MATH 0013 - ELEMENTARY STATISTICS

Catalog Description

Prerequisite: Completion of MATH D or E with grade of "C" or better; or appropriate placement
Hours: 72 lecture (4 units); 108 lecture (6 units)
Description: Introduction to the basic concepts of statistics. Emphasis on statistical reasoning and application of statistical methods. Topics include: graphical and numerical methods of descriptive statistics; methods of sampling; basic elements of probability; binomial, normal, and sampling distributions; the Central Limit Theorem; confidence interval estimates and hypothesis testing procedures for one and two population means and proportions; chi-square tests for goodness-of-fit and independence; linear regression and correlation; and an introduction to analysis of variance (ANOVA). Applications using data from business, economics, education, psychology, and the social and life sciences. (C-ID MATH 110) (CSU, UC-with unit limitation)

Course Student Learning Outcomes

- CSLO #1: Label and identify data by type and level of measurement.
- CSLO #2: Construct and interpret data using graphical and numerical methods of descriptive statistics.
- CSLO #3: Calculate and interpret problems involving basic elements of probability and sampling.
- CSLO #4: Conduct hypothesis tests and construct confidence interval estimates for population means and proportions; chi-square tests for goodness-of-fit and independence; linear regression and correlation; and one-way analysis of variance (ANOVA).
- CSLO #5: Logically present clear, complete, and sufficiently detailed solutions to demonstrate understanding and communicate reasoning of statistical methods using technology when appropriate.

Effective Term

Fall 2022

Course Type

Credit - Degree-applicable

Contact Hours

72,108

Outside of Class Hours

144,216

Total Student Learning Hours

216, 324

Course Objectives

Students will be able to:
1. Distinguish among different scales of measurement and their implications;
2. Identify the standard methods of obtaining data and identify advantages and disadvantages of each;
3. Interpret and describe data displayed in tables and graphically;
4. Calculate and interpret measures of central tendency and variation for a given data set;
5. Identify and explain the central role of variability in the field of statistics;
6. Apply concepts of sample space and basic rules of probability;
7. Calculate the mean and variance of a discrete distribution;
8. Calculate and interpret probabilities using the binomial, normal, and student's t-distributions;
9. Distinguish the difference between sample and population distributions and analyze the role played by the Central Limit Theorem;
10. Select an appropriate inferential statistics technique to apply in a given statistical problem solving and decision making process;
11. Construct and interpret confidence interval estimates for one and two population means and proportions;
12. Conduct a hypothesis testing procedure for one and two population means and proportions;
13. Determine and interpret levels of statistical significance including p-values;
14. Identify and explain Type I and II errors;
15. Perform an analysis of variance (ANOVA) and interpret the results;
16. Perform a chi-squared goodness-of-fit test and interpret the results;
17. Perform a chi-squared test for independence and interpret the results;
18. Perform a linear regression analysis and use the results to make appropriate predictions;
19. Utilize statistical computational technologies to analyze data and interpret the generated output;
20. Apply appropriate statistical techniques to analyze, interpret, and communicate results in context based on real data from a variety of disciplines including business, economics, education, psychology, and the social and life sciences.
21. Utilize the additional time in the 6 unit course to develop prerequisite skills necessary to be successful in the above objectives.

General Education Information

- Approved College Associate Degree GE Applicability
  - AA/AS - Comm & Analyt Thinking
  - AA/AS - Mathematical Skills
- CSU GE Applicability (Recommended-requires CSU approval)
  - CSUGE - B4 Math/Quantitative Reasoning
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)
  - IGETC - 2A Math/Quan Reasoning

Articulation Information

- CSU Transferable
- UC Transferable

Methods of Evaluation

- Objective Examinations
  - Example: 1. A soft drink dispenser can be adjusted to deliver any fixed number of ounces of soft drink. If the machine is operating with a standard deviation in delivery equal to 0.3 ounces, what should be the mean setting so that a 12-ounce cup will overflow less then 1% of the time? Assume a normal distribution for ounces delivered. (A) 11.23 ounces (B) 11.30 ounces (C) 11.70 ounces (D) 12.70 ounces (E) 12.77 ounces 2. A manufacturer claims that a particular automobile model will get 50 miles per gallon on the highway. The researchers at a consumer-oriented

magazine believe that this claim is high and plan a test with a simple random sample of 30 cars. Assuming the standard deviation between individual cars is 2.3 miles per gallon, what should the researchers conclude if the sample mean is 49 miles per gallon? (A) There is not sufficient evidence to reject the manufacturer's claim; 49 miles per gallon is too close to the claimed 50 miles per gallon. (B) The manufacturer's claim should not be rejected because the P-value of .0087 is too small. (C) The manufacturer's claim should be rejected because the sample mean is less than the claimed mean. (D) The P-value of .0087 is sufficient evidence to reject the manufacturer's claim. (E) The P -value of .0087 is sufficient evidence to prove that the manufacturer's claim is false.

- Problem Solving Examinations
  - Example: To assess student's understanding of certain course objectives the following problems could be placed on an examination. The instructor will evaluate the accuracy and quality of the student's solution. 1. The principal at Tahoe Elementary School randomly selected three of the school's twelve classes of students to participate in an opinion poll. All of the children in each of the three randomly selected classes were asked the question "What is your favorite fruit to eat?". The following results were obtained. Apple, Grapes, Apple, Apple, Banana, Apple, Apple, Grapes, Orange, Apple, Apple, Banana, Strawberries, Apple, Apple, Grapes, Apple, Orange, Apple, Apple, Apple, Apple, Grapes, Grapes, Apple, Orange, Apple, Apple, Banana, Apple, Apple, Apple, Strawberries, Apple, Orange, Grapes, Grapes, Apple, Grapes, Grapes, Grapes, Banana, Grapes, Banana, Apple, Banana, Grapes, Apple, Banana, Strawberries, Banana, Apple, Orange, Grapes, Orange, Grapes, Apple, Orange. Construct a percentage distribution table for this data and describe your results. 2. In a recent Harris Interactive poll, 51 out of 188 Americans living in the west said that they attend church regularly. Whereas, 58 out of 145 Americans living in the south said that they attend church regularly. Based on these results, can one conclude that the proportion of Americans who attend church regularly is lower in the west than in the south? Apply an appropriate statistical analysis technique to answer this question. 3. Before the semester began, Professor Wright predicted that 20% of her business students would receive an A, 40% a B, 25% a C, 10% a D, and 5% an F. At the end of the semester, 6 of Professor Wright's business students earned an A, 17 a B, 11 a C, 3 a D, and 1 an F. Use the Chi-Square test and a 0.05 level of significance to determine if Professor Wright's predicted percentages were accurate. Show your work.
- Projects
  - Example: The purpose of this project is to enhance and expand the student's experience with the application of statistical methods. Students must form a class group to collaborate with on this project. The group should consist of three to six students. Although the work submitted and the grade received will be as a group, each student will be accountable for all aspects of the project. The group is responsible for selecting the topic to investigate. The focus of the project can be anything of interest to the group. The only restriction is that this project must apply one of the statistical analysis techniques covered in class. The group's findings will be documented in a written report. The group project report must contain a descriptive title, an alphabetical listing of each group member's name, and be organized into four sections labeled: (1) Introduction, (2) Methods, (3) Results, and (4) Conclusions. The first section, Introduction, gives some background and a brief summary of what the project is about. The primary question or issue that this project intends to address should be clearly stated somewhere in the introduction. The second section, Methods, describes in sufficient detail how the data was collected and the process utilized in analyzing it. Include any limitations or assumptions made for the procedure applied in this project. The third section, Results, contains the essential elements and supporting information relevant to the outcome of this project. This could include the collected data, results of calculations, constructed tables or graphs, and work generated as the result of the statistical procedure. The fourth section, Conclusions, summarizes the results and answers the specific question or addresses the particular issue proposed in the introduction. The project report should be clear, complete, and concise. The project report can be evaluated on a standard rubric assessing the quality and accuracy of the content submitted in the project report.

Repeatable

No

Methods of Instruction

- Lecture/Discussion
- Distance Learning

Lecture:

1. Example 1: Lesson Plan - Reaction Time Men vs Women This learning activity involves your students in the statistical investigative process to address the issue of whether there is, on the average, a difference in the reaction time of men and women. The reaction time of students will be measured using an online reaction time test (https://www.humanbenchmark.com/tests/reactiontime) on the classroom computer presentation system (or with a reaction time app on a smartphone or by dropping a yardstick between the student's fingers). A TI-84 calculator (or other instructor preferred computational technology) will be used to conduct a two population mean hypothesis testing procedure using the reaction time sample data collected in class.
2. Introduce the learning activity by informing your students that they will follow the statistical investigative process to address the issue of whether there is, on the average, a difference in the reaction time of men and women.
3. Ask your students to share what conclusion they believe will be reached. Have them explain their reasoning.
4. Now, ask your students to identify the issue under investigation.
5. After your students respond that the issue under investigation is to determine whether or not there is, on the average, a difference in the reaction time of men and women, ask them to define the population of interest.
6. After your students realize that there are two populations of interest: men and women (or male Sierra College students and female Sierra College students), ask them to formulate the statistical question.
7. After your students formulate an appropriate statistical question, such as "Is there evidence to clearly suggest that there is a difference in the mean reaction time of men and women?", inform your students that you will be collecting relevant, representative data from male and female students in class (who are willing to participate).
8. Tell your students that the reaction time is defined as the interval of time between an application of a stimulus and the detection of

a response, and that you will be measuring their reaction time (in milliseconds) using an online reaction time test where the stimulus is a signal on the computer screen turning from red to green and the response is the student clicking the left mouse button.

9. Project the TI-84 calculator on the classroom presentation system and instruct your students to get their calculator prepared to enter the data into their calculator as it is collected in class.
10. Project the webpage www.humanbenchmark.com/tests/reactiontime in a browser on the classroom presentation system and provide your students with a detailed description and demonstration of the procedure followed to measure a student's reaction time. 1
11. Ask your students for one male and one female to volunteer and have their reaction time measured. First, follow the established procedure to measure the reaction time of the male student volunteer and enter his reaction time in the first list. Second, follow the established procedure to measure the reaction time of the female student volunteer and enter her reaction time in the second list. Have your student volunteers return to their seat so that they can enter the collected data into their calculator along with the rest of the class. 1
12. Repeat this data collection process several times. Discuss the concerns related to the small sample sizes collected and address the validity of the assumptions required to continue with the data analysis (Peoples' reaction times are approximately normally distributed). 1
13. After all of the sample data has been collected and entered into the calculator, instruct your students to work with a partner and analyze the sample data by conducting a hypothesis testing procedure to answer the statistical question. 1
14. Circulate around the classroom and observe your students' progress. Offer feedback and encouragement as needed. 1
15. After your students have completed this task, encourage them to guide you through the data analysis. Model the two population mean hypothesis testing procedure and engage your students in a discussion regarding the interpretation of the results. 1
16. Conclude this learning activity by summarizing the results and answering the statistical question. 1
17. Consider following this learning activity with the one that investigates the reaction times of a person's dominant and non-dominate hands. These learning activities complement each other. (Objectives 10, 12, 13, 14, 19 & 20) Example 2: Raisins in a Box Using an interactive lecture format, the instructor will develop the measures of central tendency and variation. To motivate the concept and start the discussion, the instructor can have the students count the number of raisins in 17 boxes. Create a method of displaying the number of raisins in each box. At this time the instructor can take the time for "just in time remediation" and spend time discussing the number of ways we can express the number of raisins in a box. (Objectives 3 & 4)

Distance Learning

1. Assign students to groups using the "People" feature of LMS labeling the "Group Set" name with the "group" feature allows students to have discussion with only members of their group. The assignment can be graded as a group. Title of the Lesson Plan/Activity. Each student will count the number of raisins in their box. A discussion question will be posted on why the size of the box of raisins makes a difference. Using the "survey" form on LMS (quiz feature – with one click to change to a feature) Your name, group name and # raisins, brand of raisins, size of the box. Be cautious that the survey will be graded because it is part of the quiz feature though not included in the gradebook). The instructor will do a conference with the all students showing the collected data which can be recorded (for those not able to attend) and made available for 14 days and discussing the different brands, the validity of the same size box, and the number of raisins and the average, range and variability. Students will submit a group summary prompted by questions given by the instructor. The instructor can create an assignment which can be assigned to "Group" and determine the "submission" as online. (Objectives 3 & 4)

Typical Out of Class Assignments

Reading Assignments

1. Read section of the textbook on standard scores before class and come to class prepared to discuss this topic and solve related problems. 2. Conduct a search of credible online statistics sources (such as Gallup at www.gallup.com, The Harris Poll at www.theharrispoll.com, or The Pew Research Center at www.pewresearch.org). Select and carefully read an article that reports a statistical result. Come to class prepared to share the article you selected and identify the issue under investigation, the population of interest, and the method of sampling used for one statistical result specified in the article. 3. Read section of the textbook on correlation and be prepared to discuss the difference between correlation and causation in class. 4. Read section of the textbook on hypothesis testing and be ready to discuss Type I and Type II errors.

Writing, Problem Solving or Performance

1. A woman wrote to Dear Abby and claimed that she gave birth 308 days after a visit from her husband, who was in the Navy. Length of pregnancies have a mean of 268 days and a standard deviation of 15 days. Is such a length unusual? What do you conclude? 2. Air America has a policy of booking as many as 15 persons on an Airplane that can seat only 14. Past studies have revealed that only 85% of the booked passengers actually arrive for the flight. Find the probability that if Air America books 15 persons, not enough seats will be available. Is this probability low enough so that overbooking is not a real concern for passengers? 3. In a recent Gallup Poll, 55% of 362 blacks polled and 64% of 438 Hispanics polled rated the risk of side effects of the childhood vaccine for measles, mumps, and rubella as low. Based on this poll, estimate the difference in the percentage of blacks and the percentage of Hispanics that rate the risk of side effects of the childhood vaccine for measles, mumps, and rubella as low with 95% confidence. Express the estimate both symbolically and verbally. 4. Investors not only desire a high return on their money, but they would also like the rate of return to be stable from year to year. An investment manager invests with the goal of reducing volatility (year-to-year fluctuations in the rate of return). The following data represent the rate of return (in percent) for his mutual fund for the past 12 years. It was verified that the data are normally distributed. 13.8 15.9 10.0 12.4 11.3 6.6 9.6 12.4 10.3 8.7 14.9 6.7 a) Determine the sample standard deviation. b) Construct a 95% confidence interval for the population standard deviation of the rate of return. c) The investment manager wants to have a population standard deviation for the rate of return below 6%. Does the confidence interval validate this desire?

Other (Term projects, research papers, portfolios, etc.)

Required Materials

- Elementary Statistics
  - Author: Triola, Mario F.
  - Publisher: Pearson
  - Publication Date: 2018
  - Text Edition: 13th
  - Classic Textbook?: No
  - OER Link:
  - OER:
- Elementary Statistics
  - Author: Navidi, William and Monk, Barry
  - Publisher: McGraw Hill
  - Publication Date: 2018
  - Text Edition: 3rd
  - Classic Textbook?: No
  - OER Link:
  - OER:
- Introduction to the Practice of Statistics
  - Author: Moore, McCabe & Craig
  - Publisher: MacMillan
  - Publication Date: 2017
  - Text Edition: 9th
  - Classic Textbook?: No
  - OER Link:
  - OER:
- Introductory Statistics
  - Author: Illowsky & Dean
  - Publisher: OpenSTAX
  - Publication Date: 2016
  - Text Edition: 1st
  - Classic Textbook?: No
  - OER Link:
  - OER:
- Mind on Statistics
  - Author: Utts & Heckard
  - Publisher: Cengage
  - Publication Date: 2015
  - Text Edition: 5th
  - Classic Textbook?: No
  - OER Link:
  - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.

A statistically enabled scientific calculator or a computer with a statistical analysis software package installed.