

**FREEHOLD REGIONAL HIGH SCHOOL DISTRICT**

**OFFICE OF CURRICULUM AND INSTRUCTION**

**SCIENCE AND ENGINEERING**

# **ADVANCED PLACEMENT STATISTICS**

Grade Level: 10-12

Credits: 5

**BOARD OF EDUCATION ADOPTION DATE:**

**AUGUST 31, 2009**

[SUPPORTING RESOURCES AVAILABLE IN DISTRICT RESOURCE SHARING](#)

APPENDIX A: ACCOMMODATIONS AND MODIFICATIONS

APPENDIX B: ASSESSMENT EVIDENCE

APPENDIX C: INTERDISCIPLINARY CONNECTIONS

# **FREEHOLD REGIONAL HIGH SCHOOL DISTRICT**

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## **Course Philosophy**

The S&E AP Statistics course introduces students to the major concepts and tools for collecting, analyzing, and drawing conclusions from data. Modern technology provides a mechanism for the simulation and analysis of data.

Through the study of statistics, students will expand their understanding of mathematics and acquire tools that will help them to be effective problem solvers in a variety of fields. Given that statistics is used in myriad disciplines, an understanding of introductory concepts is vital for success at the university level and beyond. From a Science and Engineering perspective, statistics is used to better explain relationships between variables and to reveal information to aid in the design and production of the services they provide. In addition, this statistics curriculum will cover all topics suggested by the College Board and provide students the background and preparation necessary to be successful on the AP Exam.

## **Course Description**

The S&E AP Statistics course will introduce students to the major concepts and tools for collecting, analyzing, and drawing conclusions from data. Students are exposed to four broad conceptual themes: exploring data, sampling and experimentation, probability and simulation, and statistical inference. In addition to traditional methods of instruction, students will be expected to use a graphing calculator, statistical software, and internet-based applets to explore complex statistical problems. Ultimately, the goal of the course is that students will be successful on the S&E AP Statistics exam. Further, an emphasis will be placed on statistical problems as they relate to science and engineering processes. This will culminate in a research based project in which students will apply skills learned throughout the course.

**Freehold Regional High School District  
Curriculum Map**

**S&E Advanced Placement Statistics**

Relevant Standards 1	Enduring Understandings	Essential Questions	Assessments		
			Diagnostic (before)	Formative (during)	Summative (after)
4.5 A1-5; B1-4 E1, 3	Data can be represented using a variety of numerical and graphical methods.	<p>What is data?</p> <p>Are there different types of data?</p> <p>What are the numerical methods for data representation?</p> <p>What are the graphical methods for data representation?</p>	<p>Pretest</p> <p>Oral Questions/ Discussion</p>	<p>Math Journals</p> <p>Quizzes</p> <p>Oral Presentations</p>	<p>Portfolios</p> <p>Projects</p> <p>Chapter Test</p>
4.3 B4; C1, 2 4.4 A4, 5; 4.5 A1-5; B1-4; C1; E2	Regression is an instrument used to generalize relationships for bivariate data.	<p>What is regression?</p> <p>What is bivariate data?</p> <p>How well does data fit a regression model?</p> <p>What are the properties of a linear regression model?</p> <p>How can non-linear data be linearized for regression?</p>	<p>Anticipatory Set Questions</p>	<p>Observations</p> <p>Participatory Rubrics</p> <p>Assignments</p>	<p>Mid Terms</p> <p>AP Exam</p> <p>Final Exam</p>
4.2 A1; 4.4 A5; B5; 4.5 A1-5; B1-4	A density curve is used to mimic probability.	<p>What is a density curve?</p> <p>How do density curves relate to probability?</p> <p>How are measures of central tendency relevant to density curves?</p> <p>How can density curves be used to express relative standing?</p>		<p>Closure Questions</p> <p>Investigative Activities</p>	
4.2 A1; 4.4 A5; B5; 4.5 A1-5; B1-4	The normal distribution is used to model the spread of data.	<p>What is a normal distribution?</p> <p>How does one assess normality?</p> <p>What does a normal distribution imply about the spread of data?</p> <p>Why is the normal distribution essential to the study of statistics?</p>		<p>Sample AP Exam Questions</p>	
4.4 A1-3; 4.5 A1-5; B1-4	Proper collection of data is essential for good experimental design.	<p>What is an experiment?</p> <p>What are the different sampling methods?</p> <p>How can causation be established?</p> <p>How does bias affect experimental design?</p>			
4.4 B1-6; C1, 2 4.5 A1-5; B1-4	Probability is a tool for measuring long-term behavior.	<p>What is probability?</p> <p>How can probability be simulated?</p>			

Relevant Standards 1	Enduring Understandings	Essential Questions	Assessments		
			Diagnostic (before)	Formative (during)	Summative (after)
		<p>What is a probability distribution?</p> <p>How does one determine probability for a given event?</p>			
4.4 A2; 4.5 A1-5 B1-4; D1-6	Inference is a tool for estimating an unknown population parameter.	<p>What does it mean to make an inference?</p> <p>What is a confidence interval?</p> <p>How does one distinguish among the various confidence intervals?</p>			
4.4 A2; 4.5 A1-5 B1-4; D1-6	Inference is a tool for validating a claim about a population parameter.	<p>What is a test of significance?</p> <p>How is a test of significance done?</p> <p>How does one distinguish among the various tests of significance?</p>			
4.5 A1-5; B1-4; C1-6	Statistics can be applied to many different disciplines and fields.	<p>How is statistics used in your current courses?</p> <p>What are some examples of statistics used in real life?</p> <p>How can one apply various statistical techniques to analyze results when working on novel research projects?</p>			
4.4 A5; 4.5.A1-5 B1-4; F1-4	Technology is instrumental to the study of statistics in an interactive classroom.	<p>What types of technology can be used to study statistics?</p> <p>Why is technology useful to the study of statistics?</p>			

**Freehold Regional High School District  
Course Proficiencies and Pacing**

**S&E Advanced Placement Statistics**

Unit Title	Unit Understandings and Goals	Recommended Duration
Unit #1: Exploring Data:	Data can be represented using a variety of numerical and graphical methods. Technology is instrumental to the study of statistics in an interactive classroom. Statistics can be applied to many different disciplines and fields. <ol style="list-style-type: none"> <li>1. Students will describe the distribution for any given data set of one variable.</li> <li>2. Students will interpret numerical and graphical summaries in the context of the situation</li> </ol>	2 weeks
Unit #2: Describing Location in a Distribution	A density curve is used to mimic probability. The normal distribution is used to model the spread of data. <ol style="list-style-type: none"> <li>1. Students will compute measures of relative standing for individual values in a distribution</li> <li>2. Students will demonstrate an understanding of a density curve and Normal distributions.</li> </ol>	2 weeks
Unit #3: Examining Relationships	Regression is an instrument used to generalize relationships for bivariate data. <ol style="list-style-type: none"> <li>1. Given a bivariate data set, students will construct and interpret a regression line.</li> <li>2. Students will demonstrate an understanding of the quality of the regression line as the model for bivariate data.</li> <li>3. Students will use transformations to linearize curved relationships for regression.</li> </ol>	4 weeks
Unit #4: Producing Data	Proper collection of data is essential for good experimental design. <ol style="list-style-type: none"> <li>1. Students will identify and implement appropriate types of sampling methods.</li> <li>2. Students will identify and give examples of sources of bias.</li> <li>3. Students will be able to recognize and construct a well-designed experiment.</li> </ol>	2 weeks
Unit #5: Probability and Simulations	Probability is a tool for measuring long-term behavior. <ol style="list-style-type: none"> <li>1. Students will use simulation to calculate probabilities.</li> <li>2. Students will understand and apply the laws of probability</li> </ol>	2 weeks
Unit #6: Random Variables	Probability is a tool for measuring long-term behavior. <ol style="list-style-type: none"> <li>1. Students will differentiate between discrete and continuous random variables.</li> <li>2. Students will explain the probability distribution for random variables, including binomial and geometric distributions</li> </ol>	3 weeks
Unit #7: Sampling Distributions	The normal distribution is used to model the spread of data. A density curve is used to mimic probability. <ol style="list-style-type: none"> <li>1. Students will be able to interpret a sampling distribution for means.</li> <li>2. Students will be able to interpret a sampling distribution for proportions.</li> </ol>	3 weeks
Unit #8: Estimating with Confidence	Inference is a tool for estimating an unknown population parameter. <ol style="list-style-type: none"> <li>1. Students will be able to determine a confidence interval for means.</li> <li>2. Students will be able to determine a confidence interval for proportions.</li> </ol>	3 weeks
Unit #9: Significance Testing for One Population	Inference is a tool for validating a claim about a population parameter. <ol style="list-style-type: none"> <li>1. Students will be able to carry out a test of significance for a population mean.</li> <li>2. Students will be able to carry out a test of significance for a population proportion.</li> </ol>	3 weeks

Unit Title	Unit Understandings and Goals	Recommended Duration
Unit #10: Comparing Two Population Parameters	Inference is a tool for validating a claim about a population parameter. Inference is a tool for estimating an unknown population parameter. <ol style="list-style-type: none"> <li>1. Students will be able to compare two population means and proportions using confidence intervals.</li> <li>2. Students will be able to compare two population means and proportions using tests of significance.</li> </ol>	2 weeks
Unit #11: Inference for Distributions of Categorical Variables	Inference is a tool for validating a claim about a population parameter. <ol style="list-style-type: none"> <li>1. Students will be able to perform a test for goodness of fit using a two-way table.</li> <li>2. Students will be able to perform a chi-square test of significance.</li> </ol>	1 week
Unit #12: Inference for Regressions	Regression is an instrument used to generalize relationships for bivariate data. Inference is a tool for validating a claim about a population parameter. <ol style="list-style-type: none"> <li>1. Students will be able to create a confidence interval for the slope of a regression line.</li> <li>2. Students will be able to test the hypothesis of a linear relationship of the regression line.</li> </ol>	2 week
Unit #13: Post AP Exam	Statistics can be applied to many different disciplines and fields. Technology is instrumental to the study of statistics in an interactive classroom. <ol style="list-style-type: none"> <li>1. Students will demonstrate understanding of concepts covered throughout the year via a year end project.</li> <li>2. Students will incorporate appropriate technology to augment and facilitate calculations necessary for statistical summaries.</li> </ol>	5 weeks

**Freehold Regional High School District  
S&E Advanced Placement Statistics**

**Unit #1: Exploring Data**

**Enduring Understandings:** Data can be represented using a variety of numerical and graphical methods.  
Technology is instrumental to the study of statistics in an interactive classroom.  
Statistics can be applied to many different disciplines and fields.

**Essential Questions:** What is data?  
Are there different types of data?  
What are the numerical and graphical methods for data representation?  
What types of technology can be used to study statistics?  
Why is technology useful to the study of statistics?  
How is statistics used in your current courses?  
What are some examples of statistics used in real life?

**Unit Goals:** Students will describe the distribution for any given data set of one variable.  
Students will interpret numerical and graphical summaries in the context of the situation

**Duration of Unit:** 2 weeks

**NJCCCS:** 4.4 A5; 4.5 A1-5; 4.5 B1-4; 4.5 C1-6; 4.5 E1, 3; 4.5 F1-4

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
What is the difference between categorical and quantitative variables?	Categorical variables place an individuals into one of several groups.	Current textbook and resource binders	Lecture and class discussion	Written tests and quizzes
	Quantitative variables take numerical values.	Statistical websites - see attachment	Complete the chapter study guides	
How can categorical and quantitative variables be represented graphically?	Categorical variables can be represented by bar graphs and pie charts.	Magazine articles	Compete the online quizzes from the text's website	Project assessments
	Quantitative variables can be represented by histograms, stem plots, box plots, relative frequency histograms, and ogives.	Newspapers	M&M activities	
How can data be represented numerically?	Data can be described through measures of central tendency (mean and median), spread (standard deviation and variance), IQR, and outliers.	Videos (Against all odds)	"Water Water Everywhere" Activity	Article summaries
How are distributions described?	Distributions are described by shape, center, and spread.	Previous AP Exam questions	Case Closed	Anticipatory sets
	Use mean and standard deviation for data sets that are symmetrical. Use median and IQR for data sets that are skewed.	Statistical Applets	Projects	
What is a Chebyshev Interval?	Define Chebyshev's Theorem for the minimum percentage of distribution of data about the mean.	Graphing Calculator	Alternative Assessment	Classroom discussion
How are distributions compared?	Use numerical and graphical summaries to compare data sets.	SMART Board	Previous AP Exam questions	
What is the effect of linear transformations on a data set?	When adding a constant to all values of a data set, the mean and median increase by that value, but spread is not affected.	Power Point Reviews	Jigsaw	Closure questions
			Review Relay	



Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
	When multiplying all values of data set by a constant, the mean, median, IQR and standard deviation are all multiplied by that constant.			
How can data be analyzed using technology?	Data can be imputed and manipulated using the LIST feature.			
	Numerical representations can be found using 1-var stats.			
	Graphical representations can be found using stat-plot.			

**Suggestions on how to differentiate in this unit:**

- Teaching methods will be diversified to appeal to visual, auditory and kinesthetic learners.
- Students will be given copies of data sets and other important notes.
- Students will be assessed by traditional and alternative methods.
- Students will work individually, with partners and in small groups on certain activities.

**Freehold Regional High School District  
S&E Advanced Placement Statistics**

**Unit #2: Describing location within a distribution**

**Enduring Understandings:** A density curve is used to mimic probability.  
The normal distribution is used to model the spread of data.

**Essential Questions:** What is a density curve?  
How do density curves relate to probability?  
How are measures of central tendency relevant to density curves?  
How can density curves be used to express relative standing?  
What is a normal distribution?  
How does one assess normality?  
What does a normal distribution imply about the spread of data?

**Unit Goals:** Students will compute measures of relative standing for individual values in a distribution  
Students will demonstrate an understanding of a density curve and Normal distributions.

**Duration of Unit:** 2 weeks

**NJCCCS:** 4.2 A1; 4.4 A5; 4.4 B5; 4.5 A1-5; 4.5 B1-4

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How do you measure relative standing?	Relative standing can be found by computing the standardized value (z-score). Relative standing can also be discussed as a percentile.	Current textbook and resource binders Statistical websites - see attachment	Lecture and class discussion Complete the chapter study guides	Written tests and quizzes Worksheets
What is a density curve?	A density curve is an approximation of the overall shape of a distribution. The area underneath a density is exactly 1.	Magazine articles	Compete the online quizzes from the text's website M&M activities	Project assessments Article summaries
How can the mean and median be approximated on a density curve?	The median of a density curve is the "equal-areas" point that divides the area under the curve in half. The mean of a density curve is the "balance point," at which the curve would balance if made of solid material.	Newspapers Videos (Against all odds)	Case Closed Projects	Anticipatory sets Classroom discussion
What is a Normal distribution?	A Normal distribution is a density curve that is symmetric, single-peaked, and bell-shaped. All Normal distributions follow 68-95-99.7 Rule.	Previous AP Exam questions Statistical Applets	Alternative Assessment Previous AP Exam questions Jigsaw	Closure questions
What is a standard Normal distribution?	A standard Normal distribution has a mean of zero and a standard deviation of one. $N(0, 1)$ The proportion of observations can be found using the z-table and the graphing calculator (normalcdf).	Graphing Calculator SMART Board Power Point Reviews	Review Relay	
For a Normal distribution, what is the value associated with a specific proportion?	The value for a given proportion can be found using the z-table or the graphing calculator (invNorm).			

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How can Normality be assessed?	Normality can be assessed by comparing the count of observations in each interval with the 68-95-99.7 Rule.			
	Normal probability plots can also be used to assess Normality.			

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**Freehold Regional High School District  
S&E Advanced Placement Statistics**

**Unit #3: Examining Relationships**

**Enduring Understanding:** Regression is an instrument used to generalize relationships for bivariate data.

**Essential Questions:** What is regression?

What is bivariate data?

How well does data fit a regression model?

What are the properties of a linear regression model?

How can non-linear data be linearized for regression?

**Unit Goals:** Given a bivariate data set, students will construct and interpret a regression line.

Students will demonstrate an understanding of the quality of the regression line as the model for bivariate data.

Students will use transformations to linearize curved relationships for regression.

**Duration of Unit:** 4 weeks

**NJCCCS:** 4.3 B4; 4.3 C1, 2; 4.4 A4, 5; 4.5 A1-5; 4.5 B1-4; 4.5 C1; 4.5 E2

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
What is the difference between response and explanatory variables?	A response variable measures an outcome of a study. An explanatory variable helps explain or influences changes in a response variable.	Current textbook and resource binders Statistical websites - see attachment	Lecture and class discussion Complete the chapter study guides	Written tests and quizzes Worksheets
How do you graphically represent and interpret bivariate data?	Scatterplots can be used to find the overall pattern and striking deviations of bivariate data.	Magazine articles	Complete the online quizzes from the text's website	Project assessments
How is a linear association measured?	Correlation measures the direction and strength of a linear relationship.	Newspapers	M&M activities	Article summaries
How can a regression line be used as a mathematical model?	The Least Squares Regression Line (LSRL) describes how a response variable changes as an explanatory variable changes.	Videos (Against all odds)	Case Closed	Anticipatory sets
How well does data fit a linear regression model?	A residual plot and the coefficient of determination are used to assess the appropriateness of the regression model.	Previous AP Exam questions	Projects	Classroom discussion
What are the cautions regarding regression?	Extrapolation may not be accurate for values outside of the given data set. Lurking variables may influence the interpretation of the relationship between the two variables.	Statistical Applets	Alternative Assessment Previous AP Exam questions	Closure questions
How do you transform data to achieve linearity?	Powers and Logarithms can be employed to one or both variable to linearize the relationship between the variables.	Graphing Calculator	Jigsaw	
How are the relationships between categorical variables described?	Marginal and conditional distributions are used to describe relationships between categorical variables.	SMART Board	Review Relay	
How is an associated between two variables explained?	Causation, common response, and confounding are three ways that can explain the association.	Power Point Reviews		

**Suggestions on how to differentiate in this unit:**

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- Students will work individually, with partners and in small groups on certain activities.

**Freehold Regional High School District  
S&E Advanced Placement Statistics**

**Unit #4: Producing Data**

**Enduring Understanding:** Proper collection of data is essential for good experimental design.

**Essential Questions:** What is an experiment?

What are the different sampling methods?

How can causation be established?

How does bias affect experimental design?

**Unit Goals:** Students will identify and implement appropriate types of sampling methods.

Students will identify and give examples of sources of bias.

Students will be able to recognize and construct a well-designed experiment.

**Duration of Unit:** 2 weeks

**NJCCCS:** 4.4 A1-3; 4.5 A1-5; 4.5 B1-4

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
What is the difference between an observational study and an experiment?	An observation study observes individuals and measures variables of interest.	Current textbook and resource binders	Lecture and class discussion	Written tests and quizzes
	An experiment deliberately imposes a treatment on individuals.	Statistical websites - see attachment	Complete the chapter study guides	
What are the different sampling methods?	Voluntary response, convenience, simple-random (SRS), probability, stratified random, and clusters are several different sampling methods.	Magazine articles Newspapers	Compete the online quizzes from the text's website M&M activities Jigsaw	Worksheets Project assessments Article summaries Anticipatory sets
What cautions about sample surveys exist?	Some cautions include response bias, undercoverage, nonresponse, and question wording.	Videos (Against all odds) Previous AP Exam questions	Case Closed Projects	Classroom discussion Closure questions
What are the parts of a well-designed experiment?	The components include experimental units, treatment, factors, levels, and conclusions.	Statistical Applets	Alternative Assessment	
	The basic principles of experimental design are control, replicate, and randomize.	Graphing Calculator	Previous AP Exam questions	
What are some different types of experimental design?	Blocking, matched-pairs, and completely randomized are types of experimental design.	SMART Board	Turkey-trot Olympics	
What cautions about experimentation exist?	Lack of realism and the placebo effect can prevent generalizations of the results.	Power Point Reviews	Review Relay	
	Double-blind experiments help avoid unconscious bias, such as the placebo effect.			

**Suggestions on how to differentiate in this unit:**

- Teaching methods will be diversified to appeal to visual, auditory and kinesthetic learners.
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- Students will work individually, with partners and in small groups on certain activities.

**Freehold Regional High School District  
S&E Advanced Placement Statistics**

**Unit #5: Probability and Simulations**

**Enduring Understanding:** Probability is a tool for measuring long-term behavior.

**Essential Questions:** What is probability?

How can probability be simulated?

What is a probability distribution?

How does one determine probability for a given event?

**Unit Goals:** Students will use simulation to calculate probabilities.

Students will understand and apply the laws of probability

**Duration of Unit:** 2 weeks

**NJCCCS:** 4.4 B1-6; 4.4 C1, 2; 4.5 A1-5; 4.5 B1-4

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How can simulations be used to model probability?	Simulation is the imitation of chance behavior based on a model that accurately reflects the phenomenon.	Current textbook and resource binders	Lecture and class discussion	Written tests and quizzes
How are simulations conducted?	Simulations are conducted using the five-step process along with the random digits table or random number generator from the graphing calculator.	Statistical websites - see attachment	Complete the chapter study guides	Worksheets
What is probability?	Probability is the long-term relative frequency of a random event.	Magazine articles	Compete the online quizzes from the text's website	Project assessments
What is a probability model?	A probability model consists of all possible outcomes of a random phenomenon and a way of assigning probabilities to those outcomes.	Newspapers	M&M activities	Article summaries
What are the general probability rules?	Probability of any event is always a number between 0 and 1, and the sum of all the probabilities of a distribution equals 1.	Videos (Against all odds)	Jigsaw	Anticipatory sets
	For disjoint events, the probability of the sum of the events is the sum of the probabilities of each event.	Previous AP Exam questions	Case Closed	Classroom discussion
	The probability of the intersection of two events is the product of their conditional probabilities.	Statistical Applets	Projects	Closure questions
	For any event, the probability of an event not occurring is 1 minus the probability of the event occurring.	Graphing Calculator	Alternative Assessment	
		SMART Board	Previous AP Exam questions	
		Power Point Reviews	Review Relay	



**Suggestions on how to differentiate in this unit:**

- Teaching methods will be diversified to appeal to visual, auditory and kinesthetic learners.
- Students will be given copies of data sets and other important notes.
- Students will be assessed by traditional and alternative methods.
- Students will work individually, with partners and in small groups on certain activities.

**Freehold Regional High School District  
S&E Advanced Placement Statistics**

**Unit #6: Random Variables**

**Enduring Understanding:** Probability is a tool for measuring long-term behavior.

**Essential Questions:** What is a probability distribution?

How can probability be simulated?

How does one determine probability for a given event?

**Unit Goals:** Students will differentiate between discrete and continuous random variables.

Students will explain the probability distribution for random variables, including binomial and geometric distributions.

**Duration of Unit:** 3 weeks

**NJCCCS:** 4.4 B1-6; 4.4 C1, 2; 4.5 A1-5; 4.5 B1-4

<b>Guiding / Topical Questions</b>	<b>Content, Themes, Concepts, and Skills</b>	<b>Instructional Resources and Materials</b>	<b>Teaching Strategies</b>	<b>Assessment Strategies</b>
What is a random variable?	Define both discrete and continuous random variables.	Current textbook and resource binders	Lecture and class discussion	Written tests and quizzes
What is a probability distribution for a random variable?	Show the construction of a discrete probability distribution.  Apply the formulas for mean and standard deviation.	Statistical websites - see attachment	Student investigation activities  Complete the chapter study guides	Worksheets  Project assessments
What is demonstrated by the law of large numbers?	Explain the law of large numbers in terms of long term expectations.	Magazine articles	Create posters and/or power point presentations	Notebook assessments
What is a control chart?	Show a normally distributed plot of a random variable in time sequence order.	Newspapers	Use whiteboards to show immediate feedback	Responses to discussion questions
What are the three types of Out-Of-Control Warning Signals?	Define Out-Of-Control Warning Signals I, II, and III.	Videos (Against all odds)	Use worksheets to reinforce concepts	Journal assessments
What is a binomial distribution?	Establish the settings of a binomial experiment.  Calculate binomial probabilities by applying relevant formulas.	Previous AP Exam questions		
What is a geometric distribution?	Establish the settings of a geometric experiment.  Calculate geometric probabilities by applying relevant formulas.	Statistical Applets  Graphing Calculator		
How does one use known means and standard deviations to compute the mean and standard deviation for a combination of variables.	Apply the formulas for calculating combined means and standard deviation for both independent and dependent variables.			

**Suggestions on how to differentiate in this unit:**

- Teaching methods will be diversified to appeal to visual, auditory and kinesthetic learners.
- Students will be given copies of data sets and other important notes.
- Students will be assessed by traditional and alternative methods.
- Students will work individually, with partners and in small groups on certain activities.

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**Unit #7: Sampling Distributions**

**Enduring Understandings:** The normal distribution is used to model the spread of data.  
A density curve is used to mimic probability.

**Essential Questions:** Why is the normal distribution important to the study of statistics?  
How does one assess normality?  
What is a density curve?

**Unit Goals:** Students will be able to interpret a sampling distribution for means.  
Students will be able to interpret a sampling distribution for proportions.

**Duration of Unit:** 3 weeks

**NJCCCS:** 4.2 A1; 4.4 A5; 4.4 B5; 4.5 A1-5; 4.5 B1-4

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
What is a sampling distribution?	Understand the properties of a sampling distribution.	Current textbook and resource binders	Lecture and class discussion	Written tests and quizzes
How does one compute the mean and standard deviation for a sample proportion?	Apply appropriate formulas for sample proportions.	Statistical websites - see attachment	Student investigation activities	Worksheets
When does one use a normal approximation to the sampling proportion?	Establish conditions for normal approximation to the sampling proportion.	Magazine articles	Complete the chapter study guides	Project assessments
How does one compute the mean and standard deviation for a sampling distribution of means?	Apply appropriate formulas for sampling distribution of means.	Newspapers	Create posters and/or power point presentations	Notebook assessments
What is the Central Limit Theorem?	Define Central Limit Theorem.	Videos (Against all odds)	Use whiteboards to show immediate feedback	Responses to discussion questions
How is the Central Limit Theorem applied to sampling distributions?	Establish conditions for the application of the Central Limit Theorem.	Previous AP Exam questions	Use worksheets to reinforce concepts	Journal assessments
		Statistical Applets		
		Graphing Calculator		

**Suggestions on how to differentiate in this unit:**

- Teaching methods will be diversified to appeal to visual, auditory and kinesthetic learners.
- Students will be given copies of data sets and other important notes.
- Students will be assessed by traditional and alternative methods.
- Students will work individually, with partners and in small groups on certain activities.

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**Unit #8: Estimating with Confidence**

**Enduring Understanding:** Inference is a tool for estimating an unknown population parameter.

**Essential Questions:** What does it mean to make an inference?

What is a confidence interval?

How does one distinguish among the various confidence intervals?

**Unit Goals:** Students will be able to determine a confidence interval for means.

Students will be able to determine a confidence interval for proportions.

**Duration of Unit:** 3 weeks

**NJCCCS:** 4.4 A2; 4.5 A1-5; 4.5 B1-4; 4.5 D1-6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
What is a confidence interval?	Define a confidence interval.	Current textbook and resource binders	Lecture and class discussion	Written tests and quizzes
How does one construct a confidence interval?	Distinguish between a point estimate and an interval estimate.	Statistical websites - see attachment	Student investigation activities	Worksheets
What is a margin of error?	Calculate margin or error using appropriate formula.	Magazine articles	Complete the chapter study guides	Project assessments
How does one distinguish between using the normal or the t distribution?	Establish conditions necessary for each distribution.	Newspapers	Create posters and/or power point presentations	Notebook assessments
What conditions must be present to construct a confidence interval for a population mean or proportion?	Identify the conditions necessary to distinguish each type of confidence interval.	Videos (Against all odds)	Use whiteboards to show immediate feedback	Responses to discussion questions
		Previous AP Exam questions	Use worksheets to reinforce concepts	Journal assessments
		Statistical Applets		
		Graphing Calculator		

**Suggestions on how to differentiate in this unit:**

- Teaching methods will be diversified to appeal to visual, auditory and kinesthetic learners.
- Students will be given copies of data sets and other important notes.
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**Unit #9: Significance Testing for One Population**

**Enduring Understanding:** Inference is a tool for validating a claim about a population parameter.

**Essential Questions:** What is a test of significance?

How is a test of significance done?

How does one distinguish among the various tests of significance?

**Unit Goals:** Students will be able to carry out a test of significance for a population mean.

Students will be able to carry out a test of significance for a population proportion.

**Duration of Unit:** 3 weeks

**NJCCCS:** 4.4 A2; 4.5 A1-5; 4.5 B1-4; 4.5 D1-6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
What is a test of significance?	Define a test of significance.	Current textbook and resource binders	Lecture and class discussion.	Written tests and quizzes
How does one determine significance?	Define level of significance and use it to make a decision about the null hypothesis.	Statistical websites - see attachment	Student investigation activities.	Worksheets
What are the steps to execute a test of significance for a population mean?	Establish a systematic procedure for a test of significance for a population mean.	Magazine articles	Complete the chapter study guides.	Project assessments
What are the steps to execute a test of significance for a population proportion?	Establish a system procedure for a test of significance for a population proportion.	Newspapers	Create posters and/or power point presentations.	Notebook assessments
What is the difference between a one-tailed and a two-tailed significance test?	Explain the different types of tests and the conditions necessary for each.	Videos (Against all odds)	Use whiteboards to show immediate feedback.	Responses to discussion questions
	Establish a connection between a two-tailed test and a confidence interval.	Previous AP Exam questions	Use worksheets to reinforce concepts.	Journal assessments
What are the different types of error?	Define Type I and Type II errors and the power of the test.	Statistical Applets		
		Graphing Calculator		

**Suggestions on how to differentiate in this unit:**

- Teaching methods will be diversified to appeal to visual, auditory and kinesthetic learners.
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**Unit #10: Comparing Two Population Parameters**

**Enduring Understandings:** Inference is a tool for validating a claim about a population parameter.

Inference is a tool for estimating an unknown population parameter.

**Essential Questions:** How does one distinguish among the various confidence intervals?

How does one distinguish among the various tests of significance?

**Unit Goals:** Students will be able to compare two population means and proportions using confidence intervals.

Students will be able to compare two population means and proportions using tests of significance.

**Duration of Unit:** 2 weeks

**NJCCCS:** 4.4 A2; 4.5 A1-5; 4.5 B1-4; 4.5 D1-6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
What is inference for comparing two populations?	Distinguish between inference using confidence intervals as opposed to tests of significance.	Current textbook and resource binders	Lecture and class discussion Student investigation activities	Written tests and quizzes
How does one compute a confidence interval for two population means?	Apply the appropriate formula for confidence intervals of population means using both the z statistic and the t statistic.	Statistical websites - see attachment Magazine articles	Complete the chapter study guides Create posters and/or power point presentations	Worksheets Project assessments Notebook assessments
How does one execute a test of significance for two population means?	Apply the appropriate formula for significance tests of population means using both the z statistic and the t statistic to find the p value.	Newspapers Videos (Against all odds)	Use whiteboards to show immediate feedback	Responses to discussion questions
How does one compute a confidence interval for two population proportions?	Apply the appropriate formula for confidence intervals of population proportions using both the z statistic and the t statistic.	Previous AP Exam questions	Use worksheets to reinforce concepts	Journal assessments
How does one execute a test of significance for two population proportions?	Apply the appropriate formula for significance tests of population proportions using both the z statistic and the t statistic to find the p value.	Statistical Applets Graphing Calculator		

**Suggestions on how to differentiate in this unit:**

- Teaching methods will be diversified to appeal to visual, auditory and kinesthetic learners.
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**Unit #11: Inference for Distributions of Categorical Variables**

**Enduring Understanding:** Inference is a tool for validating a claim about a population parameter.

**Essential Questions:** How is a test of significance done?

How does one distinguish among the various tests of significance?

**Unit Goals:** Students will be able to perform a test for goodness of fit using a two-way table.

Students will be able to perform a chi-square test of significance.

**Duration of Unit:** 1 week

**NJCCCS:** 4.4 A2; 4.5 A1-5; 4.5 B1-4; 4.5 D1-6

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
What is a chi-square test?	Define what is meant by a chi-square test.	Current textbook and resource binders	Lecture and class discussion	Written tests and quizzes
How does one conduct a chi-square goodness of fit test?	Define the steps necessary for carry out a chi-square goodness of fit test.	Statistical websites - see attachment  Magazine articles	Student investigation activities  Complete the chapter study guides  Create posters and/or power point presentations	Worksheets  Project assessments  Notebook assessments
What is a two-way table?	Draw and complete a two-way table.	Newspapers  Videos (Against all odds)	Use whiteboards to show immediate feedback	Responses to discussion questions
What is a chi-square test for homogeneity?	Use a two-way table to find the chi-square value and use it to generate a p value for a test of significance of homogeneity of a population proportion.	Previous AP Exam questions	Use worksheets to reinforce concepts	Journal assessments
What is a chi-square test for association/independence?	Use a two-way table to find the chi-square value and use it to generate a p value for a test of significance of association/independence for two population variables.	Statistical Applets  Graphing Calculator		

**Suggestions on how to differentiate in this unit:**

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**Unit #12: Inference for Regression**

**Enduring Understandings:** Regression is an instrument used to generalize relationships for bivariate data.  
Inference is a tool for validating a claim about a population parameter.

**Essential Questions:** How well does data fit a regression model?  
What are the properties of a linear regression model?  
How is a test of significance done?

**Unit Goals:** Students will be able to create a confidence interval for the slope of a regression line.  
Students will be able to test the hypothesis of a linear relationship of the regression line.

**Duration of Unit:** 2 weeks

**NJCCCS:** 4.3 C1, 2; 4.4 A2; 4.4 A4, 5; 4.5 A4, 5; 4.5 B1-4; 4.5 D1-6; 4.5 E2

<b>Guiding / Topical Questions</b>	<b>Content, Themes, Concepts, and Skills</b>	<b>Instructional Resources and Materials</b>	<b>Teaching Strategies</b>	<b>Assessment Strategies</b>
What conditions are necessary to do inference for regression?	Identify and list the conditions necessary for regression analysis.	Current textbook and resource binders	Lecture and class discussion	Written tests and quizzes
What is meant by the standard error about the least-squares line?	Apply the formulas for calculating standard error.	Statistical websites - see attachment	Student investigation activities	Worksheets
How does one compute a confidence interval for the slope of the least-squares line?	Establish and apply the formula for a confidence interval for the regression slope.	Magazine articles	Complete the chapter study guides	Project assessments
How does one conduct a test of significance for the slope of the least-squares line?	Establish and apply the steps for a test of significance for the regression slope.	Newspapers	Create posters and/or power point presentations	Notebook assessments
		Videos (Against all odds)	Use whiteboards to show immediate feedback	Responses to discussion questions
		Previous AP Exam questions	Use worksheets to reinforce concepts	Journal assessments
		Statistical Applets		
		Graphing Calculator		

**Suggestions on how to differentiate in this unit:**

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**Unit #13: Post AP Exam**

**Enduring Understandings:** Statistics can be applied to many different disciplines and fields.

Technology is instrumental to the study of statistics in an interactive classroom

**Essential Question:** How can one apply various statistical techniques to analyze results when working on novel research projects?

**Unit Goals:** Students will demonstrate understanding of concepts covered throughout the year via a year end project.

Students will incorporate appropriate technology to augment and facilitate calculations necessary for statistical summaries.

**Duration of Unit:** 5 weeks

**NJCCCS:** 4.3 C1, 2; 4.4 A2; 4.4 A4, 5; 4.5 A4, 5; 4.5 B1-4; 4.5 D1-6; 4.5 E2

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
How does one collect and analyze real world data?	Use scatterplots and apply correlations to analyze collected data.	Platinum Resource Binder – Special Problem 3b “What’s Your Best Offer?”	Class discussion Student investigation activities	Rubrics Project assessments
How does one use probabilities to analyze games of chance?	Use a variety of probabilistic methods to deduce mathematical likelihood of success.	Platinum Resource Binder – “Casino Lab”	Create posters and/or power point presentations Use whiteboards to show immediate feedback	Responses to discussion questions Journal assessments
How does one test a claim about a population parameter?	Use statistical principles and sample data to validate a claim.	Platinum Resource Binder – Special Problem 11b “The Pineapple Problem”		
		Movie – “A Civil Action” in conjunction with the attached handout listed in addendum		
How does one compare a claim about two population parameters?	Use statistical principles and sample data to validate a claim.	Platinum Resource Binder – Special Problem 13a “Exercising to Lose Weight”		
How does one test a claim about two population proportions?	Use Chi-Square principles to assess relationships.	Platinum Resource Binder – Special Problem 14a “Do Dogs Resemble Their Owners?”		

**Suggestions on how to differentiate in this unit:**

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## Addendum

### **Additional Resources for use in S&E AP Statistics**

#### Websites

<http://www.itl.nist.gov/div898/handbook/> - Engineering Statistics Handbook

<http://apcentral.collegeboard.com> – Official S&E AP Statistics College Board site

<http://www.stattrek.com> – Practice AP Exams and study guides

<http://www.stat.sc.edu/apstats/> - University of South Carolina Statistics website

[http://web.mac.com/statsmonkey/APStats\\_at\\_LSHS/Statsmonkey.html](http://web.mac.com/statsmonkey/APStats_at_LSHS/Statsmonkey.html) - Myriad resources, including practice exams, lab activities, and guides

<http://mathforum.org/kb/forum.jspa?forumid=67> – AP Stat listserv. Ask questions of fellow AP Stat teachers.

<http://www.learner.org/resources/series65.html> - Against All Odds video series in streaming format

[http://www.ruf.rice.edu/~lane/stat\\_sim/sampling\\_dist/index.html](http://www.ruf.rice.edu/~lane/stat_sim/sampling_dist/index.html) - Sampling Distribution applet

<http://wise.cgu.edu/power/powerapplet1.html> - Power of the test applet

[http://www.bbn-school.org/us/math/ap\\_stats/applets/applets.html#anchor123925](http://www.bbn-school.org/us/math/ap_stats/applets/applets.html#anchor123925) – Various applets

<http://exploringdata.cqu.edu.au/> - Various statistical activities and applets

***A CIVIL ACTION***  
**(A Steven Zaillian Film)**

In 1984, residents of a neighborhood in Randolph, Massachusetts, counted 67 cancer cases in their 250 residences. This cluster of cancer cases seemed unusual, and the residents expressed concern that runoff from a nearby chemical plant was contaminating their water supply and causing cancer. The residents believed that the well water was contaminated and had caused the leukemia. They proceeded to sue two companies held responsible for the contamination.

1. Identify the lawyer (actor and who he portrays)?
2. Briefly describe the plot of the movie.
3. How was statistics and math used in the movie?
4. Did the statistics affect results of the court case?



In Steven Zaiilan's Film *A Civil Action*, the attorney William Cheeseman (Bruce Norris) tells Al Love (James Gadolfini)

*If I took a hundred pennies and threw them up in the air, about half of them would land heads, and the other half tails, right? Now if I looked around closely, I'd probably find some heads grouped together in a cluster. What does that mean? Does that mean anything?*

In this assignment, we will explore these questions

Let  $\hat{p}_1$  represent the underlying rate of birth defects during the time the contaminated wells were being used, and let  $\hat{p}_2$  represent the underlying rate of birth defects during the time the contaminated wells were not being used. We want to know whether these underlying (but unknown) rates  $\hat{p}_1$  and  $\hat{p}_2$  are equal.

1. State the appropriate null and alternative hypotheses. Since we believe *a priori* that water pollution should increase, rather than decrease, the rate of birth defects, use a one sided alternative hypothesis.

The true values of  $\hat{p}_1$  and  $\hat{p}_2$  are unknowable. Instead, we observe a sample of births (from the population of all births that 'could have occurred' in Woburn during these time periods), and we observe the proportion of birth defects when the wells were or were not being used. Let  $\hat{p}_1$  represent the observed proportion of birth defects when the contaminated wells were being used, and  $\hat{p}_2$  the observed proportions of birth defects when the contaminated wells were not being used.

According to one source, there were 16 birth defects out of 414 births when the contaminated wells were being used and 3 birth defects out of 228 when the contaminated wells were not being used.

2. Calculate the values of  $\hat{p}_1$  and  $\hat{p}_2$  from these data. Also calculate  $(\hat{p}_1 - \hat{p}_2)$ , the difference between the two proportions.
  
3. If the null hypotheses were true, what would be the sampling distribution of the quantity  $(\hat{p}_1 - \hat{p}_2)$ ? Give the name of the sampling distribution, its mean, and its SD. Show your work.
  
  
  
  
  
  
  
  
  
  
4. Calculate the P-value, if the null hypothesis were true. Show your work.
  
  
  
  
  
  
  
  
  
  
5. Based on your P-value, do you reject or fail to reject the null hypothesis? Comment in context of the problem.