

Prepared by the Department of Mathematics

Date of Departmental Approval: December 4, 2017

Date approved by Curriculum and Programs: January 31, 2018

Effective: Fall 2018

**1. Course Number: MAT150**

**Course Title: Elementary Statistics**

**2. Description:** Students are introduced to descriptive and inferential statistics focusing on conceptual understanding and statistical literacy. Topics include: techniques for organizing and presenting data, measures of central tendency and dispersion, probability, discrete and continuous probability distributions, sampling distributions, estimation, one-sample hypothesis tests, and correlation and regression. (4 contact hours)

**3. Student Learning Outcomes** (instructional objectives, intellectual skills):

Upon successful completion of this course, students are able to do the following.

- Utilize appropriate statistical software throughout the course to explore concepts and analyze data both graphically and numerically; calculate numerical values and develop models to help examine and evaluate statistical samples.
- Select and produce appropriate graphical, tabular, and numerical summaries of the distributions of categorical and quantitative variables. Summarize information into verbal descriptions.
- Summarize relationships in bivariate data using graphical, tabular, and numerical methods including scatter plots, two-way tables, correlation coefficients, and least squares regression lines. Investigate and describe the relationships between two variables using caution in interpreting correlation and association.
- Interpret z-scores and compute probabilities using the normal distribution
- Demonstrate the principles of observational and experimental studies including sampling methods, randomization, replication and control. Show how the type of data collection can affect the types of conclusions that can be drawn.
- Construct a model for a random phenomenon using outcomes, events, and the assignment of probabilities. Calculate probabilities using standard probability rules and two-way tables.
- Construct and interpret probability models for discrete and continuous random variables.
- Explain the concept of a sampling distribution. Discuss the distribution of the sample mean and sample proportion under repeated sampling (Central Limit Theorem). Simulate or generate sampling distributions to observe, empirically, the Central Limit Theorem.
- Estimate a population mean or proportion using a point estimate and confidence intervals, and interpret the confidence level and margin of error. Examine the relationship between margin of error, sample size, and confidence level.
- Conduct a hypothesis test for a mean or a proportion. Given a research question involving a single population, formulate null and alternative hypotheses. Describe the logic and framework of the inference of hypothesis testing. Determine if the appropriate conditions are met. Make a decision using a  $p$ -value and draw an appropriate conclusion. Interpret statistical and practical significance in this setting.
- Conduct a hypotheses test to determine the significance of the association between two categorical variables and two quantitative variables using regression and chi-square analysis.

**4. Credits:** 3 credits

**5. Satisfies General Education Requirement:** Mathematics/Quantitative Reasoning

**6. Prerequisite:** ENL108 (Critical Reading & Thinking) and MAT035 (Algebra for Non-STEM) or MAT045 (Intermediate Algebra for STEM) or satisfactory basic skills assessment score

**7. Semester(s) Offered:** Fall, Spring, Summer

**8. Suggested General Guidelines for Evaluation:** Comprehensive final examination, hour tests, problems, cases, and quiz papers.

## 9. General Topical Outline:

### Part 1: Sampling and Design of Experiments

- Data Collection
- Observational Studies versus Designed Experiments
- Simple Random Sampling and Other Effective Sampling Method
- Bias in Sampling
- The Design of Experiments

### Part 2: Descriptive Statistics

- Organizing Qualitative Data
- Organizing Quantitative Data: The Popular Displays
- Graphical Misrepresentations of Data
- Numerically Summarizing Data
- Measures of Central Tendency
- Measures of Dispersion
- Measures of Position and Outliers
- The Five-Number Summary and Boxplots
- Describing the Relation between Two Variables
- Scatter Diagrams and Correlation
- Least-Squares Regression
- Residual Analysis on a Regression Model
- Influential Observations
- Contingency Tables and Association

### Part 3: Probability and Probability Distributions

- Probability Rules
- The Addition Rules and Complements
- Independence and the Multiplication Rule
- Discrete Probability Distributions
- Discrete Random Variables
- The Binomial Probability Distribution
- The Normal Probability Distribution
- Properties of the Normal Distribution
- Applications of the Normal Distribution
- Assessing Normality

### Part 4: Inference: From Samples to Population

- Sampling Distribution of the Sample Mean
- Sampling Distribution of the Sample Population
- Estimating a Population Proportion
- Estimating a Population Mean
- Hypothesis Tests Regarding a Parameter
- The Language of Hypothesis Testing
- Hypothesis Tests for a Population Proportion
- Hypothesis Tests for a Population Mean
- Inference on Categorical Data
- Goodness-of-fit Test
- Tests for independence and the Homogeneity of Proportions
- Testing the Significance of the Least-Squares Regression Model