MATH 1100

Professor: James J. Madden
Office: Lockett Hall 348 (telephone 578-1580).
Office hours: I will be available in my Lockett Hall office before and after class. Additional office hours will be announced.

Text: Bennett, Briggs and Triola: *Statistical Reasoning for Everyday Life*, Second Edition.
Course Web Site: http://www.math.lsu.edu/∼madden/M1100

Grading: I will keep you informed at all times of the grading requirements, and you will have an "up-to-present" grade at all times which you will be able to get from me. I will also provide anyone who wants it with an estimate of what kind of performance you will have to make on the remaining course work to earn a particular letter grade . I expect your final grade to be based on: 12 homework assignments (25%), 12 quizzes (25%), 2 tests (25%) and a final (25%). The details of this scheme may change, but you will be kept informed well in advance of any modifications.

Some background about this course.

At one time, Math 1100, *The Nature of Mathematics*, was offered primarily as a way for humanities majors to fulfill college requirements. It treated an odd assortment of topics including sets, Venn diagrams, propositional logic and truth tables, combinatorial probability, the concepts of average and standard deviation and a few other things at the choice of the instructor.

In the late 1990s, the course became one of four required courses for all elementary education majors. With this change, the mathematics department began to think more carefully about the content. In 1999, a panel of instructors proposed a model in which the course would be organized around four main topics: I. *The Language of Mathematics*; II. *Probability*; III. *Statistics*; and IV.*Finance*.

Exactly what these categories were to mean was left flexible. *The Language of Mathematics*, for example, could include the topics on set theory and logic that were traditionally part of the course. A more modern course would put the emphasis on *data analysis.* This section would address questions such as: *How is data collected or created? How is it displayed, interpreted and conceptualized? How is it used?* The underlying ideas in logic and set theory that occurred in the old course would still be very much present, but the way they would be treated and discussed would change. For example, in the old design Venn diagrams were treated as a central topic, important for their own sake. In the new course, they would arise in context. Certain kinds of exercises that were popular in the old course would be omitted to make way for material with more immediate relevance to data analysis.

Probability and some selected topics in statistics were always at the center of attention in M1100. They will remain central in the newer versions of the course. These topics play a very important role in the preparation of future teachers, since *Data Analysis and*

Probability is one of the five content standards recommended by the National Council of Teachers of Mathematics (NCTM), and *Measurement*, which is also a topic that is strongly tied in with probability and statistics, is another. (The remaining NCTM content strands are: *Number & Operations*, *Algebra*, and *Geometry*). No other LSU math course taken by elementary education majors centers on data analysis, probability and measurement. Therefore this course has an indispensable role in their training.

While much of the development of this course has been done with the needs of teachers in mind, this course is not a "teacher course" in the outdated, negative sense that that word unfortunately sometimes carries. Courses for teachers are *for teachers* because they meet the highest standards we can design and offer.

Math 1100: Central Concepts

I. Talking and thinking about data

- **A.** What is data? What is it good for? Where does it come from? Data in the news. Experiments and observational studies. Avoiding ambiguity, using valid measures. Inherent uncertainty in all measurements. Displaying and summarizing data: tables, graphs. Using data and drawing conclusions.
- **B.** Variables. Various meanings of the word "variable" (as letter in an equation versus feature of the world); quantitative (discrete and continuous), categorical and boolean variables. Numerous examples.
- **C.** Distributions. Distributions of categorical variables: pie charts and bar charts. Distributions of continuous variables: bar charts, probability density functions; measures of center and variability. Examples. Looking at distributions and drawing conclusions

II. Probability

- **A.** Randomness and relative frequency. Examples of random phenomena (coin flips, games of chance); probability as relative frequency. A selection of misconceptions. Using simulations.
- **B.** The language of probability: Sample space, outcome and events. Independent events, definitions and examples, misconceptions. Conditional probability.
- **C.** The binomial distribution and its meaning in probability. Pascal's triangle; various interpretation of the binomial coefficients. Applications to probability; Galton's Quincunx. From the binomial to the normal distribution

II. Statistics

- **A.** Populations and samples; parameters and statistics. The basic problem of statistics: finding out about populations by studying samples. Introduction of main ideas. Practical considerations. Random samples. Sample size, standard error. Example considered in depth.
- **B.** Polls, surveys; confidence interval and level of certainty. Determining a population percent. Determining a population average. Central limit theorem.
- **C.** Associations between variables, null hypothesis, p-value

IV. Risks and Decisions *(Continued next page ...)*

IV. Risks and Decisions

A. The concept of expected value; gambling.
B. Applications to personal finance.
C. Balancing risk and potential gain in making investments.

The intent of the entire course is to strengthen students' fundamental intuitions about the following big ideas: What is data? What does randomness mean? What can you infer about a large group from what you know about a sample? How can this kind of understanding guide practical decisions.

This course should aim to develop a small number of fundamentally important ideas in depth. In line with this principle, the course should be "concept-driven" and not "procedure-driven." This means challenging students' expectations concerning mathematics courses, since many students who come to M1100 equate learning math with learning how to execute computational procedures.

Designing a concept-driven course means developing deep ways to understand how students think. It is not enough to look at whether they are working the problem correctly. How do they perceive and interpret things? What tools do they have for representing mathematical ideas? When it comes to solving problems, what kinds of conceptual resources have they acquired, and how do they apply them? It is a future challenge to adapt or develop the kind of assessment tools that will tell us these things.

Appendix. The NCTM *Data Analysis and Probability* standard in grades K-12 stipulates that instructional programs should enable all students to:

- *formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them;*
- *select and use appropriate statistical methods to analyze data;*
- *develop and evaluate inferences and predictions that are based on data;*
- *understand and apply basic concepts of probability.*

According to the *Measurement* standard, students should be enabled to:

- *understand measurable attributes of objects and the units, systems, and processes of measurement;*
- *apply appropriate techniques, tools, and formulas to determine measurements.*