Name of Course: AP Statistics

Course Overview
This course helps students extend their knowledge of the major concepts and tools for collecting, analyzing, and drawing conclusions from data. This happens through the study of four broad conceptual themes: exploring data, planning a study, anticipating patterns, and statistical inference. The AP Statistics course includes material equivalent to a one-semester introductory, non-calculus based college statistics course. Prerequisite: CP Algebra II

Units of Study	**Essential Questions**	**Topics**	**Instructional Strategies**
Exploring Data	• How do you compare and contrast different distributions of univariate numerical data? • How can you tell if there is a relationship between categorical variables? • What does the shape of a distribution tell you about the data?	• Identify the individuals and variables in a set of data. • Classify variables as categorical or quantitative. • Identify units of measurement for a quantitative variable. • Make a bar graph of the distribution of a categorical variable or, in general, to compare related quantities. • Recognize when a pie chart can and cannot be used. • Identify what makes some graphs deceptive. • From a two-way table of counts, answer questions involving marginal and conditional distributions. • Describe the relationship between two categorical variables by computing appropriate conditional	1. **Worked-Examples with student self-explanation**. *(Concrete Examples)* Give students a completely worked out solution, ask for reflection *(Elaboration)*, and then students try a similar problem. 2. **Diagnostic Questions** - Multiple choice problem stems are created with common misconceptions as the distractors. Get responses of all students and have a predetermined plan of action. 3. **Retrieval Practice** - regularly *(Distributive*

		distributions. ● Construct bar graphs to display the relationship between two categorical variables. ● Make a dotplot or stemplot to display small sets of data. ● Describe the overall pattern (shape, center, spread) of a distribution and identify any major departures from the pattern (like outliers). ● Identify the shape of a distribution from a dotplot, stemplot, or histogram as roughly symmetric or skewed. Identify the number of modes. ● Make a histogram with a reasonable choice of classes. ● Identify the shape of a distribution from a dotplot, stemplot, or histogram as roughly symmetric or skewed. Identify the number of modes. ● Interpret histograms ● Calculate and interpret measures of center (mean, median) ● Calculate and interpret measures of spread (*IQR*) ● Identify outliers using the 1.5 *IQR* rule. ● Make a boxplot. ● Calculate and interpret measures of spread (standard deviation) ● Select appropriate measures of center and spread ● Use appropriate graphs and	*Practice)* ask students to recall all they know about a topic. Important to implement before complete forgetting in order to avoid the need to re-teach. a. Distributive Practice b. Pre-Tests 4. **Interleaved Practice** - Provide mixed problem types so that students must choose a strategy as well as use a strategy. 5. **Purposeful Practice** - Differentiation is achieved with carefully designed sequence of practice problems. a. First problems should ensure to early success. b. Opportunity to build fluency in key procedures c. The practice should feel different from prior practice sets. d. Problem selection should provide

		numerical summaries to compare distributions of quantitative variables	opportunities to make connections and think deeply. e. Focus is always on the practice. 6. **Multiple Representations** - Regularly use an infographic for all four ways of "seeing" mathematical ideas; Function, Graph, Table, Words *(Dual Coding)*
Modeling Distributions of Data	● How do you describe the location of a data value in a distribution? ● What are examples of variables that form a Normal distribution? ● What is the likelihood of choosing certain values within a Normal distribution? ● How do compare values in two different distributions?	● Use percentiles to locate individual values within distributions of data. ● Interpret a cumulative relative frequency graph. ● Find the standardized value (*z*-score) of an observation. Interpret *z*-scores in context. ● Describe the effect of adding, subtracting, multiplying by, or dividing by a constant on the shape, center, and spread of a distribution of data. ● Approximately locate the median (equal-areas point) and the mean (balance point) on a density curve. ● Use the 68–95–99.7 rule to estimate the percent of observations from a Normal distribution that fall in an interval involving points one, two, or three standard deviations on either side of the mean. ● Use the standard Normal distribution to calculate the proportion of values in a specified interval. ● Use the standard Normal distribution to determine a	

		z-score from a percentile. ● Use Table A to find the percentile of a value from any Normal distribution and the value that corresponds to a given percentile. ● Make an appropriate graph to determine if a distribution is bell-shaped. ● Use the 68-95-99.7 rule to assess Normality of a data set.Interpret a Normal probability plot	
Describing Relationships	● How can one variable be related to another? ● To what degree can we use data to make predictions and informed decisions? ● To what degree does one variable explain changes in another variable?	● Describe why it is important to investigate relationships between variables. ● Identify explanatory and response variables in situations where one variable helps to explain or influences the other. ● Make a scatterplot to display the relationship between two quantitative variables. ● Describe the direction, form, and strength of the overall pattern of a scatterplot. ● Recognize outliers in a scatterplot. ● Know the basic properties of correlation. ● Calculate and interpret correlation. ● Explain how the correlation *r* is	

		influenced by extreme observations. ● Interpret the slope and *y* intercept of a least-squares regression line. ● Use the least-squares regression line to predict *y* for a given *x*. ● Explain the dangers of extrapolation. ● Calculate and interpret residuals. ● Explain the concept of least squares. ● Use technology to find a least-squares regression line. ● Find the slope and intercept of the least-squares regression line from the means and standard deviations of *x* and *y* and their correlation. ● Construct and interpret residual plots to assess if a linear model is appropriate. ● Use the standard deviation of the residuals to assess how well the line fits the data. ● Use the coefficient of determination to assess how well the line fits the data. ● Identify the equation of a least-squares regression line from computer output.	

		• Explain why association doesn't imply causation. • Recognize how the slope, *y* intercept, standard deviation of the residuals, and *r*2 are influenced by extreme observations.	
Designing Studies	• How do the ways in which we collect data affect the results? • How does randomization help us understand relationships? • Can you trust the results of observational studies and experiments? • Are all data sets biased?	• Identify the population and sample in a sample survey. • Identify voluntary response samples and convenience samples. Explain how these bad sampling methods can lead to bias. • Describe how to use Table D to select a simple random sample (SRS). • Distinguish a simple random sample from a stratified random sample or cluster sample. Give advantages and disadvantages of each sampling method. • Explain how undercoverage, nonresponse, and question wording can lead to bias in a sample survey. • Distinguish between an observational study and an experiment. • Explain how a lurking variable in an observational study can lead	

		to confounding. ● Identify the experimental units or subjects, explanatory variables (factors), treatments, and response variables in an experiment. ● Describe a completely randomized design for an experiment. ● Explain why random assignment is an important experimental design principle. ● Describe how to avoid the placebo effect in an experiment. ● Explain the meaning and the purpose of blinding in an experiment. ● Explain in context what “statistically significant” means. ● Distinguish between a completely randomized design and a randomized block design. ● Know when a matched pairs experimental design is appropriate and how to implement such a design. ● Determine the scope of inference for a statistical study. ● Evaluate whether a statistical study has been carried out in an ethical manner.	

Probability	● How can real events be simulated with chance? ● How do we base decisions on chance?	● interpret probability as a long-run relative frequency. ● Use simulation to model chance behavior. ● Describe a probability model for a chance process. ● Use basic probability rules, including the complement rule and the addition rule for mutually exclusive events. ● Use a Venn diagram to model a chance process involving two events. ● Use the general addition rule to calculate P(A∪B) ● When appropriate, use a tree diagram to describe chance behavior. ● Use the general multiplication rule to solve probability questions. ● Determine whether two events are independent. ● Find the probability that an event occurs using a two-way table. ● When appropriate, use the multiplication rule for independent events to compute probabilities. ● Compute conditional probabilities.	
Random Variables	● What is a random variable? ● How do you combine	● Use a probability distribution to answer questions about possible	

	random variables?	values of a random variable. ● Calculate the mean of a discrete random variable. ● Interpret the mean of a random variable. ● Calculate the standard deviation of a discrete random variable. ● Interpret the standard deviation of a random variable. ● Describe the effects of transforming a random variable by adding or subtracting a constant and multiplying or dividing by a constant. ● Find the mean and standard deviation of the sum or difference of independent random variables. ● Determine whether two random variables are independent. ● Find probabilities involving the sum or difference of independent Normal random variables. ● Determine whether the conditions for a binomial random variable are met. ● Compute and interpret probabilities involving binomial distributions. ● Calculate the mean and standard	

		deviation of a binomial random variable. Interpret these values in context. ● Find probabilities involving geometric random variables.	
Sampling Distributions	● How many samples do you need to collect? ● How many samples do you need to consider? ● What is the difference between a sample and a sampling distribution? ● How is the normal distribution related to real world distributions?	● Distinguish between a parameter and a statistic. ● Understand the definition of a sampling distribution. ● Distinguish between population distribution, sampling distribution, and the distribution of sample data. ● Determine whether a statistic is an unbiased estimator of a population parameter. ● Understand the relationship between sample size and the variability of an estimator. ● Find the mean and standard deviation of the sampling distribution of a sample proportion for an SRS of size n from a population having proportion p of successes. ● Check whether the 10% and Normal conditions are met in a given setting. ● Use Normal approximation to calculate probabilities involving	

		sample proportions. ● Use the sampling distribution of p-hat to evaluate a claim about a population proportion. ● Find the mean and standard deviation of the sampling distribution of a sample mean from an SRS of size *n*. ● Calculate probabilities involving a sample mean when the population distribution is Normal. ● Explain how the shape of the sampling distribution of the sample mean is related to the shape of the population distribution. ● Use the central limit theorem to help find probabilities involving a sample mean .	
Estimating with Confidence	● What is inference? ● Is a small sample big enough? ● How much evidence do you need to make an informed decision?	● Interpret a confidence level. ● Interpret a confidence interval in context. ● Understand that a confidence interval gives a range of plausible values for the parameter. ● Understand why each of the three inference conditions—Random, Normal, and Independent—is important. ● Explain how practical issues like	

		nonresponse, undercoverage, and response bias can affect the interpretation of a confidence interval. ● Construct and interpret a confidence interval for a population proportion. ● Determine critical values for calculating a confidence interval using a table or your calculator. ● Carry out the steps in constructing a confidence interval for a population proportion: define the parameter; check conditions; perform calculations; interpret results in context. ● Determine the sample size required to obtain a level *C* confidence interval for a population proportion with a specified margin of error. ● Understand how the margin of error of a confidence interval changes with the sample size and the level of confidence *C*. ● Understand why each of the three inference conditions—Random, Normal, and Independent—is important. ● Construct and interpret a	

		confidence interval for a population mean. ● Determine the sample size required to obtain a level *C* confidence interval for a population mean with a specified margin of error. ● Carry out the steps in constructing a confidence interval for a population mean: define the parameter; check conditions; perform calculations; interpret results in context. ● Understand why each of the three inference conditions—Random, Normal, and Independent—is important. ● Determine sample statistics from a confidence interval.	
Testing a Claim	● Why would you use a significance test over a confidence interval? ● Are significance tests reliable? ● What are the errors that can be made when doing a significance test?	● State correct hypotheses for a significance test about a population proportion or mean. ● Interpret *P*-values in context. ● Interpret a Type I error and a Type II error in context, and give the consequences of each. ● Understand the relationship between the significance level of a test, *P*(Type II error), and power.	

		• Check conditions for carrying out a test about a population proportion. • If conditions are met, conduct a significance test about a population proportion. • Use a confidence interval to draw a conclusion for a two-sided test about a population proportion. • Check conditions for carrying out a test about a population mean. • If conditions are met, conduct a one-sample *t* test about a population mean . • Use a confidence interval to draw a conclusion for a two-sided test about a population mean. • Recognize paired data and use one-sample *t* procedures to perform significance tests for such data.	
Comparing Two Populations	• Is there a significant difference between two samples means or two proportions?	• Describe the characteristics of the sampling distribution of the difference of two proportions • Calculate probabilities using the sampling distribution of the difference of two proportions • Determine whether the	

		conditions for performing inference are met. ● Construct and interpret a confidence interval to compare two proportions. ● Perform a significance test to compare two proportions. ● Interpret the results of inference procedures in a randomized experiment. ● Describe the characteristics of the sampling distribution of the difference between two means. ● Calculate probabilities using the sampling distribution of the difference of two means. ● Determine whether the conditions for performing inference are met. ● Use two-sample *t* procedures to compare two means based on summary statistics. ● Use two-sample *t* procedures to compare two means from raw data. ● Interpret standard computer output for two-sample *t* procedures. ● Perform a significance test to compare two means. ● Check conditions for using	

		two-sample *t* procedures in a randomized experiment. ● Interpret the results of inference procedures in a randomized experiment. ● Determine the proper inference procedure to use in a given setting.	
Inference for Categorical Data	● How do you test the relationship among a series of proportions? ● How do determine if two or more variables are independent?	● Know how to compute expected counts, conditional distributions, and contributions to the chi-square statistic. ● Check the Random, Large sample size, and Independent conditions before performing a chi-square test. ● Use a chi-square goodness-of-fit test to determine whether sample data are consistent with a specified distribution of a categorical variable. ● Examine individual components of the chi-square statistic as part of a follow-up analysis. ● Check the Random, Large sample size, and Independent conditions before performing a chi-square test. ● Use a chi-square test for homogeneity to determine whether the distribution of a	

		categorical variable differs for several populations or treatments. ● Interpret computer output for a chi-square test based on a two-way table. ● Examine individual components of the chi-square statistic as part of a follow-up analysis. ● Show that the two-sample *z* test for comparing two proportions and the chi-square test for a 2-by-2 two-way table give equivalent results. ● Check the Random, Large sample size, and Independent conditions before performing a chi-square test. ● Use a chi-square test of association/independence to determine whether there is convincing evidence of an association between two categorical variables. ● Interpret computer output for a chi-square test based on a two-way table. ● Examine individual components of the chi-square statistic as part of a follow-up analysis. ● Distinguish between the three	

		types of chi-square tests.	
Inference for Regression	• What are the advantages of linearizing a scatterplot? • What does a slope of zero say about the relationship between two variables?	• Check conditions for performing inference about the slope of the population regression line. • Interpret computer output from a least-squares regression analysis. • Construct and interpret a confidence interval for the slope of the population regression line. • Perform a significance test about the slope of a population regression line. • Use transformations involving powers and roots to achieve linearity for a relationship between two variables. • Make predictions from a least-squares regression line involving transformed data. • Use transformations involving logarithms to achieve linearity for a relationship between two variables. • Make predictions from a least-squares regression line involving transformed data. • Determine which of several transformations does a better job of producing a linear relationship.	