

Applications of Normal Probability Curve:

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The principles of Normal Probability Curve are applied in the behavioural sciences in many different areas. Some of the most important applications of normal probability curve are as follows:

1. NPC is used to determine the percentage of cases in a normal distribution within given limits:

The Normal Probability Curve helps us to determine:

- i. What percent of cases fall between two scores of a distribution?
- ii. What percent of scores lie above a particular score of a distribution?
- iii. What percent of scores lie below a particular score of a distribution?

Example:

Given a distribution of scores with a mean of 24 and σ of 8. Assuming normality what percentage of the cases will fall between 16 and 32.

Solution:

Here first of all we have to convert both the scores 16 and 32 into a standard score.

$$Z = \frac{x}{\sigma}$$

Where Z = Standard Score
 x = deviation of the score ($X - M$)
 σ = Standard deviation.

$$\begin{aligned} \text{Z Score for 16} &= \frac{x}{\sigma} = \frac{16 - 24}{8} = \frac{-8}{8} \\ &= -1\sigma \end{aligned}$$

$$\text{Z score for 32} = \frac{x}{\sigma} = \frac{32 - 24}{8} = \frac{8}{8} = +1\sigma$$

After visiting the NPC table, it is found that 34.13 cases fall between mean and -1σ and 34.13 cases fall between mean and $+1\sigma$. So $\pm \sigma$ covers 68.26% of cases. So that 68.25% cases will fall between 16 and 32.

Example:

Given a distribution of scores with a mean of 40 and σ of 8. Assuming normality what percentage of cases will lie above and below the score 36.

Solution:

First of all we have to convert the raw score 36 into standard score.

$$\begin{aligned} \text{The Z score of 36} = Z &= \frac{x}{\sigma} = \frac{36 - 40}{8} = \frac{-4}{8} \\ &= -0.5\sigma \end{aligned}$$

After visiting the NPC table, it is found that 19.15% cases fall between Mean and $-.5\sigma$. Therefore the total percentage of cases above the score 36 is $50 + 19.15 = 69.15\%$ and below the score 36 is $50 - 19.15 = 30.85\%$. So in the distribution 69.15% cases are above the score 36 and 30.85% scores are below the score 36.

2. NPC is used to determine the value of a score whose percentile rank is given:

By using NPC table we can determine the raw score of the individual if the percentile rank is given.

Example:

In a distribution of scores of a class Pinky's percentile rank in statistics is 65. The mean of the distribution is 55 with a standard deviation of 10. Find but the raw score of Pinky in Statistics.

Solution:

As Pinky's percentile rank is 65 so in a normal distribution her position is 35% above the mean. By visiting the NPC table, we found that 35% from the mean is $+1.04\sigma$.

By putting the value in 'Z' score.

$$\begin{aligned}\frac{X - M}{\sigma} &= Z \\ \Rightarrow \frac{X - 55}{10} &= 1.04 \\ \Rightarrow X - 55 &= 10 \times 1.04 \\ \Rightarrow X - 55 &= 10.4 \\ \Rightarrow X &= 10.4 + 55 = 65.4 \text{ or } 65.\end{aligned}$$

So Pinky's raw score in statistics is 65.

3. NPC is used to find the limits in a normal distribution which include a given percentage of cases:

When a distribution is normally distributed and what we know about the distribution is Mean and the Standard deviation at that time by using the table area under NPC we can determine the limits which include a given percentage of cases.

Example:

Given a distribution of scores with a mean of 20 and σ of 5. If we assume normality what limits will include the middle 75% of cases.

Solution:

In a normal distribution the middle 75% cases include 37.5% cases above the mean and 37.5% cases below the mean. From the Table-A we can say that 37.5% cases covers 1.15 σ units. Therefore the middle 75% cases lie between mean and $\pm 1.15 \sigma$ units.

$$\begin{aligned}\text{As } \sigma &= 5 \\ \text{So, } 5 \times 1.15 \sigma &= \pm 5.75 \sigma \text{ units.} \\ \text{Adding the value to mean we can get} \\ 20 + 5.75 &= 25.75 \\ 20 - 5.75 &= 14.25\end{aligned}$$

So in this distribution middle 75% cases will include the limits 14.25 to 25.75.

4. It is used to compare two distributions in terms of- overlapping:

If scores of two groups on a particular variable are normally distributed. What we know about the group is the mean and standard deviation of both the groups. And we want to know

how much the first group over-laps the second group or vice-versa at that time we can determine this by using the table area under NPC.

5. NPC helps us in dividing a group into sub-groups according to certain ability and assigning the grades:

When we want to divide a large group in to certain sub-groups according to some specified ability at that time we use the standard deviation units of a NPC as units of scale.

Example:

An achievement test was administered to the 600 8th grade students. The teacher wants to assign these students in to 4 grades namely A, B, C and D according to their performance in the test. Assuming the normality of the distribution of scores calculate the number of students can be placed in each group.

Solution:

The area under a NPC is divided in to $\pm 3\sigma$ units or 6σ units.

Here we have to divide the students in to 4 sections.

So each section has

$$\frac{6\sigma}{4} = 1.5 \sigma \text{ units.}$$

So if we shall distribute the section in order of merit.

The section-A will be within 1.5σ to 3σ

Section B will be within Mean to 1.5σ

Section C will be within Mean to -1.5σ

and Section D will be with in -1.5σ to -3σ .

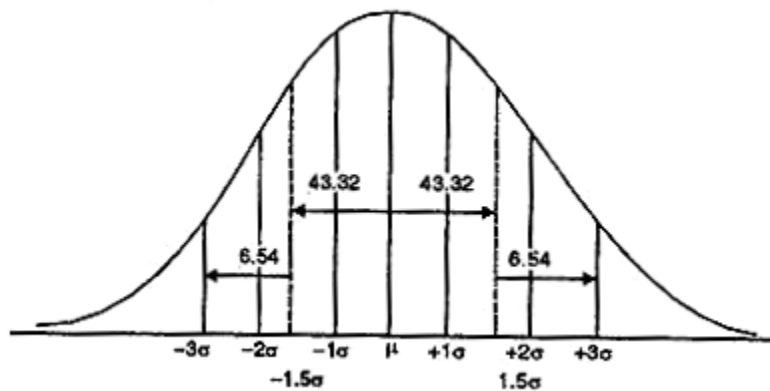


Fig. 11.9

Entering into the Table 'A' we found that
 3σ covers the 49.86% cases
 1.5σ covers the 43.32% cases
 Grade 'A' will cover = $49.86 - 43.32 = 6.54\%$
 Table area with in μ to $+1.5\sigma$ covers 43.32% cases
 So grade B will cover 43.32% cases.
 Table area with in μ and -1.5σ covers 43.32% cases.
 So grade C will cover 43.32% cases.
 Table area with in μ and -3σ covers 49.86% and -1.5σ covers 43.32% cases. So between -1.5σ and -3σ , $49.86 - 43.32 = 6.54\%$ cases lie.

6. NPC helps to determine the relative difficulty of test items or problems:

When it is known that what percentage of students successfully solved a problem we can determine the difficulty level of the item or problem by using table area under NPC.

7. NPC is useful to normalize a frequency distribution:

In order to normalize a frequency distribution we use Normal Probability Curve. For the process of standardizing a psychological test this process is very much necessary.

8. To test the significance of observations of experiments we use NPC:

In an experiment we test the relationship among variables whether these are due to chance fluctuations or errors of sampling procedure or it is real relationship. This is done with the help of table area under NPC.

9. NPC is used to generalize about population from the sample:

We compute standard error of mean, standard error of standard deviation and other statistics to generalize about the population from which the sample is drawn. For this computation we use the table area under NPC.

The End