

# INDEX

## A

Absolute value, 3  
equations, 13  
functions, 122, 136–138  
inverse of, 164–165  
inequalities, 14, 81–82  
Addition  
of complex numbers, 210–211  
distributive property of  
multiplication over, 99  
of polynomials, 9–10  
of radicals, 94–96  
of rational expressions, 53–56  
Addition property  
of equality, 5  
of inequality, 7  
Additive inverse, 2  
of complex numbers, 210  
Algebraic method in solving quadratic-linear systems, 231–233  
Ambiguous case (SSA), 569–573  
Amplitude, 447–449  
of a periodic function, 448  
Angle measures  
in degrees, 357–359, 383–384  
in radians, 400–404, 407–409  
Law of Cosines, finding triangle, 557–558  
Angle(s)  
coterminal, 359–360  
degree measures of, 357–359, 383–384  
of depression, 575  
of elevation, 575  
fourth-quadrant, 389–391  
function values of special, 378–380  
initial side of, 358  
quadrantal, 359  
radian measures of, 400–404, 407–409  
second-quadrant, 386–387  
standard position of, 358  
terminal side of, 358  
third-quadrant, 387–389

Angular speed, 361  
Antilogarithm, 333  
Arccosine, 383. *See also* Inverse cosine function  
domain of, 420  
graph of, 468–469  
range of, 420  
Arcsine, 383. *See also* Inverse sine function  
domain of, 420  
graph of, 468  
range of, 420  
Arctangent, 383. *See also* Inverse tangent function  
domain of, 421  
graph of, 469–470  
range of, 421  
Area  
under a normal curve, 702–703  
of a triangle, 559–562  
Arithmetic functions, transformations and, 152–153  
Arithmetic of imaginary numbers, 205  
Arithmetic mean(s), 255, 596–597  
Arithmetic sequence(s), 252–254, 350  
common difference for, 252  
Asymptote, 465  
horizontal, 300  
vertical, 321  
Axis of symmetry of the parabola, 140

## B

Base(s), 17  
natural, 302  
solving exponential equations with different, 306–307  
solving exponential equations with same, 306  
Base-ten number system, 39  
Bernoulli experiment, 696–697. *See also* Binomial experiment  
Bimodal data, 599  
Binomial, 10

Binomial distribution, 704  
normal approximation to the, 703–706  
Binomial expansion, 708–710  
Binomial experiment, 696–697. *See also* Bernoulli experiment  
Binomial probability  
graphing calculator and, 698–699  
normal curve and, 701–706  
Binomial probability formula, 696  
Binomial theorem, 708–710  
Bivariate statistics, 634–638  
Bombelli, Rafael, 203–204  
Box-and-whisker plot, 600–604  
Briggs, Henry, 319  
Bürge, Joost, 286

## C

Cause and effect, 644  
Census, 588  
Center of a circle, 167  
Center-radius form of the equation of a circle, 167–171  
Change of base formula, 339–340  
Circle, 167–171  
center of, 167  
diameter of, 167  
equation of  
center-radius form, 167–171  
standard form, 169–171  
radius of, 167  
unit, 362–363  
Coefficient  
correlation, 641–644  
of a quadratic equation, 221–222  
Cofunction, 425–427  
Combination, 683–685, 688–690  
Common binomial factor, 22  
Common difference, for arithmetic sequences, 252  
Common logarithms, 332–334  
Common monomial factor, 22  
Common ratio, 266

Commutative group, 3  
 Completely factored polynomial, 25  
 Completing the square, 187–191  
 Complex conjugate, 212  
 Complex fractions, 61  
   simplifying, 62–63  
 Complex number(s), 203–216  
   addition of, 210–211  
   additive inverse of, 210  
   division of, 214–215  
   graphing calculator and, 206, 207  
   multiplication of, 209, 211–214  
   multiplicative identity of, 212–213  
   operations with, 209  
   set of, 205–206  
   subtraction of, 211  
 Complex rational expressions, 61–63  
 Complex roots of a quadratic equation, 217–219  
 Composite functions, 155–156  
 Composition of functions, 155–159  
 Compounding periods, types of, 310–312  
 Conic sections, 183  
 Conjugates, 104  
 Consistent system, 229  
 Constant function, 122  
 Controlled experiment, 588  
 Convergence of sequences, 282  
 Coordinate plane  
   positioning of triangles on, 549  
   triangles in the, 560–562  
 Correlation, 635–636  
 Correlation coefficient ( $r$ ), 641–644  
   absolute value of, 641  
   properties of, 642  
 Cosecant function, 374–375, 416–417  
   domain of, 417  
   graph of, 463–464  
   range of, 417  
 Cosine function, 363, 415  
   domain of, 415  
   evaluating, 411  
   graph of, 442–445  
   unit circle and, 445  
   writing the equation of, 455–457  
   inverse, 420–421, 468–469  
   period of, 443  
   range of, 415  
 Cosine ( $A+B$ ), 493–495  
 Cosine ( $A-B$ ), 488–494  
 Cotangent function, 375  
   domain of, 418  
   graph of, 465  
   range of, 418  
 Coterminal angles, 359–360  
 Counting numbers, 2  
 Counting Principle, 673–675  
   probability form of, 689

Cube root, 84–85  
   principal, 85  
 Cubic curve, 648  
 Cumulative frequency, 606  
 Cycle, 436  
   of the sine function, 436

## D

Data, 588  
   bimodal, 599  
   collection of, 588–589  
   frequency distribution tables,  
     for grouped data, 607–611  
     for individual data values, 605–607  
   grouped, measures of central  
     tendency for, 605–611  
   linearized, 669  
   organization of, 590–593  
 Decimals, converting infinitely repeating,  
   to common fractions, 41  
 Degree measures of angles, 383–384  
 Degrees  
   changing radians to, 402–404  
   changing to radians, 401  
   relationship between radians and,  
     400–401  
 Denominator  
   least common, 54  
   rationalizing, 104–107  
 Dependent events, 674  
 Depression, angle of, 575  
 Descartes, René, 204, 286  
 Diagrams  
   box-and-whisker plots, 600–604  
   scatter plots, 634  
   stem-and-leaf, 590–593  
   tree, 673–674  
 Diameter of a circle, 167  
 Difference of two perfect squares, 25  
 Differences of angle measures  
   cosine, 488–491  
   sine, 497  
   tangent, 500  
 Directly proportional, 119, 133  
 Direct variation, 132–133  
 Discriminant, 198–201  
 Distributive property of multiplication  
   over addition or subtraction,  
     99  
 Divergence of sequences, 282  
 Division  
   of complex numbers, 214–215  
   of exponents, 287, 290, 291, 295  
   of radicals, 102–103  
   of rational expressions, 50–51  
 Division property  
   of equality, 5  
   of inequality, 17–19

Domain, 5, 120  
   of cosecant function, 417  
   of cosine function, 415  
   of cotangent function, 418  
   of secant function, 416  
   of sine function, 415  
   of tangent function, 417  
 Double-angle formulas, 504  
   cosine, 504–505  
   sine, 504  
   tangent, 505  
 Double root, 143, 199

## E

$e$ , 277  
 Element ( $\in$ ), 121  
*Elements* (Euclid), 79  
 Elevation, angle of, 575  
 Empirical probability, 688. *See also*  
   Experimental probability  
 Equality  
   addition property of, 5  
   division property of, 5  
   multiplication property of, 5  
   subtraction property of, 5  
 Equation(s), 5–6  
   absolute value, 13  
   of a circle  
     center-radius form, 167–171  
     standard form, 169–171  
   equivalent, 5  
   exponential, 340–343  
   logarithmic, 344–346  
   quadratic, 27  
   radical, 108  
   rational, 64–69  
   solving linear, 10  
 Equilateral triangle, function values,  
   378  
 Equivalent equations, 5  
 Eratosthenes, 353  
 Euclid, 79  
 Euclidean perfect numbers, 38  
 Evaluating powers, 288  
 Even function, 446  
 Events, 674  
   dependent, 674  
   independent, 674  
 Experimental probability, 688. *See also*  
   Empirical probability  
 Experiment(s)  
   Bernoulli, 696  
   binomial, 696  
   controlled, 588  
 Exponent(s), 17  
   fractional, 293–296  
   laws of, 287–288  
   negative, 290–291

Exponent(s) (*continued*)  
 solving equations involving, 304–305  
 zero, 289–290  
 Exponential curve, 647  
 Exponential decay, 298  
 Exponential equations, 306, 340–343  
   solving  
     with different bases, 306–307  
     with the same base, 306  
 Exponential function(s), 299  
   applications of, 308–310  
   compound periods and, 310–312  
   graphs of, 298–302  
   inverse of an, 320–322. *See also*  
     Logarithm  
     natural, 302  
 Exponential growth, 298  
 Extraneous root, 66  
 Extrapolation, 656–658  
 Extremes, 59

## F

Factored, completely, polynomial 25  
 Factorials, series containing, 275–276  
 Factoring,  
   polynomials, 22–25  
     binomial factors, 23  
     common binomial factor, 22  
     common monomial factor, 22  
     special products and factors, 25  
       difference of squares, 25  
   and solving trigonometric equations,  
     526–529  
 Factors  
   of monomial, 22  
   of polynomial, 22–25  
   common binomial, 22  
   common monomial, 22  
   opposite, 46–47  
 Fibonacci, 39  
 Finite sequence, 248  
 Finite series, 258  
   graphing calculator and, 259–260  
 First-degree trigonometric equations,  
   519–523  
 First-quadrant angle, 386  
 FOIL, 18  
 Formula(s)  
   binomial probability, 696  
   logarithmic change of base, 339  
   quadratic, 193–195  
   trigonometric  
     area of triangle, 560  
     differences of angle measures,  
       488–491, 497, 500  
     double-angle, 504–505,  
     half-angle, 508–511  
     Law of Cosines, 553, 557

  Law of Sines, 565  
   triple-angle, 515  
   sums of angle measures, 493–494,  
     497, 501  
 Fourth-quadrant angle, 389–391  
 Fraction(s)  
   complex, 61  
   converting infinitely repeating  
     decimal to, 41  
   reducing to lowest, 46  
   unit, 76  
 Fractional exponents, 293–296  
 Fractional radicands, 89–91  
 Frequency, 459  
   cumulative, 606  
 Frequency distribution table, 591  
   for grouped data, 607–611  
   for individual data values, 605–607  
 Function(s), 120  
   absolute value, 122, 136–138  
   composite, 155–156  
   composition of, 155  
   constant, 122  
   domain of, 120  
   even, 446  
   identity, 160–161  
   inverse, 161–164  
   linear, 122  
   odd, 440  
   polynomial, 140–141  
   quadratic, 122, 140–141  
   range of, 120  
   sequential, 247  
   square root, 122  
 Function arithmetic, 149–151  
   transformations and, 152–153  
 Function composition, transformations  
   and, 158–159  
 Function from set  $A$  to set  $B$ , 120–121  
 Function notation, 127–128  
 Function values  
   from the calculator, 381–383  
   in the right triangle, 376  
   of special angles, 378  
   equilateral triangle, 378–380  
   isosceles right triangle, 378

## G

General triangle, solving, 576–579  
 Geometric means, 267–269  
 Geometric probability, 690–691  
 Geometric sequence, 266–269, 350  
 Geometric series, 270–272  
 Graph(s)  
   of complex numbers, 207  
   of cosecant function, 463–464  
   of cosine function, 442–445  
   unit circle and, 445

  of cotangent function, 465  
   of exponential functions, 298–302  
   of logarithmic functions, 321–322  
   of quadratic functions, 190–191  
   of secant function, 464  
   of sine function, 435–438  
     unit circle and, 438–440  
   of tangent function, 460–462  
   of  $y = e^x$ , 302  
 Graphic method  
   in solving quadratic-linear systems,  
     230  
   of tangent function, 460–462  
 Graphing calculator  
   complex numbers, 206  
   function values from the, 381–383  
   probability  
     binomial, 698  
     combinations, 684  
     factorial, 680–681  
     permutations, 680–681  
   reference angles, 386–391  
   trigonometric equations 523–524  
   two variable inequalities, 235  
   sequences, 250  
     recursive, 282  
   series, finite, 259–260  
   statistics  
     binomial probabilities, 698–699  
     box-and-whisker plot, 601–602  
       with outliers, 616  
     correlation coefficient, 641  
     histogram, 593  
     mean, 610  
     median, 610  
     normal distribution, 630–631  
     normal approximation, 704–705  
     regression  
       linear 635, 641  
       non-linear, 648–649  
     standard deviation  
       population, 622  
       sample, 624–625  
 Grouped data, measures of central  
   tendency for, 605–611

## H

Half-angle formulas, 508  
   cosine, 508  
   sine, 509  
   tangent, 509  
 Harmonic motion, simple, 459  
 Hérigone, Pierre, 286  
 Higher degree polynomial equations,  
   224–226  
 Higher degree polynomial functions,  
   143–144  
 Histogram, 592–593

Horizontal asymptote, 300  
 Horizontal line test, 130–131  
 Hume, James, 286  
 Hyperbola, 175  
 Hypotenuse, 354

**I**

$i$ , powers of, 204–205  
 Identities, 411  
   proving, 485–487  
   Pythagorean, 411–412, 413, 483  
   quotient, 413, 486  
   reciprocal, 413, 483  
 Identity function (I), 160–161  
 Imaginary numbers  
   arithmetic of, 205  
   pure, 203  
   set of, 203–204  
 Independent events, 674  
 Index, 85  
 Inequalities, 7  
   absolute value, 14, 81–82  
   graphing, on the number line, 80–81  
   property of,  
     addition, 7  
     division, 7  
     multiplication, 7  
     subtraction, 7  
   quadratic, 30–34  
   solving, 32, 233–235  
 Infinite sequence, 248  
 Infinite series, 258, 273–275  
 Infinity ( $\infty$ ), 258  
 Initial side of an angle, 358  
 Integers, 2  
 Interest,  
   compounded annually, 310  
   compounded continuously, 310–311  
 Interpolation, 655–656  
 Interquartile range, 615–617  
 Interval notation, 81  
 Inverse  
   additive, 2  
   of functions,  
     absolute value, 164–165  
     cosine, 468–469  
     exponential, 320–322  
     quadratic, 165  
     sine, 468  
     tangent, 469–471  
   multiplicative, 40  
 Inverse cosine function, 420–421. *See also* Arccosine  
   domain of, 421  
   graph of, 468–469  
   range of, 421  
 Inverse of an exponential function,  
   320–322

Inverse functions, 161–165  
 Inverse sine function, 419–420. *See also* Arcsine  
   domain of, 420  
   graph of, 468  
   range of, 420  
 Inverse tangent function, 421–423. *See also* Arctangent  
   domain of, 421  
   graph of, 469–470  
   range of, 421  
 Inverse trigonometric functions,  
   419–423  
   graphs of, 468–471  
 Inverse variation, 174–176  
 Inversely proportional, 119. *See also* Vary inversely, two numbers  
 Irrational numbers, 79–80  
 Isosceles right triangle, function values,  
   378

**K**

al-Khwarizmi, Mohammed ibn Musa,  
 186

**L**

Law of Cosines, 552–554  
   using to find angle measure, 557–558  
 Law of Sines, 564–567  
 Laws of exponents, 287–288  
 Leaf, 590  
 Least common denominator (LCD), 54  
 Least common multiple (LCM), 54  
 Legs, 354  
 Leonardo of Pisa, 39  
 Like radicals, 95  
 Like terms, 10  
 Linear function(s), 122, 130–131  
   non-constant, 130  
   transformations of, 131–132  
 Linear regression, 635–637, 641–642  
 Linearized data, 669  
 Line of best fit, 635  
 Line segments  
   commensurable, 79  
   incommensurable, 79  
 Logarithm(s). *See also* Inverse of an exponential function  
   basic properties of, 327–328  
   change of base formula, 339–340  
   common, 332–334  
   natural, 336–338  
   of powers, 329–331  
   of products, 328  
   of quotients, 328–329  
 Logarithmic curve, 647

Logarithmic equations, 344–346  
 Logarithmic form of an exponential equation, 324–325  
 Logarithmic function(s), 319–351  
   common logarithms, 332–334  
   exponential equations, 340–343  
   graphs of, 321–322  
   inverse of an exponential function,  
     320–322  
   logarithmic equations, 344–346  
   logarithmic form of an exponential equation, 324–325  
   logarithmic relationships  
     basic properties of logarithms,  
       327–328  
     logarithms of powers, 329–331  
     logarithms of products, 328  
     logarithms of quotients, 328–329  
   natural, 336–338  
 Logarithmic growth, 322  
 Logarithmic relationships  
   basic properties of logarithms,  
     327–328  
   logarithms of powers, 329–331  
   logarithms of products, 328  
   logarithms of quotients, 328–329  
 Lowest terms, 45  
   reducing fraction to, 46

**M**

Many-to-one correspondence, 136  
 Mean, 59, 596–597  
   arithmetic, 255  
   geometric, 267–269  
 Measures of central tendency,  
   596–606  
   box-and-whisker plot, 600–604  
   mean, 596–597  
   median, 597–598  
   mode, 599  
 Measures of dispersion, 614–617  
   interquartile range, 615–617  
   range, 614–615  
 Median, 597–598  
 Mode, 599  
 Monomial, 9  
   multiplication of monomial by, 17–18  
   multiplication of polynomial by, 18  
 Multiplication  
   of complex numbers, 209, 211–214  
   distributive property of, over  
     addition or subtraction, 99  
   of exponents, 287, 290, 291, 294  
   of polynomials, 17–19  
   of radicals, 98–100  
   of rational expressions, 48–50  
   special products and factors in, 25  
   of sums that contain radicals, 99–100

Multiplication property  
 of equality, 5  
 of inequality, 17–19  
 Multiplicative inverse, 40  
 of complex numbers, 212–213

**N**

Napier, John, 39, 319, 350  
 Napier's bones, 350  
 Natural base, 302  
 Natural exponential function, 302  
 Natural logarithm, 336–338  
 Natural numbers, 2  
 Negative exponents, 290–291  
 Non-linear regression, 647–651  
 exponential, 647–650  
 logarithmic, 647–648, 650–651  
 power, 647–650  
   cubic, 648  
   quadratic, 648  
   sinusoidal, 654–655  
 Normal approximation to the binomial distribution, 703–706  
 Normal curve, 628  
   area under a, 702–703  
   binomial probability and, 701–706  
   standard deviation and the, 628–629  
 Normal distribution, 628–632  
   normal curve in, 628  
   standard deviation and the normal curve in, 628–629  
   z-scores in, 629–632  
 Notation  
   function, 127–128  
   interval, 81  
   set-builder, 120  
   sigma, 257–260  
 $n$  factorial, 275  
 $n$ th partial sum ( $S_n$ ), 262–263  
 $n$ th root of a number, 85–87  
 Number(s)  
   complex, 203–216  
   counting, 2  
   imaginary, 203–204  
   irrational, 79, 80  
   natural, 2  
    $n$ th root of, 85–87  
   perfect, 38  
     Euclidean, 38  
   prime, 89  
   rational, 40, 41  
   real, 80  
   whole, 2  
 Number  $e$ , 277  
 Number line, 2  
   graphing inequalities on the, 80–81

Number sentences, writing and solving, 5–6  
 Number system, base-ten, 39

**O**

Observational study, 588  
 Odd function, 440  
 One-to-one correspondence, 130  
 Onto, 121–122  
 Opposites, 2  
 Oscillation of sequences, 282  
 Outcome(s), 673  
   probability with two, 695–699  
 Outlier, 615

**P**

Parabola, 140  
   axis of symmetry of the, 140  
   turning point or vertex of, 140  
 Pascal's Triangle, 709  
 Percentile, 607  
 Perfect numbers, 38  
   Euclidean, 38  
 Perfect square trinomial, 197–198  
 Period, 436, 449–451  
   of the cosine function, 443  
   of the sine function, 436  
   of the tangent function, 460  
 Periodic function, 439  
 Permutations, 678–683, 688–690  
   with repetition, 681–683  
 Phase shift, 451–453  
 Pi ( $\pi$ ), 80  
 Plane, finding sine and cosine using any point on the, 367  
 Plot  
   box-and-whisker, 600–604  
   scatter, 634–636  
 Polynomial(s), 9  
   addition of, 9–10  
   completely factored, 25  
   factoring, 22–25  
     binomial factors, 23  
     common binomial factor, 22  
     common monomial factor, 22  
     special products and factors, 25  
       difference of squares, 25  
   multiplication of, 17–19  
     by binomial, 18  
     by monomial, 18  
     by polynomials, 19  
   prime, 25  
 Polynomial equation(s)  
   of degree two, 27  
   solving higher degree, 224–226

Polynomial function(s), 140–147  
   degree three or greater, 143–144  
   roots of, 142–144  
     and graph of, 144–147  
   solving higher degree, 224–226  
 Population, 588  
   standard deviation based on the, 622  
 Power(s), 17  
   evaluating, 288  
   of  $i$ , 204–205  
   of a product, 287, 290, 291  
   of a quotient, 287, 290, 291  
   logarithms of, 329–331  
 Power curve, 647  
 Prime number, 89  
 Prime polynomial, 25  
 Principal cube root, 85  
 Principal  $n$ th root, 85  
 Principal square root, 84  
 Probability  
   binomial  
     graphing calculator and, 698–699  
     normal curve and, 701–706  
   binomial theorem and, 708–710  
   combinations in, 683–685, 688–690  
   counting principle and, 673–675  
   empirical, 688  
   experimental, 688  
   geometric, 690–691  
   permutations in, 678–681, 688–690  
   permutations with repetition in, 681–685  
   theoretical, 687  
   with two outcomes, 695–699  
 Product, logarithm of, 328  
 Properties of equality, 5  
 Properties of inequality, 7  
 Proportion, 59–60  
 Pure imaginary number, 203  
 Pythagorean identities, 411–413, 483

**Q**

Quadratic curve, 648  
 Quadratic equation, 27  
   coefficients of, and its roots, 221–222  
   complex roots of, 217  
   discriminant and, 198–199  
   real roots of a, 187–190  
   solving, 27  
   standard form, 27  
   writing, given the roots of the equation, 219–221  
 Quadratic formula, 193–195  
   alternate derivation of the, 197–198  
   using, to solve trigonometric equations, 530–533

Quadratic function, 122, 140–141  
 graph of, 190–191  
 inverse of, 165  
 roots of, 142–143  
 transformations of, 141–142  
 Quadratic inequalities, 30–34  
 solving, 32, 233–235  
 two variable, 234–235  
 Quadratic-linear system, 229–235  
 of equations, 229–233  
 solving, 229–233  
 algebraic method, 231–233  
 graphic method, 230  
 of inequalities, 233–235  
 solving, 233–235  
 using the graphing calculator, 235  
 Quadrantal angle, 359  
 Quartile, 599–600  
 first or lower, 600  
 second, 600  
 third or upper, 600  
 Quotient identities, 413, 483  
 Quotient, logarithm of, 328–329

## R

Radian(s), 399, 400  
 changing degree to, 401  
 changing to degrees, 402–404  
 finding angle measures in, 407–409  
 in finding trigonometric function values, 406–407  
 relationship between degrees and, 400–401  
 unit circle and, 410–411  
 Radical(s), 85  
 addition of, 94–95  
 division of, 102–103  
 like, 95  
 multiplication of, 98–100  
 simplifying, 88–89  
 simplifying unlike, 95–96  
 subtraction of, 94–95  
 unlike, 95  
 Radical equation, 108  
 solving, 108–112  
 Radicand, 85  
 fractional, 89–91  
 Radius of a circle, 167  
 Raising an exponent to a power, 287, 290, 291, 295  
 Range, 614–615  
 of cosecant function, 417  
 of cosine function, 415  
 of cotangent function, 418  
 of the function, 120  
 interquartile, 615–617  
 of secant function, 416  
 of sine function, 415  
 of tangent function, 417  
 Ratio, 57  
 common, 266  
 simplest form of, 266  
 Rational equations, solving, 64–69  
 Rational expressions, 44  
 addition of, 53–56  
 complex, 61–63  
 division of, 50–51  
 multiplication of, 48–50  
 simplifying, 44–46  
 subtraction of, 53–56  
 Rational inequalities, solving, 70–73  
 Rationalizing a denominator, 104–107  
 Rational numbers, 40, 41  
 Real numbers, 80  
 Real roots of a quadratic equation, 187–190  
 Reciprocal, 40  
 Reciprocal functions, 374  
 Reciprocal identities, 413, 483  
 Reciprocal trigonometric functions, 374  
 cosecant function, 374–375  
 cotangent function, 375  
 function values in the right triangle, 376  
 graphs of, 463–466  
 secant function, 374  
 Recursive definition, 248–249  
 Reference angles, 387–391, 519  
 of fourth-quadrant angles, 389–391  
 of second-quadrant angles, 386–387, 391  
 of third-quadrant angles, 387–389, 391  
 Regression  
 linear, 635–637, 641–642  
 non-linear, 647–651  
 Regression line, 635  
 Relations, 120–124  
 Repetition, permutations with, 681–685  
 Restricted domain, 420  
 Right triangle(s)  
 function values in the, 376  
 hypotenuse of, 354  
 isosceles, 378  
 legs of, 354  
 solving, 575–576  
 trigonometry of, 354–356  
 Roomen, Adriaan van, 286  
 Roots, 5  
 of a polynomial function, 142–143.  
*See also* Zeros  
 double, 143

of a quadratic equation, 187–190  
 complex, 217–219  
 double, 199  
 sum and product of, 219–222  
 writing quadratic equation given, 219–221  
 and radicals, 84–85  
 cube, 84–85  
 principal, 85  
 $n$ th, 85–87  
 principal, 85  
 square, 84  
 principal, 84  
 with index  $n$ , 91–93  
 Rotations, angles and arcs as, 357–360

## S

Sample, 588  
 standard deviation based on a, 623–625  
 Sample space, 673  
 Scatter plot, 634–636  
 Secant function, 374, 415–416  
 domain of, 416  
 graph of, 464  
 range of, 416  
 Second-quadrant angle, 386–387  
 Sequence(s), 248–250  
 arithmetic, 252–254  
 convergence of, 282  
 divergence of, 282  
 finite, 248  
 geometric, 266–269  
 graphing calculator and, 250  
 infinite, 248  
 oscillation of, 282  
 Series, 257  
 containing factorials, 275–276  
 finite, 258  
 graphing calculator and, 259–260  
 geometric, 270–272  
 infinite, 258, 273–275  
 Set  
 of complex numbers, 205–206  
 of imaginary numbers, 203–204  
 Set-builder notation, 120  
 Sigma, Greek letter  
 capital ( $\Sigma$ ), 257  
 lowercase ( $\sigma$ ,  $\sigma_x$ ), 622  
 Sigma notation, 257–260  
 Similar terms, 10  
 Similar triangles, 354, 548–551  
 Simple harmonic motion, 459  
 Simplest form,  
 of rational expression, 45  
 of radical, 89  
 of ratio, 57–58,



Simplifying radicals, 88–93  
 Simplifying unlike radicals, 95–96  
 Sine ( $A + B$ ), 497  
 Sine ( $A - B$ ), 497  
 Sine function, 363, 415  
   cycle of, 436  
   domain of, 415  
   evaluating, 411  
   graph of, 435–438  
     unit circle and, 438–440  
       writing the equation of, 455–457  
   inverse, 419–420  
   inverse of, 468  
   period of, 436  
   range of, 415  
   and the unit circle, 363  
 Sine regression, 654–655  
 Sinusoidal regression equation,  
   654–655  
 SohCahToa, 355  
 Solution, 5  
 Solutions of a triangle  
   determining the number of, 569–573  
   finding, 575–579  
 Space, sample, 673  
 Special products and factors, 25  
 Speed, angular, 361  
 Square root function, 122  
 Square root, 84  
   principal, 84  
 Standard deviation, 622  
   based on a sample, 623–625  
   based on the population, 622  
   normal curve and, 628–629  
   symbols ( $\sigma$ ,  $\sigma_x$ ), 622  
 Standard form of the equation of a  
   circle, 169–171  
 Standard form of a quadratic equation,  
   27  
 Standard position, angle in, 358  
 Statistical summary, 600  
 Statistics, 587–669  
   bivariate, 634–638  
   cause and effect and, 644  
   collection of data in, 588–589  
   correlation coefficient in, 641–644  
   extrapolation in, 656–658  
   interpolation in, 655–656  
   measures of central tendency in,  
     596–606  
   measures of dispersion, 614–617  
   non-linear regression in, 647–651  
   normal distribution in, 628–632  
   organization of data in, 590–593  
   pitfalls of surveys in, 589–590  
   standard deviation in, 622–625  
   univariate, 588  
   variance in, 619–621  
 Stem, 590

Stem-and-leaf diagram, 590–592  
 Stevin, Simon, 39  
 Substitution  
   in solving trigonometric equations  
     involving different angle measures,  
       538–540  
     when more than one function is  
       involved, 534–537  
   synthetic, 228  
 Subtraction, 3  
   of complex numbers, 211  
   distributive property of  
     multiplication over, 99  
   of radicals, 94–95  
   of rational expressions, 53–56  
 Subtraction property  
   of equality, 5  
   of inequality, 7  
 Sums of angle measures,  
   cosine, 493–494  
   sine, 497  
   tangent, 501  
 Survey(s), 588  
   pitfalls of, 589–590  
 Synthetic substitution, 228–229

## T

Table, frequency distribution, 591  
 Tangent function, 368–372, 417  
   domain of, 417  
   graph of, 460–462  
   inverse, 421–423, 469–471  
   range of, 417  
   and the unit circle, 369  
 Tangent ( $A + B$ ), 500  
 Tangent ( $A - B$ ), 501–502  
 Term(s), 9  
   like, 10  
   lowest, 45  
   similar, 15  
 Terminal side of an angle, 358  
 Theoretical probability, 687  
 Theta ( $\theta$ ), 358  
 Third-quadrant angle, 387–389  
 Tower of Hanoi, 252  
 Transformations  
   function arithmetic and, 152–153  
   function composition and, 158–159  
   of linear function, 131–132  
   of quadratic functions, 141–142  
 Tree diagram, 673–674  
 Triangle(s), 353, 518  
   area of, 559–562  
   in the coordinate plane, 560–562  
   determining the number of solutions  
     of, 569–573  
   equilateral, 378  
   general, 576–579  
   Pascal's, 709  
   positioning of, on coordinate plane,  
     549  
   right, 575–576  
     function values in the, 376  
     hypotenuse of, 354  
     isosceles, 378  
     legs of, 354  
     trigonometry of, 354–356  
   similar, 548–551  
   solving, 575–579  
 Trigonometric equation(s), 519  
   factoring in solving, 526–529  
   first-degree, 519–523  
   graphing calculator and, 523–524  
   quadratic formula in solving, 530–533  
   solving linear, 520  
   substitution in solving  
     involving different angle measures,  
       538–540  
     when more than one function is  
       involved, 534–537  
 Trigonometric functions, 353–481  
   angles and arcs as rotations, 357–360  
   cofunctions, 425–427  
   degree measures of angles, 383–384  
   domain and range of, 414–419  
     cosecant function, 416–417  
     cosine function, 415  
     cotangent function, 418  
     secant function, 415–416  
     sine function, 415  
     tangent function, 417  
   factoring equations with two,  
     528–529  
   function values  
     approximations, 399, 411  
     from the calculator, 381–383  
     of special angles  
       equilateral triangle, 378–380  
       isosceles right triangle, 378  
   graphs of, 434–479  
     amplitude, 447–449  
     cosine function, 442–445  
     inverse of the cosine function,  
       468–469  
     inverse of the sine function, 468  
     inverse of the tangent function,  
       469–471  
     period, 449–451  
     phase shift, 451–453  
     reciprocal functions, 463–467  
     sine function, 435–440  
     sketching, 472–473  
     tangent function, 460–462  
     writing the equation of a sine or  
       cosine, 455–457  
   inverse cosine function, 420–421  
   inverse sine function, 419–420

inverse tangent function, 421–423  
 Pythagorean identities, 411–413  
 radian measure, 400  
     changing degrees to radians, 401  
     changing radians to degrees, 401–404  
     relationship between degrees and radians, 400–401  
 radians in finding values, 406–407  
 reciprocal, 374  
     cosecant function, 374–375  
     cotangent function, 375  
     function values in the right triangle, 376  
     secant function, 374  
 reference angles and the calculator  
     fourth-quadrant angles, 389–391  
     second-quadrant angles, 386–387  
     third-quadrant angles, 387–389  
 tangent function, 368–372  
 trigonometric function values and radian measure  
     finding angle measures in radians, 407–409  
     units radians to find trigonometric function values, 406–407  
     using radians to find trigonometric function values, 406–407  
 trigonometry of the right triangle, 354–356  
 unit circle, sine, and cosine, 362–365  
 Trigonometric graphs, sketching, 472–473

Trigonometric identities, 482–515  
     basic identities, 483–484  
     cosine  $(A + B)$ , 493–495  
     cosine  $(A - B)$ , 488–494  
     cosine  $\frac{1}{2}A$ , 508  
     cosine of  $2A$ , 504–505  
     graphical support for, 512–513  
     proving an identity, 485–487  
     sin  $(A + B)$ , 497  
     sin  $(A - B)$ , 497  
     sine  $\frac{1}{2}A$ , 509  
     sine of  $2A$ , 504  
     tangent  $(A + B)$ , 500  
     tangent  $(A - B)$ , 501–502  
     tangent  $\frac{1}{2}A$ , 509–511  
     tangent  $2A$ , 505–506  
 Trigonometry, 353  
     of the right triangle, 354–356  
 Trinomial, 10  
 Triple-angle formulas, 515  
 Turning point, 140. *See also* Vertex

## U

Unit circle, 362–363, 411  
     cosine function and the, 363  
     graph of the cosine function and, 445  
     graph of the sine function and, 438–440  
     radians and, 410–411  
     sine function and the, 363  
     tangent function and the, 369

unwrapping, 439  
 Unit fractions, 76  
 Univariate statistics, 588  
 Unlike radicals, 95  
     simplifying, 95–96

## V

Value, absolute, 3, 641  
 Variance, 619–621  
 Variation, inverse, 174–176  
 Vary directly, variables, 133  
 Vary inversely, two numbers, 174.  
     *See also* Inversely proportional  
 Vertex, 140. *See also* Turning point  
 Vertical asymptote, 321  
 Vertical line test, 123

## W

Whole numbers, 2

## Z

Zero exponent, 289–290  
 Zeros of a polynomial function, 142–143. *See also* Roots  
 Z-score, 629–632