In Chapter 6 thus far, we’ve worked with a linear equation in two variables in:

- Standard form
- Slope intercept form

Consider how can we tell if \((x_1, y_1)\) is on the line?

From this, we get point slope form: \(y - y_1 = m(x - x_1)\) where \(m\) is the slope and \((x_1, y_1)\) is a point on the line.

**Example 1:** Find the equation of the line that passes through \((3,6)\) and has slope \(-1/3\). Write in slope intercept form.

*These are two possible approaches to finding the equation.*

**Option I.** Using slope intercept form: \(y = mx + b\):

\[
m = \]
\[
(x, y) = \]
\[
b = ??? \]

**Option II.** Using point-slope form: \(y - y_1 = m(x - x_1)\):

\[
m = \]
\[
(x_1, y_1) = \]
Parallel Lines

In a previous section, we looked at graphs like $y = 2x - 1$ and $y = 2x + 2$. Notice that these two lines will never intersect; their “slant” or “steepness” is the same. In other words, they have the same ________________ (but different y intercepts).

Lines with the same slope (including two different vertical lines or two different horizontal lines) but different y intercepts are called **parallel lines**.

Perpendicular Lines

Consider the graphs of $y = -4x - 1$ and $y = (1/4)x - 1$. Notice that these lines are at right angles to each other. The product of their slopes is -1.

In other words, two lines with slopes that are opposite reciprocals are **perpendicular lines**. (A horizontal and a vertical line are also perpendicular.)

Example 2: Graph the equation $2x + 3y = 6$.

To graph a line you need two points OR _________________
Example 3: Find the equation of each line. Write in slope intercept form, if possible.

Hint: Sketch a graph, if it helps you!

a) through (1,2) and (-2,-4)

b) Perpendicular to \( y = 6 \): passes through (3,7)

c) Parallel to the \( x \) axis: passes through (2,-5)

d) Through (2,-5): perpendicular to \( y = \frac{1}{3}x - 2 \)

e) Through (2,-5): parallel to \( y = \frac{1}{3}x - 2 \)
Application

Example 4: In 1996, there were 135 thousand apparel stores in the U.S. In 2001, there were 152 thousand. Let $x = \text{number of years since 1996}$.

a) Write a linear equation describing this relationship.

b) If the trend continues, use the equation to predict the number of apparel stores in the U.S. in 2009.

c) Interpret the slope of the equation in context of the problem. Use units!
Equations of Lines

\[ y = mx + b \]  \quad \text{Slope-Intercept Form}

\[ y - y_1 = m(x - x_1) \]  \quad \text{Point-Slope Form}

\[ Ax + By = C \]  \quad \text{Standard Form}

\[ (\text{both } A \text{ and } B \text{ not equal to 0}) \]

\[ y = b \]  \quad \text{Horizontal Line}

\[ (b \text{ is a constant}) \quad \text{zero slope} \]

\[ x = a \]  \quad \text{Vertical Line}

\[ (a \text{ is a constant}) \quad \text{undefined slope} \]

Parallel lines: \quad \text{Same slope}

\[ m_1 = m_2 \]

Perpendicular lines: \quad \text{Opposite Reciprocal Slopes}

\[ m_1 = -\frac{1}{m_2} \text{ or } (m_1)(m_2) = -1 \]