

MAT	167	Principles of Statistics	3
Dept. Abbr.	Course No.	Course Title	Credits

MAT* 167 Principles of Statistics

This course is an introduction to the concepts and practices of statistics. The course is organized around the application to statistics of the scientific method. The scientific method is comprised of the following steps:

- Step 1: Formulate a theory
- Step 2: Collect data to test the theory
- Step 3: Analyze the results
- Step 4: Interpret the results - make a decision.

This course will explore the application of this methodology to the area of statistics.

Course Description

Graphs and charts, measures of central tendency and variation. Elementary probability theory, random variables, probability distributions, with emphasis on the binomial and normal. Sampling distributions, hypothesis testing, confidence intervals, correlation and linear regression. Use of technology included.

Prerequisite: Eligible for ENG(101 or 101E) and MAT*(137 or 137E) (or higher) with a grade of "C" or better OR eligible for ENG*(101 or 101E) and math placement.*

Calculator: A graphing calculator is required. The TI-84+ or TI-83 or TI-84CE is strongly recommended.

General Objectives of the Course

After completing this course, the student will be able to:

- Describe both descriptive statistics and inferential statistics
- Construct (by hand or using technology, as appropriate) and analyze tables, graphs, and numerical summaries of data sets, including examples of real-world phenomena, to ascertain the defining features of the subject matter under investigation
- Understand the importance of appropriate data gathering methods to ensure the quality and reliability of data collected
- Understand elementary probability theory, discrete and continuous random variables and probability distributions, and sampling distributions
- Construct (using technology, as appropriate) confidence intervals and interpret results to arrive at reasoned inferences or conclusions
- Perform (using technology, as appropriate) one- and two-sample hypothesis tests (population mean) and interpret results to arrive at reasoned inferences or conclusions
- Find (using technology), interpret, and use the least-squares regression line
- Be better informed citizens as a result of being able to understand and interpret media reports involving statistics and statistical studies
- Provide clear, logical and organized explanations through verbal and written responses.

General Education Competencies

Students in this course will:

- Quantitative Reasoning (D)
 - (1) Represent mathematical and quantitative information symbolically, graphically, numerically, and verbally.
 - (2) Apply quantitative methods to investigate routine and novel problems. This includes calculations, procedures, mathematical and /or statistical modeling, prediction, and evaluation.
 - (3) Interpret mathematical and quantitative information and draw logical inferences from Representations such as formulas, equations, graphs, tables and schematics
 - (4) Evaluate the results obtained from quantitative methods for accuracy and/or reasonableness.

- Critical Analysis and Logical Thinking (E)
 - (3) Analysis: Break subject matter into components and identify their interactions to ascertain the defining features of the work and their contributions to the whole.
 - (4) Evaluation: Identify assumptions, assessing the quality and reliability of sources of evidence, and demonstrating knowledge of the criteria for evaluating the success of each kind of inference.
 - (5) Synthesis: Draw together disparate claims into a coherent whole in order to arrive at well-reasoned and well-supported inferences that can be justified as a conclusion.

- Scientific Reasoning (D)
 - (1) Explain the methods of scientific inquiry that lead to the acquisition of knowledge. Such methods include observations, testable hypothesis, logical inferences, experimental design, data acquisition, interpretation, and reproducible outcomes
 - (2) Apply scientific methods to investigate real-world phenomena, and routine and novel problems. This includes data acquisition and evaluation, and prediction.
 - (3) Represent scientific data symbolically, graphically, numerically and verbally
 - (4) Interpret scientific information and draw logical references from representations such as formulas, equations, graphs, tables and schematics.
 - (5) Evaluate the results obtained from scientific methods for accuracy and/or reasonableness.

- Written Communication (E)
 - (3) Craft Logical Arguments
 - Generate a controlling idea or thesis
 - Provide clear and logical evidence, support, or illustration for their assertions
 - Choose appropriate and effective organizing methods, employing effective transitions and signposts.

Unit No.	Instructional Unit	Specific Objectives of Instructional Unit Assume that each statement is prefixed with "The student will be able to".
1	Introduction to Statistics	<ul style="list-style-type: none"> • Explain how the scientific method applies to statistics • Formulate null and alternative hypotheses • Explain direction of the extreme and how it determines alternative hypotheses • Explain p-value and how it is used to make decisions • Explain Type I and Type II errors and their consequences • Explain the difference between population and sample • Explain how a parameter differs from a statistic
2	Producing Data	<ul style="list-style-type: none"> • Explain various types of bias that may occur in statistical studies • Explain the difference between the target population and the sample • Explain factors to consider when designing a statistical study • Identify and explain various types of sampling • Generate random integers appropriately in applied situations • Explain the difference between response variables and explanatory variables • Explain confounding variables • Explain the difference between treatment and control groups • Explain the difference between experimental study and observational study • Explain the difference between retrospective and prospective studies
3	Summarizing Data Graphically and Numerically	<ul style="list-style-type: none"> • Explain the meaning of <i>descriptive statistics</i> • Interpret frequency distributions, relative frequency distributions, bar charts, pie charts, histograms, stem-and-leaf displays, box-plots, and time plots. • Construct (by hand or with technology, where appropriate) frequency distributions, bar charts, stem-leaf displays and box-plots • Identify misleading graphical displays • Recognize and interpret symmetry and skewness in a distribution • Interpret the numerical summary measures • Calculate (by hand or using technology, as appropriate), explain, and interpret mean, mode, median, range, variance, standard deviation, percentiles, and quartiles for a given data set

4	Probability	<ul style="list-style-type: none"> • Demonstrate understanding of normal distributions • Apply the 68-95-99.7% Rule • Explain and apply standardization • Find proportions and percentiles using normal distribution • Explain the concept, vocabulary, and rules of probability • Identify sample spaces and events • Explain disjoint events • Find probabilities of events • Combine events using complement, union, and intersection • Apply the definition of independence • Apply the laws of probability • Explain random variables • Explain the difference between discrete and continuous random variables • Construct and interpret probability distribution tables and graphs • Calculate (by hand or using technology, as appropriate) and interpret mean and standard deviation • Apply (appropriately) the binomial distribution • Explain how to move from discrete to smooth continuous distributions • Apply the knowledge that probability for continuous random variables is represented by area • Explain the concept and importance of and be able to apply normal distributions
5	Sampling Distributions; Making Decisions	<ul style="list-style-type: none"> • Calculate and apply point estimates for the population mean, standard deviation, and proportion • Explain the meaning of the sampling distribution of a statistic • Describe the characteristics of the sampling distribution of the sample mean and sample proportion • Apply the Central Limit Theorem • Apply the t-distribution, when appropriate • Construct confidence intervals (by hand and using technology, as appropriate) for mean and proportion • Determine the minimum required sample size if given level of confidence and margin of error • Perform hypothesis tests (by hand and using technology, as appropriate) for population mean and interpret their results • Interpret p-value
6	More about Making Decisions	<ul style="list-style-type: none"> • Interpret appropriate confidence intervals in two-sample situations (optional) • Perform appropriate hypothesis testing in two-sample situations. (optional) • Calculate using technology, interpret, and use appropriately the least-squares regression equation for a data set • Explain the dangers of extrapolation • Explain residuals • Interpret residual plots • Distinguish between influential points and outliers • Calculate using technology and interpret the correlation coefficient