Madison Public Schools
Statistics

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Course Overview

Description

Decisions or predictions are often based on data—numbers in context. These decisions or predictions would be easy if the data always sent a clear message, but the message is often obscured by variability. Statistics provides tools for describing variability in data and for making informed decisions that take it into account.

Statistics is designed for the college bound student who has demonstrated success in Algebra 2 and wishes to continue to explore a large range of topics with an emphasis on "real world" applications. Students are exposed to four broad conceptual themes: Exploring data, planning a study, anticipating patterns, and statistical inferences. This course would prepare students for AP Statistics or the college course equivalent.

Technology plays an important role in statistics by making it possible to generate plots, regression functions, and correlation coefficients, and to simulate many possible outcomes in a short amount of time. Students will regularly apply the tools of technology including the graphing calculator and computers to solve problems. They will be challenged through critical thinking exercises and participate in various group and individual activities that will enhance their mathematical reasoning ability and communication skills. Students are expected to use the information and technology in various ways in real world applications.

Goals

This course aims to:

- enable students to make sense of various types of problems and the reasonableness of their answers
- build student confidence with the various approaches to solving a problem and persevere in solving them
- encourage students to become abstract thinkers who make sense of quantities and their relationships in problem situations
- develop students' ability to cooperatively discuss, make conjectures and critique ideas of one another
- use, apply, and model mathematics to solve problems arising in everyday life, society, and the workplace
- consider the variety of available tools when solving a mathematical problem
- communicate mathematical ideas precisely and effectively to others
- determine a pattern or analyze structure within mathematical content to apply to related ideas
- use repeated reasoning to follow a multi-step process through to completion

Materials

Core: Discovering Statistics
Supplemental: Khan Academy, Various websites related to statistics

Resources

Suggested activities and resources page
Benchmark Assessments
Common Benchmark Assessment are given for each unit with common types of questions across the levels including problems that focus on the main ideas and anchor standards of the course.
Modifications and Adaptations for Special Needs Learners (Gifted and Talented Students, English Language Learners, Special Education Students, At-Risk Students)

Scope and Sequence
(Pacing Guide)

Unit Number	Topic of Study	Duration (Lessons Taught)
1	Describing Data	25 lessons
2	Probability	18 lessons
3	Correlation and Regression	13 lessons
4	Sampling Distribution	16 lessons
5	Confidence Intervals	16 lessons
6	Hypothesis Testing	19 lessons
7	Two-Sample Inference	18 lessons

Unit 1 Overview
Unit Title: Describing Data
Unit Summary: In this unit students are not only introduced to the basic ideas of the field of statistics and the methods for gathering data, but they also learn how to populate and analyze it. Specifically, they'll study how to graph and make tables, present data in an ethical way, develop numerical summaries of the data and measure its important statistical characteristics.
Suggested Pacing: 25 lessons
Learning Targets
Unit Essential Questions**(NJSLS)** ● How can data analysis be used to predict future happenings? ● Is all data "created equal"?

- How does the normal distribution apply to the real world?
- What is bias? How can it be identified? How can it be prevented?
- Does size matter?

Unit Enduring Understandings:
- Interpretation of data is dependent upon the graphical displays and numerical summaries.
- The Who, What, Where, Why, and How of the data are important information that must be depicted in each given data set.
- The question to be answered determines the data to be collected and how best to collect it.
- The normal distribution is a fundamental component of statistical inference.
- The analysis is only as good as the data.
- Well-designed experiments can allow us to reach appropriate cause-and-effect conclusions.

Evidence of Learning

Formative Assessments: A variety of formative assessments will be used throughout the lesson, such as warm-up and closure questions completed on paper and handed in and on Google Classroom, Four Corners, Hand It In, Pass It Out, Self-Evaluation, Think-Pair-Share, Jigsaw, Socrative, etc…

S**ummative Assessment:** This assessment will contain a variety of open-ended, short answer and multiple choice questions that contain the following material: data analysis, normal distribution, bias, center, spread, symmetry and designing experiments.

Alternative assessment: Students will create their own poll, collect data and assess the data for validity / bias.

Objectives (Students will be able to…)	**Essential Content/Skills**	**Suggested Assessments**	**Standards (NJSLS)**	**Pacing**
Realize that data is real life. Describe what statistics is. Understand that inferential statistics refers to learning about a population by studying a sample from that population. Understand basic statistical terminology (i.e. elements, variables, observations, etc.)	Content: Statistics Descriptive Statistics Elements Variables Observations Qualitative Variable Quantitative Variable Discrete Variable Continuous Variable Population Parameter Sample Skills: Use statistical inference Describe data using proper terminology	Partner Activity - Coca-Cola Activity. Give the students the scenario that about 1 in 10 wins a free coke. After how many cokes, would you expect to win? This is the beginning of promoting discussion and reasoning. Accept no short answers. Solo to Partner Activity - Have students make flashcards with different types of variables on them and then play with a student and have them say which one it is.	MP.2 Reason abstractly and quantitatively MP.3 Construct viable arguments and critique the reasoning of others MP.6 Attend to precision 9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences. 9.1.12.F.2 Demonstrate a positive work ethic in various settings, including this classroom and during structured learning experiences.	2 Lessons
Explain what a random sample is. Identify the different types of sampling methods	Content: Random sample Stratified sampling Systematic sampling Cluster sampling	Group Activity - Group students up by where they live. Have them print out all homes within half a mile or more	MP.2 Reason abstractly and quantitatively MP.3 Construct viable arguments and critique the reasoning of others	4 Lessons

Explain selection bias Understand the difference between observational and experimental studies	Convenience sampling Target population Potential population Selection bias Experimental study Predictor variable Response variable	of their house depending on where they live. Have them come up with the houses they would survey using the different sampling methods. Technology Activity - Have students go online and see how the major polling sites poll for their polls. Have students complete a journal entry about what methods they use. Presentation Activity - Have students take a current survey found on one of the major polling sites and then figure out how to sample the school for that survey. Students will then present to the class for a quiz grade.		
Construct and interpret a frequency distribution and relative frequency distribution for qualitative data. Construct and interpret a bar graphs, pie charts, etc..	Content: Frequency Relative Frequency Bar Graph Pie Chart Box Plot Skills: Interpret various ways to show data.	Partner Activity - Have students look for various data online and present that data in a number of different ways. Use spreadsheets to help with this activity.	S.ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). MP.4 Model with mathematics MP.5 Use appropriate tools strategically 8.1.12.A.5 Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.	3 Lesson
Construct and interpret a frequency distribution and relative frequency distribution for continuous data. Recognize distribution shapes, symmetry and skew.	Content: Shape Symmetry Skew Distribution Skills: Look at data and its graph and describe it.	Quiz Question - "Come up with, and then make, three different types of graphs that represent the same data that is bi-modal, non-symmetric, and left skewed"	S.ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). S.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. S.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). MP.4 Model with mathematics MP.5 Use appropriate tools strategically	2 Lessons
Understand what can make a graph misleading, confusing or deceptive.	Skills: Be able to describe why a graph is misleading.	Technology Activity - Search online for data that is misrepresented. Have groups make appropriate graphs using that data. Also, do the reverse. Find data that is represented well and then misrepresent it.	S.ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). S.ID.A.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile	4 Lessons

		Group Activity - Find data that we can represent. Collaborate with Coviello's TV class to make real commercials to show the data.	range, standard deviation) of two or more different data sets. S.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). MP.4 Model with mathematics MP.5 Use appropriate tools strategically 8.1.12.E.2 Research and evaluate the impact on society of the unethical use of digital tools and present your research to peers.	
Calculate the mean, median and mode of a set of data Describe how skewness and symmetry affect those measures. Explain what deviation is and how to find it. Calculate the variance and the standard deviation for a population or a sample.	Content: Mean Sample size Sample mean Population mean Median Mod. Skewness Standard deviation Population variance Population standard deviation Sample variance Sample standard deviation Skills: How does skewness affect the mean and median? Finding all important pieces.	Technology Activity - Students will learn how to find all information on a graphing calculator and a spreadsheet. Students will be given minimal direction at first and more as time goes on. Graph the data as we move on, as well as to determine skewness and symmetry. Quiz Question - What is the difference between population mean and sample mean and why is it important?	s-ID.1 Represent data with plots on the real number line (dot plots, histograms, and boxplots). S-ID.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. S-ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). MP.1 Make sense of problems and persevere in solving them MP.2 Reason abstractly and quantitatively CRP11. Use technology to enhance productivity.	3 Lessons
Calculate the weighted mean. Estimate the mean for grouped data. Estimate the variance and standard deviation for group data.	Content: Weighted mean Grouped data Variance and standard deviation for grouped data	Journal Entry - Students will write about why a weighted mean is different than a normal mean.	S-ID.1 Represent data with plots on the real number line (dot plots, histograms, and boxplots). S-ID.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. S-ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). WHST.11-12.1. Write arguments focused on discipline-specific content. NJSLSA.SL1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	1 Lesson

Calculate z-scores and explain what they mean. Detect outliers and explain why. Find percentiles for large and small quantities of data. Compute quartiles and interquartile ranges.	Content: Z-score Percentile Quartiles Inter-Quartile Skills: Calculation z-score Detect outliers using z-score	Partner Activity - Students will work together to find z-scores and interpret what they mean. Students will be given real world data from the high school sporting events to heighten their interest. Group Activity - (First survey experience) Students will design a simple survey to give to students. Students will then compile the results and present their information to the class. Sample survey questions - "How tall are you?" "How many facebook friends do you have?"	s-ID.1 Represent data with plots on the real number line (dot plots, histograms, and boxplots). S-ID.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. S-ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). MP.6 Attend to precision MP.7 Look for and make use of structure	3 Lessons
Find percentages and data values using the Empirical Rule.	Content: Empirical Rule Skills: Applying the empirical rule	Exploration Activity - Students will get the opportunity to guess how much data lies in specific standard deviations and give a logical reason why that is their answer. Then students will be presented with real data that is almost perfectly the Empirical Rule to see how close their guess was. Group Activity - Create flashcards that find percentages using the Empirical Rule.	s-ID.1 Represent data with plots on the real number line (dot plots, histograms, and boxplots). S-ID.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. S-ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). MP.8 Look for and express regularity in repeated reasoning 9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences. 9.1.12.F.2 Demonstrate a positive work ethic in various settings, including this classroom and during structured learning experiences. NJSLSA.SL1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	3 Lessons

Unit 2 Overview

Unit Title: Probability

Unit Summary: In this unit students will learn the details of probability, including how to quantify uncertainty, using experiments, events, outcomes, rules for combining events, conditional probability and counting methods. Random variables and probability distributions will also be explored.
Suggested Pacing: 18 lessons
Learning Targets
Unit Essential Questions: ● How can we base decisions on chance? ● What are the benefits of simulating events as opposed to gathering real data? ● Is independence desirable? ● What is randomness? ● How can modeling predict the future? ● Is anything in nature truly random?
Unit Enduring Understandings: ● Probability models are useful tools for making decisions and predictions. ● Probability is based on relative frequencies. ● The Law of Large Numbers is an important concept when simulating probability experiments but should be interpreted carefully. ● Probability is the basis of statistical inference. ● The notion and behavior of a random variable is foundational to understanding probability distributions.
Evidence of Learning
Formative Assessments: A variety of formative assessments will be used throughout the lesson, such as warm-up and closure questions completed on paper and handed in and on Google Classroom, Four Corners, Hand It In, Pass It Out, Self-Evaluation, Think-Pair-Share, Jigsaw, Socrative, etc…
S**ummative Assessment:** This assessment will contain a variety of open-ended, short answer and multiple choice questions that contain the following material: probability, simulation, modeling, randomness and law of large numbers.
Alternative Assessment: Students will create a multimedia presentation to demonstrate knowledge of exact probability, normal probability, z-score probability and inverse z-score.

Objectives (Students will be able to…)	**Essential Content/Skills**	**Suggested Assessments**	**Standards (NJSLS)**	**Pacing**
Understand the meaning of an experiment, outcome and sample space. Describe the classical method of assigning probability.	Content: Probability Experiment Outcome Sample space Event Rules of probability	Solo Activity - Students will generate definitions for the more basic terms. Then, the class will come up with a really good definition together. Partner Activity -	MP.4 Model with mathematics MP.5 Use appropriate tools strategically MP.6 Attend to precision 8.1.12.A.4 Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the	4 Lessons

Explain the Law of large numbers.	Classical method of assigning probability Law of large numbers Relative frequency method of assigning probabilities Subjective probability Skills: Using the law of large numbers Finding simple probabilities	Students will try and show the law of large number by making a spreadsheet and having it randomly pick a 1 or a 2 and then total it. When does the total seem to follow what you would expect? This will take time because students will need to learn the technological aspect of it as well.	worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results. NJSLSA.SL1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.	
Understand how to combine events. Apply the Addition Rule. Calculate conditional probabilities. Explain independent and dependent events. Apply the Multiplication Rule.	Content: Complement Union Intersection Venn diagrams Tree diagrams Mutually exclusive Conditional probabilities Independent events Skills: Finding probability for complements Using the addition and multiplication rules Finding conditional probabilities With replacement versus without replacement	Exploration Activity - Students will be given problems that deal with the multiplication rule and addition rule. Lets students struggle and see what they can come up with. Students will then look at hints posted around the room. Smart Board Activity - Put a list on the board of different types of events and have students come to board and drag them in order to characterize them as independent or dependent. Have students discuss why they are putting the event on that side. Discuss as a class.	S-CP.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. S-CP.7 Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model. S-CP.9 Use permutations and combinations to compute probabilities of compound events and solve problems. S-CP.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. S-CP.8 Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model. MP.1 Make sense of problems and persevere in solving them MP.2 Reason abstractly and quantitatively	2 Lessons
Use permutations and combinations to solve counting problems. Compute probabilities using combinations.	Content: Permutations Combinations Skills: Finding the number of combinations Finding the number of permutations	Quiz Question - How many combinations of shirts, pants and shoes do you have at home? Work is necessary. Class Activity - Have students come up with the numbers of groups that can be created with various group sizes? Really make the kids work on finding all	S-CP.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. S-CP.9 Use permutations and combinations to compute probabilities of compound events and solve problems. S-CP.4 Construct and interpret two-way frequency tables of data when two	6 Lessons

		combinations of people. Focus on the difference between order matters and order doesn't. Journal Activity - How many US phone numbers are there? Come up with a general question that you find interesting, similar to the journal activity, and present your answer and thinking.	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. MP.3 Construct viable arguments and critique the reasoning of others	
Identify random variables. Explain what discrete probability distribution is and construct a probability distribution graph. Calculate mean, variance and standard deviation of a discrete random variable.	Content: Random variable Discrete random variables Continuous random variables Probability distribution of discrete random variables Rules for discrete probability distribution Expected value of a random variable Skills: Finding mean, variance, and standard deviation to discrete random variables	Quiz Question - Explain why our idea of random is not really random at all? Solo Activity - Give students a list of H and T and ask them which one is more likely and why?	S-MD.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. S-MD.2 Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. S-MD.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. S-MD. 4 Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. MP.2 Reason abstractly and quantitatively MP.6 Attend to precision	3 Lessons
Explain what constitutes a binomial experiment. Compute probabilities using the binomial probability formula. Calculate the mean, variance, and standard deviation of the binomial random variable and find the mode of the distribution.	Content: Binomial experiment Binomial probability distribution formula Combinations Factorial Mean, variance and standard deviation of a binomial random variable Skills: Using the binomial table	Learn and Teach Activity - Split class into three groups and have each group take a piece of the topic. One group is assigned to identifying, another to the formula, and the third group to the table. Give them the entire period (or most of it) to understand their piece. The following week, the group members will help rest of their group understand what they learned in order to understand the complete picture.	S-MD.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. S-MD.2 Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. MP.8 Look for and express regularity in repeated reasoning	2 Lessons
Identify a continuous probability distribution and state the requirements. Calculate probabilities for the uniform probability distribution.	Content: Continuous probability distribution Uniform probability distribution Probability for continuous distributions	Partner Activity - Students will use http://sites.stat.psu.edu/~ajw13/stat200/mos/05_probdistr/05_probdistr_print.html to explore the continuous probability distribution. They will discuss this as a	S-MD.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.	2 Lessons

Explain the properties of the normal probability distribution.	Properties of the normal density curve Skills: Finding probabilities for content	class and then solve a set of problems given by the teacher. Solo Activity - Students will watch the following video for HW and then discuss in small groups. http://study.com/academy/lesson/normal-distribution-definition-properties-characteristics-example.html	S-MD.2 Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. S-MD.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. S-MD. 4 Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. MP.3 Construct viable arguments and critique the reasoning of others CRP11. Use technology to enhance productivity.	
Find the standard normal value. Compute probabilities for a given value of any normal random , given variable. Find the appropriate value of any normal random variables given a probability.	Content: Standard normal distribution Standardizing a normal random variable Skills: Find the area right or left of a given value Express area as a probability Finding normal data values for a given area or probability	Station Activity - Students will complete stations involving finding exact probability, normal probability, z-score probability and inverse z-score. Stations will be designed so students complete three standard questions and 1 harder question. Harder question will be for the groups that work productively and have a strong knowledge base. The three standard questions will be geared toward majority of the class.	S-MD.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. S-MD. 4 Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. MP.7 Look for and make use of structure 9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences. 9.1.12.F.2 Demonstrate a positive work ethic in various settings, including this classroom and during structured learning experiences.	2 Lessons

Unit 3 Overview
Unit Title: Correlation and Regression
Unit Summary: In this unit, students will learn to analyze the relationship between two quantitative variables using scatterplots, correlation, and regression.
Suggested Pacing: 13 lessons
Learning Targets
Unit Essential Questions: • What does it mean to regress? • What is association? What is correlation? How are they connected? • Does association imply causation? • How can modeling data help us to understand patterns? • Can we use extrapolation to predict the future?

- Is it possible to test for lack of correlation?

Unit Enduring Understandings:
- Regression is an effective model for prediction.
- There is a difference between causation and correlation.
- Scatterplots and other graphs are used to illustrate solutions and solve problems.
- The way that data is collected, organized, analyzed and displayed influences interpretation.
- Data is analyzed to verify the truth.

Evidence of Learning

Formative Assessments: A variety of formative assessments will be used throughout the lesson, such as warm-up and closure questions completed on paper and handed in and on Google Classroom, Four Corners, Hand It In, Pass It Out, Self-Evaluation, Think-Pair-Share, Jigsaw, Socrative, etc…

Summative Assessment: This assessment will require students to use real world data either gathered or found and perform the correct regression to the data. The students will then present the data in an engaging and informative way. Student work will be assessed using a rubric with multiple measures.

Objectives (Students will be able to…)	**Essential Content/Skills**	**Suggested Assessments**	**Standards (NJSLS)**	**Pacing**
Construct and interpret scatter plots for two quantitative variables. Calculate and interpret the correlation coefficient. Determine whether a linear correlation exists between two variables.	Content: Scatterplots Linear relationships Correlation coefficient Comparison test for linear correlation Skills: Calculation the correlation coefficient	Technology Activity - Students will use the internet to find out all information they can on the correlation coefficient. They will then discuss as a class and then the teacher will lead in how to use technology to help find the answer. Matching Game - Students will look at various scatter plots and match them with a matching description.	S-ID.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. MP.3 Construct viable arguments and critique the reasoning of others CRP11. Use technology to enhance productivity.	4 Lessons
Calculate the value and understand the meaning of the slope and y intercept of the regression line. Predict values of y for given values of x, and calculate the prediction error for a given prediction.	Content: Equation of the regression line Relationships between slope and correlation coefficient Prediction error. Residual Extrapolation Skills: Find the regression line Analyze the regression equation	Algebra Review Activity - Students will start simple and remember what they know about linear equations. They will write what they know on the board in a collaborative note guide format. Solo Activity - Students will use data to find the line of best fit on paper and using technology..	S-ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. 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. b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association.	4 Lessons

			S-ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. S-ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. S-ID.9 Distinguish between correlation and causation. CRP.11 Use technology to enhance productivity. MP.7 Look for and make use of structure MP.8 Look for and express regularity in repeated reasoning CRP4. Communicate clearly and effectively with reason. 8.1.12.A.4 Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.	
Calculate the sum of square errors and use the standard error of the estimate. Explain the meaning of the coefficient of determination as a measure of usefulness of the regression.	Content: Sum of the squares error Least-squares criterion Standard error of the estimate Relationships amongst SST, SSR, and SSE Skills: Finding the coefficient of the determination	Old-School Activity - Students will find the sum of the square errors by hand. This is just to give students a peek at what statistics used to be like. Then teacher will lead in how to do it on the calculator and students will practice. Unit Activity - Students will design and give a survey that will result in them creating a scatter plot (i.e. “football rushing total yards” “bill from shopping”). Students will then compile their information and present it to the class. Students must use spreadsheets appropriately and multiple tabs to present their data. This should take at least 2 lessons as you really need to stress the importance of the presentation.	S-ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. 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. b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association. S-ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. S-ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. S-ID.9 Distinguish between correlation and causation. MP.2 Reason abstractly and quantitatively MP.3 Construct viable arguments and critique the reasoning of others CRP4. Communicate clearly and effectively with reason. CRP11. Use technology to enhance productivity. 9.1.12.A.1	5 Lessons

			Apply critical thinking and problem-solving strategies during structured learning experiences. 9.1.12.F.2 Demonstrate a positive work ethic in various settings, including this classroom and during structured learning experiences.	

Unit 4 Overview
Unit Title: Sampling Distributions
Unit Summary: In this unit, students will learn that seemingly random statistics have predictable behaviors. The special type of distribution we use to describe these behaviors is called the sampling distribution or the sampling mean. This will lead us to perhaps the most important result in statistical inference: The Central Limit Theorem.
Suggested Pacing: 16 Lessons
Learning Targets
Unit Essential Questions: ● How can modeling predict the future? ● How does the normal distribution apply to the real world? ● Does the Central Limit Theorem test one's limit? ● Is all data "created equal"?
Unit Enduring Understandings: ● Many discrete phenomena may be described and thus predicted by binomial and geometric models. ● The normal distribution and central limit theorem are essential to analyzing samples of data. ● Variation can be expected in the results of random samples and is affected by the design of the sample or experiment.
Evidence of Learning
Formative Assessments: A variety of formative assessments will be used throughout the lesson, such as warm-up and closure questions completed on paper and handed in and on Google Classroom, Four Corners, Hand It In, Pass It Out, Self-Evaluation, Think-Pair-Share, Jigsaw, Socrative, etc...
Summative Assessment: This assessment will contain a variety of open-ended, short answer and multiple choice questions that contain the following material: modeling, central limit theorem, discrete phenomena and variation.

Objectives (Students will be able to...)	**Essential Content/Skills**	**Suggested Assessments**	**Standards** (NJSLS)	**Pacing**

Explain the sampling distribution of the sample mean. Describe the sampling distribution of the sample mean when the population is normal. Find probabilities and percentiles for the sample mean when the population is normal.	Content: Sampling distribution of the sample mean Standard deviation of the sampling distribution of the sample mean Sampling distribution of the sample mean for a normal population Standardizing a normal sampling distribution for means Skills: Performing all tests and intervals for the content Find probabilities and percentiles	Review and Enhance Activity - Have students give the number of instagram followers and find all possible combinations of the followers and find the mean. Then have students find the mean of the means. Discuss and share out the findings. Learn and Share - Split class into 4 groups. The 1st group will learn what sampling distribution is and some examples. The 2nd group will look at the sampling distribution when the population is normal. The 3rd and 4th groups will look at probabilities. One student from each group will meet together and review what others learned. Technology Activity - Students will gather data online and complete questions related to sampling distribution of the sample mean. Students will share their file with the class and we will review and critique each other's' answers.	S-MD.2 Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. S-MD.7 Analyze decisions and strategies using probability concepts. S-CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. MP.4 Model with mathematics MP.5 Use appropriate tools strategically NJSLSA.SL1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively. NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. RST.11-12.9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.	4 Lessons
Use normal probability plots to assess normality. Describe sampling distribution of the sample mean for skewed and symmetric population as the sample size increases. Apply the Central Limit Theorem for Means to solve probability questions about the sample mean.	Content: Analyzing normal probability plots Central Limit Theorem for means Situations for the sampling distribution of the sample mean Skills: Performing all tests and intervals for the content Rule of thumb when to use Central Limit Theorem	Partner Activity - Students will look at a series of graphs and put them in order as to which ones they think go together. The goal is for students to see that the data, no matter what it looks like at first, can become normal as we increase the sample size. Quiz Question - Explain why the Central Limit Theorem is so useful.	S-MD.2 Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. S-MD.7 Analyze decisions and strategies using probability concepts. S-CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. CRP4. Communicate clearly and effectively and with reason. MP.7 Look for and make use of structure	6 Lessons
Explain the sampling distribution of the sample proportion. Apply the Central Limit Theorem of Proportions to solve probability questions about the sample proportion.	Content: Sample proportion Sample distribution Mean of the sampling distribution of the sample proportion. Standard deviation of the sampling distribution of the sample proportion Conditions for approximate normality of the sampling distribution of the sample proportion	Group Activity - Have students design a study. Make sure they collect over 100 pieces of data. Then, have students perform the Central Limit Theorem on the results and present their information. Each group will have different problems to solve, depending on what they decided to survey. Journal Activity - How can the Central Limit Theorem	S-MD.2 Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. S-MD.7 Analyze decisions and strategies using probability concepts. S-CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. CRP11. Use technology to enhance productivity.	6 Lessons

	Central Limit Theorem for proportions Standardizing a normal sampling distribution for proportions Skills: Performing all tests and intervals for the content	come in handy in your future careers?	8.1.12.A.4 Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results. 9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences. 9.1.12.F.2 Demonstrate a positive work ethic in various settings, including this classroom and during structured learning experiences.	

Unit 5 Overview
Unit Title: Confidence Intervals
Unit Summary: In this unit, students will perform confidence intervals, where they will learn to infer to a certain level of confidence that our target parameter lies within a particular interval.
Suggested Pacing: 16 Lessons
Learning Targets
Unit Essential Questions: ● How much evidence do you need before you are able to make a reasonable conjecture? ● Is it reasonable to think that different people require different amounts of convincing? ● How is statistical inference used to draw conclusions from data? ● How is probability used to express the strength of our conclusions? ● What is inference? To what extent should decisions be made based on chance?
Unit Enduring Understandings: ● Statistical inference guides the selection of appropriate models. ● Inference is based upon chance. ● Confidence intervals are effective tools for estimation. ● Tests of significance and confidence intervals drive decision making in our world. ● Error analysis is a critical component of significance testing.
Evidence of Learning
Formative Assessments: A variety of formative assessments will be used throughout the lesson, such as warm-up and closure questions completed on paper and handed in and on Google Classroom, Four Corners, Hand It In, Pass It Out, Self-Evaluation, Think-Pair-Share, Jigsaw, Socrative, etc...
Summative Assessment: This assessment will contain a variety of open-ended, short answer and multiple choice questions that contain the following material: inference, confidence intervals, significance tests, and error analysis.

Objectives (Students will be able to...)	**Essential Content/Skills**	**Suggested Assessments**	**Standards (NJSLS)**	**Pacing**
Calculate a point estimate of the population mean. Calculate and interpret a Z interval for the population mean when the population is normal and when the sample size is large. Find ways to reduce the margin of error. Calculate sample size need to estimate the population mean.	Content: Point estimate Confidence interval Confidence level Z interval for the population mean Margin of error Sample size for estimating the population mean Skills: Performing all tests and intervals for the content Reducing the margin of error	Introduction Activity - Give students a worksheet on solving multi-step rationals algebraic equations. Group Activity - Students will look at various confidence intervals to a certain problem and match each one with a specific confidence. Explanations must accompany. Students will then see if they can figure out where the numbers came from based off of previous knowledge. Technology Activity - Students will use spreadsheets and TI to find z intervals. They will present data in the most appealing way.	S-IC.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. MP.3 Construct viable arguments and critique the reasoning of others MP.4 Model with mathematics CRP2. Apply appropriate academic and technical skills.	5 Lessons
Describe the characteristics of the t distribution Calculate and interpret a t interval for the population mean	Content: t distribution Characteristics of t distribution Degrees of freedom Finding t interval for the mean Margin of error for the t interval Skills:Performing all tests and intervals for the content	Partner Activity - Give students two examples of a t interval and have them use different degrees of freedom and have them explain what happens. Then have them guess which one they think they should use and why. Technology Activity - Create a spreadsheet that can calculate an interval with given information.	S-IC.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. MP.2 Reason abstractly and quantitatively MP.7 Look for and make use of structure	5 Lessons
Calculate the point estimate of the population proportion. Construct and interpret the Z interval for the population proportion. Compute and interpret the margin of error for the Z interval for the population proportion. Determine the sample size needed to estimate the population proportion.	Content: Point estimate of the population proportion Central Limit Theorem for proportions Z interval for proportions Margin of error for the Z interval for proportion Sample size for estimating a population proportion Skills: Performing all tests and intervals for the content	Group Activity - Use data from the recent election cycle to have students figure out how they got the results they did and to make sure they are all totally accurate. Journal Activity - Why is margin of error so important to state?	S-IC.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. MP.3 Construct viable arguments and critique the reasoning of others MP.4 Model with mathematics CRP 8. Utilize critical thinking to make sense of problems and persevere in solving them. WHST.11-12.1. Write arguments focused on discipline-specific content. NJSLSA.SL1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.	6 Lessons

			NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences. 9.1.12.F.2 Demonstrate a positive work ethic in various settings, including this classroom and during structured learning experiences.	

Unit 6 Overview
Unit Title: Hypothesis Testing
Unit Summary: In this unit, students will learn how to perform hypothesis testing. Hypothesis testing forms the bedrock of the scientific method and is the most widely used method for statistical inference.
Suggested Pacing: 19 Lessons
Learning Targets
Unit Essential Questions: • To what extent are significance tests reliable? • How can one prepare for errors from significance tests? • What makes an argument statistically convincing? • What is significant about significance?
Unit Enduring Understandings: • Confidence intervals are effective tools for estimating the mean or proportion of a population. • Significance tests determine the likelihood of a sample. • The analysis is only as good as the data.
Evidence of Learning
Formative Assessments: A variety of formative assessments will be used throughout the lesson, such as warm-up and closure questions completed on paper and handed in and on Google Classroom, Four Corners, Hand It In, Pass It Out, Self-Evaluation, Think-Pair-Share, Jigsaw, Socrative, etc…
Summative Assessment: This assessment will contain a variety of open-ended, short answer and multiple choice questions that contain the following material: significance tests, statistically significant, and meeting conditions.

Objectives (Students will be able to...)	**Essential Content/Skills**	**Suggested Assessments**	**Standards (NJSLS)**	**Pacing**
Construct the null hypothesis and the alternative hypothesis from the statement of a problem. State the two types of errors made in hypothesis testing.	Content: Hypotheses Ho Ha Key Words for equality symbols Statistical significance Skills: State and explain the Ho and Ha State and explain the Type I and II errors	Partner Activity - Have students take a set of examples and come up with the Ho and Ha. Have students explain why they chose what they chose. Class Activity - Brainstorm all equality words and write them on post-it notes and put them on the board. Partner Activity - Have students talk about the various outcomes of a court trial in small groups. Come back together as class and review what each group discussed. As a whole class, dive deeper into topic and really begin to think about the “type I and type II errors”	S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. MP.7 Look for and make use of structure MP.8 Look for and express regularity in repeated reasoning	2 Lessons
Explain the essential idea about hypothesis testing for the population mean. Perform the Z test for the mean, using the critical value method.	Content: The essential idea about hypothesis testing for the mean Test statistic for z test for the mean Critical region Non-Critical region Critical value Z test for the population mean using critical value Skills: Performing all tests and intervals for the content	Partner Activity - Ask students to consider this scenario - Your friend has made a claim that the average price for sneakers for men is no more the $75. You feel the average price is higher. Come up with one way to prove your friend right. Come up with one way to prove your friend wrong. Journal Entry - Is what we did in class today moral?	S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. MP.5 Use appropriate tools strategically CRP 11. Use technology to enhance productivity.	4 Lessons
Perform the Z test for the mean, using the p-value method. Assess the strength of evidence against the null hypothesis. Use the Z confidence interval for the mean to perform the two-tailed Z test for the mean.	Content: p-value Ho Ha Z-test for population mean using p-value method Equivalence of a two-tailed hypothesis test and a confidence interval Skills: Performing all tests and intervals for the content Assess the strength of the Ha	Quiz Question - What makes one have a significant feeling about a hypothesis? Exploration Activity - Explore the various strengths of evidence to make a case of why one is better than the rest. Use resources and enter in a forum to discuss and debate.	S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. MP.4 Model with mathematics CRP 2. Use appropriate academic and technical schools.	4 Lessons
Perform the t test for the mean using the critical value method and the p-value method.	Content: t test for the population mean using critical value	Group Activity - Is the population mean of the sum of two fair dice equal to 7?	S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.	4 Lessons

Use confidence intervals to perform two-tailed hypothesis tests.	method and p-value method Confidence interval for two-tailed hypothesis test Skill: Performing all tests and intervals for the content	Group Activity - Come up with a question that deals with a proportion and perform a survey. Compile and analyze the data. Present the information in an engaging and informative way.	MP.2 Reason abstractly and quantitatively MP.7 Look for and make use of structure	
Perform the Z test for p using the critical value method and the p-value method. Use confidence intervals for p to perform two-tailed hypothesis tests.	Content: Essential idea about hypothesis testing for the proportion Z test for population proportion for p using critical value method and p-value method Confidence interval for two-tailed hypothesis test Skills: Performing all tests and intervals for the content	Technology Activity - http://www.intuitor.com/statistics/CurveApplet.html	S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. MP.3 Construct viable arguments and critique the reasoning of others MP.4 Model with mathematics CRP 8 . Utilize critical thinking to make sense of problems and persevere in solving them. 9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences. 9.1.12.F.2 Demonstrate a positive work ethic in various settings, including this classroom and during structured learning experiences.	5 Lessons

Unit 7 Overview
Unit Title: Two-Sample Inference
Unit Summary: In this unit, students will learn to make inferences based on the difference in the parameters of two populations.
Suggested Pacing: 18 Lessons
Learning Targets
Unit Essential Questions: ● What does it mean to be 95% confident ? ● How do you determine if there is a statistical significance? ● What does it mean to make an inference? ● What makes an argument statistically convincing?
Unit Enduring Understandings: ● Significance tests determine the likelihood of a sample. ● The analysis is only as good as the data. ● Inference is a tool for validating a claim about a population parameter. ● Inference is a tool for estimating an unknown population parameter.
Evidence of Learning

Formative Assessments: A variety of formative assessments will be used throughout the lesson, such as warm-up and closure questions completed on paper and handed in and on Google Classroom, Four Corners, Hand It In, Pass It Out, Self-Evaluation, Think-Pair-Share, Jigsaw, Socrative, etc...
Summative Assessment: This assessment will be a presentation that is a culminating experience for the year. Students will come up with a survey question from a big idea that they have. They will sample using an appropriate sampling method. They will analyze the data and present the data in an appropriate and engaging manner.

Objectives (Students will be able to...)	**Essential Content/Skills**	**Suggested Assessments**	**Standards (NJSLS)**	**Pacing**
Distinguish between independent samples and dependent samples. Perform hypothesis tests for population mean difference for dependent samples. Construct and interpret confidence intervals for population mean difference for dependent samples.	Content: Independent samples Dependent samples Paired sample t test for population mean of the difference using critical value method and p-value method Confidence interval for population mean difference Skills: Performing all tests and intervals for the content	Class Activity - Have students group different types of samples into independent and dependent. Discuss as a class and have students walk to a side of the room. Solo Activity - Define confidence interval. Have students define it with no prior knowledge and then talk about the central “x” percent of data and how the two relate.	S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. MP.1 Make sense of problems and persevere in solving them MP.2 Reason abstractly and quantitatively NJSLSA.SL1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others’ ideas and expressing their own clearly and persuasively. NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.	4 Lessons
Use confidence intervals for the difference of means to perform two-tailed t tests about the difference of means. Apply Z test and Z intervals for the difference in the mean when the standard deviations are known.	Content: Sampling distribution for the difference in means Hypothesis test for the difference in two population means using the critical value method and p-value method Confidence interval for difference in means Skills: Performing all tests and intervals for the content	Quiz Question - What do you think is the difference in true mean height between men and women? Give students the opportunity to survey. Partner Activity - Keeping balance as you age. (Chapter 10 Resources)	S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. MP.6 Attend to precision	5 Lessons
Perform and inter tests for the difference in proportions.	Content: Sampling distribution for the difference in proportions	Technology Activity - Give students data and have them use a spreadsheet to solve what we are doing.	S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.	5 Lessons

Compute and interpret Z intervals for the difference in proportions. Use Z intervals for the difference in proportions to perform two-tailed Z tests.	Hypothesis test for the difference in two population proportions using the critical value method and p-value method Confidence interval for difference in proportions Skills: Performing all tests and intervals for the content	Discussion Topics - Why is this so important in statistics?	MP.4 Model with mathematics CRP 11. Use technology to enhance productivity.	
Perform hypothesis tests for two population standard deviation using critical value method and p-value method.	Content: Test statistic for the F test for two population standard deviation Properties of F curve Procedure for finding F critical value for a given area F tests for comparing two populations of standard deviations using the critical value method and p-value method Skills: Performing all tests and intervals for the content	Group Activity - Have students take data that they obtained throughout the year and compare that with other groups. Have students compile and present data to class.	S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. MP.5 Use appropriate tools strategically MP.6 Attend to precision CRP 1. Act as a responsible and contributing citizen and employee. CRP 6. Demonstrate and creativity and innovation. 8.1.12.A.1 Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review. 9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences. 9.1.12.F.2 Demonstrate a positive work ethic in various settings, including this classroom and during structured learning experiences.	4 Lessons