3.2.1: Coefficient of Variation

Coefficient of Variation

Coefficient of variation is the standard deviation divided by the mean; it summarizes the amount of variation as a percentage or proportion of the total. It is useful when comparing the amount of variation for one variable among groups with different means, or among different measurement variables. For example, the United States military measured foot length and foot width in 1774 American men. The standard deviation of foot length was $13.1mm$ and the standard deviation for foot width was $5.26mm$, which makes it seem as if foot length is more variable than foot width. However, feet are longer than they are wide. Dividing by the means ($269.7mm$ for length, $100.6mm$ for width), the coefficients of variation is actually slightly smaller for length (4.9%) than for width (5.2%), which for most purposes would be a more useful measure of variation.

Coefficient of Variation Formulas

The coefficient of variation, denoted by CVar or CV, is used to compare standard deviations from different populations.

For samples:

$$CV = \frac{s}{\bar{X}} \cdot 100 \tag{3.2.1.1}$$

For populations:

$$CV = \frac{\sigma}{\mu} \cdot 100 \tag{3.2.1.2}$$

Example

According to FuelEconomy.gov, for the year 2014, automatic Sport-Utility Vehicles with 4-wheel drive have an average fuel economy of 21 miles per gallon (mpg), with a standard deviation of 2.3 mpg. Standard trucks with 4-wheel drive and automatic transmission have an average fuel economy of 17 mpg and standard deviation of 2.0 mpg.

Compare the variations of the two.

Solution:

SUVs: 2.3/21*100% = 11.0%

Trucks: 2.0/17*100% = 11.8%

Comparing the coefficients of variation for the SUVs and the Trucks, the truck fuel economy is more variable than the SUVs.

Source: FuelEconomy.gov