STAGE 2

Code	Evaluative Criteria	Assessment Evidence
T, M, A	Evaluative Criteria consists of ● An explanation of the methods used for gathering the data. ● Data organized into an appropriate table ● Measures of center are accurate and appropriately represented visually ● A coherent summation of the data with an explanation of the current housing prices in the area	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.

	Evaluative criteria consists of:	OTHER EVIDENCE:
T, M, A	● Is the correct sampling technique used to gather the data?	● Alternative assessment projects such as posters, computer generated graphs and real world applications
M, A	● Is the correct vocabulary and/or notation used to describe the data	● Review of standardized test questions to prep students for the challenge of the SAT and ACT exams
M, A	● Are the measures of center calculations (mean, median, mode, weighted mean, and standard deviation) accurate?	● Participation in class discussion, group work, and responses.
		● Quizzes
T, M, A	● Is the data modeled appropriately	
T, M, A	● Was the appropriate technology utilized?	● Unit Test - to include a variety of DOK level of problems and may include SAT style problems.
T, M, A	● Are justified conclusions made based on the data gathered?	

Code	***Pre-Assessment*** ● Teacher checks for prerequisite and prior knowledge via warm-up and questioning activities, such as basic problems on interpreting data and data models. ● 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 ● Monitoring class work through board work, group work, questioning, and walk-arounds
A	● Teacher will review measures of center	● Check for understanding via going over homework and mediums such as reflections and exit tickets
M, A	● Teacher will discuss the concept of skewed versus normal data	● Class worksheets with direct teacher observation or self assessment
M, A	● Teacher and students will collectively practice calculating measures of center and analyze shape	● Practice on whiteboard/chalkboard with direct teacher observation
T, M, A	● Students should calculate the measures of center for a variety of data sets	● Kahoot quiz or pear deck slideshow with review questions and direct teacher observation
T, M, A	● Students analyze data and determine which measure of center is appropriate based on the presence of an outlier	● Reflective journals or exit tickets at the end of the lesson
M, A	● Teacher will introduce the weighted mean formulas and provide applications of them	● Edulastic or google form review assignments
M, A	● Teacher will introduce the concept of standard deviation and demonstrate how to calculate it using the sample standard deviation formula	● Homework assignments with direct teacher observation or self assessment

T, M, A	• Teacher will demonstrate how to enter a data list in the graphing calculator and how to retrieve the mean and standard deviation calculations	
T, M, A	• Teacher and students will collectively practice calculating weighted means, standard deviations and spread	
T, M, A	• 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 the benefits of using technology with respect to time spent doing calculations and how it relates to productivity	
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	• 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	• 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	
T, M	• 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.	
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	• 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 calculator to create boxplots	
T, M	• Students interpret boxplots for information relative to quartiles for the data set.	
T, M	• Students will explore measures of center using the unit's performance task and complete an activity based review in preparation for a unit assessment.	

Suggested Resources and supplies

Resources:

All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval.

- Textbook: Triola, Mario F . *Elementary Statistics.* 13th ed. Boston Ma. : Pearson, Prentice Hall, 2018. Print.
- Resource materials provided by Pearson such as implementation and applications of statistics, differentiation and standardized test practice
- Resource from the Bureau of Labor Statistics
- Kahoot; interactive game: Wiggins and Murphy
- Desmos; advanced graphing calculator
- Google forms and Google slides with pear deck extension
- Microsoft excel and google sheets
- Supplies: White boards, straight edge, graph paper, colored pencils, graphing calculator

Subject/Course: Honors Statistics Unit: 3 The Relationship between Two Variables(linear regression)
Grade:11/12
Time frame: approx 5-6 weeks

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. CCSS.MATH.CONTENT.HSS.ID.B.6.C Fit a linear function for a scatter plot that suggests a linear	***Transfer*** ● Model real data using equations and graphs ● Analyze equations and their graphs in order to make predictions ● Make sense of problems and persevere in solving them	
	Meaning	
	UNDERSTANDINGS *Students will understand that…* ● Scatter plots serve determine if there is a useful relationship between two variables, ● Scatter plots determine the family of equations that describes the relationship. ● Data is collected for a purpose and has meaning in a context. ● Direction and strength of the	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? ● What is the meaning of the slope and

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.	association between two variables is significant ● 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.	y-intercept in the line of regression? ● What determines a regression equation is an appropriate model?
	Acquisition	

	Students will know…	*Students will be skilled at…*
	● 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 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. ● Residuals have a relation to the least squares linear equation?	● 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 statistics software output table. ● Using regression to predict a value of y for a given x. ● Computing the residual for each data value and displaying 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-values

STAGE 2

Code	Evaluative Criteria	Assessment Evidence
T, M, A M, A T, M,A T, M, A	Evaluative Criteria consists of ● An explanation of the two variables being examined ● Accurate calculations used to determine if a correlation exists ● Clear and thoughtful summation of the results of the calculations ● Final determination as to whether or not a correlation exists	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* ** continuation of performance task from unit 2 **Goal**: Have students research data for two related variables to determine if there is an existing correlation (one variable is from performance task in unit 2) **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 determination of the existence of a correlation between the two variables

	Evaluative criteria consists of:	OTHER EVIDENCE:
A M, A T, M, A T, M, A T, M, A	• Is appropriate data collected? • Are the correct calculations performed and are the solutions accurate? • Are the correct conclusions drawn about the existence of a correlation between the two variables? • Is there a clear understanding of the values calculated in the context of the data? • Do the residuals tell us anything about the data?	• Alternative assessment projects such as a examining correlations for sets of real data, defining the values calculated in the context of the real data, and looking at the residuals for real data. • Review of standardized test questions to prep students for the challenge of the SAT and ACT exams • Participation in class discussion, group work, and responses. • Quizzes • Unit Test - to include a variety of DOK level of problems and may include SAT style problems.

Stage 3 – Learning Plan

Code	***Pre-Assessment***	
M	• 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	• 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.	• Monitoring class work through board work, group work, questioning, and walk-arounds • Check for understanding via going over homework and mediums such as reflections and exit tickets • Class worksheets with direct teacher observation or self assessment • Practice on whiteboard/chalkboard with direct teacher observation • Kahoot quiz or pear deck slideshow with review questions and direct teacher observation • Reflective journals or exit tickets at the end of the lesson • Edulastic or google form review assignments • Homework assignments with direct teacher observation or self assessment

T, M, A	● Teacher will instruct students on residuals by using a scatter plot and having students record the residual for each point and explain the meaning of the residuals in the context of the problem. ● 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 ● Teacher and students will collectively practice finding residuals for a regression line ● 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. ● 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 ● 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) ● 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 a few points gives students a more visual experience.	● Projects/performance tasks modeling real world problems involving all aspects of transformations and symmetry ● Summative assessments Quizzes Unit test
T, M, A		
M, A		
T, M, A		
T, M, A		
T, M, A		
T, M, A		

T, M, A T, M	● 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) ● 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. **Suggested Resources and supplies** <u>Resources:</u> All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval. ● Textbook: Triola, Mario F . *Elementary Statistics.* 13th ed. Boston Ma. : Pearson, Prentice Hall, 2018. Print. ● Resource materials provided by Pearson such as implementation and applications of statistics, differentiation and standardized test practice ● Resource from the Bureau of Labor Statistics ● Kahoot; interactive game: Wiggins and Murphy ● Desmos; advanced graphing calculator ● Google forms and Google slides with pear deck extension ● Microsoft excel and google sheets ● Supplies: White boards, straight edge, graph paper, colored pencils, graphing calculator	

Subject/Course: Honors Statistics Unit: 4 Probability
Grade:11/12
Time frame: approx 4 - 5 weeks

ESTABLISHED GOALS	***Transfer***	
<u>CCSS.MATH.CONTENT.HSS.CP2</u> 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. <u>CCSS.MATH.CONTENT.HSS.CP.A.3</u> 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 the conditional probability of B given A is the same as the probability of B. <u>CCSS.MATH.CONTENT.HSS.CP.A4</u>	*Students will be able to independently use their learning to…* ● Work carefully to solve problems by looking for and using rules and patterns ● Verify that calculations are accurate and solutions are reasonable ● Use a simulation to determine the likelihood of an event occurring ● Analyze real data by using and/or creating probability models	
	Meaning	
	UNDERSTANDINGS *Students will understand that…* ● Probability describes the likelihood an event will occur. ● Outcomes which do not occur in event A are considered the compliment to event A. ● Mutually exclusive events are events that cannot occur simultaneously are mutually exclusive events.	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?

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 <u>CCSS.MATH.CONTENT.HSS.CP.B.6</u> Find the conditional probability of A given B as the fraction of B's	• 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. • Probability is a number between 0 and 1 inclusively • Combinations and permutations can be used in the calculation of a statistical probability	• 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 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	*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

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	• 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,	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

STAGE 2

Code	Evaluative Criteria	Assessment Evidence

T, M ,A	Evaluative criteria consists of: ● An explanation of how the game is played. ● An explanation of the method used to determine the probabilities ● Accurate calculations of the probabilities ● Clear and thoughtful summation of the results of the calculations ● Determination and explanation of the profitability of the game.	PERFORMANCE TASK(S): *Students will show that they really understand evidence of…* **Goal**: to create a game of chance for a carnival or boardwalk concession and determine the probabilities associated with the game. **Role**: Entrepreneur **Audience**: Carnival owner or manager of Boardwalk **Situation**: Design a game of chance that can be played at a carnival or on the Boardwalk. **Product or Performance:** completion of the game along with probabilities associated with the game which can be used to determine whether or not the game will be profitable. Students should 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. **Standards for Success**: Accurate results for the design of the game and its probabilities

	Evaluative criteria consists of:	OTHER EVIDENCE:
T, M, A	● Is the appropriate method and/or formula used?	● Alternative assessment projects such as posters, computer generated graphs and real world applications(i.e. gaming, business and sporting events)
T, M ,A	● Is the correct vocabulary used when explaining possible outcomes.	● Review of standardized test questions to prep students for the challenge of the SAT and ACT exams
M, A	● Are the correct calculations performed and are the solutions accurate?	● Participation in class discussion, group work, and responses.
T, M, A	● Are the correct conclusions drawn from the probabilities?	● Quizzes
T, M, A	● Is there a clear understanding of the values calculated in the context of the data?	● Unit Test - to include a variety of DOK level of problems and may include SAT style problems.

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 ● 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	● Teacher will introduce vocabulary and notation for basic probability	● Monitoring class work through board work, group work, questioning, and walk-arounds
M, A	● Teacher and students will collectively practice using the vocabulary and basic probability	● Check for understanding via going over homework and mediums such as reflections and exit tickets
T, M, A	● Students will complete practice problems to demonstrate their level of understanding of vocabulary and notation	● Class worksheets with direct teacher observation or self assessment
M, A	● Teacher will instruct students on the topic of odds and the difference between odds and probability	● Practice on whiteboard/chalkboard with direct teacher observation
M, A	● Teacher and students will collectively practice odds and probability	● Kahoot quiz or pear deck slideshow with review questions and direct teacher observation
T, M ,A	● Students will complete activity cards designed to review basic concepts and odds using manipulatives and real data	● Reflective journals or exit tickets at the end of the lesson
M, A	● Teacher will instruct students on the use of the addition and multiplication rules of probability and vocabulary associated with these topics	● Edulastic or google form review assignments ● Homework assignments with direct teacher observation or self assessment
M, A	● Teacher and students will collectively practice problems comparing the addition and multiplication rules	

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)	

Suggested Resources and supplies

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- Resource from the Bureau of Labor Statistics
- Kahoot; interactive game: Wiggins and Murphy
- Desmos; advanced graphing calculator
- Google forms and Google slides with pear deck extension
- Microsoft excel and google sheets
- Supplies: White boards, straight edge, graph paper, colored pencils, graphing calculator, manipulatives(i.e.: dice, spinners, coins cards)

Subject/Course: Honors Statistics Unit: 5 Normal distributions
Grade:11/12
Time frame: approx 2 - 3 weeks

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… ● Support ideas clearly and concisely using proper mathematical language/notation. ● Construct viable arguments involving mathematics and critique the reasoning of others. ● Work carefully to solve the problem and verify that calculations are accurate and solutions are reasonable. ● Make sense of problems and persevere in solving them	
	Meaning	
	UNDERSTANDINGS *Students will understand that…* ● Mean and standard deviation define the family of curves used in normal distributions. ● Areas under the curve represent probabilities associated with continuous distributions. ● Area under the curve is always to the left of the corresponding z-score ● Total area under the normal curve is 1. ● Outcomes of many real life events can	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?

	be approximated by the normal curve ● Probability for groups can be found by applying the Central Limit Theorem	● Why is an understanding of the normal curve essential to statistics? ● In what situations can the normal curve be applied to data? ● 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

Code	Evaluative Criteria	Assessment Evidence
T, M, A	Evaluative Criteria consists of: ● Accurate use of mathematical concepts ● Identification of the appropriate formula for the application ● Accurate calculations using either the z-score and chart method or the normal functions on the graphing calculator ● Complete explanation of final results	PERFORMANCE TASK(S): **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
T, M, A T, M, A M, A T, M, A	Evaluative criteria consists of: ● Is the correct information identified to be used to solve the problem? ● Is the correct method chosen to solve the problem? ● Is the solution the result of accurate substitution and calculation ● Are the answers to a real world problem reasonable and clearly communicated?	OTHER EVIDENCE: ● Alternative assessment projects including a variety of applications involving normal probabilities ● Review of standardized test questions to prep students for the challenge of the SAT and ACT exams ● Participation in class discussion, group work, and responses. ● Quizzes ● Unit Test - to include a variety of DOK level of problems and may include SAT style problems.

Code	***Pre-Assessment***	
M	• 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 probability 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	• Monitoring class work through board work, group work, questioning, and walk-arounds
A	• Teacher will demonstrate how to use the z-score chart to find values for specific probabilities	• Check for understanding via going over homework and mediums such as reflections and exit tickets
M, A	• Teacher and students will collectively practice using the z score chart to find probabilities	
M, A	• Students will practice finding z-scores and probabilities using the z-score chart and complete applications problems	• Class worksheets with direct teacher observation or self assessment
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/chalkboard with direct teacher observation
M, A	• Teacher and students will collectively practice applications using both methods	• Kahoot quiz or pear deck slideshow with review questions and direct teacher observation
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	• Reflective journals or exit tickets at the end of the lesson
T, M, A	• Students will analyze data related to application problems to determine the appropriate method for finding a solution	• Edulastic or google form review assignments
T, M, A	• Teacher will introduce the Central Limit Theorem and provide examples of real applications(i.e. weight limits, manufacturing specifications)	• Homework assignments with direct teacher observation or self assessment • Projects/performance tasks modeling real

M,A T, M T, M	● Teacher and students will collectively practice using the central limit theorem in calculating probabilities ● Students will research uses for the Central Limit Theorem, complete appropriate calculations and provide interpretations of the results ● Students will explore Normal Distributions using the unit's performance task and complete an activity based review in preparation for a unit assessment. . **Suggested Resources and supplies** <u>Resources:</u> All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval. ● Textbook: Triola, Mario F . *Elementary Statistics.* 13th ed. Boston Ma. : Pearson, Prentice Hall, 2018. Print. ● Resource materials provided by Pearson such as implementation and applications of statistics, differentiation and standardized test practice ● Resource from the Bureau of Labor Statistics ● Kahoot; interactive game: Wiggins and Murphy ● Desmos; advanced graphing calculator ● Google forms and Google slides with pear deck extension ● Microsoft excel and google sheets	world problems involving all aspects of area, surface area and volume ● Summative assessments Quizzes Unit test

	● Supplies: White boards, straight edge, graph paper, colored pencils, graphing calculator, z-score tables	

Subject/Course: Honors Statistics Unit: 6 Probability distributions (geometric and binomial)
Grade:11/12
Time frame: approx 5-6 weeks

<table>
<tr><td rowspan="4">ESTABLISHED GOALS

<u>CCSS.MATH.CONTENT.HSS.MD.A.1</u>
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.
<u>CCSS.MATH.CONTENT.HSS.MD.A.2</u>
Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
<u>CCSS.MATH.CONTENT.HSS.MD.A.3</u>
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</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Support ideas clearly and concisely using proper mathematical language/notation.
● Construct viable arguments involving mathematics and critique the reasoning of others.
● Work carefully to solve the problem and verify that calculations are accurate and solutions are reasonable.
● Make sense of problems and persevere in solving them</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

● Random Variables are used to create a probability distribution.
● Binomial and geometric probability distributions can be developed to model a real-world context.
● Mean and standard deviations for probability distributions can be calculated.
● Binomial distributions can be used to calculate probabilities associated with</td><td>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?</td></tr>
</table>

theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes. 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?	experiments for which there are only two possible outcomes. ● Expected values are used to simulate real world probabilities. ● Unusual values can be identified.	● How can expected values be used to predict real world probabilities
	Acquisition	
	Students will know… ● Random variables have values that are determined by chance. ● Probability distributions consist of all values of a random variable, along with their respective probabilities. ● Probability distributions must satisfy two requirements: the sum of the probabilities equals 1 and each probability is between and including 0 and 1. ● Probability histogram construction techniques. ● 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. ● Usual outcomes can be distinguished from those considered to be unusual. ● Mean, variance, and standard deviation of a random variable can be calculated ● Notation for population parameters.	*Students will be skilled at…* ● Recognizing the difference between discrete and continuous random variables. ● Calculating probabilities for random variables and displaying 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

	● Mean and standard deviation must be recalculated after adding a constant or multiplying by a constant. ● Expected value and standard deviation of a random variable must be given meaning in the proper context.	

STAGE 2

Code	Evaluative Criteria	Assessment Evidence

T, M, A	Evaluative Criteria consists of: ● Identification of the appropriate formulas needed to complete the probability calculations ● Accurate use of mathematical concepts ● Precise calculations ● Complete explanation of final results	PERFORMANCE TASK(S): **Goal**: To determine the odds and probabilities associated with players on a professional sporting team and the likelihood of a successful performance in their next game **Role**: Team statistician **Audience**: Team manager **Situation**: Students choose a professional sports team and use geometric and binomial probabilities to determine which players are most likely to have a successful performance in their next game. **Product or Performance**: A clear analysis of the probabilities for at least six players on the team and a conclusion on the success of their next outing. **Standards for Success:** Accurate calculations and reasonable conclusions based on the data

T, M, A T, M, A M, A T, M, A	Evaluative criteria consists of: ● Is the correct information identified to be used to solve the problem? ● Is the correct method chosen to solve the problem? ● Is the solution the result of accurate substitution and calculation ● Are the answers to a real world problem reasonable and clearly communicated?	OTHER EVIDENCE: ● Alternative assessment projects including a variety of applications involving geometric and binomial probabilities ● Review of standardized test questions to prep students for the challenge of the SAT and ACT exams ● Participation in class discussion, group work, and responses. ● Quizzes ● Unit Test - to include a variety of DOK level of problems and may include SAT style problems.

Code	***Pre-Assessment***	
M	● 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 ● Teacher will provide review and assessment on prerequisite probability 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	● Monitoring class work through board work, group work, questioning, and walk-arounds
A	● Teacher will demonstrate how to use the z-score chart to find values for specific probabilities	● Check for understanding via going over homework and mediums such as reflections and exit tickets
M, A	● Teacher and students will collectively practice using the z score chart to find probabilities	
M, A	● Students will practice finding z-scores and probabilities using the z-score chart and complete applications problems	● Class worksheets with direct teacher observation or self assessment
M, A	● Teacher will provide training on how to complete the application problems using the appropriate functions on the graphing calculator	● Practice on whiteboard/chalkboard with direct teacher observation
M, A	● Teacher and students will collectively practice applications using both methods	
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	● Kahoot quiz or pear deck slideshow with review questions and direct teacher observation ● Reflective journals or exit tickets at the end of the lesson
T, M, A	● Students will analyze data related to application problems to determine the appropriate method for finding a solution	● Edulastic or google form review assignments
M, A	● Teacher will introduce the Central Limit Theorem and provide examples of real applications(i.e. weight limits, manufacturing specifications)	● Homework assignments with direct teacher observation or self assessment
M, A	● Teacher and students will collectively practice using the central limit theorem in calculating probabilities	● Projects/performance tasks modeling real world problems involving all aspects of area,

T, M T, M	● 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. **Suggested Resources and supplies** <u>Resources:</u> All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval. ● Textbook: Triola, Mario F . *Elementary Statistics.* 13th ed. Boston Ma. : Pearson, Prentice Hall, 2018. Print. ● Resource materials provided by Pearson such as implementation and applications of statistics, differentiation and standardized test practice ● Resource from the Bureau of Labor Statistics ● Kahoot; interactive game: Wiggins and Murphy ● Desmos; advanced graphing calculator ● Google forms and Google slides with pear deck extension ● Microsoft excel and google sheets ● Supplies: White boards, straight edge, graph paper, colored pencils, graphing calculator, binomial tables, manipulatives (i.e.: basketball and 'hoop', centimeter cubes, candy)	surface area and volume ● Summative assessments Quizzes Unit test

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

<table>
<tr><td rowspan="4">ESTABLISHED GOALS

<u>CCSS.MATH.CONTENT.HSS.IC.A1</u>

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

<u>CCSS.MATH.CONTENT.HSS.IC.A2</u>
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?</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

● Support ideas clearly and concisely using proper mathematical language/notation.
● Construct viable arguments involving mathematics and critique the reasoning of others.
● Work carefully to solve the problem and verify that calculations are accurate and solutions are reasonable.
● Make sense of problems and persevere in solving them</td></tr>
<tr><td colspan="2">Meaning</td></tr>
<tr><td>UNDERSTANDINGS
Students will understand that…

● Estimation of the value of a parameter based on a statistic is a primary goal of sampling
● Confidence intervals use the sample statistic to construct an interval of values that one can be reasonably</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</td></tr>
</table>

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.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.	certain contains the true (unknown) parameter. ● Confidence intervals and tests of significance are complementary procedures. ● Paired comparisons experimental design allows control for possible effects of extraneous variables. ● Z- tests can be used in specific situations . ● Correlations exist between sets of data. ● Mean can be used to find a confidence interval when the standard deviation is known. ● Hypothesis tests determine the difference between the alternative hypothesis and null hypothesis ● Null hypothesis can be rejected in certain situations	from data and make inferences about populations? ● How can the language of statistics be used to communicate mathematical ideas coherently and precisely? ● 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.	*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

	● 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. ● 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	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 hypothesis about a population mean..

STAGE 2

Code	Evaluative Criteria	Assessment Evidence

T, M, A	Evaluative Criteria consists of: ● Accurate use of mathematical concepts ● Identification of the appropriate formula to solve the problem ● Precise calculations ● Complete explanation of final results	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 publicly published percentages disclosed by the company. 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

T, M, A M, A M, A T,M,A T, M,A	Evaluative criteria consists of: ● Are key pieces of information identified properly to be used in solving the problem? ● Is the correct calculation used to solve the problem? ● Is the solution the result of accurate substitution and calculation ● Is the interpretation of the solution clearly explained? ● Are the answers to a real world problem clearly communicated?	OTHER EVIDENCE: ● Alternative assessment projects such interpreting confidence intervals , identifying real world applications of confidence intervals and looking at real world problems involving the rejection of the null hypothesis ● Review of standardized test questions to prep students for the challenge of the SAT and ACT exams ● Participation in class discussion, group work, and responses. ● Quizzes ● Unit Test - to include a variety of DOK level of problems and may include SAT style problems.

Code	***Pre-Assessment***	
M	● 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 ● Monitoring class work through board work, group work, questioning, and walk-arounds
M, A	● Teacher will continue to emphasize the importance of vocabulary and notation, specifically related to confidence intervals and margins of error	● Check for understanding via going over homework and mediums such as reflections and exit tickets
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 with direct teacher observation or self assessment ● Practice on whiteboard/chalkboard with direct teacher observation
M, A	● Each of these topics can be taught individually or by having students work in small groups verifying results.	● Kahoot quiz or pear deck slideshow with review questions and 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.	● Reflective journals or exit tickets at the end of the lesson
M, A	● Teacher and students will collectively practice calculating confidence intervals and margin of error	● Edulastic or google form review assignments
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.	● Homework assignments with direct teacher observation or self assessment
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	● Projects/performance tasks modeling real world problems involving all aspects of area, surface area and volume

	check whether the confidence interval they created captured the true proportion. Hopefully not all of them will if our sample size is large enough.	● Summative assessments Quizzes Unit test
T, M, A	● Teacher will introduce hypothesis testing and how to identify the hypothesis, alternative and the null hypothesis for a given claim	
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.	
	Suggested Resources and supplies <u>Resources:</u> All Resources and materials must adhere to all New Milford Board of Education policies and regulations and are subject to New Milford Board of Education approval. Resources and materials must be researched and vetted by the writers and department heads prior to submission for approval.	

	● Textbook: Triola, Mario F . *Elementary Statistics.* 13th ed. Boston Ma. : Pearson, Prentice Hall, 2018. Print. ● Resource materials provided by Pearson such as implementation and applications of statistics, differentiation and standardized test practice ● Resource from the Bureau of Labor Statistics ● Kahoot; interactive game: Wiggins and Murphy ● Desmos; advanced graphing calculator ● Google forms and Google slides with pear deck extension ● Microsoft excel and google sheets ● Supplies: White boards, straight edge, graph paper, colored pencils, graphing calculator, z-table/t-table	