

Choosing an Appropriate Window for Applications Math PrintView

Objective:

- Recognize concepts that must be positive and resulting quadrants
- Observe how percent is expressed: Percent or decimal?
- Observe how time is expressed: “Year” or “years since a given date”?
- Use context to find the smallest and largest reasonable values for x and y
- Determine usable scales for the axes
- Graph in an appropriate window

Recognize concepts that must be positive and resulting quadrants

IMPORTANT: In many applications, negative values for x and y simply don’t make sense, for example:

- Time: years, months, weeks, days, hours, minutes, seconds
- Most money: prices, interest, principal, revenue, cost, profit, sales, salary, dollars, pesos, euros
- **CAUTION:** “Money lost” might be negative, and, before breaking even, “profit” can be negative.
- Length, including distance, height, width or dimensions: kilometers, meters, centimeters, millimeters, micrometers, light years, miles, yards, feet, inches
- Volume: liters, milliliters, cubic centimeters, gallons, quarts, pints, cups, fluid ounces, bushels
- Weight: metric tons, kilograms, grams, milligrams, tons, pounds, ounces.
- Population: number of people or animals
- Number or size: sales, supply, demand, employees, restaurants
- Concepts from science: current, force, horsepower, intensity of light, pH, resistance, speed, rate

values that make sense	Quadrants that result	Xmin, Xmax, Ymin, Ymax
x and y must be positive	Quadrant I only	Xmin =0 and Ymin=0
x must be positive, but y can be positive or negative	Quadrants I and IV only	Xmin = 0
x can be positive or negative, but y must be positive	Quadrants I and II only	Ymin = 0
Both x and y can be positive or negative	All four Quadrants	No conclusions yet

Observe how percent is expressed: Percent or decimal?

Percent from none to all is 0% to 100%, making minimum 0 and maximum 100. A good scale is often 10.

CAUTION: If percent is expressed as a decimal, then 100% = 1, so the minimum is 0 but the maximum is 1. A good scale is often 0.1

Observe how time is expressed: “Year” or “years since a given date”?

Example 1: Let x represent the number of years since 2018.

This means: If x = 0, then no time has passed since 2018 and it’s referring to 2018. On the graph, x is 0. If x = 10, then ten years have passed since 2018 and it’s referring to 2028. On the graph, x is 10.

PRO TIP: To find x from a given year, subtract. Example: 2035 – 2018 = 17, so year 2035 means x = 17.

Example 2: Let x represent the year. In 2018, ...

This means: If x = 2018, it means it’s 2018. On the graph, x is 2018, which is bigger than in Example 1!

Use context to find the smallest and largest reasonable values for x and y

Example 3: A company makes a toy. The price of one toy x (in dollars) is related to the number of toys sold y by the equation $y = -250x + 3500$. Find the smallest and largest reasonable values for x and y .

Solution: The smallest price is to give the toy away (price $x = \$0$). $X_{\min} = 0$.

The smallest number of toys sold is none. $Y_{\min} = 0$.

If we substitute $x = 0$, we get $y = 3500$. $Y_{\max} = 3500$.

If we substitute $y = 0$ and solve for x , we get $x = \frac{-3500}{-250} = 14$. $X_{\max} = 14$.

The graph for this application should be in Quadrant I.

Determine usable scales for the axes

PRO TIP: The choice of scale can be personal taste, so there are many correct answers!

It can be useful to calculate the number of ticks for a given scale, or the scale for a number of ticks.

$$\# \text{ ticks} = \frac{\text{max} - \text{min}}{\text{scale}} \quad \text{or} \quad \text{scale} = \frac{\text{max} - \text{min}}{\# \text{ ticks}}$$

PRO TIP: Many people prefer 2 to 20 ticks on an axis, so long as they are easy to interpret.

Example 4: Use work from Example 3 to choose scales (tick spacing) a graph of $y = -250x + 3500$.

Solution:

$X_{\max} - X_{\min} = 14 - 0 = 14$. 14 is divisible by scale 2 (7 ticks) or scale 1 (14 ticks).

$Y_{\max} - Y_{\min} = 3500 - 0 = 3500$. 3500 is divisible by scale 500 (7 ticks) or scale 250 (14 ticks).

Do you prefer $X_{\text{scl}} = 2$ or $X_{\text{scl}} = 1$? Or even $X_{\text{scl}} = 5$? Do you prefer $Y_{\text{scl}} = 500$ or $Y_{\text{scl}} = 250$? Or $Y_{\text{scl}} = 1000$?

Graph in an appropriate window

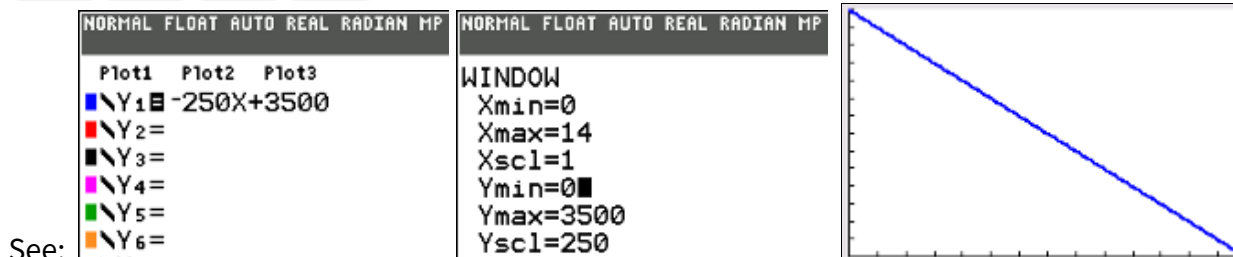
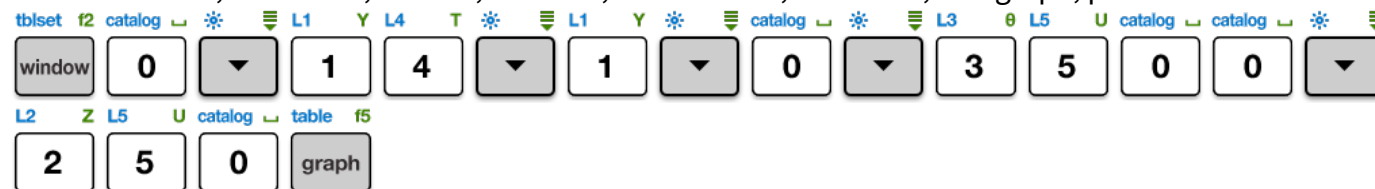
Example 5: Graph $y = -250x + 3500$ in an appropriate window.

Solution:

Input the function, press:



To use $X_{\min} = 0$, $X_{\max} = 14$, $X_{\text{scl}} = 1$, $Y_{\min} = 0$, $Y_{\max} = 3500$, $Y_{\text{scl}} = 250$, and graph, press:



See:

Try It!

Graph in an appropriate window.

- 1) The equation $y(x) = 0.212x + 12.04$ tells the percentage of the labor force y which are adults over age 65 for x the number of years since 1990 until the pandemic in 2020.
- 2) The equation $f(x) = 0.124x + 0.505$ tells the cost of a 30-second Super Bowl commercial, f , in millions of dollars, for x the number of years since 1990.
- 3) The number of smartphones shipped per year, y , in millions, is related to the number of years since 2000, x , by the equation $y = 26.351x - 199.843$
- 4) The number of admissions to movie theatres y in billions, for x years after 2002, is given by $y(x) = -0.04x + 1.62$
- 5) The fraction, expressed as a decimal, y of females age 18 and under who smoke during year x , where x is the number of years since 1960, is given by $y = -0.00391x + .36218$

Solutions

