

Cigarette Use A report in the Child Trends DataBase indicated that, in 2000, 20.6% of twelfth grade students reported daily use of cigarettes. In 2009, 11.2% of twelfth grade students reported daily use of cigarettes.¹

- a. Write a linear equation that relates the percent y of twelfth grade student who smoke cigarettes daily to the number x of years after 2000.

To write the linear equation, we need to decide which of the percentage or the year is the independent variable (sometimes called the input or control variable.) In this situation, the year is the independent variable because the year determines the percentage. The problem tells us to use x as the number of years after 2000, so we will. As we progress through this course and into others, we would probably prefer to use a variable that reminds us of what it represents. For example, it would be more common to have t (for time) represent the number of years since 2000 and to have p (for percentage) represent the percentage of twelfth grade daily smokers.

Since x is the independent variable, y , representing the percentage of twelfth grade daily smokers is the dependent variable. We'll write the given information as two ordered pairs.

"...2000, 20.6% of twelfth grade students ..." gives us the point $(0, 20.6)$ and "...2009, 11.2% of twelfth grade students ..." gives us the point $(9, 11.2)$. We use these points to find the slope m of the line

$$m = \frac{11.2 - 20.6}{9 - 0} \approx -1.04$$

We substitute this into the slope-intercept form for the equation of a line to get

$$y = -1.04x + b$$

Now we substitute either of the points into our equation and solve for b . Let's use $(0, 20.6)$.

$$\begin{aligned} y &= -1.04x + b \\ 20.6 &= -1.04 \cdot 0 + b \\ 20.6 &= 0 + b \\ 20.6 &= b \end{aligned}$$

Thus the equation that relates the percent y of twelfth grade student who smoke cigarettes daily to the number x of years after 2000 is

$$y = -1.04x + 20.6$$

- b. Find the intercepts of the graph of your equation.

Since we choose to write our equation in slope-intercept form, we know the y -intercept is $(0, 20.6)$.

To find the x -intercept, we substitute $y = 0$ and solve for x .

$$\begin{aligned} y &= -1.04x + 20.6 \\ 0 &= -1.04x + 20.6 \\ -20.6 &= -1.04x \\ \frac{-20.6}{-1.04} &= x \\ 19.8 &\approx x \end{aligned}$$

Thus the x -intercept is $(19.8, 0)$ and the y -intercept is $(0, 20.6)$.

¹Sullivan, *Precalculus: Enhanced with Graphing Utilities*, p.43, #124.

Precalculus
Lines

c. *Do the intercepts have any meaningful interpretation?*

The y -intercept tells us that 0 years after 2000, i.e., in the year 2000, 20.6% of twelfth grade students reported daily use of cigarettes. The x -intercept tells us that 19.8 years after 2000, i.e., sometime in the years 2019-2020, 0% of twelfth grade students will report daily use of cigarettes.

d. *Use your equation to predict the percent for the year 2025. Is this result reasonable?*

The year 2025 corresponds to $x = 25$ since x is the number of years after 2000. We substitute $x = 25$ into our equation and solve for y

$$y = -1.04x + 20.6$$

$$y = -1.04 \cdot 25 + 20.6$$

$$y = -26 + 20.6$$

$$y = -5.4$$

So the equation tells us in 2025, -5.4% of twelfth grade students will report daily use of cigarettes. This result is not reasonable.