MAT 221 Intermediate Applied Statistics

Department of Mathematics
Southern Connecticut State University

I. Catalog Description

A treatment of statistics concentrating on techniques used in science and industry. Topics include descriptive statistics, probability, sampling distributions, estimation, hypothesis testing, regression analysis, and correlation. Use of appropriate calculator is required.

II. Credit

(A) MAT 221 carries four (4) semester hours of University credit.

(B) MAT 221 is required of all mathematics majors.

III. Prerequisite

MAT 120 or MAT 122 or MAT 124 or MAT 125 or MAT 139 or MAT 150 or appropriate mathematics placement.

IV. Format

MAT 221 is primarily a lecture-based course.

V. Outline

- Descriptive Statistics
- Statistical Graphs
- Empirical Probability
- Mathematical Probability
- Conditional probability
- Counting principles
- Bayes Theorem
- Discrete Random variables
- Properties of Discrete Random Variables
- Important Discrete Random Variables
- Continuous Random variables

- Properties of Continuous Random Variables
- Important Continuous Random Variables
- Sampling Distributions
- Confidence Intervals
- Hypothesis Testing
- Categorical Data Analysis
- Linear Regression

VI. Proposed Text

James T. McClave and Terry Sincich, Statistics, Thirteenth, Pearson Prentice Hall, 2014

VII. Other Recommended Text

Stephen Kokoska, Introductory Statistics, Second Edition, W.H. Freeman and Company, 2015

VIII. Outcomes

Upon completion of MAT 221 students should be able to demonstrate satisfactory knowledge of the major concepts of probability and statistical inference. In particular students should:

1. Calculate and interpret the mean, median, and standard deviation of a dataset.
2. Create and interpret a histogram, stem-and-leaf plot, and box plot.
3. Comprehend the concepts of probability and randomness.
4. Calculate the probability of unions, intersections and compliments.
5. Understand the meaning of conditional probability and apply it.
6. Calculate the expected value for simple discrete random variables and interpret its meaning.
7. Solve and interpret the results of actual problems using probability.
8. Calculate and interpret Binomial, Hyper-Geometric, Geometric probabilities.
9. Calculate and interpret Uniform, Exponential, and Normal probabilities.
10. Apply the Central Limit Theorem to problems about sample means.
11. Calculate and interpret Confidence Intervals for the population mean and proportion for both large and small samples.

12. Calculate and interpret Hypothesis Tests for the population mean and proportion for both large and small samples.

13. Calculate and interpret Hypothesis Tests for the difference of two population means and proportions for both large and small samples. 14. Interpret the slope, and coefficient of determination for bivariate data.

14. Use a regression line for prediction and evaluate the model.

IX. Course Outline

Descriptive Statistics (1 week 7%)

1. Statistical Graphs
2. Measures of Central Tendency
3. Standard Deviation
4. Percentiles

Probability (2 weeks 13%)

1. Probability Contingency Tables
2. Probability with Venn Diagrams
3. Probability with Tree Diagrams
4. Bayes Theorem
5. Independence
6. Counting

Discrete Random Variable (2 weeks 13%)

1. Probability Mass Functions
2. Expectation and Variance
3. The Binomial Distribution
4. The Poisson Distribution
5. The Geometric Distribution
6. The Hypergeometric Distribution

Continuous Rand Variables (1 week 7%)

1. Uniform Random Variables
2. Normal Random Variables
3. Exponential Random Variables

Limit Theorems (1 week 7%)

1. The Central Limit Theorem
2. Law of Large Numbers

Confidence Intervals (2 weeks 13%)

1. Confidence Intervals for a population mean
2. Confidence Intervals for a population proportion
3. Sample Size calculations

Hypothesis Testing (2 weeks 13%)

1. Hypothesis Tests for a population mean
2. Hypothesis Tests for a population proportion
3. Type I and Type II errors
4. Limitations of statistical inference

Two-Sample Inference (1 week 7%)

1. Confidence Intervals for the difference of independent population means
2. Confidence Intervals for the difference of paired population means
3. Hypothesis Tests for the difference of independent population means
4. Hypothesis Tests for the difference of paired population means

Categorical Data Analysis (1 week 7%)

1. Goodness of Fit Test
2. Tests for Independence

Linear Regression (2 weeks 13%)

1. The least-squares methodology

2. Interpretation of the slope, correlation coefficient and coefficient of determination
3. Statistical inference for the slope
4. Residual analysis
5. Inference for future values
6. Limitations of linear regression
7. Basic non-linear models

X. Assessment

Individual instructors may vary assessment modes, but typically grades will be based on a combination of homework assignments, quizzes, and exams.

XI. Waiver Policy

MAT 221 may be waived by a satisfactory score on departmental waiver exam.

XII. Preparation

- Prepared October, 2017. (Raymond Mugno)
- Approved by the Mathematics DCC on October 8, 2019.

XIII. Bibliograph

1. G. Casella, R. Berger, Statistical Inference, Duxbury Press, 1999.
2. J. Devore, Probability and Statistics for Engineers, Thompson, Toronto 2004.
3. J. McClave, T. Sincich, Statistics, Prentice Hall, New Jersey, 2012.
4. S. Ross, A First Course in Probability, Seventh Edition, Pearson, 2006.