Southern Connecticut State University
School of Arts and Science
Department of Mathematics

Mathematics 320 – Probability and Statistics I

I. Description.

Catalog Description: Introduction to Probability and Statistics, Probability Axioms, Conditional Probability, Probability Distributions, Random Variables, Probability Densities, Multivariable Distributions and Densities, Sampling Distributions, Central Limit Theorem, Inferences Concerning the Mean, Type I and Type II Errors, Inferences Concerning Variances, Estimation of Variances, Inferences Concerning Proportions, Analysis of Frequency Tables, Goodness of Fit, Regression.

Departmental Description: The course is a post-calculus introduction to mathematical probability theory and statistical inference. It balances theory and applications. Mathematical theory is presented, along with techniques for practical calculation in a number of models.

II. Credit.

Mathematics 320 carries 4 semester-hours of University credit. A student cannot receive credit towards graduation for both MAT 221 and MAT 320.

III. Prerequisites.

Mathematics 320 has a prerequisite of C- or better in both MAT 252 (Calculus III) and MAT 250 (Foundations of Mathematics).

IV. Purpose.

To present the theory of probability and statistics, at a post-calculus pre-measure theory level, and the various applications of probability and statistics, including physical sciences, life sciences, social sciences, engineering, operations research and computer science. The course also serves as a suitable background for further work in mathematical and applied probability and statistics.

V. Format.

Mathematics 320 will follow a lecture format with homework assignments of both theory and applications. Use of a computer software, such as a spreadsheet or statistical software package, is strongly recommended.

VI. Outline.

(assuming 56 hours less 6 hours for exams/review in addition to the Final exam for a total of 50 hours) (Historical figures are noted in parentheses by topics)

A. Introduction to Statistics: (4 hours = 8%)

1. A brief history of Probability and Statistics
2. Treatment of Data: Frequency Distributions, Histograms (Nightingale)
3. Descriptive Measures: Central Tendency, Variation, Percentiles.

B. Probability: (6 hours = 12%)

1. Sample Spaces, Events and Sets
2. Counting: Combinations, Permutations, Partitions
3. Axioms of Probability: Simple Theorems and Proofs
4. Conditional Probability, Bayes' Theorem (Bayes)

C. Discrete Random Variables: (8 hours = 16%)

1. Discrete Probability Distributions: general, expected value, Chebyshev's Theorem (Chebyshev)
2. The Binomial Distribution
3. The Poisson Distribution
4. The Hyper-geometric Distribution
5. The Geometric Distribution
6. The Multinomial Distribution

D. Continuous Random Variables: (8 hours = 16%)

1. Probability Densities: general, expected value
2. The Uniform Distribution
3. The Normal Distribution (Gauss)
4. The Gamma Distribution
5. The Beta Distribution
6. Joint Distributions and Densities

E. Sampling Distributions: (4 hours = 8%)

1. Populations and Samples
2. The distribution of the sample mean, Central Limit Theorem
3. The T-distribution (Student aka Gossett)

F. Inferences Concerning the Mean: (8 hours = 16%)

1. Confidence Intervals, known and unknown variance
2. Test of Hypotheses, known and unknown variance
3. Type I and Type II Errors (Neyman and Pearson)
4. Sample size calculations

G. Inferences Concerning Variances: (4 hours = 8%)

1. Estimation of Variances
2. The Chi Squared Distribution
3. The F Distribution. (Fisher)

H. Inferences Concerning Proportions: (4 hours = 8%)

1. Estimation of Proportions (Pearson and Fisher)
2. Analysis of Frequency Tables and Independence
3. Goodness of Fit Tests

I. Regression: (4 hours = 8%)

1. Method of Least squares
2. ANOVA Table Analysis (Fisher)
3. Inferences based on Estimators
4. Residual Analysis

VII. Objectives.

Students in MAT 320 should achieve several objectives. These objectives, provided by the Mathematics Department and National Council of Accreditation of Teacher Education (NCATE), are listed below. Also listed are the topics from Section VI which satisfy the objectives.

Mathematics Department Objectives.

1. Demonstrate that they can model and solve problems that represent a wide variety of realistic applications. (Applied Math Goal 1, Topics C, D and I)
2. Appreciate the beauty, joy, and challenge in mathematics and experience mathematics as an engaging field with contemporary open questions. (Department Goal 8, Topics C and D)
3. Think analytically and critically and be able to formulate problems, solve them, and interpret their solutions. (Department Goal 9, Topics F, G and H)

NCATE Objectives

1. Problem solving: provide opportunities for your candidates to mature in their problem solving abilities. (NCATE 1.1, Topics A though I).
2. Connections: provide opportunities for your candidates to demonstrate an understanding of mathematical relationships across disciplines across connections within mathematics. (NCATE 1.4, Topics C and D)
3. Apply numerical computation and estimation techniques and extend them to algebraic expressions. (NCATE 1.5.2, Topics E, F, G, H and I)
4. Use both descriptive and inferential statistics to analyze data, make predictions and draw conclusions. (NCATE 1.5.6, Topics F, G and H)
5. Understand the concept of a random variable, distribution function, and the difference between theoretical and simulated probability and to apply the concepts to real world situations. (NCATE 1.5.7, Topics B, C and D)
6. Use mathematical modeling to solve problems from fields such as natural sciences, social sciences, business, and engineering. (NCATE 1.5.12, Topics C, D and I)

VIII. Sample Texts.

Devore, Jay L. Probability and Statistics for Engineering and the Sciences, fifth edition. Duxbury, California, 2000.

Johnson, Richard A. Miller and Freund's Probability and Statistics for Engineers, sixth edition. Prentice Hall, Upper Saddle River New Jersey, 2000.

Larsen, Richard and Marx, Morris. An Introduction to Mathematical Statistics Third Edition, Prentice Hall, New Jersey, 2001.

IX. Waiver Policy.

Mathematics 320 can be waived by a departmental examination.

X. Bibliography.

Casella, George and Berger, Roger. Statistical Inference, Duxbury Press, California, 1990.

Devore, Jay L. Probability and Statistics for Engineering and the Sciences, fifth edition. Duxbury, California, 2000.

Devore, Jay L and Farnum, Nicholas. Applied Statistics for Engineers and Scientists. Duxbury, California, 2000.

Johnson, Richard A. Miller and Freund's Probability and Statistics for Engineers, sixth edition. Prentice Hall, Upper Saddle River New Jersey, 2000.

Larsen, Richard and Marx, Morris. An Introduction to Mathematical Statistics Third Edition, Prentice Hall, New Jersey, 2001.

Miller, Irwin and Miller, Marylees. John E. Freund's Mathematical Statistics Sixth Edition, Prentice Hall, New Jersey, 1999

XI. Prepared.

March 2005

XII. Preparer.

Raymond Mugno