



Statewide Framework Document for: 279998

Standards may be added to this document prior to submission, but may not be removed from the framework to meet state credit equivalency requirements. Performance assessments may be developed at the local level. In order to earn state approval, performance assessments must be submitted within this framework. **This course is eligible for 1 credit of Statistics.** Washington Mathematics Standards ([Common Core State Standards](#)) support foundational mathematical knowledge and reasoning. While it is important to develop a conceptual understanding of mathematical topics and fluency in numeracy and procedural skills, teachers should also focus on the application of mathematics to career fields to support the [three \(3\) key shifts of CCSS](#). The [Standards for Mathematical Practice](#) develop mathematical habits of mind and are to be modeled and integrated throughout the course.

Business Statistics	
Course Title: Business Statistics	Total Framework Hours: 180
CIP Code: 279998 <input checked="" type="checkbox"/> Exploratory <input type="checkbox"/> Preparatory	Date Last Modified: May 4, 2015
Career Cluster: Business, Management, and Administration	Cluster Pathway: General Management
Eligible for Equivalent Credit in: <input checked="" type="checkbox"/> Math <input type="checkbox"/> Science	Total Number of Units: 15
Course Overview	
<p>Summary: This applied statistics course will give students the opportunity to explore many practical concepts in modern statistics. Students will learn how to analyze sales, purchasing, business systems and personal finance data using statistical methods and graphs. They will measure variability in data sets and account for statistical error. Students will also look at distribution patterns including binomial and geometric distributions.</p>	

Unit 1: Exploring Data	Total Learning Hours for Unit: 10
<p>Unit Summary: In this unit, competencies include:</p> <ul style="list-style-type: none"> • Use a variety of graphical techniques to display a distribution given quantitative or categorical variables: Dotplot, Histogram, Relative Frequency Histogram, Stemplot, Boxplot, Bar Chart, Ogive, Time Plot, and Pie Chart. • Interpret the graphical displays and distributions with respect to shape, outliers, center, and spread: “S.O.C.S.” • Use a variety of numerical techniques to summarize a set of univariate data: mean, median, quartiles, five-number summary, interquartile range, standard deviation, range, and variance. • Interpret numerical summaries and distributions of a set of data in the <i>context</i> of the situation. • Identify and calculate outliers in a set of data. • Explore the effects of linear transformations of a set of data. 	

- Compare distributions using graphical displays: back-to-back stemplots and side-by-side boxplots.
- Use technology to calculate numerical summaries.
- Use technology to display distributions.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Complete a graphical representation of the shoe size of math students.

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

The Guidelines for Assessment and Instruction in Statistics Education (GAISE):

I. Formulate Question

Students can make the statistics question distinction.
Questions seek generalization.

National Business Education Association (NBEA) Computation Standards:

Number Relationships and Operations

Achievement Standard: Solve problems involving whole numbers, decimals, fractions, percentages, ratios, averages, and proportions.

Patterns, Functions, and Algebra

Achievement Standard: Use algebraic operations to solve problems.

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Problem-Solving Applications

Achievement Standard: Use mathematical procedures to analyze and solve business problems.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Interpret functions that arise in applications in terms of the context.

F.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Cluster: Summarize, represent, and interpret data on a single count or measurement variable.

S.ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.A.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

S.ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

S.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.

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 11-12):

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Unit 2: Describing Location in a Distribution**Total Learning Hours for Unit: 10****Unit Summary:**

In this unit, competencies include:

- Compute measures of relative standing for individuals in a distribution using standardized values (z-scores) and percentile ranks.
- Demonstrate an understanding of a density curve with respect to its mean and median.
- Demonstrate an understanding of a normal distribution and the empirical (68 - 95 - 99.7) rule.
- Use both tables and technology to find the proportion of observations within an interval using a normal distribution.
- Use a variety of techniques to assess whether a normal model is appropriate, such as a histogram or a normal probability plot.
- Interpret standardized values in context to compare relative standing among a set of data.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Explore the 68-95-99.7 rule through a fine-grained distribution activity.

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies**The Guidelines for Assessment and Instruction in Statistics Education (GAISE):**

I. Formulate Question

Students can make the statistics question distinction.

III. Analyze Data

Understand and use distributions in analysis as a global concept.

Measure variability within a group; measure variability between groups.

Compare group to group using displays and measures of variability.

Quantification of association; fitting of models for association.

IV. Interpret Results

Students are able to look beyond the data in some contexts.

Interpret measures of strength of association.

Interpret models of association.

National Business Education Association (NBEA) Computation Standards:

Mathematical Foundations

Achievement Standard: Apply basic mathematical operations to solve problems.

Number Relationships and Operations

Achievement Standard: Solve problems involving whole numbers, decimals, fractions, percentages, ratios, averages, and proportions.

Patterns, Functions, and Algebra

Achievement Standard: Use algebraic operations to solve problems.

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Aligned Washington State Standards**Standards for Mathematical Practice (Common Core State Standards):**

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.
Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Create equations that describe numbers or relationships.

A.CED.A.1 Create equations and inequalities in one variable and use them to solve problems.

A.CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

A.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Cluster: Apply geometric concepts in modeling situations.

G.MG.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

G.MG.A.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

G.MG.A.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Cluster: Summarize, represent, and interpret data on a single count or measurement variable.

S.ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.A.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

S.ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

S.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.

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 11-12):

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Unit 3: Examining Relationships

Total Learning Hours for Unit: 10

Unit Summary:

In this unit, competencies include:

- Construct and interpret a scatterplot for a set of bivariate quantitative data.
- Use technology to compute and interpret the correlation coefficient between two variables.

- Know and understand the basic properties of the correlation coefficient.
- Identify the explanatory and response variables in context to a given situation.
- Describe direction, strength, and form of the overall pattern in a scatterplot.
- Use technology to calculate the least squares regression line.
- Explain and interpret the meaning of the slope and y -intercept of a regression line.
- Use statistics (mean and standard deviation) of both sets of data to calculate the least squares regression line.
- Use the regression line to interpolate and extrapolate given a specific value of x .
- Calculate and interpret the residuals of a regression line.
- Use the coefficient of determination, r^2 , to interpret the regression line.
- Recognize, identify, and explain influential observations and outliers in a scatterplot.
- Identify and explain lurking variables.
- Understand correlation does not imply causation.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Determine if there is a relationship between height and shoe size.
- Complete *The Case of the Missing M&Ms* activity (CCSS: Mathematical Modeling).

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

The Guidelines for Assessment and Instruction in Statistics Education (GAISE):

I. Formulate Question

Students can make the statistics question distinction.
Questions seek generalization.

III. Analyze Data

Understand and use distributions in analysis as a global concept.
Measure variability within a group; measure variability between groups.
Quantification of association; fitting of models for association.

IV. Interpret Results

Students are able to look beyond the data in some contexts.
Generalize from sample to population.
Interpret measures of strength of association.
Interpret models of association.

National Business Education Association (NBEA) Computation Standards:

Mathematical Foundations

Achievement Standard: Apply basic mathematical operations to solve problems.

Number Relationships and Operations

Achievement Standard: Solve problems involving whole numbers, decimals, fractions, percentages, ratios, averages, and proportions.

Patterns, Functions, and Algebra

Achievement Standard: Use algebraic operations to solve problems.

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Problem-Solving Applications

Achievement Standard: Use mathematical procedures to analyze and solve business problems.

Aligned Washington State Standards**Standards for Mathematical Practice (Common Core State Standards):**

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Interpret the structure of expressions.

A.SSE.A.1 Interpret expressions that represent a quantity in terms of its context.

1a Interpret part of an expression, such as terms, factors, and coefficients.

1b Interpret complicated expressions by viewing one or more of their parts as a single entity.

A.SSE.A.2 Use the structure of an expression to identify ways to rewrite it.

Cluster: Create equations that describe numbers or relationships.

A.CED.A.1 Create equations and inequalities in one variable and use them to solve problems.

A.CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

A.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Cluster: Represent and solve equations and inequalities graphically.

A.REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

A.REI.D.11 Explain why the x -coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations.

Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

A.REI.D.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Cluster: Understand the concept of a function and use function notation.

F.IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y = f(x)$.

F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

F.IF.A.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.

Cluster: Interpret functions that arise in applications in terms of the context.

F.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Cluster: Analyze functions using different representations.

F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

7a Graph linear and quadratic functions and show intercepts, maxima, and minima.

7b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

7c Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

7d Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

F.IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

8a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

8b Use the properties of exponents to interpret expressions for exponential functions.

F.IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Cluster: Build new functions from existing functions.

F.BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

F.BF.B.4 Find inverse functions.

4a Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse.

4b Verify by composition that one function is the inverse of another.

4c Read values of an inverse function from a graph or a table, given that the function has an inverse.

4d Produce an invertible function from a non-invertible function by restricting the domain.

F.BF.B.5 Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

Cluster: Interpret expressions for functions in terms of the situation they model.

F.LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.

Cluster: Summarize, represent, and interpret data on two categorical and quantitative variables.

S.ID.B.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

- S.ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
- 6a 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.
 - 6b Informally assess the fit of a function by plotting and analyzing residuals.
 - 6c Fit a linear function for a scatter plot that suggests a linear association.

Cluster: Interpret linear models.

- S.ID.C.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- S.ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.
- S.ID.C.9 Distinguish between correlation and causation.

Washington English Language Arts Standards (Common Core State Standards) – Science and Technology Literacy Standards (Grades 11-12):

- RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
- RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

Unit 4: More About Relationships Between Two Variables

Total Learning Hours for Unit: 10

Unit Summary:

In this unit, competencies include:

- Identify when a transformation is necessary to achieve linearity.
- Use the transformations involving powers and logarithms to linearize curved relationships.
- Use technology to achieve and assess linearity for curved relationships.
- Use a residual plot to determine if a linear model is appropriate.
- Use a two-way table to describe the relationship between two categorical variables.
- Calculate the marginal distribution and joint frequencies of a two-way table.
- Calculate conditional relative frequencies of a two-way table.
- Recognize possible lurking variables interfering with cause-and-effect relationships.
- Describe how confounding is an issue with determining cause-and-effect relationships.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Explore two variables (weight and length) with the activity *How to Weigh an Alligator*.

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

The Guidelines for Assessment and Instruction in Statistics Education (GAISE):

IV. Formulate Question

Students can make the statistics question distinction.

III. Analyze Data

Understand and use distributions in analysis as a global concept.

Measure variability within a group; measure variability between groups.

Compare group to group using displays and measures of variability.

Quantification of association; fitting of models for association.

IV. Interpret Results

Students are able to look beyond the data in some contexts.

Interpret measures of strength of association.

Interpret models of association.

National Business Education Association (NBEA) Computation Standards:

Mathematical Foundations

Achievement Standard: Apply basic mathematical operations to solve problems.

Number Relationships and Operations

Achievement Standard: Solve problems involving whole numbers, decimals, fractions, percentages, ratios, averages, and proportions.

Patterns, Functions, and Algebra

Achievement Standard: Use algebraic operations to solve problems.

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Problem-Solving Applications

Achievement Standard: Use mathematical procedures to analyze and solve business problems.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

N.RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.

N.RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Cluster: Reason quantitatively and use units to solve problems.

N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Interpret the structure of expressions.

A.SSE.A.1 Interpret expressions that represent a quantity in terms of its context.

1a Interpret part of an expression, such as terms, factors, and coefficients.

1b Interpret complicated expressions by viewing one or more of their parts as a single entity.

A.SSE.A.2 Use the structure of an expression to identify ways to rewrite it.

Cluster: Write expressions in equivalent forms to solve problems.

A.SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

3a Factor a quadratic expression to reveal the zeros of the function it defines.

3b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

3c Use the properties of exponents to transform expressions for exponential functions.

A.SSE.B.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems.

Cluster: Create equations that describe numbers or relationships.

A.CED.A.1 Create equations and inequalities in one variable and use them to solve problems.

A.CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

A.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Cluster: Represent and solve equations and inequalities graphically.

A.REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

A.REI.D.11 Explain why the x -coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

A.REI.D.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Cluster: Understand the concept of a function and use function notation.

F.IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y = f(x)$.

F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

F.IF.A.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.

Cluster: Interpret functions that arise in applications in terms of the context.

F.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the

rate of change from a graph.

Cluster: Analyze functions using different representations.

F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

7a Graph linear and quadratic functions and show intercepts, maxima, and minima.

7b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

7c Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

7d Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

F.IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

8a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

8b Use the properties of exponents to interpret expressions for exponential functions.

F.IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Cluster: Build new functions from existing functions.

F.BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

F.BF.B.4 Find inverse functions.

4a Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse.

4b Verify by composition that one function is the inverse of another.

4c Read values of an inverse function from a graph or a table, given that the function has an inverse.

4d Produce an invertible function from a non-invertible function by restricting the domain.

F.BF.B.5 Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

Cluster: Construct and compare linear, quadratic, and exponential models and solve problems.

F.LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.

1a Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.

1b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

1c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F.LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

F.LE.A.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.A.4 For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a , c , and d are numbers and the base b is 2, 10, or e ; evaluate the logarithm using technology.

Cluster: Interpret expressions for functions in terms of the situation they model.

F.LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.

Cluster: Summarize, represent, and interpret data on two categorical and quantitative variables.

S.ID.B.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

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

6a 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.

6b Informally assess the fit of a function by plotting and analyzing residuals.

6c Fit a linear function for a scatter plot that suggests a linear association.

Unit 5: Producing Data

Total Learning Hours for Unit: 10

Unit Summary:

In this unit, competencies include:

- Differentiate between observational studies, experiments, and surveys.
- Identify and perform different sampling methods: Simple Random Sample, Convenient Sample, Stratified Random Sample, Systematic Random Sample, and Cluster Sample.
- Identify and explain possible sources of *bias* within sampling and surveys.
- Identify and explain the three principles of experimental design: Randomization, Control, and Replication.
- Understand and explain the components of a completely randomized design and a randomized block design (matched pairs as well).
- Identify and explain the treatments, experimental units, control groups, and response variable of an experiment.
- Differentiate between the concept of control and a control group.
- Explain placebo and blinding within an experiment.
- Use a variety of techniques to randomly assign experimental units to groups for treatment: random digit table and technology.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Explore different ways of collecting data and types of bias with the *Rolling Down the River* activity.

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

The Guidelines for Assessment and Instruction in Statistics Education (GAISE):

I. Formulate Question

Students can make the statistics question distinction.

Students pose their own questions of interest.

Questions seek generalization.

II. Collect Data

- Students make design for differences.
- Sampling designs with random selection.
- Experimental designs with randomization.

IV. Interpret Results

- Aware of the effect of randomization on the results of experiments.
- Understand the difference between observational studies and experiments.

National Business Education Association (NBEA) Computation Standards:

Patterns, Functions, and Algebra

- Achievement Standard: Use algebraic operations to solve problems.

Measurements

- Achievement Standard: Use common international standards of measurement when solving problems.

Statistics and Probability

- Achievement Standard: Analyze and interpret data using common statistical procedures.

Problem-Solving Applications

- Achievement Standard: Use mathematical procedures to analyze and solve business problems.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

- Practice 1: Make sense of problems and persevere in solving them.
- Practice 2: Reason abstractly and quantitatively.
- Practice 3: Construct viable arguments and critique the reasoning of others.
- Practice 4: Model with mathematics.
- Practice 5: Use appropriate tools strategically.
- Practice 6: Attend to precision.
- Practice 7: Look for and make use of structure.
- Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

- Cluster: Reason quantitatively and use units to solve problems.
 - N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
 - N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
 - N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Cluster: Understand and evaluate random processes underlying statistical experiments.
 - S.IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
 - S.IC.A.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
- Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
 - S.IC.B.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
 - S.IC.B.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
 - S.IC.B.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
 - S.IC.B.6 Evaluate reports based on data.

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 11-12):

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Unit 6: Probability and Simulation: The Study of Randomness

Total Learning Hours for Unit: 10

Unit Summary:

In this unit, competencies include:

- Understand and perform a simulation of random phenomena using technology and a random digit table.
- Construct a simulation using the five components: state problem, state assumptions, assign digits, simulate many trials, and state conclusion in context.
- Understand the three types of probability: theoretical, empirical, and personal probability.
- Learn the law of large numbers.
- Learn how to use the multiplication counting principle, Venn diagrams, tree diagrams, and two-way tables to calculate probabilities.
- Differentiate between the general addition rule and the general multiplication rule for calculating probabilities.
- Determine and understand when events are disjoint, complementary, and independent.
- Determine when the assumption of independence is appropriate.
- Understand how to calculate conditional probabilities for not independent events.
- Understand how to calculate probabilities for not disjoint events.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will complete the following activities:

- *Aardvark*—a sample simulation
- Edgar Martinez Simulation

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

The Guidelines for Assessment and Instruction in Statistics Education (GAISE):

IV. Interpret Results

Students are able to look beyond the data in some contexts.

National Business Education Association (NBEA) Computation Standards:

Mathematical Foundations

Achievement Standard: Apply basic mathematical operations to solve problems.

Patterns, Functions, and Algebra

Achievement Standard: Use algebraic operations to solve problems.

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Understand and evaluate random processes underlying statistical experiments.

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

S.IC.A.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.

Cluster: Understand independence and conditional probability and use them to interpret data.

S.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).

S.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.

S.CP.A.3 Understand the conditional probability of A given B as $P(A \text{ and } B)/P(B)$, and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A , and the conditional probability of B given A is the same as the probability of B .

S.CP.A.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.

S.CP.A.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.

Cluster: Use the rules of probability to compute probabilities of compound events in a uniform probability model.

S.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.

S.CP.B.7 Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, and interpret the answer in terms of the model.

S.CP.B.8 Apply the general Multiplication Rule in a uniform probability model, $P(A \text{ and } B) = P(A)P(B|A) = P(B)P(A|B)$, and interpret the answer in terms of the model.

S.CP.B.9 Use permutations and combinations to compute probabilities of compound events and solve problems.

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 11-12):

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Unit 7: Random Variables

Total Learning Hours for Unit: 10

Unit Summary:

In this unit, competencies include:

- Recognize and define discrete random variables.
- Construct a probability distribution table and histogram for a discrete random variable.
- Determine probabilities for discrete and continuous random variables.
- Use a normal model to determine probabilities for a continuous random variable.
- Calculate the mean, standard deviation, and variance of a discrete random variable.
- Calculate the expected value of a discrete random variable.
- Use simulation methods and the law of large numbers to approximate the mean of a discrete random variable.
- Use rules to calculate the sums and differences of discrete random variables.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Explore the probability of games using the *Casino Lab: Craps Expected Value* (CCSS: *Mathematical Modeling*) activity.

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

The Guidelines for Assessment and Instruction in Statistics Education (GAISE):

II. Collect Data

Sampling designs with random selection.

III. Analyze Data

Understand and use distributions in analysis as a global concept.

Measure variability within a group; measure variability between groups.

IV. Interpret Results

Students are able to look beyond the data in some contexts.

National Business Education Association (NBEA) Computation Standards:

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Calculate expected values and use them to solve problems.

S.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.

S.MD.A.2 Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.

S.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.

S.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.

Cluster: Use probability to evaluate outcomes of decisions.

S.MD.B.5 Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.

5a Find the expected payoff for a game of chance.

5b Evaluate and compare strategies on the basis of expected values.

S.MD.B.6 Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).

S.MD.B.7 Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

Unit 8: The Binomial and Geometric Distributions**Total Learning Hours for Unit: 10****Unit Summary:**

In this unit, competencies include:

- Recognize and identify a random variable as binomial or geometric.
- Use the binomial formula to determine probabilities of a binomial random variable.
- Use technology to calculate probabilities of a binomial and geometric random variable.
- Construct histograms of the distribution of a binomial and geometric random variable.
- Calculate cumulative distributions of a binomial random variable.
- Calculate the mean and standard deviation of a binomial and geometric random variable.
- Use a normal model to approximate the probabilities of a binomial random variable.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Investigate binomial distributions in a song using Twelve Days of Christmas.

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies**The Guidelines for Assessment and Instruction in Statistics Education (GAISE):**

III. Analyze Data

Understand and use distributions in analysis as a global concept.
Quantification of association; fitting of models for association.

IV. Interpret Results

Aware of the effect of randomization on the results of experiments.

National Business Education Association (NBEA) Computation Standards:

Mathematical Foundations

Achievement Standard: Apply basic mathematical operations to solve problems.

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Problem-Solving Applications

Achievement Standard: Use mathematical procedures to analyze and solve business problems.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

- Practice 1: Make sense of problems and persevere in solving them.
- Practice 2: Reason abstractly and quantitatively.
- Practice 3: Construct viable arguments and critique the reasoning of others.
- Practice 4: Model with mathematics.
- Practice 5: Use appropriate tools strategically.
- Practice 6: Attend to precision.
- Practice 7: Look for and make use of structure.
- Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

- Cluster: Reason quantitatively and use units to solve problems.
 - N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
 - N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
 - N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Cluster: Interpret the structure of expressions.
 - A.SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
 - 1a Interpret part of an expression, such as terms, factors, and coefficients.
 - 1b Interpret complicated expressions by viewing one or more of their parts as a single entity.
 - A.SSE.A.2 Use the structure of an expression to identify ways to rewrite it.
- Cluster: Use polynomial identities to solve problems.
 - A.APR.C.4 Prove polynomial identities and use them to describe numerical relationships.
 - A.APR.C.5 Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n , where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.
- Cluster: Create equations that describe numbers or relationships.
 - A.CED.A.1 Create equations and inequalities in one variable and use them to solve problems.
 - A.CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
 - A.CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
 - A.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
- Cluster: Analyze functions using different representations.
 - F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
 - 7a Graph linear and quadratic functions and show intercepts, maxima, and minima.
 - 7b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
 - 7c Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
 - 7d Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
 - 7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

<p>F.IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.</p> <p>8a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.</p> <p>8b Use the properties of exponents to interpret expressions for exponential functions.</p> <p>F.IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).</p> <p>Cluster: Build a function that models a relationship between two quantities.</p> <p>F.BF.A.1 Write a function that describes a relationship between two quantities.</p> <p>1a Determine an explicit expression, a recursive process, or steps for calculation from a context.</p> <p>1b Combine standard function types using arithmetic operations.</p> <p>1c Compose functions.</p> <p>F.BF.A.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.</p> <p>Cluster: Interpret expressions for functions in terms of the situation they model.</p> <p>F.LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.</p>

Unit 9: Sampling Distributions	Total Learning Hours for Unit: 10
<p>Unit Summary: In this unit, competencies include:</p> <ul style="list-style-type: none"> • Identify parameters and statistics in a sample or experiment. • Understand how sampling variability affects the differences from sample to sample. • Describe bias and variability of a statistic in terms of the mean and spread of its sampling distribution. • Understand how sample size affects the variability of a sampling distribution. • Recognize when to use sample proportions. • Calculate the mean and standard deviation of the sampling distribution of a sample proportion. • Understand how sample size affects variability of the sampling distribution of a sample proportion. • Understand when a normal model is appropriate to approximate the probabilities of distribution for a sample proportion. • Calculate the mean and standard deviation of the sampling distribution of a sample mean. • Understand when a normal model is appropriate to calculate probabilities for the sampling distribution of a sample mean. • Understand the central limit theorem. 	
<p>Performance Assessments: <i>Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.</i></p> <p><i>It is expected that students will:</i></p> <ul style="list-style-type: none"> • Explore a serial number sample using the <i>German Tanks</i> activity. 	
<p>Leadership Alignment:</p> <ul style="list-style-type: none"> • Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. • The event, activity, or project and the associated 21st Century Skill should be clearly articulated. Example: Students will demonstrate the ability to communicate clearly through their group project presentation. 	

Industry Standards and Competencies

The Guidelines for Assessment and Instruction in Statistics Education (GAISE):

I. Formulate Question

Students can make the statistics question distinction.

Questions seek generalization.

II. Collect Data

Sampling designs with random selection.

III. Analyze Data

Understand and use distributions in analysis as a global concept.

Measure variability within a group; measure variability between groups.

Quantification of association; fitting of models for association.

IV. Interpret Results

Generalize from sample to population.

National Business Education Association (NBEA) Computation Standards:

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Summarize, represent, and interpret data on a single count or measurement variable.

S.ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

S.ID.A.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

S.ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

S.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.

Unit 10: Estimating with Confidence**Total Learning Hours for Unit: 10****Unit Summary:**

In this unit, competencies include:

- Construct and interpret a confidence interval for a population mean and a population proportion.
- Describe the margin of error for a confidence interval for a population mean and a population proportion.
- Calculate the sample size needed to construct a confidence interval for a specific margin of error.
- Understand how to use the t -distribution for constructing a confidence interval for a population mean.
- Identify the conditions that must be present in order to calculate a confidence interval for a population mean and population proportion.
- Explain and interpret the standard error of a sample mean and a sample proportion.
- Interpret a confidence interval in context.
- Understand how sample size changes our conditions for interpreting and calculating a confidence interval for a population mean.
- Use one-sample confidence interval procedures to calculate the confidence interval for matched pairs data.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will complete the following activities:

- MLB sampling C.I.
- Movie sampling C.I. (CCSS: *Mathematical Modeling*).

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies**The Guidelines for Assessment and Instruction in Statistics Education (GAISE):****I. Formulate Question**

- Students can make the statistics question distinction.
- Students pose their own questions of interest.
- Questions seek generalization.

III. Analyze Data

- Understand and use distributions in analysis as a global concept.
- Measure variability within a group; measure variability between groups.
- Describe and quantify sampling error.

IV. Interpret Results

- Generalize from sample to population.
- Aware of the effect of randomization on the results of experiments.

National Business Education Association (NBEA) Computation Standards:

Mathematical Foundations

Achievement Standard: Apply basic mathematical operations to solve problems.

Number Relationships and Operations

Achievement Standard: Solve problems involving whole numbers, decimals, fractions, percentages, ratios, averages, and proportions.

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Problem-Solving Applications

Achievement Standard: Use mathematical procedures to analyze and solve business problems.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

S.IC.B.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

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

S.IC.B.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

S.IC.B.6 Evaluate reports based on data.

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 11-12):

RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Unit 11: Testing a Claim

Total Learning Hours for Unit: 10

Unit Summary:

In this unit, competencies include:

- Explain, interpret, and understand the logic of significance testing.
- Differentiate between the null hypothesis and the alternative hypothesis.
- Discuss and understand the meaning of statistically significant results.
- Construct and interpret a hypothesis test for a population mean.
- Compare a two-sided test of significance to a confidence interval for inference.
- Differentiate between statistical significance and practical significance.
- Explain and interpret the two types of errors in hypothesis testing.
- Define and discuss the power of a test.
- Understand and interpret a p -value.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Complete the *Red or Black Card* guessing (CCSS: *Mathematical Modeling*) activity.

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

The Guidelines for Assessment and Instruction in Statistics Education (GAISE):

I. Formulate Question

- Students can make the statistics question distinction.
- Students pose their own questions of interest.
- Questions seek generalization.

III. Analyze Data

Understand and use distributions in analysis as a global concept.
Measure variability within a group; measure variability between groups.

IV. Interpret Results

Generalize from sample to population.
Aware of the effect of randomization on the results of experiments.

National Business Education Association (NBEA) Computation Standards:

Mathematical Foundations

Achievement Standard: Apply basic mathematical operations to solve problems.

Number Relationships and Operations

Achievement Standard: Solve problems involving whole numbers, decimals, fractions, percentages, ratios, averages, and proportions.

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Problem-Solving Applications

Achievement Standard: Use mathematical procedures to analyze and solve business problems.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

- Practice 1: Make sense of problems and persevere in solving them.
- Practice 2: Reason abstractly and quantitatively.
- Practice 3: Construct viable arguments and critique the reasoning of others.
- Practice 4: Model with mathematics.
- Practice 5: Use appropriate tools strategically.
- Practice 6: Attend to precision.
- Practice 7: Look for and make use of structure.
- Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

- Cluster: Reason quantitatively and use units to solve problems.
 - N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
 - N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
 - N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 11-12):

- RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
- RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Unit 12: Significance Tests in Practice**Total Learning Hours for Unit: 10****Unit Summary:**

In this unit, competencies include:

- Construct and interpret a one-sample t -test.
- Construct and interpret a one-sample t -test for matched pairs data.
- Construct and interpret a one-proportion z -test.
- Differentiate between the one-sample confidence interval for a population proportion and a one-sample significance test for a population proportion.
- Understand and state the assumptions and conditions that verify the appropriateness of a one-sample t -test and a one-proportion z -test.
- Recognize the importance of the design of the study, outliers, and skewness of a distribution with respect to a t -test.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Use a hypothesis to state confidence by completing the *Is One Side of a Coin Heavier* activity.

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies**The Guidelines for Assessment and Instruction in Statistics Education (GAISE):****I. Formulate Question**

- Students can make the statistics question distinction.
- Students pose their own questions of interest.
- Questions seek generalization.

III. Analyze Data

- Understand and use distributions in analysis as a global concept.
- Measure variability within a group; measure variability between groups.

IV. Interpret Results

- Generalize from sample to population.
- Aware of the effect of randomization on the results of experiments.

National Business Education Association (NBEA) Computation Standards:**Mathematical Foundations**

- Achievement Standard: Apply basic mathematical operations to solve problems.

Number Relationships and Operations

- Achievement Standard: Solve problems involving whole numbers, decimals, fractions, percentages, ratios, averages, and proportions.

Statistics and Probability

- Achievement Standard: Analyze and interpret data using common statistical procedures.

Problem-Solving Applications

Achievement Standard: Use mathematical procedures to analyze and solve business problems.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

- Practice 1: Make sense of problems and persevere in solving them.
- Practice 2: Reason abstractly and quantitatively.
- Practice 3: Construct viable arguments and critique the reasoning of others.
- Practice 4: Model with mathematics.
- Practice 5: Use appropriate tools strategically.
- Practice 6: Attend to precision.
- Practice 7: Look for and make use of structure.
- Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

- Cluster: Reason quantitatively and use units to solve problems.
 - N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
 - N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
 - N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Cluster: Summarize, represent, and interpret data on a single count or measurement variable.
 - S.ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).
 - S.ID.A.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
 - S.ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
 - S.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.
- Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
 - S.IC.B.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
 - S.IC.B.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
 - S.IC.B.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
 - S.IC.B.6 Evaluate reports based on data.

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 11-12):

- RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
- RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Unit 13: Comparing Two Population Parameters**Total Learning Hours for Unit: 10****Unit Summary:**

In this unit, competencies include:

- Construct and interpret a two-sample t -test for a significance test for the difference between population means.
- Construct and interpret a two-sample t -interval for the difference between population means.
- Construct and interpret a two-proportion z -test for a significance test for the difference between population proportions.
- Construct and interpret a two-proportion z -interval for the difference between population proportions.
- Understand the interpretation of a two-sample t -interval and two-proportion z -interval approximate the magnitude of the difference between the parameters.
- Use technology to calculate the two-sample t -tests and t -intervals.
- Use technology to calculate the two-proportion z -tests and z -intervals.
- Verify the conditions are met to perform the two-sample t -tests and t -intervals as well as the two-proportion z -tests and z -intervals.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Compare two populations by completing the *Paper Airplane Build-Off* activity.

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies**The Guidelines for Assessment and Instruction in Statistics Education (GAISE):****I. Formulate Question**

- Students can make the statistics question distinction.
- Students pose their own questions of interest.
- Questions seek generalization.

II. Collect Data

- Students make design for differences.

III. Analyze Data

- Understand and use distributions in analysis as a global concept.
- Measure variability within a group; measure variability between groups.
- Compare group to group using displays and measures of variability.

IV. Interpret Results

- Generalize from sample to population.
- Aware of the effect of randomization on the results of experiments.

National Business Education Association (NBEA) Computation Standards:

Mathematical Foundations

Achievement Standard: Apply basic mathematical operations to solve problems.

Number Relationships and Operations

Achievement Standard: Solve problems involving whole numbers, decimals, fractions, percentages, ratios, averages, and proportions.

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Problem-Solving Applications

Achievement Standard: Use mathematical procedures to analyze and solve business problems.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies

S.IC.B.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

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

S.IC.B.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

S.IC.B.6 Evaluate reports based on data.

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 11-12):

RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Unit Summary:

In this unit, competencies include:

- Explain when a chi-square test is for goodness of fit, a test of independence, or a test of homogeneity.
- Construct and interpret a chi-square test of goodness of fit.
- Construct and interpret a chi-square test of independence.
- Construct and interpret a chi-square test of homogeneity.
- Use technology to calculate a chi-square test.
- Verify the conditions are met to perform a chi-square test.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Investigate the color distribution of samples of M&Ms compared with the advertised distribution using the *Chi-Square M&Ms* activity.

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies**The Guidelines for Assessment and Instruction in Statistics Education (GAISE):****I. Formulate Question**

Students can make the statistics question distinction.

Questions seek generalization.

II. Collect Data

Students make design for differences.

III. Analyze Data

Understand and use distributions in analysis as a global concept.

Measure variability within a group; measure variability between groups.

Compare group to group using displays and measures of variability.

Quantification of association; fitting of models for association.

IV. Interpret Results

Students are able to look beyond the data in some contexts.

Generalize from sample to population.

Aware of the effect of randomization on the results of experiments.

Understand the difference between observational studies and experiments.

Interpret measures of strength of association.

Interpret models of association.

Distinguish between conclusions from association studies and experiments.

National Business Education Association (NBEA) Computation Standards:

Mathematical Foundations

Achievement Standard: Apply basic mathematical operations to solve problems.

Number Relationships and Operations

Achievement Standard: Solve problems involving whole numbers, decimals, fractions, percentages, ratios, averages, and proportions.

Statistics and Probability

Achievement Standard: Analyze and interpret data using common statistical procedures.

Problem-Solving Applications

Achievement Standard: Use mathematical procedures to analyze and solve business problems.

Aligned Washington State Standards**Standards for Mathematical Practice (Common Core State Standards):**

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Summarize, represent, and interpret data on two categorical and quantitative variables.

S.ID.B.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

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

6a 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.

6b Informally assess the fit of a function by plotting and analyzing residuals.

6c Fit a linear function for a scatter plot that suggests a linear association.

Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

S.IC.B.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

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

S.IC.B.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

S.IC.B.6 Evaluate reports based on data.

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 11-12):

RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Unit 15: Inference for Regression

Total Learning Hours for Unit: 10

Unit Summary:

In this unit, competencies include:

- Construct and interpret a test of the hypothesis that the slope of the regression line is 0 in the population.
- Use technology to construct a *t*-test for slope of the regression line.
- Verify the conditions and assumptions are met in order to construct a *t*-test for slope of the regression line.
- Explain and interpret the meaning of the standard error about the least-squares regression line.

Performance Assessments:

Performance assessments may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

It is expected that students will:

- Complete a case study: Three pointers in college basketball—inference vs. regression.

Leadership Alignment:

- Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

The Guidelines for Assessment and Instruction in Statistics Education (GAISE):

I. Formulate Question

- Students can make the statistics question distinction.
- Students pose their own questions of interest.
- Questions seek generalization.

III. Analyze Data

- Understand and use distributions in analysis as a global concept.
- Measure variability within a group; measure variability between groups.
- Quantification of association; fitting of models for association.

IV. Interpret Results

- Students are able to look beyond the data in some contexts.
- Generalize from sample to population.
- Aware of the effect of randomization on the results of experiments.
- Interpret measures of strength of association.
- Interpret models of association.
- Distinguish between conclusions from association studies and experiments.

National Business Education Association (NBEA) Computation Standards:

Mathematical Foundations

- Achievement Standard: Apply basic mathematical operations to solve problems.

Number Relationships and Operations

- Achievement Standard: Solve problems involving whole numbers, decimals, fractions, percentages, ratios, averages, and proportions.

Statistics and Probability

- Achievement Standard: Analyze and interpret data using common statistical procedures.

Problem-Solving Applications

- Achievement Standard: Use mathematical procedures to analyze and solve business problems.

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

- Practice 1: Make sense of problems and persevere in solving them.
- Practice 2: Reason abstractly and quantitatively.
- Practice 3: Construct viable arguments and critique the reasoning of others.
- Practice 4: Model with mathematics.
- Practice 5: Use appropriate tools strategically.
- Practice 6: Attend to precision.
- Practice 7: Look for and make use of structure.
- Practice 8: Look for and express regularity in repeated reasoning.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Extend the properties of exponents to rational exponents.

- N.RN.A.1 Explain how the definition of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
- N.RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Cluster: Create equations that describe numbers or relationships.

- A.CED.A.1 Create equations and inequalities in one variable and use them to solve problems.
- A.CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- A.CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
- A.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Cluster: Interpret functions that arise in applications in terms of the context.

- F.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
- F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the

rate of change from a graph.

Cluster: Build new functions from existing functions.

F.BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

F.BF.B.4 Find inverse functions.

4a Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse.

4b Verify by composition that one function is the inverse of another.

4c Read values of an inverse function from a graph or a table, given that the function has an inverse.

4d Produce an invertible function from a non-invertible function by restricting the domain.

F.BF.B.5 Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

Cluster: Construct and compare linear, quadratic, and exponential models and solve problems.

F.LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.

1a Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.

1b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

1c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F.LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

F.LE.A.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

F.LE.A.4 For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a , c , and d are numbers and the base b is 2, 10, or e ; evaluate the logarithm using technology.

Cluster: Summarize, represent, and interpret data on two categorical and quantitative variables.

S.ID.B.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

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

6a 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.

6b Informally assess the fit of a function by plotting and analyzing residuals.

6c Fit a linear function for a scatter plot that suggests a linear association.

Cluster: Interpret linear models

S.ID.C.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

S.ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.

S.ID.C.9 Distinguish between correlation and causation.

Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

S.IC.B.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

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

S.IC.B.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

S.IC.B.6 Evaluate reports based on data.

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 11-12):

RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

21st Century Skills

Students will demonstrate in this course:

LEARNING & INNOVATION

Creativity and Innovation

- Think Creatively
- Work Creatively with Others
- Implement Innovations

Critical Thinking and Problem Solving

- Reason Effectively
- Use Systems Thinking
- Make Judgments and Decisions
- Solve Problems

Communication and Collaboration

- Communicate Clearly
- Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS

Information Literacy

- Access and Evaluate Information
- Use and Manage Information

Media Literacy

- Analyze Media
- Create Media Products

Information, Communications and Technology (ICT Literacy)

- Apply Technology Effectively

LIFE & CAREER SKILLS

Flexibility and Adaptability

- Adapt to Change
- Be Flexible

Initiative and Self-Direction

- Manage Goals and Time
- Work Independently
- Be Self-Directed Learners

Social and Cross-Cultural

- Interact Effectively with Others
- Work Effectively in Diverse Teams

Productivity and Accountability

- Manage Projects
- Produce Results

Leadership and Responsibility

- Guide and Lead Others
- Be Responsible to Others