STAT 110: Fundamentals of Statistics
WINTER 2024-2025

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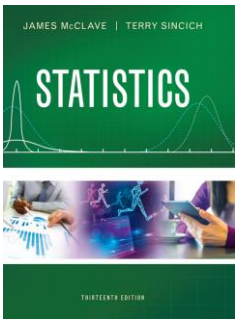
Text (Not Required):

Text: The official text for the course is Statistics 13th Edition by J. McClave and T. Sincich.	

Prerequisites: Qualifying score on the mathematics placement or STAT 100 - Numbers and Data in Society. Students in certain majors should take STAT 210 - Statistics instead of STAT 110.

Learning Outcomes

1. Use logical reasoning by studying mathematical patterns and relationships. A successful student will be able to investigate the different ways in which to determine patterns for variables and evaluate the relationship between them.
2. Use mathematical models to describe real-world phenomena and to solve real-world problems, as well as understand the limitations of models in making predictions and drawing conclusions. A successful student will be able to design and carry out a real-world experiment or observational study and properly state the findings and conclusions.
3. Organize data, communicate the essential features of the data, and interpret the data in a meaningful way. A successful student will be able to organize data, communicate essential features of the data both numerically and graphically and provide interpretations and conclusions.
4. Do a critical analysis of scientific and other research. A successful student will be able to answer a desired research question through hypothesis testing by providing implications, interpretations and conclusions.

5. Extract correct information from tables and common graphical displays. A successful student will be able to draw conclusions and express relationships (both orally and written) illustrated in graphical displays such as line graphs, scatter plots, histograms and frequency tables.
6. Use appropriate technology to describe and solve quantitative problems. A successful student will be able to use the statistical software package JMP to perform most analyses in this course. The students will also be able to interpret the results from the given output.

Assessments

Interactive Course Notes (Approximately 20-25% of grade)

A set of interactive course notes will be available for this course. The course notes are divided into modules and parts. These interactive notes may require that you complete various tasks and/or answer questions that are embedded within the notes. After you submit your notes, the answers to questions and/or tasks are provided so that you can check your understanding of the content being covered.

Homework Assignments (Approximately 75-80% of grade)
Most modules will include either a guided homework assignment and/or regular homework assignment. Guided homework assignments are setup where a particular data/analysis task is divided into small straight forward parts. My intention is that I "guide" you through a data/analysis the task to be completed. Guided homework assignments should take you about 30-60 minutes to complete. Some modules will include regular homework assignments. These are more traditional in nature and you will be asked to complete more substantial data/analysis task. You can expect regular homework assignments to take about 60-90 minutes to complete. All homework assignments will be distributed via Google Docs and completed assignments must be saved to your Google Drive.

Grades

Your grade is determined by the completion and performance of the required work for this course.

You must complete the interactive course notes for each module / part. The course notes will be scored as follows:

- 0 pts: Did not complete tasks and/or answer questions posed
- 3 pts: Attempted to successfully complete tasks and/or answer questions posed

After completing the set of course notes for a module / part, you will be required to complete either 1) Guided Homework Assignment and/or 2) Regular Homework Assignment.

For the Guided Homework Assignment, scoring will be done as follows

- 0 pts: Did not make a reasonable attempt to complete the assignment by the due date
- 4 pts: Made a reasonable attempt to sufficiently complete the assignment by the due date
- 7 pts: Sufficiently completed the assignment by the due date

Solutions to guided homework assignments will be provided upon submission. You should carefully review these solutions before moving onto the next content to be covered.

The Regular Homework Assignments will take more time to complete and are more typical in nature. These assignments will be worth between 20-25 points.

Note: You cannot submit homework assignments after solutions have been posted; thus, it is important that you submit your work before the specified deadline for the assignment.

Final grades will be determined using the following scale

- F: Less than 60%
- D: 60% - 70%
- C: 70% - 80%
- B: 80% - 90%
- A: 90% and above

Academic Integrity Policy:

The Academic Integrity Policy at Winona State University can be found at: http://www.winona.edu/sld/academicintegrity.asp Copying another student's work and/or allowing someone to copy your work are clear violations of WSU's Academic Integrity Policy. If there is reasonable evidence of copying another individual's or group's work, it will be construed as an act of plagiarism. The first occurrence of cheating will result in a score of zero on that specific homework assignment or exam portion; the second occurrence will result in failure of the course.

General Education Requirement - Goal 4:

The purpose of General Education Requirement – Goal 4 is to increase students' knowledge about mathematical and logical modes of thinking. This will enable students to appreciate the breadth of applications of mathematics, evaluate arguments, and detect fallacious reasoning. Students will learn to apply mathematics, logic, and\or statistics to help them make decisions in their lives and careers. Minnesota's public higher education systems have agreed that developmental mathematics includes the first three years of a high school mathematics sequence through intermediate algebra.

Student Competencies for Goal 4: Students will be able to:

- Illustrate historical and contemporary applications of mathematical/logical systems
- Clearly express mathematical/logical ideas in writing
- Explain what constitutes a valid mathematical/logical argument (proof)
- Apply higher-order problem-solving and/or modeling strategies

Aside from the Goal 4 competencies list above, the Department of Mathematics and Statistics have the following additional learning outcomes for the Stat 110 course.

- use logical reasoning by studying mathematical patterns and relationships;
- use mathematical models to describe real-world phenomena and to solve real-world problems - as well as
- understand the limitations of models in making predictions and drawing conclusions;
- organize data, communicate the essential features of the data, and interpret the data in a meaningful way;
- do a critical analysis of scientific and other research;
- extract correct information from tables and common graphical displays, such as line graphs, scatter plots, histograms, and frequency tables;
- use appropriate technology to describe and solve quantitative problems.

The following is the official course outline for this course. My goal is to cover most of these topics, but not necessarily in the order given.

OUTLINE OF MAJOR CONTENT AREAS

1. The Research Process
    a. The research question/hypothesis and the predictor, response, and population of interest
    b. The role of random samples; population vs. sample
    c. Types of studies
        i. experiments and the role of randomization
        ii. observational studies and effects of confounding
        iii. surveys and possible biases

2. Data Displays and Summary Statistics
    a. Categorical variables
        i. bar charts
        ii. frequency distributions
    b. For numeric variables
        i. measure of central tendency: mean/average, median
        ii. measures of variation: variance, standard deviation, interquartile range
        iii. robustness
        iv. histograms and boxplots
    c. Contingency tables
        i. row/column percentages
        ii. relative risk, difference between proportions, and odds ratios
        iii. relationships in r x c tables
    d. Scatterplots
        i. measures of correlation
        ii. simple linear regression
3. Introduction to Sampling Distributions
    a. Statistics vs. parameters
    b. Sampling errors
    c. The importance of random samples
4. Confidence Interval Estimation
    a. One-sample confidence intervals
        i. Inference about a single proportion
        ii. Inference about a single mean
    b. Two-sample confidence intervals
        i. Inference about a difference between two proportions
        ii. Inference about relative risks
        iii. Inference about a difference between means
    c. Paired-sample confidence interval, involving inference about a mean difference
5. Hypothesis Testing

a. Logic of hypothesis tests
b. Formulating hypotheses
c. P-values, type I & type II errors
d. Interpretation of results
    i. association vs. causation
    ii. description of a sample vs. inference about a population
    iii. statistical vs. practical significance

6. Comparative Analysis
    a. Independent samples
        i. difference between proportions
        ii. difference between means
        iii. Mann-Whitney-Wilcoxon Test
    b. Paired-sample tests
        i. paired-sample t-test
        ii. Wilcoxon signed-rank test
    c. Tests for contingency tables
        i. Fisher's Exact Test for 2x2 tables
        ii. ii. Chi-square test