
# Algebra I
# Content Standards
# 2022

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| Course Title: | Algebra I |
| Course/Unit Credit: | 1 |
| Course Number: | 430000 |
| Teacher Licensure: | Please refer to the Course Code Management System (https://adedata.arkansas.gov/ccms/) for the most current licensure codes. |
| Grades: | 9-12 |

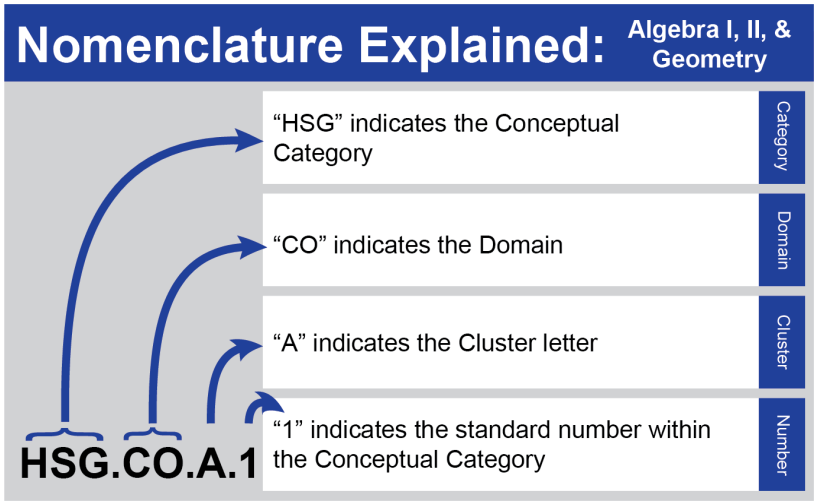
**Course Description:** The fundamental purpose of this course is to formalize and extend the mathematics that students learned in the middle grades. Students explore more complex algebraic situations and deepen and extend understanding of linear and exponential relationships by contrasting them with each other and by applying linear models to data that exhibit a linear trend. Students engage in methods for analyzing, solving, and using quadartic functions.

## Introduction to the Algebra I, Algebra II, and Geometry Arkansas Mathematics Standards

When the Division of Elementary and Secondary Education (DESE) began the process of revising math standards, a diverse group of qualified educators from across the state came together to craft Arkansas standards specific to the schools and students in the state. The result of this work, the Arkansas Mathematics Standards, is contained in this document. These standards reflect what educators across the state know to be best for Arkansas students.

**Standards Organization:** The revision committee maintained the organizational structure and nomenclature of the previous standards. Algebra I, Algebra II, and Geometry Arkansas Mathematics Standards are categorized into conceptual categories, domains, clusters, and standards.

- **Conceptual categories** represent the big picture across the high school grades.
- **Domains** represent the big ideas to be studied in each course. These big ideas support educators in determining the proper amount of focus and instructional time to be given to each of these topics.
- **Clusters** represent collections of standards grouped to help educators understand the building blocks of rich and meaningful instructional units. These units help students make connections within clusters and avoid seeing mathematics as a discrete list of skills they must master.
- **Standards** represent the foundational building blocks of math instruction. The standards outlined in this document work together to ensure that students are college and career ready and on track for success.




**Standards Support:** The revision of the Arkansas Mathematics Standards represent the work of the committee to provide greater clarity, strength, and support of the standards. Additionally, the revised mathematics standards are designed to help educators better understand the areas of emphasis and the focus within the standards. Educators should address the bulleted content as more than a checklist of items that they must teach individually. Content is bulleted to provide specificity of learning expectations included within some extensive standards. In some instances, the standard document includes Arkansas examples, teacher notes, specifications, and italicized words to assist educators with planning, teaching, and student learning.

- **Examples** included in the original standards were either changed for clarity or separated from the body of the actual standard. The examples included in the body of the standards document in no way reflect all of the possible examples. Likewise, these examples do not mandate curriculum or problem types. Local districts are free to select the high-quality curricula and instructional methods that best meet the needs of their students.
- **Teacher notes** offer clarification of the standards. These notes are intended to clarify, for teachers, what the expectations are for the learner. Likewise, these notes provide instructional guidance and limitations so that educators can better understand the scope of the standard. This will help with determining what is developmentally appropriate for students when working with specific standards.
- **Standard specifications** are to strengthen standards. The specifications are precise statements highlighting the need for mastery or function-type parameters for specific standards. This will assist educators in pinpointing the best opportunities for students to gain and master the knowledge and skills needed to succeed in a progression.
- **Asterisks (*)** are denoted to represent the modeling component of the standards. These standards should be presented in a modeling context which allows students to engage in the modeling process that is outlined in the Standards for Mathematical Process. (See Appendix A)
- **Italicized words** are defined in the glossary.

Finally, the Arkansas Mathematics Standards will be a living document. As these standards are implemented across schools in the state, DESE welcomes further suggestions related to notes of clarification, examples, professional development needs, and future revisions of the standards.

## K - 12 Standards for Mathematical Practices

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

## Algebra I Standards: Overview

**Abbreviations**: The following abbreviations are for the conceptual categories and domains for the Arkansas Academic Mathematics Standards.
For example, the standard HSN.RN.B.3 is in the High School Number and Quantity conceptual category and in The Real Number System domain.

**High School Number and Quantity – HSN**

- The Real Number System – RN
  - Use properties of rational and irrational numbers
- Quantities – Q
  - Reason quantitatively and use units to solve problems

**High School Algebra – HSA**

- Seeing Structure in Expressions – SSE
  - Interpret the structure of expressions
  - Write expressions in equivalent forms to solve problems
- Arithmetic with Polynomials and Rational Expressions – APR
  - Perform arithmetic operations on polynomials
- Creating Equations – CED
  - Create equations that describe numbers or relationships
- Reasoning with Equations and Inequalities – REI
  - Understand solving equations as a process of reasoning and explain the reasoning
  - Solve equations and inequalities in one variable
  - Solve systems of equations and inequalities graphically
  - Solve systems of equations

**High School Functions – HSF**

- Interpreting Functions – IF
  - Understand the concept of a function and use function notation
  - Interpret functions that arise in applications in terms of the context
  - Analyze functions using different representations
- Building Functions – BF
  - Build a function that models a relationship between two quantities
  - Build new functions from existing functions
- Linear, Quadratic and Exponential Models – LE

- Construct and compare linear, quadratic, and exponential models and solve problems
- Interpret expressions for functions in terms of the situation they model

**High School Statistics and Probability – HSS**

- Interpreting Categorical and Quantitative Data – ID
  - Summarize, represent, and interpret data on a single count or measurement variable
  - Summarize, represent, and interpret data on two categorical and quantitative variables
  - Interpret linear models

| The Real Number System | |
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| **Cluster B: Use properties of rational and irrational numbers.** | |
| HSN.RN.B.3 | Explain why:<br>● The sum/difference or product/quotient (where defined) of two *rational numbers* is *rational.*<br>● The sum/difference of a *rational number* and an *irrational number* is *irrational.*<br>● The product/quotient of a nonzero *rational number* and an *irrational number* is *irrational.*<br>● The product/quotient of two nonzero *rational numbers* is a nonzero *rational.* |
| HSN.RN.B.4 | Operations with radical expressions.<br>● Simplify *radical expressions.*<br>● Perform operations (add, subtract, multiply, and divide) with *radical expressions.*<br>● Rationalize denominators.<br><br>Teacher Note:This standard is shared with Algebra II.<br><br>Specification: Algebra I is limited to square roots and cube roots of whole numbers (no *variables*). Rationalizing denominators should not include conjugates (e.g., $\frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$ ). |

| Quantities | |
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| **Cluster A: Reason quantitatively and use units to solve problems.** | |
| HSN.Q.A.1* | Use units in a problem to:<br>● Interpret the problem and guide the process to find a solution in multi-step problems.<br>● Consider and select the appropriate units to be used, when given a formula (e.g., $A = 3\,m * 3m = 9m^2$).<br>● Choose and interpret appropriate units and scale on graphs and data displays in contextual situations. |
| HSN.Q.A.2* | Define appropriate quantities including units of measure for descriptive modeling of real-world problems (e.g., variables to consider, relevant quantities and information, describe mathematically different methods for solving).<br><br>Teacher Note:<br>● This standard is shared with Algebra II.<br>● This standard should be addressed in all Algebra I units of study through modeling tasks. |

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| HSN.Q.A.3* | Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.<br><br>Teacher Note:<br><br>Example:<br>● An appropriate place value for rounding an answer of 4.5 bus riders would reflect a level of accuracy to the nearest whole number based on the limitation from the context.<br>● If using a ruler that has centimeter divisions, when measuring the length of an object the reported length must be to the nearest centimeter. |

| Seeing Structure in Expressions | |
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| **Cluster A: Interpret the structure of expressions.** | |
| HSA.SSE.A.1* | Interpret *expressions* that represent a quantity in terms of its context.<br>● Interpret parts of an *expression*, such as *terms*, *factors*, and *coefficients.*<br>● Interpret complicated *expressions* by viewing one or more of their parts as a single entity.<br><br>Teacher Note:<br><br>Example: Consider the expression $8.50x + 11.00y$. The variable *x* is a factor, but also represents a quantity (e.g., the number of movie tickets) and the coefficient, 8.50, represents the cost of one movie ticket. |
| HSA.SSE.A.2 | Use the structure of an *expression* to identify ways to rewrite it.<br><br>Teacher Note: This standard is shared with Algebra II.<br><br>Specification: When factoring quadratics, the focus should be on expressions where $a = 1$.<br><br>Examples:<br>● See that $(x + 3)(x + 3)$ is the same as $(x + 3)^2$.<br>● See $x^4 - 25$ as $(x^2)^2 - (5)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - 5)(x^2 + 5)$.<br>● Recognize $53^2 - 47^2$ as a difference of squares and see an opportunity to rewrite it in the easier-to-evaluate form.<br>● See an opportunity to rewrite $a^2 + 9a + 14$ as $(a + 7)(a + 2)$. |
| **Cluster B: Write expressions in equivalent forms to solve problems.** | |

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| HSA.SSE.B.3* | Choose and produce an equivalent form of a *quadratic expression* to reveal and explain properties of the quantity represented by the *expression* in a real-world context.<br>● Factor to reveal the *zeros* of the *function* it defines.<br>● Complete the square to reveal the *maximum* or *minimum* value of the *function* it defines.<br>● Recognize that each form (*standard, factored*, and *vertex* form) has its appropriate place to analyze the quantities represented by the *expression* in context.<br><br>Teacher Note: This standard is shared with Algebra II.<br><br>Specification: *Quadratic functions* are limited to where $a = 1$, and when completing the square, *b* is an even integer. This could include factoring out a GCF to meet the constraints. |

| **Arithmetic with Polynomials and Rational Expressions** | |
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| **Cluster A: Perform arithmetic operations on polynomials.** | |
| HSA.APR.A.1 | Understand that *polynomials*, like the integers, are *closed* under the operations of addition, subtraction, and multiplication by adding, subtracting, and multiplying *polynomials.* |

| **Creating Equations** | |
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| **Cluster A: Create equations that describe numbers or relationships.** | |
| HSA.CED.A.1* | Create *equations* (arising from *linear, quadratic, and exponential* functions) and *linear inequalities* in one *variable;* use them to solve problems.<br><br>Teacher Note: This standard is shared with Algebra II.<br><br>Specification: Algebra I tasks are limited to *quadratic functions* where $a = 1$, and *exponential functions*, when $f(x) = a(b)^x$ where $a > 0$ and $b > 0; b \neq 1$. |
| HSA.CED.A.2* | Create *equations* in two *variables* to represent relationships between quantities and graph on a *coordinate plane* using appropriate labels and scales.<br><br>Teacher Note: This standard is shared with Algebra II.<br><br>Specification: Algebra I tasks are limited to *linear*, *quadratic functions* where $a = 1$, and *exponential functions*, when $f(x) = a(b)^x$ where $a > 0$ and $b > 0;\ b \neq 1$. |

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| HSA.CED.A.3* | Create *equations* and *inequalities* to:<br>● Represent and interpret constraints by *linear equations* or *inequalities*, and by *systems of linear equations* and/or *inequalities.*<br>● Interpret solutions as viable or nonviable options in a modeling context.<br><br>Teacher Note: This standard is shared with Algebra II. |
| HSA.CED.A.4* | Rearrange formulas to isolate a quantity of interest, using the same reasoning as in solving *equations* (e.g., rearrange $A = lw$ to isolate length).<br><br>Teacher Note: This standard is shared with Algebra II.<br><br>Specification: Algebra I should focus on linear formulas. |

| **Reasoning with Equations and Inequalities** | |
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| **Cluster A: Understand solving equations as a process of reasoning and explain the reasoning.** | |
| HSA.REI.A.1 | Explain each step when solving a *linear equation*. Construct a viable argument to justify a solution method. |
| **Cluster B: Solve equations and inequalities in one variable.** | |
| HSA.REI.B.3 | Solve *linear equations*, *inequalities*, and *absolute value equations* in one *variable.* |
| HSA.REI.B.4 | Solve *quadratic equations* in one *variable with real number solutions* using appropriate methods depending on the form of the *quadratic* (factored, standard, or vertex) by:<br>● Inspecting a graph.<br>● Taking square roots.<br>● Completing the square.<br>● Using the quadratic formula.<br>● Factoring the equation.<br><br>Teacher Note: This standard is shared with Algebra II.<br><br>Specification: *Quadratic functions* are limited to equations where $a = 1$ and when completing the square, *b* is an even integer. This could include factoring out a GCF, to meet the constraints. |
| **Cluster C: Solve systems of equations.** | |
| HSA.REI.C.5 | Solve *systems of linear equations* in two *variables* using substitution and elimination; and understand that the solutions will be the same. |
| HSA.REI.C.6* | Solve *systems of linear equations* by substitution, elimination, and graphing with and without a real-world context. |

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| HSA.REI.C.7* | Solve *systems of equations* consisting of *linear equations* and nonlinear *equations* in two *variables* graphically with the assistance of technology.<br><br>Teacher Note: This standard is shared with Algebra II.<br><br>Example: Find the points of intersection between $y = (-3x)$ and $y = x^2 + 2$. |
| **Cluster D: Solve systems of equations and inequalities graphically.** | |
| HSA.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* $f(x) = g(x)$<br>● Find the solutions approximately using technology to graph the *functions* or making tables of values.<br>● Include cases where $f(x)$ and/or $g(x)$ are *linear, quadratic, absolute value, and exponential.*<br><br>Teacher Note: This standard is shared with Algebra II.<br><br>Specification: Algebra I *exponential functions* are limited to $f(x) = a(b)^x$ where $a > 0$ and $b > 0; b \neq 1$. |
| HSA.REI.D.12 | Solve *linear inequalities* and systems of *linear inequalities* in two variables by graphing. |

| **Interpreting Functions** | |
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| **Cluster A: Understand the concept of a function and use function notation.** | |
| HSF.IF.A.1 | Understand that:<br>● 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.*<br>● 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 $x$.<br>● The graph of $f$ is the graph of the equation $y = f(x)$. |
| HSF.IF.A.2 | In terms of a real-world context:<br>● Use *function notation.*<br>● Evaluate *functions* for inputs in their *domains.*<br>● Interpret statements that use *function notation.*<br><br>Teacher Note: While the focus of the standard is a real-world context, students should evaluate functions without context to practice procedural fluency. |
| HSF.IF.A.3 | Recognize that a sequence is a *function* that can be defined explicitly and recursively. Understand that a sequence can be described as a *function* with the input numbers (*domain*) consisting of a subset of the integers and the output numbers being the terms of the sequence. |

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| **Cluster B: Interpret functions that arise in applications in terms of the context.** | |
| HSF.IF.B.4* | For a *function* that models a relationship between two quantities:<br>● Interpret key features of graphs and tables in terms of the quantities, including *intercepts* and *zeros;* intervals where the *function* is increasing, decreasing, positive, or negative; *maxima*, *minima*; and symmetries.<br>● Sketch graphs showing key features given a verbal description of the relationship.<br>Teacher Note: This standard is shared with Algebra II.<br><br>Specification: Algebra I tasks have a real-world context and are limited to the following *functions*: *linear, quadratic, absolute value*, and *exponential functions* of the form $f(x) = a(b)^x$ where $a > 0$ and $b > 0$ $(b \neq 1)$. |
| HSF.IF.B.5* | Relate the *domain* of a *function* to its graph and to the quantitative relationship it describes.<br><br>Teacher Note:<br><br>Example: If the *function* $h(n)$ gives the number of person-hours it takes to assemble *n* engines in a factory, then the positive integers would be an appropriate *domain* for the *function*. |
| HSF.IF.B.6* | In a real-world context:<br>● Calculate and interpret the *average rate of change* of a *function* (presented algebraically or as a table) over a specified interval.<br>● Estimate the *rate of change* from a graph.<br><br>Teacher Note: This standard is shared with Algebra II.<br><br>Specification: Algebra I tasks are limited to the following *functions: linear, quadratic, absolute value*, and *exponential functions* of the form $f(x) = a(b)^x$ where $a > 0$ and $b > 0$ $(b \neq 1)$. |
| **Cluster C: Analyze functions using different representations.** | |
| HSF.IF.C.7* | Graph *functions* expressed algebraically and show key features of the graph.<br>● Graph *linear* and *quadratic functions* without technology and show *intercepts*, *maxima*, and *minima,* when applicable.<br>● Graph *absolute value functions* with technology.<br>● Graph *exponential functions* with technology, and show *intercepts* and *end behavior*.<br><br>Teacher Note: This standard is shared with Algebra II. |
| HSF.IF.C.8 | Write expressions for functions in different but equivalent forms to reveal key features of the function.<br>● Write *quadratic functions* in different but equivalent forms using factoring and completing the square to reveal key features such as *zeros*, extreme values (vertex), and symmetry of the graph, and interpret these in terms of a context.<br><br>Teacher Note: This standard is connected to HSA.SSE.B.3 and shared with Algebra II.<br><br>Specification: Algebra I tasks are limited to *quadratic functions* where $a = 1$ and, when completing the square, *b* is an even integer. This could include factoring out a GCF to meet the constraints. |

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| HSF.IF.C.9 | Compare properties of two *functions* each represented in a different way (algebraically, graphically, numerically in tables, or verbally described).<br><br>Teacher Note: This standard is shared with Algebra II.<br><br>Specification: Algebra I tasks are limited to the following *functions*: *linear, quadratic, absolute value*, and *exponential functions* of the form $f(x) = a(b)^x$ where $a > 0$ and $b > 0$ $(b \neq 1)$. |

| Building Functions | |
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| **Cluster A: Build a function that models a relationship between two quantities.** | |
| HSF.BF.A.1* | Write a *function* that describes a relationship between two quantities.<br>● Determine an explicit *expression*, a recursive process, or steps for calculation from a real-world context.<br><br>Teacher Note: This standard is shared with and extended in Algebra II.<br><br>Specification: Algebra I tasks are limited to the following *functions*: *linear, quadratic*, and *exponential functions* of the form $f(x) = a(b)^x$ where $a > 0$ and $b > 0$ $(b \neq 1)$. |
| **Cluster B: Build new functions from existing functions.** | |
| HSF.BF.B.3 | Explore different transformations and generalize the results.<br>● Identify the effect on linear or quadratic graphs by replacing $f(x)$ $by$ $f(x) + k$, $kf(x)$, $f(kx)$ and $f(x + k)$ for specific values of *k* (*k* is a *constant* and both positive and negative).<br>● Find the value of *k* given the graphs of the transformed *linear* or *quadratic functions.*<br>● Experiment with multiple transformations and illustrate an explanation of the effects on the graphs of *linear*, *quadratic*, *absolute value*, and *exponential functions* with technology.<br><br>Teacher Note: This standard is shared with Algebra II. |

| Linear, Quadratic, and Exponential Models | |
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| **Cluster A: Construct and compare linear, quadratic, and exponential models and solve problems.** | |
| HSF.LE.A.1* | Distinguish between situations that can be modeled with *linear functions* and with *exponential functions.*<br>● Show that *linear functions* grow by equal differences over equal intervals, and that *exponential functions* grow by equal *factors* over equal intervals.<br>● Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.<br>● Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. |
| HSF.LE.A.2* | Construct linear and exponential *equations* including *arithmetic* and *geometric sequences* given the following:<br>● A graph,<br>● A verbal description of a relationship, and/or<br>● Two input-output pairs (include reading these from a table).<br><br>Teacher Note: This standard is connected to HSF.BF.A.2 in Algebra II.<br><br>Specification: Algebra I tasks are limited to *linear* and *exponential functions* of the form $f(x) = a(b)^x$ where $a > 0$ and $b > 0$ $(b \neq 1)$. |
| HSF.LE.A.3* | Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or any *polynomial function*.<br><br>Teacher Note: The study of *polynomial functions*, in general, is reserved for Algebra II. This standard leads to discussions of relative rates of growth in further coursework. |
| **Cluster B: Interpret expressions for functions in terms of the situation they model.** | |
| HSF.LE.B.5* | In terms of a real-world context, interpret the parameters (e.g., rates of growth or decay, *domain* and *range* restrictions where applicable) in a *function.*<br><br>Teacher Note:<br><br>Specification: Tasks are limited to the following *functions*: *linear, quadratic*, square root, *piecewise-defined* (including step and *absolute value*), and *exponential functions* of the f $f(x) = a(b)^x$ where $a > 0$ and $b > 0$ $(b \neq 1)$. |

| Interpreting categorical and quantitative data | |
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| **Cluster A: Summarize, represent, and interpret data on a single count or measurement variable.** | |
| HSS.ID.A.1 | Represent data with plots on the real number line (dot plots, histograms, and box plots). |

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| HSS.ID.A.2 | Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.<br><br>Teacher Note:<br><br>Specification: The focus is not on computing standard deviation but on comparing two data sets when given measures of center and spread of the distributions. |
| HSS.ID.A.3 | Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers) including:<br>● Using characteristics of center, shape, and spread to identify and name different shapes.<br>● Recognizing and understanding the appropriate measures of center and spread given the characteristics of a distribution.<br>● Understanding the tendency of the mean is to shift toward a skew or extreme value. |
| **Cluster B: Summarize, represent, and interpret data on two categorical and quantitative variables.** | |
| HSS.ID.B.5 | Use categorical data:<br>● Summarize categorical data for two categories in two-way frequency tables.<br>● Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies).<br>● Recognize possible associations and trends in the data.<br><br>Teacher Note: This is a shared standard with Algebra I. |
| HSS.ID.B.6 | Represent data on two *quantitative variables* on a *scatter plot*; describe how the *variables* are related.<br>● Fit a *function* to the data; use *functions* fitted to data to solve problems in the context of the data.<br><br>Teacher Note: This is a shared standard with Geometry and Algebra II.<br><br>Specification: Use given *functions* or choose a *function* suggested by the context. Algebra I students will use given *functions* or choose a *function* suggested by the context. The focus of Algebra I should be on linear and exponential models. |
| **Cluster C: Interpret linear models.** | |
| HSS.ID.C.7 | Interpret the *slope* (*rate of change*) and the *intercept* (constant term) of a linear model in the context of the data.<br><br>Teacher Note: This is a shared standard with Geometry. |
| HSS.ID.C.8 | Compute (using technology) and interpret the *correlation coefficient* of a linear fit.<br><br>Teacher Note: This is a shared standard with Geometry.<br><br>Specification: The focus is not on computing the *correlation coefficient* but on understanding what it tells us about the strength of the relationship between the two sets of data. |

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| HSS.ID.C.9 | Distinguish between *correlation* and *causation.*<br><br>Teacher Note: This is a shared standard with Geometry. |

# Glossary

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| Absolute value equation | Any equation with an algebraic expression contained in absolute value symbols; Ex: $\|2x - 7\| = 21$. |
| Absolute value function | Any function with an algebraic expression contained in absolute value symbols, in the family with parent function $f(x) = \|x\|$. |
| Algebraic expression | A symbolic representation of mathematical operations that can involve both numbers and variables. |
| Arithmetic sequence | A sequence such as $1, 5, 9, 13, 17, \ldots$ or $12, 7, 2, -3, -8, -13, -18, \ldots$ which has a common difference between terms. |
| Average rate of change | The difference between two output (y) values divided by the difference between corresponding input (x) values.<br>● Linear functions describe the average rate of change as the "slope", which is the rate of change between any two points on the line.<br>● Exponential and Quadratic functions can be described by finding the slope of a line segment connecting two points on the curve. |
| Causation | A relationship in which changes in one variable cause changes in another variable. |
| Closed | If p and q are polynomials *p* + *q*, *p* – *q*, and *pq* are also polynomials. Closed means that when an operation is performed on a set, then the result is within the same set. When you add, subtract, or multiply two polynomials it is still a polynomial. |
| Coefficient | A constant number or variable by which a variable is multiplied.<br>Examples: $3x + 7$, 3 is the coefficient; $y = mx + b$, $m$ is the coefficient |
| Constant | A fixed value; in 7x + 2 = 4, 2 and 4 are constants. |
| Coordinate plane | A plane divided by perpendicular number lines creating four quadrants. The perpendicular number lines represent the axes and where they intersect represents the origin (0,0). Points can be identified using coordinates (x,y) found within the quadrants. |
| Correlation | The relationship between two variables that may or may not imply causation. The strength of the relationship is measured by the correlation coefficient. |
| Correlation Coefficient | A measure (*r*) of the strength and direction of a linear relationship between two variables on a scatter plot<br>● The correlation coefficient is always between $-1$ and $+ 1$.<br>● A value of 1 denotes a perfect positive correlation; both variables move in the same direction.<br>● A value of -1 denotes a perfect negative or inverse correlation; one variable moves up while the other moves down.<br>● A value of 0 denotes no linear correlation exists. |

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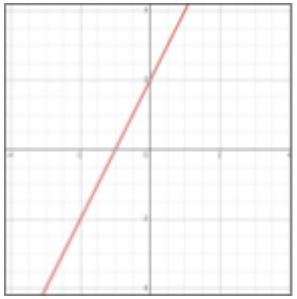
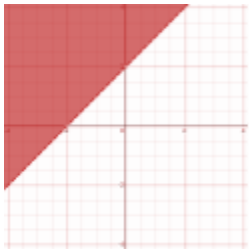
| Domain | The set of input (x) values for a function. |
| End behavior | The behavior of a graph of *f(x)* as *x* approaches positive or negative infinity. |
| Equation | A statement that has one value or algebraic expression equal to another value or algebraic expression. |
| Exponential function | A function in which a variable appears in the exponent; $f(x) = 2^x$. |
| Expression | A mathematical phrase consisting of numbers, variables, and operations. |
| Factor | One of the numbers, variables, or expressions multiplied to obtain a product. |
| Factored Form | A quadratic function in the form $f(x) = a(x - r_1)(x - r_2)$. |
| Function | A rule or relationship in which there is exactly one output value for each input value. |
| Function notation | $f(x)$ is a way to represent a function, named $f$, where the input is represented by $x$ and the output ($y$-value) is represented by $f(x)$. Example $f(x) = 3x$ is the same as $y = 3x$. |
| Geometric sequence | A sequence such as $2, 6, 18, 54, 162, \ldots$ or $3, 1, \frac{1}{3}, \frac{1}{9}, \frac{1}{27}, \frac{1}{81}, \ldots$ which has a common ratio between terms. |
| Inequality | A numerical sentence containing one of the symbols: >,<,≥,≤ or ≠ indicates the relationship between two quantities. |
| Intercept | A point where the graph of an equation intersects the x-axis (x-intercept) or the y-axis (y-intercept). |
| Irrational number | A number that cannot be expressed as a fraction $\frac{p}{q}$ for any integers *p* and *q*; have decimal expansions that neither terminate nor become periodic. |
| Linear equation | An algebraic equation in which the variables are of the first degree. The graph of such an equation is a straight line.   |

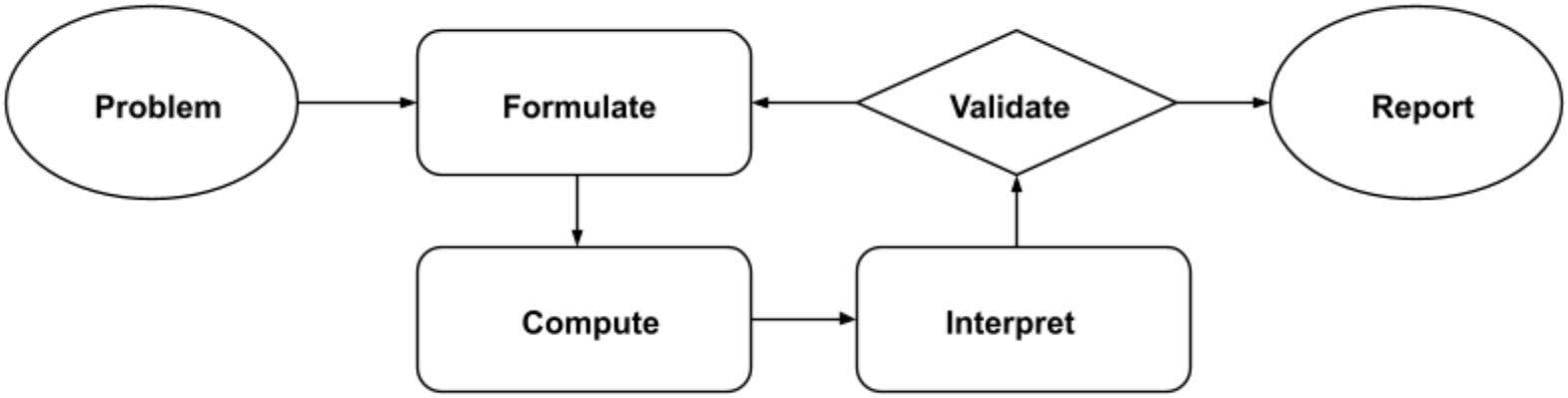
| | |
|---|---|
| Linear function | A function characterized by a constant rate of change (slope). |
| Linear inequality | An algebraic inequality in which the variables are of the first degree. The graph of such an inequality is a straight line that divides the plane and uses shading to represent the solution set.<br>  <br>$y > x+2$ |
| Maximum (plural: Maxima) | The coordinates of the point on the graph of the function with the highest y-value. |
| Minimum (plural: Minima) | The coordinates of the point on the graph of the function with the lowest y-value. |
| Piecewise function | A function that consists of two or more functions defined on different intervals. |
| Polynomial | A sum of terms that have positive integer exponents. |
| Quadratic function | Any function in the family with parent function $f(x) = x^2$. |
| Quantitative variable | Variables that are numerical and represent a measurable quantity |
| Radical | The symbol used to represent a root; $\sqrt{\ }$ |
| Radical expression | Any expression containing a root symbol $\sqrt{\ }$ |
| Range | The set of output (y) values for a function. |
| Rational expression | A ratio of two polynomial expressions with a non-zero denominator. Ex: $\frac{3x+1}{x+2}$ |
| Rational number | A number that can be written as a ratio of two integers $\frac{a}{b}$, where $b \neq 0$. |

| | |
|---|---|
| Scatter plot | A two-variable data display where points are plotted to show the relationship (correlation) between two variables. |
| Slope | The ratio of the vertical change compared to the horizontal change between two points on a line. |
| Standard Form | A quadratic Function in the form $f(x) = ax^2 + bx + c$. |
| Systems of equations | A set of two or more equations with the same variables. To solve a system is to find all common solutions or points that satisfy all equations. |
| Term | Terms are constants, variables, or the product or quotient of constant(s) and variable(s). |
| Variable | A symbol used to represent an unknown or undetermined value in an expression or equation. |
| Vertex Form | A quadratic function in the form $f(x) = a(x - h)^2 + k$. |
| Zeros | The values of the independent variable (*x*-value) that make the corresponding values of the function equal to zero. The zeros of a function are the x-intercepts of its graph. |

# Appendix A

**Mathematical Modeling Cycle**

The basic modeling cycle is summarized in this diagram. It involves: (1) identifying variables in the situation and selecting those that represent essential features; (2) formulating a model by creating and selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between the variables; (3) analyzing and performing operations on these relationships to draw conclusions; (4) interpreting the results of the mathematics in terms of the original situation; (5) validating the conclusions by comparing them with the situation, and then either improving the model or, if it is acceptable; (6) reporting on the conclusions and the reasoning behind them. Choices, assumptions, and approximations are present throughout this cycle.



# Appendix B

**Table 1: Properties of Operations**

| | |
|---|---|
| Associative property of addition | $(a + b) + c = a + (b + c)$ |
| Commutative property of addition | $a + b = b + a$ |
| Additive identity property of 0 | $a + 0 = 0 + a = a$ |
| Existence of additive inverses | For every a there exists –a so that $a + (-a) = (-a) + a = 0$ |
| Associative property of multiplication | $(a \times b) \times c = a \times (b \times c)$ * |
| Commutative property of multiplication | $a \times b = b \times a$ * |
| Multiplicative identity property 1 | $a \times 1 = 1a = a$ * |
| Existence of multiplication inverses | For every $a \neq 0$ there exists $\frac{1}{a}$ so that $a \times \frac{1}{a} = \frac{1}{a} \times a = 1$ * |
| Distributive property of multiplication over addition | $a \times (b + c) = a \times b + a \times c$ * |

*The x represents multiplication not a variable.

**Table 2: Properties of Equality**

| | |
|---|---|
| Reflexive property of equality | $a = a$ |
| Symmetric property of equality | If $a = b$, then $b = a$. |
| Transitive property of equality | If $a = b$ and $b = c$, then $a = c$. |
| Addition property of equality | If $a = b$, then $a + c = b + c$. |
| Subtraction property of equality | If $a = b$, then $a - c = b - c$. |
| Multiplication property of equality | If $a = b$ then $a \times c = b \times c$. * |
| Division property of equality | If $a = b$ and $c \neq 0$, then $a \div c = b \div c$. |
| Substitution property of equality | If $a = b$, then b may be substituted for a in any expression containing a. |

*The x represents multiplication not a variable.

**Table 3: Properties of Inequality**

| |
|---|
| Exactly one of the following is true: $a < b, a = b, a > b$. |
| If $a > b$ and $b > c$, then $a > c$. |
| If $a > b$, $b < a$. |
| If $a > b$, then $a \pm c > b \pm c$. |
| If $a > b$ and $c > 0$, then $a \times c > b \times c$. * |
| If $a > b$ and $c < 0$, then $a \times c < b \times c$. * |
| If $a > b$ and $c > 0$, then $a \div c > b \div c$. |
| If $a > b$ and $c < 0$, then $a \div c < b \div c$. |

*The x represents multiplication not a variable.