MAT 107 Elementary Statistics

Department of Mathematics

Southern Connecticut State University

I. Catalog Description

Topics include measures of central tendency and measures of variation; elements of probability; random variables; introduction to estimation and hypothesis testing; linear regression analysis. A graphing calculator approved by the instructor is required. (3 credits).

II. Purpose

The purpose of MAT 107 is to give students a background in elementary statistical ideas and techniques which are applicable to any major. The course is intended for a general audience.

III. Credit

(A) MAT 107 carries 3 semester-hours of university credit.

(B) MAT 107 satisfies the University's Liberal Education Program Quantitative Reasoning requirement.

(C) MAT 107 satisfies the University's General Education Mathematics Requirement.

(D) MAT 107 is required of all Nursing, Public Health, Social Work, and Human Performance majors and is an option for several other majors.

IV. Liberal Education Program

This course satisfies the University's Liberal Education Program (LEP) requirement in Quantitative Reasoning (QR). It addresses the key elements of the QR requirement as indicated in Section IX: Course Objectives. Further, as a Tier 1 LEP course, it will do the following:

(A) MAT 107 addresses at least one *Area of Knowledge and Experience*, such as *Mind and Body* (inferential statistics in Public Health or Psychological issues), *Global Awareness* (descriptive statistics in Environmental issues), or the *Natural World I* (random variables in Chemistry or Physics), through examples and assignments.

(B) MAT 107 will incorporate at least one *Discussion of Values*, e.g., *Rational Thought* (drawing the correct conclusion from a confidence interval or hypothesis test) or *Civic Engagement* (using statistics to make a case for change).

(C) MAT 107 addresses at least one *Embedded Competency* in a significant manner, e.g., Creative Thinking (project/poster/essay), or Oral Communication (class presentations).

(D) Present *Quantitative Reasoning* in context.

V. Prerequisites

The prerequisite for MAT 107 is MAT 100 or MAT 100P or MAT 102. Students can also place into MAT 107.

VI. Format

MAT 107 has a lecture format and may or may not be offered with a laboratory component. Use of technology is encouraged.

VII. Technology

A graphing calculator is required.

VIII. Quantitative Reasoning Key Elements

(A) **QR1**: Quantitative Situations - Identifying the essential quantitative elements in both routine and novel situations and understanding the relationships between those quantitative elements, and producing mathematical models appropriate for the intended analysis (e.g., writing equation(s) to represent the situation).

(B) **QR2**: Quantitative Data - Representing quantitative information in both technical and common language by using symbolic, graphical, and tabular formats, and drawing correct inferences from quantitative information through the interpretations of such representations.

(C) **QR3**: Methods - Acquiring the tools and methods necessary to resolve both routine and novel quantitative questions, including a correct sequencing of procedures, and using them appropriately, given the nature and constraints of a situation. In addition to using knowledge previously acquired in intermediate algebra, students will demonstrate proficiency with information presented in numerical or statistical form and mathematical concepts of growth and decay with their applications (e.g., linear, quadratic, exponential, etc.).

(D) **QR4**: Reliability of Data and Solutions - Correctly evaluating the level of accuracy stated or implied for given data, and assessing the correctness and accuracy of an analysis, including the assessment of the method and model used and the reasonableness of the solution.

(E) **QR5**: Mathematical Process - Using discovery (e.g., exploration and pattern-recognition), conjecture, and testing to develop mathematical formulas, theorems, and then giving persuasive mathematical arguments to establish their validity.

IX. Course Objectives

In addition to satisfying LEP Tier 1 requirements, MAT 107 has some specific course objectives. The Key Elements of Quantitative Reasoning(QR) are referenced. By the end of the course, a successful student should be able to do the following:

(A) Calculate and interpret the mean, median, and standard deviation of a dataset.

(B) Create and interpret a histogram, stem-and-leaf plot, and box plot. (QR2)

(C) Comprehend the concepts of probability and randomness. (QR2, QR3)

(D) Calculate the expected value for simple discrete random variables and interpret its meaning. (QR2, QR3)

(E) Calculate the probability of unions, intersections and complements. (QR2, QR3)

(F) Understand the meaning of conditional probability and apply it. (QR2, QR3)

(G) Calculate and interpret Binomial probabilities.(QR1, QR3)

(H) Calculate and interpret Normal probabilities and percentiles. (QR1, QR2)

(I) Solve and interpret the results probability problems using counting techniques. (QR3)

(J) Apply the Central Limit Theorem to problems about sample means.

(K) Calculate and interpret Confidence Intervals for the population mean and proportion. (QR3)

(L) Calculate the required sample size needed in order to estimate with a certain confidence and error bound. (QR4)

(M) Calculate and interpret Hypothesis Tests for the population mean and proportion. (QR2, QR3, QR4)

(N) Interpret the slope, intercept and coefficient of determination for bivariate data. (QR1)

(O) Use a regression line for prediction. (QR1)

X. Laboratory

The Mathematics Department maintains a computer laboratory that may be used to enhance the class.

XI. Outline (optional topics are marked with an *)

Percentages are based on a 28 class semester, with 5 classes reserved for testing and review.

(A) Descriptive Statistics (10 %)

1. Frequency distributions.
2. Geometrical representation - histograms, stem and leaf plots, boxplots.
3. Measures of central tendency - the mean and median.
4. Measures of dispersion - the variance and standard deviation.

(B) Elementary Probability Theory (18 %)

1. Experiments - sample spaces, outcomes, events.
2. Basic operations and properties of events: union, intersection, and complementation.
3. Mutually exclusive events.
4. Counting Techniques - minimally the multiplicative principle and combinations.
5. Conditional probability - definition and applications.
6. Independent events.

(C) Discrete Random Variables (12 %)

1. Discrete probability distributions.
2. Expected Value.
3. Variance and standard deviation.
4. The Binomial Distribution - characteristics and applications.

*5. The Hyper-Geometric Distribution - characteristics and applications.

(D) Continuous Random Variables (10 %)

*1. The Uniform and related distributions - characteristics and applications.
2. The Normal Distribution - characteristics and applications.
3. Assessing Normality.

(E) Sampling Distributions (5 %)

1. The distribution of the Sample Mean.
2. The Central Limit Theorem.

*3. The distribution of the sample proportion.

(F) An introduction to Estimation (15 %)

1. Confidence intervals for a population mean.
2. Confidence intervals for a population proportion.
3. Sample Size Calculations for confidence intervals.

*4. Confidence interval for a population variance.

(G) An Introduction to Hypothesis Testing (15 %)

1. The nature of hypothesis testing, critical regions and p–values.
2. Inferences concerning a population mean.
3. Inferences concerning a population proportion.
4. Type I and Type II Errors - Definitions in context

(H*) Statistical Inference for Two Parameters (5 %)

1. Confidence Intervals and Hypothesis Tests for the difference of two population means.
   a. Independent Samples.
   b. Matched Pairs.
2. Confidence Intervals and Hypothesis Tests for the difference of two population proportions.
3. Confidence Intervals and Hypothesis Tests for the ratio of two population variances.

(I) Regression and Correlation (10 %)

1. Simple Linear Regression.
2. The Correlation Coefficient and Coefficient of Determination.
3. Using Regression for Prediction.
4. Limitations of Regression.

*5. Statistical Inference for the slope.

XII. Assessment

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

	QR 1 Quantitative Situations	QR 2 Quantitative Data	QR 3 Methods	QR 4 Reliability of Data and Solutions	QR 5 Mathematical Process
Homework	Individual instructors decide which QR will be assessed appropriately.				
Quizzes	Individual instructors decide which QR will be assessed appropriately.				
Tests	✓	✓	✓	✓	✓
Final Exam	✓	✓	✓	✓	✓

XIII. Recommended Texts

(A) *Introductory Statistics; A Problem Solving Approach*, Stephen Kokoska, W.H. Freeman and Company, 2010.

(B) *First Course in Statistics*, James McClave, Terry L. Sincich and Terry T. Sincich, Prentice Hall, 2006.

(C) *Introductory Statistics*, Neil A. Weiss, Addison-Wesley, 2002.

(D) *Collaborative Statistics*, Barbara Illowsky and Susan Dean. Available to download at `http://cnx.org/conten`

XIV. Waiver Policy

MAT 107 may be waived by departmental exam.

XV. Bibliography

(A) *Probability and Statistics for Engineering and the Sciences*, Jay L. Devore, Thomson Publishing, 2008.

(B) *Introductory Statistics; A Problem Solving Approach*, Stephen Kokoska, W.H. Freeman and Company, 2010.

(C) *Statistics*, James T. McClave and Terry Sincich, Pearson Prentice Hall, 2009.

(D) *Introduction to the Practice of Statistics*, David S. Moore, George P. McCabe, Brice A. Craig, W.H. Freeman and Company, 2009.

(E) *Elementary Statistics from Discovery to Decision*, Marilyn K. Pelosi and Theresa M. Sandifer, Wiley, 2003

(F) *Introductory Statistics*, Neil A. Weiss, Addison-Wesley, 2002.

XVI. Preparation

Proposed outline prepared by Raymond Mugno, October 2011.

Approved by the MDCC, 8–0–2, May 11, 2010.

Approved by the department of mathematics, 12–1–0, May 20, 2010.