# Exercise.2

## Measures of central tendency – mean median, mode, geometric mean, harmonic mean for raw data

### Arithmetic mean or mean

Arithmetic mean or simply the mean of a variable is defined as the sum of the observations divided by the number of observations. If the variable x assumes n values x1, x2 … xn then the mean, $\bar{x}$ , is given by

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \ldots + x_n}{n}$$

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

This formula is for the ungrouped or raw data.

**Example 1**

Calculate the mean for 2, 4, 6, 8, 10

**Solution**

$$\bar{x} = \frac{2+4+6+8+10}{5} = \frac{30}{5} = 6$$

**Short-Cut method**

Under this method an assumed or an arbitrary average (indicated by A) is used as the basis of calculation of deviations from individual values. The formula is

$$\bar{x} = A + \frac{\sum d}{n}$$

Where, A = the assumed mean or any value in x

d = the deviation of each value from the assumed mean

**Example 2**

A student's marks in 5 subjects are 75, 68, 80, 92, 56. Find his average mark.

**Solution**

| X | d=x-A |
|---|---|
| 75 | 7 |
| 68 | 0 |
| 80 | 12 |
| 92 | 24 |
| 56 | -12 |
| **Total** | **31** |

$$\bar{x} = A + \frac{\sum d}{n}$$

$$= 68 + \frac{31}{5}$$

=68+6.2

=74.2

**Median**

The median is the middle most item that divides the group into two equal parts, one part comprising all values greater, and the other, all values less than median.

**Ungrouped or Raw data**

Arrange the given values in the ascending or decreasing order. If the number of values is odd, median is the middle value

If the number of values are even, median is the mean of middle two values.

By formula

When n is odd Median = Md = $\left(\frac{n+1}{2}\right)^{th}$ *value*

When n is even Average of $\left(\frac{n}{2}\right) and \left(\frac{n}{2}+1\right)^{th}$ *value*

**Example 3**

If the weights of sorghum ear heads are 45, 60, 48, 100, 65 gms. Calculate the median

**Solution**

Here n = 5

First arrange it in ascending order

45, 48, 60, 65, 100

Median $=\left(\frac{n+1}{2}\right)^{th}$ *value*

$=\left(\frac{5+1}{2}\right) = 3^{rd}$ *value* =60

**Example 4**

If the sorghum ear- heads are 5, 48, 60, 65, 65, 100 gms. Calculate the median.

**Solution**

Here n = 6

Meadian = Average of $\left(\frac{n}{2}\right) and \left(\frac{n}{2}+1\right)^{th}$ *value*

$\left(\frac{n}{2}\right) = \frac{6}{2} = 3^{rd}\ value = 60$ and $\left(\frac{n}{2}+1\right) = \frac{6}{2}+1 = 4^{th}\ value = 65$

Median = $\frac{60+65}{2} = 62.5\,g$

**Mode**

The mode refers to that value in a distribution, which occur most frequently.

**Computation of the mode**

**Ungrouped or Raw Data**

For ungrouped data or a series of individual observations, mode is often found by mere inspection.

**Example 5**

Find the mode for the following seed weight

2 , 7, 10, 15, 10, 17, 8, 10, 2 gms

Mode = 10

In some cases the mode may be absent while in some cases there may be more than one mode.

**Example 6**

1. 12, 10, 15, 24, 30 (no mode)

2. 7, 10, 15, 12, 7, 14, 24, 10, 7, 20, 10

the modes are 7 and 10

**Geometric mean**

The geometric mean of a series containing n observations is the nth root of the product of the values.

If x1, x2…, xn are observations then

$$G.M=\sqrt[n]{x_1, x_2 \ldots x_n}$$

$$= (x_1, x_2 \ldots x_n)^{1/n}$$

$$\text{Log GM} = \frac{1}{n}\log(x_1, x_2 \ldots x_n)$$

$$= \frac{1}{n}(\log x_1 + \log x_2 + \ldots + \log x_n)$$

$$= \frac{\sum \log x_i}{n}$$

$$GM = \text{Antilog } \frac{\sum \log x_i}{n}$$

For grouped data

$$GM = \text{Antilog } \left[ \frac{\sum f \ \log x_i}{N} \right]$$

**Example 7**

If the weights of sorghum ear heads are 45, 60, 48,100, 65 gms. Find the Geometric mean for the following data

| **Weight of ear head x (g)** | **Log x** |
|---|---|
| 45 | 1.653 |
| 60 | 1.778 |
| 48 | 1.681 |
| 100 | 2 |
| 65 | 1.813 |
| **Total** | **8.925** |

**Solution**

Here n = 5

$$GM = \text{Antilog } \frac{\sum \log x_i}{n}$$

$$= \text{Antilog } \frac{8.925}{5}$$

= Antilog 1.785

= 60.95

**Harmonic mean (H.M)**

Harmonic mean of a set of observations is defined as the reciprocal of the arithmetic average of the reciprocal of the given values. If $x_1, x_2 \ldots.. x_n$ are n observations,

$$H.M = \frac{n}{\sum_{i=n}^{n}\left(\frac{1}{x_i}\right)}$$

**Example 8**

From the given data calculate H.M 5, 10, 17, 24, 30

| X | $\frac{1}{x}$ |
|---|---|
| 5 | 0.2000 |
| 10 | 0.1000 |
| 17 | 0.0588 |
| 24 | 0.0417 |
| 30 | 0.4338 |

$$H.M = \ = \frac{5}{0.4338} = 11.526$$

**Learning Exercise**

The weight of 15 earheads of sorghum are 100, 102, 118, 124, 126, 98, 100, 100, 118, 95, 113, 115, 123, 121, 117.Find

(i) Average of weight

(ii) Median

(iii) Mode

**(iv)** Harmonic mean

**(v)** Geometric mean