

# Fair Lawn Public Schools

Fair Lawn, NJ

**AP  
Statistics**

**Adopted August**

**2017**

**Revised August 2017  
Developed August 2012**

---

AP Statistics is advanced placement course accredited by the College Board, aligned to the Student Learning Standards Initiative and Student Learning Standards for College and Career Readiness.

**AP  
Statistics**

# **Fair Lawn School District**

## **Committee Credits AP Statistics Team**

Marco Infante  
Lauren Gimon, Supervisor

# Statistics AP

## I. Course Synopsis

The purpose of the AP course in statistics is to introduce students to the major concepts and tools for collecting, analyzing and drawing conclusions from data. Students are exposed to four broad conceptual themes:

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

## II. Philosophy & Rationale

AP Statistics is effective preparation for students interested in the fields of social sciences, health sciences, business, engineering, and mathematics. This course will allow students to build inter-disciplinary connections with other subjects and with the outside world. This course will give students opportunity to connect to college and possibly reward college credit by providing them the challenges and rewards of a rigorous academic program. Additionally, students who successfully complete the course and exam may receive credit, advanced placement or both for a one-semester introductory college statistics course.

*The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important “processes and proficiencies” with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council’s report Adding It Up: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one’s own efficacy).*

### **MATH.PRACTICE.MP1 - Make sense of problems and persevere in solving them.**

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information

they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

**MATH.PRACTICE.MP2 - Reason abstractly and quantitatively.**

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

**MATH.PRACTICE.MP3 - Construct viable arguments and critique the reasoning of others.**

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

**MATH.PRACTICE.MP4 - Model with mathematics.**

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high

school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

**MATH.PRACTICE.MP5 - Use appropriate tools strategically.**

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

**MATH.PRACTICE.MP6 - Attend to precision.**

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

**MATH.PRACTICE.MP7 - Look for and make use of structure.**

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see  $7 \times 8$  equals the well-remembered  $7 \times 5 + 7 \times 3$ , in preparation for learning about the distributive property. In the expression  $x^2 + 9x + 14$ , older students can see the 14 as  $2 \times 7$  and the 9 as  $2 + 7$ . They recognize the significance of an

existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see  $5 - 3(x - y)^2$  as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers  $x$  and  $y$ .

**MATH.PRACTICE.MP8 - Look for and express regularity in repeated reasoning.**

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through  $(1, 2)$  with slope 3, middle school students might abstract the equation  $(y - 2)/(x - 1) = 3$ . Noticing the regularity in the way terms cancel when expanding  $(x - 1)(x + 1)$ ,  $(x - 1)(x^2 + x + 1)$ , and  $(x - 1)(x^3 + x^2 + x + 1)$  might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

### III. Scope & Sequence

#### **Unit 1: Distributions of Data and Measures of Central Tendency (7 days)**

Bar Graphs and Pie charts  
Two-Way Tables and Marginal Distributions  
Relationships between Categorical Variables  
Conditional Distributions  
Dotplots, Describing Shape, Comparing Distributions, Stem plots  
Histograms  
Measuring Center: Mean and Median  
Comparing Measures of Center  
Measuring Spread: Outliers, Five Number Summary, Standard Deviation  
Five Number Summary and Boxplots, measuring Spread:  
Standard Deviation, Choosing Measures of Center and Spread

#### **Unit 2: Normal Distribution (5 days)**

Measuring Position: Percentiles, Cumulative Relative Frequency Graphs, Z-Scores  
Transforming Data: Density Curves  
Empirical rule (68-95-99.7 Rule) : The Standard Normal Distribution  
Normal Distribution Calculations  
Assessing Normality

#### **Unit 3: Displaying Relationships and Regression Analysis (5 days)**

Explanatory and Response Variables  
Displaying Relationships: Scatterplots  
Interpreting Scatterplots  
Measuring Linear Association: Correlation  
Facts about Correlation  
Least-Squares Regression  
Interpreting a Regression Line  
Prediction  
Residuals and the Least-Square Regression Line  
Calculating the Equation of the Least-Regression Line  
Residual Plots  
Role of  $r^2$  in regression.  
Interpreting computer regression output  
Correlation and regression wisdom

#### **Unit 4: Sampling and Experimental Design (7 days)**

Sample Survey  
Random Sampling  
SRS vs. stratified random sample or cluster sample  
Inference for Sampling (undercoverage, non-response, wording)

Observational Study vs. Experiment  
Principles of experimental design  
Inference for Experiments  
Blocking, Matched Pair Design  
Scope of Inference, Challenges of Causation  
Class Experiments or Data Ethics (optional)

**Unit 5: Probability****(7 days)**

Probability Models  
Two-Way Tables and Probability, Venn Diagrams and Probability  
Conditional Probability, Independence, Tree Diagrams and General Multiplication Rule  
Calculating Conditional Probabilities

**Unit 6: Operations of Discrete and Continuous Random Variables****(6 days)**

Discrete Random Variables, Mean (Expected Value of a Discrete Random Variable)  
Standard Deviation (and Variance) of Discrete Random Variable, Continuous Random Variables  
Linear Transformation  
Combining Random Variables, Combining Normal Random Variables  
Binomial Settings and Binomial Random Variables, Binomial Probabilities  
Mean and Standard Deviation of a Binomial Distribution, Binomial Distributions in Statistical Sampling

**Unit 7: Sampling Distributions****(6 days)**

Sampling Variability, Describing Sampling Distribution  
Sampling Distribution of  $\bar{x}$ , Using the Normal Approximation for  
Sampling Distribution of  $s$ ; Mean and Standard Deviation, Sampling from a Normal Population  
Central Limit Theorem

**Unit 8: Estimating with confidence****(7 days)**

Confidence Interval, Interpreting Confidence Levels and Confidence Intervals,  
Constructing a  
Confidence Interval  
Conditions from Estimating  $p$ , Constructing a Confidence Interval for  $p$   
Four-Step Process, Choosing a Sample Size  
When  $\sigma$  is known: The One-Sample  $z$  Interval for a Population Mean, When  $\sigma$  is Unknown:  
The  $t$ -Distributions, Constructing a Confidence Interval for  
Using  $t$  Procedures Wisely

**Unit 9: 1 Sample Significance Testing****(7 days)**

Reasoning of Significance Tests, Stating Hypotheses, Interpreting P-values, Statistical Significance



Type 1 and Type II Errors, Planning Studies: Power of a Statistical Test  
Carrying out a Significance Test, The One-Sample  $z$  Test for a Proportion  
Two-Sided Tests, Why Confidence Intervals Give More Information  
Carrying Out a Significance Test for  $\mu$ , The One-Sample  $t$  Test, Two-sided Tests and  
Confidence Intervals  
Inference for Means: Paired Data, Using Tests Wisely

**Unit 10: 2 Sample Statistical Inference****(5 days)**

Sampling Distribution of a Difference between Two Proportions  
Confidence Intervals for  
Significance Tests for  $p$ , Inference for Experiments  
Sampling Distribution of a Difference between Two Means  
Two-Sample  $t$  Statistic, Confidence Intervals for  
Significance Tests for  $\mu$ , Using Two-Sample  $t$  Procedures Wisely

**Unit 11: Chi-Square Distribution****(5 days)**

Comparing Observed and Expected Counts: The Chi-Square Statistic, The Chi-Square  
Distributions and P-values  
The Chi-Square Goodness-of-Fit Test, Follow-Up Analysis  
Comparing Distributions of a Categorical Variable, Expected Counts and the Chi-Square  
Statistic, The Chi-Square Test for Homogeneity, Follow-Up Analysis, Comparing Several  
Populations  
Chi-Square Test of Association/Independence

**Unit 12: Inference on Regression****(5 days)**

Sampling Distribution of  $b$ , Conditions for Regression Inference  
Estimating Parameters, Constructing a Confidence Interval for the Slope  
Performing a Significance Test for the Slope  
Transforming with Powers and Roots  
Transforming with Logarithms

## IV. Unit Descriptions

### Unit 1: Distributions of Data and Measures of Central Tendency (7 days)

#### Enduring Understanding

1. A density curve is used to mimic probability.
2. The normal distribution is used to model the spread of data.

#### Essential Questions

1. What is the difference between categorical and quantitative variables?
2. How can categorical and quantitative variables be represented graphically?
3. How can data be represented numerically?
4. How are distributions compared?
5. What is the effect of linear transformations on a data set?
6. How can data be analyzed using technology?
7. How to describe a distribution by reporting various measures of tendency.

#### Learning Objectives

1. Students will be able to:
  - a. Identify the different types of variables.
  - b. Identify that categorical variables can be represented by bar graphs and pie charts.
  - c. Identify that quantitative variables can be represented by histograms, stemplots, box plots, relative frequency histograms, and ogives.
  - d. Identify that data can be described through measures of central tendency (mean and median), spread (standard deviation and variance), IQR, and outliers.
  - e. Understand that distributions are described by shape, center, and spread.
  - f. Use mean and standard deviation for data sets that are symmetrical. Use median and IQR for data sets that are skewed.
  - g. Use numerical and graphical summaries to compare data sets.
  - h. Understand that when adding a constant to all values of a data set, the mean and median increase by that value, but spread is not affected.
  - i. Identify that data can be imputed and manipulated using the LIST feature.
  - j. Identify that numerical representations can be found using 1-var stats.
  - k. Identify that graphical representations can be found using stat-plot.

#### New Jersey Student Learning Standards

- HSS.ID.A.1 – Represent data with plots on the real number line (dot plots, histograms, and box plots).
- HSS.ID.A.2 – Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

- HSS.ID.A.3 – Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- HSS.ID.A.4 – Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
- HSS.ID.B.5 – Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities
  - a. Do Now activities
  - b. Classwork
  - c. Homework
  - d. Use of white boards
  - e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology
  - k. AP Practice
2. English Language Learners.
  - a. Students may use a bilingual dictionary.
  - b. Read written instructions.
  - c. Students may be provided with note organizers / study guides to reinforce key topics.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
  - a. Students may be provided with note organizers / study guides to reinforce key topics.
  - b. Extended time on assessments when needed.
  - c. Preferred seating to be determined by student and teacher.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
  - f. Establish a non-verbal cue to redirect student when not on task.
  - g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.

- a. Provide enrichment activities to expand upon the curriculum.
- b. Use higher level questioning techniques in class and on assessments.

### New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

### Career Readiness Practices

- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

### Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

## **Unit 2: Normal Distribution**

**(5 days)**

### Enduring Understanding

1. A density curve is used to mimic probability.
2. The normal distribution is used to model the spread of data.

### Essential Questions

1. What is a density curve?
2. How do density curves relate to probability?
3. How are measures of central tendency relevant to density curves?
4. How can density curves be used to express relative standing?
5. What is a normal distribution?
6. How does one assess normality?
7. What does a normal distribution imply about the spread of data?
8. How do you measure relative standing?
9. How can the mean and median be approximated on a density curve?
10. What is a standard Normal distribution?
11. For a Normal distribution, what is the value associated with a specific proportion?
12. How can Normality be assessed?

### Learning Objectives

1. Students will be able to:
  - a. Identify that relative standing can be found by computing the standardized value (z-score).
  - b. Identify that Relative standing can also be discussed as a percentile.
  - c. Identify that a density curve is an approximation of the overall shape of a distribution.
  - d. Identify that the area underneath a density is exactly 1.
  - e. Identify that the median of a density curve is the “equalareas” point that divides the area under the curve in half.
  - f. Identify that the mean of a density curve is the “balance point,” at which the curve would balance if made of solid material.
  - g. Identify that a normal distribution is a density curve that is symmetric, single-peaked, and bell-shaped.
  - h. Identify that all Normal distributions follow 68-95-99.7 Rule.
  - i. Identify that a standard Normal distribution has a mean of zero and a standard deviation of one.  $N(0, 1)$
  - j. Identify that the proportion of observations can be found using the z-table and the graphing calculator (normalcdf).
  - k. Identify that the value for a given proportion can be found using the z-table or the graphing calculator (invNorm).
  - l. Identify that Normality can be assessed by comparing the count of observations in each interval with the 68-95-99.7 Rule.
  - m. Identify that Normal probability plots can also be used to assess Normality.

### New Jersey Student Learning Standards

- HSS.ID.A.4 – Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
- HSS.ID.B.5 – Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities
  - a. Do Now activities
  - b. Classwork
  - c. Homework
  - d. Use of white boards

- e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology
  - k. AP Practice
2. English Language Learners.
    - a. Students may use a bilingual dictionary.
    - b. Read written instructions.
    - c. Students may be provided with note organizers / study guides to reinforce key topics.
    - d. Provide modified assessments when necessary.
    - e. Student may complete assessments in alternate setting when requested.
  3. Special Education/504 Students.
    - a. Students may be provided with note organizers / study guides to reinforce key topics.
    - b. Extended time on assessments when needed.
    - c. Preferred seating to be determined by student and teacher.
    - d. Provide modified assessments when necessary.
    - e. Student may complete assessments in alternate setting when requested.
    - f. Establish a non-verbal cue to redirect student when not on task.
    - g. Maintain strong teacher / parent communication.
  4. Gifted and Talented Students.
    - a. Provide enrichment activities to expand upon the curriculum.
    - b. Use higher level questioning techniques in class and on assessments.

New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

Career Readiness Practices

- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.

- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

**Unit 3: Displaying Relationships and Regression Analysis****(5 days)**Enduring Understanding

1. Regression is an instrument used to generalize relationships for bivariate data.

Essential Question(s)

1. What is regression?
2. What is bivariate data?
3. How well does data fit a regression model?
4. What are the properties of a linear regression model?
5. How can non-linear data be linearized for regression?

Learning Objectives

1. Students will be able to:
  - a. Identify that a response variable measures an outcome of a study.
  - b. Identify that an explanatory variable helps explain or influences changes in a response variable.
  - c. Identify that scatterplots can be used to find the overall pattern and striking deviations of bivariate data.
  - d. Identify that correlation measures the direction and strength of a linear relationship.
  - e. Identify that the Least Squares Regression Line (LSRL) describes how a response variable changes as an explanatory variable changes.
  - f. Identify that a residual plot and the coefficient of determination are used to assess the appropriateness of the regression model.
  - g. Identify that extrapolation may not be accurate for values outside of the given data set.
  - h. Identify that lurking variables may influence the interpretation of the relationship between the two variables.
  - i. Identify that powers and logarithms can be employed to one or both variable to linearize the relationship between the variables.
  - j. Identify that marginal and conditional distributions are used to describe relationships between categorical variables.
  - k. Identify that causation, common response, and confounding are three ways that can explain the association.

New Jersey Student Learning Standards

- HSS.ID.B.6 – Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

- HSS.ID.B.6.A– Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
- HSS.ID.B.6.B– Informally assess the fit of a function by plotting and analyzing residuals.
- HSS.ID.B.6.C– Fit a linear function for a scatter plot that suggests a linear association.
- HSS.ID.C.7– Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- HSS.ID.C.8– Compute (using technology) and interpret the correlation coefficient of a linear fit.
- HSS.ID.C.9– Distinguish between correlation and causation.

### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities
  - a. Do Now activities
  - b. Classwork
  - c. Homework
  - d. Use of white boards
  - e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology
  - k. AP Practice
2. English Language Learners.
  - a. Students may use a bilingual dictionary.
  - b. Read written instructions.
  - c. Students may be provided with note organizers / study guides to reinforce key topics.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
  - a. Students may be provided with note organizers / study guides to reinforce key topics.
  - b. Extended time on assessments when needed.
  - c. Preferred seating to be determined by student and teacher.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
  - f. Establish a non-verbal cue to redirect student when not on task.
  - g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.



- a. Provide enrichment activities to expand upon the curriculum.
- b. Use higher level questioning techniques in class and on assessments.

### New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

### Career Readiness Practices

- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

### Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

## **Unit 4: Sampling and Experimental Design**

**(7 days)**

### Enduring Understanding

1. Proper collection of data is essential for good experimental design.
2. Proper sampling and surveying techniques are essential to determining efficacy of data values.

### Essential Question(s)

1. What is the difference between an observational study and an experiment?
2. What cautions about sample surveys exist?
3. What are the different sampling methods?
4. What are the parts of a well-designed experiment?
5. What are some different types of experimental design?
6. What cautions about experimentation exist?
7. How can causation be established?
8. How does bias affect experimental design?

### Learning Objectives

1. Students will be able identify that:
  - a. An observation study observes individuals and measures variables of interest.

- b. An experiment deliberately imposes a treatment on individuals.
- c. Voluntary response, convenience, simple random (SRS), probability, stratified random, and clusters are several different sampling methods.
- d. Some cautions include response bias, under-coverage, nonresponse, and question wording.
- e. The components include experimental units, treatment, factors, levels, and conclusions.
- f. The basic principles of experimental design are control, replicate, and randomize.
- g. Blocking, matched-pairs, and completely randomized are types of experimental design.
- h. Lack of realism and the placebo effect can prevent generalizations of the results.
- i. Double-blind experiments help avoid unconscious bias, such as the placebo effect.

#### New Jersey Student Learning Standards

- HSS.IC.A.1– Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- HSS.IC.A.2– Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*
- HSS.IC.B.3– Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

#### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities
  - a. Do Now activities
  - b. Classwork
  - c. Homework
  - d. Use of white boards
  - e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology
  - k. AP Practice
2. English Language Learners.
  - a. Students may use a bilingual dictionary.
  - b. Read written instructions.

- c. Students may be provided with note organizers / study guides to reinforce key topics.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
    - a. Students may be provided with note organizers / study guides to reinforce key topics.
    - b. Extended time on assessments when needed.
    - c. Preferred seating to be determined by student and teacher.
    - d. Provide modified assessments when necessary.
    - e. Student may complete assessments in alternate setting when requested.
    - f. Establish a non-verbal cue to redirect student when not on task.
    - g. Maintain strong teacher / parent communication.
  4. Gifted and Talented Students.
    - a. Provide enrichment activities to expand upon the curriculum.
    - b. Use higher level questioning techniques in class and on assessments.

#### New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

#### Career Readiness Practices

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

#### Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

**Unit 5: Probability****(5 days)**Enduring Understanding

1. Probability is a tool for measuring long-term behavior.

Essential Question(s)

1. How can simulations be used to model probability?
2. How are simulations conducted?
3. What is probability?
4. What is a probability model?
5. What is a probability distribution?
6. How does one determine probability for a given event?
7. What are the general probability rules?

Learning Objectives

1. Students will be able to identify that:
  - a. Simulation is the imitation of chance behavior based on a model that accurately reflects the phenomenon.
  - b. Simulations are conducted using the five-step process along with the random digits table or random number generator from the graphing calculator.
  - c. Probability is the long-term relative frequency of a random event.
  - d. A probability model consists of all possible outcomes of a random phenomenon and a way of assigning probabilities to those outcomes.
  - e. Probability of any event is always a number between 0 and 1, and the sum of all the probabilities of a distribution equals 1.
  - f. For disjoint events, the probability of the sum of the events is the sum of the probabilities of each event.
  - g. The probability of the intersection of two events is the product of their conditional probabilities.

New Jersey Student Learning Standards

- HSS.CP.A.1 – Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").
- HSS.CP.A.2 – Understand that two events  $A$  and  $B$  are independent if the probability of  $A$  and  $B$  occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
- HSS.CP.A.3 – Understand the conditional probability of  $A$  given  $B$  as  $P(A \text{ and } B)/P(B)$ , and interpret independence of  $A$  and  $B$  as saying that the conditional probability of  $A$  given  $B$  is the same as the probability of  $A$ , and the conditional probability of  $B$  given  $A$  is the same as the probability of  $B$ .
- HSS.CP.A.4 – Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional

probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*

- HSS.CP.A.5 – Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*
- HSS.CP.B.6 – Find the conditional probability of  $A$  given  $B$  as the fraction of  $B$ 's outcomes that also belong to  $A$ , and interpret the answer in terms of the model.
- HSS.CP.B.7 – Apply the Addition Rule,  $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ , and interpret the answer in terms of the model.
- HSS.CP.B.8 – Apply the general Multiplication Rule in a uniform probability model,  $P(A \text{ and } B) = P(A)P(B|A) = P(B)P(A|B)$ , and interpret the answer in terms of the model.
- HSS.CP.B.9 – Use permutations and combinations to compute probabilities of compound events and solve problems.

### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities
  - a. Do Now activities
  - b. Classwork
  - c. Homework
  - d. Use of white boards
  - e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology
  - k. AP Practice
2. English Language Learners.
  - a. Students may use a bilingual dictionary.
  - b. Read written instructions.
  - c. Students may be provided with note organizers / study guides to reinforce key topics.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
  - a. Students may be provided with note organizers / study guides to reinforce key topics.
  - b. Extended time on assessments when needed.

- c. Preferred seating to be determined by student and teacher.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
  - f. Establish a non-verbal cue to redirect student when not on task.
  - g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
- a. Provide enrichment activities to expand upon the curriculum.
  - b. Use higher level questioning techniques in class and on assessments.

#### New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

#### Career Readiness Practices

- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

#### Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

### **Unit 6: Operations of Discrete and Continuous Random Variables (6 days)**

#### Enduring Understanding

1. Probability is a tool for measuring long-term behavior.

#### Essential Question(s)

1. What is a probability distribution?
2. How can probability be simulated?
3. What is a random variable?
4. What is a probability distribution for a random variable?
5. How does one determine probability for a given event?
6. What is demonstrated by the law of large numbers?
7. What is a binomial distribution?
8. How does one use known means and standard deviations to compute the mean and standard deviation for a combination of variables?

### Learning Objectives

1. Students will be able to identify that:
  - a. Define both discrete and continuous random variables.
  - b. Show the construction of a discrete probability distribution.
  - c. Apply the formulas for mean and standard deviation.
  - d. Explain the law of large numbers in terms of long term expectations.
  - e. Establish the settings of a binomial experiment.
  - f. Calculate binomial probabilities by applying relevant formulas.
  - g. Apply the formulas for calculating combined means and standard deviation for both independent and dependent variables.

### New Jersey Student Learning Standards

- HSS.MD.A.1 – Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.
- HSS.MD.A.2 – Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
- HSS.MD.A.3 – Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.*
- HSS.MD.A.4 – Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. *For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?*
- HSS.MD.B.5.A – Find the expected payoff for a game of chance. *For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.*
- HSS.MD.B.5.B – Evaluate and compare strategies on the basis of expected values. *For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.*
- HSS.MD.B.6 – Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
- HSS.MD.B.7 – Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities

- a. Do Now activities
  - b. Classwork
  - c. Homework
  - d. Use of white boards
  - e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology
  - k. AP Practice
2. English Language Learners.
    - a. Students may use a bilingual dictionary.
    - b. Read written instructions.
    - c. Students may be provided with note organizers / study guides to reinforce key topics.
    - d. Provide modified assessments when necessary.
    - e. Student may complete assessments in alternate setting when requested.
  3. Special Education/504 Students.
    - a. Students may be provided with note organizers / study guides to reinforce key topics.
    - b. Extended time on assessments when needed.
    - c. Preferred seating to be determined by student and teacher.
    - d. Provide modified assessments when necessary.
    - e. Student may complete assessments in alternate setting when requested.
    - f. Establish a non-verbal cue to redirect student when not on task.
    - g. Maintain strong teacher / parent communication.
  4. Gifted and Talented Students.
    - a. Provide enrichment activities to expand upon the curriculum.
    - b. Use higher level questioning techniques in class and on assessments.

#### New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

#### Career Readiness Practices

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.



- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

#### Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

### **Unit 7: Sampling Distributions**

**(6 days)**

#### Enduring Understanding

1. The normal distribution is used to model the spread of data.
2. A density curve is used to mimic probability.

#### Essential Question(s)

1. Why is the normal distribution important to the study of statistics?
2. How does one assess normality?
3. What does the normal distribution imply about the spread of data?
4. What is a sampling distribution?
5. How does one compute the mean and standard deviation for a sample proportion?
6. When does one use a normal approximation to the sampling proportion?
7. How does one compute the mean and standard deviation for a sampling distribution of means?
8. What is the Central Limit Theorem?
9. How is the Central Limit Theorem applied to sampling distributions?

#### Learning Objectives

1. Students will be able to identify that:
  - a. The properties of a sampling distribution. Show the construction of a discrete probability distribution.
  - b. Appropriate formulas for sample proportions can be applied.
  - c. Conditions for normal approximation to the sampling proportion can be established.
  - d. Appropriate formulas for sampling distribution of means can be applied.
  - e. Define Central Limit Theorem
  - f. Establish conditions for the application of the Central Limit Theorem.

### New Jersey Student Learning Standards

- HSS.ID.A.4 – Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
- HSS.ID.B.5 – Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities
  - a. Do Now activities
  - b. Classwork
  - c. Homework
  - d. Use of white boards
  - e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology
  - k. AP Practice
2. English Language Learners.
  - a. Students may use a bilingual dictionary.
  - b. Read written instructions.
  - c. Students may be provided with note organizers / study guides to reinforce key topics.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
  - a. Students may be provided with note organizers / study guides to reinforce key topics.
  - b. Extended time on assessments when needed.
  - c. Preferred seating to be determined by student and teacher.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
  - f. Establish a non-verbal cue to redirect student when not on task.
  - g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.

- a. Provide enrichment activities to expand upon the curriculum.
- b. Use higher level questioning techniques in class and on assessments.

New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

Career Readiness Practices

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

**Unit 8: Estimating with Confidence**

**(6 days)**

Enduring Understanding

1. Inference is a tool for estimating an unknown population parameter.

Essential Question(s)

1. What does it mean to make an inference?
2. What is a confidence interval?
3. How does one distinguish among the various confidence intervals?
4. How does one construct a confidence interval?
5. What is a margin of error?
6. How does one distinguish between using the normal or the t distribution?
7. What conditions must be present to construct a confidence interval for a population mean or proportion?

### Learning Objectives

1. Students will be able to:
  - a. Define a confidence interval.
  - b. Distinguish between a point estimate and an interval estimate.
  - c. Calculate margin or error using appropriate formula.
  - d. Establish conditions necessary for each distribution.
  - e. Identify the conditions necessary to distinguish each type of confidence interval.

### New Jersey Student Learning Standards

- HSS.IC.B.4 – Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.

### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities
  - a. Do Now activities
  - b. Classwork
  - c. Homework
  - d. Use of white boards
  - e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology
  - k. AP Practice
2. English Language Learners.
  - a. Students may use a bilingual dictionary.
  - b. Read written instructions.
  - c. Students may be provided with note organizers / study guides to reinforce key topics.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
  - a. Students may be provided with note organizers / study guides to reinforce key topics.
  - b. Extended time on assessments when needed.
  - c. Preferred seating to be determined by student and teacher.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
  - f. Establish a non-verbal cue to redirect student when not on task.

- g. Maintain strong teacher / parent communication.
- 4. Gifted and Talented Students.
  - a. Provide enrichment activities to expand upon the curriculum.
  - b. Use higher level questioning techniques in class and on assessments.

#### New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

#### Career Readiness Practices

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

#### Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

### **Unit 9: Significance Testing about a Population Parameter**

**(7 days)**

#### Enduring Understanding

1. Inference is a tool for validating a claim about a population parameter.

#### Essential Question(s)

1. What is a test of significance?
2. How does one determine significance?
3. What are the steps to execute a test of significance for a population mean?
4. What are the steps to execute a test of significance for a population proportion?
5. What is the difference between a one-tailed and a two-tailed significance test?
6. What are the different types of error?

7. How does one distinguish among the various tests of significance?

### Learning Objectives

1. Students will be able to:
  - a. Define a test of significance.
  - b. Define level of significance and use it to make a decision about the null hypothesis.
  - c. Establish a systematic procedure for a test of significance for a population mean.
  - d. Establish a system procedure for a test of significance for a population proportion.
  - e. Explain the different types of tests and the conditions necessary for each.
  - f. Establish a connection between a two-tailed test and a confidence interval.
  - g. Define Type I and Type II errors and the power of the test.

### New Jersey Student Learning Standards

- Topics in this unit extend past NJSL.

### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities
  - a. Do Now activities
  - b. Classwork
  - c. Homework
  - d. Use of white boards
  - e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology
  - k. AP Practice
2. English Language Learners.
  - a. Students may use a bilingual dictionary.
  - b. Read written instructions.
  - c. Students may be provided with note organizers / study guides to reinforce key topics.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
  - a. Students may be provided with note organizers / study guides to reinforce key topics.
  - b. Extended time on assessments when needed.
  - c. Preferred seating to be determined by student and teacher.

- d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
  - f. Establish a non-verbal cue to redirect student when not on task.
  - g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
- a. Provide enrichment activities to expand upon the curriculum.
  - b. Use higher level questioning techniques in class and on assessments.

#### New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

#### Career Readiness Practices

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

#### Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

### **Unit 10: Comparing 2 Population Parameters**

**(7 days)**

#### Enduring Understanding

1. Inference is a tool for validating a claim about a population parameter.
2. Inference is a tool for estimating an unknown population parameter.

#### Essential Question(s)

1. What is inference for comparing two populations?
2. How does one compute a confidence interval for two population means?
3. How does one execute a test of significance for two population means?

4. How does one compute a confidence interval for two population proportions?
5. How does one execute a test of significance for two population proportions?
6. How does one distinguish among the various confidence intervals?
7. How does one distinguish among the various tests of significance?

### Learning Objectives

1. Students will be able to:
  - a. Distinguish between inference using confidence intervals as opposed to tests of significance.
  - b. Apply the appropriate formula for confidence intervals of population means using both the z statistic and the t statistic.
  - c. Apply the appropriate formula for significance tests of population means using both the z statistic and the t statistic to find the p value.
  - d. Apply the appropriate formula for confidence intervals of population proportions using both the z statistic and the t statistic.
  - e. Apply the appropriate formula for significance tests of population proportions using both the z statistic and the t statistic to find the p value.

### New Jersey Student Learning Standards

- HSS.IC.B.5 – Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
- HSS.IC.B.6 – Evaluate reports based on data.

### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities
  - a. Do Now activities
  - b. Classwork
  - c. Homework
  - d. Use of white boards
  - e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology
  - k. AP Practice
2. English Language Learners.
  - a. Students may use a bilingual dictionary.
  - b. Read written instructions.
  - c. Students may be provided with note organizers / study guides to reinforce key topics.



- d. Provide modified assessments when necessary.
- e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
  - a. Students may be provided with note organizers / study guides to reinforce key topics.
  - b. Extended time on assessments when needed.
  - c. Preferred seating to be determined by student and teacher.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
  - f. Establish a non-verbal cue to redirect student when not on task.
  - g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
  - a. Provide enrichment activities to expand upon the curriculum.
  - b. Use higher level questioning techniques in class and on assessments.

New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

Career Readiness Practices

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

**Unit 11: The Chi-Square Distribution**

**(7 days)**

Enduring Understanding

1. Inference is a tool for validating a claim about a population parameter.

### Essential Question(s)

- How is a test of significance done?
- How does one distinguish among the various tests of significance?
- What is a chi-square test?
- How does one conduct a chi-square goodness of fit test?
- What is a two-way table?
- What is a chi-square test for homogeneity?
- What is a chi-square test for association/independence?

### Learning Objectives

1. Students will be able to:
  - a. Define what is meant by a chi-square test.
  - b. Define the steps necessary for carry out a chisquare goodness of fit test.
  - c. Draw and complete a two-way table.
  - d. 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.
  - e. 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.

### New Jersey Student Learning Standards

- HSS.IC.A.1 – Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- HSS.IC.A.2 – Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities
  - a. Do Now activities
  - b. Classwork
  - c. Homework
  - d. Use of white boards
  - e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology

- k. AP Practice
2. English Language Learners.
  - a. Students may use a bilingual dictionary.
  - b. Read written instructions.
  - c. Students may be provided with note organizers / study guides to reinforce key topics.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
3. Special Education/504 Students.
  - a. Students may be provided with note organizers / study guides to reinforce key topics.
  - b. Extended time on assessments when needed.
  - c. Preferred seating to be determined by student and teacher.
  - d. Provide modified assessments when necessary.
  - e. Student may complete assessments in alternate setting when requested.
  - f. Establish a non-verbal cue to redirect student when not on task.
  - g. Maintain strong teacher / parent communication.
4. Gifted and Talented Students.
  - a. Provide enrichment activities to expand upon the curriculum.
  - b. Use higher level questioning techniques in class and on assessments.

#### New Jersey Student Learning Standards - Technology

- HSS.IC.A.1 –Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- HSS.IC.A.2 – Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

#### New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

#### Career Readiness Practices

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.

- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

### Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

## **Unit 12: Inference for Regression**

**(7 days)**

### Enduring Understanding

1. Regression is an instrument used to generalize relationships for bivariate data.
2. Inference is a tool for validating a claim about a population parameter.

### Essential Question(s)

How well does data fit a regression model?

What are the properties of a linear regression model?

How is a test of significance done?

What conditions are necessary to do inference for regression?

What is meant by the standard error about the least-squares line?

How does one compute a confidence interval for the slope of the least squares line?

How does one conduct a test of significance for the slope of the least squares line?

### Learning Objectives

1. Students will be able to:
  - a. Identify and list the conditions necessary for regression analysis.
  - b. Apply the formulas for calculating standard error.
  - c. Establish and apply the formula for a confidence interval for the regression slope.
  - d. Establish and apply the steps for a test of significance for the regression slope.

### New Jersey Student Learning Standards

- HSS.IC.A.1- Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

### Suggested Activities/Modifications

*Below is a list of suggested activities, modifications, accommodations, and enrichment opportunities. This includes, but is not limited to,:*

1. Activities
  - a. Do Now activities

- b. Classwork
  - c. Homework
  - d. Use of white boards
  - e. Unit Test (extended time when needed)
  - f. Review Game
  - g. Project
  - h. Graphic Organizer
  - i. Calculator Use
  - j. Assistive Technology
  - k. AP Practice
2. English Language Learners.
    - a. Students may use a bilingual dictionary.
    - b. Read written instructions.
    - c. Students may be provided with note organizers / study guides to reinforce key topics.
    - d. Provide modified assessments when necessary.
    - e. Student may complete assessments in alternate setting when requested.
  3. Special Education/504 Students.
    - a. Students may be provided with note organizers / study guides to reinforce key topics.
    - b. Extended time on assessments when needed.
    - c. Preferred seating to be determined by student and teacher.
    - d. Provide modified assessments when necessary.
    - e. Student may complete assessments in alternate setting when requested.
    - f. Establish a non-verbal cue to redirect student when not on task.
    - g. Maintain strong teacher / parent communication.
  4. Gifted and Talented Students.
    - a. Provide enrichment activities to expand upon the curriculum.
    - b. Use higher level questioning techniques in class and on assessments.

New Jersey Student Learning Standards – Technology and Career Awareness, Exploration, and Preparation

- See Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix

Career Readiness Practices

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.

- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

Career & Technical Education Content Area: 21<sup>st</sup> Century Life and Careers Standards

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.4 Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.

**V. Course Materials** (included, but not limited to)

- Textbook – Starnes, D., Yates, D., & Moore, D. (2012). *The practice of statistics* (2nd ed.). New York: W.H. Freeman.
- Calculator – TI-Nspire
- Rulers
- Graph Paper
- Computer Programs: Fathom
- Internet Resources: Kahoot, [www.tenmarks.com](http://www.tenmarks.com); Assisments Review Practice, [www.assistments.org](http://www.assistments.org)

**VI. Assessments** (included, but not limited to)

1. Do Now Problems
2. Quizzes
3. Unit Tests
4. Projects
5. Classwork
6. Homework
7. Individual White Boards
8. Exit Tickets
9. Final Exam
10. AP Practice
11. AP Assessment
12. Review Games

**VII. Cross Curricular Aspects**

*Sciences – Question Context*