



GLOSSARY

For commonly-used formulas, see inside back cover.

A

- abscissa** (5) the first element of an ordered pair
- absolute maximum** (171) a point that represents the maximum value a function assumes over its domain
- absolute minimum** (171) a point that represents the minimum value a function assumes over its domain
- absolute value function** (47) a piecewise function, written as $f(x) = |x|$, where $f(x) \geq 0$ for all values of x
- absolute value of a complex number** (586) The absolute value of the complex number $a + bi$ is $|a + bi| = \sqrt{a^2 + b^2}$.
- additive identity matrix** (80) If an $m \times n$ matrix I is a zero matrix, then I is an additive identity matrix, such that for any $m \times n$ matrix A , $A + I = A$.
- alternate optimal solutions** (114) When there are two or more optimal solutions for a linear programming problem, the problem is said to have alternate optimal solutions.
- ambiguous case** (320) Given two sides and a nonincluded angle, there exist two possible triangles with the given measures.
- amplitude** (368) $|A|$ for functions in the form $y = A \sin kx$ or $y = A \cos kx$
- amplitude of a complex number** (587) the angle θ when a complex number is written in the form $r(\cos \theta + i \sin \theta)$
- analytic geometry** (618) the study of coordinate geometry from an algebraic perspective
- angle of depression** (300) the angle between a horizontal line and the line of sight from the observer to an object at a lower level
- angle of elevation** (300) the angle between a horizontal line and the line of sight from the observer to an object at a higher level
- angular displacement** (352) As any circular object rotates counterclockwise about its center, an object at the edge moves through an angle relative to its starting position known as the angular displacement, or angle of rotation.
- angular velocity** (352) the change in the central angle with respect to time as an object moves along a circular path
- antiderivative** (955) $F(x)$ is an antiderivative of $f(x)$ if and only if $F'(x) = f(x)$.

- antilogarithm** (729) If $\log x = a$, then x is called the antilogarithm of a , abbreviated antilog a .
- apothem** (300) a segment from the center of a regular polygon perpendicular to a side of the polygon
- arccosine** (305) the inverse of $y = \cos x$, written as $x = \arccos y$
- arcsine** (305) the inverse of $y = \sin x$, written as $x = \arcsin y$
- arctangent** (305) the inverse of $y = \tan x$ written as $x = \arctan y$
- argument of a complex number** (587) The argument of the complex number $r(\cos \theta + i \sin \theta)$ is the angle θ .
- arithmetic mean** (758; 897) 1. the terms between any two nonconsecutive terms of an arithmetic sequence 2. a measure of central tendency found by dividing the sum of all values by the number of values
- arithmetic sequence** (757) a sequence in which the difference between successive terms is a constant
- arithmetic series** (759) the indicated sum of the terms of an arithmetic sequence
- asymptote** (180) a line that a graph approaches but never intersects
- axis of symmetry** (653) a line about which a figure is symmetric

B

- back-to-back bar graph** (889) a graph plotted on a two-quadrant coordinate system with the horizontal scale repeated in each direction from the central axis used to show comparisons
- bar graph** (889) a graphic form using bars to make comparisons of statistics
- Basic Counting Principle** (837) If event M can occur in m ways and is followed by an event N that can occur in n ways, then the event M followed by the event N can occur in $m \cdot n$ ways.
- best-fit line** (38) the graph of a prediction equation
- bimodal data** (899) data with two modes
- binomial experiment** (878) a problem that can be solved using binomial expansion
- boundary** (52) a line or curve that separates the coordinate plane into two regions
- box-and-whisker plot** (909) a diagram that graphically displays the median, quartiles, extreme values, and outliers in a set of data





cardioid (563) the graph of a polar equation of the form $r = a \pm a \sin \theta$ or $r = a \pm a \cos \theta$

center of a circle See circle.

center of a hyperbola (642) the midpoint of the segment whose endpoints are the foci

central angle (345) an angle whose vertex lies at the center of a circle

characteristic (727) the part of the logarithm of a number which is the exponent of 10 used to write the number in scientific notation

circle (623) the locus of all points in a plane at a given distance, called the radius, from a fixed point on the plane, called the center

circular arc (345) a part of a circle that is intercepted by a central angle of the circle

circular functions (292) functions defined using a unit circle

circular permutation (847) a circular arrangement of objects in a certain order

classic curves (564) special curves formed by graphing polar equations

class interval (890) the range of each class in a frequency distribution

class limits (890) the upper and lower values in each class in a frequency distribution

class marks (890) the means of the class limits in a frequency distribution

coinciding lines (32) The graphs of two equations that represent the same line are coinciding lines.

column matrix (78) a matrix that has only one column

combination (841) an arrangement of objects where the order is not a consideration

combinatorics (837) the investigation of the different possibilities for the arrangement of objects

common difference (757) the difference between the successive terms of an arithmetic sequence

common logarithms (726) logarithms that use 10 as the base

common ratio (764) the ratio of successive terms of a geometric sequence

comparison test (787) a method to test convergence in an infinite series

complements (853) Two events are complements if and only if the sum of their probabilities is 1.

completing the square (213) a process used to create a perfect square trinomial

complex conjugates (216, 582) The conjugate of the complex number $a + bi$ is $a - bi$.

complex number (206, 580) any number that can be written in the form $a + bi$, where a and b are real numbers and i is the imaginary unit

complex plane (586) The complex number $a + bi$ is graphed as the ordered pair (a, b) in the complex plane. The real axis is horizontal, and the imaginary axis is vertical.

components of a vector (488) two or more vectors whose sum is the given vector

composite (15) Given functions f and g , the composite function $f \circ g$ can be described by $[f \circ g](x) = f(g(x))$.

composition of functions See composite.

compound function (382) a function consisting of the sums or products of trigonometric functions

concentric circles (623) circles with the same center

conditional probability (868) the probability of an event under the condition that some preceding event has occurred

conic section (623) a curve determined by the intersection of a plane with a double right cone

conjugate See complex conjugates.

conjugate axis (642) the segment perpendicular to the transverse axis of a hyperbola through its center

consistent (67) A system of equations that has at least one solution is called consistent.

constant function (22, 137, 164) a function of the form $f(x) = b$

constant of variation (189) the constant k used with direct or inverse variation

constraints (112) conditions given to variables, often expressed as linear inequalities

continuous (160) A function is said to be continuous at point (x_1, y_1) if it is defined at that point and passes through that point without a break.

converge (784) If a sequence has a limit, then the related infinite series is said to converge.

convergent series (784) an infinite series that has a sum or limit

correlation coefficient (40) a value that describes the nature of a set of data. The more closely the data fit a line, the closer the correlation coefficient, r , approaches 1 or -1 .

cosecant (286, 292) For any angle, with measure α , a point $P(x, y)$ on its terminal side, $r = \sqrt{x^2 + y^2}$, $\csc \alpha = \frac{r}{y}$.

cosine (285, 291) For any angle, with measure α , a point $P(x, y)$ on its terminal side, $r = \sqrt{x^2 + y^2}$, $\cos \alpha = \frac{x}{r}$.

cotangent (286, 292) For any angle, with measure α , a point $P(x, y)$ on its terminal side, $r = \sqrt{x^2 + y^2}$, $\cot \alpha = \frac{x}{y}$.

coterminal angles (279) two angles in standard position that have the same terminal side



counterexample (421) an example used to show that a given statement is not always true

critical points (171) points at which the nature of a graph changes

cross product (507) The cross product of \vec{a} and \vec{b} if $\vec{a} = (a_1, a_2, a_3)$ and $\vec{b} = (b_1, b_2, b_3)$ is defined as follows.

$$\vec{a} \times \vec{b} = \begin{vmatrix} a_2 & a_3 \\ b_2 & b_3 \end{vmatrix} \vec{i} - \begin{vmatrix} a_1 & a_3 \\ b_1 & b_3 \end{vmatrix} \vec{j} + \begin{vmatrix} a_1 & a_2 \\ b_1 & b_2 \end{vmatrix} \vec{k}$$

cumulative frequency distribution (902) the sum of the frequency of a class and the frequencies of previous classes



decreasing (164) A function f is decreasing on an interval I if and only if for every a and b contained in I , $f(a) > f(b)$ whenever $a < b$.

definite integral (962) an integral that has lower and upper bounds

degenerate conic (623) the intersection of a plane with a double right cone resulting in a point, a line, or two intersecting lines

degree (277) the measure of an angle that is $\frac{1}{360}$ of a complete rotation in the positive direction

degree of a polynomial in one variable (206) the greatest exponent of the variable of the polynomial

dependent events (837) events that affect each other

dependent system (67) A system of equations that has infinitely many solutions is called dependent.

depressed polynomial (224) the quotient when a polynomial is divided by one of its factors

derivative of $f(x)$ (953) the function $f'(x)$, which is defined as $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$

determinant (98) a square array of numbers having a numerical value; the numerical value of the square array of numbers

differentiation (952) the process of finding derivatives

dilation (88) a transformation in which a figure is enlarged or reduced

dimensional analysis (353) a procedure in which unit labels are treated as mathematical factors and can be divided out

dimensions of a matrix (78) the number of rows, m , and the number of columns, n , of the matrix written as $m \times n$

direction of a vector (485) the directed angle between the positive x -axis and the vector

direction vector (520) a vector used to describe the slope of a line

directrix See parabola.

direct variation (189) y varies directly as x^n if there is some nonzero constant k such that $y = kx^n$, $n > 0$. The variable k is called the constant of variation.

discontinuous (159) A function is said to be discontinuous at point (x_1, y_1) if there is a break in the graph of the function at that point.

discriminant (215) in the quadratic formula, the expression under the radical sign, $b^2 - 4ac$

diverge (784) If a sequence does not have a limit, then the related infinite series is said to diverge.

divergent series (784) an infinite series that does not have a sum or limit

domain (5) the set of all abscissas of the ordered pairs of a relation

dot product See inner product.

doubling time (740) the amount of time it takes a quantity to reach twice its initial amount



eccentricity (636) the ratio of the distance between any point of a conic section and a fixed point to the distance between the same point of the conic section to a fixed line

element of a matrix (78) any value in the array of values

elimination method (68) a technique used to solve a system of equations

ellipse (631) the locus of all points in a plane such that the sum of the distances from two given points in the plane, called foci, is constant

end behavior (162) the behavior of $f(x)$ as $|x|$ becomes very large

equilateral hyperbola (647) a hyperbola with perpendicular asymptotes

equal matrices (79) Two matrices are equal if and only if they have the same dimensions and their corresponding elements are identical.

equal vectors (485) Two vectors are equal if and only if they have the same direction and the same magnitude.

escape set (599) the set of initial values for which the iterates of a function approach infinity

escaping point (816) If the iterates of a function approach infinity for some initial value, the initial point is called an escaping point.

even function (133) a function whose graph is symmetric with respect to the y -axis

everywhere discontinuous (159) A function that is impossible to graph in the real number system is said to be everywhere discontinuous.

experimental probability (877) a probability determined by performing tests or experiments and observing the outcomes

exponential decay (706, 712) Exponential decay occurs when a quantity decreases exponentially over time.

exponential function (704) a function in the form $y = a^x$, where a is a positive real number

exponential growth (706, 712) Exponential growth occurs when a quantity increases exponentially over time.

exponential series (806) the series by which e^x may be approximated;

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \frac{x^5}{5!} \dots$$

extraneous solution (251) a solution that does not satisfy the original equation

extremum (171) a maximum or minimum value of a function

F

failure (852) any outcome other than the desired outcome of an event

family of graphs (26) a group of graphs that displays one or more similar characteristics

Fibonacci sequence (804) a sequence in which the first two terms are 1 and each of the additional terms is generated by adding the two previous terms

focus (pl. **foci**) See parabola, ellipse, hyperbola.

fractal geometry (815) the study of the properties of fractals and their application to natural phenomena

frequency (372) the number of cycles per unit of time

frequency distribution (890) a system of organizing data by determining classes and the frequency of values in each class

frequency polygon (892) a broken line graph drawn by connecting the class marks on a histogram

function (6) a relation in which each element of the domain is paired with exactly one element in the range

function notation (7) In function notation, an equation of y in terms of x can be rewritten so that $y = f(x)$.

G

geometric mean (766) the terms between any two nonconsecutive terms of a geometric sequence

geometric sequence (764) a sequence in which the ratio between successive terms is a constant

geometric series (767) the indicated sum of the terms of a geometric sequence

goodness of fit (40) the degree to which data fits a regression line

greatest integer function (46) a step function, written as $f(x) = [x]$, where $f(x)$ is the greatest integer not greater than x

H

half plane (52) The graph of $y = mx + b$ separates the coordinate plane into two regions, called half planes.

hinges (909) in a box-and-whisker plot, the ends of the rectangular box which are located at the first and third quartiles

histogram (890) a type of bar graph in which the width of each bar represents a class interval and the height of the bar represents the frequency in that interval

horizontal asymptote (180) The line $y = b$ is a horizontal asymptote for a function $f(x)$ if $f(x) \rightarrow b$ as $x \rightarrow \infty$ or as $x \rightarrow -\infty$.

horizontal line test (153) a test used to determine if the inverse of a relation is a function

hyperbola (642) the locus of all points in the plane such that the absolute value of the difference of the distances from two given points in the plane, called foci, is constant.

hypotenuse (284) the side opposite the right angle in a right triangle

I

identity (421) a statement of equality between two expressions that is true for all values of the variable for which the expression is defined

identity matrix (99) The identity matrix of n th order, I_n , is the square matrix whose elements in the main diagonal, from upper left to lower right, are 1s, while all other elements are 0s.

image (88) the graph of an object after a transformation

image point (127) When applying point symmetry to a set of points, each point P in the set must have an image point P' which is also in the set.

imaginary number (206, 581) a complex number of the form $a = bi$ where $b \neq 0$ and i is the imaginary unit

imaginary part of a complex number (581) b in the complex number $a + bi$

inclusive events (863) two events whose outcomes may be the same

inconsistent system (67) a system of equations that has no solutions

increasing (164) A function f is increasing on an interval I if and only if for every a and b contained in I , $f(a) < f(b)$ whenever $a < b$.

indefinite integral (973) The antiderivative of $f(x)$, denoted by $\int f(x) dx$ is called the indefinite integral of $f(x)$.

independent events (837) events that do not affect each other

independent system (67) a system of equations that has exactly one solution

index of summation (792) the variable used with the summation symbol

infeasible (113) When the constraints of a linear programming problem cannot be satisfied simultaneously, then the system is infeasible.

inferential statistics (927) statistics based on information gathered in a sample to make predictions about a population

infinite discontinuity (159) as the graph of $f(x)$ approaches a given value of x , $|f(x)|$ becomes increasingly greater

infinite sequence (772) a sequence which has infinitely many terms

infinite series (776) the indicated sum of the terms of an infinite sequence

initial side of an angle (277) the fixed ray of an angle

inner product (505) If \vec{a} and \vec{b} are two vectors, $\langle a_1, a_2, a_3 \rangle$ and $\langle b_1, b_2, b_3 \rangle$, then the inner product of \vec{a} and \vec{b} is defined as follows.

$$\vec{a} \cdot \vec{b} = a_1b_1 + a_2b_2 + a_3b_3$$

This is also called a dot product.

integral (961) the area between the curve of a function, the x -axis, and the lines $x = a$ and $x = b$

integration (962) the process of finding the area under a curve

interquartile range (909) the difference between the first quartile point and the third quartile point

inverse function (152, 155) Two functions are inverse functions if and only if $[f \circ g](x) = [g \circ f](x)$ for all values of x .

inversely proportional (191) y varies inversely as x^n if there is some nonzero constant k such that $x^n y = k$ or $y = \frac{k}{x^n}$, $n > 0$.

inverse matrix (99) If $A = \begin{bmatrix} a_1 & b_1 \\ a_2 & b_2 \end{bmatrix}$ and

$$\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} \neq 0, \text{ then } A^{-1} = \frac{1}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}} \begin{bmatrix} b_2 & -b_1 \\ -a_2 & a_1 \end{bmatrix}.$$

inverse of a trigonometric function (305) the arccosine, arcsine, and arctangent relations

inverse process (154) To find the inverse of a function, an inverse process is used to solve for y after switching variables.

inverse relations (152) Two relations are inverse relations if and only if one relation contains the element (b, a) , whenever the other relation contains the element (a, b) .

iterate (16) each output of an iterated function

iteration (16, 581) the composition of a function and itself



joint variation (192) y varies jointly as x^n and z^n if there is some nonzero constant k such that $y = kx^n z^n$, where $x \neq 0$, $z \neq 0$, and $n > 0$.

Julia set (599) the boundary between the escape set and the prisoner set for the iteration of complex numbers through the quadratic equation $f(z) = z^2 + c$ where c is a complex number

jump discontinuity (159) The graph of $f(x)$ stops and then begins again with an open circle at a different range value for a given value of the domain.



leading coefficient (206) the coefficient of the term with the highest degree

leaf See stem-and-leaf plot.

legs (284) the two sides of a right triangle forming the right angle

lemniscate (564) The graph of a polar equation of the form $r^2 = a^2 \sin 2\theta$ or $r^2 = a^2 \cos 2\theta$.

level of confidence (929) The probability of the true mean being within a certain range of a sample mean may be expressed as a level of confidence.

limaçon (562) The graph of a polar equation of the form $r = a \pm b \sin \theta$ or $r = a \pm b \cos \theta$.

limit (772, 943) If there is a number L such that the value of $f(x)$ gets closer and closer to L as x gets closer to a number a , then L is called the limit of $f(x)$ as x approaches a . In symbols, $L = \lim_{x \rightarrow a} f(x)$.

linear equation (20) an equation of the form $Ax + By = 0$, where A and B are not both 0

linear function (22) a function defined by $f(x) = mx + b$, where m and b are real numbers

linear inequality (52) a relation whose boundary is a straight line

linearizing data (743) a method for modeling curve or exponential data that can be analyzed by linearizing the data and then applying a linear regression

linear programming (112) a procedure for finding the maximum or minimum value of a function in two variables subject to given constraints on the variables

linear velocity (353) distance traveled per unit of time

line plot (889) a display of statistical data on a number line so that patterns and variability in data can be determined

line symmetry (129) Two distinct points P and P' are symmetric with respect to a line ℓ if and only if ℓ is the perpendicular bisector of $\overline{PP'}$. A point P is symmetric to itself with respect to a line ℓ if and only if P is on ℓ .

locus (658) a set of points and only those points that satisfy a given set of conditions

logarithm (718) In the function $x = a^y$, y is called the logarithm, base a , of x .

logarithmic function (718) $y = \log_a x$, $a > 0$ and $a \neq 1$, which is the inverse of the exponential function $y = a^x$.

lower bound (238) the integer less than or equal to the least real zero of the polynomial $P(x)$

M

$m \times n$ matrix (78) a matrix with m rows and n columns

magnitude of a vector (485) the length of the directed line segment

major axis (631) the axis of symmetry of an ellipse which contains the foci

mantissa (727) the common logarithm of a number between 1 and 10

mathematical induction (820) a method of proof that depends on a recursive process

matrix (78) any rectangular array of terms called elements

maximum (121) a critical point of a graph where the curve changes from an increasing curve to a decreasing curve

mean (897) a measure of central tendency found by dividing the sum of all values by the number of values

mean deviation (910) the arithmetic mean of the absolute value of the deviations from the mean of a set of data

measure of central tendency (897) a number that represents the center or middle of a set of data

measure of variability (908) a number that represents the variability or diversity of a set of data

median (897) the middle value of a set of data that has been arranged into an ordered sequence

median class (902) in a frequency distribution, the class in which the median of the data is located

midline (380) a horizontal axis used as the reference line for vertical shifts of the graphs of sine and cosine functions

minimum (171) a critical point of a graph where the curve changes from a decreasing curve to an increasing curve

minor (98) The minor of an element of an n th-order matrix is the determinant of $(n - 1)$ th order found by deleting the row and column containing the element.

minor axis (631) the axis of symmetry of an ellipse which does not contain the foci

minute (277) a unit of angle measure that is $\frac{1}{60}$ of a degree

mode (897) the item of data that appears more frequently than any other in the set

model (27) an equation used to approximate a real-world set of data

modulus (587) the number r when a complex number is written in the form $r(\cos \theta + i \sin \theta)$

monotonicity (163) A function is said to be monotonic on an interval I if and only if the function is increasing on I or decreasing on I .

mutually exclusive events (862) two events whose outcomes can never be the same

N

natural logarithm (733) logarithms that use e as the base, written $\ln x$

n factorial (794) written $n!$, for n , an integer greater than zero, the product $n(n - 1)(n - 2) \cdots 1$

nonlinear regression (741) the process of fitting an equation to nonlinear data

nonsingular matrix (98) a matrix with a nonzero determinant

normal curve (918) a symmetric bell-shaped graph of a normal distribution

normal distribution (918) A frequency distribution that often occurs when there is a large number of values in a set of data: about 68% of the values are within one standard deviation of the mean, 95% of the values are within two standard deviations from the mean, and 99% of the values are within three standard deviations.

normal form (463) the equation of a line that is written in terms of the length of the normal from the line to the origin

normal line (463) a line that is perpendicular to another line, curve, or surface

n th order matrix (78) a square matrix with n rows and n columns

n th partial sum (759) the sum of the first n terms of a series



- odd function** (133) a function whose graph is symmetric with respect to the origin
- odds** (854) the ratio of the probability of the success of an event to the probability of its complement
- opposite vectors** (487) two vectors that have the same magnitude and opposite directions
- orbit** (815) the graph of the sequence of successive iterates
- ordered triple** (74; 500) 1. the solution of a system of equations in three variables 2. coordinates of the location of a point in space
- ordinate** (5) the second element of an ordered pair
- outlier** (909) a value of a set of data that is more than 1.5 interquartile ranges beyond the upper or lower quartiles



- parabola** (653) the locus of all points in a given plane that are the same distance from a given point, called the focus, and a given line, called the directrix
- parallel lines** (32) nonvertical coplanar lines that have equal slopes; any two coplanar vertical lines
- parallel vectors** (488) two vectors that have the same or opposite directions
- parameter** (520) the independent variable t in the vector equation of a line
- parametric equation of a line** (520) the vector equation $\langle x - x_1, y - y_1 \rangle = t\langle a_1, a_2 \rangle$ written as the two equations $x = x_1 + ta_1$ and $y = y_1 + ta_2$
- parent graph** (137) an anchor graph from which other graphs in the family are derived
- partial fraction** (244) one of the fractions that was added or subtracted to result in a given rational expression
- Pascal's triangle** (799) a triangular array of numbers such that the $(n + 1)^{th}$ row is the coefficient of the terms of the expansion $(x + y)^n$ for $n = 0, 1, 2, \dots$
- percentile** (922) The n th percentile of a set of data is the value of the data that is equal to or greater than n percent of the data.
- periodic function** (359) A function is periodic if, for some real number α , $f(x + \alpha) = f(x)$ for each x in the domain of f . The least positive value of α for which $f(x) = f(x + \alpha)$ is the *period* of the function.
- permutation** (838) the arrangement of objects in a certain order
- permutation with repetition** (846) the arrangement of objects in a certain order in which some of the objects are alike
- perpendicular lines** (34) any two nonvertical lines, the product of whose slopes is -1 ; any vertical line and any horizontal line
- phase shift** (378) the least value of $|k\theta + c|$, for which the trigonometric function $f(k\theta + c) = 0$
- piecewise function** (45) a function in which different equations are used for different intervals of the domain
- point discontinuity** (159) When there is a value in the domain for which $f(x)$ is undefined, but the pieces of the graph match up, then $f(x)$ has point discontinuity.
- point of inflection** (171) a critical point of a graph where the graph changes its curvature from concave down to concave up or vice versa
- point-slope form** (28) the equation of the line that contains the point with coordinates (x_1, y_1) and having slope m written in the form $y - y_1 = m(x - x_1)$
- point symmetry** (127) Two distinct points P and P' are symmetric with respect to point M , if and only if M is the midpoint of PP' . Point M is symmetric with respect to itself.
- polar axis** (553) a ray whose initial point is the pole
- polar coordinate system** (553) a grid of concentric circles and their center, which is called the pole, whose radii are integral multiples of 1
- polar equation** (556) an equation that uses polar coordinates
- polar form** (588) the complex number $x + yi$ written as $r(\cos \theta + i \sin \theta)$ where $r = \sqrt{x^2 + y^2}$ and $\theta = \text{Arctan} \frac{y}{x}$ where $x > 0$ and $\theta = \text{Arctan} \frac{y}{x} + \pi$ where $x < 0$
- polar graph** (556) the representation of the solution set which is the set of points whose coordinates (r, θ) satisfy a given polar equation
- polar plane** See polar coordinate system.
- pole** (180) 1. See polar coordinate system.
2. vertical asymptote of a rational function
- polygonal convex set** (108) the solution of a system of linear inequalities
- polyhedron** (535) a closed three-dimensional figure made up of flat polygonal regions
- polynomial equation** (206) a polynomial that is set equal to zero
- polynomial function** (206) a function $y = P(x)$ where $P(x)$ is a polynomial in one variable
- polynomial in one variable** (205) an expression of the form $a_0x^n + a_1x^{n-1} + \dots + a_{n-1}x + a_n$ where the coefficients a_0, a_1, \dots, a_n represent complex numbers, a_0 is not zero, and n represents a nonnegative integer
- population** (927) the entire set of items or individuals in the group being considered



power function (704) a function in the form $y = x^b$, where b is a real number

prediction equation (38) an equation suggested by the points of a scatter plot used to predict other points

pre-image (88) the graph of an object before a transformation

principal values (406, 456) the unique solutions of a trigonometric equation if the values of the function are restricted to two adjacent quadrants

prisoner point (816) If the iterates do not approach infinity for some initial value, that point is called a prisoner point.

prisoner set (599) the set of initial values for which the iterates of a function do not approach infinity

probability (852) the measure of the chance of a desired outcome happening

pure imaginary number (206, 581) the complex number $a + bi$ when $a = 0$ and $b \neq 0$

Q

quadrantal angle (278) an angle in standard position whose terminal side coincides with one of the axes

quartile (909) one of four groupings of a set of data determined by the median of the set and the medians of the sets determined by the median

R

radian (343) the measure of a central angle whose sides intercept an arc that is the same length as the radius of the circle

radical equation (251) an equation that contains a radical expression with the variable in the radicand

radical inequality (253) an inequality that contains a radical expression with the variable in the radicand

radius See circle.

random sample (927) a sample in which every member of the population has an equal chance to be selected

range (890) the difference of the greatest and least values in a set of data

range of a relation (5) the set of all ordinates of the ordered pairs of a relation

rate of change (956) the derivative of a function when applied to real-world applications

rational equation (243) an equation that consists of one or more rational expressions

rational function (180) the quotient of two polynomials in the form $f(x) = \frac{g(x)}{h(x)}$, where $h(x) \neq 0$

rational inequality (245) an inequality that consists of one or more rational expressions

ratio test (785) a method to test convergence in an infinite series

real part of a complex number (581) a in the complex number $a + bi$

rectangular form (581) a complex number written as $x + yi$, where x is the real part and yi is the imaginary part

rectangular hyperbola (648) A special case of the equilateral hyperbola, where the coordinate axes are the asymptotes. The general equation of a rectangular hyperbola is $xy = c$, where c is a nonzero constant.

recursive formula (758) a formula used for determining the next term of a sequence using one or more of the previous terms

reduced sample space (862) the subset of a sample space that contains only those outcomes that satisfy a given condition

reduction identity (446) identity that involves adding and subtracting the quadrantal angles, 90° , 180° , and 270° , from the angle measure to find equivalent values of a trigonometric function

reference angle (280) the acute angle formed by the terminal side of an angle in standard position and the x -axis

reflection (88) a linear transformation that flips a figure over a line called the line of symmetry

reflection matrix (89) a matrix used to reflect an object over a line or plane

regression line (40) a best-fit line

relation (5) a set of ordered pairs

relative extremum (172) a point that represents the maximum or minimum for a certain interval

relative maximum (172) a point that represents the maximum for a certain interval

relative minimum (172) a point that represents the minimum for a certain interval

resultant of vectors (486) the sum of two or more vectors

root (206) a solution of the equation $P(x) = 0$

rose (563) The graph of a polar equation of the form $r = a \cos n\theta$ or $r = a \sin n\theta$.

rotation (88) a transformation in which an object is moved around a center point

rotation matrix (91) a matrix used to rotate an object

row matrix (78) a matrix that has only one row

S

sample space (852) the set of all possible outcomes of an event

- scalar** (80, 488) a real number
- scalar quantity** (488) A quantity with only magnitude is called a scalar quantity.
- scatter plot** (38) a visual representation of data
- scientific notation** (695) the expression of a number in the form $a \times 10^n$, where $1 \leq a < 10$ and n is an integer
- secant** (286, 292) For any angle, with measure α , a point $P(x, y)$ on its terminal side, $r = \sqrt{x^2 + y^2}$, $\sec \alpha = \frac{r}{x}$.
- secant line** (953) a line that intersects a curve at two or more points
- second** (277) a unit of angle measure that is $\frac{1}{60}$ of a minute
- sector of a circle** (346) a region bounded by a central angle and the intercepted arc
- semi-interquartile range** (909) one-half the interquartile range of a set of data
- semi-major axis** (632) one of the two segments into which the center of an ellipse divides the major axis
- semi-minor axis** (632) one of the two segments into which the center of an ellipse divides the minor axis
- sequence** (757) a set of numbers in a specific order
- side adjacent** (284) the side of a right triangle that is a side of an acute angle in the triangle
- side opposite** (284) the side of a right triangle that is opposite an acute angle in the triangle
- sigma notation** (792) For any sequence a_1, a_2, a_3, \dots , the sum of the first k terms may be written $\sum_{n=1}^k a_n$, which is read “the summation from $n = 1$ to k of a_n .” Thus, $\sum_{n=1}^k a_n = a_1 + a_2 + a_3 + \dots + a_k$, where k is an integer value.
- simulation** (877) a technique used to model probability experiments for real-world applications
- sine** (285, 291) For any angle, with measure α , a point $P(x, y)$ on its terminal side, $r = \sqrt{x^2 + y^2}$, $\cos \alpha = \frac{y}{r}$.
- sinusoidal function** (388) a function of the form $y = A \sin(k\theta + c) + h$ or $y = A \cos(k\theta + c) + h$
- slant asymptote** (183) The oblique line ℓ is a slant asymptote for a function $f(x)$ if the graph of $f(x)$ approaches ℓ as $x \rightarrow \infty$ or as $x \rightarrow -\infty$.
- slope-intercept form** (21) the equation of a line with slope, m , and y -intercept, b , written in the form $y = mx + b$
- slope of a curve** (949) the slope of a line tangent to a particular point on the graph of a curve
- slope of a line** (20-21) the value $m = \frac{y_2 - y_1}{x_2 - x_1}$ where (x_1, y_1) and (x_2, y_2) , $x_2 \neq x_1$, are two points of the line
- solution** (67) an ordered pair representing the solution common to both equations in a system of equations
- solve a triangle** (307) to find all of the measures of a triangle’s sides and angles
- spiral of Archimedes** (564) a function of the form $r = n\theta$
- square matrix** (78) a matrix with the same number of rows as columns
- standard deviation** (911) a measure of the average amount by which individual items of data deviate from the arithmetic mean of all the data
- standard error of the mean** (927) the standard deviation of the distribution of a sample mean
- standard form** (21) a linear equation written in the form $Ax + By + C = 0$, where A , B , and C are real numbers and A and B are not both zero
- standard position** (277) an angle with its vertex at the origin and its initial side along the positive x -axis
- standard position of a vector** (485) If a vector has its initial point at the origin, it is in standard position.
- stem-and-leaf plot** (899) a display of numerical data for which each value is separated into two numbers, the stem which consists of the digits in the greatest common place value, and the leaf which contains the other digits of each item of data
- step function** (46) a function whose graph is a series of disjoint lines or steps
- substitution method** (68) a method for solving a system of equations
- success** (850) the desired outcome of an event
- symmetry identity** (424) trigonometric identities related to the symmetries of the unit circle
- symmetry with respect to the origin** (128) The graph of a relation S is symmetric with respect to the origin if and only if $(a, b) \in S$ implies that $(-a, -b) \in S$. A function has a graph that is symmetric with respect to the origin if and only if $f(-x) = -f(x)$ for all x in the domain of f .
- synthetic division** (223) a method used to divide a polynomial by a binomial
- system of equations** (67) a set of equations with the same variables
- system of linear inequalities** (107) a set of inequalities with the same variables



tangent (953; 285, 292) 1. a line that intersects a curve at exactly one point 2. For any angle, with measure α , a point $P(x, y)$ on its terminal side, $r = \sqrt{x^2 + y^2}$, $\tan \alpha = \frac{y}{x}$.

term (757) a number in a sequence or series

terminal side of an angle (277) a ray of an angle that rotates about the vertex

theoretical probability (877) probability determined using mathematical methods to model outcomes of a given situation

three-dimensional bar graph (890) a graphic form using bars to make comparisons among multiple aspects of statistical data

transformation (88) functions that map points of a graph onto its image

translation (88) a linear transformation that slides the graph vertically and/or horizontally on the coordinate plane, but does not change its shape

translation matrix (88) the matrix used to represent the translation of a set of points with respect to (h, k) which is equal to $\begin{bmatrix} h & h & h & h \\ k & k & k & k \end{bmatrix}$

transverse axis (642) the line segment that has as its endpoints the vertices of a hyperbola

tree diagram (837) a diagram used to show the total number of possible outcomes of an event

trigonometric form See polar form.

trigonometric functions (292) For any angle, with measure α , a point $P(x, y)$ on its terminal side, $r = \sqrt{x^2 + y^2}$, the trigonometric functions of α are as follows.

$$\begin{array}{lll} \sin \alpha = \frac{y}{r} & \cos \alpha = \frac{x}{r} & \tan \alpha = \frac{y}{x} \\ \csc \alpha = \frac{r}{y} & \sec \alpha = \frac{r}{x} & \cot \alpha = \frac{x}{y} \end{array}$$

trigonometric identity (421) an equation involving a trigonometric function that is true for all values of the variable. *See inside back cover for complete list of identities.*

trigonometric ratio (285) a ratio of the sides of a right triangle used to define the sine, cosine, and tangent ratios of the triangle

trigonometric series (806) infinite series that define the trigonometric functions sine and cosine

U

unbounded (113) The solution of a linear programming problem is unbounded if the region defined by the constraints is infinitely large.

unit circle (291) a circle of radius 1 unit whose center is at the origin of a rectangular coordinate system

unit vector (496) a vector of length 1 that is parallel to the x -, y -, or z -axis

upper bound (238) the integer greater than or equal to the greatest zero of the polynomial function

V

variance (912) the mean of the squares of the deviations from the arithmetic mean

vector (485) a quantity, or directed distance, that has both magnitude and direction

vector equation (520) A line through $P(x, y)$ parallel to the vector $\vec{a} = \langle a_1, a_2 \rangle$ is defined by the set of points $P_1(x_1, y_1)$ and $P(x, y)$ such that $\overrightarrow{P_1P} = t\vec{a}$ for some real number t . Therefore, $\langle x - x_1, y - y_1 \rangle = t\langle a_1, a_2 \rangle$.

vertex (277; 535) 1. the common endpoint of two rays forming an angle 2. the common endpoints of the sides of a polygon or where three or more edges of a polyhedron intersect

vertex matrix (88) a matrix used to represent the coordinates of the vertices of an object

vertex of a conic section (631, 642, 653) a point at which a conic section intersects its axis of symmetry

vertical asymptote (180) The line $x = a$ is a vertical asymptote for a function $f(x)$ if $f(x) \rightarrow \infty$ or $f(x) \rightarrow -\infty$ as $x \rightarrow a$ from either the left or the right.

vertical line test (7) a test used to determine if a relation is a function

W

whisker (909) the segments extending from the ends of the box in a box-and-whisker plot

X

x -intercept (20) the x -coordinate of the point at which the graph of an equation crosses the x -axis

Y

y -intercept (20) the y -coordinate of the point at which the graph of an equation crosses the y -axis

Z

zero (22, 206) a value of x for which $f(x) = 0$

zero matrix (80) a matrix whose elements are all zero

zero vector (485) a vector with initial and terminal points at the origin