April 29, 2013

DEPARTMENT OF MATHEMATICS
SYLLABUS

I. MATH 333 - INTRODUCTION TO PROBABILITY AND STATISTICS - 4 credits

II. Catalog Description

This course is designed for mathematics education majors to provide a rigorous one-semester study of probability, distribution theory and the basics of statistical inference. Topics to be covered include probability, expectation, discrete and continuous distributions, descriptive statistics and both estimation and hypothesis testing for one and two-sample problems. No credit for both MATH 333 and MATH 235 or for both MATH 333 and MATH 335. PREREQUISITE: MATH 311.

III. Objectives

A. To provide students with a basic understanding of probability theory.
B. To provide students with thorough training in distribution theory for both discrete and continuous random variables
C. To cover the basics of descriptive statistics including graphical approaches to data description and exploratory data analysis.
D. To cover the basics of statistical inference including estimation and hypothesis testing for both one and two-sample inference for means and proportions. The theory and practical interpretation of statistical inference will be discussed.
E. To provide Mathematics Education majors with some guidelines for teaching probability and statistics.
F. To provide students with an introduction to statistical computing using Minitab; a statistical software package.

IV. Course Outline

A. Introduction to Statistics and Data Analysis
   1. Overview
   2. The role of probability
   3. Measures of location: the sample mean
   4. Measures of variability
   5. Discrete and continuous data
   6. Statistical Modeling, Scientific Inspection, and Graphical Diagnostics

B. Probability
   1. Sample space
   2. Events
   3. Counting sample points
   4. Probability of an event
   5. Additive rules
   6. Conditional probability
   7. Multiplicative rules
   8. Bayes' Rule

C. Random Variables and Probability Distribution

1. Concept of a random variable
2. Discrete probability distributions
3. Continuous probability distributions
4. Empirical distributions
5. Joint probability distributions

D. Mathematical Expectation
1. Mean of a random variable
2. Variance and covariance
3. Means and variances of linear combinations of random variables
4. Chebyshev's Theorem

E. Some Discrete Probability Distributions
1. Introduction
2. Discrete uniform distribution
3. Binomial and multinomial distributions
4. Hypergeometric distribution
5. Negative binomial and geometric distributions
6. Poisson distribution

F. Some Continuous Probability Distributions
1. Normal distribution
2. Areas under the normal curve
3. Applications of the normal distribution
4. Normal approximation to the binomial
5. Gamma and exponential distributions
6. Applications of the exponential and gamma distribution
7. Chi-squared distribution

G. Random Sampling, Data Description, and some Fundamental Sampling Distributions
1. Random sampling
2. Some important statistics
3. Data displays and graphical methods
4. Sampling distributions
5. Sampling distributions of means
6. Sampling distributions of S^2
7. t-Distribution
8. F-Distribution

H. One- and Two-Sample Estimation Problems
1. Introduction
2. Statistical inference
3. Classical methods of estimation
4. Single sample: estimating the mean
5. Standard error of a point estimate
6. Tolerance limits
7. Two samples: estimating the difference between two means
8. Paired observations
9. Single sample: estimating a proportion
10. Two samples: estimating the difference between two proportions
11. Maximum likelihood estimation

I. One- and Two-Sample Tests of Hypotheses
1. Statistical hypotheses: general concepts
2. Testing a statistical hypothesis
3. One- and Two-tailed tests
4. The use of P-values in decision making

5. Single sample: tests concerning a single mean (variance known)
6. Relationship to confidence interval estimation
7. Single sample: tests on a single mean (variance unknown)
8. Two samples: tests on two means
9. Choice of sample size of testing means
10. Graphical methods for comparing means
11. One and Two sample tests on proportions

V. Criteria for Evaluating Student Performance

The method for evaluation may include in-class exams, regularly collected and graded problem sets, Minitab projects, and a final examination.

VI. Suggested Texts

Walpole, R.E., Myers, R.H., Myers, S.L., and Ye, K., Probability and Statistics for Engineers and Scientists, 9th Edition, Prentice Hall Publishing Co., 2012.

Devore, J.L., Probability and Statistics for Engineering and the Sciences, Eighth Edition, Brooks/Cole Publishing Co., 2012.

VII. General Education Credit

This course may not be taken for general education credit

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