15 Main Properties of Normal Probability Curve | Statistics

1. The normal curve is symmetrical:

The Normal Probability Curve (N.P.C.) is symmetrical about the ordinate of the central point of the curve. It implies that the size, shape and slope of the curve on one side of the curve is identical to that of the other.

That is, the normal curve has a bilateral symmetry. If the figure is to be folded along its vertical axis, the two halves would coincide. In other words the left and right values to the middle central point are mirror images.

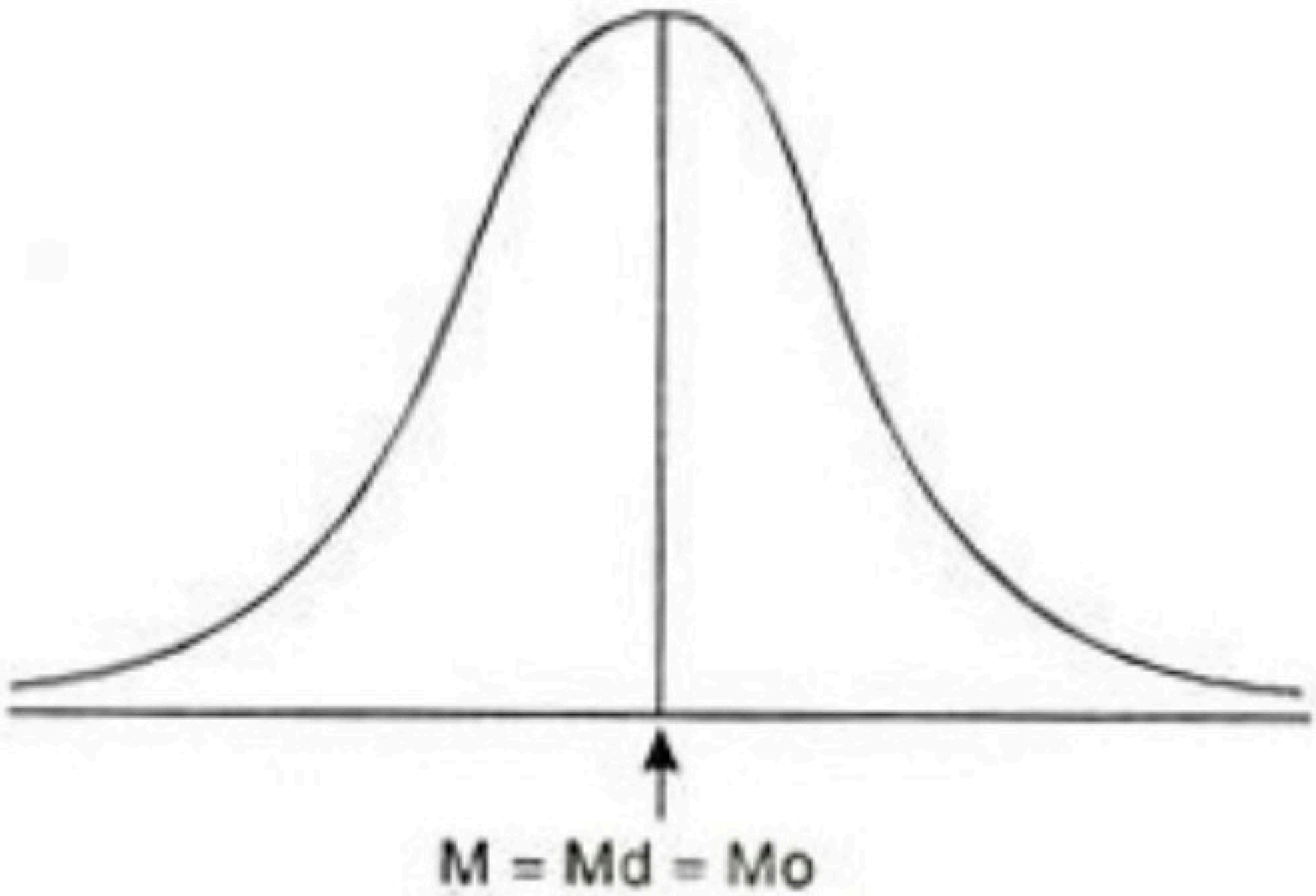

Fig. 6.2 N.P.C.., M = Mdn = Mode

2. The normal curve is unimodal:

Since there is only one point in the curve which has maximum frequency, the normal probability curve is unimodal, i.e. it has only one mode.

3. Mean, median and mode coincide:

The mean, median and mode of the normal distribution are the same and they lie at the centre. They are represented by 0 (zero) along the base line. [Mean = Median = Mode]

4. The maximum ordinate occurs at the centre:

The maximum height of the ordinate always occurs at the central point of the curve that is, at the mid-point. The ordinate at the mean is the highest ordinate and it is denoted by Y_0. (Y_0 is the height of the curve at the mean or mid-point of the base line).

Y_0 is given by $Y_0 = \frac{Ni}{\sigma\sqrt{2\pi}}$ where $\pi = 3.1416$. $\sqrt{2\pi} = 2.5066$

5. The normal curve is asymptotic to the X-axis:

The Normal Probability Curve approaches the horizontal axis asymptotically i.e., the curve continues to decrease in height on both ends away from the middle point (the maximum ordinate point); but it never touches the horizontal axis.

It extends infinitely in both directions i.e. from minus infinity (-∞) to plus infinity (+∞) as shown in Figure below. As the distance from the mean increases the curve approaches to the base line more and more closely.

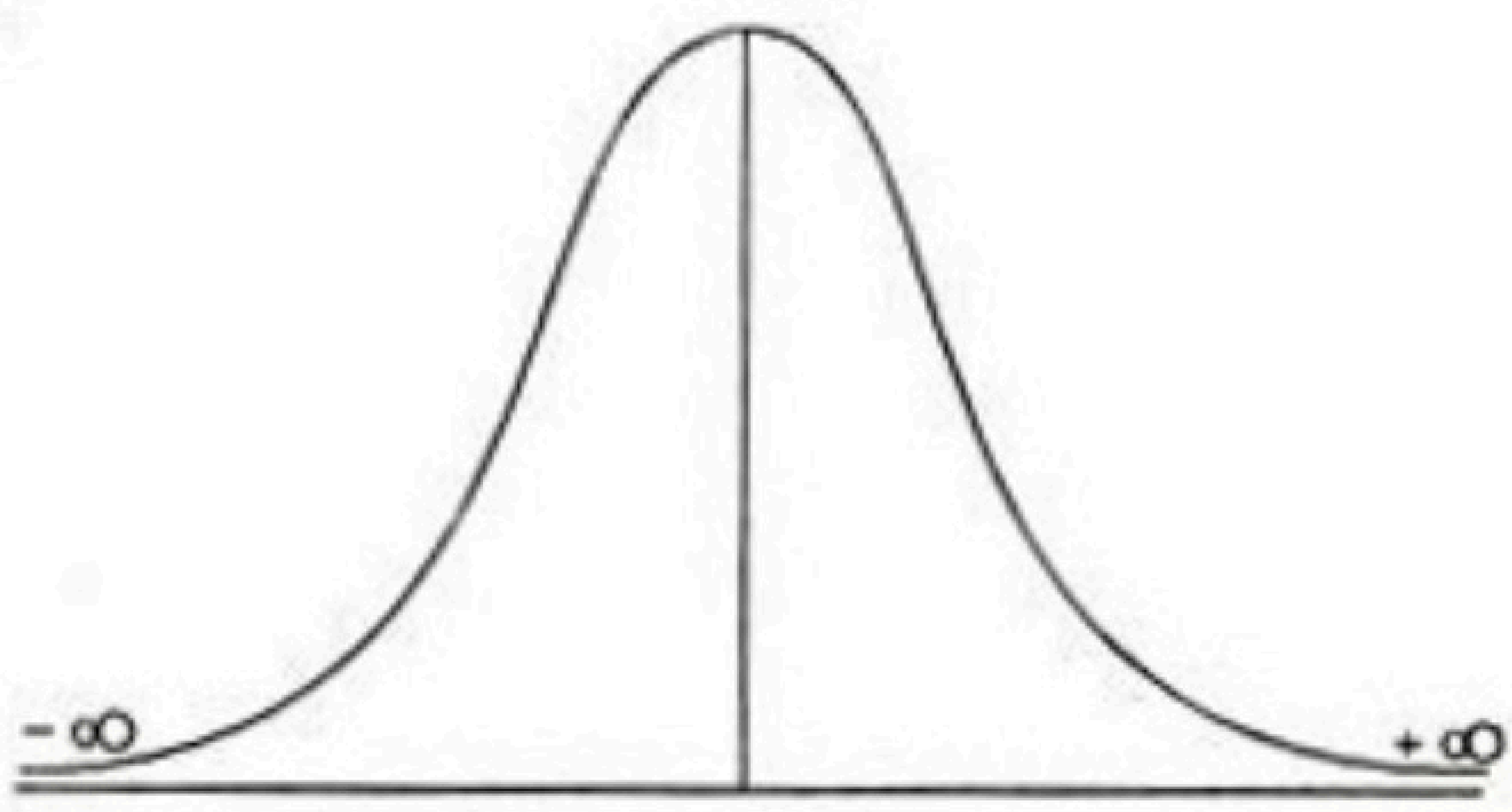

Fig. 6.3 Normal Curve is Asymptotic to the X-axis

6. The height of the curve declines symmetrically:

In the normal probability curve the height declines symmetrically in either direction from the maximum point. Hence the ordinates for values of $X = \mu \pm K$, where K is a real number, are equal.

For example:

The heights of the curve or the ordinate at $X = \mu + \sigma$ and $X = \mu - \sigma$ are exactly the same as shown in the following Figure:

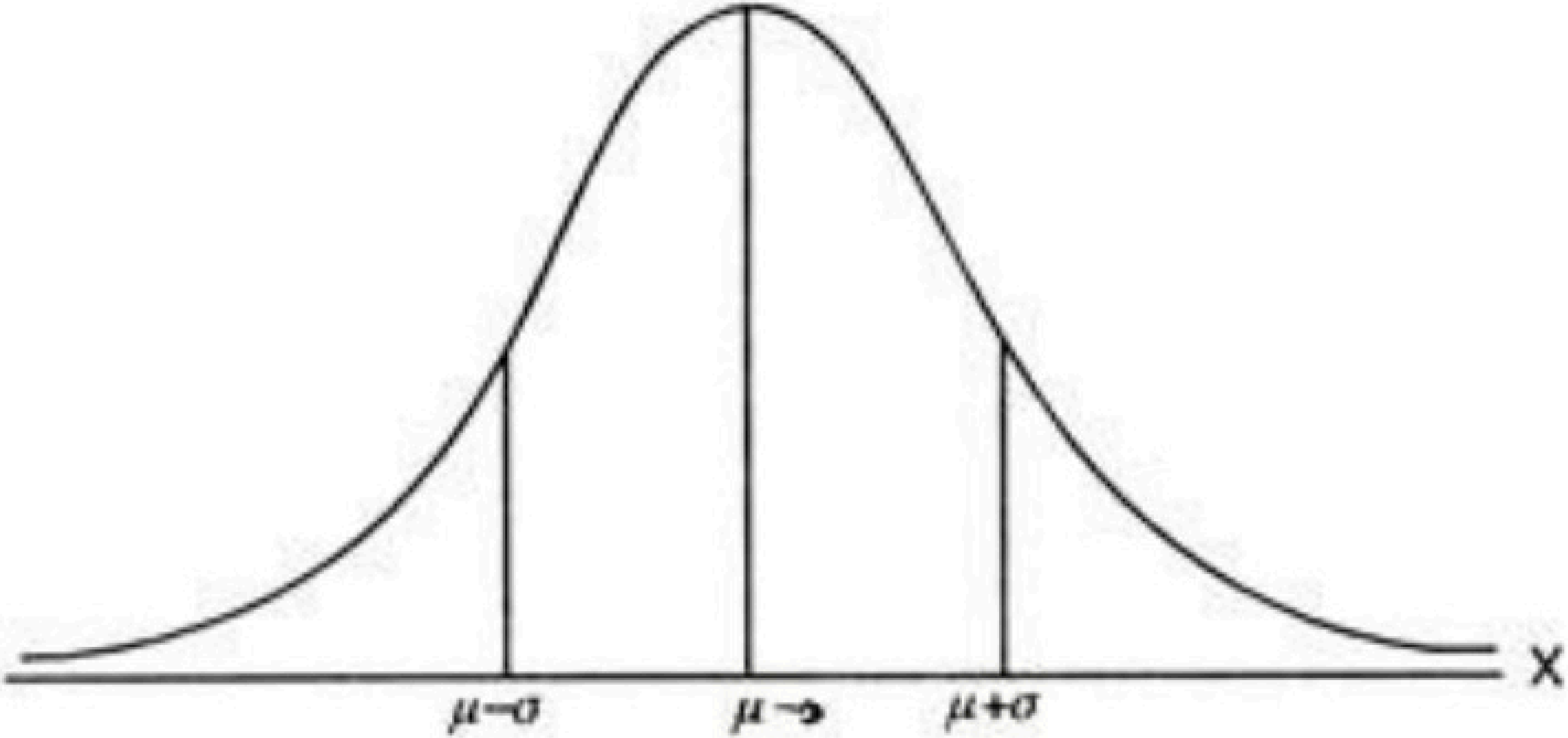

Fig. 6.4 Ordinates of a normal curve

7. The points of Influx occur at point ± 1 Standard Deviation (± 1 a):

The normal curve changes its direction from convex to concave at a point recognized as point of influx. If we draw the perpendiculars from these two points of influx of the curve on horizontal axis, these two will touch the axis at a distance one Standard Deviation unit above and below the mean (± 1 σ).

8. The total percentage of area of the normal curve within two points of influxation is fixed:

Approximately 68.26% area of the curve falls within the limits of ±1 standard deviation unit from the mean as shown in figure below.

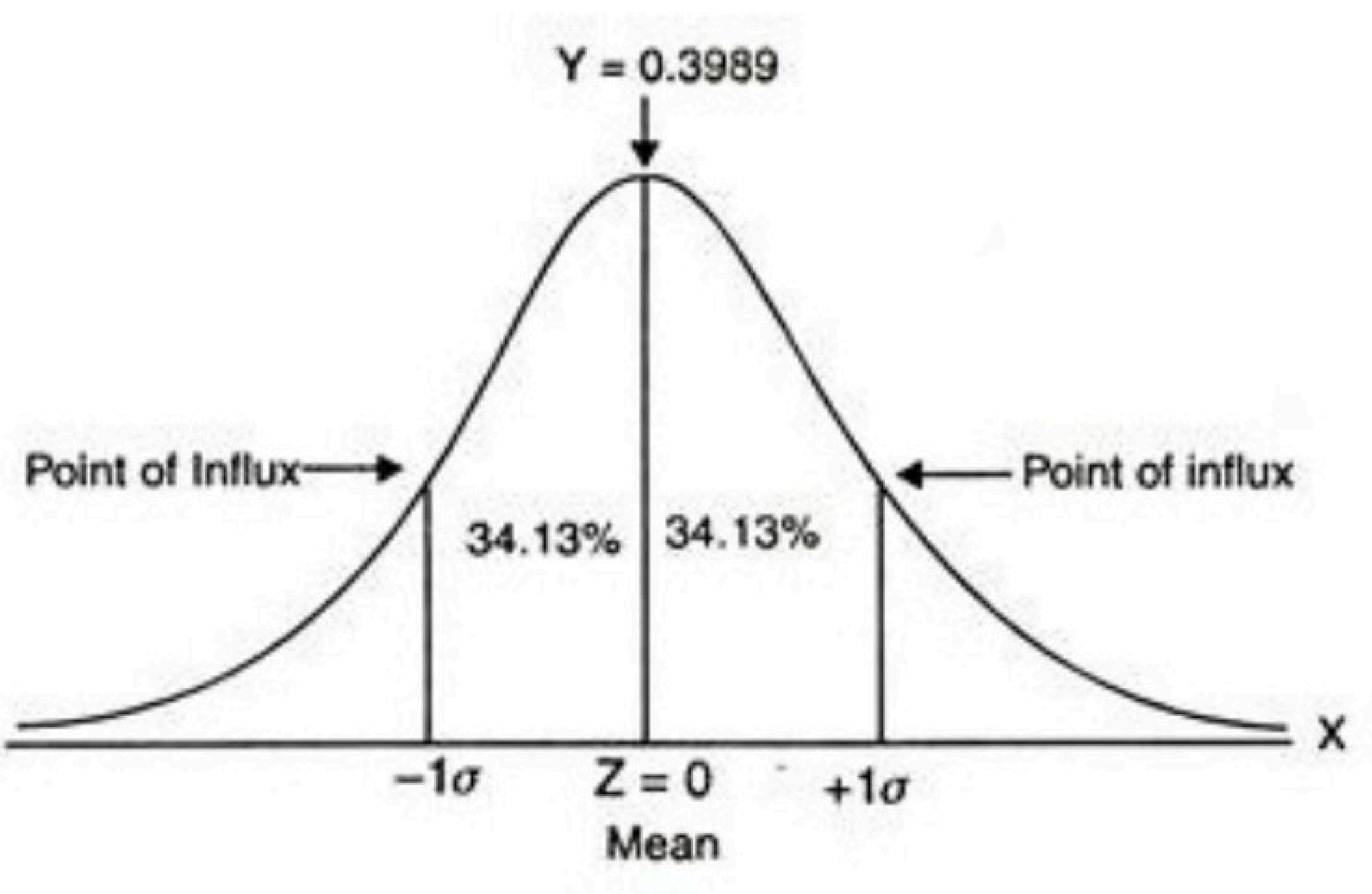

Fig. 6.5 N.P.C., 68.26% area of the curve within the limits of ±1σ

9. Normal curve is a smooth curve:

The normal curve is a smooth curve, not a histogram. It is moderately peaked. The kurtosis of the normal curve is 263.

10. The normal curve is bilateral:

The 50% area of the curve lies to the left side of the maximum central ordinate and 50% lies to the right side. Hence the curve is bilateral.

11. The normal curve is a mathematical model in behavioural sciences:

The curve is used as a measurement scale. The measurement unit of this scale is $\pm \sigma$ (the unit standard deviation).

12. Greater percentage of cases at the middle of the distribution:

There is a greater percentage of cases at the middle of the distribution. In between -1σ and + 1σ, 68.26% (34.13 + 34.13), nearly 2/3 of eases lie. To the right side of +1σ, 15.87% (13.59 + 2.14 + .14), and to the left of-1σ, 15.87% (13.59 + 2.14 + .14) of cases lie. Beyond +2σ. 2.28% of eases lie and beyond -2σ also 2.28% of cases lie.

Thus, majority of eases lie at the middle of the distribution and gradually number of cases on either side decreases with certain proportions.

Percentage of cases between Mean and different a distances can be read from the figure below:

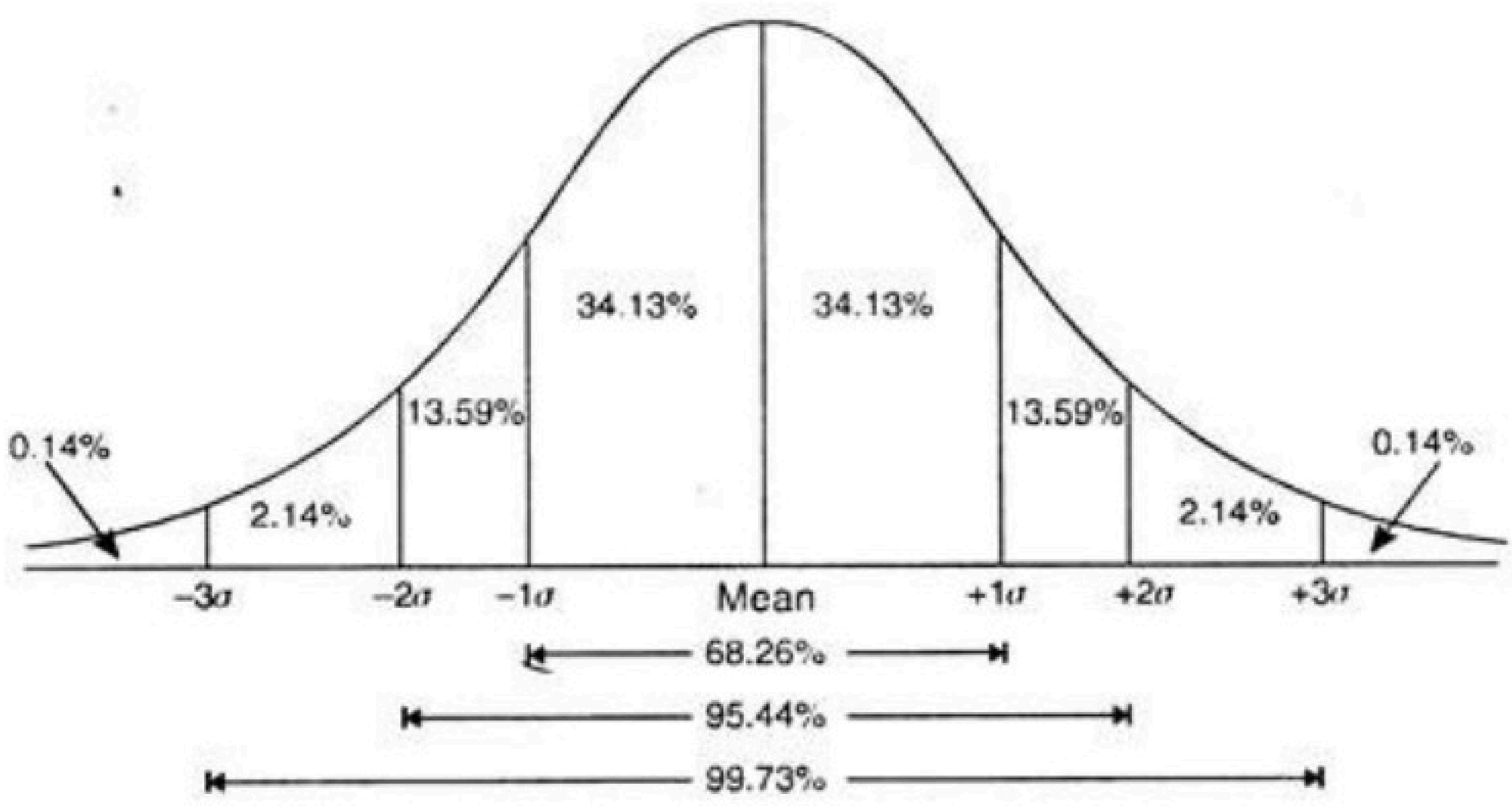

Fig. 6.6 The percentage of the cases falling between Successive Standard Deviations in Normal Distribution.

13. The scale of X-axis in normal curve is generalised by Z deviates

14. The equation of the normal probability curve reads

$$y = \frac{N}{\sigma\sqrt{2\pi}} e^{-\frac{x^2}{2\sigma^2}}$$

(equation of the normal probability curve) in which

x = scores (expressed as deviations from the mean) laid off along the base line or X-axis.

y = the height of the curve above the X axis, i.e., the frequency of a given x-value.

The other terms in the equation are constants:

N = number of eases

a = standard deviation of the distribution

π = 3.1416 (the ratio of the circumference of a circle to its diameter)

e = 2.7183 (base of the Napierian system of logarithms).

15. The normal curve is based on elementary principles of probability and the other name of the normal curve is the ‘normal probability curve’.

Significance of Normal Curve:

Normal Curve has great significance in mental measurement and educational evaluation. It gives important information about the trait being measured.

If the frequency polygon of observations or measurements of a certain trait is a normal curve, it indicates that:

1. The measured trait is normally distributed in the Universe.

2. Most of the cases are average in the measured trait and their percentage in the total population is about 68.26%

3. Approximately 15.87% of (50-34.13%) cases are high in the trait measured.

4. Similarly 15.87% cases approximately are low in the trait measured.

5. The test which is used to measure the trait is good.

6. The test has good discrimination power as it differentiates between poor, average and high ability group individuals, and

7. The items of the test used are fairly distributed in terms of difficulty level.

Applications/Uses of Normal Curve/Normal Distribution:

There are a number of applications of normal curve in the field of measurement and evaluation in psychology and education.

These are:

(i) To determine the percentage of cases (in a normal distribution) within given limits or scores.

(ii) To determine the percentage of cases that are above or below a given score or reference point.

(iii) To determine the limits of scores which include a given percentage of cases.

(iv) To determine the percentile rank of a student in his group.

(v) To find out the percentile value of a student's percentile rank.

(vi) To compare the two distributions in terms of overlapping.

(vii) To determine the relative difficulty of test items, and

(viii) Dividing a group into sub-groups according to certain ability and assigning the grades.