

150 Lecture Notes Section 1.11
Modeling Variation

Definition - Direct Variation

If the quantities x and y are related by the equation

$$y = k \cdot x$$

for values of $k \neq 0$, then y **varies directly** as x . The constant k is the **constant of proportionality**.

Example 1: The distance between you and a thunderstorm varies directly as the time interval between the lightning and the thunder.

- (a) Suppose the thunder takes 5 seconds to reach you from a storm 5400 ft. away. Write the equation for the variation.
- (b) Sketch the graph. What does k represent?
- (c) If the time interval is 2 sec, how far away is the storm?

Definition - Inverse Variation

If the quantities x and y are related by the equation

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

for values of $k \neq 0$, then y **varies inversely** as x .

Example 2: z varies inversely as t . If $t = 3$ when $z = 5$, find the value of z when $t = \frac{1}{2}$.

Definition - Joint Variation

If the quantities x and y are related by the equation

$$z = k \cdot x \cdot y$$

for values of $k \neq 0$, then z **varies jointly** as x and y .

Example 3: Given t is jointly proportional to x and y and inversely proportional to the square root of r .

(a) If $t = 30$ when $x = 3$, $y = 4$ and $r = 4$, find the equation that expresses the proportionality.

(b) What happens to the value of t when x and y are doubled and r is quadrupled?

(c) Find the value of t when $x = 4$, $y = 6$, and $r = 9$.

Example 4: The heat from a campfire is proportional to the amount of wood on the fire, and inversely proportional to the cube of the distance from the fire. If you are 20 ft from the fire, and someone doubles the amount of wood burning, how far from the fire would you have to be so that you feel the same heat as before?