

Statistics – Measures of Central Tendency



Mean, Median &
Mode

What is the average / expected /
most frequent value?

Measures of central Tendency – mean

The **mean** (average) is the **sum** of all observations divided by the **number** of observations.

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

μ : mean

X_i : value of observation i

N : total number of observations

1, 2, 2, 2,
4, 4, 6

$$\text{mean} = \frac{1+2+2+2+4+4+6}{7} = \frac{21}{7} = 3$$

Measures of central Tendency – median

The **median** is the **midpoint of a dataset** when the data is arranged in ascending or descending order. Half of the observations lie above the median and half are below.



1, 2, 2, 2, 4, 4, 6

Measures of central Tendency – mode

The **mode** is the value that occurs **most frequently** in a data set. A data set may have one mode (**unimodal**), more than one mode or even no mode.



1, 2, 2, 2, 4, 4, 6

Measures of central Tendency – mean vs. median

The **mean** is sensitive to outliers. In some cases, the median is the better metric as the **median** is not affected by outliers.

1, 2, 2, 2,
4, 4, 6

mean: 3
median: 2

1, 2, 2, 2,
4, 4, 50

mean: 9.3
median: 2

Measures of central Tendency – geometric mean

The geometric mean is often used when calculating investment returns over multiple periods or when measuring compound interest / growth rates.

$$1 + R_G = \sqrt[n]{(1 + R_1) * (1 + R_2) * \dots * (1 + R_n)}$$

R_t : Return in period t
 n : total number of periods

10%, -5%, 12%

$$R_G = (1.1 * 0.95 * 1.12)^{\left(\frac{1}{3}\right)} - 1 = 5.38\%$$

arithmetic mean: 5.67%