COST

Statistical Estimation Theory

Z Score

- **Mean**

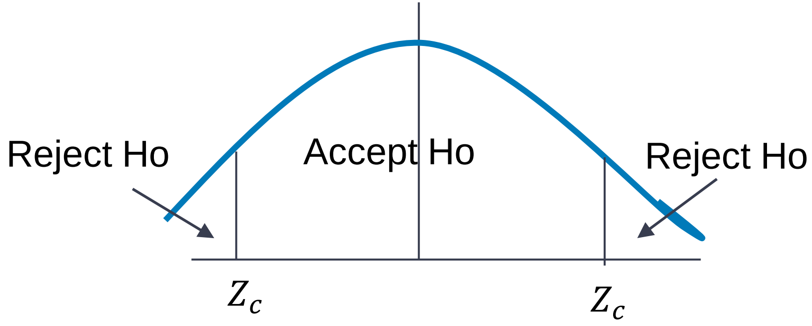
$$Z = \frac{\bar{X} - \mu}{\frac{\sigma}{\sqrt{N}}}$$

- **Proportion**

$$Z = \frac{P - p}{\sqrt{\frac{pq}{N}}}$$

Steps for hypothesis testing

1. Write given values.
2. Propose Ho and H1.
3. Identify test-
   - one tailed (if < , >)
   - two tailed (if ≠)
4. Get table value Z_c according to LOS mentioned in the problem.
5. Find Z score using the formula.
6. Inference-
   - If Z < Z_c , accept Ho.
   - If Z > Z_c , reject Ho.



Question

Qn) The breaking strength of cables produced by a manufacturer have a mean of 1800 lb and a standard deviation of 100lb. By a new technique in the manufacturing process, it is claimed that the breaking strength can be increased. To test this claim, a sample of 50 cables is tested and it is found that the mean breaking strength is 1850lb. Can we support the claim at the 0.01 significance level?

Step 1- Write given values

- $\mu = 1800\ lb$
- $\sigma = 100\ lb$

Population Parameter

- N = 50
- $\bar{X} = 18500\ lb$

Sample data

- LOS = α = 0.01= 1 %

Cont..

- Step 2- Propose H0

H_0: $\mu = 1800lb$ and there is really no change in breaking strength.

H_1: $\mu > 1800lb$ and there is a change in breaking strength.

- Step 3- Identify Test
  - As > sign is there, use One tailed Test

Cont….

	$\boldsymbol{\alpha = 0.05\ (5\ \%)}$	$\boldsymbol{\alpha = 0.01\ (1\ \%)}$
Two-tailed Test	Z_c=1.96	Z_c= 2.58
One-tailed Test	Z_c=1.645	Z_c= 2.33

- Step 4- Get table value of Z_c for LOS $\boldsymbol{\alpha = 0.01\ (1\ \%)}$

Z_c= 2.33

- Step 5- Find Z score using formula-

$$Z = \frac{\bar{X} - \mu}{\frac{\sigma}{\sqrt{N}}}$$

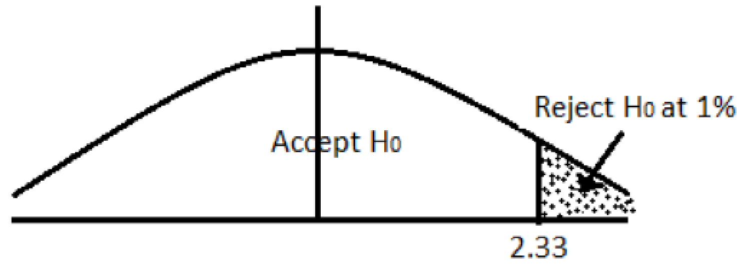
μ	1800
σ	100
N	50
$\bar{X}$	1850

Z =3.5355

Cont. ..

- Step 6 – Inference

  Z = 3.5355 , $Z_c = 2.33$



Reject H_0

- As Z > Z_c, reject Ho.
- Therefore, we can support the claim at 0.01 LOS. i.e., the cable strength is increased.

Question

Qn) On an examination given to students at a large number of different schools, the mean grade was 74.5 and standard deviation was 8.0. At one particular school where 200 student took the examination, the mean grade was 75.9. Discuss the significance of this result at he 0.05 level from the view point of

a. One tailed test

b. Two tailed test

Step 1- Write given values

- $\mu = 74.5$
- $\sigma = 8$
- $N = 200$
- $\bar{X} = 75.9$
- $LOS = \alpha = 0.05 = 5\ \%$

Cont..

One tailed Test

- Step 2- Propose H0
  - H_0: $\mu = 74.5$; performance of school is same as population
  - H_1: $\mu > 74.5$; performance of school is better than population

Two tailed Test

- Step 2- Propose H0
  - H_0: $\mu = 74.5$; performance of school is same as population
  - H_1: $\mu \neq 74.5$; performance of school is different than population

	$\boldsymbol{\alpha = 0.05}$ **(5 %)**	$\boldsymbol{\alpha = 0.01}$ **(1 %)**
Two-tailed Test	Z_c=1.96	Z_c= 2.58
One-tailed Test	Z_c=1.645	Z_c= 2.33

Cont….

One tailed Test

- Step 4- Get table value of Z_c for LOS $\boldsymbol{\alpha = 0.05}$ (5 %)

Z_c= 1.645

- Step 5- Find Z score using formula-

$$Z = \frac{\bar{X} - \mu}{\frac{\sigma}{\sqrt{N}}}$$

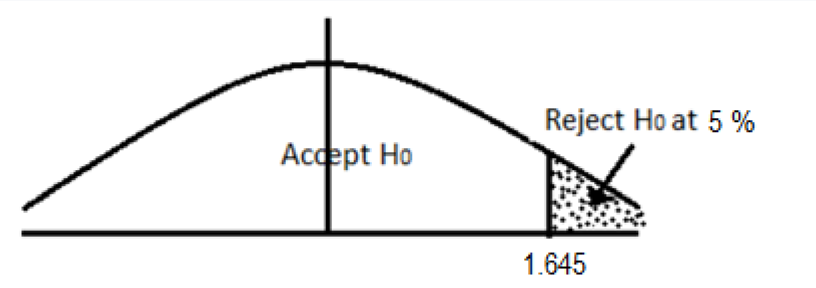
μ	74.5
σ	8
N	200
$\bar{X}$	75.9

Z =2.4748

Cont. ..

- Step 6 – Inference

  Z =2.4748, $Z_c = 1.645$



Reject H_0

- As Z $> Z_c$, reject Ho.
- Therefore, we can support the claim at 0.05 LOS. i.e., the performance of the school is better than population

Cont….

Two tailed Test

	$\alpha = 0.05$ (5 %)	$\alpha = 0.01$ (1 %)
Two-tailed Test	Z_c=1.96	Z_c= 2.58
One-tailed Test	Z_c=1.645	Z_c= 2.33

- Step 4- Get table value of Z_c for LOS $\alpha = 0.05$ (5 %)

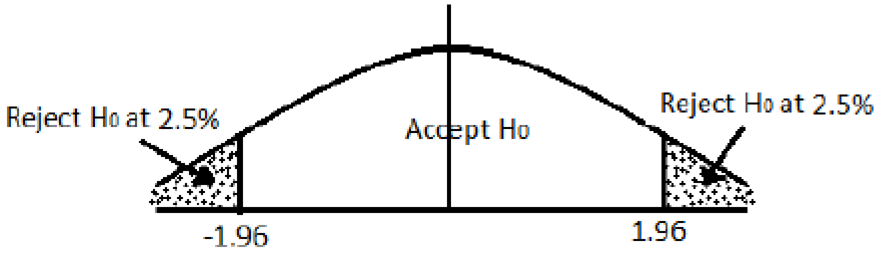
  Z_c= 1.96

- Step 5- Calculate Z value

  Z =2.4748

- Step 6 – Inference

  As Z $> Z_c$, reject Ho.



Therefore, we can support the claim at 0.05 LOS. i.e., the performance of the school is different than population

Question

- Internet shoppers spend on an average \$335 per year with standard deviation \$105. Three hundred Internet shoppers are surveyed, and it is found that the average spending is \$324. Examine the scenario at 5 % LOS.