

AP Statistics Course Syllabus

Course Overview

Statistics are used everywhere from fast food businesses ordering hamburger patties to insurance companies setting rates to predicting a student's future success by the results of a test. Students will become familiar with the vocabulary, method, and meaning in the statistics which exist in the world around them. This is an applied course in which students actively construct their own understanding of the methods, interpretation, communication, and application of statistics. [C4] Each unit is framed by enduring understandings and essential questions designed to allow students a deep understanding of the concepts at hand rather than memorization and emulation. Students will also complete several performance tasks throughout the year consisting of relevant, open-ended tasks requiring students to connect multiple statistical topics together. [C4] The TI-83+/84 OR 89 calculator and computers will be used to explore the world of data and the patterns which can be found by analyzing this information as well as statistical relationships. [C5] General topics of study include "exploring data," "planning and design of a study," "anticipating patterns," and "statistical inference."

C4: The course teaches students how to communicate methods, results, and interpretations using the vocabulary of statistics.

C5: The course teaches students how to use graphing calculators and demonstrates the use of computers and/or computer output to enhance the development of statistical understanding through exploration and analysis of data, assessment of models, and simulations.

Primary Textbook References and Resource Materials

AP Statistics content located at www.class.spokaneschools.org .

Selected, released free response questions from The College Board.

Various free website resources including but not limited to: HyperStat, www.StatTrek.com, www.ti.com, www.mathbits.com, www.shodor.org, and illuminations.nctm.org/

Teacher Reference: Yates, Daniel S., Moore, David S., and McCabe, George P. *The Practice of Statistics*. First Edition. New York: W. H. Freeman and Company, 1999.

Overarching Enduring Understandings for the course

- Mathematics is a useful language for symbolically modeling and thus simplifying and analyzing our world.
- Mathematics is a logical and objective means of analyzing and solving problems.
- The effective communication of mathematics is essential to its application. [C4]

Topical Enduring Understandings for the course

- Students will understand that statistical information is a powerful, pervasive force in our world.
- Exploratory analysis of data makes use of graphical and numerical techniques to study patterns and departures from patterns. [C2a]
- Data must be collected according to a well-developed plan if valid information is to be obtained. [C2b]
- Probability is the tool used for anticipating what the distribution of data should look like under a given model. [C2c]
- Statistical inference guides the selection of appropriate models. [C2d]
- Students will understand that statistics can be used to make valuable, reliable inferences from empirical information. [C2d]
- The appropriate communication and interpretation of statistics is essential to avoiding statistical abuse and/or misunderstanding. [C4]
- Analysis of data is made possible through the use of calculator and computer technology. [C5]

C4: The course teaches students how to communicate methods, results, and interpretations using the vocabulary of statistics.

C2a: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on exploring data.

C2b: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on sampling and experimentation.

C2c: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on anticipating patterns.

C5: The course teaches students how to use graphing calculators and demonstrates the use of computers and/or computer output to enhance the development of statistical understanding through exploration and analysis of data, assessment of models, and simulations.

C4: The course teaches students how to communicate methods, results, and interpretations using the vocabulary of statistics.

C2d: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on statistical inferences.

Unit 1 – Exploring Univariate Data (3.5 Weeks)

Enduring Understandings

- Interpretation of data is dependent upon the graphical displays and numerical summaries. [C2a]
- Graphical displays are created for the purpose of analysis and communication. [C4]

C2a: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on exploring data.

Essential Questions

- How do we communicate data?
- How do we understand data?
- Can you lie with statistics? How and to what extent?

C4: The course teaches students how to communicate methods, results, and interpretations using the vocabulary of statistics.

Knowledge and Skills

- Construct dotplots, stemplots, histograms, and cumulative frequency plots.
- Interpret dotplots, stemplots, histograms, and cumulative frequency plots.
- Describe center, shape, spread, clusters, gaps, outliers and other unusual features
- Measure center using mean and median
- Measure spread using range, interquartile range, and standard deviation
- Measure position using quartiles, percentiles, and standardized (z) scores
- Use boxplots (and modified) with the five number summary
- Understand the effect of changing units on summary measures
- Do normal calculations
- Use dotplots, back-to-back stemplots, and parallel boxplots
- Compare center and spread both within a group and between groups
- Discuss shape, outliers, center, and spread of distributions
- Compare position of different distributions using standardization

C5: The course teaches students how to use graphing calculators and demonstrates the use of computers and/or computer output to enhance the development of statistical understanding through exploration and analysis of data, assessment of models, and simulations.

Sample Assessments/Activities

- Using one of the sites below (from the [DASL website](#)), students perform an analysis of the distribution of the data. Analysis includes graphically displaying the data, evaluating its ‘normalcy’, describing it numerically, and making claims about the distribution of individual data values. Students then locate an individual data point, find its standardized value, and determine its percentile ranking. Findings are presented in a format of their choice. [C2a, C4, C5]
- Students complete a variety of released free response items focused on summarizing and comparing univariate data.

Unit 2 – Exploring Bivariate and Categorical Data (4 Weeks)

Enduring Understandings

- Regression is an effective model for prediction. [C2a]
- There is a difference between causation and correlation. [C2a]

Essential Questions

- To what extent can we predict the future?
- Is correlation ever causation?
- How can modeling data help us to understand patterns?

Knowledge and Skills

- Create and analyze patterns in scatterplots
- Understand correlation and linearity
- Construct, interpret and use least-squares regression lines
- Construct and interpret residual plots
- Identify and describe outliers and influential points
- Make transformations to achieve linearity (logarithmic and power)
- Create and interpret frequency tables and bar charts
- Create and interpret marginal and joint frequencies for two-way tables
- Create and interpret conditional relative frequencies and determine association
- Compare distributions using bar charts

Sample Assessments/Activities

- Choose a problem that interests you involving a dependent variable and an independent variable. The sample data for this problem must consist of at least 20 data points and must come from your own research or from an official, reputable site on the World Wide Web. Using technology (TI-Interactive or other application), construct a scatterplot and then perform a correlation & regression analysis on this data set. Write a report on the data and its analysis which includes a complete reference for the source of your data, the computer analysis of your data (must consist of a scatterplot, correlation analysis and regression analysis) and one or two well-written paragraphs summarizing your interpretation of these results. Be sure to address both sides of the story statistically. [C2a, C5]
- Students complete a variety of released free response items focused on linear and non-linear regression.

C2a: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on exploring data.

C5: The course teaches students how to use graphing calculators and demonstrates the use of computers and/or computer output to enhance the development of statistical understanding through exploration and analysis of data, assessment of models, and simulations.

Unit 3 – Planning and Conducting Studies and Experiments (3 Weeks)

Enduring Understandings

- Careful planning is essential to obtaining valid data. [C2b]
- Clarifying the question leads to appropriate methodology. [C2b]
- The analysis is only as good as the data. [C2b]
- Students will understand how to deconstruct statistical information in an effort to evaluate its validity and assess the aims of the authors in presenting the information. [C2b]

C2b: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on sampling and experimentation.

Essential Questions

- How do we obtain data?
- To what extent is all data biased?
- To what extent does data collection methodology affect results?
- How can variable be eliminated through randomization?
- How does one decide between an observational study, an experiment, and a simulation?
- To what extent can data be purposefully biased?

Knowledge and Skills

Methods of data collection:

- Census, Sample survey, Experiment, Observational study

Planning and conducting surveys

- Know the characteristics of a well-designed survey
- Understand populations, samples, and random selection
- Recognize sources of bias in sampling and surveys (undercoverage, voluntary response, etc.)
- Recognize and apply sampling methods (simple random sampling, stratified random sampling, and cluster sampling)

Planning and conducting experiments

- Know the characteristics of a well-designed and well-conducted experiment
- Understand treatments, control groups, experimental units, random assignments, and replication
- Recognize sources of bias (including confounding variables, the placebo effect, and blinding)
- Recognize and apply completely randomized designs
- Recognize and apply different experimental designs (randomized block design, matched pairs design)

Generalize results from collected data

Understand the types of conclusions that may be drawn from collected data

Sample Assessments/Activities

- Students find and statistically analyze an article in a newspaper, magazine, or other current publication. Students consider: [C2b, C4, C3]

C4: The course teaches students how to communicate methods, results, and interpretations using the vocabulary of statistics.

- Is this an observational study or an experiment?
- What was the sampling design or experimental design?
- What are the possible biases in the study?
- How was randomization utilized?
- To what extent are the conclusions in the article justified and able to be generalized?
- Students complete a variety of released free response items focused on sampling methods, simulations, and experimental design.

C3: The course draws connections between all aspects of the statistical process, including design, analysis, and conclusions.

Unit 4 – Probability and Random Variables (3.5 Weeks)

Enduring Understandings

- Probability models are useful tools for making decisions and predictions. [C2c]
- Students will understand that probability is the basis of statistical inference. [C2c]
- The notion and behavior of a random variable is foundational to understanding probability distributions. [C2c]

C2c: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on anticipating patterns.

Essential Questions

- When is probability a sure thing?
- How can we base decisions on chance?
- What is a random variable?
- How may random variables be combined?

Knowledge and Skills

- Create and interpret probability models
- Find and interpret long-run relative frequencies
- Apply the Law of Large Numbers
- Apply the addition and multiplication rules
- Understand independence and disjoint
- Understand conditional probability
- Create and apply simulations to access their probability distributions [C5]
- Mean and standard deviation for sums and differences of independent random variables.

Sample Assessments/Activities

- Students design and play a game of chance (using dice or cards) to illustrate their understanding of the rules of probability, expected value, the law of large numbers, and the nature of random variables. Students first use simulation [C5] to 'test' the variance of their game and follow up by actually playing the game with classmates and subsequently write a summary of their results. Results help students to conceptualize the notions of sampling variability and set the stage for the study of sampling distributions. [C2c]

C5: The course teaches students how to use graphing calculators and demonstrates the use of computers and/or computer output to enhance the development of statistical understanding through exploration and analysis of data, assessment of models, and simulations.

- Students complete a variety of released free response items focused on probability and expected value.

Units 5 & 6 – Binomial, Geometric, and Sampling Distributions (3.5 Weeks)

Enduring Understandings

- Many discrete phenomena may be described and thus predicted by binomial and geometric models. [C2b, C2c]
- The normal distribution and central limit theorem are essential to analyzing samples of data. [C2b, C2c]

C2b: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on sampling and experimentation.

Essential Questions

- How can modeling predict the future?
- To what extent does our world exhibit binomial and geometric phenomena?
- How do sampling distributions relate to population distributions?
- What is a normal distribution?
- How does the normal distribution apply to the real world?

C2c: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on anticipating patterns.

Knowledge and Skills

- Recognize and apply the binomial distribution
- Find the mean and standard deviation of a binomial distribution
- Recognize and apply the geometric distribution
- Find the geometric mean
- Properties of the normal distribution
- The normal distribution as a model for measurements
- Sampling distribution of a sample proportion
- Sampling distribution of a sample mean
- Central Limit Theorem
- Sampling distribution of a difference between two sample proportions
- Sampling distribution of a difference between two sample means

Sample Assessments/Activities

- Students visit the [Rice Virtual Lab](#) to explore the Central Limit Theorem and sampling distributions. Students construct their understanding of how sample size and the shape of the population distribution affect the sampling distribution of the mean (and other statistics). [C2c, C5]
- Students complete a variety of released free response items focused on binomial, geometric, and sampling distributions.

C5: The course teaches students how to use graphing calculators and demonstrates the use of computers and/or computer output to enhance the development of statistical understanding through exploration and analysis of data, assessment of models, and simulations.

Unit 7 – Introduction to Inference (3.5 Weeks)

Enduring Understandings

- Students will understand the underpinnings of statistical inference. [C2d]
- Inference is based upon chance. [C2d]
- Confidence intervals are effective tools for estimation. [C2d]
- Tests of significance and confidence intervals drive decision making in our world. [C2d]
- Error analysis is a critical component of significance testing. [C2d]

C2d: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on statistical inferences.

Essential Questions

- What is inference?
- How can decisions be based on chance?
- To what extent should decisions be based on chance?
- How can we determine the mean of a population with a “small” sample?
- When are tests of significance and confidence intervals used?
- How can one prepare for errors from significance tests?

Knowledge and Skills

- Check assumptions for confidence intervals and significance tests
- Find confidence intervals
- Conduct significance tests
- Type I, Type II errors, and Power
- Find the probability of Type I errors
- Understand the relationship between the probabilities of Type I and Type II errors

Sample Assessments/Activities

- Class activity to determine which students had ESP (extra sensory perception). Students work in pairs setting up an experiment to determine if their partner has ESP. Data is then analyzed through conducting a significance test as well as a discussion of significance level and probability of Type I and Type II errors. [C2d, C4]

C4: The course teaches students how to communicate methods, results, and interpretations using the vocabulary of statistics.

Units 8 & 9 – Inference for Means and Proportions (3.5 Weeks)

Enduring Understandings

- Confidence intervals are effective tools for estimating the mean of a population. [C2d]
- Significance tests determine the likelihood of a sample. [C2d]
- The analysis is only as good as the data. [C3]
- Confidence intervals are effective tools for estimating the proportion of a population. [C2d]
- Significance tests determine the likelihood of a sample. [C2d]

C2d: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on statistical inferences.

Essential Questions

- How can we determine the mean of a population with a “small” sample?
- To what extent are significance tests reliable?
- How can we determine the proportion of a population with a “small” sample?
- To what extent are significance tests reliable?

C3: The course draws connections between all aspects of the statistical process, including design, analysis, and conclusions.

Knowledge and Skills

- Check assumptions for confidence intervals and significance tests of means (both 1 sample and 2 sample)
- Find confidence intervals for means (both 1 sample and 2 sample)
- Conduct significance tests for means (both 1 sample and 2 sample)
- Determine sample size for a desired margin of error
- Check assumptions for confidence intervals and significance tests of proportions (both 1 sample and 2 sample)
- Find confidence intervals for proportions (both 1 sample and 2 sample)
- Conduct significance tests for proportions (both 1 sample and 2 sample)
- Determine sample size for a desired margin of error

Sample Assessments/Activities

- Parking lot proportions: Students venture out to the school parking lot and collect data about the vehicles in the staff lot as well as the student lot. Data such as car color, make, country of origin, and type of car. Students then construct confidence intervals and run significance tests to determine if and what differences there are between the students' cars and staffs' cars. [C2d, C4]
- Students complete a variety of released free response items focused on inference for means and proportions.

C4: The course teaches students how to communicate methods, results, and interpretations using the vocabulary of statistics.

Units 10 & 11 – Inference for Goodness of Fit, Independence, Homogeneity, and Regression (4 Weeks)

Enduring Understandings

- Significance tests can also determine the likelihood of a sample from a series of proportions. [C2d]
- Significance tests can also determine the whether two variables are independent. [C2d]
- Significance tests can determine the likelihood of a bivariate sample's slope. [C2d]

C2d: The course provides instruction in each of the following four broad conceptual themes outlined in the Course Description with appropriate emphasis on statistical inferences.

Essential Questions

- How can we test a series of proportions?
- How can we verify that two variables are independent?
- How can we test the slope of a correlation?

C3: The course draws connections between all aspects of the statistical process, including design, analysis, and conclusions.

Knowledge and Skills

- Check assumptions for both chi-squared goodness of fit and chi-squared test of independence
- Conduct significance tests for both chi-squared goodness of fit and chi-squared test of independence
- Check assumptions for inference for regression or a linear regression test.
- Conduct significance tests for linear regressions

Sample Assessments/Activities

- Have you ever wondered why the package of M&Ms you just bought never seems to have enough of your favorite color? Or, why is it that you always seem to get the package of mostly brown M&Ms? What's going on at the Mars Company? Is the number of the different colors of M&Ms in a package really different from one package to the next, or does the Mars Company do something to insure that each package gets the correct number of each color of M&M? Students run a complete significance test both in groups and as an entire class to justify their results. [C2d, C3, C4]
- Students complete a variety of released free response items focused on inference for independence, goodness of fit, and regression.

C3: The course draws connections between all aspects of the statistical process, including design, analysis, and conclusions.

C4: The course teaches students how to communicate methods, results, and interpretations using the vocabulary of statistics.