Most important — Paper - II (Unit 2) 1

P.G. Sem II - Statistics for Psy.

Normal Probability Curve Unit - I

What is normal probability curve? What are its characteristics. Discuss its uses & applications

(1)

Introduction

Normal distribution curve or normal curve is graphic representation of frequency distribution. It is bell shaped figure which shows the nature of the distribution of frequency (the sample). It is a very important graphic method of mental measurement. 'Garrett' says this bell shaped figure is called "the normal probability curve or simply the normal curve & is of great value in mental measurement". This curve indicates the maximum number of scores in the middle position & progressive falling off towards the high score-end of the scale.

Normal distribution curve or the normal curve is a graphic representation of the frequency distribution (of the sample). It is a bell-shaped figure which indicates the nature of the distribution of frequency (of the sample). It is a very important graphic method of mental measurement. 'Garrett' says this bell shaped figure is called "the normal probability curve, or simply the normal curve, & is of great value in mental measurement". A typical normal curve indicates maximum measures or scores at the middle position & progressive falling off towards the high score-end of the scale. The below mentioned figure is a representation of such a typical normal probability curve.

Typical Graph

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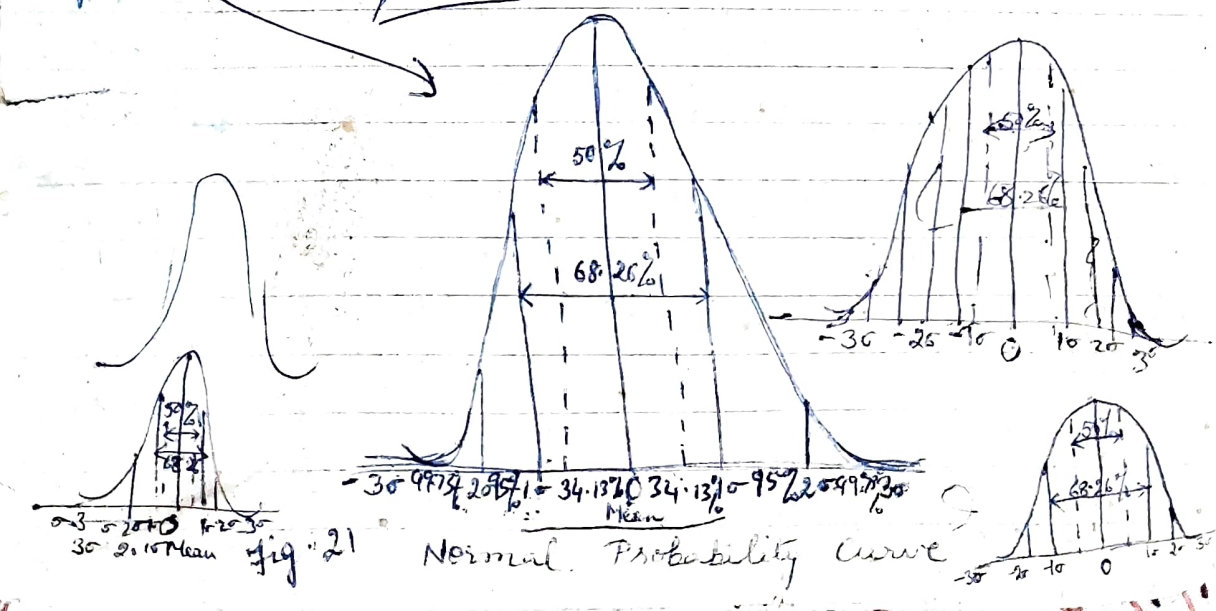


Fig - 21 Normal Probability Curve

(2)

Properties or characteristics of Probability curve

Properties & characteristics of Probability curve :-

There are various characteristics principles, or features of a normal probability curve. The following principles or characteristics are important :-

(1) Normal distribution of Scores :- (1) Normal Distribution of Scores — The most striking property of a normal probability curve is that the maximum scores fall at the centre of the curve. At both the left & the right sides of the centre the number of scores goes on decreasing, & both the halves of the curve are symmetrical. The result is that the normal curve looks like a bell shaped figure. This is very clearly apparent from the typical curve mentioned above.

(2) Measures of central tendency :- (2) Measures of Central tendency :- An important property of this curve is that the measures of central tendency fall exactly at the centre of the distribution ; the mean, the median & the mode are the same having zero difference among themselves.

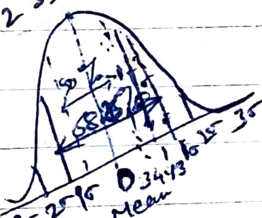
(3) Measures of variability :- (3) Measures of variability :- The S.D. is an important measure of variability. It has a significant role in the determination of the normal curve of distribution. The base line that is

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

abscissa ±3 SD — +3σ — axis up 3σ — ±3σ ±3σ

The base line (x axis) is divided into +3 S.D (σ) & −3 SD (σ). From the mean (centre) & the upper end of the curve there is range of +3 S.D. It means it is divided into 3 equal distances like +1 SD (σ) +2 SD (σ) & +3 SD (σ). The same principle applies to the distance between centre (mean) of the lower end of the curve (abscissa) that is −1 SD (σ) −2 SD (σ) & −3 SD (σ)

The x axis of the normal curve is divided into +3 SD & −3 SD. From the mean (centre) and the upper end of the curve there is the range of +3 SD. It means that it is divided into 3 equal distances at the abscissa represented by +1 SD (σ), +2σ, & +3σ. The same principle applies to the distance between the mean (centre) & the lower end of the abscissa. It is represented by −1σ −2σ & −3σ. The above mentioned typical normal curve is indicative of the property of the curve.



(4) The Equation of the normal curve

The Equation of the normal curve is always constant. It's formulla is $y = \frac{N}{\sigma\sqrt{2\pi}} e^{-\frac{x^2}{2\sigma^2}}$ Page-96

(4) The Equation of the normal curve :- The equation of the normal curve is always constant. It is represented by the formulla which reads as

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

(5) Areas of normal curve

The total area under the curve is taken arbitrarily to be 10,000 (ten thousand). The area of mean ±1σ is 34.13% either in positive (+) or in negative (−) direction. So between the mean & ±1σ there ... the case ... 68.26

(5) Areas of the normal curve :- The total area under the curve is taken arbitrarily to be 10,000. The area of the curve between the mean & 1σ is 34.13% either in the positive or in the negative direction, so between the mean & the ±1σ (S.D.) there are the ~~68 point~~ 68.26% of the cases in the normal distribution. In the same way $\frac{N}{...} e^{-\frac{x^2}{...}}$

4

Bet. mean +±1σ - 68.26% of the cases lie.
Bet. mean + ±2σ 95% of the cases lie.
Bet. mean + ±3σ 99.73% of the cases lie.

And between mean ± 3σ 99.73% of the cases lie. These areas of normal curve remain constant in all cases.

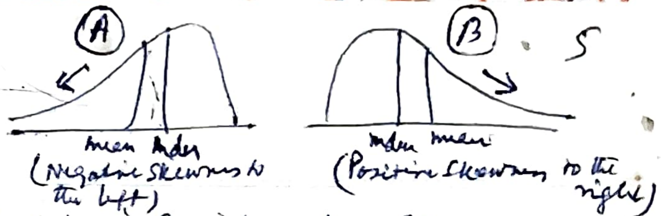
99.73% of the entire distribution lies within the limits of ± 3S.D. These areas of the normal curve remain constant in all the cases.

(6) Relationships among the constants of the normal curve :- It has been already pointed out that in the normal curve the mean, the median & the mode fall exactly at the mid point of the distribution. They are numerically equal. The normal curve is bilaterally symmetrical, so all of the measures of central tendency must coincide at the centre of the distribution. In the same way the measures of variability include certain constant fractions of the total area of the normal curve. Between the mean & ± 1σ (S.D) 68.26%, between the mean & ± 2 SD, 95% & between the mean & ± 3σ 99.73% or 100% cases of the distribution fall. They are constant fractions in all the cases.

(6) Relationship among constants of the normal curve :- The mean, median & the mode fall exactly at the mid point of the distribution. They are numerically equal. The normal curve is bilaterally symmetrical so all the measures of central tendency coincide at the centre of the distribution. In the same way measures of variability include certain constant fractions of the total area of the curve. Between mean & ±1σ 68.26% cases lie. Between mean & ±2σ 95% cases lie. Between mean & ±3σ 99.73% i.e. 100% cases fall. They are constant fractions in all the cases.

(7) Divergences :- Two types of divergences may take place in a normal distribution curve, called skewness & kurtosis.

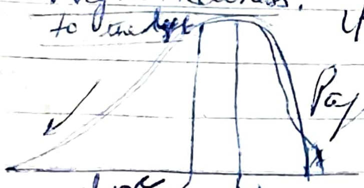
(7) Divergence :- Two types of divergence may take place in a normal distribution curve. They are skewness & kurtosis.



A skewed distribution is that where mean & the median fall at different points of the distribution & the balance is shifted either to the left or to the right.

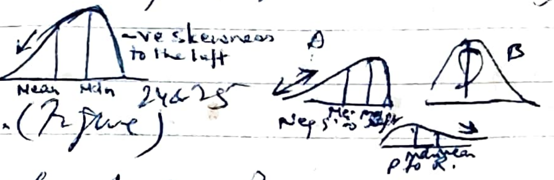
A distribution is said to be skewed when the mean & the median fall at different points in the distribution & the balance is shifted to left or right. The following figure demonstrates it clearly.

Example (A)



See above (2)

Fig. 24.



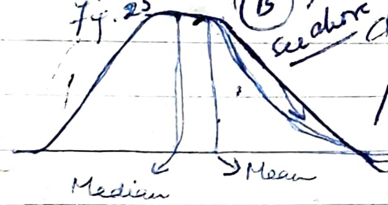
24 & 25

Page 98 & 100. (Figure)

Kurtosis refers to the peakedness or flatness of a frequency distribution as compared with the normal distribution. A distribution more peaked & flatter than the normal curve are called 'leptokurtic' & 'platykurtic' respectively. The following figure shows the forel. itself. The distri in bet. the leptokurtic & platykurtic is called mesokurtic.

Page 101. (Fig-26).

(B) see above



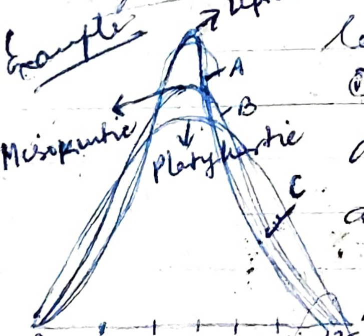
Positive skewness to the right.

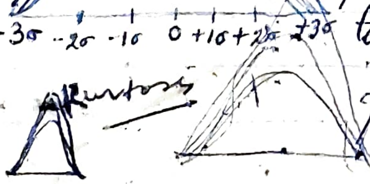
Kurtosis refers to peakedness or flatness of a frequency distribution in comparison to normal curve. A peaked distribution is called 'leptokurtic' & a flatter curve is called 'platykurtic'.

(B) Uses & applications :- (1) see next page above Determination of percentage of cases within given limits - A practical use of the normal curve is that it enables us to determine any percentage of cases in a normal distribution & within given limits. Suppose that 12.5 the mean & 4 is the S.D. of a given distribution of scores

Fig: 26.

Example





Peaked curve - Leptokurtic
Flatten curve - Platykurtic & in bet. Lepto & Platy is Mesokurtic

1) Determination of %
2) "
3) Comparison of two
4) Determination of rele of test quees + prob

① % Determination of % of cases within given limits
(Normal distribution curve is very useful in determination of percentage of cases within given limits) Suppose that 12 is the mean & 4 is S.D of a given distribution of scores. Now the question is what % will fall between 8 & 16. What % of scores lie above 18 and below 6. Assuming normality of distribution, desired % of cases can be easily determined on the basis of normal curve.

Now the question is what % of cases will fall between 8 & 16, what % scores lie above 18 & below 6. Assuming normality of distribution the desired % of the cases can be easily determined on the basis of the normal curve.

② Determination of limits which include a given % of cases:–
(On the basis of normal curve we can determine the limits which include any % of cases. If the percent is given its limits can be determined) for example if 16 is the mean & 4 is S.D its limits can be easily determined.

② Determination of the limits which include a given % of the cases:– On the basis of the normal curve we can determine the limits which include any % of the cases. If the % is given its limits can be determined. Suppose that 16 is the mean & 4 is the S.D. of a given distribution of scores. Assuming normality we can determine the limits which include 75%, 80% or any % of the cases.

On the basis of normality we can determine any % of the cases. Assuming normality we can determine the 75%, 80% or any % of cases. ✓

Similarly the limits of a highest & the lowest % can also be determined with the help of normal probability curve.

Similarly the limits which include any highest %, say 20% as well as any lowest %, say 10% can be determined with the help of the normal probability curve.

③ Comparisons of two distributions:–

③ Comparison of two distributions.

5) Classification of groups into sub groups.
6) Mental measurement.

The normal curve enables us to compare two distributions in terms of overlapping. Suppose that the Boys' mean score is 21 & S.D is 4. & Girls mean score is 24 & S.D is 5. The medians of boys & girls are 21 & 24 respectively. on the basis of these statistics we can determine the % of boys exceeding the median of girls distribution.

In the same way comparison between two groups in respect of any trait can be made by normal distribution curve.

(4) Determination of relative difficulty of test questions or problems:-

The normal curve can be used to determine the relative difficulty of test questions or problems or other test items.

For example suppose that a problem is solved by 10% of the sample, the second problem is solved by 20% of the sample & third problem is solved by 30% of the sample.

The normal curve enables us to compare two distributions in terms of overlapping. Suppose that the Boys' mean score is 21 with a S.D of 4, and the girls mean score is 24 with a S.D of 5. The medians of the boys & girls are 21 & 24 respectively. on the basis of these statistics in a normal distribution we can determine the % of boys exceeding the median of the girls' distribution.

In the same way the comparison between two groups in respect of any trait can be made with the help of normal distribution curve.

Determination of the relative difficulty of test questions or problems. The normal distribution can be used to determine the relative difficulty of a test questions, test problems, or other test items. For example suppose a test question or problem is solved by 10% of the sample, the second problem solved by 20% the same sample and a third problem solved by

※ measurements & errors of observation.

Among the normal distribution ... the normal curve has wide application in fields of mental measurement & mental operations. ~~Both the~~ with theoretical & practical)

30%. Now assuming normal distribution we can determine the relative difficulty of these three types of questions or problems.

(5) Classification of a group into subgroups

The normal distribution curve enables us to separate a given group into subgroups according to capacity. Suppose that we have administered an entrance exam to 100 college students. Now we wish to classify these students into 5 subgroups according to their ability. On the assumption that the trait measured is normally distributed the students can be divided into A B C D & E, as being 4, 24, 45, 24, 43 respectively.

(6) Mental measurement: The utility of the normal probability curve in mental measurement may be viewed in different areas. 'Garrett' 1929 has stated that in its respect the normal curve has utility in biological statistics, anthropometrical data, social [illegible]

hence by applying the normal distribution we can assume the relative difficulty of the 3 types of problems.

(5) Classification of groups into subgroups

The normal curve enables us to classify a given group into subgroups according to capacity.) For example if we have applied an entrance exam on 100 college students & we want to classify those students according to their ability into 5 subgroups on a normal distribution curve the students can be divided into A B C D & E being 4, 24, 45, 24 & 3 respectively. 4/24/2?/100

(6) Mental measurement: usefulness of this curve in mental measurement may be viewed in different areas. Garrett (1979) has said that normal curve can be used in biological data, anthropological data, [illegible]