NEW MILFORD PUBLIC SCHOOLS

New Milford, Connecticut

College Prep Statistics

June 2019

BOE Approved November 2019

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New Milford's Mission Statement

The mission of the New Milford Public Schools, a collaborative partnership of students, educators, family and community, is to prepare each and every student to compete and excel in an ever-changing world, embrace challenges with vigor, respect and appreciate the worth of every human being, and contribute to society by providing effective instruction and dynamic curriculum, offering a wide range of valuable experiences, and inspiring students to pursue their dreams and aspirations.

BOE Approved November 2019

Statistics CP

grades 11/12

This is a full year course designed for students who have passed College Prep Algebra 2. Topics include: probability, vocabulary, frequency tables and graphs, measures of central tendency, work with usual values and outliers, normal and binomial distributions, scatterplots and hypothesis testing, as well as word problems associated with these topics. Work in the course will provide students with an excellent background in statistics as preparation for work in their college classes. The use of computers and graphing calculators is an integral part of this course and therefore a graphing calculator (TI-83+/TI84+) is required for the class.

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PACING GUIDE

UNIT #	TITLE	Weeks
1	Probability	6
2	Sample Distributions	5
3	Numerical Descriptors	5
4	Normal Distributions	4
5	Probability Distributions	5
6	The Relationship between Two Variables	5
7	Inferential Statistics	6

Subject/Course: College Prep Statistics Unit: 1 Probability
Grade:11/12
Time frame: approx 5-6 weeks

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="3">ESTABLISHED GOALS

CCSS.MATH.CONTENT.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").

CCSS.MATH.CONTENT.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.

CCSS.MATH.CONTENT.HSS.CP.A.3
Understand the conditional probability of A given B as P(A 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</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Apply concepts of probability to problems related to business and manufacturing models, the sports and gaming industry, and health related services.
● CCSS.Math.Practice.MP1: Make sense of problems and persevere in solving them
● CCSS.Math.Practice.MP2: Reason abstractly and quantitatively.
● CCSS.Math.Practice.MP4 Model with mathematics.
● CCSS.Math.Practice.MP5 Use appropriate tools strategically
● CCSS.Math.Practice.MP6 Attend to precision</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

● Probability describes the likelihood an event will occur.
● The complement of event A consists of all outcomes in which event A does not occur..
● Two events, A and B are independent if the occurrence of one does not affect the probability of the occurrence of the other. If A and B are not independent, then they are said to be dependent.
● Events A and B are mutually exclusive if they cannot occur simultaneously.
● A probability is a number between 0 and 1 inclusively</td><td>ESSENTIAL QUESTIONS
Students will keep considering…

● How is probability used in everyday life?
● How are events defined and what are examples of each?
● How does the study of probability integrate itself into the study of statistics?
● How do you conduct a probability experiment?
● What is conditional probability?
● What is meant by independent/dependent outcomes?
● How do you determine if 2 events are mutually exclusive?
● Can the fundamental counting principle and rules for combinations and</td></tr>
</table>

the conditional probability of B given A is the same as the probability of B. <u>CCSS.MATH.CONTENT.HSS.CP.A.4</u> 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. <u>CCSS.MATH.CONTENT.HSS.CP.A.5</u> 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.	● Combinations and permutations can be used in the calculation of a statistical probability	permutations help us calculate statistical probabilities
	Acquisition	
	Students will know… ● The basic definition and rules of probability ● The difference between odds and probability ● How and when to apply the Addition Rule ● How and when to apply the Multiplication Rule ● How to use the Complement Rule to make calculating probabilities simpler ● How to use combinations and permutations to calculate probabilities ● Probabilities have a direct relationship to the gaming and sports industries ● Probabilities are used to influence actions in various other industries such as manufacturing, construction and retail marketing	*Students will be skilled at…* ● Calculating simple probabilities, including complements of events ● Calculating the odds in favor and against an event ● Calculating conditional probabilities ● Differentiating between independent and dependent events ● Differentiating between mutually exclusive and overlapping events ● Understanding and applying basic concepts of probability ● Recognizing and calculating probabilities using combinations and permutations ● Working with data in 2-way frequency tables

CCSS.MATH.CONTENT.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. CCSS.MATH.CONTENT.HSS.CP.B.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. CCSS.MATH.CONTENT.HSS.CP.B.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 CCSS.MATH.CONTENT.HSS.CP.B.9 (+) Use permutations and combinations to compute probabilities of compound		

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**

T, M	Scoring Rubric used to evaluate successful understanding of the concepts of probability as they apply to each application	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Goal**: to successfully answer probability questions as they relate to several real applications(i.e. probabilities for dart board, carnival games, sporting events) **Role**: student **Audience:** teacher **Situation**: complete a series of tasks related to probability through the use of games, manipulatives and real data. **Product or Performance**: completion of the activities at all stations **Standards for Success**: Accurate results for the majority of the activities

M, A	Thorough understanding of vocabulary, probability notation and ability to successfully complete basic probability and odds problems	OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Monitoring class work through board work, group work, questioning, and walk-arounds ● Check for understanding using homework as a checkpoint, whiteboard activities, and reflections and exit tickets ● Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving scaffolding, games and use of hands-on manipulatives ● Alternative assessment projects involving real world applications such as carnival games and sporting events ● Review of standardized test questions to prepare students for the challenge of the SAT and ACT exams ● Quizzes ● Unit Test - to include a variety of DOK level problems and may include SAT style problems.
T, M, A	Accurate application of content in completing problems involving the addition and multiplication rules and demonstrating an understanding of the vocabulary associated with these topics and recognizing the difference between them	
T, M, A	Accurate application of content in completing problems involving combinations and permutations. Understanding of the difference between combinations and permutations and using them to calculate probabilities.	

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Teacher checks for prerequisite and prior knowledge via warm-up and questioning activities, such as basic problems on solving equations,order of operations and substitution ● Prerequisite knowledge is reinforced through algebra review assignments ● Teacher will provide review and assessment on prerequisite probability vocabulary knowledge to ensure all students are capable of communicating effectively	
transfer master acquire	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
A	● Teacher will introduce vocabulary and notation for basic probability	● Warm up questions on solving equations, order of operations and substitution and probability vocabulary
M, A	● Teacher and students will collectively practice using the vocabulary and basic probability	● Class worksheets on probability (addition rule, multiplication rules, combinations, permutations) with direct teacher observation and/or student self assessment
T, M, A	● Students will complete practice problems to demonstrate their level of understanding of vocabulary and notation	● Practice on whiteboard with direct teacher observation
M, A	● Teacher will instruct students on the topic of odds and the difference between odds and probability	● Kahoot quiz with basic probability/odds review questions
M, A	● Teacher and students will collectively practice odds and probability	● Students self-assess homework using answer keys and/or teacher collects homework to assess understanding
T, M, A	● Students will complete activity cards designed to review basic concepts and odds using manipulatives and real data	● Projects/performance tasks Activity cards: Working with manipulatives Working with games
M, A	● Teacher will instruct students on the use of the addition and multiplication rules of probability and vocabulary associated with these topics	

M, A	● Teacher and students will collectively practice problems comparing the addition and multiplication rules	Working with real data ● Summative assessments quizzes unit test
T, M, A	● Students will complete practice problems to demonstrate their level of understanding of the addition and multiplication rule. Practice will include work with 2-way frequency tables and problems similar to those seen on standardized tests	
T, M	● Students will analyze information in a series of problems to determine whether the addition or multiplication rule is appropriate in finding the solution	
M, A	● Teacher will instruct students on the counting principle, combinations and permutations and their use in the calculation of probabilities.	
M, A	● Teacher and students will collectively practice/compare the difference between combinations and permutations	
T, M, A	● Students will analyze problems in order to distinguish when combinations or permutations are appropriate in solving applications and then use them to calculate probabilities	
T, M	● Students will explore probability using the unit's performance task and complete an activity based review in preparation for a unit assessment. (i.e. carnival games, sporting data and manipulatives)	

Subject/Course: College Prep Statistics Unit: 2 Sample Distributions
Grade:11/12
Time frame: approx 5-6 weeks

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS

CCSS.MATH.CONTENT.HSS.ID.A.1

Represent data with plots on the real number line (dot plots, histograms, and box plots).

CCSS.MATH.CONTENT.HSS.IC.B.3

Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● Present data in both table and graphic formats
● CCSS.Math.Practice.MP1: Make sense of problems and persevere in solving them
● CCSS.Math.Practice.MP2: Reason abstractly and quantitatively.
● CCSS.Math.Practice.MP4 Model with mathematics.
● CCSS.Math.Practice.MP5 Use appropriate tools strategically
● CCSS.Math.Practice.MP6 Attend to precision
● CCSS.Math.Practice.MP7: Look for and make use of structure.</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

● Random sampling allows results of surveys and experiments to be extended to the population from which the sample was taken
● Variability is natural and is also predictable and quantifiable
● Data can be gathered and classified through a variety of methods
● Data can be presented in both chart and graph form
● Data gathered inappropriately can cause a bias in the conclusions</td><td>ESSENTIAL QUESTIONS
Students will keep considering…

● What are the keys to data classification and experimental design
● How can graphs be used to communicate information and/or misinformation
● What can cause results to be biased
● What is required to plan and conduct a survey?
● What are sampling techniques and how do they reduce bias?
● What are different methods by which data can be displayed?
● How do measures of dispersion describe</td></tr>
</table>

	● The way that data is collected, organized and displayed influences interpretation. ● The purpose of sampling is to provide sufficient information so that population characteristics may be inferred. ● Inherent bias diminishes as sample size increases. ● Data are collected for a purpose and have meaning in a context. ● Graphical displays of data may be analyzed informally.	data? ● What are the various methods of data collection? ● What are the differences between controlled experiments and observational studies? ● What considerations should be made when designing an experiment? ● How do graphs enhance the display of data? ● How does one know which graph is appropriate to use for a given set of data?
	Acquisition	
	Students will know… ● Vocabulary related to types of data and sampling techniques. ● The key issues that can be problematic in data gathering and cause bias in interpretation ● How to obtain and generate data ● How to organize data into a frequency distribution, relative frequency distribution or a cumulative frequency distribution ● How to graph the data as a first step in analyzing data ● How to display the distribution of a quantitative variable with a stemplot, dot plot or pie chart ● How to make a line graph, frequency polygon, ogive, bar graph, histogram, and pareto chart	*Students will be skilled at…* ● Identifying types of data and recognizing sampling techniques ● Understanding issues that arise when gathering data that can cause data to be biased ● Identifying the methods for gathering data ● Identifying sampling techniques as they relate to ‘real world’ situations ● Identifying common sources of bias in surveys and experiments ● Summarizing the data in a frequency table ● Gathering data from a variety of sources and determining the appropriate graph ● Displaying the distribution with the appropriate line graph, bar graph, or pie chart ● Describing the distribution of a

	● How to make a timeplot of data that may vary over time ● How to interpret numerical summaries and graphical displays of data ● How to create organize data and produce graphs using appropriate computer software	quantitative variable in terms of its shape, center and spread. ● Entering data into a spreadsheet and using the software to create a graph.

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T, M, A	Scoring Rubric used to evaluate successful understanding of the vocabulary associated with data gathering, completion of frequency table to organize the data and presentation of an appropriate graph of the data	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Goal:** Produce an appropriate graph of data gathered **Role**: Career counselor **Audience**: High school seniors **Situation**: Gather data about salaries for a specific career from the Bureau of Labor Statistics **Product or Performance**: A comparison, in graphic form, of salaries for a specific career relative to a variety of locations within the United States. **Standards for Success**: An appropriate graph representative of the data gathered.

		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…*
T, M, A	Thorough understanding of vocabulary associated with data collection and analysis	● Monitoring class work through board work, group work, questioning, and walk-arounds ● Check for understanding using homework as a checkpoint, whiteboard activities, and reflections and exit tickets
T, M, A	Accurate application of content in collecting data and summarizing it in frequency tables. Understanding the use of intervals for data without unique data points.	● Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving technology
T, M, A	Accurate application of content by knowing how to create a variety of graphs and differentiating which graph is appropriate for a given set of data.	● Alternative assessment projects such as posters, computer generated graphs and real world applications ● Review of standardized test questions to prepare students for the challenge of the SAT and ACT exams ● Quizzes
T, M, A	Production of graphs through the use of Microsoft Excel and Google Sheets	● Unit Test - to include variety of DOK level of problems and may include SAT style problems.

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Teacher checks for prerequisite and prior knowledge via warm-up and questioning activities, such as basic problems on percents and reading graphs ● Teacher will provide review and assessment on prerequisite Sampling distribution vocabulary knowledge to ensure all students are capable of communicating effectively	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
A	● Students complete an introductory activity that will provide reference during lessons on vocabulary and frequency tables	● Warm up questions on percents and reading graphs
A	● Teacher will introduce statistical vocabulary and provide sampling models to which they apply	● Class worksheets on statistical graphs with direct teacher observation and/or student self assessment
A	● Teacher discusses sampling techniques which may cause data to be biased	
M, A	● Teacher and students will collectively practice using sampling techniques	● Practice on whiteboard with direct teacher observation
T, M, A	● Students practice problems related to data gathering to determine their level of understanding	● Kahoot quiz with vocabulary review questions
M, A	● Kahoot quizzes used to review and master the vocabulary	● Students self-assess homework using answer keys and/or teacher collects homework to assess understanding
T, M, A	● Teacher demonstrates how to organize data into frequency tables and identify the various frequency tables used	
M, A	● Teacher and students will collectively practice organizing data into frequency tables	● Projects/performance tasks Activity cards using manipulatives Work with real data
T, M, A	● Students summarize real data in frequency tables	
A	● Teacher will introduce and provide practice on creating line and time-series graphs, ogives and frequency polygons	● Summative assessments quizzes

A A T, M, A M, A M, A T, M, A T, M, A T, M	● Teacher will introduce and provide practice on creating bar graphs, histograms and pareto charts ● Teacher will introduce and provide practice on creating other graphs: dotplot, stemplot, pie chart ● Teacher will provide information as to when it is appropriate to use each type of graph ● Teacher will discuss scales on the graph and how graphs can be made to be misleading ● Teacher and students will collectively practice a variety of graphs using statistical data ● Students analyze a series of data sets to determine which graph is appropriate for each given data set and then create graphs by hand ● Students create specific graphs for given data using appropriate technology (i.e. Microsoft Excel and Google Sheets) ● Students will explore sampling distributions using the unit's performance task and complete an activity based review in preparation for a unit assessment.	unit test

Subject/Course: College Prep Statistics
Grade:11/12
Time frame: approx 5-6 weeks

Unit: 3 Numerical Descriptions

Stage 1 Desired Results	
ESTABLISHED GOALS	***Transfer***

CCSS.MATH.CONTENT.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. CCSS.MATH.CONTENT.HSS.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. CCSS.MATH.CONTENT.HSS.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. CCSS.MATH.CONTENT.HSS.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to	*Students will be able to independently use their learning to…* *Students will be able to independently use their learning to…* ● Apply concepts of numeral descriptors to analyze and draw conclusions for real data associated with business and manufacturing models, the sports and gaming industry, and health related services. ● CCSS.Math.Practice.MP1: Make sense of problems and persevere in solving them ● CCSS.Math.Practice.MP2: Reason abstractly and quantitatively. ● CCSS.Math.Practice.MP4 Model with mathematics. ● CCSS.Math.Practice.MP5 Use appropriate tools strategically ● CCSS.Math.Practice.MP6 Attend to precision

each. CCSS.MATH.CONTENT.HSS.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. CCSS.MATH.CONTENT.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. CCSS.MATH.CONTENT.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).		
	Meaning	
	UNDERSTANDINGS *Students will understand that…* ● Measures of central tendency describe how the data cluster or group. ● Measures of dispersion describe how the data spread (disperse) around the center of the data.	ESSENTIAL QUESTIONS *Students will keep considering…* ● Why is data collected and analyzed? ● How do people use data to influence others? ● How technology can be used as a time saving measure in calculating measure of

	● Data are collected for a purpose and have meaning within a context. ● Analysis of the descriptive statistical information generated by a univariate data set should include the interplay between central tendency and dispersion as well as among specific measures. ● The Median and IQR resist the effects of outliers, while the mean and standard deviation do not. ● That in a skewed distribution, the mean is pulled in the direction of the skewness (toward the longer tail) relative to the mean. ● That the mean and standard deviation can be used to determine if an observation is 'usual' ● That a z-score can be used to determine if an observation is 'usual' ● That the values in a 5 number summary can be used to create a boxplot for the data	center? ● How can predictions be made based on data? ● What is an outlier and how does it influence a data set? ● What does it mean for the data to be skewed? ● Do all dispersions contain an outlier? ● How are measures of central tendency used? ● What is meant by the spread of the data? ● When is an observation considered 'usual' ● What does it mean for an observation to be considered 'usual'? ● How do z-scores determine if an observation is 'usual'
	Acquisition	
	Students will know… ● The basic properties of the median and the mean ● That an outlier can cause data to be skewed relative to the position of the mean and median on the normal curve ● That the standard deviation summarizes how spread out all the data are around the mean. ● What z-scores means	*Students will be skilled at…* ● Calculating the mean, median, mode, midrange and standard deviation for a set of data ● Selecting and using appropriate statistical methods to analyze data ● Calculating weighted means for frequency distributions and to find grades such as for GPA ● Using the 1.5 IQR rule to identify possible

	● How to compare values of two different variables using their z-scores ● How to determine if an observation is 'usual' ● What it means to be 'usual' ● How to calculate a range of usual values using the rule of thumb, empirical rule and Chebyshev's theorem ● How to find the value at a specific percentile ● How to find the percentage of observations falling below any value in a Normal model using appropriate technology ● How to use appropriate technology to find the 5 number summary and create a box plot for the data.	outliers and identify outliers in boxplots ● Calculating the z-score of an observation and determining whether a value is 'usual' ● Calculating ranges of usual values using the rule of thumb, empirical rule and Chebyshev's theorem ● Determining whether or not an observation is 'usual' ● Creating the 5-number summary of a variable ● Constructing a box plot by hand from a 5-number summary ● Calculating which value lies at a specific percentile ● Calculating the percentile for a specific value

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T, M, A	Scoring Rubric used to evaluate successful understanding of data gathering and analysis and a clear presentation on the meaning of the analysis.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Goal:** gather data, produce an appropriate graph and make appropriate calculations for the data **Role:** Realtor **Audience**: Home buyers **Situation**: gather data about housing prices in a specific area and calculate measures of center for the data **Product or Performance**: Present the results of the survey to prospective home buyers to give them an understanding of the housing prices in that area. **Standards for Success**: Accurate calculations and a knowledgeable presentation of the data gathered
T, M, A T, M, A	Thorough understanding of organizing data into an appropriate frequency table Accurate application of content in completing calculations mean, median, mode, weighted mean, standard deviation through the use of formulas as well as technology	OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Monitoring class work through board work, group work, questioning, and walk-arounds ● Check for understanding using homework as a checkpoint, whiteboard activities, and reflections and exit tickets ● Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving technology

T, M, A	Accurate application of content by using both the z-score formula and ranges of usual values to determine if a specific value is 'usual'	● Alternative assessment projects using real world applications ● Review of standardized test questions to prep students for the challenge of the SAT and ACT exams ● Quizzes ● Unit Test - to include variety of DOK level of problems and may include SAT style problems.
T, M, A	Understanding percentiles and quartiles and calculations of percentiles for specific values	
T, M, A	Accurate application of content through the use of outlier formulas and the 5 number summary to create boxplots and determine outliers for a data set.	

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Teacher checks for prerequisite and prior knowledge via warm-up and questioning activities, such as basic problems on solving percents, equations, order of operations and substitution ● Teacher will provide review and assessment on prerequisite numerical descriptors vocabulary knowledge to ensure all students are capable of communicating effectively	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
A A M, A T, M, A T, M, A M, A M,A T, M, A M, A T, M, A	● Teacher will review measures of center ● Teacher will discuss the concept of skewed versus normal data ● Teacher and students will collectively practice calculating measures of center and analyze shape ● Students should calculate the measures of center for a variety of data sets ● Students analyze data and determine which measure of center is appropriate based on the presence of an outlier ● Teacher will introduce the weighted mean formulas and provide applications of them ● Teacher will introduce the concept of standard deviation and demonstrate how to calculate it using the sample standard deviation formula ● Teacher will demonstrate how to enter a data list in the graphing calculator and how to retrieve the mean and standard deviation calculations ● Teacher and students will collectively practice calculating weighted means, standard deviations and spread ● Students should calculate the mean, weighted mean and sample standard deviation on a variety of data sets and then rework them using technology in order to see	● Warm up questions on solving percents, equations, order of operations and substitution ● Class worksheets on calculating measures of center and usual values with direct teacher observation and/or student self assessment ● Practice on whiteboard with direct teacher observation ● Kahoot quiz with basic calculation review questions ● Students self-assess homework using answer keys and/or teacher collects homework to assess understanding ● Projects/performance tasks Activity cards using manipulatives Work with real data ● Summative assessments quizzes unit test

	the benefits of using technology with respect to time spent doing calculations and how it relates to productivity	
T, M, A	● Teacher will provide examples of the mean and standard deviation formulas involving frequency distributions and then demonstrate how the calculations can be completed using the graphing calculator	
M,A	● Teacher and students will collectively practice calculations involving frequency distributions	
T, M, A	● Students will use calculations of mean and standard deviation to determine how the concept of normal applies to the data set. Specifically the empirical rule, range rule of thumb and Chebyshev's theorem	
T, M, A	● Students will use the mean and standard deviations of normal and skewed data to determine the ranges of 'usual values'	
A	● Teacher will explain the concept of percentiles and how to calculate them, focusing specifically on the 1st and 3rd quartiles.	
M,A	● Teacher and students will collectively practice calculating percentiles	
M, A	● Students should be able to calculate the percentile of a value and find the value at a specific percentile	
A	● Teacher will introduce the concept of outliers and use the 1.5 IQR formula to determine the existence of outliers in a data set.	
M, A	● Teacher explains how to create a boxplot and how it is affected by the existence of outliers in the data set	
M, A	● Teacher will demonstrate how to set up a boxplot using formulas to calculate the 5 number summary and how to find the same information using the graphing calculator	
T, M, A	● Teacher and students will collectively practice finding the five number summary and creating an appropriate boxplot	
T, M	● Students should use calculations of the 5 number summary, through both formulas and graphing	

T, M T, M	calculator to create boxplots ● Students interpret boxplots for information relative to quartiles for the data set. ● Students will explore measures of center using the unit's performance task and complete an activity based review in preparation for a unit assessment.	

Subject/Course: College Prep Statistics Unit: 4 Normal Distributions
Grade:11/12
Time frame: approx. 4-5 weeks

Stage 1 Desired Results

ESTABLISHED GOALS

CCSS.MATH.CONTENT.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.

Transfer

Students will be able to independently use their learning to…

- Apply concepts of the normal curve to probabilities related to business and manufacturing models, the sports and gaming industry, and health related services.
- CCSS.Math.Practice.MP1: Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP2: Reason abstractly and quantitatively.
- CCSS.Math.Practice.MP4 Model with mathematics.
- CCSS.Math.Practice.MP5 Use appropriate tools strategically
- CCSS.Math.Practice.MP6 Attend to precision

Meaning

UNDERSTANDINGS

Students will understand that…

- The normal distribution curve is a family of symmetrical curves defined by the mean and the standard deviation.
- Areas under the curve represent probabilities associated with continuous distributions.
- The area under the curve is always to the left of the corresponding z-score
- The normal curve is a probability distribution and the total area under the curve is 1.
- The distribution of outcomes of many real life events can be approximated

ESSENTIAL QUESTIONS

Students will keep considering…

- What is a normal curve?
- What are the properties of a normal probability distribution?
- How can one recognize a normal (bell shaped) distribution.
- How is the probability of an event calculated using the z-score formula?
- How does the standard deviation and mean affect the graph of the normal distribution?
- Why is an understanding of the normal curve essential to statistics?
- In what situations can the normal curve be applied to data?

	by the normal curve ● The Central Limit Theorem can be applied when finding probabilities for groups	● When is it appropriate to use the Central Limit Theorem ● How can one recognize a normal (bell shaped) distribution.
	Acquisition	
	Students will know… ● The total area under a normal curve is 1 ● Part of the area under a normal curve represents the probability for a specific observation ● The z-score formula can be used to find the probability for a specific observation ● The probability associated with a z-score always represents the area to the left on the curve ● Normal probabilities have a variety of real world applications ● How to determine when the Central Limit Theorem is appropriate for solving an application problem	*Students will be skilled at…* ● Using the z-score formula to find a normal probability for a specific observation ● Using the z-score formula to find a value for a specific percentile or probability ● Applying knowledge of normal probabilities to real world situations ● Using the graphing calculator to solve problems involving normal probabilities ● Using the Central Limit Theorem calculating probabilities for specific applications

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T, M, A	Scoring Rubric used to evaluate successful understanding of data gathering and analysis and a clear presentation on the meaning of the analysis.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Goal:** gather information about a mode of transportation that requires specific safety requirements as they pertain to weight loads(i.e. elevators, ski gondolas, water taxis) and to provide the statistical basis for the limitations to be imposed **Role:** Construction Supervisor **Audience**: Contractors **Situation**: gather data about safety specifications for construction as how statistics is used to determine the limits for weight loads in **Product or Performance**: Present a clear explanation as to the need for specific safety requirements to be put in place and how the requirements are determined through statistical models **Standards for Success**: Accurate calculations and a knowledgeable presentation of the data gathered

		OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…*
M, A	Thorough understanding of the properties of normal curve	● Monitoring class work through board work, group work, questioning, and walk-arounds
M, A	Accurate application of content in completing calculations of z-scores and corresponding probabilities	● Check for understanding using homework as a checkpoint, whiteboard activities, and reflections and exit tickets
M, A	Accurate application of content by using the z-score formula to find a value for a specific percentile or probability	● Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving technology ● Alternative assessment projects using real world applications
T, M, A	Appropriate use of technology by using the graphing calculator to solve problems involving normal probabilities	● Quizzes ● Unit Test - to include variety of DOK level of problems
T, M, A	Applying knowledge of normal probabilities to real world situations; specifically through the use of the Central Limit Theorem	

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Teacher checks for prerequisite and prior knowledge via warm-up and questioning activities, such as basic problems on solving equations,order of operations and substitution and work with the z-score formula ● Teacher will provide review and assessment on prerequisite normal curve vocabulary knowledge to ensure all students are capable of communicating effectively	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
A	● Teacher will introduce the z-score charts and how to use them to find probabilities	● Warm up questions on solving equations,order of operations and substitution and work with the z-score formula
A	● Teacher will demonstrate how to use the z-score chart to find values for specific probabilities	
M, A	● Teacher and students will collectively practice using the z score chart to find probabilities	● Class worksheets on calculating z scores and using them to find probabilities with direct teacher observation and/or student self assessment
M, A	● Students will practice finding z-scores and probabilities using the z-score chart and complete applications problems	
T, M, A	● Teacher will provide training on how to complete the application problems using the appropriate functions on the graphing calculator	● Practice on whiteboard with direct teacher observation
M, A	● Teacher and students will collectively practice applications using both methods	● Kahoot quiz with z-score review questions
T, M	● Students will complete a variety of application problems using the formulas and charts and then rework them using technology in order to see the benefits of using technology with respect to time spent doing calculations and how it relates to productivity	● Students self-assess homework using answer keys and/or teacher collects homework to assess understanding
T, M, A	● Students will analyze data related to application problems to determine the appropriate method for finding a solution	● Projects/performance tasks Activity cards using applications from various fields of study Work with real data
T, M, A	● Teacher will introduce the Central Limit Theorem and provide examples of real applications(i.e. weight limits,	● Summative assessments quizzes

M,A T, M T, M	manufacturing specifications) ● Teacher and students will collectively practice using the central limit theorem in calculating probabilities ● Students will research uses for the Central Limit Theorem and complete appropriate calculations ● Students will explore Normal Distributions using the unit's performance task and complete an activity based review in preparation for a unit assessment. .	unit test

Subject/Course: College Prep Statistics Unit: 5 Probability Distributions
Grade:11/12
Time frame: approx. 5-6 weeks

Stage 1 Desired Results

ESTABLISHED GOALS

CCSS.MATH.CONTENT.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.
CCSS.MATH.CONTENT.HSS.MD.A.2
(+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
CCSS.MATH.CONTENT.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

Transfer

Students will be able to independently use their learning to…

- apply concepts of probability to problems related to business and manufacturing models, the sports and gaming industry, and health related services.
- CCSS.Math.Practice.MP1: Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP2: Reason abstractly and quantitatively.
- CCSS.Math.Practice.MP4 Model with mathematics.
- CCSS.Math.Practice.MP5 Use appropriate tools strategically
- CCSS.Math.Practice.MP6 Attend to precision

Meaning

UNDERSTANDINGS
Students will understand that…

- How random variables are used to create a probability distribution.
- How to develop binomial and geometric probability distributions within a real-world context.
- How to calculate the mean and standard deviation for the probability distributions.
- How to use the binomial distribution to calculate probabilities associated with experiments for which there are only two possible outcomes.
- Expected values are used to simulate real world probabilities.

ESSENTIAL QUESTIONS
Students will keep considering…

- How are the mean and standard deviation calculated for a binomial variable?
- What are the differences between binomial and geometric probabilities.
- What is the relationship between variances and standard deviation?
- How are binomial and geometric probabilities determined?
- How can these distributions be applied to real-world applications?
- How can expected values be used to predict real world probabilities

each question has four choices, and find the expected grade under various grading schemes. CCSS.MATH.CONTENT.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?* CCSS.MATH.CONTENT.HSS.MD.B.5 (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. CCSS.MATH.CONTENT.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.* CCSS.MATH.CONTENT.HSS.MD.B.5.B Evaluate and compare	● How to identify unusual values.	
	Acquisition	
	Students will know… ● A random variable has values that are determined by chance. ● A probability distribution consists of all values of a random variable, along with their respective probabilities. ● A probability distribution must satisfy two requirements: the sum of the probabilities equals 1 and each probability is between and including 0 and 1. ● How to construct a probability histogram. ● Binomial distributions have two categories of outcomes and a fixed number of independent trials with a constant probability. ● Geometric distributions only deal with the probability of when the first success occurs. ● Probability distributions have a mean and standard deviation. ● How to distinguish between usual outcomes and those considered to be unusual. ● How to find the mean, variance, and standard deviation of a random variable. ● To always use the proper notation for	*Students will be skilled at…* ● Recognizing the difference between discrete and continuous random variables. ● Calculating probabilities for random variables and display them in a probability distribution table. ● Calculating means and standard deviations for all three types of probability distributions using appropriate formulas. ● Calculating expected values, variance, and standard deviation of a random variable. ● Determining whether a probability distribution is binomial or geometric ● Using a binomial probability formula to calculate an exact, at least, or more than a certain number of successes. ● Discerning between a permutation and a combination. ● Using a geometric probability formula to determine the probability of the first success on a particular trial. ● Using formulas to determine if outcomes are unusual. ● Reporting any probabilities or other such values including the parameters in the context of the problem using complete

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.* CCSS.MATH.CONTENT.HSS.CP.B.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems.	these population parameters. ● How to determine the new mean and standard deviation after adding a constant or multiplying by a constant. ● Be able to interpret the meaning of the expected value and standard deviation of a random variable in the proper context.	sentences.

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T, M, A	Scoring Rubric used to evaluate successful understanding of creating a game and using the expected value model to predict the probability of making a profit	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Goal**: Have students design their own games of chance. **Role**: Carnival Worker **Audience**: Carnival attendee **Situation**: Have students describe the rules, payouts, and the cost of playing. Games could be based on cards, dice, coins, spinners, etc…Try and get them to create an appealing game that people would be eager to play but have an expected value where the person running the game would be likely to realize a profit. **Product or Performance**: A game that can be set up in a carnival booth **Standards for Success**: Accurate calculations and detailed clear explanations of the rules and payouts.

M, A	Thorough understanding of the properties of probability and binomial distributions	OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Monitoring class work through board work, group work, questioning, and walk-arounds
T, M, A	Accurate application of content in completing calculations of binomial and geometric	● Check for understanding using homework as a checkpoint, whiteboard activities, and reflections and exit tickets
T, M, A	Accurate application of content by using expected value to calculate real world probabilities	● Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving technology ● Alternative assessment projects using real world applications
T, M, A	Appropriate use of technology by using the graphing calculator to solve problems involving binomial, geometric and Poisson probabilities	● Quizzes ● Unit Test - to include variety of DOK level of problems

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Teacher checks for prerequisite and prior knowledge via warm-up and questioning activities, such as basic problems on probability and the normal curve ● Teacher will provide review and assessment on prerequisite probability distributions vocabulary knowledge to ensure all students are capable of communicating effectively	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
A	● Teacher will introduce random variables and describe them with probability models.	● Warm up questions on probability and the normal curve
A	● Teacher will continue to emphasize the importance of vocabulary and notation.	● Class worksheets on probability, binomial and geometric distributions with direct teacher observation and/or student self assessment
M, A	● Teacher and students will collectively practice the use of vocabulary related to random variables.	
M, A	● Students will create their own probability distribution tables in pairs or small groups and explain what properties it possesses that make it a probability distribution.	● Practice on whiteboard with direct teacher observation
T, M, A	● Teacher will introduce formulas and show examples for calculating probabilities and parameters by hand. The teacher will then at some point show students how to use technology to get the identical values in order for students to make connections with what technology can do and be confident they are getting accurate results.	● Kahoot quiz with binomial and geometric probability review questions ● Students self-assess homework using answer keys and/or teacher collects homework to assess understanding
M, A	● Teacher and students will collectively practice calculating probabilities and parameters	● Projects/performance tasks Activity cards comparing binomial and geometric distributions Work with real data for expected value predictions
T, M, A	● Students will work in small groups working formulas by hand and compare answers to verify results. They should then do the same exercise using technology in order to see the benefits of using technology with respect to time spent doing calculations and how it relates to productivity.	● Summative assessments quizzes

T, M, A	● Students participate in a basketball activity to master the concepts of binomial and geometric probabilities	unit test
T, M	● As an exercise, each student could roll a die and keep track of which roll produces the first six. Students could then average all those values in order to make the connection to a geometric distribution.	
T, M, A	● Teacher explains expected values and standard deviations, and examines the effects of shifting and scaling on mean and variance.	
T, M, A	● Teacher will continue to stress the "law of large numbers" in order for students to make connections to the real world, such as the insurance or gaming industries.	
M, A	● Teacher and students will collectively practice finding expected values	
T, M, A	● Students design their own games of chance. They will describe the rules, payouts, and the cost of playing. Games could be based on cards, dice, coins, spinners, etc…Try and get them to create an appealing game that people would be eager to play but have an expected value where the person running the game would be likely to realize a profit.	
A	● Teacher will describe various methods for determining whether values are unusual.	
M	● Teacher may want to supply organized formula/symbol sheets for students as there are extensive formulas and symbols used in this unit.	
M, A	● Teacher should explain there are three steps that should be followed when answering these types of questions. **Think** (the students should state the question and make a plan), **Show** (the students should show their calculations), and **Tell** (interpret your results in the context of the problem)	
T, M	● Students will explore correlations using the unit's performance task and complete an activity based review in preparation for a unit assessment.	

Subject/Course: College Prep Statistics Unit: 6 The Relationship between Two Variables
Grade:11/12
Time frame: approx 5-6 weeks

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">ESTABLISHED GOALS

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

CCSS.MATH.CONTENT.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.

CCSS.MATH.CONTENT.HSS.ID.B.6.B
Informally assess the fit of a function by plotting and analyzing residuals.</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…
● apply concepts of graphs and their equations to analysis and predictions related to business and manufacturing models, the sports and gaming industry, weather forecasting and health related services.
● CCSS.Math.Practice.MP1: Make sense of problems and persevere in solving them
● CCSS.Math.Practice.MP2: Reason abstractly and quantitatively.
● CCSS.Math.Practice.MP4 Model with mathematics.
● CCSS.Math.Practice.MP5 Use appropriate tools strategically
● CCSS.Math.Practice.MP6 Attend to precision</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

● A scatter plot serves two purposes: - to determine if there is a useful relationship between two variables, and - to determine the family of equations that describes the relationship.
● Data are collected for a purpose and have meaning in a context.</td><td>ESSENTIAL QUESTIONS
Students will keep considering…

● How can graphs be used to examine data?
● What is the role of outliers in data observations?
● What is the strength of an association between two variables?
● What is the meaning behind the least squares line?</td></tr>
</table>

CCSS.MATH.CONTENT.HSS.ID.B.6.C Fit a linear function for a scatter plot that suggests a linear association. CCSS.MATH.CONTENT.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. CCSS.MATH.CONTENT.HSS.ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit. CCSS.MATH.CONTENT.HSS.ID.C.9 Distinguish between correlation and causation. CCSS.MATH.CONTENT.HSS.IC.B.6 Evaluate reports based on data.	● The association between two variables considers both the direction and strength of the association ● The strength of an association between two variables reflects how accurately the value of one variable can be predicted based on the value of the other variable. ● Outliers are observations with large residuals and do not follow the pattern apparent in the other data points.	● What is the meaning of the slope and y-intercept in the line of regression? ● What determines a regression equation is an appropriate model?
	Acquisition	
	Students will know… ● How to identify the roles of variables and to place the response variable on the y-axis and the explanatory variable on the x-axis using proper context. ● The conditions for correlation and how to check them. ● Correlations are between -1 and +1 (inclusive), and each extreme indicates a perfect linear association. ● How the magnitude of the correlation reflects the strength of the linear association. ● The correlation has no units. ● The correlation coefficient is not changed by changing the center or scale of either variable. ● Causation cannot be demonstrated by a scatterplot or correlation. ● How a linear equation summarizes the	*Students will be skilled at…* ● Making a scatter plot by hand (for a small set of data) and with technology. ● Computing the correlation of two variables. ● Reading a correlation table produced by a statistics program. ● Describing the direction, form, and strength of a scatter plot. ● Using a correlation as part of the description of the scatterplot. ● Being aware of misinterpretations of correlation. ● Using a plot of the residuals against predicted values as a check for the appropriateness of the generated line of regression. ● Finding a regression equation from the summary statistics for each variable and the correlation between the variables. ● Finding a regression equation using a

	relationship between two variables. ● That the least squares slope is easily affected by extreme values. ● Residuals are the differences between data values and the corresponding predicted values. ● How the residuals relate to the least squares linear equation	statistics software output table. ● Using regression to predict a value of y for a given x. ● Computing the residual for each data value and display them. ● Writing a sentence in context showing the meaning of the slope and y-intercept. ● Describing a prediction made from a regression equation, relating the predicted value to the specified x-value.

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T, M, A	Scoring Rubric used to evaluate successful understanding of data gathering and analysis and a clear presentation on the meaning of the analysis.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Goal**: Have students research data for two related variables to determine if there is an existing correlation **Role**: Statistician **Audience**: Manager in a field related to the chosen topic **Situation**: Have students choose 2 variables to research and determine if there is a correlation(i.e.: temperature and ice cream sales, height and foot size, etc..) Students should examine the scatter and residual plots, determine the correlation coefficient and the line of regression. Then they should draw a conclusion as to the nature of the correlation; strength, direction and form and the usefulness of the line of regression as a predictive model for the data. **Product or Performance**: Presentation on the data gathered and the corresponding conclusion **Standards for Success**: Accurate calculations and detailed clear explanations of the variables and the correlation

M, A	Thorough understanding of the properties of a scatter plot and an equation of a line	OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Monitoring class work through board work, group work, questioning, and walk-arounds
M, A	Accurate application of content in graphing a scatter plot by hand, drawing the line of best fit and writing an equation for the regression line	● Check for understanding using homework as a checkpoint, whiteboard activities, and reflections and exit tickets
T, M, A	Accurate application of content by using technology to access the scatter plot and line of regression	● Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving technology
M, A	Thorough understanding of the correlation coefficient, how to make an approximation from a graph and how to calculate the actual value using the graphing calculator	● Alternative assessment projects using real world applications ● Quizzes
M, A	Accurate application of the content in determining the nature of the correlation for a set of data	● Unit Test - to include variety of DOK level of problems
T, M, A	Accurate application of the content in determining if a regression equation is a good model and then making predictions using the	

	equation. Then understanding what the slope and intercept mean in the context of the problem	
T, M, A	Thorough understanding of residuals and how they relate to the predicted values	

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Teacher checks for prerequisite and prior knowledge via warm-up and questioning activities, such as basic problems on graphing equations in slope intercept form and calculating slope, substitution and evaluation, solving equations ● Teacher will provide review and assessment on prerequisite correlations vocabulary knowledge to ensure all students are capable of communicating effectively	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
A M, A M, A M, A M, A M, A T, M, A T, M, A	● Teacher will emphasize the importance of the first rule of data analysis: make a picture. ● Teacher will continue to emphasize the importance of vocabulary and notation. ● Teacher will introduce formulas and show examples for calculating regression equations by hand. The teacher will then at some point show students how to use technology to get the identical equations in order for students to make connections with what technology can do and be confident they are getting accurate results. ● Each of these topics can be taught individually or by having students work in small groups verifying results. ● Teacher supplies visual scatterplots and asks students to describe form, direction, strength, and approximate a correlation coefficient. Students should describe scatter plots verbally indicating direction, form, and strength. ● Teacher and students will collectively practice finding lines of regressions ● Students plot unusual values and then determine if they understand if and why they are unusual. ● Teacher will instruct students on residuals by using a scatter plot and having students record the residual for	● Warm up questions on graphing equations in slope intercept form and calculating slope, substitution and evaluation, solving equations ● Class worksheets which practice plotting data and finding regression lines and residuals.with direct teacher observation and/or student self assessment ● Practice on whiteboard with direct teacher observation ● Kahoot quiz with regression equation review questions ● Students self-assess homework using answer keys and/or teacher collects homework to assess understanding ● Projects/performance tasks Gathering and graphing real data to determine the equation that can be

	each point and explain the meaning of the residuals in the context of the problem.	used as a predictive model Work with real data from a variety of areas of study
T, M, A	● Teacher will instruct students on the use of the graphing calculator to access a plot of the residuals and how to use it to determine if the regression equation is a good model for the population	● Summative assessments quizzes unit test
M, A	● Teacher and students will collectively practice finding residuals for a regression line	
T, M, A	● Students practice in small groups working problems by hand and verifying results. They should then do the same exercise using technology in order to see the benefits of using technology with respect to time spent doing calculations and how it relates to productivity and accuracy.	
T, M, A	● Students present their work to the class in order for students to observe more instances of good models and models that are not representative of the true nature of the data	
T, M, A	● Students work in small groups to find their own bivariate data. For instance each group could gather measurements of height as related to the golden ratio, write their own regression equations, and compare them with the other groups. They could then learn that the larger their sample sizes, the more closely their equations will resemble each other. They can gain a better understanding of the slope and intercept in the context of the problem. (a brief tangent can be taken into an understanding of the significance of the golden ratio)	
T, M, A	● Students will be given 4 or 5 ordered pairs to plot, write an equation, and find the correlation coefficient. They would then be instructed to change one of the points and see how the values could have dramatically changed. Using few points gives students a more visual experience.	
T, M, A	● Teacher should explain there are three steps that should be followed when answering these types of	

T, M	questions. **Think** (the students should state the question and make a plan), **Show** (the students should show their calculations), and **Tell** (interpret your results in the context of the problem) ● Students will explore lines of regression and residual values using the unit's performance task and complete an activity based review in preparation for a unit assessment.	

Subject/Course: College Prep Statistics Unit: 7 Inferential Statistics
Grade:11/12
Time frame: approx 5-6 weeks

<table>
<tr>
<td rowspan="3">ESTABLISHED GOALS
CCSS.MATH.CONTENT.HSS.IC.A1

Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

CCSS.MATH.CONTENT.HSS.IC.A2
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?

CCSS.MATH.CONTENT.HSS.IC.B3
Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

CCSS.MATH.CONTENT.HSS.IC</td>
<td colspan="2">Transfer</td>
</tr>
<tr>
<td colspan="2">Students will be able to independently use their learning to…

● apply concepts of confidence intervals and hypothesis testing to problems related to business and manufacturing models, the sports and gaming industry, the political arena and health related services.
● CCSS.Math.Practice.MP1: Make sense of problems and persevere in solving them
● CCSS.Math.Practice.MP2: Reason abstractly and quantitatively.
● CCSS.Math.Practice.MP4 Model with mathematics.
● CCSS.Math.Practice.MP5 Use appropriate tools strategically
● CCSS.Math.Practice.MP6 Attend to precision</td>
</tr>
<tr>
<td colspan="2">Meaning</td>
</tr>
<tr>
<td>UNDERSTANDINGS
Students will understand that…

● A primary goal of sampling is to estimate the value of a parameter based on a statistic.
● Confidence intervals use the sample statistic to construct an interval of values that one can be reasonably certain contains the true (unknown) parameter.
● Confidence intervals and tests of significance are complementary procedures.</td>
<td>ESSENTIAL QUESTIONS
Students will keep considering…

● Why are confidence intervals and tests of significance important?
● How is sampling used and why is it important?
● How do you use inferential models to draw statistically significant conclusions from data and make inferences about populations?
● How can the language of statistics be used to communicate mathematical ideas coherently and precisely?</td>
</tr>
</table>

.B4 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. CCSS.MATH.CONTENT.HSS.IC.B5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. CCSS.MATH.CONTENT.HSS.IC.B.6 Evaluate reports based on data.	● Paired comparisons experimental design allows control for possible effects of extraneous variables. ● Understand when you use a z test. ● Determine if a correlation exists between sets of data. ● Find the confidence interval for the mean when the standard deviation is known. ● The difference between the alternative hypothesis and null hypothesis in a hypothesis test ● How to determine when it is appropriate to reject the null hypothesis	● How can technology be applied to create and interpret models? ● How can improperly applied inference procedures lead to bad conclusions? ● How do I construct a confidence interval? ● What type of information does a confidence interval provide me? ● How can hypothesis testing provide the statistical structure to reject or fail to reject the null hypothesis? ● When does a person choose to use the z-test type of hypothesis testing
	Acquisition	
	Students will know… ● That the margin of error of a confidence interval for a proportion changes with the sample size and the level of confidence. ● How to examine their data for violations of conditions that would make inferences about a population proportion unwise or invalid. ● How to find a confidence interval for a population proportion or mean. ● The conditions that must be true for a one-proportion z-test to be appropriate and how to check for these conditions.	*Students will be skilled at…* ● Constructing a one-proportion z-interval. ● Interpreting a one-proportion z-interval in a simple sentence or two within the context of the problem. ● Stating the null and alternative hypotheses for a one-proportion z-test. ● Performing a one-proportion z-test. ● Writing a sentence interpreting the results of a one-proportion z-test in context. ● Interpreting the meaning of a P-value in nontechnical language. ● Explaining the meaning of a confidence interval for a population mean. ● Interpreting the result of a test of a

	● How to choose between a one-sided and two-sided alternative hypothesis and be able to explain their choice. ● How the critical value for a test is related to the specified alpha level. ● The close relationship between hypothesis tests and confidence intervals. ● That we do not “accept” a null hypothesis if we cannot reject it, but rather that we can only “fail to reject” the hypothesis for lack of evidence against it. ● Know that the P-value of a test does not give the probability that the null hypothesis is correct.	hypothesis about a population mean..

Code	Evaluative Criteria	Assessment Evidence
T, M, A	Scoring Rubric used to evaluate successful understanding of data gathering and analysis and a clear presentation on the meaning of the analysis.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Goal**: Perform a hypothesis test checking the published proportion of blue M&Ms or red Skittles. **Role:** Marketing Department for Mars Co. **Audience:** CEO for Mars Co. **Situation**: Have the marketing department calculate the percentage of blue M&Ms in their bag. Perform a hypothesis test comparing it to the published percentage available at www.mars.com. Decide whether they will reject or fail to reject the null hypothesis. **Product or Performance**: Board presentation. **Standards for Success**: Accurate calculations and detailed clear explanations of the testing and the conclusions

M, A	Thorough understanding of the notation and vocabulary associated with confidence intervals and hypothesis testing	OTHER EVIDENCE: *Students will show they have achieved Stage 1 goals by…* ● Monitoring class work through board work, group work, questioning, and walk-arounds
T, M, A	Accurate application of content in computing critical values, probabilities and margins of error	● Check for understanding using homework as a checkpoint, whiteboard activities, and reflections and exit tickets
T, M, A	Accurate application of content by using calculations to determine the confidence interval for certain criteria	● Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving technology ● Alternative assessment projects using real world applications
M, A	Thorough understanding of the hypothesis and how to determine the null and alternative hypotheses.	● Quizzes
T, M, A	Appropriate application of content by calculating a test statistic and using it to determine whether or not to reject the null hypothesis	● Unit Test - to include variety of DOK level of problems

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** ● Teacher checks for prerequisite and prior knowledge via warm-up and questioning activities, such as basic problems on solving equations, order of operations and substitution and work with the z-score formula ● Teacher will provide review and assessment on prerequisite inferential statistics vocabulary knowledge to ensure all students are capable of communicating effectively	
	Summary of Key Learning Events and Instruction *Student success at transfer meaning and acquisition depends on…*	Progress Monitoring
M, A	● Teacher will continue to emphasize the importance of vocabulary and notation, specifically related to confidence intervals and margins of error	● Warm up questions on solving equations, order of operations and substitution and work with the z-score formula
T, M, A	● Teacher will introduce formulas and show examples for creating confidence intervals by hand. The teacher will then at some point show students how to use technology to get the identical results in order for students to make connections with what technology can do and be confident they are getting accurate results.	● Class worksheets on finding confidence intervals and hypothesis testing with direct teacher observation and/or student self assessment
M, A	● Each of these topics can be taught individually or by having students work in small groups verifying results.	● Practice on whiteboard with direct teacher observation
M, A	● Teacher may want to supply organized formula/symbol sheets for students as there are extensive formulas and symbols used in this unit. A z-table needs to be provided.	● Kahoot quiz with confidence interval and margin of error review questions
M, A	● Teacher and students will collectively practice calculating confidence intervals and margin of error	● Students self-assess homework using answer keys and/or teacher collects homework to assess understanding
T, M, A	● Students research daily or weekly to find statistics available online or as a hard copy relating to the topics in this unit. They may want to share them individually to the class.	● Projects/performance tasks Tasks involving an examination of confidence intervals (i.e. in politics or business) Work with real data to create
T, M, A	● Students individually or in small groups create confidence intervals using published percentiles for M&M colors and their own sample bag. They can	

	check whether the confidence interval they created captured the true proportion. Hopefully not all of them will if our sample size is large enough.	confidence intervals such as in medicine or physics
T, M, A	● Teacher will introduce hypothesis testing and how to identify the hypothesis, alternative and the null hypothesis for a given claim	● Summative assessments quizzes unit test
T, M, A	● Teacher will instruct students on the calculation of the test statistic and its use in determining whether or not to reject the null hypothesis	
T, M, A	● Teacher will provide students with practice on hypothesis testing and review how to determine whether the data indicates a one or two tailed test	
M, A	● Teacher and students will collectively practice setting up a hypothesis test and determining its relevance	
M, A	● Students will analyze data to determine whether it indicates a one tailed or two tailed test is appropriate in testing a hypothesis	
M, A	● Students will work in small groups working formulas by hand and verify results with each other.	
T, M	● Students will describe confidence intervals and results of their hypothesis test verbally as well as writing complete sentences in context.	
T, M	● Students will explore confidence intervals and hypothesis testing using the unit's performance task and complete an activity based review in preparation for a unit assessment.	
