Types of Variation

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Ratio, proportion, and variation should begin in early grades with ratio. Proportion follows naturally with equivalent fractions.

Proportion becomes an important problem-solving tool when students become comfortable with variables and solving simple equations. Applications include similarity in geometry and an amazing array of practical situations in science and engineering -- hence, this topic is included with Rainbows and Starscapes.

Variation includes these:

* *Direct variation*, where increase in one variable means increase in another. Example: if speed is held constant, an increase in distance means an increase in time. Two ideas vary directly if the ordered division of the variables yields a consistent quotient.

Two forms: if K is a constant, $y = Kx$ or $K = \frac{y}{x}$.

* *Inverse variation*, where increase in one variable means decrease in another. Example: if distance is constant, an increase in speed means a decrease in time. Two ideas vary inversely if the product of these variables yields a consistent product.

Forms: $xy = K$ or $x = K/y$.

* *Joint variation* involves a constant K and three variables. If x varies jointly with y and z, then $x = Kyz$ or $K = \frac{x}{yz}$. Example: K might be rate of interest, x is amount of interest, y is principal, and z is time.

Another example is similar to the riddle that begins, "If a hen-and-a-half can lay an egg-and-a-half in a day-and-a-half, how…?" Situations involving products or units of work (eggs), workers (hens), and time (days) show joint-variation constancy this way:

$$K = \frac{jobs}{(\text{workers})(\text{time})}$$

* *Combined variation* involves both direct and inverse variation. If x varies directly as the square of y and inversely as z, then

$x = Ky^2/z$, or $K = \frac{xz}{y^2}$.

Of the two forms given above in each case, the form that is solved for K is the most convenient to use when solving problems. The other form is more often given in textbooks.