Z Test

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Z Test

- Z-test is a statistical method to determine whether the distribution of the test statistics can be approximated by a normal distribution.
- It is the method to determine whether two sample means are approximately the same or different when their variance is known and the sample size is large (should be >= 30).

Z Test

- You would use a Z test if:
  - Your sample size is greater than 30. Otherwise, use a t test.
  - Data points should be independent from each other. In other words, one data point isn't related or doesn't affect another data point.
  - Your data should be normally distributed. However, for large sample sizes (over 30) this doesn't always matter.
  - Your data should be randomly selected from a population, where each item has an equal chance of being selected.
  - Sample sizes should be equal if at all possible.

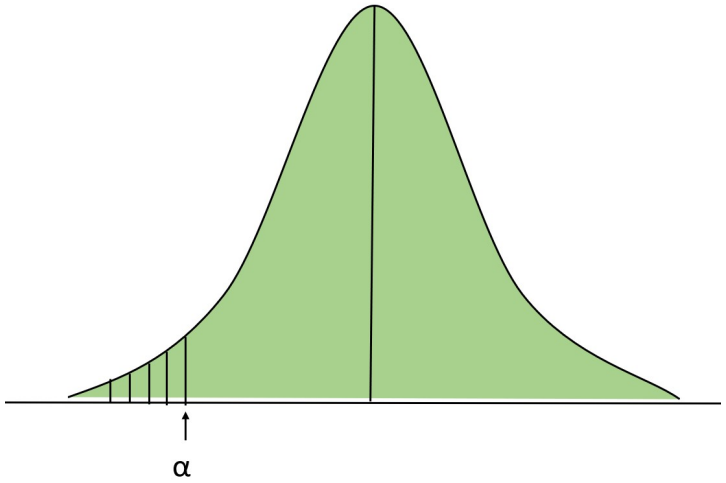
Z Test

- First, identify the null and alternate hypotheses.
- Determine the level of significance (∝).
- Find the critical value of z in the z-test using
- Calculate the z-test statistics. Below is the formula for calculating the z-test statistics.
- where,
  - $\bar{X}$: mean of the sample.
  - Mu: mean of the population.
  - Sd: Standard deviation of the population.
  - n: sample size.

$$Z = \frac{(\bar{X} - \mu)}{(\sigma / \sqrt{n})}$$

Z Test

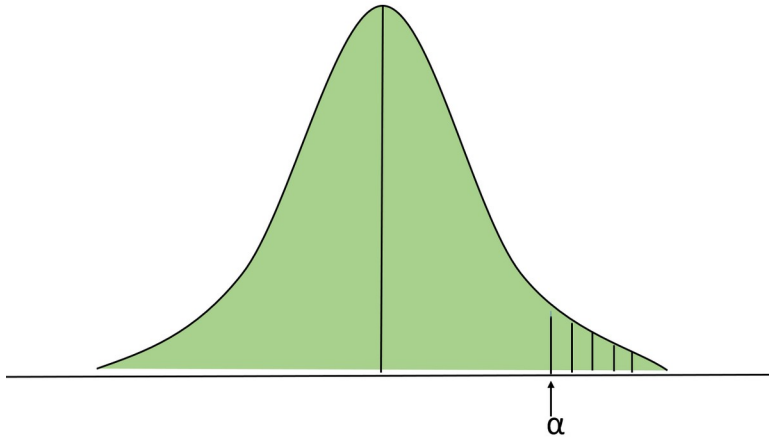
- Left-tailed Test: In this test, our region of rejection is located to the extreme left of the distribution.
- Here our null hypothesis is that the claimed value is less than or equal to the mean population value.



Left-tailed Test

Z Test

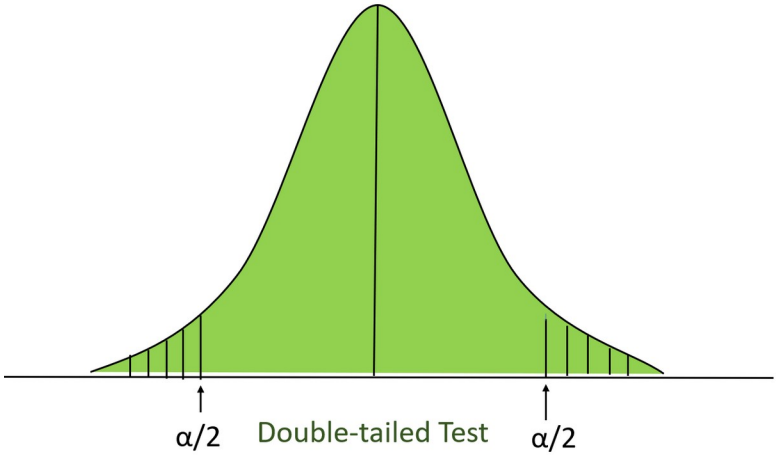
- Right-tailed Test: In this test, our region of rejection is located to the extreme right of the distribution.
- Here our null hypothesis is that the claimed value is less than or equal to the mean population value.



Right-tailed test

Z Test

- Two-tailed test: In this test, our region of rejection is located to both extremes of the distribution.
- Here our null hypothesis is that the claimed value is equal to the mean population value.



Z Test : Example

- Problem: A school claimed that the students' study that is more intelligent than the average school.
- On calculating the IQ scores of 50 students, the average turns out to be 11.
- The mean of the population IQ is 100 and the standard deviation is 15.
- State whether the claim of principal is right or not at a 5% significance level.

Z Test : Example

- First, we define the null hypothesis and the alternate hypothesis. Our null hypothesis will be:

$$H_0 : \mu = 100$$

and our alternate hypothesis.

$$H_A : \mu > 100$$

- State the level of significance. Here, our level of significance given in this question ($\propto$ =0.05), if not given then we take $\propto$=0.05.
- Now, we look up to the z-table. For the value of $\propto$=0.05, the z-score for the right-tailed test is 1.645.

Z Test : Example

Confidence Level	Alpha	Alpha/2	z alpha/2
90%	10%	5.0%	1.645
95%	5%	2.5%	1.96
98%	2%	1.0%	2.326
99%	1%	0.5%	2.576

Z Test : Example

- State the level of significance. Here, our level of significance given in this question ($\propto$ =0.05), if not given then we take $\propto$=0.05.
- Now, we look up to the z-table. For the value of $\propto$=0.05, the z-score for the right-tailed test is 1.645.
- Now, we perform the Z-test on the problem:

$$Z = \frac{(\overline{X} - \mu)}{(\sigma/\sqrt{n})}$$

Z Test : Example

- Where:

  X = 110

  Mean (mu) = 100

  Standard deviation (sigma) = 15

  Significance level (alpha) = 0.05

  n = 50

$$\frac{(110-100)}{15/\sqrt{50}}$$
$$\frac{10}{(15/sqrt(50))}$$
$$\frac{10}{2.12}$$
$$4.71$$

- Here 4.71 >1.645, so we reject the null hypothesis. If z-test statistics is less than z-score, then we will not reject the null hypothesis.

Z Test

- Example again we are using z-test for blood pressure with some mean like 156 (python code is below for same) one-sample Z test.

Z Test

- In two sample z-test , similar to t-test here we are checking two independent data groups and deciding whether sample mean of two group is equal or not.

  H0 : mean of two group is 0

  H1 : mean of two group is not 0
- Example : we are checking in blood data after blood and before blood data

Thank you

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