AP Statistics

Course Description:

Advanced Placement Statistics is a 2-trimester elective course. The curriculum, typical of an introductory college-level statistics course, is developed from the College Board. This is a weighted course (1.0). Successful completion of the AP Exam in Statistics, a score of 3 or better, could result in college credit earned in Statistics. The information in this course overview outlines what students should understand and be able to do by the end of two trimesters.

In this course, students develop strategies for collecting, organizing, analyzing, and drawing conclusions from data. Students design, administer, and tabulate results from surveys and experiments. Probability and simulations aid students in constructing models for chance phenomena. Sampling distributions provide the logical structure for confidence intervals and hypothesis tests. Students use a TI-84 graphing calculator and Web-based java applets to investigate statistical concepts. Daily classroom discussions will refine students' understanding of the course topics.

Course Design
This course places an appropriate emphasis on the four major themes of AP statistics, which include:

- Exploring Data: Describing patterns and departures from patterns.
- Sampling and Experimentation: Planning and conducting a study.
- Anticipating Patterns: Exploring random phenomena using probability.
- Statistical Inference: Estimating population parameters and testing hypotheses.

Course Goals
In AP Statistics, students are expected to learn:

- Statistical Concepts: Describe the four major conceptual themes above.
- Statistical Skills: Produce oral and written statistical arguments, using appropriate terminology, in a variety of applied settings. Know when and how to use technology as an aid in solving statistical problems.
- Statistical Knowledge: Employ techniques for producing data, analyzing data, modeling data, and drawing conclusions from data in context.
- Statistical Habits of Mind: Students should be critical consumers of published statistical results by heightening awareness of ways in which statistics can be improperly used to mislead, confuse, or distort the truth.

Mastery Standards:

Interpret expressions that represent a quantity in terms of its context.

Analyze functions using different representations.

Construct and compare linear, quadratic, and exponential models and solve problems.

Interpret expressions for functions in terms of the situation they model.

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

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

Understand and evaluate random processes underlying statistical experiments.

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

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

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

Use probability to evaluate outcomes of decisions.

Unit	Description of Unit and Learning Targets
Unit Title: Exploring Data Essential Questions: ● How do we communicate and understand data?	Students will……. Learning Targets: ● Identify the individuals and variables in a set of data. ● Classify variables as categorical or quantitative. ● Make and interpret bar graphs for categorical data. ● Identify what makes some graphs of categorical data misleading. ● Calculate marginal and joint relative frequencies from a two-way table. ● Calculate conditional relative frequencies from a two-way table. ● Use bar graphs to compare distributions of categorical data. ● Describe the nature of the association between two categorical variables. ● Make and interpret dot plots, stemplots, and histograms of quantitative data. ● Identify the shape of a distribution from a graph. ● Describe the overall pattern (shape, center, and variability) of a distribution and identify any major departures from the pattern (outliers). ● Compare distributions of quantitative data using dot plots, stemplots, and histograms. ● Calculate measures of center (mean, median) for a distribution of quantitative data. ● Calculate and interpret measures of variability (range, standard deviation, IQR) for a distribution of quantitative data. ● Explain how outliers and skewness affect measures of center and variability. ● Make and interpret boxplots of quantitative data. ● Identify outliers using the 1.5 X IQR rule. ● Use boxplots and numerical summaries to compare distributions of quantitative data.
Unit Title: The Normal Distribution Essential Questions: ● How does the normal distribution apply to the real world?	Students will... Learning Targets: ● Find and interpret the percentile of an individual value in a distribution of data. ● Estimate percentiles and individual values using a cumulative relative frequency graph. ● Find and interpret the standardized score (z-score) of an individual value in a distribution of data. ● Describe the effect of adding, subtracting, multiplying by, or dividing by a constant on the shape, center, and variability of a distribution of data. ● Use a density curve to model distributions of quantitative data. ● Identify the relative locations of the mean and median of a distribution from a density curve. ● Use the 68–95–99.7 rule to estimate (i) the proportion of values in a specified interval, or (ii) the value that corresponds to a given percentile in a Normal distribution. ● Find the proportion of values in a specified interval in a Normal

	distribution using Table A or technology. ● Find the value that corresponds to a given percentile in a Normal distribution using Table A or technology. ● Determine whether a distribution of data is approximately Normal from graphical and numerical evidence.
Unit Title: Examining Relationships <u>Essential Questions:</u> ● To what extent can we predict the future? ● Is correlation ever causation?	Students will... <u>Learning Targets:</u> ● Distinguish between explanatory and response variables for quantitative data. ● Make a scatterplot to display the relationship between two quantitative variables ● Describe the direction, form, and strength of a relationship displayed in a scatterplot and identify unusual features. ● Interpret the correlation. ● Understand the basic properties of correlation, including how the correlation is influenced by outliers. ● Distinguish correlation from causation. ● Make predictions using regression lines, keeping in mind the dangers of extrapolation. ● Calculate and interpret a residual. ● Interpret the slope and y intercept of a regression line. ● Determine the equation of a least-squares regression line using technology or computer output. ● Determine the equation of a least-squares regression line using technology or computer output. ● Construct and interpret residual plots to assess whether a regression model is appropriate. ● Interpret the standard deviation of the residuals and *r*-squared and use these values to assess how well a least-squares regression line models the relationship between two variables. ● Describe how the least-squares regression line, standard deviation of the residuals, and r^2 are influenced by outliers. ● Find the slope and y intercept of the least-squares regression line from the means and standard deviations of x and y and their correlation.
Unit Title: More on Two-Variable Data <u>Essential Questions:</u> ● How can modeling data help us to understand patterns?	Students will... <u>Learning Targets:</u> ● Use transformations involving powers and roots to find a power model that describes the relationship between two variables, and use the model to make predictions. ● Use transformations involving logarithms to find a power model or an exponential model that describes the relationship between two variables, and use the model to make predictions. ● Determine which of several transformations does a better job of producing a linear relationship.
Unit Title: Producing Data <u>Essential Questions:</u> ● How do we obtain data? ● To what extent is all data biased?	Students will... <u>Learning Targets:</u> ● Identify the population and sample in a statistical study. ● Identify voluntary response sampling and convenience sampling and explain how these sampling methods can lead to bias.

	● Describe how to select a simple random sample with technology or a table of random digits. ● Describe how to select a sample using stratified random sampling and cluster sampling, distinguish stratified random sampling from cluster sampling, and give an advantage of each method. ● Explain how undercoverage, nonresponse, question wording, and other aspects of a sample survey can lead to bias. ● Explain the concept of confounding and how it limits the ability to make cause-and-effect conclusions. ● Distinguish between an observational study and an experiment, and identify the explanatory and response variables in each type of study. ● Identify the experimental units and treatments in an experiment. ● Describe the placebo effect and the purpose of blinding in an experiment. ● Describe how to randomly assign treatments in an experiment using slips of paper, technology, or a table of random digits. ● Explain the purpose of comparison, random assignment, control, and replication in an experiment. ● Describe a completely randomized design for an experiment. ● Describe a randomized block design and a matched pairs design for an experiment and explain the purpose of blocking in an experiment. ● Explain the concept of sampling variability when making an inference about a population and how sample size affects sampling variability. ● Explain the meaning of statistically significant in the context of an experiment and use simulation to determine if the results of an experiment are statistically significant. ● Identify when it is appropriate to make an inference about a population and when it is appropriate to make an inference about cause and effect. ● Evaluate if a statistical study has been carried out in an ethical manner.
Unit Title: Probability: The Study of Randomness <u>Essential Questions:</u> ● When is probability a sure thing? ● How can we base decisions on chance?	Students will... <u>Learning Targets:</u> ● Interpret probability as a long-run relative frequency. ● Use simulation to model chance behavior. ● Give a probability model for a chance process with equally likely outcomes and use it to find the probability of an event. ● Use basic probability rules, including the complement rule and the addition rule for mutually exclusive events. ● Apply the general addition rule to calculate probabilities. ● Use a two-way table or Venn diagram to model a chance process and calculate probabilities involving two events. ● Use a two-way table or Venn diagram to model a chance process and calculate probabilities involving two events. ● Calculate and interpret conditional probabilities. ● Determine if two events are independent. ● Use the general multiplication rule to calculate probabilities. ● Use a tree diagram to model a chance process involving a sequence of outcomes and to calculate probabilities. ● When appropriate, use the multiplication rule for independent events to calculate probabilities.

Unit Title: Random Variables Essential Questions: ● What role do Random variables play in statistics? ● Combining random variables leads to what?	Students will... Learning Targets: ● Use the probability distribution of a discrete random variable to calculate the probability of an event. ● Make a histogram to display the probability distribution of a discrete random variable and describe its shape. ● Calculate and interpret the mean (expected value) of a discrete random variable. ● Calculate and interpret the standard deviation of a discrete random variable. ● Use the probability distribution of a continuous random variable (uniform or Normal) to calculate the probability of an event. ● Describe the effect of adding or subtracting a constant or multiplying or dividing by a constant on the probability distribution of a random variable. ● Calculate the mean and standard deviation of the sum or difference of random variables. ● Find probabilities involving the sum or difference of independent Normal random variables.
Unit Title: The Binomial and Geometric Distributions Essential Questions: ● To what extent does our world exhibit binomial and geometric phenomena?	Students will... Learning Targets: ● Determine whether the conditions for a binomial setting are met. ● Calculate and interpret probabilities involving binomial distributions. ● Determine whether the conditions for a binomial setting are met. ● Calculate the mean and standard deviation of a binomial random variable. Interpret these values in context. ● Calculate and interpret probabilities involving binomial distributions. ● When appropriate, use the Normal approximation to the binomial distribution to calculate probabilities. ● Find probabilities involving geometric random variables.
Unit Title: Sampling Distributions Essential Questions: ● How do sampling distributions relate to population distributions?	Students will... Learning Targets: ● Distinguish between a parameter and a statistic. ● Create a sampling distribution using all possible samples from a small population. ● Distinguish among the distribution of a population, the distribution of a sample, and the sampling distribution of a statistic. ● Use the sampling distribution of a statistic to evaluate a claim about a parameter. ● Determine if a statistic is an unbiased estimator of a population parameter. ● Describe the relationship between sample size and the variability of a statistic. ● Calculate the mean and standard deviation of the sampling distribution of a sample proportion and interpret the standard deviation. ● Determine if the sampling distribution of a sample proportion is

	approximately Normal. ● If appropriate, use a Normal distribution to calculate probabilities involving a sample proportion . ● Calculate the mean and standard deviation of the sampling distribution of a sample mean and interpret the standard deviation. ● If appropriate, use a Normal distribution to calculate probabilities involving sample means. ● Explain how the shape of the sampling distribution of a sample mean is affected by the shape of the population distribution and the sample size. ● If appropriate, use a Normal distribution to calculate probabilities involving a sample mean.
Unit Title: Introduction to Inference <u>Essential Questions:</u> ● What does Inference leads to? ● 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?	Students will... <u>Learning Targets:</u> ● Identify an appropriate point estimator and calculate the value of a point estimate. ● Interpret a confidence interval in context. ● Determine the point estimate and margin of error from a confidence interval. ● Use a confidence interval to make a decision about the value of a parameter. ● Interpret a confidence level in context. ● Describe how the sample size and confidence level affect the margin of error. ● Explain how practical issues like nonresponse, undercoverage, and response bias can affect the interpretation of a confidence interval. ● Interpret a P-value in context. ● Make an appropriate conclusion for a significance test. ● Interpret a Type I error and a Type II error in context. Give a consequence of each error in a given setting. ● Interpret the power of a significance test and describe what factors affect the power of a test.
Unit Title: Inference for Distributions <u>Essential Questions:</u> ● How can we determine the mean of a population with a “small” sample? ● To what extent are significance tests reliable?	Students will... <u>Learning Targets:</u> ● State appropriate hypotheses for a significance test about a population parameter. ● Interpret a P-value in context. ● Make an appropriate conclusion for a significance test. ● State and check the Random, 10%, and Normal/ Large Sample conditions for constructing a confidence interval for a population mean. ● Construct and interpret a confidence interval for a population mean. ● Construct and interpret a confidence interval for a population mean. ● Determine the sample size required to obtain a C% confidence interval for a population mean with a specified margin of error. ● Calculate the standardized test statistic and P-value for a test about a population mean. ● Perform a significance test about a population mean. ● Describe the shape, center, and variability of the sampling distribution of the difference of means.

	● Determine whether the conditions are met for doing inference about a difference between two means. ● Construct and interpret a confidence interval for a difference between two means. ● Calculate the standardized test statistic and P-value for a test about a difference between two means. ● Perform a significance test for the difference between two means. ● Analyze the distribution of differences in a paired data set using graphs and summary statistics. ● Construct and interpret a confidence interval for a mean difference. ● Perform a significance test about a mean difference. ● Determine when it is appropriate to use paired t procedures versus two-sample t
Unit Title: Inference for Proportions <u>Essential Questions:</u> ● How can we determine the proportion of a population with a “small” sample? ● To what extent are significance tests reliable?	Students will... <u>Learning Targets:</u> ● Construct and interpret a confidence interval for a population proportion. ● State appropriate hypotheses for a significance test about a population parameter. ● Determine the sample size required to obtain a C% confidence interval for a population proportion with a specified margin of error. ● State and check the Random, 10%, and Large Counts conditions for constructing a confidence interval for a population proportion. ● Calculate the standardized test statistic and P-value for a test about a population proportion. ● Determine the critical value for calculating a C% confidence interval for a population proportion using a table or technology. ● Perform a significance test about a population proportion. ● Describe the shape, center, and variability of the sampling distribution for a difference of proportions. ● Determine whether the conditions are met for doing inference about a difference between two proportions. ● Construct and interpret a confidence interval for a difference between two proportions. ● Calculate the standardized test statistic and P-value for a test about a difference between two proportions. ● Perform a significance test about a difference between two proportions.
Unit Title: Inference for Tables: Chi-Square Procedures <u>Essential Questions:</u> ● How can we test a series of proportions? ● How can we verify that two variables are independent?	Students will... <u>Learning Targets:</u> ● State appropriate hypotheses and compute the expected counts and chi-square test statistic for a chi-square test for goodness of fit. ● Calculate the degrees of freedom and P-value for a chi-square test for goodness of fit. ● State and check the Random, 10%, and Large Counts conditions for performing a chi-square test for goodness of fit. ● Perform a chi-square test for goodness of fit. ● Conduct a follow-up analysis when the results of a chi-square test are statistically significant.

	● State appropriate hypotheses and compute the expected counts and chi-square test statistic for a chi-square test based on data in a two-way table. ● State and check the Random, 10%, and Large Counts conditions for a chi-square test based on data in a two-way table. ● Calculate the degrees of freedom and P-value for a chi-square test based on data in a two-way table. ● Perform a chi-square test for homogeneity. ● Perform a chi-square test for independence. ● Choose the appropriate chi-square test in a given setting.
Unit Title: Inference for Regression <u>Essential Questions:</u> ● How can we test the slope of a correlation?	Students will... <u>Learning Targets:</u> ● Identify and interpret parameters and statistics for linear regression. ● Determine values of statistics from computer outputs. ● Check conditions for inference for a slope. ● Construct and interpret a confidence interval for the slope of the population (true) regression line. ● Perform a significance test about the slope of the population (true) regression line.