

Office of Academic Affairs
Tarleton State University

Master Course Syllabus Outline

Department: Mathematics, Physics, & Engineering

Course Prefix/Number: MAED 540

Official Course Title: **Statistical Reasoning**

Master Syllabus Approved by Department on: **10/1/2007**

I. Catalog Description (50 words; brief synopsis of course content, emphases)

This course focuses on the mathematical foundations of statistical reasoning and sound decision making. Teachers engage in activities and discussions that strengthen their own content knowledge in probability and statistics, enabling them to provide their students with a depth of understanding. The course activities incorporate technology and real-world applications.

II. Prerequisites?

3 hours of undergraduate statistics

III. Expanded Course Description (150 words; primary course content, intended student level and role(s) course is to play in the curriculum.

Course topics will include:

1: Descriptive Statistics

Overview: In this section, teachers investigate the concepts underlying descriptive data analysis. They will identify different types of data and will explore concepts used to characterize quantitative data, including familiar measures of central tendency and spread. The elements of this section are the initial building blocks of probability essential to sound decision-making.

Key Concepts: categorical data, quantitative data, mean or average, variance, standard deviation, median, mode, frequency distribution, frequency plot

2: Experiments

Overview: Teachers investigate the role of well-designed experiments in quantifying the uncertainty inherent in daily decision-making processes. The activities lead teachers in exploring concepts that form the underpinnings of probability.

Key Concepts: experiments, sample points, sample spaces, events and their occurrence, repeated trials, sampling with and without replacement, bias, randomization, Bernoulli trials

3: Probability of an Event

Overview: Teachers use simulations to develop the long-run definition of probability. They will also extend their understanding of the variety of legitimate ways to model realworld situations and describe sample spaces for an experiment.

Key Concepts: long-run definition of probability, mathematical models, simulations, cumulative relative frequency

4: Probability Functions and Laws

Overview: Teachers will review the concept of function and extend that idea to a function whose domain elements are sets, developing the definition and properties of a probability function. The section also develops the important ideas of conditional probability and

independence. Finally, participants will become familiar with the major probability rules useful for computation.

Key Concepts: function, domain, range, sets, set operations, set function, probability function, complementary events, mutually exclusive events, conditional probability, multiplication rule, independent events, complement rule, addition rule.

5: Random Variables

Overview: Teachers will be introduced to the idea of a random variable. The role and importance of random variables are explained and demonstrated using examples that have a probability behavioral structure. Teachers will learn the difference between discrete random variables and continuous random variables. Probability functions and their distributions are defined for discrete random variables. The ideas of expected value and standard deviation of a random variable are developed. The binomial random variable is formally defined.

Key Concepts: cardinality of a sample space, discrete random variables, continuous random variables, distribution of a random variable, expected value, variance, standard deviation, binomial random variable, Bernoulli trial

6: Special Random Variables

Overview: Section 5 was presented without the use of any generalized class of random variable. It turns out that the examples in that section can be modeled as a Binomial random variable. The distribution of a binomial random variable, its expected value and standard deviation are given by formula. Section 6 introduces the binomial random variable and illustrates its use in modeling particular problems. Section 6 also introduces the normal random variable. The normal random variable is a continuous random variable and is the most used and useful model for continuous random variables. The reason for this is the robustness of the distribution and the Central Limit Theorem.

Key Concepts: distribution of a random variable, binomial random variable, normal random variable, Central Limit Theorem

7: Inferential Thinking

Overview: The idea of testing hypotheses based on the occurrence or non-occurrence of rare events is a cornerstone in statistical applications. In applications of inferential thinking, one must understand where statistical inference ends and personal opinion begins. This section introduces teachers to the study of inferential thinking. Decision making in the face of uncertainty is illustrated with examples. Terminology used in testing hypotheses is introduced in context in order to enhance understanding of sophisticated ideas involved in inferential thinking.

Key Concepts: inferential thinking, hypothesis, null hypothesis, alternative hypothesis, reject an hypothesis, Type I error, Type II error, rare event

IV. Intended Student Learning Outcomes? Required; **knowledge outcomes** (what students who successfully complete the course will be expected to know). Optional; **skill outcomes** (what students who successfully complete the course will be able to do). Optional; **value outcomes** (what students who successfully complete the course will value or appreciate).

Knowledge Outcomes:

Upon completion of this course, the student will be expected to:

1. Understand the mathematical concepts within the content.
2. Understand the learning theory and pedagogy related to the content.
3. Make informed decisions about choices of activities and assessment.

4. Use technology appropriate to the content.

And, as recommended by the National Council of Teachers of Mathematics (NCTM) in the Principles and Standards for School Mathematics (2000),

5. Problem Solving:
 - a. Build new mathematical knowledge through problem solving.
 - b. Solve problems that arise in mathematics and in other contexts.
 - c. Apply and adapt a variety of appropriate strategies to solve problems.
 - d. Monitor and reflect on the process of mathematical problem solving.
6. Reasoning and Proof:
 - a. Recognize reasoning and proof as fundamental aspects of mathematics.
 - b. Make and investigate mathematical conjectures.
 - c. Develop and evaluate mathematical arguments and proofs.
 - d. Select and use various types of reasoning and methods of proof.
7. Communication:
 - a. Organize and consolidate their mathematical thinking through communication.
 - b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
 - c. Analyze and evaluate the mathematical thinking and strategies of others.
 - d. Use the language of mathematics to express mathematical ideas precisely.
8. Connections:
 - a. Recognize and use connections among mathematical ideas.
 - b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
 - c. Recognize and apply mathematics in contexts outside of mathematics.
9. Representation:
 - a. Create and use representations to organize, record, and communicate mathematical ideas.
 - b. Select, apply, and translate among mathematical representations to solve problems.
 - c. Use representations to model and interpret physical, social, and mathematical phenomena.

V. Unless otherwise stipulated in this master syllabus by the department, the following items are subject to faculty discretion as described in each faculty member's individual course outline/syllabus:

a) Course Requirements? (grading/evaluation procedures; class attendance policy; term papers, projects, field assignments; examinations; class participation, etc.)

b) Required Text(s)?

c) Bibliography?

Department Head Signature/Date:

_____/_____/_____