STATISTICS

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Relation Between

Mean, Median, Mode

$\bar{X}$ M_d M_o

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Relation Between

Mean, Median, Mode

$\bar{X}$ M_d M_o

Source - Business Statistics, Excel Books, 2006, RS Bhardwaj

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Relation between Mean, Median and Mode

The relationship between the measures of central tendency - Mean ($\bar{\mathbf{X}}$), Median ($\mathbf{M_d}$) , Mode ($\mathbf{M_o}$) will be interpreted in terms of ***continuous frequency curve***.

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Relation between Mean, Median and Mode

If the number of observations of a frequency distribution are *increased gradually*, then accordingly, we need to have more number of classes, for approximately the same range of values of the variable, and simultaneously, the width of the corresponding classes would decrease.

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Relation between Mean, Median and Mode

Consequently, the histogram of the frequency distribution will get transformed into a ***smooth frequency curve***, as shown in the following figure.

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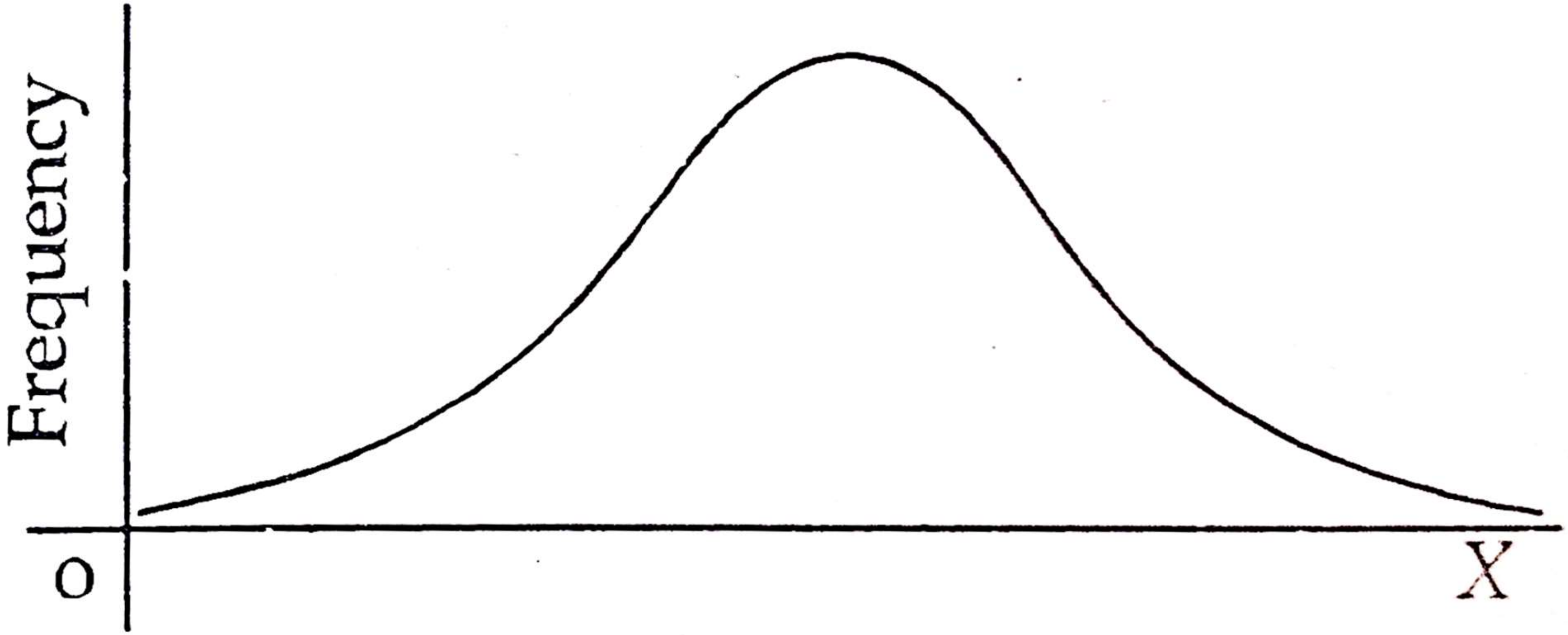

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Relation between Mean, Median and Mode

For a given distribution,

the **mean** is the value of the variable which is the ***Point of balance*** or ***Centre of gravity*** of the distribution.

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Relation between Mean, Median and Mode

For a given distribution,

the **median** is the value such that half of the observations are below it and remaining half are above it. In terms of the *frequency curve*, the total area under the curve is divided into ***two equal parts by the median***.

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For a given distribution,

Mode of a distribution is a value around which there is maximum concentration of observations and is given by the point at which peak of the curve occurs.

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Relation between Mean, Median and Mode

For a **Symmetrical distribution**, all the three measures of central of tendency are equal, i.e.

Mean = Median = Mode

$$\bar{X} = M_d = M_o$$

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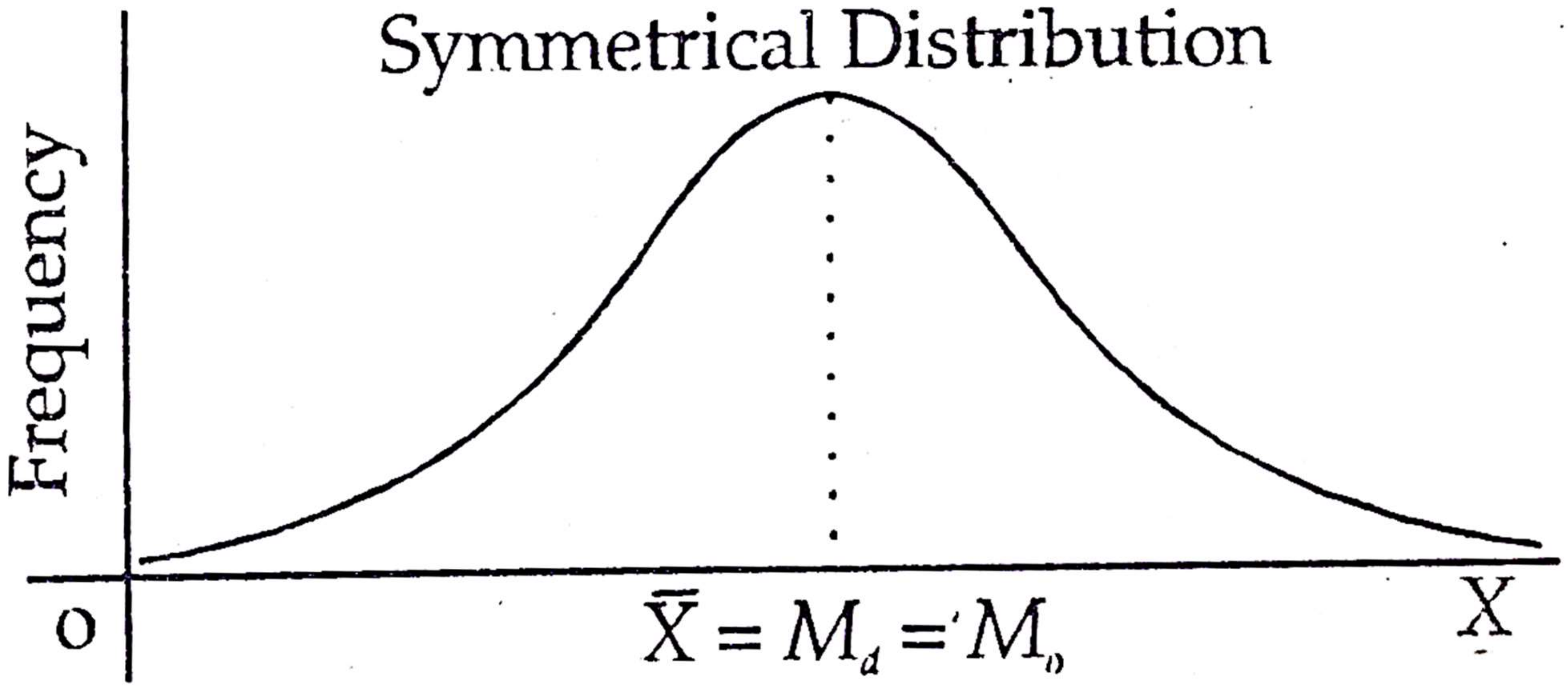

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Relation between Mean, Median and Mode

Imagine a situation - in which the above distribution is made **asymmetrical** or **positively (or negatively) skewed** by adding some observations of very high (or very low) magnitudes, so that the right hand (or the left hand) tail of the frequency curve gets elongated. …

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Relation between Mean, Median and Mode

... consequently, the three measures will depart from each other.

Since **mean** takes into account the magnitudes of observations, it would be **highly affected**. Further, since the total number of observations will also increase, the **median** would also be **affected** but to a **lesser extent than mean**.

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Relation between Mean, Median and Mode

Finally, there would be ***no change*** in the position of **mode**.

More specifically, we shall have

$$\mathbf{M_o < M_d < \bar{X}} \qquad \textbf{when skewness is positive}$$

$$\mathbf{\bar{X} < M_d < M_o} \qquad \textbf{when skewness is negative}$$

as shown in the following figure.

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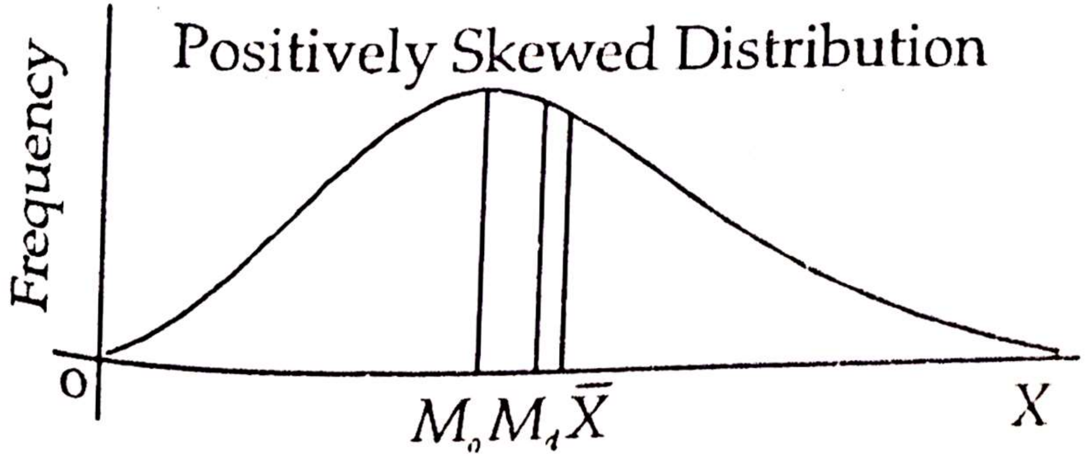
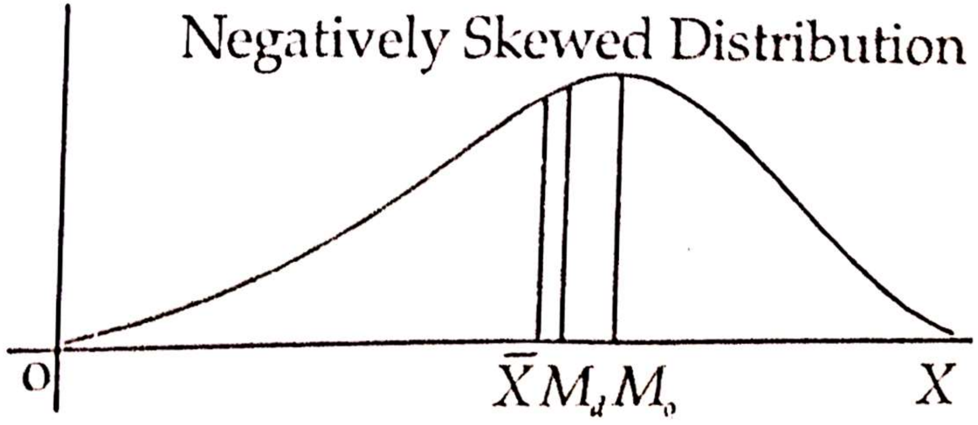


Frequency
Positively Skewed Distribution
O
M_o M_d $\bar{X}$
X



Negatively Skewed Distribution
O
$\bar{X}$ M_d M_o
X

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Empirical Relation between Mean, Median and Mode

Empirically, it has observed that for a ***moderately skewed distribution***, the **difference between mean and mode** is approximately **three times** the **difference between mean and median**, i.e.,

$$\overline{X} - M_o = 3(\overline{X} - M_d)$$

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Empirical Relation between Mean, Median and Mode

$$\bar{X} - M_o = 3(\bar{X} - M_d)$$

This relation can be used to estimate the value of one of the measures when the values of the other two are known.

Thank you!

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