

FST 2-7 Notes

Topic: Inverse Variation Models

GOAL:

Review inverse variation functions as models in a variety of situations.

SPUR Objectives

E Describe properties of inverse variation functions.

Inverse Variation

Suppose you have 6 pounds of ground meat to make hamburger patties of equal weight. The more patties you make, the less each patty will weigh. The weight per patty *varies inversely as* (or is inversely proportional to) the number of patties.

W = weight of patties and N = number of patties

$$W = \frac{6}{N}$$

Warm-Up

1. If A and B are inversely proportional and $A = 10$ when $B = 5$, then what is the value of B when $A = 50$?

$$A = \frac{k}{B} \quad 5(10) = \left(\frac{k}{5}\right)5$$

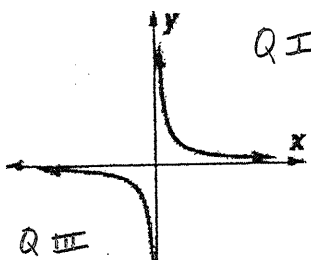
$$k = 50$$

$$50 = \frac{50}{B}$$

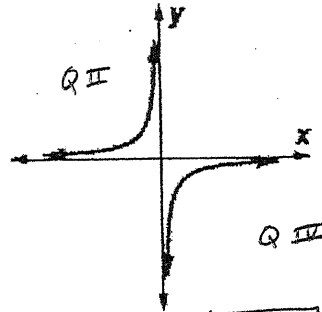
$$\boxed{B = 1}$$

Inverse Variation Models

$$y = \frac{k}{x}$$



$$y = \frac{k}{x}, \boxed{k > 0} \text{ positive}$$



$$y = \frac{k}{x} = kx^{-1}, \boxed{k < 0} \text{ negative}$$

Properties

- Graph is a hyperbola
- k is the constant of variation
- Domain: $\{x \mid x \neq 0\}$
- vertical asymptote at $x = 0$ (y-axis)
- Range: $\{y \mid y \neq 0\}$
- Horizontal asymptote at $y = 0$ (x-axis)

Vocabulary

varies inversely as, is inversely proportional to

constant of variation, " k "

constant of proportionality

inverse-square relationship

varies inversely as the square of, is inversely proportional to the square of

power function

$$\frac{A}{10} \downarrow \times 5 \quad 50$$

$$\frac{B}{5} \downarrow \div 5 \quad B? = 1$$

$$y = \frac{k}{x^2}$$

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1. The average song size (in MB) and approximate number of songs for a sample of 32 GB MP3 players are listed in the table below.

Average song size L_1 (MB) s	Approximate number of songs L_2 on 32GB MP3 player h
3.6	8000
4.7	7000
4.5	7200
4.2	7600
4.1	7800
5.8	5500
4.9	6500
5.1	6300

$$h = \frac{k}{s}$$

- Find a formula that gives the average number n of songs that will fit on an MP3 player as a function of the average song size s .
- Graph both the data and the model on a single set of axes.
- Use residuals to assess the quality of your model.
- About 10,000 songs would correspond to what average song size?

a) $n = \frac{k}{s}$ * pick a "typical point" $\rightarrow (4.9, 6500)$
 s, h

$4.9 (6500) = \left(\frac{k}{4.9}\right) 4.9$ $k = 31,850$ $h = \frac{31,850}{s}$

b) $L_1, L_2, 2nd, Y =$ Scatterplot Zoom 9
 In $y =$, $y_1 = \frac{31,850}{x}$

c) $L_3 = \text{Predicted}$, $L_3 = 31,850 / L_1$

$R = Obs - Pred$
 $L_4 = L_2 - L_3$

Stat - Calc - 1: - L_4

$\sum x^2 = 787,004$

d) $10,000 = \frac{31,850}{s}$

$s = 3.2 \text{ MB}$

2. The intensity of light from a point source is inversely proportional to the square of the distance from the light source. Suppose that at a distance of 5 cm, the light intensity is rated at 600 lux. What will the intensity be at a distance of 10 cm? At 23 cm?

$$L = \frac{K}{d^2} \quad 5^2 (600) = \left(\frac{K}{5^2}\right) 5^2$$

$$K = 15,000$$

$$L = \frac{15,000}{d^2}$$

$$10 \text{ cm}$$

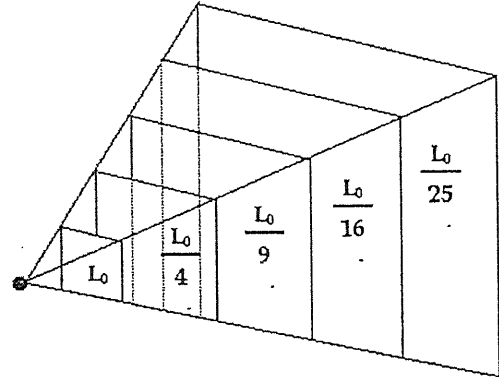
$$L = \frac{15,000}{10^2}$$

$$L = 150 \text{ lux}$$

$$23 \text{ cm}$$

$$L = \frac{15,000}{23^2}$$

$$L = 28.36 \text{ lux}$$



An example of the "one over r squared" relationship for light

<http://img.gla.ac.uk/gla/yba/MS1-velocity/1overR2-more.html>

Illuminance is a measure of how much luminous flux is spread over a given area. One can think of luminous flux (measured in lumens) as a measure of the total "amount" of visible light present, and the illuminance as a measure of the intensity of illumination on a surface. A given amount of light will illuminate a surface more dimly if it is spread over a larger area, so illuminance is inversely proportional to area.

<http://en.wikipedia.org/wiki/Lux>

