flexible ways at both graduate school and in future employment. It will emphasize real data and authentic applications, and will present data in a context that is both meaningful to students and indicative of the field of science underlying the data. The course will encourage synthesis of theory, methods and application, and will include extensive experience with statistical computing. There will be frequent opportunities to develop communication skills through in-class presentations of project work. Students will also see how the design of experiments fits into the broader process of research and decision making.

On completion of this course students should have achieved the following learning goals:

(i) A clear understanding of the theoretical development of statistical techniques for design and analysis.
(ii) The selection of appropriate techniques in given contexts.
(iii) The skills to design experiments and apply correct statistical procedures to a wide variety of real-life problems.
(iv) The ability to clearly compare and contrast the advantages and disadvantages of the different experimental approaches.
(v) The practice of assessing the reasonableness of analytic results.
(vi) The ability to provide correct interpretations of results and graphical output, and to recommend appropriate decisions.
(vii) The possession of strong computing skills and familiarity with statistical software for analysis of experiments.
(viii) The possession of skills directed to the communication of statistical results to a variety of audiences.

III. Student Assessment

Students will receive regular feedback on their work through the assignment of homework, quizzes, student presentations and examinations. Through this feedback, students will be able to see and correct their misunderstandings and improve their performance. Student performance on these assessment instruments and the performance of students in their statistics options will be used to assess the success of Design of Experiments in achieving its learning goals and its contribution to the fulfillment of the MATC course program goals. Peer reviews and student evaluations will also be used to evaluate the course.

IV. Learning Activities

Learning activities will consist of a combination of lectures, group work, student presentations and computer assignments. The specific choice will depend upon the individual instructor. Outside class, students are expected to do a significant amount of individual and group homework to achieve the learning goals. These learning activities are typical of the learning activities in the MATA, MATT and MATC programs. By giving students a variety of ways and means to conduct statistical analyses, the learning activities promote a deeper understanding of the concepts appropriate to designing and analyzing experiments and contribute to the learning goals of these programs.