1. Normal Distribution
2. Standard Normal Distribution
3. Z score

Hypothesis Testing

Population	Sample
100000	100

Hypothesis: It is a statement about one or more population.

Our invented drug can cure fever in 2 days.

2 types of hypothesis:
1. Null Hypothesis: It is the hypothesis to be tested
2. Alternative Hypothesis: It is a statement about what we believe is true if our sample data cause us to reject the null hypothesis.

A random sample of 50 items gives the mean 6.2 and variance 10.24. Can it be regarded as drown from a normal population with mean 5.4 at 10% level of significance.

Step 1

What will be the null hypothesis?

Null Hypothesis H_0: mean = 5.4

Alternative hypothesis, Ha: mean not equal to 5.4

What is the relation between variance and sd->
sd = sqrt(Variance)

Step 2: Test Statistics

$$z = \left| \frac{\bar{x} - \mu}{\sigma / \sqrt{n}} \right|$$

$\bar{X}$ = 6.2

μ = 5.4

n = 50

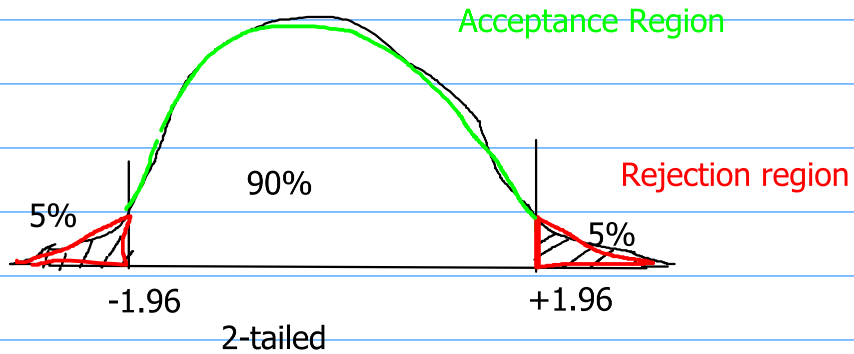
σ = sqrt(10.24)

$\sqrt{10.24}$

= 1.77

Level of significance:
The level of significance α is a probability of rejecting a true null hypothesis. eg. 5% , 1%

Level of Confidence: opposite of level of signifance



2 kinds of error:
1. type -1
2. Type 2

Condition of Null Hypothesis

	True	False
Accept the null hypothesis	Correct action	Type 2 error
Reject Hypothesis	Type 1 error	Correct Action

Population -> 1 Lakh   Efficiency 68 %

My drug efficiency 68 % by taking sample of 1000 people.

1. If Null Hypothesis is True and we accept it, then it is correct.
2. If Null Hypothesis is True and we reject it, then it is Type-1 error
3. If Null Hypothesis is False and we accept it, then it is Type-2 error.
4. If Null Hypothesis is False and we reject it, then it is correct.

Level of significance

p	Significance level	Two-tailed Test	One-tailed test
0.1	10%	1.65	1.28
0.05	5%	1.96	1.64
0.01	1%	2.58	2.33
0.001	0.1 %	3.29	3.10

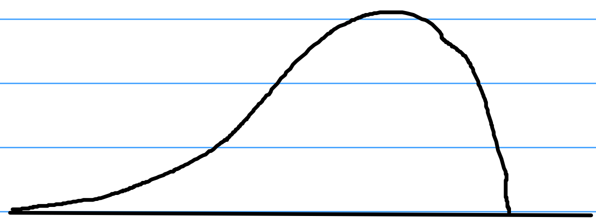
Does 1.77 belong to -1.65 to +1.65? No -> Then we reject our null hypothesis

1. Define Null Hypothesis and Alternative hypothesis
2. Test statistics
3. Level of significance

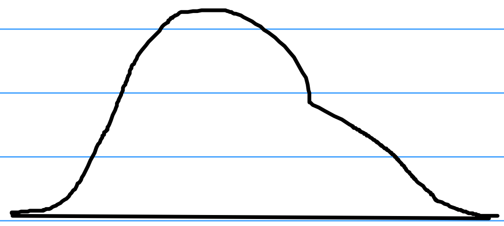
A random sample of 50 items gives the mean 6.2 and variance 10.24. We estimate that the mean should not be less than 5.6.

Null Hypothesis :

Our mean is greater than 5.6



One tailed



Two tailed

Practice Problems - 03rd December, 2023

1) Assume the mean height of soldiers to be 68·22 inches with a variance of 10·8 inches2. How many soldiers in a regiment of 1,000 would you expect to be
(i) over six feet tall, and (ii) below 5·5 feet ? Assume heights to be normally distributed
Note that $P(0 \le Z \le 1{\cdot}15) = 0{\cdot}3749$ and $P(0 < Z < 0{\cdot}6756) = 0.2501$

2) The average test marks in a particular class is 79. The standard deviation is 5. If the marks are distributed normally, how many students in a class of 200 did not receive marks between 75 and 82 ? Given :
$\Pr\{0 \le Z \le {\cdot}7\} = {\cdot}2580$, $\Pr\{0 \le Z \le {\cdot}8\} = {\cdot}2881$
$\Pr\{0 \le Z \le {\cdot}6\} = {\cdot}2257$, where Z is a standard normal variable.

3) The mean marks obtained by the students of a Biostatistics course in DU is 54.5 with a standard deviation 8.0. At RPSU, where 100 students took the examination, the mean marks were 55.9. Are the students of RPSU significantly a) different from b) better than, the rest of the students of that course in DU at 0.01 level?

$$z = \frac{x-\mu}{\sigma}$$

Sd = $\sqrt{\text{Variance}}$

Solution (1) (i)

The probability that a soldier is over 6 feet tall = 12 x 6 = 72 inches tall is given by

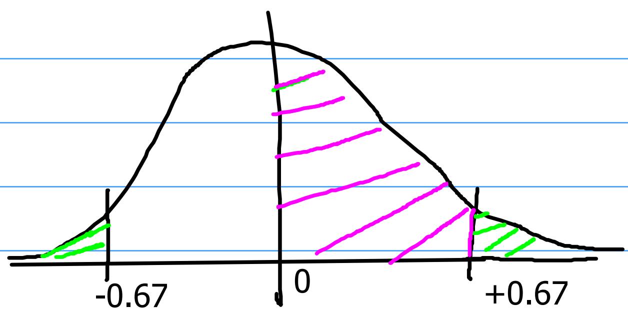
P(X>72) = P(z> (72-68.22)/sqrt(10.8))
= P(z>1.15)
= 0.5 - $P(0 \le Z \le 1{\cdot}15)$
= 0.5 - 0.3749
= 0.1251

The number of Soldiers over 6 feet tall
= 1000 x 0.1251 = 125

Mean = 0
S. D = 1

(1) (ii) The probability that a soldier is below 5.5 feet = 66 inch is given by

P(X< 66) = P(z < (66- 68.22)/ sqrt(10.8)) = P(z< - 0.67) = P(Z > 0.67)
= 0.5 - 0.2501 = 0.2499 (approx)

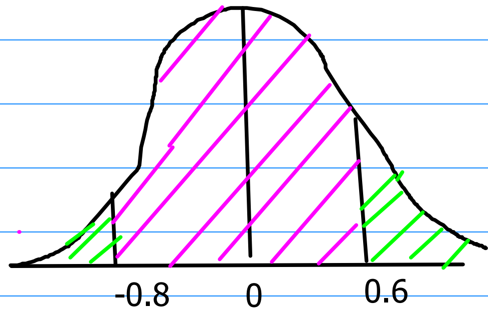


Number of soldiers below 5.5 feet = 1000 x 0.25 = 250

Solution (2)

The probability that a student gets marks between 75 and 82 is given by

P(75 < x < 82) = P((75-79)/5 < z < (82-79)/5)
= P (-0.8 < z < 0.6)
= P(-0.8 <z< 0) + P(0<z<0.6)
= P(0<z<0.8) + P(0<z<0.6)
= 0.2881 + 0.2257 = 0.5138



The probability p that a student does not get marks between 75 and 82 is given by:

p = 1 - 0.5138 = 0.4862

Number of students who did not receive marks between 75 and 82 is : 200 x 0.4862
= 97.24
= 97

Solution

3) a)

1) Formulate null hypothesis and alternative hypothesis:
My null hypothesis will be mean is 54.5 and
alternative hypothesis : mean ≠ 54.5

2) Choose a test statistics:

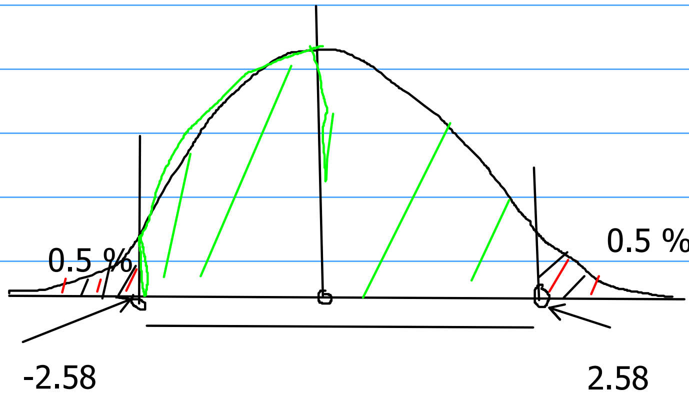
$$z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$$

= (55.9 - 54.5) / (8 / sqrt(100)) = 1.75

3) Specify the significance level:

Here at 1 % significance level our range should be -2.58 to 2.58.

0.01 / 2 =



Our calculated z value which is 1.75 lies in acceptance region.

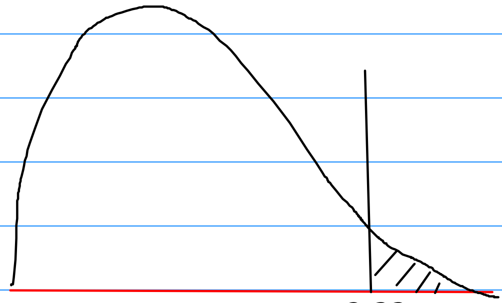
So we can accept our null hypothesis.

3) b)

Null hypothesis : mean = 54.5
Alternative hypothesis: mean > 54.5

1% level of significance , -> value = 2.33

z = 1.75 which is less than 2.33 and therefore
we fail to accept the Null hypothesis.



2.33

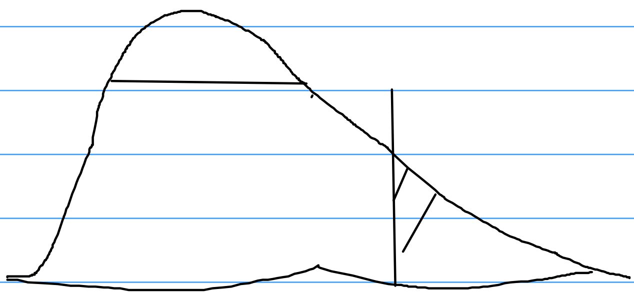
Two tailed test (equal or not equal)

Null hypothesis mean = 54.5
ALternative hypothesis mean not equal to 54.5

z = val

Signifance level 1%, 5%

5% -> 1.96 (-1.96 <= val <= +1.96) ?
if yes : accept the null hypothesis
if no: we reject the null hypothesis



2.33

Null hypo equal
Alternative hypo greater than or
less than