Glossary

absolute value The distance that a number is from zero, without regard to direction. It is always non-negative. Thus the absolute value of a negative number is its opposite, while the absolute value of a non-negative number is just the number itself. The absolute value of x is usually written "$|x|$." For example, $|-5| = 5$ and $|22| = 22$.

additive identity The number 0 is called the additive identity because adding 0 to any number does not change the number.

Additive Identity Property Adding zero to any expression leaves the expression unchanged. That is, $a + 0 = a$. For example, $-2xy^2 + 0 = -2xy^2$.

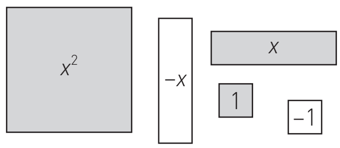
additive inverse The number added to another number to get the additive identity, 0. So for the number 5, the additive inverse is –5; for the number –13, the additive inverse is 13. For any number x, the additive inverse is $-x$.

Additive Inverse Property For every number a, there is a number $-a$, such that $a + (-a) = 0$. For example, the number 5 has an additive inverse of –5; $5 + (-5) = 0$. The additive inverse of a number is often called its opposite. For example, 5 and –5 are opposites.

Additive Property of Equality The Additive Property of Equality states that equality is maintained if the same amount is added to both sides of an equation. That is, if $a = b$, then $a + c = b + c$. For example, if $y = 3x$, then $y + 1.5 = 3x + 1.5$.

algebra A branch of mathematics that uses variables to generalize the rules of numbers and numerical operations.

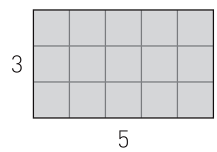
algebra tiles A manipulative whose area represents a constant or variable quantity. The algebra tiles used in this course consist of large squares with dimensions x by x and y by y, rectangles with dimensions x by 1, y by 1, and x by y, and small squares with dimensions 1 by 1. These tiles are named by their areas: x^2, y^2, x, y, xy, and 1, respectively. The smallest squares are called "unit tiles." In this text, shaded tiles will represent positive quantities while unshaded tiles will represent negative quantities.



annual Occurring once every year.

appreciation An increase in value.

area The number of non-overlapping square units needed to cover a two-dimensional region. The area of the image shown is 15 square units.



area model See *generic rectangle*.

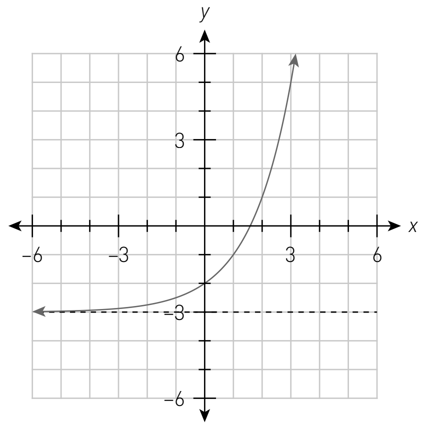
arithmetic sequence A sequence in which the difference between sequential terms is constant. Each term in an arithmetic sequence can be generated by adding the common difference to the previous term. For example, in the sequence 4, 7, 10, 13, ..., the common difference is 3.

association A relationship between two variables. An association between numerical variables can be displayed on a scatter plot and described by its form, direction, strength, and outliers. A possible association between two categorical variables can be studied in a two-way table using conditional relative frequencies. Also see *scatter plot* and *two-way table*.

Associative Property of Addition If a sum contains terms that are grouped, the sum can be grouped differently with no effect on the total. That is, $a + (b + c) = (a + b) + c$. For example, $3 + (4 + 5) = (3 + 4) + 5$

Associative Property of Multiplication If a product contains terms that are grouped, the product can be grouped differently with no effect on the result. That is, $a(bc) = (ab)c$. For example, $2 \cdot (3 \cdot 4) = (2 \cdot 3) \cdot 4$.

asymptote A line that a graph of a curve infinitely approaches. An asymptote is often represented by a dashed line on a graph. For example, the graph has an asymptote at $y = -3$.

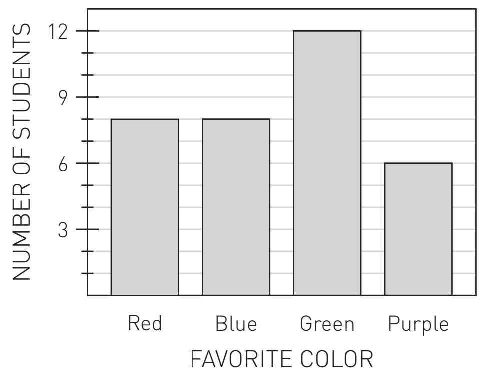


average See *mean*.

axes See *coordinate axes*.

b When the equation of a line is expressed in $y = mx + b$ form, the constant b gives the y-intercept of the line. For example, the y-intercept of the line $y = -\frac{1}{3}x + 7$ is 7.

bar graph A set of rectangular bars that have height proportional to the number of data elements in each category. Usually, the bars are separated from each other. It is a way of displaying one-variable data that can be categorized (e.g., color preference, hair color, or place of birth). Also see *histogram*.



base When working with an exponential expression in the form b^a, b is called the base. For example, 2 is the base in 2^5. (5 is the exponent, and 32 is the value.) Also see *exponent*.

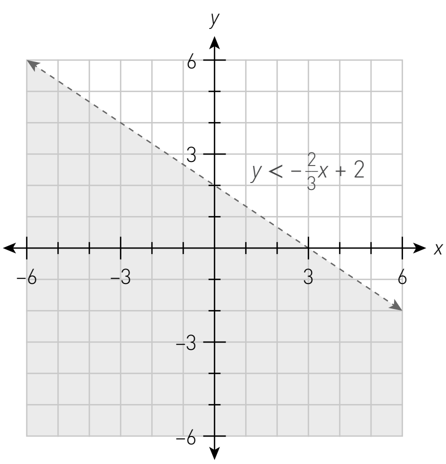
bin width An interval, or the width of a bar, on a histogram.

binomial An expression that is the sum or difference of exactly two terms, each of which is a monomial. For example, $-2x + 3y^2$ is a binomial.

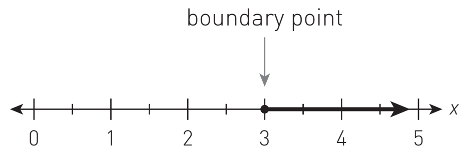
boundary line or curve

(a) The line that determines the upper or lower limit on the values that a prediction from a linear model is likely to be. Also see *upper boundary* line and *lower boundary line*.

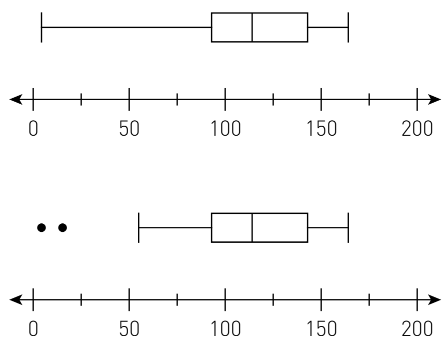
(b) A line or curve on a two-dimensional graph that divides the graph into two regions. A boundary line or curve is used when graphing inequalities with two variables. For example, the graph of the inequality $y < -\frac{2}{3}x + 2$ is shown. The dashed boundary line has the equation $y = -\frac{2}{3}x + 2$. A boundary line is also sometimes called a "dividing line."



boundary point The endpoint of a ray or segment on a number line where an inequality is true. For strict inequalities (that is, inequalities involving < or >), the point is not part of the solution. Solving the equality associated with the inequality produces the boundary point(s). For example, the solution to the equation $2x + 5 = 11$ is $x = 3$, so the inequality $2x + 5 \geq 11$ has a boundary point at 3. The solution to that inequality is illustrated on the number line. A boundary point is also sometimes called a "dividing point."



box plot A graphic way of displaying the five-number summary of a distribution of data: minimum, first quartile, median, third quartile, and maximum. A **modified box plot** displays outliers separately from the box plot. Also see *five-number summary*.



categorical data Data that can be put into categories (like what color you prefer, hair color, or the state you were born in), as opposed to numerical data that can be placed on a number line. Two-way tables are often used to determine association between two categorical variables. Also see *two-way table*.

center (of a data distribution) A number that represents the middle of a data set, or that represents a "typical" value of the set. Two ways to measure the center of a data set are the mean and the median. When dealing with measures of center, it is often useful to consider the distribution of the data. For symmetric distributions with no outliers, the mean or median can represent the middle, or "typical" value of the data. However, when outliers or non-symmetrical distributions are present, the median may be a better measure. Also see *mean* and *median*.

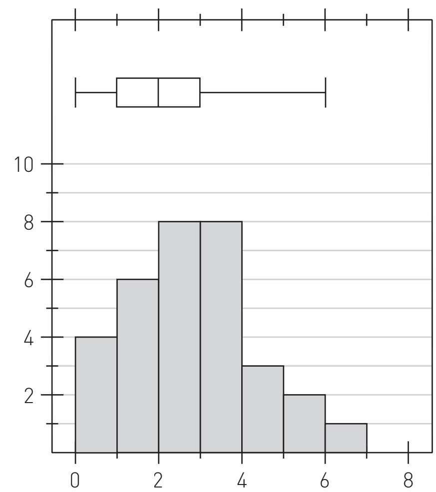
closed sets A set of numbers is said to be closed under an operation if the result of applying the operation to any two numbers in the set produces a number in that set. For example, the whole numbers are a closed set under addition, because if you add any two whole numbers, the result is always a whole number. However, the whole numbers are not closed under division; if you divide any two whole numbers, you do not always get a whole number.

closure properties The properties of a particular set of numbers that state when that set is closed under a specific operation. For example, the closure property of rational numbers states that the product or sum of two rational numbers is a rational number. For example, $\frac{1}{2}$ and $\frac{3}{4}$ are both rational numbers; $\frac{1}{2} + \frac{3}{4}$ is $\frac{5}{4}$; and $\frac{5}{4}$ is a rational number. Also, 2.2 and 0.75 are both rational numbers; $22 \cdot 0.75$ is 1.65; and 1.65 is a rational number.

coefficient A numerical or algebraic factor multiplying a variable or expression. For example, 3 is the coefficient of $3x^2$, and $2x$ is a coefficient of $2xy$.

coincide When two graphs have all their points in common. When the graphs of two equations coincide, those equations share all the same solutions and have an infinite number of intersection points. For example, the graphs of $y = 2x + 4$ and $3y = 6x + 12$ coincide; both graphs are lines with a slope of 2 and a y-intercept of 4.

combination histogram and box plot A way to visually represent a distribution of data. The *box plot* is drawn with the same x-axis as the *histogram*.



combining like terms Summing terms of the same variable that are raised to the same power (or constants) to rewrite an expression. For example, combining like terms in the expression $3x + 7 + 5x - 3 + 2x^2 + 3y^2$ gives $8x + 4 + 2x^2 + 3y^2$. When working with algebra tiles, combining like terms involves putting together tiles with the same dimensions.

common difference The difference between consecutive terms of an arithmetic sequence or the generator of the sequence. When the common difference is positive, the sequence increases; when it is negative, the sequence decreases. In the sequence 3, 7, 11, ..., 43, the common difference is 4.

common factor A factor that is the same for two or more terms. For example, x^2 is a common factor of $3x^2$ and $-5x^2y$.

common ratio Another name for the multiplier or generator of a geometric sequence. It is the number to multiply one term by to get the next one. In the sequence 96, 48, 24, ..., the common ratio is $\frac{1}{2}$.

Commutative Property of Addition If two terms are added, the order can be reversed with no effect on the total. That is, $a + b = b + a$. For example, $7 + 12 = 12 + 7$.

Commutative Property of Multiplication If two expressions are multiplied, the order can be reversed with no effect on the result. That is, $ab = ba$. For example, $5 \cdot 8 = 8 \cdot 5$.

complete graph A graph that includes everything important about the graph (such as intercepts and other key points, asymptotes, limitations on the domain or range, etc.) and makes the rest of the graph predictable based on what is shown. All information and important points on the graph are clearly labeled.

completing the square In this course, completing the square is used to convert a quadratic equation in standard form into perfect square form. To complete the square, add (or subtract) a constant to (or from) both sides of the equation so that the quadratic expression can be factored into a perfect square. For example, when given the quadratic equation $x^2 - 6x + 4 = 0$, complete the square by adding 5 to both sides. The resulting equation, $x^2 - 6x + 9 = 5$, has a left-hand side that can be factored, resulting in the perfect square form quadratic equation $(x - 3)^2 = 5$.

complex numbers Numbers written in the form $a + bi$, where a and b are real numbers. Each complex number has a real part, a, and an imaginary part, bi. Note that real numbers are also complex numbers with $b = 0$, and imaginary numbers are complex numbers where $a = 0$.

compound interest Interest that is paid on both the principal and the previously accrued interest.

conditional relative frequency table A two-way table that shows proportions or percentages with respect to a particular variable.

consecutive integers Integers that are in order without skipping. For example, 8, 9, and 10 are consecutive integers.

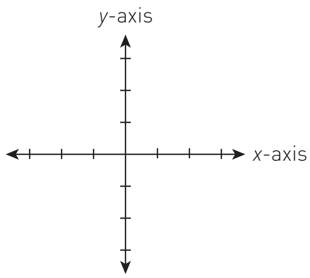
constant of proportionality (*k*) In a proportional relationship, equations are of the form $y = kx$, where k is the constant of proportionality.

constant term A number that is not multiplied by a variable. In the expression $2x + 3y - 5xy^2 + 8$, the number 8 is a constant term.

constraint A limitation or restriction placed on a function or situation, either by the context of the situation or by the nature of the function.

continuous For this course, when the points on a graph are connected, and it makes sense to connect them, the graph is continuous. Such a graph will have no holes or breaks. This term will be more completely defined in a later course.

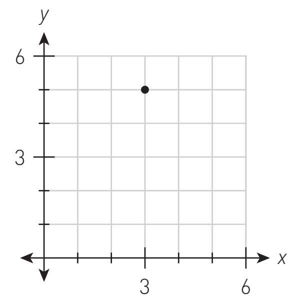
coordinate axes For two dimensions, two perpendicular number lines (the x- and y-axes) that intersect where both are zero and that provide the scale(s) for labeling each point in a plane with its horizontal and vertical distances and directions from the origin (0, 0).



coordinate graph A visual representation of a specific relationship (such as a line) or data set on the coordinate plane. The points (x, y) are plotted according to their positions on two perpendicular linear axes, often labeled the x-axis and y-axis. Also known as a "rectangular coordinate graph" or a "Cartesian coordinate graph." Also see *graph*.

coordinate plane A two-dimensional flat surface defined by two perpendicular number lines (the coordinate axes) meeting at right angles at their zero points. A coordinate plane is also sometimes called a "Cartesian plane."

coordinate system A system of graphing ordered pairs of numbers on a coordinate plane. Also sometimes called a "Cartesian system." An ordered pair represents a point, with the first number indicating the horizontal position relative to the x-axis and the second indicating the vertical position relative to the y-axis. For example, the diagram shows the point (3, 5) graphed on a coordinate plane.



coordinate(s) The number corresponding to a point on the number line or an ordered pair (x, y) used to locate a point in the plane in relation to a set of coordinate axes. In an ordered pair, the x-coordinate appears first, and the y-coordinate appears second. For example, the point (3, 5) has an x-coordinate of 3.

correlation coefficient (r) A measure of how much or how little data is scattered around the least-squares regression line. It is a measure of the strength of an association that has already been determined to be linear. The correlation coefficient takes on values between –1 and 1. The closer the correlation coefficient is to 1 or –1, the less scattered the data are around the LSRL.

counterexample An example showing that a statement has at least one exception; that is, a situation in which the statement is false. For example, the number 4 is a counterexample to the hypothesis that all even numbers are greater than 7.

counting numbers See *natural numbers*.

cube root For a given number, the value that, when cubed (taken to the third power), gives that number. That is, the cube root of x is the value a such that $a^3 = x$. For example, the cube root of 8 is 2 because $8 = 2 \cdot 2 \cdot 2 = 2^3$. This is written $\sqrt[3]{8} = 2$.

cubic Describes a polynomial of the form $y = ax^3 + bx^2 + cx + d$. "Cube" refers to the third (3) power.

data distribution See *distribution*.

decimal approximation A decimal value that is close to, but not exactly equal to, the true value of a number. It is used when an exact answer (like a radical) is difficult to visualize or use practically. The symbol ≈ (meaning "approximately equal to") is used instead of =. For example, $\sqrt{5} \approx 2.236$. Also see *irrational numbers*.

delta (Δ) A Greek letter that is often used to represent a difference. Common uses include Δx and Δy, which represent the lengths of the horizontal and vertical legs of a slope triangle, respectively. The symbol means "change in."

dependent variable A variable whose value is affected by one or more other variables. For example, the speed of a car is dependent on the amount of force you apply to the gas pedal. The dependent variable appears as the output value in an (x, y) table and is plotted on the vertical axis of a graph. The letter y and the vertical y-axis are often used for the dependent variable. In Statistics, the dependent variable is often called the response variable. Also see *independent variable*.

depreciation A decrease in value.

description of a function Includes a description of the shape of the graph, where it increases and/or decreases, all the intercepts, domain and range, description of special points, and description of lines of symmetry.

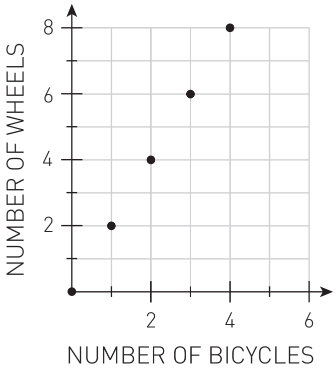
difference of squares A polynomial that can be factored as the product of the sum and difference of two terms. The general pattern is $x^2 - y^2 = (x + y)(x - y)$. Most of the differences of squares found in this course are of the form $a^2x^2 - b^2 = (ax + b)(ax - b)$, where a and b are nonzero real numbers. For example, the difference of squares $4x^2 - 9$ can be factored as $(2x + 3)(2x - 3)$.

dimensions The measurement of how far a flat region or space extends in each direction. For example, the dimensions of a rectangle might be 16 cm wide by 7 cm high.

direct proportion (or direct variation) Two quantities, such as x and y, that have the relationship $y = kx$, where $k \neq 0$ and is the constant of proportionality. In a proportional situation, if the x-value is doubled (or tripled), the y-value is also doubled (or tripled). The graph of a direct proportion is a line that passes through the origin. Also see *inverse proportion*.

direction (of an association) A description of how two variables are related. If one variable increases as the other variable increases, the direction is a positive association. If one variable decreases as the other variable increases, the direction is a negative association. If there is no apparent pattern in the scatter plot, then the variables have no association. When describing a linear association, you can use the slope and its numerical interpretation in context to describe the direction of the association.

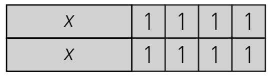
discrete graph A graph that consists entirely of separated points. For example, the graph shown is discrete. Also see *continuous*.

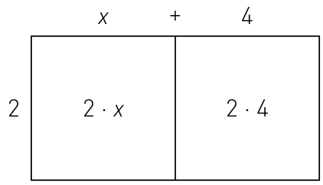


discriminant $b^2 - 4ac$, for quadratic equations in standard form $ax^2 + bx + c = 0$. If the discriminant is positive, the equation has two roots; if the discriminant is zero, the equation has one root; if the discriminant is negative, the equation has no real-number roots. For example, the discriminant of the quadratic equation $2x^2 - 4x - 5$ is $(-4)^2 - 4(2)(-5) = 56$, which indicates that the equation has two roots (solutions).

distribution A description (usually a list, table, or graph) of the number of times each possible outcome occurs. Data distributions are often summarized by their center, shape, spread, and outliers, and can be displayed with a combination histogram and box plot.

Distributive Property For any numbers or expressions *a*, *b*, and *c*, $a(b + c) = ab + ac$. For example, $2(x + 4) = 2 \cdot x + 2 \cdot 4 = 2x + 8$. This can be demonstrated with algebra tiles or in a generic rectangle.

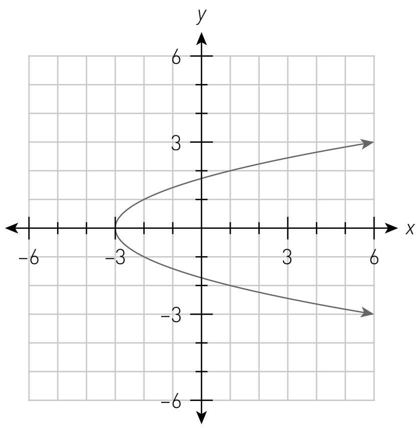




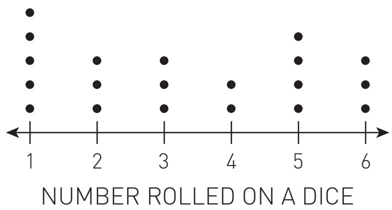
dividing line See *boundary line*.

dividing point *See boundary point*.

domain The set of all input values for a relation or function. For example, the domain of the relation graphed is $x \geq -3$. For variables, the domain is the set of numbers it may represent. Also see *input value*.



dot plot A way of displaying single-variable data that has an order and can be placed on a number line. Dot plots are generally used when the data is discrete (separate and distinct) and numerous pieces of data are of equal value.



double-peaked See *shape (of a data distribution)*.

Elimination Method A method for solving a system of equations. Add or subtract both sides of two equations to eliminate one of the variables. For example, the two equations in the system shown can be added together to get the result $7x = 14$.

$$\begin{aligned} 5x + 2y &= 10 \\ 2x - 2y &= 4 \end{aligned} \quad \longrightarrow \quad \begin{array}{r} 5x + 2y = 10 \\ +\ \underline{2x - 2y = 4} \\ 7x = 14 \end{array}$$

Solve this equation to calculate x, then substitute the x-value back into either of the original equations to calculate the value of y.

$$\begin{aligned} 7x &= 14 \\ x &= 2 \\ 5x + 2y &= 10 \\ 5(2) + 2y &= 10 \\ 10 + 2y &= 10 \\ 2y &= 0 \\ y &= 0 \end{aligned}$$

endpoint Either of the two points that mark the ends of a line segment. Also see *line segment*.

equal Two quantities that have the same value. For example, when $x = 4$, the expression $x + 8$ is equal to the expression $3x$ because their values are the same.

Equal Values Method A method for solving a system of equations. Take two expressions that are each equal to the same variable and set those expressions equal to each other. For example, in the system of equations $y = -2x + 5$ and $y = x - 1$, $-2x + 5$ and $x - 1$ each equal y, so $-2x + 5 = x - 1$.

$$y = \underbrace{-2x + 5} \qquad y = \underbrace{x - 1}$$

$$-2x + 5 = x - 1$$

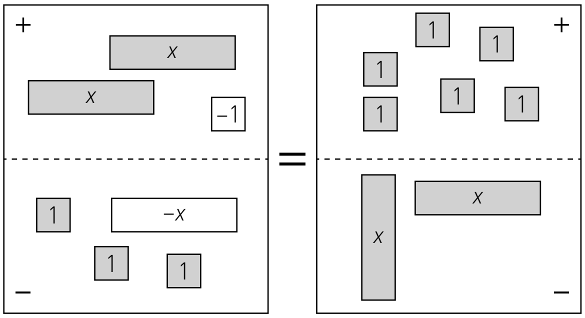
Solve that equation for x. Then, substitute that value into either of the original equations to determine the value of y.

$$\begin{aligned} -2x + 5 &= x - 1 \\ 5 &= 3x - 1 \\ 6 &= 3x \\ 2 &= x \end{aligned}$$

$$\begin{aligned} y &= x - 1 \\ y &= 2 - 1 \\ y &= 1 \end{aligned}$$

equation A mathematical sentence in which two expressions appear on either side of an "equals" sign (=), stating that the two expressions are equivalent. For example, the equation $7x + 4.2 = -8$ states that the expression $7x + 4.2$ has the value -8. In this course, an equation is often used to represent a rule relating two quantities. For example, a rule for calculating the area y of a tile pattern with figure number x might be written $y = 4x - 3$.

Equation Mat An organizing tool used to visually represent two equal expressions using algebra tiles. For example, the Equation Mat represents the equation $2x - 1 - (-x + 3) = 6 - 2x$.



equivalent Two expressions of the same value. For example, 2 + 3 is equivalent to 1 + 4. Two equations are equivalent if they have all the same solutions. For example, $y = 3x$ is equivalent to $2y = 6x$. Equivalent equations have the same graph.

evaluate To determine the value of an expression. Substitute the value(s) given for the variable(s) and perform the operations according to the Order of Operations. For example, evaluating $2x + y - 10$ when $x = 4$ and $y = 3$ gives the value 1.

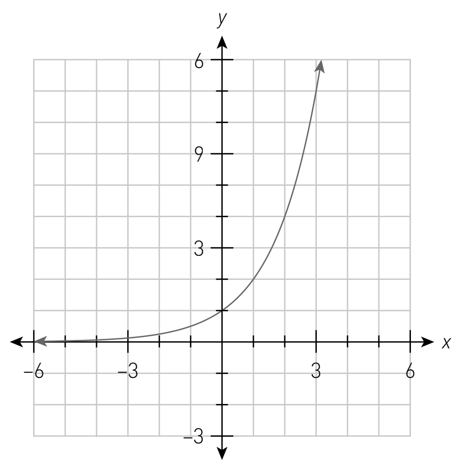
event One or more results of an experiment.

exact form An answer written precisely, without any rounding or estimation. It represents the true value of a number or expression. For example, the exact form of the square root of 8 is $\sqrt{8}$. Also see *irrational numbers*.

explicit equation (for a sequence) An equation for a term in a sequence that determines the value of any term $f(n)$ directly from n, without necessarily knowing any other terms in the sequence. Also see *recursive equation*.

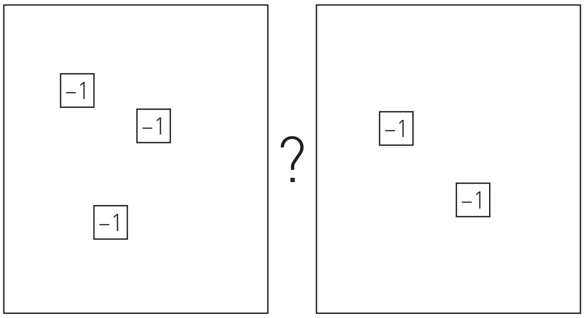
exponent In an expression of the form b^a, a is called the exponent. For example, in the expression 2^5, 5 is called the exponent. (2 is the base, and 32 is the value.) The exponent indicates how many times to use the base as a multiplier. For example, in 2^5, 2 is multiplied 5 times: $2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$. For exponents of zero, the rule is: for any number $x \neq 0$, $x^0 = 1$. For negative exponents, the rule is: for any number $x \neq 0$, $x^{-n} = \frac{1}{x^n}$, and $\frac{1}{x^{-n}} = x^n$. Also see *properties of exponents*.

exponential function In this course, a function that has an equation of the form $y = ab^x + k$, where a is the initial value, b is positive and is the multiplier, and $y = k$ is the equation of the horizontal asymptote. An example of the graph of an exponential function is shown.



expression A combination of individual terms separated by plus or minus signs. Numerical expressions combine numbers and operation symbols; algebraic (variable) expressions include variables. For example, 4 + (5 − 3) is a numerical expression. In an algebraic expression, if each of the following terms, $6xy^2$, 24, and $\frac{y-3}{4+x}$, are combined, the result may be $6xy^2 + 24 - \frac{y-3}{4+x}$. An expression does not have an "equals" sign.

Expression Comparison Mat A tool that uses two Expression Mats side-by-side so two expressions can be compared to see which represents the greater value. For example, the left side of the Expression Comparison Mat shown represents –3, while the right side represents –2. Since –2 > –3, the right side is greater.



Expression Mat An organizing tool used to visually represent an expression with algebra tiles.

extrapolation A prediction made outside the range of the observed data. Often, extrapolations are not very reliable predictions.

factor

(a) In arithmetic: When two or more integers are multiplied, each of the integers is a factor of the product. For example, 4 is a factor of 24, because $4 \cdot 6 = 24$.

(b) In algebra: When two or more algebraic expressions are multiplied together, each of the expressions is a factor of the product. For example, x^2 is a factor of $-17x^2y^3$, because $(x^2)(-17y^3) = -17x^2y^3$.

(c) To factor an expression is to write it as a product. For example, the factored form of $x^2 - 3x - 18$ is $(x - 6)(x + 3)$.

factored completely The form of a polynomial that cannot be factored further using integer coefficients. For example, $-2(x + 3)(x - 1)$ is the completely factored form of $-2x^2 - 4x + 6$.

factored form A quadratic equation in the form $a(x + b)(x + c) = 0$, where a is nonzero. For example, $-7(x + 2)(x - 1.5) = 0$ is a quadratic equation in factored form.

family of functions A group of functions that have at least one common characteristic, usually the shape of the graph and the structure of the equation. For example, the quadratic family of functions has graphs that are parabolas, and equations of the form $y = ax^2 + bx + c$. Examples of other families include linear, exponential, and absolute value functions.

Fibonacci Sequence The sequence of numbers 1, 1, 2, 3, 5, 8, 13, ... Each term of the Fibonacci sequence (after the first two terms) is the sum of the two preceding terms.

Figure 0 The figure that comes before Figure 1 in a tile pattern. When representing a tile pattern with a graph, the y-intercept of the graph is the number of tiles in Figure 0. When representing a tile pattern with an equation in $y = mx + b$ form, b gives the number of tiles in Figure 0.

first quartile (Q1) The median of the lower half of a set of data that has been written in numerical order.

five-number summary A way of summarizing the center and spread of a single-variable distribution of data. The five-number summary includes the minimum, first quartile, median, third quartile, and maximum of a data set. Also see *box plot*.

form (of an association) Can be linear or nonlinear. The form can contain a cluster of data. A residual plot can help determine if a particular model is a good fit for the data.

fraction The quotient of two quantities in the form $\frac{a}{b}$ where b is not equal to 0.

Fraction Busters A method of rewriting equations involving fractions that uses the Multiplicative Property of Equality to eliminate the fractions. To use this method, multiply both sides of an equation by the common denominator of all the fractions in the equation. The result will be an equivalent equation with no fractions. For example, when given the equation $\frac{x}{7} + 2 = \frac{x}{3}$, multiply both sides by the "fraction buster" 21. The resulting equation, $3x + 42 = 7x$, is equivalent to the original but contains no fractions.

fractional exponents Raising a number to a fractional exponent indicates a power as well as a root. $x^{\frac{a}{b}} = \sqrt[b]{x^a} = (\sqrt[b]{x})^a$.

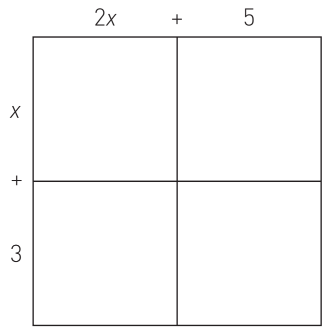
frequency The number of times that something occurs within an interval or data set.

function A relationship in which for each input value, there is one and only one output value. In terms of ordered pairs (x, y), no input (x) is paired with more than one different output (y). See the Methods & Meanings box in Lesson 1.3.3 for a fuller discussion. See also *description of a function* and *function notation*.

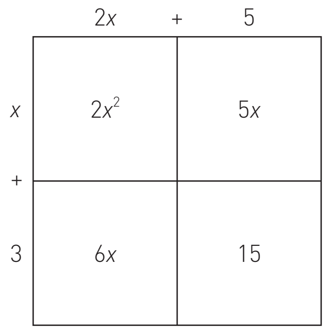
function notation A way of writing functions. When a rule expressing a function is written using function notation, the function is given a name, most commonly "f," "g," or "h." The notation $f(x)$ represents the output of a function, named f, when x is the input. It is pronounced "f of x". For example, $g(2)$, is pronounced "g of 2", and represents the output of the function g when $x = 2$. If $g(x) = x^2 + 3$, then $g(2) = 7$.

generator The mathematical rule for a sequence that tells you what to do to each term to get the next term. Note that this is different from the function for the nth term of the sequence. The generator only tells you how to determine the following term when you already know one term. In an arithmetic sequence, the generator is the common difference; in a geometric sequence, it is the multiplier or common ratio.

generic rectangle A type of diagram used to visualize multiplying expressions without algebra tiles. The expressions to be multiplied are adjacent side lengths of the rectangle, and the product is the sum of the areas of the sections of the rectangle. For example, the generic rectangle can be used to multiply $(2x + 5)$ by $(x + 3)$.



$(2x + 5)(x + 3)$
area as a product

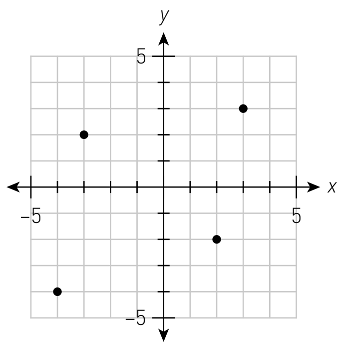


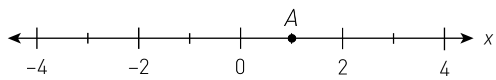
$2x^2 + 11x + 15$
area as a sum

geometric sequence A sequence generated by a multiplier. This means that each term of a geometric sequence is the product of the previous term and a constant (multiplier, generator, or common ratio). For example: 5, 15, 45… is the beginning of a geometric sequence with generator (common ratio) 3. In general, a geometric sequence can be represented as $a, ar, ar^2, \ldots, ar^{n-1}$.

Giant One A fraction that is equal to 1. Multiplying any fraction by a Giant One will create a new fraction equivalent to the original fraction. Giant Ones can also be made from the units of measurement.

graph A spatial representation of numerical information. The numbers may come from a table, situation (pattern), or equation (or inequality). Most of the graphs in this course show points, lines, and/or curves on a two-dimensional coordinate system, or on a single axis called a number line. Also see *complete graph*.





graphing form A form of the equation of a function or relation that clearly shows key information about the graph. For example, the graphing form for the general equation of a quadratic function (also called vertex form) is $y = a(x - h)^2 + k$. The vertex (h, k), orientation (whether a is positive or negative), and amount of stretch or compression can be determined from $|a| > 1$ or $|a| < 1$ in the equation.

greater than One expression is greater than another if its value is larger. This relationship is indicated with the greater than symbol ">". For example, 4 + 5 is greater than 1 + 1. So, $4 + 5 > 1 + 1$.

greatest common factor (GCF)

(a) For integers, the greatest positive integer that is a common factor of two or more integers. For example, the greatest common factor of 28 and 42 is 14.

(b) For two or more algebraic monomials, the product of the greatest common integer factor of the coefficients of the monomials and the lowest power of each shared variable in every term. For example, the greatest common factor of $12x^3y^2$ and $8xy^4$ is $4xy^2$.

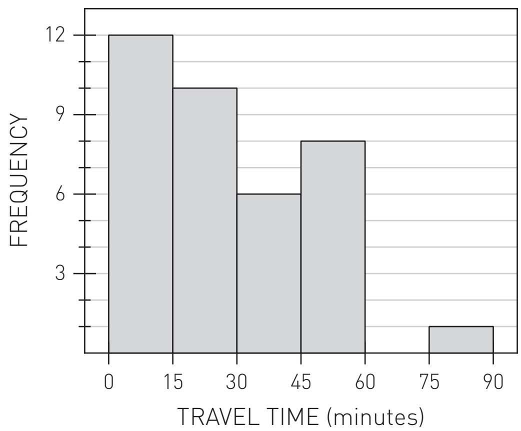
(c) For a polynomial, the greatest common monomial factor of its terms. For example, the greatest common factor of $16x^4 + 8x^3 + 12x$ is $4x$.

growth The increase of the output value as the input value increases. The growth of a graph of a linear relationship can be seen from the slope of the graph. Examining the growth is one useful way to analyze a mathematical relationship.

(h, k) In this course, h and k are used as parameters in general equations for families of functions or relations, to represent the horizontal and vertical shifts to the parent graph. In the case of quadratic functions, $f(x) = a(x - h)^2 + k$, the point (h, k) represents the coordinates of the vertex.

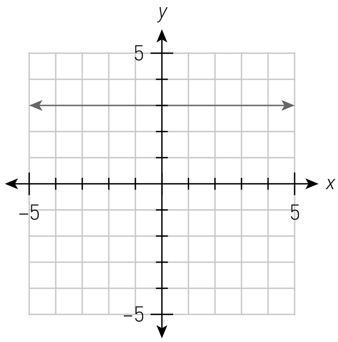
half-life The time it takes until only half of a decaying material remains.

histogram A way of displaying single-variable data that is similar to a bar graph in that the height of the bars is proportional to the number of elements. A histogram is for numerical data. Each bin (bar) of a histogram represents the number of data elements in a range of values, such as the number of people who take from 15 minutes up to, but not including, 30 minutes to get to school. Each bin should be the same width, and the bins should touch each other. Also see *bar graph*.



horizontal Parallel to the horizon. The x-axis of a coordinate graph is the horizontal axis.

horizontal lines Lines that are parallel to the x-axis. Horizontal lines have equations of the form $y = b$, where b can be any number. For example, the graph shows the horizontal line $y = 3$. The slope of any horizontal line is 0. The x-axis has the equation $y = 0$ because $y = 0$ everywhere on the x-axis.



horizontal shift The amount a graph is moved left or right relative to its parent graph. Used with parent graphs and general equations for functions and relations. For example, $y = a(x - h)^2 + k$ contains a horizontal shift of the parent graph $y = x^2$. The horizontal shift will be h units to the right if h is positive, and h units to the left if h is negative.

imaginary numbers The set of numbers created by multiplying the imaginary number i by every possible real number. The imaginary number i is defined as the square root of –1, or $i = \sqrt{-1}$. Therefore $i^2 = -1$. They are not positive, negative, or zero. These numbers are solutions of equations of the form x^2 = [a negative number]. In general, operations with imaginary numbers behave as they do with real numbers (e.g., $i + i = 2i$).

independent variable A variable that does not depend on the changes of another variable. For example, the speed of a car is related to the amount of force you apply to the gas pedal. In this example, the amount of force applied to the gas pedal is under the driver's control, so it serves as the independent variable. The independent variable appears as the input value in an (x, y) table and is plotted on the horizontal axis of a graph. The letter x and the horizontal x-axis are often used for the independent variable. In Statistics, the independent variable is often called the explanatory variable. Also see *dependent variable*.

inequality Consists of two expressions on either side of an inequality symbol. For example, the inequality $7x + 4.2 < -8$ states that the expression $7x + 4.2$ has a value less than –8.

inequality symbols $<$, $\leq$, $>$, and $\geq$. The symbol $\leq$ read from left to right means "less than or equal to." The symbol $\geq$ read from left to right means "greater than or equal to." The symbols $<$ and $>$ mean "less than" and "greater than" respectively. For example, "$7 < 13$" means that 7 is less than 13.

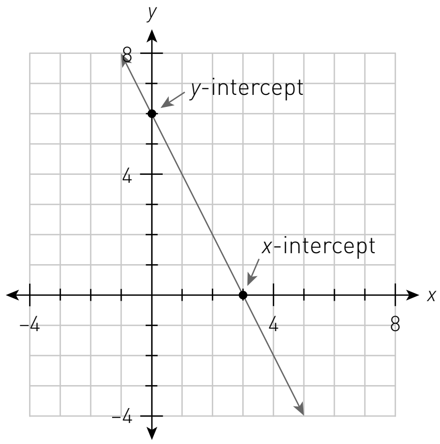
initial value The first term of a sequence.

input A replacement value for a variable in a function or relation. The first number in an ordered pair. The set of all possible input values is the domain of a function.

input value The independent variable in a relation. Substitute the input value into the rule (equation) to determine the output value. For example, consider a rule that calculates the cost of a salad at a salad bar based on its weight in ounces. The number of ounces would be the input value. The input value is in the first column in an (x, y) table, and is usually represented by the variable x. With functions, the input value is an element of the domain, and is the value that is substituted into the function.

integers The set of numbers { . . . −3, −2, −1, 0, 1, 2, 3, . . . }.

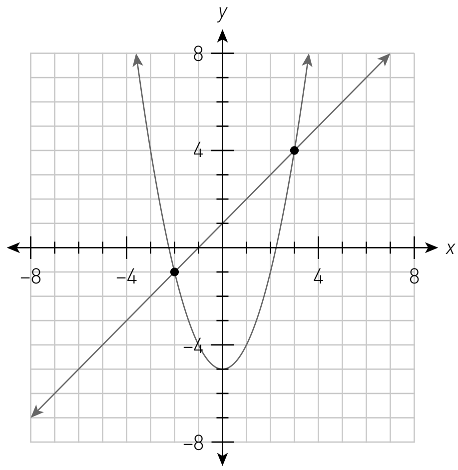
intercepts Points where a graph crosses the axes. x-intercepts are points at which the graph crosses the x-axis, and y-intercepts are points at which the graph crosses the y-axis. On the graph shown, the x-intercept is (3, 0) and the y-intercept is (0, 6).



interest An amount paid, which is a percentage of an initial value (principal). For example, a bank may offer 4% annual interest on a savings account, which means they will pay \$4.00 in interest for a principal of \$100 kept in the account for one year.

interquartile range (IQR) A way to measure the spread of data. It is calculated by subtracting the first quartile from the third quartile.

intersection A point that the graphs of two or more equations have in common. Graphs may intersect at one, two, or more points, or no points. The set of coordinates of a point of intersection is a solution to the equation for each graph.



interval A set of numbers between two given numbers.

inverse function A function that "undoes" what the original function does. The inverse of a function performs in reverse order the inverse operation for each operation of the function. The graph of an inverse function is a reflection of the graph of the original function across the line $y = x$. For example, the inverse of $y = x^3 + 2$ is $x = \sqrt[3]{y-2}$.

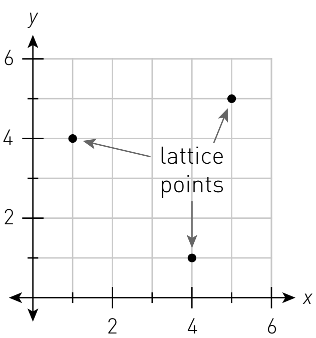
inverse operations Operations that undo each other. For example, subtraction is the inverse operation of addition, division is the inverse of multiplication, and square rooting is the inverse of squaring.

inverse proportion (or inverse variation) Two quantities, such as x and y, that have the relationship $y = \frac{k}{x}$, where $k \neq 0$ is the constant of proportionality. Also see *direct proportion*.

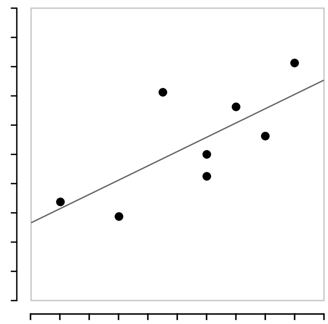
investigating a function To make a complete graph of the function and to write down everything you know about it. Some things to consider are domain, range, intercepts, asymptotes, inverse, and symmetry. Also see *complete graph*.

irrational numbers The set of numbers that cannot be expressed in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$. For example, π and $\sqrt{2}$ are irrational numbers. The decimal representation of irrational numbers never repeats and never ends. The square root of a number that is not a perfect square is irrational. It can be written in exact form as a radical, or it can be written as a decimal approximation: $\sqrt{2} \approx 1.414$.

lattice points The points on a coordinate grid where the grid lines intersect. The diagram shows three lattice points. In this course, the coordinates of lattice points are known coordinates, not approximations, and are typically integers.



least-squares regression line (LSRL) A unique best-fit line that is determined by making the squares of the residuals as small as possible.



less than

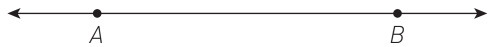
(a) One expression is less than another if its value is not as large. The relationship is indicated with the less-than symbol "<". For example, 1 + 1 is less than 4 + 5, and write $1 + 1 < 4 + 5$.

(b) Something is a certain quantity less than another amount. For example, a student movie ticket might cost two dollars less than an adult ticket.

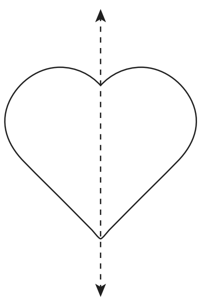
"let" statement Written at the beginning of a solution to identify the variable that will represent a certain quantity. For example, in solving a problem about sandwiches, begin by writing "Let s = the number of sandwiches eaten." It is particularly important to use "let" statements when writing mathematical sentences so that the readers will know what the variables in the sentences represent.

like terms Two or more terms that contain the same variable(s), with corresponding variables raised to the same power. For example, $5x$ and $2x$ are like terms. Also see *combining like terms*.

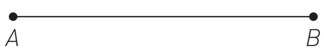
line Made up of an infinite number of points, is one-dimensional, straight, and extends without end. On the coordinate plane, a line is the graph of an equation of the form $y = mx + b$ or $ax + by = c$. A line can be named with a letter (such as *l*), but also can be labeled using two points on the line, such as $\overleftrightarrow{AB}$ shown. A line is a mathematically undefined term in geometry. Also see *ray* and *line segment*.



line of symmetry A line that divides a figure into two congruent parts that are reflections of each other across the line. Folding a shape over its line of symmetry results in both sides matching perfectly. Some shapes have more than one line of symmetry. Other shapes may only have one line of symmetry or no lines of symmetry.



line segment The portion of a line between two points. A line segment is named using its endpoints. For example, the line segment shown may be named either $\overline{AB}$ or $\overline{BA}$.



linear association See *association*.

linear equation An equation in two variables whose graph is a line. For example, $y = 2.1x - 8$ is a linear equation. The standard form for a linear equation is $ax + by = c$, where a, b, and c are constants and a and b are not both zero. Most linear equations can be written in $y = mx + b$ form, which is useful to determine the line's slope and y-intercept.

linear factor A factor of the form $(ax + b)$.

linear function A polynomial function of degree one or zero. The graph of a linear function is a line.

linear inequality An inequality with a boundary line represented by a linear equation.

linear model A linear function that summarizes the trend of bivariate data and can be used to make predictions. Trend lines and least-squares regression lines are examples of linear models.

linear regression A method for fitting a linear model to data on a scatter plot. Also see *regression* and *least-squares regression line*.

Looking Inside A method of solving one-variable equations that involves grouping, such as parentheses or absolute value. To use "Looking Inside," determine what the value of the entire expression inside the parentheses (or absolute value symbol) must be. Then use that fact to solve for the value of the variable. For example, to use "Looking Inside" to solve the equation $4(x + 2) = 36$, we first determine that $x + 2$ must equal 9. Then solve the equation $x + 2 = 9$, giving $x = 7$.

lower bound The lowest value that a prediction is likely to be. The lower bound is determined by the lower boundary line.

lower boundary line A line drawn parallel to and below a linear model, such as a least-squares regression line, at a distance equivalent to the largest residual. The lower boundary line determines the lower bound on the values that a prediction is likely to be.

lurking variable A hidden variable that was not part of the statistical study under investigation. Sometimes a lurking variable explains the true cause of an association between two variables.

m When the equation of a line is expressed in $y = mx + b$ form, the parameter m gives the slope of the line. For example, the slope of the line $y = -\frac{1}{3}x + 7$ is $-\frac{1}{3}$.

mapping Generally synonymous with "function." In this course, "mapping" refers to functions that take points on a line or in the plane to other points on a line or in the plane.

margin of error Half of the spread between the upper and lower bounds of a statistical prediction. For example, if the predicted weight is likely to be between a lower bound of 12 kg and an upper bound of 18 kg, the margin of error is 3 kg, and the prediction of the weight can be written as 15 ± 3 kg.

mathematical sentence An equation or inequality. For example, $2 + 7 = 3 \times 3$ is a mathematical sentence. A mathematical sentence can also contain variables. The mathematical sentence $b + g = 23$ might represent the fact that the total number of blue and green marbles in a bag is 23. It is helpful to define variables using "let" statements before using them in a mathematical sentence. Also see *"let" statement*.

maximum value The largest value in the range of a function.

mean One way of defining the "center" or "middle" or "typical value" of a set of numbers. The arithmetic mean is also known as the *average*. To calculate the mean of a numerical data set, add the values together and then divide by the number of values in the set. For example, the mean of the numbers 1, 5, and 6 is $(1 + 5 + 6) \div 3 = 4$. The mean accurately represents the center of a set of data when the distribution is symmetric and there are no outliers.

measure of central tendency Measures of the "center" or "middle" or "typical value" of a set of data such as mean and median. See *center (of a data distribution)*.

mean absolute deviation A way to measure the spread, or the amount of variability, in a set of data. The mean absolute deviation is the average of the distances to the mean, after the distances have been made positive with the absolute value. The standard deviation is a much more commonly used measure of spread than the mean absolute deviation.

median The middle number of a set of data that has been written in numerical order. If there is no distinct middle, then the mean of the two middle numbers is the median. The median is generally more representative of the "middle" or of a "typical value" than the mean when there are outliers or if the data distribution is not symmetric.

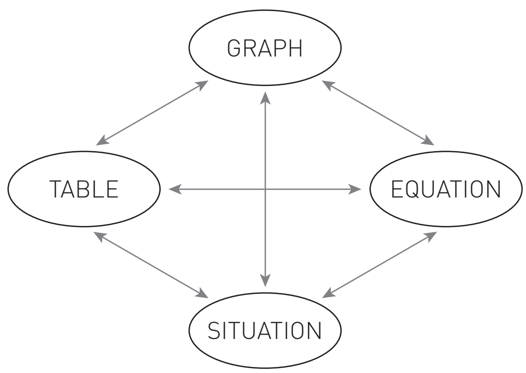
minimum value The smallest value in the range of a function or in a data set. For example, the y-coordinate of the vertex of a parabola that opens upward is the minimum value of that quadratic function.

model A mathematical summary (often an equation) of a trend in data, after making assumptions and approximations to represent a complicated situation. Models make it possible to describe data to others, compare data more easily with other data, and make predictions. For example, mathematical models of weather patterns predict the weather. No model is perfect, but some models are better at describing trends than others. Regression is a type of model. Also see *regression*.

modified box plot See *box plot*.

monomial An expression with only one term. It can be a number, a variable, or the product of a number and one or more variables. For example, 7, $3x$, $-4ab$, and $3x^2y$ are each monomials.

Multiple Representations Web An organizational tool used to emphasize the connections between the four representations of relationships. In this course, the four different ways of representing a relationship are a graph, a table, a situation (pattern), or a rule (equation or inequality).



multiplicative identity The number 1 is called the multiplicative identity because multiplying any number by 1 does not change the number. For example, $7(1) = 7$.

Multiplicative Identity Property Multiplying any expression by 1 leaves the expression unchanged. That is, $a(1) = a$. For example, $437x \cdot 1 = 437x$.

multiplicative inverse For a non-zero number, the number that can be multiplied by to get the multiplicative identity, 1. For example, for the number 5, the multiplicative inverse is $\frac{1}{5}$; for the number $\frac{2}{3}$, the multiplicative inverse is $\frac{3}{2}$.

Multiplicative Inverse Property For every nonzero number a, there is a number $\frac{1}{a}$ such that $a \cdot \frac{1}{a} = 1$. For example, the number 6 has a multiplicative inverse of $\frac{1}{6}$; $6 \cdot \frac{1}{6} = 1$. The multiplicative inverse of a number is usually called its reciprocal. For example, $\frac{1}{6}$ is the reciprocal of 6. For a number in the form $\frac{a}{b}$, where a and b are non-zero, the reciprocal is $\frac{b}{a}$.

Multiplicative Property of Equality Equality is maintained if both sides of an equation are multiplied by the same amount. That is, if $a = b$, then $a \cdot c = b \cdot c$. For example, if $y = 3x$, then $2(y) = 2(3x)$.

multiplier In a geometric sequence, the number multiplied by each term to get the next term. Also called the common ratio or the generator. The multiplier is also the number you can multiply by in order to increase or decrease an amount by a given percentage in one step. For example, to increase a number by 4%, the multiplier is 1.04. The multiplier for a decrease of 4% is 0.96.

mutually exclusive Two events are mutually exclusive if they have no outcomes in common.

natural numbers The positive integers, $\{1, 2, 3, \ldots\}$. They are also called the counting numbers.

negative exponents Raising a number to a negative exponent is the same as taking the reciprocal of the number. $x^{-a} = \frac{1}{x^a}$ for $x \neq 0$.

negative number A number less than zero. Negative numbers are graphed on the negative side of a number line. Zero is neither positive nor negative.

non-commensurate When no whole number multiple of one measurement can ever equal a whole number multiple of another measurement. For example, measures of 1 cm and $\sqrt{2}$ cm are non-commensurate, because no combination of items 1 cm long will ever have exactly the same length as a combination of items $\sqrt{2}$ cm long.

number line A diagram representing all real numbers as points on a line. All real numbers are assigned to points. The numbers are called the coordinates of the points, and the point for which the number 0 is assigned is called the origin. Also see *boundary point*.

number system The organizational structure used to categorize numbers. Examples include the real and complex number systems.

numerical data Data that can be represented on a number line.

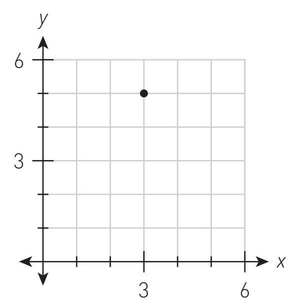
observed value An actual measurement, as opposed to a prediction made from a model.

one-dimensional Not having any width or depth. In this course, lines and curves are one-dimensional.

opposite Two numbers are opposites if they are the same distance from zero, but one is positive and the other negative. For example, 5 and −5 are opposites. The opposite of a number is also called its additive inverse, indicating that the sum of a number and its opposite is zero.

Order of Operations The specific order in which certain operations are to be carried out to evaluate or rewrite expressions. The order is: parentheses (or other grouping symbols), exponents (powers or roots), multiplication and division (from left to right), and addition and subtraction (from left to right).

ordered pair Two numbers written in order as follows: (x, y). The primary use of ordered pairs in this course is to represent points in an xy-coordinate system. The first coordinate (x) represents the horizontal distance and direction from the origin; the second coordinate (y) represents the vertical distance and direction from the origin. For example, the ordered pair (3, 5) represents the point shown. The input and output values of a function or relation can be represented as ordered pairs where x is the input and y is the output.



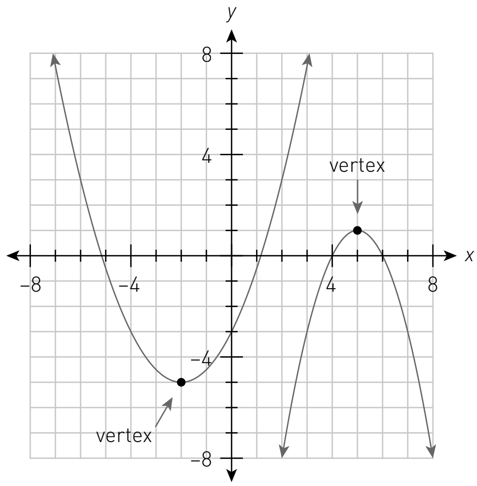
origin The point on a coordinate plane where the x- and y-axes intersect. This point has coordinates (0, 0). The point on a number line assigned to zero is also called the origin.

outlier A number in a set of data that is far away from the bulk of the data.

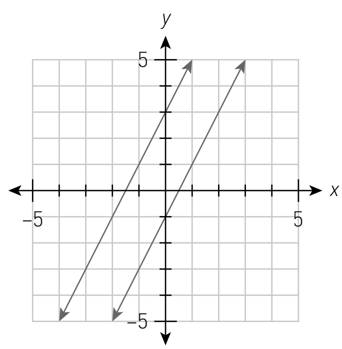
output Used to describe the result of applying a function or relationship rule to an input value. For the function $f(x) = x^2 - 73$ when the input is 10, the output is 27. Function notation shows how the function operates on the input to produce the output: $f(10) = 10^2 - 73 = 27$.

output value The value of the dependent variable for a particular input value in a given relation. Substituting the input value into a rule (equation) produces the output value. For example, consider a rule that calculates the cost of a salad at a salad bar based on its weight in ounces. The cost would be the output value. The output value appears in the second column in an (x, y) table, and is often represented by the variable y. With functions, the output value is an element of the range, and is the value that results from applying the rule for the function to an input value.

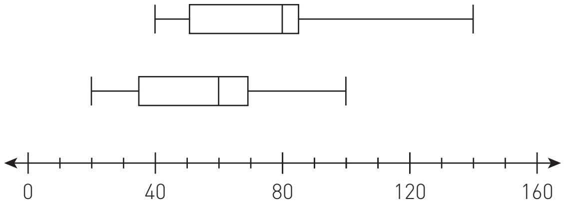
parabola A parabola is a particular kind of mathematical curve. In this course, a parabola is always the graph of a quadratic function, $y = ax^2 + bx + c$, where a does not equal 0. The diagram shows two parabolas. The highest or lowest point on the graph is called the vertex.



parallel Two or more straight lines on a flat surface that do not intersect, no matter how far they are extended, are parallel. If two lines have the same slope and do not coincide, they are parallel. For example, the graphs of $y = 2x + 3$ and $y = 2x - 1$ are parallel. When two equations have parallel graphs, the equations have no solutions in common.



parallel box plots Two box plots drawn on the same x-axis. Parallel box plots are used to compare the center and spread of two sets of data.



parameter In general equations where x and y represent the inputs and outputs of the function, variables such as a, b, c, m, h, and k are referred to as parameters, and they are often replaced with specific values. For example, in the equation $y = a(x - h)^2 + k$, a, h, and k are (variable) parameters that determine the shape and location, while x and y are the independent and dependent variables.

pattern A set of things in order that change in a regular way. For example, the numbers 1, 4, 7, 10, … form a pattern, because each number increases by 3. The numbers 1, 4, 9, 16, … form a pattern, because they are squares of consecutive integers. In this course, tile patterns are often examined because the number of tiles relates to the figure number. This relationship can be represented with a table, a rule (equation), or a graph.

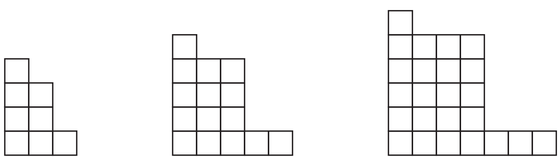


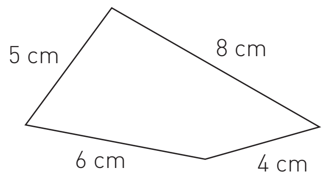
FIGURE 2 FIGURE 3 FIGURE 4

percent A ratio that compares a number to 100. Percents are written using the "%" symbol. For example, 0.75 is equal to $\frac{75}{100}$ or 75%.

perfect square form A quadratic equation in the form $(ax + b)^2 = c$, where a is nonzero. For example, $(2x + 3)^2 = 20$ is a quadratic equation in perfect square form.

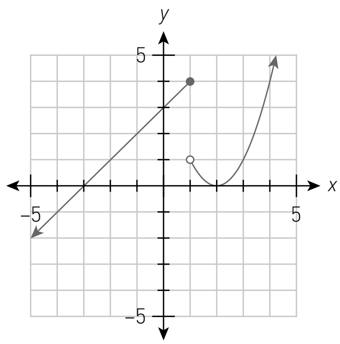
perfect square trinomials Trinomials of the form $a^2x^2 + 2abx + b^2$, where a and b are nonzero real numbers, and that factor as $(ax + b)^2$. For example, the perfect square trinomial $9x^2 - 24x + 16$ can be factored as $(3x - 4)^2$.

perimeter The distance around the exterior of a figure on a flat surface. For a polygon, the perimeter is the sum of the lengths of its sides. The perimeter of a circle is also called the circumference.

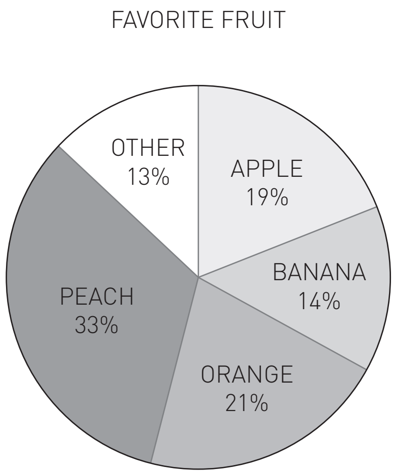


Perimeter = 23 cm

piecewise function A function composed of parts of two or more functions. Each part consists of a function with a restricted (limited) domain.

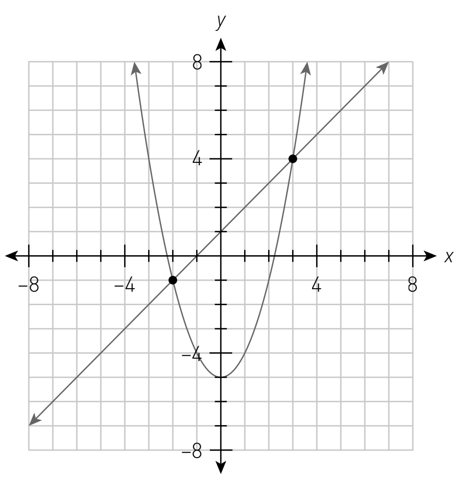


pie chart A way of displaying data that can be put into categories (like color preferences or the state you were born in). A pie chart shows the proportion of each category within the whole.



point An exact location in space. In two dimensions, an ordered pair specifies a point on a coordinate plane. *See ordered pair*.

point of intersection A point that the graphs of two equations have in common. For example, (3, 4) is a point of intersection of the two graphs shown. Two graphs may have one, several, or no points of intersection. The ordered pair representing a point of intersection gives a solution to the equations of both graphs.



point–slope form A linear equation written in the form $y - k = m(x - h)$, where (h, k) are the coordinates of a point on the line, and m is the slope of the line. For example, a line with slope −4 passing through the point (5, 8) has the equation $y - 8 = -4(x - 5)$. To determine the equation of the line in $y = mx + b$ form, solve the point–slope form equation for y.

polynomial An expression that is the sum or difference of two or more monomials (terms). For example, $x^8 - 4x^6y + 6x^4y^2$ is a polynomial.

positive number A number greater than zero. Positive numbers are graphed on the positive side of a number line. Zero is neither positive nor negative.

power An expression in the form x^n, or its value, where x is the base and n is the exponent. For example, 10^3 is a power with base 10 and exponent 3, and its value is 1,000. Also see *exponent*.

predicted value (of an association) The dependent (y-value) that is predicted for an independent (x-value) by the model for an association.

prime number A positive integer with exactly two factors. The only factors of a prime number are 1 and itself. For example, the numbers 2, 3, 17, and 31 are all prime. 31 has only 1 and 31 as factors.

principal Initial investment or capital. An initial value.

probability The likelihood of an outcome. The probability that an event A with a finite number of equally likely outcomes will occur is the number of outcomes for event A divided by the total number of equally likely outcomes. This can be written as $\frac{\text{number of outcomes for event } A}{\text{total number of possible outcomes}}$. The probability of an event A, written $P(A)$, is a ratio, $0 \leq P(A) \leq 1$.

probability table Another name for *two-way table*.

problem-solving strategies This course incorporates several problem-solving strategies, specifically, making a guess and checking it, using manipulatives (such as algebra tiles), making systematic lists, collecting data, graphing, drawing a diagram, breaking a large problem into smaller subproblems, working backward, and writing and solving equations. For example, a person who wishes to purchase a salad at a salad bar, knowing the cost per ounce, wants to figure out how many ounces they could buy with $10.00. They might approach the problem by writing an equation and solving it, making a table of ounces and prices, graphing the relationship, or guessing and checking various ounce amounts.

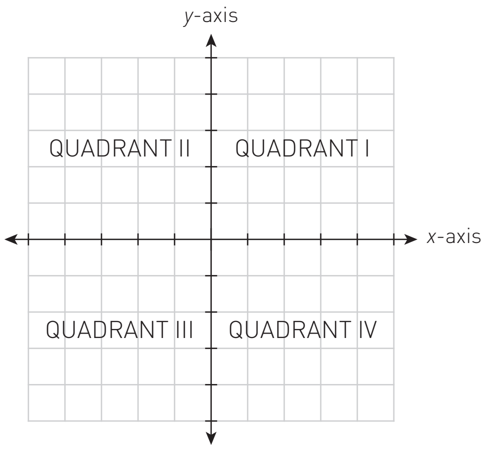
product The result of multiplying. For example, the product of 4 and 5 is 20; the product of $3a$ and $8b^2$ is $24ab^2$.

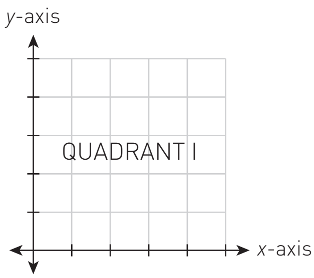
properties of exponents The properties of exponents are shown.

Property	Examples
$x^m x^n = x^{m+n}$ for all x	$x^3x^4 = x^{3+4} = x^7$ $2^5 \cdot 2^{-1} = 2^4$
$\frac{x^m}{x^n} = x^{m-n}$ for $x \neq 0$	$x^{10} \div x^4 = x^{10-4} = x^6$ $\frac{5^4}{5^7} = 5^{-3}$
$(x^m)^n = x^{mn}$ for all x	$(x^4)^3 = x^{3 \cdot 4} = x^{12}$ $(10^5)^6 = 10^{30}$
$x^0 = 1$ for $x \neq 0$	$\frac{y^2}{y^2} = y^0 = 1$ $9^0 = 1$
$x^{-1} = \frac{1}{x}$ for $x \neq 0$	$\frac{1}{x^2} = \left(\frac{1}{x}\right)^2 = (x^{-1})^2 = x^{-2}$ $3^{-1} = \frac{1}{3}$
$x^{\frac{m}{n}} = \sqrt[n]{x^m}$ for $x \geq 0$	$\sqrt{k} = k^{\frac{1}{2}}$ $y^{\frac{2}{3}} = \sqrt[3]{y^2}$

proportion An equation stating that two ratios (fractions) are equal. For example, the equation $\frac{x-8}{2x+1} = \frac{5}{6}$ is a proportion. A proportion is a useful type of equation when solving problems involving proportional situations.

quadrants The four sections of the coordinate plane divided by its axes. The quadrants are numbered as shown in the first diagram. When graphing data with no negative values, the graph may show only the first quadrant.



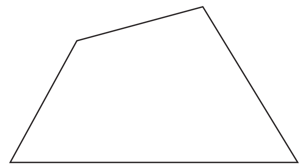


quadratic equation A polynomial equation where the highest power of the variable is 2. Quadratic equations can be written in the form $ax^2 + bx + c = 0$, where a, b, and c are real numbers, and a is nonzero. A quadratic equation written in this form is said to be in standard form. For example, $3x^2 - 4x + 7.5 = 0$ is a quadratic equation written in standard form.

quadratic expression An expression that can be written in the form $ax^2 + bx + c$, where a, b, and c are real numbers, and a is nonzero. For example, $3x^2 - 4x + 7.5$ is a quadratic expression.

Quadratic Formula $ax^2 + bx + c = 0$ and $a \neq 0$, then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. For example, if $5x^2 + 9x + 3 = 0$, then $x = \frac{-9 \pm \sqrt{9^2 - 4(5)(3)}}{2a} = \frac{-9 \pm \sqrt{21}}{10}$

quadrilateral A polygon with exactly four sides. The following shape is a quadrilateral.



quarterly Occurring four times a year.

quartile Along with the median, the quartiles divide a set of data into four groups of the same size. Also see *box plot*.

quotient The result of a division problem.

r See *correlation coefficient*.

radical An expression in the form $\sqrt{a}$, where $\sqrt{a}$ is the positive square root of a. For example, $\sqrt{49} = 7$. Also see *square root*.

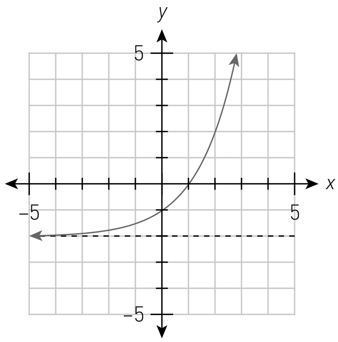
radical form A way of expressing a number using a radical symbol ($\sqrt{\ }$). It is a type of exact form used when a number cannot be simplified into a whole number or a clean fraction. For example, $\sqrt{5}$, $\sqrt{12}$, and $\sqrt{32}$ are all written in radical form. Also see *exact form* and *irrational numbers*.

radicand The expression under a radical sign. For example, in the expression $3 + 2\sqrt{x - 7}$, the radicand is $x - 7$.

range

(a) The range of a set of data is a statistic that represents the spread of the data. The range is the difference between the highest and lowest values.

(b) The set of all output values for a function or relation. For example, the range of the function graphed is $y > -2$. Also see *domain*.

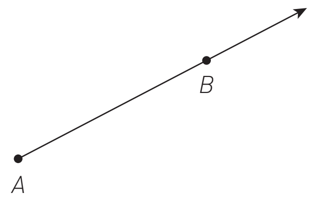


rate A ratio comparing two quantities, often a comparison of time. For example, miles per hour.

ratio A comparison of two quantities by division. A ratio can be written using a colon, but is more often written as a fraction. For example, a ratio of 5 to 11 can be written as 5:11 or as the fraction $\frac{5}{11}$.

rational number A number that can be written as a fraction $\frac{a}{b}$ where a and b are integers and $b \neq 0$. For example, 0.75 is a rational number because it can be expressed in the form $\frac{3}{4}$. The decimal representation of a rational number either terminates or repeats.

ray Part of a line that starts at one point and extends without end in one direction. In the example, ray $\overrightarrow{AB}$ is part of $\overleftrightarrow{AB}$ that starts at A and contains all the points of $\overleftrightarrow{AB}$ that are on the same side of A as point B, including A. Point A is the endpoint of $\overrightarrow{AB}$.



real numbers Irrational numbers together with rational numbers form the set of the real numbers. The following are all real numbers: 2.78, −13,267, 0, $\frac{3}{7}$, π, $\sqrt{2}$. A number line is a representation of all real numbers.

reciprocal The multiplicative inverse of a non-zero number. That is, for any non-zero number x, the reciprocal of x is $\frac{1}{x}$. For a number in the form $\frac{a}{b}$, where a and b are non-zero, the reciprocal is $\frac{b}{a}$. The product of a number and its reciprocal is 1. For example, the reciprocal of 12 is $\frac{1}{12}$, and $12 \cdot \frac{1}{12} = 1$. Also see *multiplicative inverse*.

recursive equation (for a sequence) An equation for a term in a sequence that requires knowing the previous term (or terms) in the sequence. For example, the equation for the Fibonacci sequence is recursive because you need to know the previous two terms to determine any other term. The equation for the Fibonacci sequence is $f(n) = f(n - 2) + f(n - 1)$, $f(1) = 1$, $f(2) = 1$. Also see *explicit equation*.

recursive sequence A sequence that can be described by a recursive equation. Also see *recursive equation*.

reflective symmetry A type of symmetry where one half of the image is a reflection across a line of the other half of the image. Folding along the line of symmetry will result in both halves matching exactly. Also see *line of symmetry*.

regression A method for calculating a best-fit line or curve from a set of points on a scatter plot. The most common type of regression is the least-squares regression line. In this course, there are also curved regressions: exponential regressions (fitting $y = a \cdot b^x$) and quadratic regressions (fitting $y = ax^2 + bx + c$).

relative frequency A ratio or percent. For example, if 60 people are asked their favorite color, and 15 people prefer "red," the relative frequency of people preferring red is $\frac{15}{60} = 25\%$.

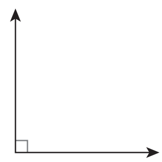
repeating decimal A decimal that repeats the same sequence of digits forever from some point onward. For example, 4.56073073073... is a decimal for which the three digits 073 continue to repeat forever. Repeating decimals are always the decimal expansions of rational numbers.

residual The distance a prediction is from the actual observed measurement in an association. The residual is the difference between the model-predicted y-value and the observed y-value. A residual can be graphed as a vertical segment extending from the observed point to the line or curve made by the model. It has the same units as the dependent variable (on the y-axis).

residual plot A display of the residuals of an association. A residual plot is created to assess the appropriateness of a model. If a model fits the data well, the residuals will not form a pattern—they will be randomly scattered.

Rewriting To write a different but equivalent equation or expression. In this course, "Rewriting" also refers to a method of solving one-variable equations. In "Rewriting," use algebraic techniques to write an equation equivalent to the original. An example is using the Distributive Property to eliminate parentheses. Then solve the equation using various solution methods, including, perhaps, rewriting it again. For example, to solve the equation $4(x + 2) = 36$ by "Rewriting," use the Distributive Property to rewrite the equation as $4x + 8 = 36$. Then solve this equation to determine that $x = 7$.

right angle An angle that measures 90°. A small square is used to denote a right angle, as shown.

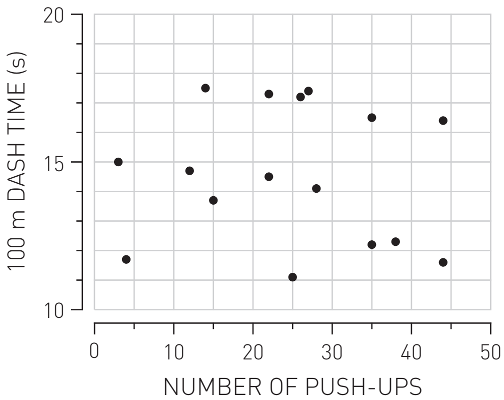


roots of a quadratic expression A value of x that makes a quadratic expression equal to zero. The roots or zeros are the solutions when the expression is set equal to zero. The x-intercepts of any quadratic function are roots.

rule An equation or inequality that represents the relationship between two numerical quantities. Use a rule to represent the relationship between quantities in a table, a pattern, a real-world situation, or a graph. For example, if x is the number of ounces of a salad, and y is the total cost of the salad, then the rule $y = 0.75x + 0.50$ represents the total cost y of a salad weighing x ounces.

scatter The variability in data. If data forms a pattern, then it can be described and modeled. Random scatter has no discernible pattern. (Note that "random scatter" does not mean "evenly scattered"—randomly scattered data often forms clusters and gaps.) Also see *variability* and *spread*.

scatter plot A way of displaying two-variable numerical data graphically. To create a scatter plot, the two corresponding values are plotted as coordinate pairs on a pair of coordinate axes (each axis representing a variable). Also see *association*.



scientific notation A way of writing a number as a product of two factors separated by a multiplication sign. The first factor must be less than 10 and greater than or equal to 1. The second factor has a base of 10 and an integer exponent.

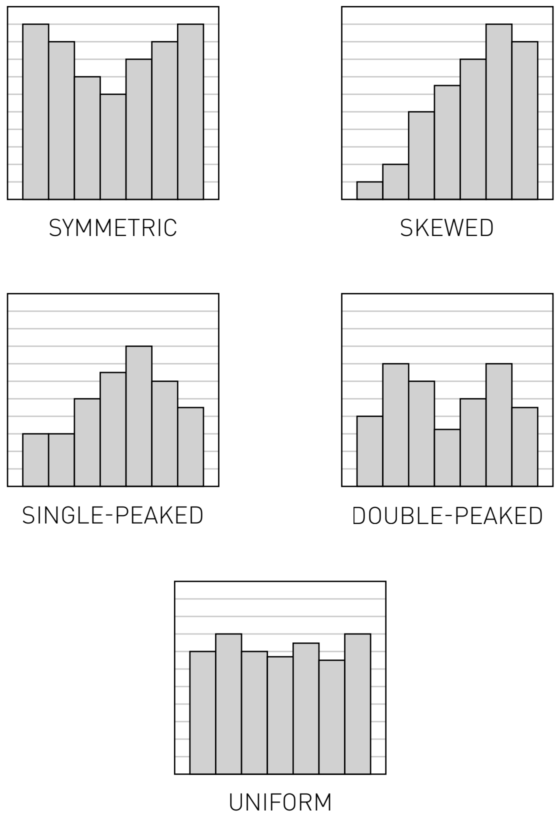
segment See *line segment*.

sequence An ordered set of objects, usually written as a list of numbers. A sequence can be thought of as a function in which the independent variable is the term number and the dependent variable is the term value.

sequence generator Tells what you do to each term to get the next term. Note that this is different from the function for the nth term of the sequence. In an arithmetic sequence, the generator is the common difference; in a geometric sequence, it is the multiplier or common ratio. Also see *arithmetic sequence* and *geometric sequence*.

set A collection of data or items.

shape (of a data distribution) Statisticians use the following words to describe the overall shape of a data distribution: symmetric, skewed, single-peaked, double-peaked, and uniform.



simple interest Interest paid on the principal alone.

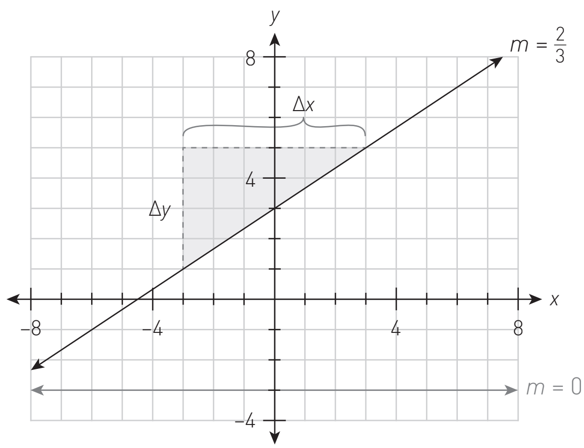
simple radical form A number, $r\sqrt{s}$, when there are no perfect square factors of s and no radicals in the denominator. For example, $5\sqrt{12}$ is not in simple radical form since 4 (the square of 2) is a factor of 12. But $10\sqrt{3}$ is in simple radical form and is equivalent to $5\sqrt{12}$.

single-peaked See *shape (of a data distribution)*.

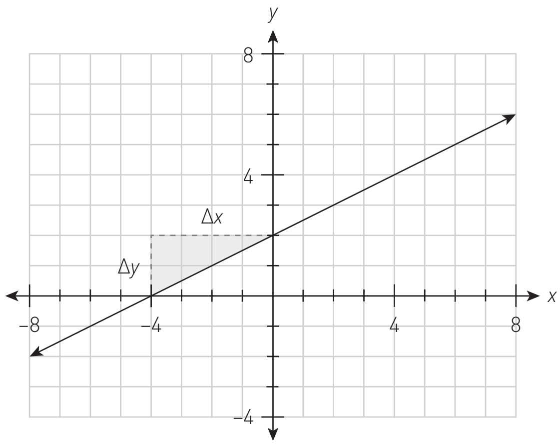
sketch To show the approximate shape of a graph in the correct location with respect to the axes, with key points clearly labeled.

skewed (data display) See *shape (of a data distribution)*.

slope A ratio that describes how steep (or flat) a line is. Slope can be positive, negative, or zero, but a straight line has only one slope. Slope is the ratio $\frac{\text{vertical change}}{\text{horizontal change}}$ or $\frac{\text{change in } y\text{-value}}{\text{change in } x\text{-value}}$, and is sometimes written $\frac{\Delta y}{\Delta x}$. When the equation of a line is written in $y = mx + b$ form, m is the slope of the line. Some texts refer to slope as the ratio "rise over the run." A line has a positive slope if it slopes upward from left to right on a graph, a negative slope if it slopes downward from left to right, zero slope if it is horizontal, and an undefined slope if it is vertical. Slope is interpreted in context as the amount of change in the y-variable for an increase of one unit in the x-variable.



slope triangle A right triangle drawn on a graph of a line so that the hypotenuse of the triangle is part of the line. The vertical leg length is the change in the y-value (Δy); the horizontal leg length is the change in the x-value (Δx). The lengths of the legs in the triangle are used to calculate the slope ratio $\frac{\Delta y}{\Delta x}$. For example, the diagram shows a slope triangle with $\Delta y = 2$, $\Delta x = 4$. The slope of the line in the example is $\frac{2}{4}$, or $\frac{1}{2}$.



slope–intercept form A linear equation written in the form $y = mx + b$. In this form, m is the slope of the line and the point $(0, b)$ is the y-intercept. Also see $y = mx + b$.

solution The number or numbers that, when substituted into an equation or inequality make the equation or inequality true. For example, $x = 4$ is a solution to the equation $3x - 2 = 10$ because $3(4) - 2 = 10$. A solution to a two-variable equation is sometimes written as an ordered pair (x, y). For example, $x = 3$ and $y = -2$ is a solution to the equation $y = x - 5$; this solution can be written as $(3, -2)$.

solve

(a) To calculate all the solutions to an equation or an inequality (or a system of equations or inequalities). For example, solving the equation $x^2 = 9$ gives the solutions $x = 3$ and $x = -3$.

(b) Solving an equation for a variable gives an equivalent equation that expresses that variable in terms of other variables and constants. Solving $2y - 8x = 16$ for y gives $y = 4x + 8$. The equation $y = 4x + 8$ has the same solutions as $2y - 8x = 16$, but it is another way to write the equation.

spread (of a data distribution) A measure of the amount of variability, or how "spread out" a set of data is. Some ways to measure spread are the range, the mean absolute deviation, the standard deviation, and the interquartile range. For symmetric distributions with no outliers, the standard deviation or the interquartile range can represent the spread of the data well. However, when outliers or non-symmetrical distributions are present, the interquartile range may be a better measure. Also see *variability*.

square root For a given number, the value that, when squared, gives that number. That is, a number a is a square root of b if $a^2 = b$. A negative number has no real square roots; a positive number has two; and zero has just one square root, namely, itself. Also see *radical*.

standard deviation A way to measure the spread, or the amount of variability, in a set of data. The standard deviation is the square root of the average of the distances to the mean, after the distances have been made positive by squaring. The standard deviation accurately reflects the spread of a set of data when the distribution is symmetric and has no outliers.

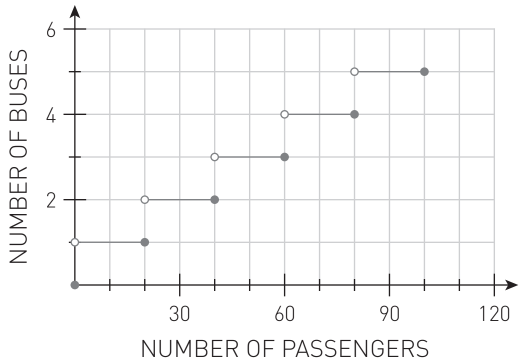
standard form of a linear equation A linear equation written in the form $ax + by = c$, where a, b, and c are real numbers and a and b are not both zero. For example, the equation $2.5x - 3y = 12$ is in standard form. When given the equation of a line in standard form, it can be useful to write an equivalent equation in $y = mx + b$ form to determine the line's slope and y-intercept.

standard form of a quadratic A quadratic expression in the form $ax^2 + bx + c$, $a \neq 0$. For example, the following are all expressions in standard form: $3m^2 + m - 1$, $x^2 - 9$, and $3x^2 + 5x$.

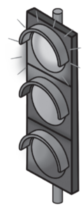
standard form of a sequence Uses the first term instead of the zeroth term. An arithmetic sequence in standard form is written as $f(n) = f(1) + d(n - 1)$, where $f(1)$ is the first term and d is the common difference. A geometric sequence in standard form is written as $f(n) = f(1) \cdot r^{n-1}$, where $f(1)$ is the first term and r is the common ratio.

statistic A numerical fact or calculation that is formed from data. For example, a mean or a correlation coefficient is a statistic. With a capital "S," Statistics is the field of study that is concerned with summarizing data and using probability to make predictions from data with natural variability.

step function A special kind of piecewise function (a function composed of parts of two or more functions). A step function has a graph consisting of a series of line segments that often resembles a set of steps.



stoplight icon The icon shown will appear periodically throughout the text. Problems that display this icon contain an error.



strength (of an association) A description of how much scatter there is in the data away from the line or curve of best fit. If an association is linear, the correlation coefficient, r, can be used to numerically describe and interpret the strength of the association.

subjects The people or items being measured in a statistical study.

substitution Replacing a variable or expression with a number, another variable, or another expression. For example, when evaluating the function $f(x) = 5x - 1$ for $x = 3$, substitute 3 for x to get $f(3) = 5(3) - 1 = 14$.

Substitution Method A method for solving a system of equations by replacing one variable with an expression involving the remaining variable(s). For example, in the system of equations $y = -3x + 5$ and $2y + 10x = 18$, the first equation tells you that y is equal to $-3x + 5$. Substitute $-3x + 5$ for y in the second equation to get $2(-3x + 5) + 10x = 18$, then solve this equation to determine x.

$$\begin{aligned} y &= -3x + 5 \\ 2y + 10x &= 18 \end{aligned} \quad \longrightarrow \quad \begin{aligned} y &= -3x + 5 \\ 2y + 10x &= 18 \\ 2(-3x + 5) + 10x &= 18 \\ -6x + 10 + 10x &= 18 \\ 10 + 4x &= 18 \\ 4x &= 8 \\ x &= 2 \end{aligned}$$

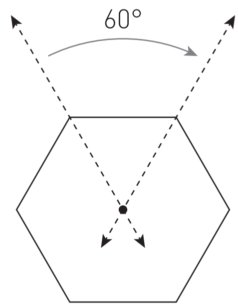
With x, substitute that value back into either of the original equations to calculate the value of y.

$$\begin{aligned} x &= 2 \\ y &= -3x + 5 \\ y &= -3(2) + 5 \\ y &= -6 + 5 \\ y &= -1 \end{aligned}$$

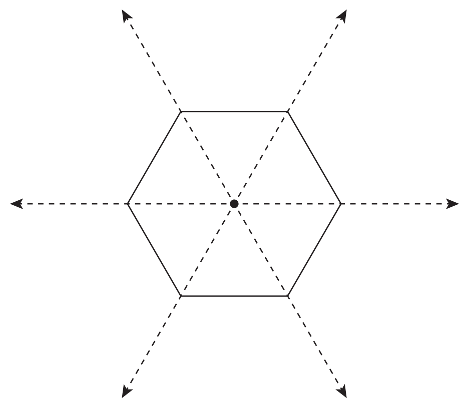
sum The result of adding two or more numbers. For example, the sum of 4 and 5 is 9.

symmetry

(a) Rotation symmetry: A shape has rotation symmetry when it can be rotated less than 360°, and it appears not to change. For example, a regular hexagon appears not to change if it is rotated 60° clockwise (or counterclockwise).



(b) Reflection symmetry: A shape has reflection symmetry when it appears not to change after being reflected across a line. A regular hexagon also has reflection symmetry across any line drawn through opposite vertices. See *reflection*, *rotation*, and *line of symmetry*.

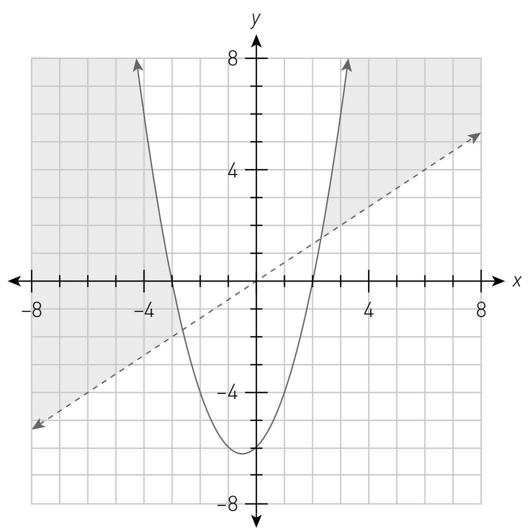


system of equations A set of equations with the same variables. Solving a system of equations means calculating one or more solutions that make each of the equations in the system true at the same time. A solution to a system of equations gives a point of intersection of the graphs of the equations in the system. There may be zero, one, or several solutions to a system of equations. For example, (1.5, −3) is a solution to the system of equations shown; setting $x = 1.5$, $y = -3$ makes both of the equations true. Also, (1.5, −3) is a point of intersection of the graphs.

$$y = 2x - 6$$
$$y = -2x$$

system of inequalities A set of inequalities with the same variables. Solving a system of inequalities means determining one or more regions on the coordinate plane whose points represent solutions to each of the inequalities in the system at the same time. There may be zero, one, or several such regions for a system of inequalities. For example, the shaded region shown is a graph of the system of inequalities.

$$y \le x^2 + x - 6$$
$$y > \frac{2}{3}x$$



term A single number, variable, or product of numbers and variables. A monomial is a term. In an expression, terms are separated by addition or subtraction signs. For example, in the expression $1.2x - 45 + 3xy^2$, the terms are $1.2x$, -45, and $3xy^2$. A term is also a component of a sequence.

term number In a sequence, a number that gives the position of a term in the sequence. A replacement value for the independent variable in a function that determines the sequence. Also see *sequence*.

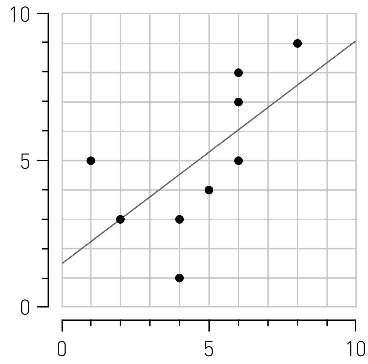
terminating decimal A decimal that has only a finite number of non-zero digits, such as 4.067. Terminating decimals are a particular kind of repeating decimal for which the repeating portion is zeros, so the example could be written 4.0670000000..., but it is not necessary to write the zeros at the end.

third quartile (Q3) The median of the upper half of a set of data that has been written in numerical order.

tile pattern See *pattern*.

transformation (of a function) The conversion of a function to a corresponding function, often by a factor of constant k. Transformations often slide, reflect, stretch, and/or compress graphs of functions. For example, the transformation $f(x) + k$ moves the graph of the function up or down by an amount k. The transformation $f(-x)$ reflects the graph of the function across the y-axis.

trend line A line drawn through the center of data plotted on a scatter plot. The trend line helps describe the data to make predictions. See *linear model*.



trinomial A polynomial that is the sum or difference of exactly three terms, each of which is a monomial. For example, $x^2 + 6x + 9$ is a trinomial.

two-dimensional Having length and width.

two-way table A way to display categorical two-variable data. The category of one variable is the row header, and the other variable is the column header. The entries in the table can be counts (frequencies) or percents (relative frequencies). Also see *conditional relative frequency table*.

Undoing A method of solving one-variable equations. In "Undoing," undo the last operation that was applied to an expression by applying its inverse operation. Then solve the resulting equation using various solution methods, including perhaps undoing again. For example, in the equation $4(x + 2) = 36$, the last operation that was applied to the left-hand side was a multiplication by 4. To use "Undoing," *divide* both sides of the equation by 4, giving $x + 2 = 9$. Then solve the equation $x + 2 = 9$ (perhaps by "Undoing" again and subtracting 2 from both sides) to determine that $x = 7$.

uniform See *shape (of a data distribution)*.

unit rate A rate written with a denominator of one.

upper bound The highest value that a prediction is likely to be. The upper bound is determined by the upper boundary line.

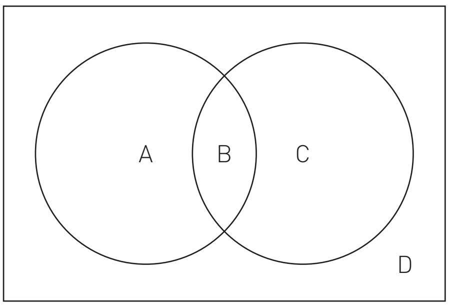
upper boundary line A line drawn parallel to and above a linear model, such as a least-squares regression line, at a distance equivalent to the largest residual. The upper boundary line determines the upper bound on the values that a prediction is likely to be.

"valid" moves When working with an Equation Mat or Expression Comparison Mat, there are certain "valid" moves that can be made with the algebra tiles that keep the relationship between the two sides of the mat intact. For example, removing an x tile from the positive region of each side of an Equation Mat is a valid move; it keeps the expressions on each side of the mat equal. The valid moves are those justified by the properties of the real numbers.

variability The inconsistency in measured data. Variability comes from two sources. Measurement error is the inconsistency in measurements of the same element repeated times and/or by different people. Element variability is the natural variation of the elements themselves. For example, even though in general, people with larger shoe sizes are taller, not all people with the same shoe size have the same height. That is element variability. Measurement error, on the other hand, might occur when the same person's height is measured multiple times, yielding slightly different results due to posture or the way the measuring tape is positioned. See *spread*.

variable A symbol used to represent one or more numbers. In this course, letters of the English alphabet are used as variables. For example, in the expression $3x - (8.6xy + z)$, the variables are x, y, and z.

Venn diagram A type of diagram used to classify objects, which is usually composed of two or more overlapping circles representing different conditions. An item is placed or represented in the Venn diagram in the appropriate position based on the conditions it meets. In the example Venn diagram, if an object meets one of two conditions, it is placed in region A or C, but not in region B. If an object meets both conditions, it is placed in the intersection (B) of both circles. If an object does not meet either condition, it is placed outside of both circles (region D).

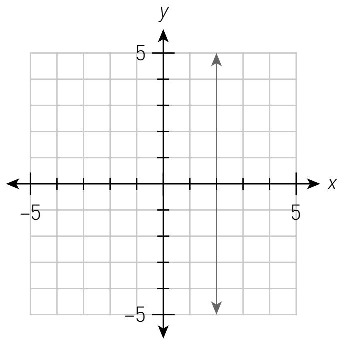


vertex (of a parabola) The highest (maximum) or lowest (minimum) point on a parabola, depending on the parabola's orientation. See *parabola*.

vertex form The form of a quadratic equation (also called graphing form) is written $y = a(x - h)^2 + k$. The point (h, k) is the vertex of this parabola.

vertical At right angles to the horizon. On a coordinate graph, the y-axis runs vertically.

vertical lines Lines that are parallel to the y-axis. All vertical lines have equations of the form $x = a$, where a can be any number. For example, the graph shows the vertical line $x = 2$. The y-axis has the equation $x = 0$ because $x = 0$ at every point on the y-axis. Vertical lines have an undefined slope.

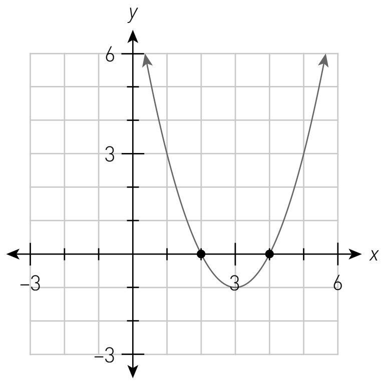


whole numbers The positive integers and zero, { 0, 1, 2, 3, . . . }.

***x*-axis** The horizontal number line on a coordinate graph. See *axes*.

***x*-coordinate** In an ordered pair, (x, y), that represents a point in the coordinate plane, x is the value of the x-coordinate. That is, the distance from the y-axis that is needed to plot the point.

***x*-intercept(s)** The point(s) where a graph intersects the x-axis. In two dimensions, the coordinates of the x-intercept are $(x, 0)$. A graph may have several x-intercepts, no x-intercepts, or just one. The x-intercepts of a graph can be written with coordinate pairs, but since the y-coordinate is always zero, often, just the x-coordinates of the x-intercepts are given. For example, the x-intercepts of the graph shown are (2, 0) and (4, 0), or simply say that the x-intercepts are 2 and 4.



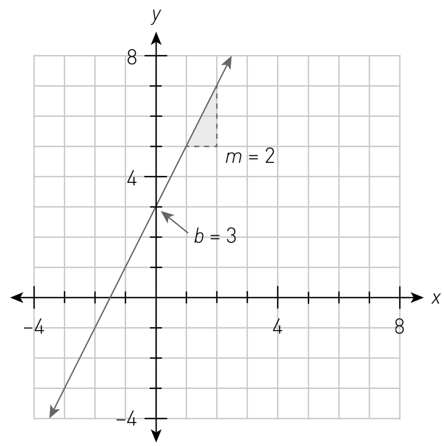
(*x*, *y*) table An (x, y) table represents pairs of values of two related quantities. The input value (x) appears first, and the output value (y) appears second. For example, the (x, y) table shows that the input value 10 is paired with the output value 18 for some rule.

In (x)	Out (y)
	8
0	−2
−4	−10
10	18
−2	
	198
0.5	

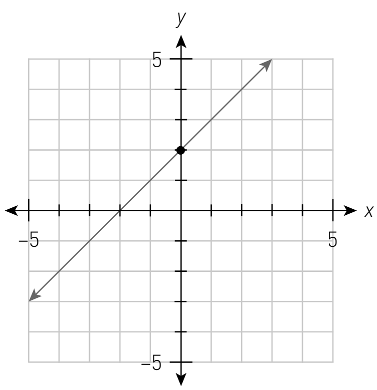
***y*-axis** The vertical number line on a coordinate graph. See *axes*.

***y*-coordinate** In an ordered pair, (x, y), that represents a point in the coordinate plane, y is the value of the y-coordinate. That is, the distance from the x-axis required to plot the point.

$y = mx + b$ The form of an equation used to represent two quantities, x and y, that have a linear relationship. The constant m is the slope, and b is the y-intercept of the graph. For example, the graph shows the line $y = 2x + 3$, which has a slope of 2 and a y-intercept of 3. This form of a linear equation is also called the slope–intercept form.



y-intercept(s) The point(s) where a graph intersects the y-axis. A function has at most one y-intercept; a relation may have several. The y-intercept of a graph is important because it often represents the starting value of a quantity in a real-world situation. For example, on the graph of a tile pattern, the y-intercept represents the number of tiles in Figure 0. The y-intercept of a graph can be written as a coordinate pair, but since the x-coordinate is always zero, the y-intercept is often given only by its y-coordinate. For example, the y-intercept of the graph shown is (0, 2), or simply, the y-intercept is 2. When a linear equation is written in $y = mx + b$ form, b is the y-intercept of the graph. For example, the equation of the graph shown is $y = x + 2$, and its y-intercept is 2.



zero A number often used to represent "having none of a quantity." Zero is neither negative nor positive. Zero is the additive identity.

Zero Product Property When the product of two or more factors is zero, one of these factors must equal zero. That is, if $a \cdot b = 0$, then either $a = 0$ or $b = 0$ (or both). For example, if $(x + 4)(2x - 3) = 0$, then either $x + 4 = 0$ or $2x - 3 = 0$ (or both). The Zero Product Property can be used to solve factorable quadratic equations.

zeros of a quadratic expression See *roots of a quadratic expression.*

zero power To raise any base (except 0) to an exponent of zero. The result of raising any number (except zero) to the zero power is 1. $x^0 = 1$ for any number $x \neq 0$.

zeroth term The initial value or starting point of a sequence.