Descriptive statistics are measures of location and shape that pertain to probability distributions. The primary measures of location is the arithmetic mean (more commonly called the mean) and the geometric mean. Please note that there is a population mean and a sample mean. We usually cannot know the former, but we can always know the latter. Later, we will infer the population mean from the sample mean. Right now, we will simply master the basic concepts.

Arithmetic Mean
Suppose there is only a finite number N of items in the system of interest. Then the population arithmetic mean is

$$\mu = \frac{\sum_{i=1}^{N} x_i}{N}.$$

Suppose we have a sample of size n drawn from the population. Then the sample arithmetic mean is

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}.$$

The sample mean $\bar{x}$ will be used to draw inferences about the population mean $\mu$. As noted, the population mean is generally unknown.

INTERPRETATION: The population arithmetic mean is simply a measure of the center of gravity of the population, and the sample arithmetic mean is simply a measure of the center of gravity of the sample.

IN EXCEL
The sample mean is found via the AVERAGE function or via the Descriptive Statistic tool under Tools/Data Analysis/Descriptive Statistics.
Geometric Mean
Suppose there is only a finite number $N$ of items in the system of interest. Then the population geometric mean is

$$\text{gm}_{\text{population}} = \left( \prod_{i=1}^{N} x_i \right)^{\frac{1}{N}}.$$

Suppose we have a sample of size $n$ drawn from the population. Then the sample geometric mean is

$$\text{gm}_{\text{sample}} = \left( \prod_{i=1}^{n} x_i \right)^{\frac{1}{n}}.$$

**INTERPRETATION:** The geometric mean does not have a simple interpretation. The geometric mean will be used in finance to account for continuously compounding.

**IN EXCEL:** Excel has a GEOMEAN function, but does not have a geometric mean tool in Data Analysis.

**EXAMPLE**
Suppose we have the data set $\{1, 2, 3, 4, 5\}$.

Then the sample arithmetic mean is

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{1 + 2 + 3 + 4 + 5}{5} = \frac{15}{5} = 3.0$$

and the sample geometric mean is

$$\text{gm}_{\text{sample}} = \left( \prod_{i=1}^{n} x_i \right)^{\frac{1}{n}} = (1 \cdot 2 \cdot 3 \cdot 4 \cdot 5)^{\frac{1}{5}} = (120)^{\frac{1}{5}} = 2.60517108.$$

**PROBLEMS:** Ch. 2, #4b, 12