Statistics

Grade Level:	11-12
Prerequisite:	It is recommended that students have successfully completed 3 years of the college prep math curriculum (Algebra I, Algebra II, Geometry).
Length:	1 Year
Period(s) Per Day:	1
Credit:	1
Credit Requirement Fulfilled:	Mathematics

Course Description

Statistics is an alternative math course for those students that do not want to take AP Calculus. The course will be spilt into four parts: Getting information, Descriptive Statistics, Probability and Probability Distribution and Hypothesis Testing. The course will start with sampling methods and collecting data to organizing data to hypothesis testing with two means. If time allows ANOVA will be taught. **This course can be taken as a dual credit within the Montana University System (STAT 216).**

Theme Samples

Sample Methods

Organizing Qualitative and Quantitative Data (Graphs and Tables)

Measures of Central Tendency

Measures of Dispersion

Five Number Summary

Least Squares Regression

Probability

Probability Distributions

Normal Distributions and Standard Normal Distributions

Distributions of Samples

Confidence Intervals

Hypothesis Tests

Type 1 and Type II Error

Inference about Two Means

ANOVA Test

Objectives and Expectations

1. To summarize, represent, and interpret data on a single count or measurement variable.
2. To summarize, represent, and interpret data on two categorical and quantitative variables.
3. To interpret linear models.
4. To understand independence and conditional probability and use them to interpret data.
5. To use the rules of probability to compute probabilities of compound events in a uniform probability model.
6. To calculate expected values and use them to solve problems.
7. To use probability to evaluate outcomes of decisions.
8. To understand and evaluate random processes underlying statistical experiments.
9. To make inferences and justify conclusions from sample surveys, experiments, and observational studies.

Pacing	***timeline***	***MCCSM***
Semester 1		
Chapter 1 Data Collection	3 weeks	S-ID
Chapter 2 Organizing and Summarizing Data	2 weeks	S-ID
Chapter 3 Numerically Summarizing Data	2 weeks	S-ID
Chapter 4 Describing the Relation between Two Variables	3 weeks	S-ID
Chapter 5 Probability	3 weeks	S-CP
Chapter 6 Discrete Probability Distribution	2 weeks	S-MD
Project for first semester	2 weeks	S-ID, S-CP, S-MD
Semester 2		
Chapter 7 The Normal Probability Distribution	3 weeks	S-MD
Chapter 8 Sampling Distribution	1 week	S-MD
Chapter 9 Estimating the value of a Parameter Using Confidence Intervals	2 weeks	S-IC
Chapter 10 Hypothesis Tests Regarding a Parameter	3 weeks	S-IC
Chapter 11 Inferences on Two Samples	2 weeks	S-IC
Chapter 12 Inference on Categorical Data	1 week	S-IC
Chapter 13 Comparing Three or More Means	2 weeks	S-IC
Project for second semester	2 weeks	S-ID, S-CP,S-MD, S-IC

Montana Standards for Statistics

Interpreting Categorical and Quantitative Data S-ID

Summarize, represent, and interpret data on a single count or measurement variable.

1. Represent data with plots on the real number line (dot plots, histograms, and box plots).
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables, and Montana American Indian data sources to estimate areas under the normal curve.

Summarize, represent, and interpret data on two categorical and quantitative variables.

5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
    a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
    b. Informally assess the fit of a function by plotting and analyzing residuals.
    c. Fit a linear function for a scatter plot that suggests a linear association.

Interpret linear models.

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
8. Compute (using technology) and interpret the correlation coefficient of a linear fit.
9. Distinguish between correlation and causation.

Making Inferences and Justifying Conclusions S-IC

Understand and evaluate random processes underlying statistical experiments.

1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
4. Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
6. Evaluate reports based on data.

Conditional Probability and the Rules of Probability S-CP

Understand independence and conditional probability and use them to interpret data.

1. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").
2. Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
3. Understand the conditional probability of *A* given *B* as *P*(*A* and *B*)/*P*(*B*), and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A*, and the conditional probability of *B* given *A* is the same as the probability of *B*.
4. Construct and interpret two-way frequency tables of data including information from Montana American Indian data sources when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*
5. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*

Use the rules of probability to compute probabilities of compound events in a uniform probability model.

6. Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model.
7. Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.
8. (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.
9. (+) Use permutations and combinations to compute probabilities of compound events and solve problems.

Using Probability to Make Decisions **S-MD**

Calculate expected values and use them to solve problems.

1. (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.
2. (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
3. (+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.*
4. (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. *For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?*

Use probability to evaluate outcomes of decisions.

5. (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
    a. Find the expected payoff for a game of chance. *For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.*
    b. Evaluate and compare strategies on the basis of expected values. *For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.*
6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
7. (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

Resources:

Textbook**:** Statistics Informed Decisions Using Data, fifth edition
Authors: Michael Sullivan, III
Company: Pearson
Copyright: 2017
Solution Manuel that is downloaded onto my computer.