Points and Lines

Consider two points in our coordinate system:

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

The small, lower numbers next to x and y are called indices and are only used to distinguish two variables with the same letter. The indices have no effect on calculations, such as the following important measures:

$$\frac{y_2 - y_1}{x_2 - x_1}$$

The **slope** of the line connecting two points is the difference between the *y* values divided by the difference in the *x* values.

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

The **midpoint** between two points has the average *x* value and the average *y* value of the two original points.

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

The **distance** between two points is the square root of the sum of the difference in *x* values squared and the difference in *y* values squared (this comes from the Pythagorean Theorem).

An equation with two variables in the first power will be true for infinitely many combinations of values for those variables. If we were to plot all these pairs of values as points in our coordinate system, the result would be the graph of a line. Such equations are called linear, we typically use x and y to represent the variables, and the equations are most often expressed in one of the following forms:

$$ax + by = c$$

The **standard form** puts both variables on the same side, with *a*, *b*, and *c* representing whole numbers, where *a* is not negative.

$$(y - y_1) = m(x - x_1)$$

The **point-slope form** allows us to create line equations when we know the slope *m* and a single point (x_1, y_1).

$$y = mx + b$$

The **slope-intercept form** puts the equation puts y by itself on one side so that the slope *m* and the value of y where $x = 0$ are immediately apparent on the other side.

The value of y where a line crosses the x-axis is known as the y-intercept and the value of x where a line crosses the y axis is called the x-intercept.