Course Name : AP Statistics

Course Overview
AP Statistics is the high school equivalent of an introductory college statistics course. The course focuses on four major themes: exploratory data analysis, designing studies, probability models and simulation, and statistical inference. Emphasis is placed on developing strategies for collecting, organizing, analyzing, and drawing conclusions from data. Students design, administer, and tabulate results from surveys and experiments. Furthermore, probability and simulations aid students in constructing models for chance phenomena, while sampling distributions provide the logical structure for confidence intervals and hypothesis tests.

Students use a TI-83/84 graphing calculator to investigate statistical concepts. To develop effective statistical communication skills, students are required to prepare frequent written and oral analyses of real data.

Course Materials/Resources/Technology
Binder with loose leaf [notes and homework]
Pencils and eraser
TI-83 or TI-84 graphing calculator

UNIT 1: Exploring Data

Duration of Unit: 14 Days

Description of Unit:
Unit 1 introduces students to data and the vocabulary of statistics. Students also learn to talk about data in real-world contexts. Variability in data may seem to suggest certain conclusions about the data distribution, but not all variation is meaningful. Statistics allows us to develop shared understandings of uncertainty and variation. In this unit, students will define and represent categorical and quantitative variables, describe and compare distributions of one-variable data, and interpret statistical calculations to assess claims about individual data points or samples. Students will also explore relationships in two-variable categorical or quantitative data sets. They will use graphical and numerical methods to investigate an association between two categorical variables.

Essential Questions and/or Enduring Understandings:
1. I can analyze distributions graphically and describe distributions numerically using statistics.

Academic Vocabulary:	
Materials/Resources/Technology:	
ESSENTIAL Standards	**Learning Targets**
	Identify the individuals and variables in a set of data
	Classify variables as categorical or quantitative
	Display categorical data with a bar graph and decide if a pie chart would be appropriate
	Identify what makes some graphs of categorical data deceptive
	Calculate and display the marginal distribution of a categorical variable from a two-way table
	Calculate and display the conditional distribution of a categorical variable for a particular value of the other categorical variable in a two-way table
	Describe the association between two categorical variables by comparing appropriate conditional distributions
	Make and interpret dotplots and stemplots of quantitative data
	Describe overall patterns of a distribution and identify outliers
	Identify the shape of a distribution from a graph as symmetric or skewed
	Make and interpret histograms of quantitative data
	Compare distributions of quantitative data using dotplots, stemplots, or histograms
	Calculate measures of center and measures of spread
	Identify outliers using the 1.5 X IQR rule
	Make and interpret boxplots of quantitative data
	Use appropriate graphs and numerical summaries to compare distributions of quantitative variables

UNIT 2: The Normal Curve

Duration of Unit: 12 days

Description of Unit:
Students will begin to apply the normal distribution model as an introduction to how theoretical models for populations can be used to describe some distributions of sample data.

Essential Questions and/or Enduring Understandings:

2. I can solve problems involving a normal distribution.

Materials/Resources/Technology:

ESSENTIAL Standards	Learning Targets
	Find and interpret the percentile of an individual value within a distribution of data
	Estimate percentiles and individual values using a cumulative relative frequency graph
	Find and interpret the standardized score of an individual value within a distribution of data
	Estimate the relative locations of the median and mean on a density curve
	Use the 68-95-99.7 rule to estimate areas in a Normal distribution
	Find the proportion of z-values in a specified interval or the value that corresponds to a given percentile in the standard Normal distribution
	Determine whether a distribution of data is approximately Normal from graphical and numerical evidence

Unit 3: LEast Squares Regression

Duration of Unit: 12 days

Description of Unit:
Students will describe form, direction, strength, and unusual features for an association between two quantitative variables. They will assess correlation and, if appropriate, use a linear model to predict values of the response variable from values of the explanatory variable. Students will interpret the least-squares regression line in context, analyze prediction errors (residuals), and explore departures from a linear pattern.

Essential Questions and/or Enduring Understandings:

3. I can solve problems involving least squares regression.

Materials/Resources/Technology:

ESSENTIAL Standards	Learning Targets
	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 a relationship displayed in a scatterplot and recognize outliers in a scatterplot
	Understand the basic properties of correlation, including how the correlation is influenced by outliers
	Use technology to calculate correlation
	Explain why association does not imply causation
	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, and explain the dangers of extrapolation
	Calculate and interpret residuals

	Explain the concept of least squares regression
	Determine the equation of a least-squares regression line using technology or computer output
	Construct and interpret residual plots to assess whether a linear model is appropriate
	Interpret the standard deviation of the residuals and r2 and use these values to assess how well the least-squares regression line models the relationship between two variables
	Describe how the slope, y-intercept, standard deviation of the residuals, and r2 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 4: Collecting Data

Duration of Unit: 11 days

Description of Unit:
Depending on how data are collected, we may or may not be able to generalize findings or establish evidence of causal relationships. For example, if random selection is not used to obtain a sample from a population, bias may result and statistics from the sample cannot be assumed to generalize to the population. For data collected using well-designed experiments, statistically significant differences between or among experimental treatment groups are evidence that the treatments caused the effect. Students learn important principles of sampling and experimental design in this unit

Essential Questions and/or Enduring Understandings:

4. I can analyze observational studies and experiments.

Materials/Resources/Technology:

ESSENTIAL Standards	Learning Targets
	Identify the population and sample in a statistical study

	Identify voluntary response samples and convenience samples and explain how these sampling methods can lead to bias
	Distinguish a simple random sample from a stratified random sample or cluster sample
	Explain how under coverage, nonresponse, question wording, and other aspects of a sample survey can lead to bias
	Distinguish between an observational study and an experiment
	Explain the concept of confounding and how it limits the ability to make cause-and-effect conclusions
	Identify the experimental units, explanatory and response variables, and treatments in an experiment
	Explain the purpose of comparison, random assignment, control, and replication in an experiment
	Describe a completely randomized design for an experiment, including how to randomly assign treatments
	Describe the placebo effect and the purpose of blinding in an experiment
	Interpret the meaning of statistically significant in the context of an experiment
	Explain the purpose of blocking in an experiment
	Describe the scope of inference that is appropriate in a statistical study

Unit 5: Probability and Random Variables

Duration of Unit: 29 days

Description of Unit:
Probabilistic reasoning allows statisticians to quantify the likelihood of random events over the long run and to make statistical inferences. Simulations and concrete examples can help students to understand the abstract definitions and calculations of probability. This unit builds on understandings of simulated or empirical data distributions and fundamental principles of probability to represent, interpret, and calculate parameters for theoretical probability distributions for discrete random variables. Interpretations of probabilities and parameters associated with a probability distribution should use appropriate units and relate to the context of the situation.

Essential Questions and/or Enduring Understandings:
5. I can solve problems involving probability using two-way tables and tree diagrams
6. I can solve problems involving probability distributions and random variables
7. I can solve problems involving binomial and geometric random variables

Materials/Resources/Technology:

ESSENTIAL Standards	Learning Targets
	Interpret the probability as a long-run relative frequency
	Use simulation to model chance behavior
	Determine the probability model for a chance process
	Use basic probability rules, including the complement rule and the addition rule for mutually exclusive events
	Use a two-way table or Venn diagram to model a chance process and calculate probabilities involving two events
	Use the general addition rule to calculate probabilities

	Calculate and interpret conditional probabilities
	Use the general multiplication rule to calculate probabilities
	Use tree diagrams to model a chance process and calculate probabilities involving two or more events
	Determine whether two events are independent
	When appropriate, use the multiplication rule for independent events to compute probabilities
	Compute probabilities using the probability distribution of a discrete random variable and continuous random variables
	Calculate and interpret the mean and standard deviation of a discrete 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
	Find the probability involving the sum or difference of independent Normal random variables
	Determine whether the conditions for using a binomial random variable are met
	Compute and interpret probabilities involving binomial distributions
	Calculate the mean and standard deviation of a binomial random variable and interpret these values in context
	Find probabilities involving geometric random variables

Unit 6: Sampling Distributions

Duration of Unit: 11 days

Description of Unit:
This unit applies probabilistic reasoning to sampling, introducing students to sampling distributions of statistics they will use when performing inference in Units 7-9. Students should understand that sample statistics can be used to estimate corresponding population parameters and that measures of center (mean) and variability (standard deviation) for these sampling distributions can be determined directly from the population parameters when certain sampling criteria are met. For large enough samples from any population, these sampling distributions can be approximated by a normal distribution. Simulating sampling distributions helps students to understand how the values of statistics vary in repeated random sampling from populations with known parameters.

Essential Questions and/or Enduring Understandings:
8. I can solve problems involving involving the sampling distribution of a population proportion or population mean.

Materials/Resources/Technology:

ESSENTIAL Standards	Learning Targets
	Distinguish between a parameter and a statistic
	Use the sampling distribution of a statistic to evaluate a claim about a parameter
	Distinguish among the distribution of a population, the distribution of a sample, and the sampling distribution of a statistic
	Determine whether or not a statistic is an unbiased estimator of a population parameter
	Describe the relationship between sample size and the variability of a statistic
	Find the mean and standard deviation of the sampling distribution of a sample proportion $\hat{p}$
	Determine if the sampling distribution of $\hat{p}$ is approximately Normal
	Use a Normal distribution to calculate probabilities involving $\hat{p}$
	Find the mean and standard deviation of the sampling distribution of a sample mean $\bar{x}$

	Explain how the shape of the sampling distribution of $\bar{x}$ is affected by the shape of the population distribution and sample size
	Use a Normal distribution to calculate probabilities involving $\bar{x}$

Unit 7: Confidence Intervals

Duration of Unit: 10 days

Description of Unit:
This unit introduces statistical inference, which will continue through the end of the course. Provided conditions are met, students will use statistical inference to construct and interpret confidence intervals to estimate population proportions. Students will also analyze quantitative data to make inferences about population means. Students should understand that t∗ and t- tests are used for inference with means when the population standard deviation is not known. Using s for in the formula for z gives a slightly different value, t, whose distribution, which depends on sample size, has more area in the tails than a normal distribution. Students should understand how and why conditions for inference with proportions and means are similar and different.

Essential Questions and/or Enduring Understandings:
9. I can solve problems by constructing a confidence interval for a mean or proportion involving one sample

Materials/Resources/Technology:

ESSENTIAL Standards	Learning Targets
	Determine the point estimate and margin of error from a confidence interval
	Interpret a confidence interval and confidence level in context
	Describe how the sample size and confidence level affect the length of a confidence interval
	Explain how practical issue like nonresponse, under coverage, and response bias can affect the interpretation of a confidence interval
	State and check the Random, 10% , and Large Counts conditions for constructing a confidence interval for a population proportion and population mean

	Explain how the t distributions are different from the standard Normal distribution and why it is necessary to use a t distribution when calculating a confidence interval for a population mean
	Determine critical values for calculating a C% confidence interval for a population proportion and population mean using a table or technology
	Construct and interpret a confidence interval for a population proportion and population mean
	Determine the sample size required to obtain C% confidence interval for a population proportion and population mean with a specified mean with a specified margin of error

Unit 8: Hypothesis Tests

Duration of Unit: 11 days

Description of Unit:
This unit continues our discussion of statistical inference. Provided conditions are met, students will use statistical inference to perform significance tests to evaluate claims about population proportions and means. They will also interpret the two types of errors that can be made in a significance test, their probabilities, and possible consequences in context.

Essential Questions and/or Enduring Understandings:
10. I can solve problems by conducting a hypothesis test for a mean or proportion involving one sample

Materials/Resources/Technology:

ESSENTIAL Standards	Learning Targets
	State the null and alternative hypotheses for a significance test about a population parameter
	Interpret a P-Value in context
	Determine if the results of a study are statistically significant and draw an appropriate conclusion using a significance level

	Interpret a Type I and Type II error in context, and give a consequence of each
	Perform a significance test about a population proportion
	Interpret the power of a test and describe what factors affect the power of a test
	Describe the relationship among the probability of a Type I error, a Type II error, and the power of a test
	State and recheck the Random, 10%, and Normal/Large Sample conditions for performing a significance test about a population mean
	Perform a significance test about a population mean
	Use a confidence interval to draw a conclusion for a two-sided test about a population parameter
	Perform a significance test about a mean difference using paired data

Unit 9: Two Sample Inference

Duration of Unit: 9 days

Description of Unit:
This unit continues our discussion of statistical inference. Provided conditions are met, students will use statistical inference to perform significance tests to evaluate claims about two different population proportions or means or to construct confidence intervals for the difference betweentwo different population proportions or means.

Essential Questions and/or Enduring Understandings:
11. I can solve problems by constructing a confidence interval or conducting a hypothesis test for the difference between two population proportions or means

Materials/Resources/Technology:

ESSENTIAL Standards	Learning Targets
	Describe the shape, center, and spread of the sampling distribution of the difference between two proportions

	Determine whether the conditions are met for doing inference about p1 – p2
	Construct and interpret a confidence interval to compare two proportions
	Perform a significance test to compare two proportions
	Describe the shape, center, and spread of the sampling distribution the difference between two means
	Construct and interpret a confidence interval to compare two means
	Perform a significance test to compare two means
	Determine when it is appropriate to use two-sample t procedures versus paired t procedures

Unit 10: Chi-Square

Duration of Unit: 9 days

Description of Unit:
This unit introduces chi square tests, which can be used when there are two or more categories. Students need to understand how to select from the following tests: the chi-square test for goodness of fit (for a distribution of proportions of one categorical variable in a population), the chi-square test for independence (for associations between categorical variables within a single population), or the chi-square test for homogeneity (for comparing distributions of a categorical variable across populations or treatments). The chi-square statistic is introduced to measure the distance between observed and expected counts relative to expected counts.

Essential Questions and/or Enduring Understandings:
12. I can solve problems by performing significance tests to evaluate claims about categorical data

Materials/Resources/Technology:

ESSENTIAL Standards	Learning Targets
	State appropriate hypotheses and compute expected counts for a chi-square test for goodness of fit
	Calculate the chi-square statistic, degrees of freedom, and P-value for 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
	Compare conditional distributions for data in a two-way table
	State appropriate hypotheses and compute expected counts for a chi-square test based on data in a two-way table
	Calculate the chi-square statistic, degrees of freedom, and P-value for a chi-square test for homogeneity
	Perform a chi-square test for homogeneity and test for independence