Choosing an Appropriate Window for Applications Classic View

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). Xmin = 0.
The smallest number of toys sold is none. Ymin = 0.
If we substitute x = 0, we get y = 3500. Ymax = 3500.
If we substitute y = 0 and solve for x, we get $x = \frac{-3500}{-250} = 14$. Xmax = 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.

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

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 $y = -250x + 3500$.

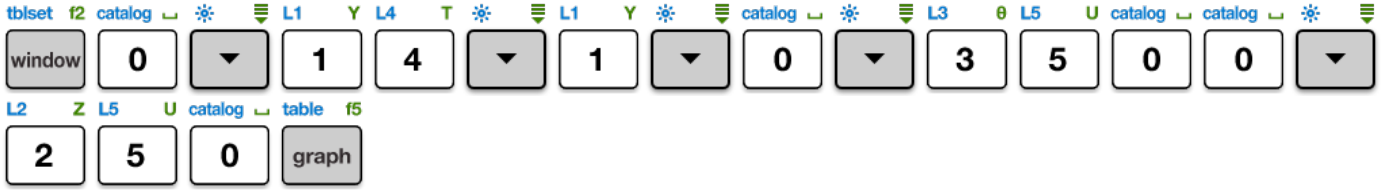
Solution:
Xmax – Xmin = 14 – 0 = 14. 14 is divisible by scale 2 (7 ticks) or scale 1 (14 ticks).
Ymax – Ymin = 3500 – 0 = 3500. 3500 is divisible by scale 500 (7 ticks) or scale 250 (14 ticks).
Do you prefer Xscl = 2 or Xscl = 1? Or even Xscl = 5? Do you prefer Yscl = 500 or Yscl = 250? Or Yscl = 1000?

Graph in an appropriate window

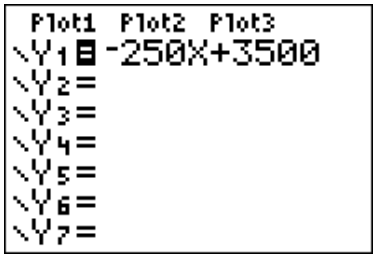
Example 5: Graph $y = -250x + 3500$ in an appropriate window.

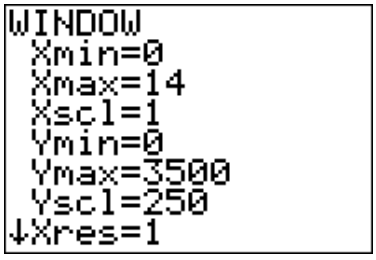
Solution:
Input the function, press:

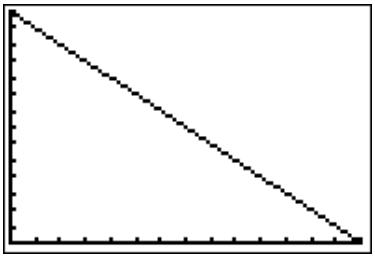
To use Xmin = 0, Xmax = 14, Xscl = 1, Ymin = 0, Ymax = 3500, Yscl = 250, and graph, press:



See:







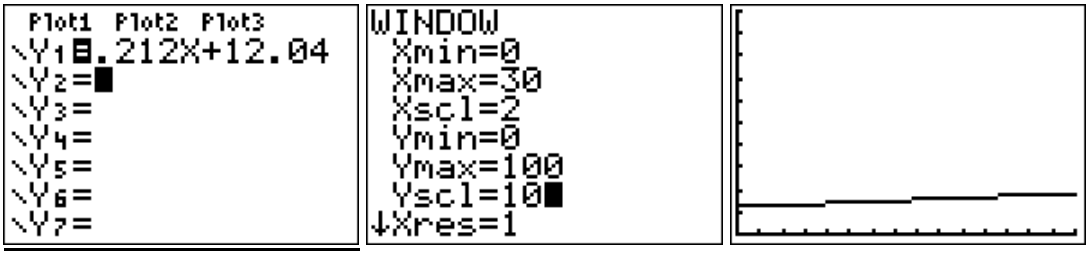
Try It!

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

1)



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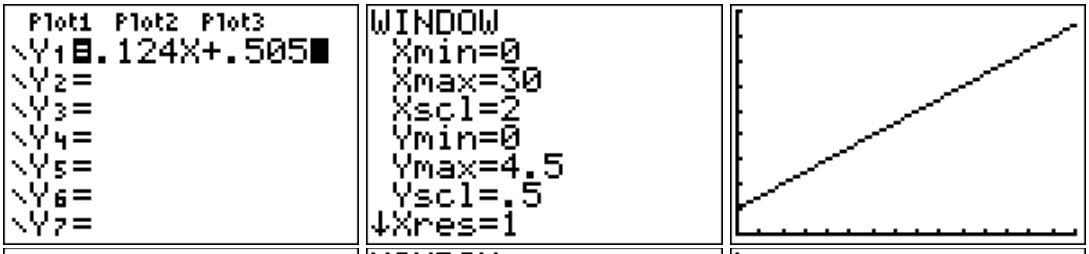
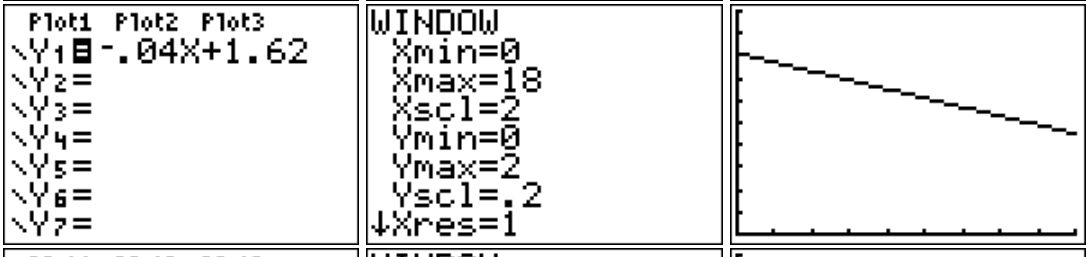


3)

4)



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