Model data with linear functions and make predictions.

89. Use the data for males shown in the bar graph at the bottom of the previous column to solve this exercise.

- a. Let $x$ represent the number of birth years after 1960 and let $y$ represent male life expectancy. Create a scatter plot that displays the data as a set of six points in a rectangular coordinate system.
- b. Draw a line through the two points that show male life expectancies for 1980 and 2000. Use the coordinates of these points to write a linear function that models life expectancy, $E(x)$, for American men born $x$ years after 1960.
- c. Use the function from part (b) to project the life expectancy of American men born in 2020.
**Objectives**

1. Find slopes and equations of parallel and perpendicular lines.
2. Interpret slope as rate of change.
3. Find a function’s average rate of change.

Parallel lines have the same slope.

\[ y = 2x + 1 \]

\[ y = 2x + 3 \]

Perpendicular lines have slopes that multiply to -1.

\[ y = \frac{1}{2}x + 1 \]

\[ y = -\frac{1}{2}x + 5 \]
Ex: Give the equation for a line that is parallel to \( y = 2x + 6 \) and goes through \((1,3)\).

\[ m = 2 \]

\[ y = m(x-x_1) + y_1 \]
\[ = 2(x-1) + 3 \]
\[ = 2x - 2 + 3 \]
\[ = 2x + 1 \]

If perpendicular, \( m = \frac{-1}{2} \)

\[ m = \frac{-1}{\text{given slope}} \]

The slope tells you how the value is changing.

\( f(t) = 3t + 1 \), tank starts with one foot of water and we add water at a rate of 3 ft per hour.

After 1 hour, \( f(1) = 3(1) + 1 = 4 \)

Solve \( 15.6 = 3t + 1 \)
\[-1 \]
\[-1 \]
\[ 14.6 = 3t \]
\[ t = \frac{14.6}{3} \approx 4.9 \]

It will take about 4.9 hours to get the water level 15.6 feet.

Distance - rate - time formula \( d = rt \)

Start 45 miles from SA, travel north at 70 mph.
distance from SA as a function of time will be \( d(t) = 45 + 70t \).

\[ f(x) = \sqrt{x-2} \] average rate of change from \( x = 3 \) to \( x = 5 \).

This average rate of change between \( x = 3 \) and \( x = 5 \) is the slope between \( (3, f(3)) \) and \( (5, f(5)) \).

\[
M = \frac{f(5) - f(3)}{5-3} = \frac{\sqrt{5-2} - \sqrt{3-2}}{5-3} = \frac{\sqrt{3} - 1}{2} \approx 0.366
\]

(this is also a difference quotient)
SECTION 2.5
Transformations of Functions

**Objectives**
1. Recognize graphs of common functions.
2. Use vertical shifts to graph functions.
3. Use horizontal shifts to graph functions.
4. Use reflections to graph functions.
5. Use vertical stretching and shrinking to graph functions.
6. Use horizontal stretching and shrinking to graph functions.
7. Graph functions involving a sequence of transformations.

\[ y = x \]
\[ y = x - 1 \text{ (horiz)} \]
\[ y + 1 = x \text{ (vert)} \]

\[ y = x^2 \]
\[ y = (x + 2)^2 \]
\[ y = (2x)^2 \]
\[ y = 4x^2 \]
\[ y = x^2 \]

Graph showing transformations:
- \((0, 0)\)
- \((1, 0)\)
- \((2, 4)\)
- \((1, 4)\)
- \((\frac{1}{2}, 1)\)
\[ y = 2x + 1 \]

When you modify the coordinate in the equation, the opposite change occurs in the graph (points). \( y = 2x + 1 \)

For every action there is an equal and opposite reaction.

\[ y = x^2 + 1 \]
\[ (7, 50) \longrightarrow (\text{new eqn}) \quad y = (-x)^2 + 1 \quad (-7, 50) \]

\[ y = 3x + 4 \]
\[ (5, 19) \longrightarrow (\text{new eqn}) \quad y = 3(-x) + 4 \quad (-5, 19) \]

\[ y + 10 = 3x + 4 \]
\[ y = 3x - 6 \]
\[ y = x + 3 \quad \rightarrow \quad y = x^2 + 3 \]

\[ (1, 4) \quad \rightarrow \quad (11, 4) = (1, 4) \quad 1^2 + 3 = 4 \]

\[ (4, 7) \quad \rightarrow \quad (14, 7) = (2, 7) \quad 2^2 + 3 = 7 \]

\[ y = \frac{4}{x} \quad \rightarrow \quad \left( \frac{4}{4}, 1 \right) \]

\[ y = mx + b \]

\[ 4y = mx + b \]

\[ y = \frac{mx + b}{4} \]

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Parent Function

Graph

\[ y = |2x - 1| + 1 \]

\[ y = |2x - 1| \]

\[ y = |x - 1| \]

\[ y = |x| \]

This is wrong. See below.
The horizontal compression included by going from \( y = |x-1| \) to \( y = \frac{1}{2|x-1|} \) is not centered on the axis of symmetry of \( y = |x-1| \). Each x-coordinate is simply cut in half.