* Z-test

→ We use Z-test when we have sample size > 30.
(This is based on the assumption from the Central Limit Theoram, the larger the sample we have it is more likely to become normally distributed).

→ We need to know the standard deviation of population, if it is unknown then we can't assume sample S.D. to be equal to the population ~~mean~~ standard deviation.

→ Also, the sample that we are taking out from the population must be choosen at random.

Types of Z-test

(i) One sample Z-test
(ii) Two-sample Z-test
(iii) Paired Z-test

One (or) Two-tailed

Mathematical Formula

One-sample

$$Z = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}}$$

Here, $\bar{x}$ = Sample mean
σ = Poplulation S.D.
n = sample size

Two-sample

$$Z = \frac{(\bar{x}_1 - \bar{x}_2)(\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Population std. deviation ~ Sample S.D. ($n > 30$).
$\bar{x}_1, \bar{x}_2$ are sample mean
μ_1 & μ_2 are popul^n mean.

Example 1: Company "A" claims that products on their platform have higher selling rate.

Sol^n: Our hypothesis is company A claiming that they sell more products on their platform. So, we need to do some kind of test to prove this hypothesis. Hence, we will do a one sample z-test suppose, mean of sample = 150 & Mean of population (all the companies) = 120 & Let Standard Deviation equal 18.
So, we will calculate Z test $= \frac{150 - 120}{18/\sqrt{25}} = \frac{30^{6}}{18 \times 5} = \frac{1}{3} = 0.33$

since, Z test > 0.05, it is significant, so our null hypothesis is will be accepted.

Note: All values are dummy

When we talk about only one side of the alternate hypothesis it is used in one-tailed Z-test.

Suppose, we have a null hypothesis saying, the mean height of all the boys is equal to 180 cm.

So, our alternate hypothesis can be said as mean height of the sample is less than 180 cm, or can be greater than 180 cm.

So, we are worried about both side of the sample. Hence, it is called two-tailed Z-test.

Two-sample Z-test:

In this case, we compare two different samples

Suppose, we have two institutions A & B, then if we want to compare whether student of A has better performance then student of institute B, then in this case we can use the 2-sample Z-test.

Paired Z-test: We compare the same product in before and after scenario.

Suppose, company A sells a mobile phone having some feature and after introducing a new feature in their phone they compare sells of the same phone with respect to before scenario, then in such cases, we use the paired Z-test.

→ T-test: In t-test the sample size<30 & standard deviation/variance of the population is unknown.

$$t = \frac{\bar{X} - \mu}{\frac{S}{\sqrt{n}}}$$

S → S.D. of sample

n → size of sample

$$S = \sqrt{\frac{(x-\bar{x})^2}{n}}$$