

## MATH CHEAT SHEET

### Basic Math and Pre-Algebra Cheat Sheet

#### Groups of Numbers

- **Natural or counting numbers:** 1, 2, 3, 4, ...
- **Whole numbers:** 0, 1, 2, 3, ...
- **Integers:** ...-3, -2, -1, 0, 1, 2, 3,
- **Rational numbers:** Integers and fractions.
- **Irrational numbers:** Cannot be written as fractions:  $\sqrt{3}$  or  $\pi$ .
- **Prime numbers:** Divisible only by 1 and itself: 2, 3, 5, 7, 11, 13, ... (0 and 1 are not prime or composite.)
- **Composite numbers:** Divisible by more than just 1: 4, 6, 8, 9, 10, 12, ...

#### Properties of Addition and Multiplication

- **Closure:** All answers fall into original set.
- **Commutative:** Order does not make any difference:  $a + b = b + a$ ,  $ab = ba$ .
- **Associative:** Grouping does not make any difference:  $(a + b) + c = a + (b + c)$ ,  $(ab)c = a(bc)$ .
- **Identity:** 0 for addition, 1 for multiplication.
- **Inverse:** Negative for addition, reciprocal for multiplication.

#### Order of Operations

1. **Work within parentheses ( ), brackets [ ], and braces { } from innermost and work outward.**
2. **Simplify exponents and roots working from left to right.**
3. **Do multiplication and division, whichever comes first left to right.**
4. **Do addition and subtraction, whichever comes first left to right.**

#### Rounding Off

1. **Underline the place value to which you're rounding off.**
2. **Look to the immediate right (one place) of your underlined place value.**
3. **Identify the number (the one to the right).**

If it is 5 or higher, round your underlined place value up 1 and change all the other numbers to its right to zeros. If less than 5, leave your underlined place value as it is and change all the other numbers to the right to zeros.

#### Decimals

- To add or subtract decimals, simply line up the decimal points and then add or subtract as usual.

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- To multiply decimals, just multiply as usual and then count the total number of digits above the line that are to the right of all decimal points. Place the decimal point in your answer so that there are the same number of digits to the right of the decimal point as there are above the line.
- To divide decimals, if the number you're dividing by has a decimal, move the decimal to the right as many places as possible and then move it under the division sign just as many places (add zeros if necessary). Move the decimal up to your answer.

### Fractions

To add or subtract fractions, you must have a common denominator.

- If two fractions have a common denominator (these are called *like fractions*), you simply add or subtract the numerator and keep the same denominator. (For example,  $1/5 + 2/5 = 3/5$ .)
- If two fractions do not have a common denominator (*unlike fractions*), find a lowest common denominator (LCD), change each of the fractions to equivalent fractions with the new denominator, and then add or subtract the numerators and keep the same denominator. (For example,  $1/2 + 1/3 = 3/6 + 2/6 = 5/6$ )
- When subtracting mixed numbers, you may have to "borrow" from the whole number. When you borrow 1 from the whole number, the 1 must be changed to a fraction.
- To multiply fractions, simply multiply the numerators and then multiply the denominators. (For example,  $2/3 \times 1/5 = 2/15$ .) Reduce to lowest terms if necessary.
- To divide fractions, invert the second fraction and then multiply. (For example,  $1/5 \div 1/4 = 1/5 \times 4/1 = 4/5$ .)

### A

**additive inverse:** The opposite (negative) of a number. Any number plus its additive inverse equals 0.

**associative property:** Grouping of elements makes no difference in the outcome. This is only true for multiplication and addition.

### B

**braces:** Grouping symbols used after the use of brackets; signs { } used to represent a set.

**brackets:** Grouping symbols [ ], used after the use of parentheses.

### C

**canceling:** In multiplication of fractions, dividing the same number into both a numerator and a denominator.

**circumference:** The distance around a circle; equals  $2 \times \pi \times$  the radius or  $\pi \times$  the diameter ( $C = 2\pi r$  or  $\pi d$ ).

**closure property:** When all answers fall into the original set.

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**combinations:** The total number of independent possible choices.

**common denominator:** A number that can be divided evenly by all denominators in the problem.

**common factors:** Factors that are the same for two or more numbers.

**common multiples:** Multiples that are the same for two or more numbers.

**commutative property:** The order of elements does not make any difference in the outcome. This is only true for multiplication and addition.

**complex fraction:** A fraction having a fraction or fractions in the numerator and/or denominator.

**composite number:** A number divisible by more than just 1 and itself.

**cube:** The result when a number is multiplied by itself twice.

**cube root:** A number that when multiplied by itself twice gives you the original number; its symbol is  $\sqrt[3]{}$ .

## D

**decimal fraction:** Fraction with a denominator 10, 100, 1,000, and so on, written using a decimal point; for example, .3 and .275.

**decimal point:** A point used to distinguish decimal fractions from whole numbers.

**denominator:** The bottom symbol or number of a fraction.

**dependent events:** When the outcome of one event has a bearing or effect on the outcome of another event.

**difference:** The result of subtraction.

**distributive property:** The process of distributing a number on the outside of the parentheses to each number on the inside;  $a(b + c) = ab + ac$ .

## E

**even number:** An integer (positive whole numbers, zero, and negative whole numbers) divisible by 2 (with no remainder).

**expanded notation:** Pointing out the place value of a digit by writing a number as the digit  $\times$  its place value. For example,  $342 = (3 \times 10^2) + (4 \times 10^1) + (2 \times 10)$ .

**exponent:** A small number placed above and to the right of a number; expresses the power to which the quantity is to be raised or lowered.

## F

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**factor (noun):** A number or symbol that divides evenly into a larger number. For example, 6 is a factor of 24.

**factor (verb):** To find two or more quantities whose product equals the original quantity.

**fraction:** symbol that expresses part of a whole and consists of a numerator and a denominator; for example,  $3/5$ .

## G

**greatest common factor:** The largest factor common to two or more numbers.

## I

**identity element for addition 0:** Any number added to 0 gives the original number.

**identity element for multiplication 1:** Any number multiplied by 1 gives the original number.

**improper fraction:** A fraction in which the numerator is greater than the denominator; for example,  $3/2$ .

**independent events:** When the outcome of one event has no bearing or effect on the outcome of another event.

**integer:** A whole number, either positive, negative, or zero.

**invert:** Turn upside down, as in "invert  $2/3 = 3/2$ ."

**irrational number:** A number that is not rational (cannot be written as a fraction  $x/y$ , with  $x$  a natural number and  $y$  an integer); for example,  $\sqrt{3}$  or  $\pi$ .

## L

**least common multiple:** The smallest multiple that is common to two or more numbers.

**lowest common denominator:** The smallest number that can be divided evenly by all denominators in the problem.

## M

**mean (arithmetic):** The average of a number of items in a group (the total items divided by the number of items).

**median:** The middle item in an ordered group. If the group has an even number of items, the median is the average of the two middle terms.

**mixed number:** A number containing both a whole number and a fraction; for example,  $5\frac{1}{2}$ .

**mode:** The number appearing most frequently in a group.

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**multiples:** Numbers found by multiplying a number by 2, by 3, by 4, and so on.

**multiplicative inverse:** The reciprocal of a number. Any number multiplied by its multiplicative inverse equals 1.

## N

**natural number:** A counting number; 1, 2, 3, 4, and so on.

**negative number:** A number less than 0.

**number series:** A sequence of numbers with some pattern. One number follows another in some defined manner.

**numerator:** The top symbol or number of a fraction.

## O

**odd number:** An integer not divisible by 2.

**operation:** Multiplication, addition, subtraction, or division.

**order of operations:** The priority given to an operation relative to other operations. For example, multiplication is performed before addition.

## P

**parentheses:** Grouping symbols ( ).

**percent or percentage:** A common fraction with 100 as its denominator. For example, 37% is  $37/100$ .

**permutations:** The total number of dependent choices.

**place value:** The value given a digit by the position of a digit in the number.

**positive number:** A number greater than zero.

**power:** A product of equal factors.  $4 \times 4 \times 4 = 4^3$ , reads "four to the third power" or "the third power of four." Power and exponent are sometimes used interchangeably.

**prime number:** A number that can be divided by only itself and one. **probability:** The numerical measure of the chance of an outcome or event occurring.

**product:** The result of multiplication.

**proper fraction:** A fraction in which the numerator is less than the denominator; for example,  $2/3$ .

**proportion:** Written as two equal ratios. For example, 5 is to 4 as 10 is to 8, or  $5/4 = 10/8$ .

## Q

**quotient:** The result of division.

## R

**range:** The difference between the largest and the smallest number in a set of numbers.

**ratio:** A comparison between two numbers or symbols; may be written  $x:y$ ,  $x/y$ , or  $x$  is to  $y$ .

**rational number:** An integer or fraction such as  $7/8$  or  $9/4$  or  $5/1$ . Any number that can be written as a fraction  $x/y$  with  $x$  a natural number and  $y$  an integer.

**real number:** Any rational or irrational number.

**reciprocal:** The multiplicative inverse of a number. For example,  $2/3$  is the reciprocal of  $3/2$ .

**reducing:** Changing a fraction into its lowest terms. For example,  $2/4$  is reduced to  $1/2$ .

**rounding off:** Changing a number to the nearest place value as specified; a method of approximating.

## S

**scientific notation:** A number between 1 and 10 and multiplied by a power of 10, used for writing very large or very small numbers; for example,  $2.5 \times 10^4$ .

**square:** The result when a number is multiplied by itself.

**square root:** A number that when multiplied by itself gives you the original number; its symbol is  $\sqrt{\quad}$ . For example, 5 is the square root of 25;  $\sqrt{25} = 5$ .

**sum:** The result of addition.

## T

**tenth:** The first decimal place to the right of the decimal point. For example, .7 is seven-tenths.

## W

**weighted mean:** The mean of a set of numbers that have been weighted (multiplied by their relative importance or  $\times$  of occurrence).

**whole number:** 0, 1, 2, 3, and so on.

## Algebra I Cheat Sheet

### Axioms of Equality

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**Reflexive axiom:**  $a = a$

**Symmetric axiom:** If  $a = b$ , then  $b = a$

**Transitive axiom:** If  $a = b$  and  $b = c$ , then  $a = c$

**Additive axiom:** If  $a = b$  and  $c = d$ , then  $a + c = b + d$

**Multiplicative axiom:** If  $a = b$  and  $c = d$ , then  $ac = bd$

### Solving Equations

1. Simplify if necessary.
2. Get the variable on one side of the equal sign and numbers on the other.
3. Divide by the number in front of the variable.

### Solving Systems of Equations

**Addition/Subtraction Method:** Combine equations to eliminate one variable. The equations may need to be multiplied by a common multiple first.

**Substitution Method:** Solve one equation for one variable and substitute that variable into other equations.

**Graphing Method:** Graph each equation on the same graph. The coordinates of the intersection are the solution.

### Monomials

A *monomial* is an algebraic expression that consists of only one term.

- Add or subtract monomials with like terms only:  $3xy + 2xy = 5xy$ .
- To multiply monomials, add the exponents of the same bases:  $x^4(x^3) = x^7$ .
- To divide monomials, subtract the exponent of the divisor from the exponent of the dividend of the same base:  $x^8/x^3 = x^5$ .

### Polynomials

A *polynomial* is an algebraic expression of two or more terms, such as  $x + y$ . *Binomials* consist of exactly two terms. *Trinomials* consist of exactly three terms.

- To add or subtract polynomials, add or subtract like terms only.
- To multiply two polynomials, multiply each term in one polynomial by each term in the other polynomial.

The F.O.I.L. method (first, outer, inner, last) is often used when multiplying binomials.

- To divide a polynomial by a monomial, divide each term by the monomial.
- To divide a polynomial by another polynomial, make sure both are in descending order, then use long division (divide by first term, multiply, subtract, bring down).

### Solving Inequalities

Solve exactly like equations, except if you multiply or divide both sides by a negative number, you must reverse the direction of the inequality sign.

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### Factoring

A common factor

1. Find the largest common monomial and factor of each term.
2. Divide the original polynomial to obtain the second factor.

Difference of two squares

1. Find the square root of the first term and the second term.
2. Express your answer as the product of the sum and difference of those quantities.  
Example:  $x^2 - 9 = (x + 3)(x - 3)$

Trinomials

1. Check to see if you can monomial factor.
2. Use double parentheses and factor the first term and place the factors in the left side of the parenthesis.
3. Factor the last term and place the factors in the right sides of the parentheses.
4. Deciding the signs of the numbers, and the numbers themselves, may take trial and error. Multiply the means and extremes; their sum must equal the middle term.  
Example:  $x^2 + 3x + 2 = (x + 2)(x + 1)$

### Axioms of Inequality

**Trichotomy axiom:**  $a > b$ ,  $a = b$ , or  $a < b$ .

**Transitive axiom:** If  $a > b$  and  $b > c$ , then  $a > c$ .

**Additive axiom:** If  $a > b$ , then  $a + c > b + c$ .

**Positive multiplication axiom:** If  $c > 0$ , then  $a > b$  if, and only if,  $ac > bc$ .

**Negative multiplication axiom:** If  $c < 0$ , then  $a > b$  if, and only if,  $ac < bc$ .

### Solving Quadratic Equations

**By factoring:** Put all terms on one side of the equal sign and factor. Set each factor to zero and solve.

**By using the quadratic formula:**

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Plug into the formula

**By completing the square:** Put the equation in the form of  $ax^2 + bx = -c$  (make a -1 by dividing if necessary). Add  $(b/2)^2$  to both sides of the equation to form a perfect square on the left side of the equation. Find the square root of both sides of the equation. Solve the resulting equation.

## Algebra II Cheat Sheet

### Geometry Formulas



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|                         |                                             |
|-------------------------|---------------------------------------------|
| Perimeter               | $P = \text{sum of sides}$                   |
| Area of a triangle      | $A = \frac{1}{2}bh$                         |
| Area of a rectangle     | $A = lw$                                    |
| Area of a parallelogram | $A = bh$                                    |
| Area of a trapezoid     | $A = \frac{1}{2} \cdot (b_1 + b_2) \cdot h$ |
| Area of a circle        | $A = \pi r^2$                               |

### Word Problem Formulas

|                   |                                                       |
|-------------------|-------------------------------------------------------|
| Distance          | Distance = rate X time                                |
| Interest          | Interest = principal X rate X time                    |
| Compound Interest | $A = P(1 + \frac{r}{n})^{nt}$                         |
| Work accomplished | work accomplished =<br>(rate of work) X (time worked) |

### Graphing Formulas

|                       |                                                       |
|-----------------------|-------------------------------------------------------|
| Distance (for graphs) | $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$            |
| Midpoint              | $M = (\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2})$      |
| Slope                 | $m = \frac{y_2 - y_1}{x_2 - x_1}, \quad x_2 \neq x_1$ |
| Slope-Intercept Form  | $y = mx + b$                                          |

### Quadratic Equations

|                       |                                          |
|-----------------------|------------------------------------------|
| Standard Form         | $ax^2 + bx + c = 0$                      |
| Difference of squares | $x^2 - b^2 = (x + b)(x - b)$             |
| Quadratic formula     | $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ |

### Conic Sections

|        |                                                                         |
|--------|-------------------------------------------------------------------------|
| Circle | Centered at (h, k) with a radius of r:<br>$(x - h)^2 + (y - k)^2 = r^2$ |
|--------|-------------------------------------------------------------------------|

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Ellipse *Centered at (h, k) with its major axis parallel to the x-axis:*

$$\frac{(x - h)^2}{a^2} + \frac{(y - k)^2}{b^2} = 1 \quad (a^2 > b^2)$$

*Centered at (h, k) with its major axis parallel to the y-axis:*

$$\frac{(x - h)^2}{b^2} + \frac{(y - k)^2}{a^2} = 1 \quad (a^2 > b^2)$$

Parabola *If parabola opens vertically:*

$$y = a(x - h)^2 + k$$

*If parabola opens horizontally:*

$$x = a(y - k)^2 + h$$

Hyperbola *If transverse axis is horizontal:*

$$\frac{(x - h)^2}{a^2} - \frac{(y - k)^2}{b^2} = 1$$

*If transverse axis is vertical:*

$$\frac{(y - k)^2}{a^2} - \frac{(x - h)^2}{b^2} = 1$$

### Sequences and Series


Arithmetic Sequence  $a_n = a_1 + (n - 1)d$

Geometric Sequence  $a_n = a_1 r^{n-1}$


Arithmetic Series  $S_n = \frac{n}{2} (a_1 + a_n)$

Geometric Series  $S_n = \frac{a_1 (1 - r^n)}{1 - r} \quad (r \neq 1)$

### Geometry Cheat Sheet

|                                                                                     |                     |
|-------------------------------------------------------------------------------------|---------------------|
| $\sphericalangle, \sphericalangle s$                                                | Angle, angles       |
| $m\sphericalangle AB$                                                               | Measure of angle AB |
| $\widehat{AB}$                                                                      | Arc AB              |
| $m\widehat{AB}$                                                                     | Measure of arc AB   |
|  | Circle, circles     |
| $\cong$                                                                             | Congruent           |
| $\not\cong$                                                                         | Not congruent       |
| $^\circ$                                                                            | Degree              |

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|                                                                                   |                           |
|-----------------------------------------------------------------------------------|---------------------------|
| =                                                                                 | Equal                     |
| ≠                                                                                 | Not equal                 |
| >                                                                                 | Greater than              |
| <                                                                                 | Less than                 |
| AB                                                                                | Length of line segment AB |
| AB                                                                                | Line AB                   |
| $\overline{AB}$                                                                   | Line segment AB           |
| $\overrightarrow{AB}$                                                             | Ray AB                    |
|                                                                                   | Parallel                  |
| ∦                                                                                 | Not parallel              |
|  | Parallelogram             |
| ⊥                                                                                 | Perpendicular             |
| ~                                                                                 | Similar                   |
| Δ                                                                                 | Triangle                  |
| (x,y)                                                                             | Ordered pair in plane     |
| $\frac{a}{b} = \frac{c}{d}$                                                       | Proportion                |
| a: b or $\frac{a}{b}$                                                             | Ratio                     |

**Famous Abbreviations**

|       |                                                           |
|-------|-----------------------------------------------------------|
| AA    | Angle-angle, for proving triangles similar                |
| AAS   | Angle-angle-side, for proving triangles congruent         |
| ASA   | Angle-side-angle, for proving triangles congruent         |
| cos   | Cosine                                                    |
| cot   | Cotangent                                                 |
| CPCTC | Congruent parts of congruent triangles are congruent      |
| csc   | Cosecant                                                  |
| CSSTP | Corresponding sides of similar triangles are proportional |
| SAS   | Side-angle-side, for proving triangles congruent          |
| sin   | Sine                                                      |
| tan   | Tangent                                                   |

**Commonly Used Variables**

|         |                                    |
|---------|------------------------------------|
| a       | Apothem                            |
| a, b, c | Lengths of the sides of a triangle |
| A       | Area of a polygon                  |
| B       | Area of the base of a solid        |
| C       | Circumference of a circle          |
| h       | Height of an altitude              |
| α       | Alpha (name of an angle)           |

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|              |                                              |
|--------------|----------------------------------------------|
| $\beta$      | Beta (name of an angle)                      |
| $X_1$ or $x$ | Unknown value                                |
| $\theta$     | Theta (name of an angle)                     |
| $\pi$        | Pi                                           |
| $l$          | Slant length of a side of a solid            |
| $l$ or $l$   | Length of a rectangle                        |
| $L$          | Lateral area of a solid                      |
| $m$          | Slope of a line                              |
| $M$          | Midpoint of a line segment                   |
| $n$          | Number of sides of a polygon                 |
| $P$          | Perimeter of a polygon                       |
| $P$ or $P'$  | Plane                                        |
| $r$          | Radius                                       |
| $s$          | Length of the side of an equilateral polygon |
| $S$          | Surface area of a solid                      |
| $T$          | Total area                                   |
| $V$          | Volume                                       |
| $w$ or $w$   | Width of a rectangle                         |

**Formulae**

|               |                                                                                                              |
|---------------|--------------------------------------------------------------------------------------------------------------|
| Area          | (A) of a triangle $A = \frac{1}{2}bh$ where $b$ measures the base and $h$ the altitude                       |
| Perimeter (P) | of a triangle $P = a + b + c$ where $a$ , $b$ , and $c$ are the lengths of the sides                         |
| Area          | (A) of a rectangle $A = lw$ where $l$ measures the length and $w$ the width                                  |
| Perimeter (P) | of a rectangle $P = 2b + 2h$ where $b$ measures the width and $h$ the height                                 |
| Area          | (A) of a circle $A = \pi r^2$ where $r$ measures the radius                                                  |
| Area          | Circumference (C) of a circle $C = 2\pi r$ or $C = \pi d$ where $r$ measures the radius and $d$ the diameter |

**Geometry Glossary**

A B C D E H I L M N O P Q R S T V

**A**

**acute angle:** an angle whose measure is less than  $90^\circ$ .

**acute triangle:** a triangle containing all acute angles.

**adjacent angles:** angles that share a common side and a common vertex.

**angle:** formed by two rays with a common endpoint.



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**arc:** the set of points on a circle that lie in the interior of a central angle.

**area:** the space within a shape; measured in square units.

## B

**bisects:** divides into two equal parts.

## C

**central angle:** an angle whose vertex is the center of the circle. The measure of a central angle is equal to the measure of its arc.

**chord:** a line segment joining any two points on a circle.

**circle:** in a plane, the set of points all equidistant from a given point.

**circumference:** the distance around a circle; equals  $2 \times \pi \times \text{radius}$  or  $\pi \times \text{diameter}$  ( $C = 2\pi r$  or  $\pi d$ ).

**complementary angles:** two angles the sum of whose measures is  $90^\circ$ .

**concave polygon:** a polygon which contains at least one diagonal outside the figure.

**concentric circles:** circles with the same center.

**congruent:** exactly alike. Identical in shape and size.

**consecutive:** next to each other

**convex polygon:** a polygon in which all diagonals lie within the figure.

**corresponding:** in the same position. Coinciding.

**cube:** a six-sided solid. All sides are equal squares and all edges are equal.

## D

**decagon:** a plane closed figure with ten sides and ten angles.

**degree:** a unit of measurement of an angle.

**diagonal of a polygon:** a line segment connecting one vertex to another vertex, and not a side of the polygon.

**diameter:** a line segment that contains the center and has its endpoints on the circle. Also, the length of this segment. (A chord through the center of the circle.)

## E



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**equilateral triangle:** a triangle in which all three angles are equal in measure and all three sides have the same length.

**exterior angle:** an angle formed outside the polygon by extending one side. In a triangle, the measure of an exterior angle equals the sum of the measures of the two remote interior angles.

## H

**height:** altitude. From the highest point, a perpendicular drawn to the base.

**heptagon:** a plane closed figure with seven sides and seven angles.

**hexagon:** a plane closed figure with six sides and six angles.

**hypotenuse:** in a right triangle, the side opposite the  $90^\circ$  angle.

## I

**inscribed angle:** in a circle, an angle formed by two chords. Its vertex is on the circle. The measure of an inscribed angle equals one-half the measure of its arc.

**interior angles:** angles formed inside the shape or within two parallel lines.

**intersecting lines:** lines that meet at a point.

**isosceles right triangle:** a triangle having two equal sides, two equal angles, and one  $90^\circ$  angle. Its sides are always in the ratio 1, 1,  $\sqrt{2}$ .

**isosceles triangle:** a triangle having two equal sides (and thus two equal angles across from those sides).

## L

**legs:** in a right triangle, the two sides forming the  $90^\circ$  angle. In a trapezoid, the nonparallel sides.

**line segment:** a part of a line; has two endpoints

## M

**median:** in a triangle, a line segment drawn from a vertex to the midpoint of the opposite side.

**median:** in a trapezoid, a line segment parallel to the bases and bisecting the legs.

**midpoint:** the halfway point of a line segment, equidistant from each endpoint.

**minute:** a subdivision of an angle, one-sixtieth of a degree.

## N

**nonagon:** a plane closed figure with nine sides and nine angles

## O

**obtuse angle:** an angle greater than  $90^\circ$  but less than  $180^\circ$

**obtuse triangle:** a triangle containing an obtuse angle

**octagon:** a plane closed figure with eight sides and eight angles

## P

**parallel lines:** two or more lines, always the same distance apart. Parallel lines never meet.

**parallelogram:** a four-sided plane closed figure having opposite sides equal and parallel. (Opposite angles are equal, and consecutive angles are supplementary.)

**pentagon:** a five-sided plane closed figure. The sum of its five angles is  $540^\circ$ .

**perimeter:** the total distance around the outside of any polygon. The total length of all the sides.

**perpendicular lines:** two lines that intersect at right angles.

**pi ( $\pi$ ):** a constant used in determining a circle's area or circumference. Equals approximately 3.14 or  $22/7$

**plane:** often described as a flat surface.

**plane figure:** shape having only length and width (two dimensional).

**plane geometry:** the study of shapes and figures in two dimensions.

**point:** a basic element of geometry, a location. If two lines intersect, they do so at a point.

**polygon:** many-sided plane closed figure. Triangle, quadrilateral, pentagon, and so on.

**prism:** a three-dimensional shape bounded by congruent parallel faces and a set of parallelograms formed by joining the corresponding vertices of the bases.

**Pythagorean theorem:** a theorem that applies to right triangles. The sum of the squares of a right triangle's two legs equals the square of the hypotenuse ( $a^2 + b^2 = c^2$ ).

## Q

**quadrilateral:** a four-sided plane closed figure. The sum of its four angles equals  $360^\circ$ .

## R

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**radii:** plural of radius.

**radius:** a line segment whose endpoints lie one at the center of a circle and one on the circle. Also, the length of this segment.

**ray:** a half-line. Continues forever in one direction. Has one endpoint.

**rectangle:** a four-sided plane closed figure having opposite sides equal and parallel and four right angles.

**regular polygon:** a polygon in which sides and angles are all equal. For example, a regular pentagon has five equal angles and five equal sides.

**rhombus:** a parallelogram with four equal sides.

**right angle:** an angle whose measure is equal to  $90^\circ$ .

**right circular cylinder:** a solid shaped like a can. Base meets side at a right angle.

**right triangle:** a triangle containing a  $90^\circ$  angle.

## S

**scalene triangle:** a triangle having none of its sides equal (or angles equal).

**similar:** having the same shape but not the same size, in proportion.

**solid geometry:** the study of shapes and figures in three dimensions: length, width, and thickness.

**square:** a four-sided plane closed figure having equal sides and four right angles. Its opposite sides are parallel.

**straight angle:** an angle equal to  $180^\circ$ . Often called a line.

**straight line:** often described as the shortest distance between two points. Continues forever in both directions. (Line means straight line.)

**supplementary angles:** two angles the sum of which measures  $180^\circ$ .

**surface area:** the total surface of all sides of a solid, or the total area of faces.

## T

**tangent to a circle:** a line, line segment, or ray that touches a circle at one point (cannot go within the circle).

**transversal:** a line crossing two or more parallel or nonparallel lines in a plane.

**trapezoid:** a four-sided plane closed figure with only one pair of parallel sides, called bases.



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**triangle:** a three-sided plane closed figure. Contains three angles the sum of whose measures is  $180^\circ$ .

## V

**vertex:** the point at which two rays meet and form an angle, or the point at which two sides meet in a polygon.

**vertical angles:** the opposite angles formed by the intersection of two lines. Vertical angles are equal in measure.

**vertices:** plural of vertex.

**volume:** capacity to hold, measured in cubic units. Volume of rectangular prism = length x width x height.

## Trigonometry Glossary

[A](#) [B](#) [C](#) [D](#) [E](#) [G](#) [H](#) [I](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [Z](#)

## A

**AAS:** reference to solving a triangle given the measure of two angles and the length of a non-included side.

**absolute value of a complex number:** square root of the sum of the squares of its real and imaginary coefficients.

**algebraic vector:** an ordered pair of numbers representing the terminal point of a standard vector.

**amplitude of a complex number:** same as the argument of a complex number.

**amplitude:** the vertical stretch of a function.

**angle:** a measure of rotation.

**angle of depression:** an angle measured below the horizontal.

**angle of elevation:** an angle measured above the horizontal.

**angular velocity:** defined in terms of angle of rotation and time.

**argument of a complex number:** angle formed between the positive x-axis and a line segment between the origin and the number.

**ASA:** reference to solving a triangle given the measure of two angles and the length of the included side.

**ASTC:** an acronym representing which trigonometric functions are positive in the I, II, III, and IV quadrants respectively.

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**asymptotes:** lines representing undefined values for trigonometric functions.

## B

**bearing:** an angle measured clockwise from due north to a vector.

## C

**circular functions:** functions whose domains are angles measured in radians and whose ranges are values that correspond to analogous trigonometric functions.

**cofunction identities:** fundamental identities that involve the basic trig functions of complementary angles.

**cofunctions:** pairs of trigonometric functions of complimentary angles whose trigonometric ratios are equal.

**complex plane:** a coordinate system for complex numbers.

**component vectors:** the horizontal and vertical component vectors of a given vector.

**components of an algebraic vector:** the ordered pair of numbers representing the vector.

**components:** the individual vectors that are combined to yield the resultant vector.

**conditional equation:** an equation that is valid for a limited number of values of the variable.

**conditional trigonometric equations:** true for only a limited number of replacement values.

**conjugate of a complex number:** same as original except for the sign of the imaginary component.

**cosecant:** the reciprocal of the sine function.

**cosine:** a trigonometric ratio equal to the adjacent side divided by the hypotenuse.

**cotangent:** the reciprocal of the tangent function.

**coterminal:** two angles in standard position that share a terminal side.

## D

**De Moivre's theorem:** a theorem involving powers of complex numbers.

**degree:** a unit of angle measurement equal to  $1/360$  of a revolution.

**difference identities for tangent:** identities involving the tangents of differences of angles.

**difference identity for cosine:** one of the trigonometric addition identities.

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**difference identity for sine:** one of the trigonometric addition identities.

**directed line segment:** a line segment of a given length and a given direction.

**dot product:** a process of combining two vectors yielding a single number.

**double-angle identities for tangent:** useful in writing trig functions involving double angles as functions of single numbers.

**double-angle identities:** useful in writing trig functions involving double angles as trig functions of single angles.

## E

**equivalent vectors:** two vectors that have the same magnitude and direction.

**even function:** a function is even if  $f(-x) = f(x)$ .

## G

**general solution:** solutions defined over entire domain.

**geometric vector:** a quantity that can be represented by a directional line segment.

## H

**half-angle identities for tangent:** useful in writing trig functions involving half angles as functions of single angles.

**half-angle identities:** useful in writing trig functions involving half angles as trig functions of single angles.

**Heron's formula:** a formula for finding the area of a triangle given the lengths of the three sides.

## I

**identities for negatives:** fundamental identities that involve the basic trig functions of negative angles.

**identity:** an equation made up of trigonometric functions of an angle that is valid for all values of the angle Also called trigonometric identity.

**imaginary axis:** an axis in the complex plane.

**initial point:** the beginning point of a vector.

**initial side:** side of angle where angle measurement begins.

**inverse cosecant function:** defined in terms of the restricted sine function.



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**inverse cosine function:** inverse of the restricted cosine function.

**inverse cotangent function:** defined in terms of the restricted tangent function.

**inverse notation:** notation used to express an angle in terms of the value of trigonometric functions.

**inverse secant function:** defined in terms of the restricted cosine function.

**inverse sine function:** inverse of the restricted sine function.

**inverse tangent function:** inverse of the restricted tangent function.

## L

**law of cosines:** a relationship between the lengths of the three sides of a triangle and the cosine of one of the angles.

**law of sines:** a relationship between the ratios of the sines of angles of a triangle and the side opposite those angles.

**linear interpolation:** a method of approximating values in a table using adjacent table values.

**linear velocity:** defined in terms of arc length and time.

## M

**magnitude of a vector:** the length of the directional line segment.

**mathematical induction:** a method of mathematical proof.

**maximum value:** largest value of a function in a given interval.

**minimum value:** smallest value of a function in a given interval.

**minute:** an angle measurement equal to 1/60 of a degree.

**modulus of a complex number:** same as absolute value of a complex number.

## N

**negative angle:** results from clockwise rotation.

**norm:** another name for the magnitude of a vector.

**nth root theorem:** an extension of De Moivre's theorem involving roots of complex numbers.

## O



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**odd function:** a function is odd if  $f(-x) = -f(x)$ .

**odd-even identities:** fundamental identities that involve the basic trig functions of negative angles. Also called identities for negatives.

**one-to-one:** a characteristic of functions where each element in the domain is paired with one and only one element in the range and vice versa.

**orthogonal:** perpendicular.

## P

**parallelogram rule:** a process used to add together two nonparallel vectors.

**period:** the smallest value of  $q$  such that  $f(x) = f(x+q)$  where  $f(x)$  is a periodic function.

**periodic functions:** trigonometric functions whose values repeat once each period.

**phase shift:** the horizontal displacement of a function to the right or left of the vertical axis.

**polar axis:** a ray extending from the pole in a polar coordinate system.

**polar coordinate system:** a coordinate system using distance and angle for position.

**polar coordinates:** an ordered pair consisting of a radius and an angle.

**pole:** the fixed center of the polar coordinate system.

**position vector:** another name for a standard vector.

**positive angle:** results from counterclockwise rotation.

**primary solutions:** solutions defined over a limited domain.

**principal  $n$ th root:** the unary root of a complex number.

**product-sum identities:** useful in writing the product of trig functions as the sum and difference of trig functions.

**projections:** another name for component vectors, the horizontal and vertical component vectors of a given vector.

**proving the identity:** showing the validity of one identity by using previously known facts.

**Pythagorean identities:** fundamental identities that relate the sine and cosine functions and the Pythagorean Theorem.

## Q

**quadrantal angle:** an angle in standard position with its terminal side on a coordinate axis.

**quotient identities:** fundamental identities that involve the quotient of basic trig functions.

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## R

**radian:** the measure on an angle with vertex at the center of a circle that subtends an arc equal to the radius of the circle.

**radius vector:** another name for a standard vector, a vector in standard position.

**real axis:** an axis in the complex plane.

**reciprocal identities:** fundamental identities that involve the reciprocals of basic trig functions.

**reduction formulas for cosine:** useful in rewriting cosines of angles greater than  $90^\circ$  as functions of acute angles.

**reduction formulas for sine:** useful in rewriting sines of angles greater than  $90^\circ$  as functions of acute angles.

**reduction formulas for tangent:** useful in rewriting tangents greater than  $90^\circ$  as functions of acute angles.

**reference angle:** an acute angle whose trigonometric ratios are the same (except for sign) as the given angle.

**resultant vector:** the result obtained after vector manipulation.

## S

**SAS:** reference to solving a triangle given the lengths of two sides and the measure of the included angle.

**scalar multiplication:** changing the magnitude of a vector without changing its direction.

**scalar multiplication of algebraic vectors:** a processes of multiplying vector components.

**scalar quantity:** the value of a dot product of two vectors.

**secant:** the reciprocal of the cosine function.

**second:** an angle measurement equal to  $1/60$  of a minute.

**sector:** a portion of a circle enclosed by a central angle and its subtended arc.

**semiperimeter:** one-half the perimeter of a triangle.

**similar triangles:** two triangles whose angle measurements are the same.

**simple harmonic motion:** a component of uniform circular motion.

**sine:** a trigonometric ratio equal to the opposite side divided by the hypotenuse.

**solving the triangle:** a process for finding the values of sides and angles of a triangle given



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the values of the remaining sides and angles.

**SSA:** reference to solving a triangle given the lengths of two sides and the measure of a non-included angle.

**SSS:** reference to solving a triangle given the lengths of the three sides.

**standard position (angle):** an angle with its initial side on the positive x-axis and vertex at the origin.

**standard position (vector):** a vector that has been translated so that its initial point is at the origin.

**standard vector:** a vector in standard position.

**static equilibrium:** the sum of all the force vectors add up to zero.

**sum identities for tangent:** identities involving the tangents of sums of angles.

**sum identity for cosine:** one of the trigonometric addition identities.

**sum identity for sine:** one of the trigonometric addition identities.

**sum-product identities:** useful in writing the sum and difference of trig functions as the product of trig functions.

## T

**tangent:** a trigonometric ratio equal to the opposite side divided by the adjacent side.

**terminal point:** the ending point of a vector.

**terminal side:** side of angle where angle measurement ends.

**tip-tail rule:** a process for doing vector addition.

**trigonometric addition identities:** identities involving the trig functions of sums and differences of angles.

**trigonometric identity:** an equation made up of trigonometric functions of an angle that is valid for all values of the angle.

**trigonometric ratios:** the ratios of the length of two side of a right triangle.

## U

**uniform circular motion:** circular motion about a point at a uniform linear and angular velocity.

**unit circle:** a circle with a radius of one unit.

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## V

**vector addition:** process of combining two vectors.

**vector quantity:** a quantity that has both size and direction.

**velocity vector:** a vector representing the speed and direction of a moving object.

**vertical shift:** the vertical displacement of a function above or below the horizontal axis.

## Z

**zero algebraic vector:** an algebraic vector whose components are both zero.

**zero vector:** a vector with a magnitude of zero and any direction.

## Calculus Cheat Sheet

### Geometry Table

#### All Triangles

$$\text{Area} = \frac{1}{2} \text{base} \cdot \text{height}$$

#### Equilateral Triangle

$$\text{Area} = \frac{\text{side}^2 \sqrt{3}}{4}$$

#### Right Triangle

Pythagorean Theorem:  $a^2 + b^2 = c^2$  ( $c$  is the hypotenuse.)

#### Parallelogram

$$\text{Area} = \text{base} \cdot \text{height}$$

#### Trapezoid

$$\text{Area} = \frac{\text{base}_1 + \text{base}_2}{2} \cdot \text{height}$$

#### Circle

$$\text{Area} = \pi r^2$$

$$\text{Circumference} = 2\pi r = \pi d$$



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### Sector of Circle

(think piece of pizza)

$$\text{Area} = \pi r^2 \left( \frac{\theta}{360^\circ} \right)$$

( $\theta$  is the central angle)

$$\text{Arc Length} = 2\pi r \left( \frac{\theta}{360^\circ} \right)$$

(Arc Length is the length of the crust.)

### Sphere

$$\text{Volume} = \frac{4}{3} \pi r^3$$

$$\text{Surface Area} = 4\pi r^2$$

### Cone or Pyramid

(flat base, pointy top)

$$\text{Volume} = \frac{1}{3} A \cdot h$$

(A is the area of the base.)

### Right Circular Cylinder, Right Prism, or Box (flat base, flat top)

$$\text{Volume} = A \cdot h$$

(A is the area of the base.)

$$\text{Lateral Surface Area} = P \cdot \text{height}$$

(P is the perimeter [or circumference] of the base.)

### Coordinate Geometry

Given two points

$$(x_1, y_1) \text{ and } (x_2, y_2)$$

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$\text{Midpoint} = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$



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### Trigonometry Table

#### Right Triangle Trig

SohCahToa:

$$\sin \theta = \frac{O}{H} \quad \csc \theta = \frac{H}{O}$$

$$\cos \theta = \frac{A}{H} \quad \sec \theta = \frac{H}{A}$$

$$\tan \theta = \frac{O}{A} \quad \cot \theta = \frac{A}{O}$$

#### Degrees and Radians

$$2\pi \text{ radians} = 360^\circ \quad \frac{\pi}{3} \text{ radians} = 60^\circ$$

$$\pi \text{ radians} = 180^\circ \quad \frac{\pi}{4} \text{ radians} = 45^\circ$$

$$\frac{\pi}{2} \text{ radians} = 90^\circ \quad \frac{\pi}{6} \text{ radians} = 30^\circ$$

To convert from radians to degrees,  
multiply by  $\frac{180^\circ}{\pi}$

To convert from degrees to  
radians, multiply by  $\frac{\pi}{180^\circ}$

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## Identities

Reciprocal Identities:

$$\csc \theta = \frac{1}{\sin \theta}$$

$$\sec \theta = \frac{1}{\cos \theta}$$

$$\cot \theta = \frac{1}{\tan \theta}$$

Quotient Identities:

$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

$$\cot \theta = \frac{\cos \theta}{\sin \theta}$$

Pythagorean Identities:

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$\tan^2 \theta + 1 = \sec^2 \theta$$

$$1 + \cot^2 \theta = \csc^2 \theta$$

## Formulas

Half-Angle Formulas:

$$\sin^2 \theta = \frac{1}{2}(1 - \cos 2\theta)$$

$$\cos^2 \theta = \frac{1}{2}(1 + \cos 2\theta)$$

Double-Angle Formulas:

$$\sin 2\theta = 2 \sin \theta \cos \theta$$

$$\cos 2\theta = 2 \cos^2 \theta - 1$$

Reduction Formulas:

$$\sin(-\theta) = -\sin \theta$$

$$\cos(-\theta) = \cos \theta$$

$$\tan(-\theta) = -\tan \theta$$

## Derivative Table

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Product Rule:

$$\frac{d}{dx}(uv) = u'v + v'u$$

Quotient Rule:

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{u'v - v'u}{v^2}$$

$$1. \quad \frac{d}{dx}c = 0$$

$$2. \quad \frac{d}{dx}x = 1$$

$$3. \quad \frac{d}{dx}cx = c$$

$$4. \quad \frac{d}{dx}x^n = nx^{n-1}$$

$$5. \quad \frac{d}{dx}e^x = e^x$$

$$6. \quad \frac{d}{dx}\ln x = \frac{1}{x}$$

$$7. \quad \frac{d}{dx}a^x = a^x \ln a$$

$$8. \quad \frac{d}{dx}\log_a x = \frac{1}{x} \cdot \frac{1}{\ln a}$$

$$9. \quad \frac{d}{dx}\sin x = \cos x$$

$$10. \quad \frac{d}{dx}\cos x = -\sin x$$

$$11. \quad \frac{d}{dx}\tan x = \sec^2 x$$

$$12. \quad \frac{d}{dx}\cot x = -\csc^2 x$$

$$13. \quad \frac{d}{dx}\sec x = \sec x \tan x$$

$$14. \quad \frac{d}{dx}\csc x = -\csc x \cot x$$

$$15. \quad \frac{d}{dx}\arcsin x = \frac{1}{\sqrt{1-x^2}}$$

$$16. \quad \frac{d}{dx}\arccos x = \frac{-1}{\sqrt{1-x^2}}$$

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$$17. \quad \frac{d}{dx} \arctan x = \frac{1}{1+x^2}$$

$$18. \quad \frac{d}{dx} \operatorname{arccot} x = \frac{-1}{1+x^2}$$

$$19. \quad \frac{d}{dx} \operatorname{arcsec} x = \frac{1}{|x|\sqrt{x^2-1}}$$

$$20. \quad \frac{d}{dx} \operatorname{arccsc} x = \frac{-1}{|x|\sqrt{x^2-1}}$$

#### Integral Table

$$1. \quad \int dx = x + C$$

$$2. \quad \int x^n dx = \frac{x^{n+1}}{n+1} + C \quad (n \neq -1)$$

$$3. \quad \int e^x dx = e + C$$

$$4. \quad \int \frac{dx}{x} = \ln|x| + C$$

$$5. \quad \int a^x dx = \frac{1}{\ln a} a^x + C$$

$$6. \quad \int \ln x dx = x(\ln x - 1) + C$$

$$7. \quad \int \sin x dx = -\cos x + C$$

$$8. \quad \int \cos x dx = \sin x + C$$

$$9. \quad \int \tan x dx = -\ln|\cos x| + C$$

$$10. \quad \int \cot x dx = \ln|\sin x| + C$$

$$11. \quad \int \sec x dx = \ln|\sec x + \tan x| + C$$

$$12. \quad \int \csc x dx = -\ln|\csc x + \cot x| + C$$

$$13. \quad \int \sec^2 x dx = \tan x + C$$

$$14. \quad \int \csc^2 x dx = -\cot x + C$$

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$$15. \int \sec x \tan x dx = \sec x + C$$

$$16. \int \csc x \cot x dx = -\csc x + C$$

$$17. \int \frac{dx}{\sqrt{a^2 - x^2}} = \arcsin \frac{x}{a} + C$$

$$18. \int \frac{dx}{a^2 + x^2} = \frac{1}{a} \arctan \frac{x}{a} + C$$

$$19. \int \frac{dx}{x \sqrt{x^2 - a^2}} = \frac{1}{a} \operatorname{arcsec} \frac{|x|}{a} + C$$

$$20. \int \frac{dx}{x^2 - a^2} = \frac{1}{2a} \ln \left| \frac{x-a}{x+a} \right| + C$$

## Statistics Glossary

A B C D E F G H I J L M N O P Q R S T U V Z

### A

**addition rule:** for mutually exclusive random events, the chance of at least one of them occurring is the sum of their individual probabilities.

**alternative hypothesis:** a research hypothesis; the hypothesis that is supported if the null hypothesis is rejected.

### B

**bar chart:** a graphic that displays how data fall into different categories or groups.

**bell-shaped curve:** symmetrical, single-peaked frequency distribution.

Also called the normal curve or gaussian curve.

**bias:** the consistent underestimation or overestimation of a true value, because of preconceived notion of the person sampling the population.

**bimodal:** curve with two equal scores of highest frequency.

**binomial:** event with only two possible outcomes.

**binomial probability distribution:** for binomial events, the frequency of the number of favorable outcomes. For a large number of trials, the binomial distribution approaches the normal distribution.



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**bivariate:** involving two variables, especially, when attempting to show a correlation between two variables, the analysis is said to be bivariate.

**box plot (box-and-whiskers):** a graphic display of data indicating symmetry and central tendency.

## C

**Central Limit Theorem:** a rule that states that the sampling distribution of means from any population will be normal for large sample  $n$ .

**chi-square:** a probability distribution used to test the independence of two nominal variables.

**class frequency:** the number of observations that fall into each class interval.

**class intervals:** categories or groups contained in frequency graphics.

**coefficient of determination:** a measure of the proportion of each other's variability that two variables share.

**confidence interval:** the range of values that a population parameter could take at a given level of significance.

**confidence level:** the probability of obtaining a given result by chance.

**continuous variable:** a variable that can be measured with whole numbers and fractional (or decimal) parts thereof.

**correlated:** two (or more) quantities that change together in a consistent manner. Thus, if the value of one variable is known, the other can be immediately determined from their relationship.

**correlation coefficient:** a measure of the degree to which two variables are linearly related.

**critical value:** the value of a computed statistic used as a threshold to decide whether the null hypothesis will be rejected.

## D

**data:** numerical information about variables; the measurements or observations to be analyzed with statistical methods.

**degrees of freedom:** a parameter used to help select the critical value in some probability distributions.

**dependent events:** events such that the outcome of one has an effect on the probability of the outcome of the other.

**dependent variable:** a variable that is caused or influenced by another.

**descriptive statistics:** numerical data that describe phenomena.



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**deviation:** the distance of a value in a population (or sample) from the mean value of the population (or sample).

**directional test:** a test of the prediction that one value is higher than another; also called a one-tailed test.

**discrete variable:** a variable that can be measured only by means of whole numbers; or one which assumes only a certain set of definite values, and no others.

**disjoint occurrence:** both outcomes unable to happen at the same time.

**distribution:** a collection of measurements; how scores tend to be dispersed about a measurement scale.

**dot plot:** a graphic that displays the variability in a small set of measures.

**double counting:** a mistake encountered in calculating the probability of at least one of several events occurring, when the events are not mutually exclusive. In this case, the addition rule does not apply.

## E

**empirical rule:** a rule that is founded on observation, without a theoretical basis. Or a "rule of thumb."

## F

**frequency distribution:** the frequency of occurrence of the values of a variable. For each possible value of the variable, there is an associated frequency with which the variable assumes that value.

**frequency histogram:** a graphic that displays how many measures fall into different classes, giving the frequency at which each category is seen observed.

**frequency polygon:** a graphic presentation of frequency of a phenomenon that typically uses straight lines and points.

## G

**grouped data:** data that has been sorted into categories, usually in order to construct a frequency histogram.

**grouped measures:** a set of values that belong to the same class.

## H

**histogram:** a graphic presentation of frequency of a phenomenon.

## I



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**independent events:** events such that the outcome of one has no effect on the probability of the outcome of the other.

**independent variable:** a variable that causes, or influences, another variable.

**inference:** conclusion about a population parameter based upon analysis of a sample statistic. Inferences are always stated with a confidence level.

**intercept:** the value of  $y$  at which a line crosses the vertical axis.

**interquartile range:** set of measures lying between the lower quartile (25th percentile) and the upper quartile (75th percentile), inclusive.

**interval:** a scale using numbers to rank order; its intervals are equal but with an arbitrary 0 point.

## J

**joint occurrence:** both outcomes happening simultaneously;  $P(AB)$ .

## L

**least squares:** any line- or curve-fitting model that minimizes the squared distance of data points to the line.

**lower quartile:** ( $Q_1$ ), the 25th percentile of a set of measures.

## M

**mean:** the sum of the measures in a distribution divided by the number of measures; the average.

**measures of central tendency:** descriptive measures that indicate the center of a set of values, for example, mean, median, and mode.

**measures of variation:** descriptive measures that indicate the dispersion of a set of values, for example, variance, standard deviation, and standard error of the mean.

**median:** the middle measure in an ordered distribution.

**middle quartile:** ( $Q_2$ ), the 50th percentile of a set of measures; the median.

**mode:** most frequent measure in a distribution; the high point on a frequency distribution.

**mound-shaped curve:** symmetrical, single-peaked frequency distribution. Also called the normal curve or gaussian curve. Also called a bell-shaped curve.

**multiplication rule:** the probability of two or more independent (hence, not mutually exclusive) events all occurring is the product of their individual probabilities.

**mutually exclusive:** events such that the occurrence of one precludes the occurrence of the other.

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## N

**negative relationship:** a relationship between two variables such that when one increases, the other decreases.

**negatively skewed curve:** a probability or frequency distribution that is not normal, but rather is shifted such that the mean is less than the mode.

**nominal:** a scale using numbers, symbols, or names to designate different subclasses.

**non-directional test:** a test of the prediction that two values are equal or a test that they are not equal; a two-tailed test.

**non-parametric test:** statistical test used when assumptions about normal distribution in the population cannot be met, or when the level of measurement is ordinal or less. For example, the c-square test.

**normal distribution:** smooth bell-shaped curve symmetrical about the mean such that its shape and area obey the empirical rule.

**null hypothesis:** the reverse of the research hypothesis. The null hypothesis is directly tested by statistical analysis so that it is either rejected or not rejected, with a confidence level. If the null hypothesis is rejected, the alternative hypothesis is supported.

**numerical statistics:** statistical parameters presented as numbers (as opposed to pictorial statistics).

## O

**ogive:** a graphic that displays a running total.

**one-tailed test:** a test of the prediction that one value is higher than another.

**ordinal:** a scale using numbers or symbols to rank order; its intervals are unspecified.

**outlier:** a data point that falls far from most other points; a score extremely divergent from the other measures of a set.

## P

**parameter:** a characteristic of a population. The goal of statistical analysis is usually to estimate population parameters, using statistics from a sample of the population.

**Pearson's product moment coefficient:** identical to the correlation coefficient.

**percentile:** the value in an ordered set of measurements such that P% of the measures lie below that value.

**pictorial statistics:** statistical parameters that are presented as graphs or charts (as opposed to simply as numbers).

**pie chart:** a graphic that displays parts of the whole, in the form of a circle with its area

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divided appropriately.

**point estimate:** a number computed from a sample to represent a population parameter.

**population:** a group of phenomena that have something in common. The population is the larger group, whose properties (parameters) are estimated by taking a smaller sample from within the population, and applying statistical analysis to the sample.

**positive relationship:** a relationship between two variables such that when one increases, the other increases, or when one decreases, the other decreases.

**positively skewed curve:** a probability or frequency distribution that is not normal, but rather is shifted such that the mean is greater than the mode.

**power:** the probability that a test will reject the null hypothesis when it is, in fact, false.

**probability:** a quantitative measure of the chances for a particular outcome or outcomes.

**probability distribution:** a smooth curve indicating the frequency distribution for a continuous random variable.

**proportion:** for a binomial random event, the probability of a successful (or favorable) outcome in a single trial.

## Q

**qualitative variable:** phenomenon measured in kind, that is, non-numerical units. For example, color is a qualitative variable, because it cannot be expressed simply as a number.

**quantitative variable:** phenomenon measured in amounts, that is, numerical units. For example, length is a quantitative variable.

## R

**random:** an event for which there is no way to know, before it occurs, what the outcome will be. Instead, only the probabilities of each possible outcome can be stated.

**random error:** error that occurs as a result of sampling variability, through no direct fault of the sampler. It is a reflection of the fact that the sample is smaller than the population; for larger samples, the random error is smaller.

**range:** difference between the largest and smallest measures of a set.

**ratio:** a scale using numbers to rank order; its intervals are equal, and the scale has an absolute 0 point.

**region of acceptance:** the area of a probability curve in which a computed test statistic will lead to acceptance of the null hypothesis.

**region of rejection:** the area of a probability curve in which a computed test statistic will lead to rejection of the null hypothesis.

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**regression:** a statistical procedure used to estimate the linear dependence of one or more independent variables on a dependent variable.

**relative frequency:** the ratio of class frequency to total number of measures.

**relative frequency principle of probability:** if a random event is repeated a large number of times, then the proportion of times that a particular outcome occurs is the probability of that outcome occurring in a single event.

**research hypothesis:** a prediction or expectation to be tested. If the null hypothesis is rejected, then the research hypothesis (also called alternative hypothesis) is supported.

**residual:** the vertical distance between a predicted value  $y$  and its actual value.

## S

**sample:** a group of members of a population selected to represent that population. A sample to which statistical analysis is applied should be randomly drawn from the population, to avoid bias.

**sampling distribution:** the distribution obtained by computing a statistic for a large number of samples drawn from the same population.

**sampling variability:** the tendency of the same statistic computed from a number of random samples drawn from the same population to differ.

**scatter plot:** a graphic display used to illustrate degree of correlation between two variables.

**skewed:** a distribution displaced at one end of the scale and a tail strung out at the other end.

**slope:** a measure of a line's slant.

**standard deviation:** a measure of data variation; the square root of the variance.

**standard error:** a measure of the random variability of a statistic, such as the mean (i.e., standard error of the mean). The standard error of the mean is equal to the standard deviation divided by the square root of the sample size ( $n$ ).

**standardize:** to convert to a z-score.

**statistic:** a characteristic of a sample. A statistic is an estimate of a population parameter. For larger samples, the statistic is a better estimate of the parameter.

**statistical significance:** the probability of obtaining a given result by chance. High statistical significance does not necessarily imply importance.

**statistics:** a branch of mathematics that describes and reasons from numerical observations; or descriptive measures of a sample.

**stem-and-leaf graphic:** display that shows actual scores as well as distribution of classes.

**symmetry:** a shape such that one side is the exact mirror image of the other.

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**symmetric distribution:** a probability or frequency distribution that has the property in which the mean, median, and mode are all the same value.

**systematic error:** the consistent underestimation or overestimation of a true value, due to poor sampling technique.

## T

**t-distribution:** a probability distribution often used when the population standard deviation is not known or when the sample size is small.

**tabled value:** the value of a computed statistic used as a threshold to decide whether the null hypothesis will be rejected.

**test statistic:** a computed quantity used to decide hypothesis tests.

**two-tailed test:** a test of the prediction that two values are equal, or a test that they are not equal.

**Type I error:** rejecting a null hypothesis that is, in fact, true.

**Type II error:** failing to reject a null hypothesis that is, in fact, false.

## U

**upper quartile:** (Q3), the 75th percentile of a set of measures.

## V

**value:** a measurement or classification of a variable.

**variable:** an observable characteristic of a phenomenon that can be measured or classified.

**variance:** a measure of data variation; the mean of the squared deviation scores about the means of a distribution.

## Z

**z-score:** a unit of measurement obtained by subtracting the mean and dividing by the standard deviation.

Courtesy: Cliff Notes.