

§ 1.11: Modeling Variation

Direct Variation

Direct Variation

If the quantities x and y are related by an equation

$$y = kx$$

for some constant $k \neq 0$, we say that y **varies directly as** x , or y is **directly proportional to** x , or simply y is **proportional to** x . The constant k is called the **constant of proportionality**.

Example 1	Direct Variation
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During a thunderstorm you see the lightning before you hear the thunder because light travels faster than sound. The distance between you and the storm varies directly as the time interval between the lightning and the thunder.

- (a) Suppose that the thunder from a storm 5400 ft away takes 5 s to reach you. Determine the constant of proportionality and write the equation for the variation.
- (b) Sketch the graph of this equation. What does the constant of proportionality represent?
- (c) If the time interval between the lightning and thunder is now 8 s, how far away is the storm?

Inverse Variation

Inverse Variation

If the quantities x and y are related by the equation

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

for some constant $k \neq 0$, we say that y is **inversely proportional to x** , or y **varies inversely as x** .

Example 2	Inverse Variation
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Boyle's Law states that when a sample of gas is compressed at a constant temperature, the pressure of the gas is inversely proportional to the volume of the gas.

- (a) Suppose the pressure of a sample of air that occupies 0.106 m^3 at $25 \text{ }^\circ\text{C}$ is 50 kPa . Find the constant of proportionality, and write the equation that expresses the inverse proportionality.
- (b) If the sample expands to a volume of 0.3 m^3 , find the new pressure.

Joint Variation

Joint Variation

If the quantities x , y , and z are related by the equation

$$z = kxy$$

for some constant $k \neq 0$, we say that z **varies jointly as** x and y , or z is **jointly proportional to** x and y .

Example 3	Newton's Law of Gravitation
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Newton's Law of Gravitation says that two objects with masses m_1 and m_2 attract each other with a force F that is jointly proportional to their masses and inversely proportional to the square of the distance r between the objects. Express Newton's Law of Gravitation as an equation.

Homework

Due: _____

2 – 22 (even), 24, 30, 36, 40, 42