# Assignment - 2

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Q1.
**Hypothesis**

Given $\mu_0$ = mean height = 15cm
Let $H_0$ = Baker Bread is more than 15 cm in height .

$H_1$ = Baker Bread is not more than 15 cm in height .

Therefore, our hypothesis becomes:

$$H_0: \mu \neq \mu_0 \text{ v/s } H_1: \mu = \mu_0$$

**Testing**

The test statistic is obtained using the following formula as it is not a T series: we use qnorm and pnorm.

test_statistic<-(sample_mean - mu.null)/(population_standard_deviation/sqrt(n))

And the p_value is obtained by:

p_value <- pnorm(abs(test_statistic), lower.tail = FALSE )

**Results**

Below is output of our code:

Test statistic:12.64911

Test Critical Value: 1.644854

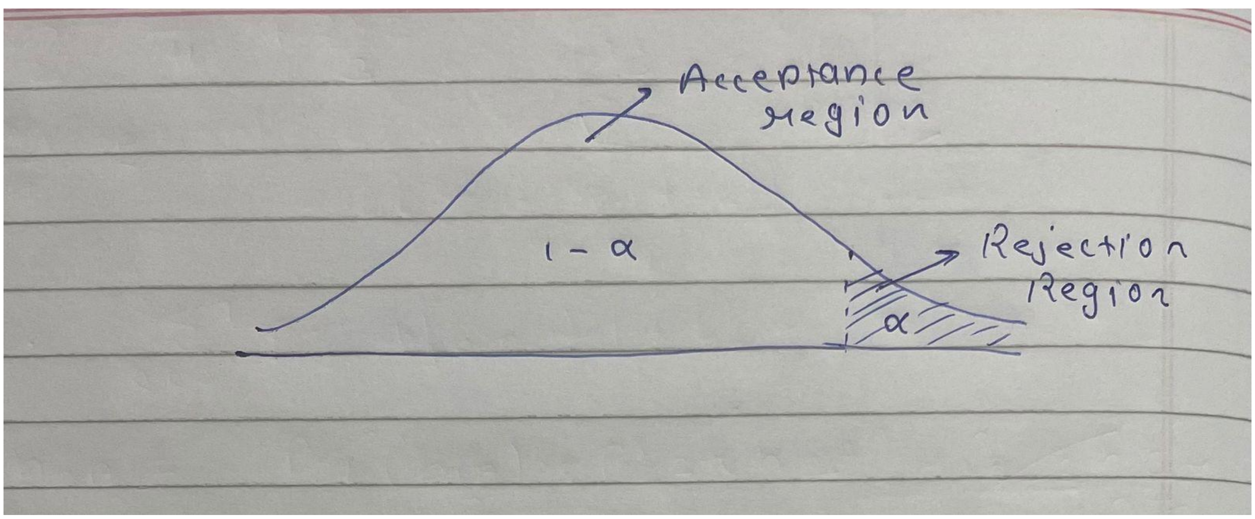
P Value: 5.657419e-37

**Inference**

As we can see, the test statistic value does lie in the rejection region(as inferred from critical value) Also, our p-value < $\alpha$ = 0.05. Thus, we **reject $H_0$** or, Baker Bread is more than 15 cm in height .

**Baker's bread is not more than 15 cm in height, on average.**

| Values | |
|---|---|
| mu.null | 15 |
| n | 10 |
| p_value | 5.65741895121656e-37 |
| population_sta… | 0.5 |
| sample_mean | 17 |
| test_critical_… | 1.64485362695147 |
| test_statistic | 12.6491106406735 |




T(alpha) = 1.644854

Q2.

**Hypothesis**

Given $\mu_0$ = mean length of time on death row.

time
Let $H_0$ = the mean length of time on death row is 15 years

$H_1$ =the mean length of time on death row is not 15 years

$H_0$: $\mu \neq \mu_0$ v/s $H_1$: $\mu = \mu_0$

Here, $\mu_0 = 15$

**Testing**

We use a two-tailed t-test to test our hypothesis.
We will make our inferences using 2 ways, by test statistic and p-value The test statistic is calculated as below:

$T_{test}$ = ((sample_mean - $\mu_0$) * √n )/s ~ T(n-1) where n = sample size and s = standard deviation

From this, we get our p-value as:

P(T > |t|) = 2*P(T > t)

**Results**

Below is output of our code:

Test statistic: 3.299144

Test Critical Value: 1.992543

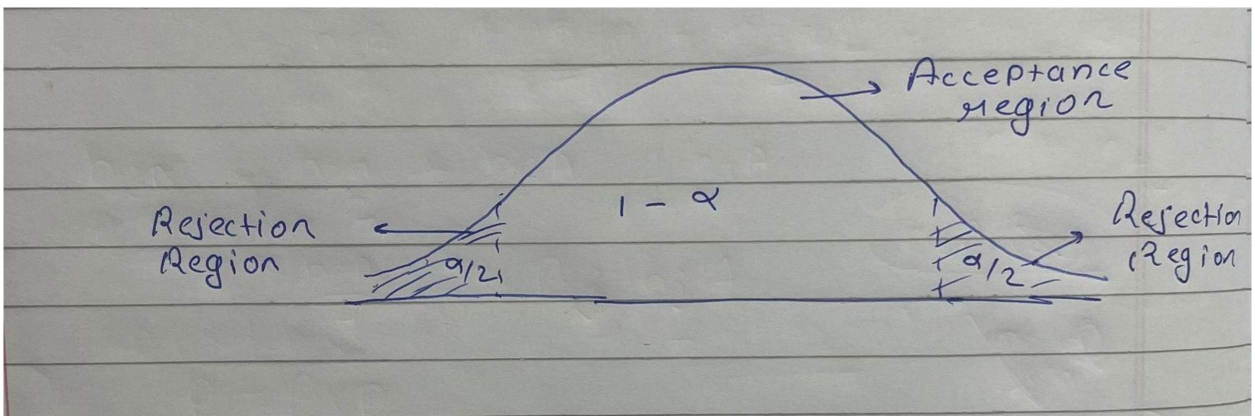
P Value: 0.001493164

**Inference**

As we can see, the test statistic value lies in the rejection region(as inferred from critical value) Also, our p-value < $\alpha$ = 0.05. Thus, we **reject $H_0$**

**The mean length of time on death row is not 15 years.**

| Values | |
|---|---|
| mu.null | 15 |
| n | 75 |
| p_value | 0.00149316364683508 |
| sample_mean | 17.4 |
| sample_standar… | 6.3 |
| test_critical_… | 1.99254349518093 |
| test_statistic | 3.29914439536929 |




T(alpha/2) =  1.992543

Q3.

**Hypothesis**

Given $\mu_0$ = mean production per hectare = 12 quintals.
Let $H_0$ = the mean production per hectare is more than 12 quintals.

$H_1$ = the mean production per hectare is not more than 12 quintals.

$H_0$: $\mu \neq \mu_0$ v/s $H_1$: $\mu = \mu_0$

**Testing**

We use a two-tailed t-test to test our hypothesis.
We will make our inferences using 2 ways, by test statistic and p-value The test statistic is calculated as below:

$T_{test}$ = ((sample_mean - $\mu_0$) * $\sqrt{n}$ )/s ~ T(n-1) where n = sample size and s = standard deviation

From this, we get our p-value as:

P(T > |t|) = 2*P(T > t)

**Results**

Below is output of our code:

Test statistic: 1.835644

Test Critical Value: 2.262157

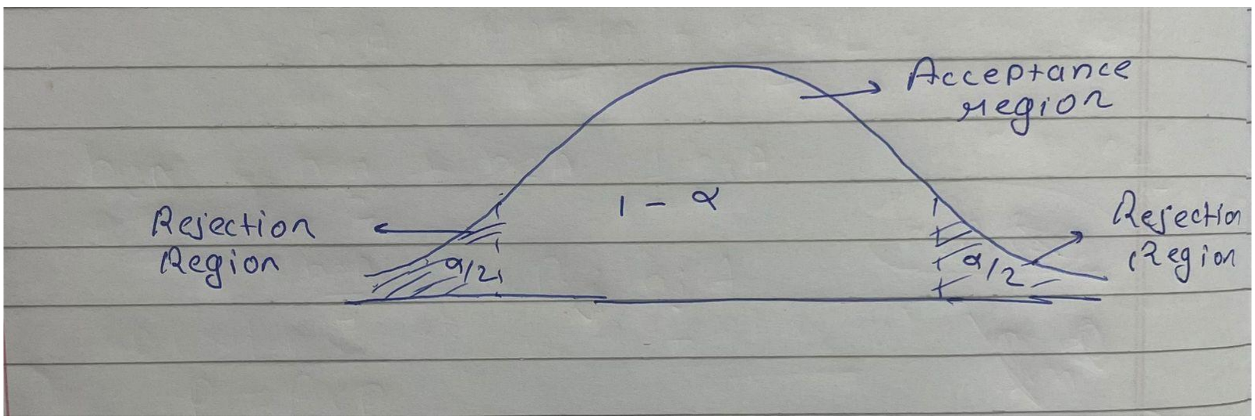
P Value: 0.09959876

**Inference**

As we can see, the test statistic value lies in the rejection region(as inferred from critical value) Also, our p-value > $\alpha$ = 0.05. Thus, we **accept $H_0$.**

**The mean production per hectare is more than 12 quintals.**

| Values | |
|---|---|
| mu.null | 12 |
| n | 10 |
| p_value | 0.0995987600465332 |
| sample_mean | 12.63 |
| sample_standar… | 1.0853058964591 |
| test_critical_… | 2.2621571627982 |
| test_statistic | 1.83564369493053 |
| x | num [1:10] 14.3 12.6 13.7 10.9 13.7 12… |




T(alpha/2) =  2.262157

Q4.

**Hypothesis**

Given $\mu_0$ = mean time playing
Let $H_0$ =Mean playing time of boys and girls is same

$H_1$ = Mean playing time of boys and girls are not the same.

Therefore, our hypothesis becomes:

$H_0$: $\mu_1 = \mu_2$ v/s $H_1$: $\mu_1 \neq \mu_2$

**Testing**

Both s.d's are known so we use a two-tailed t-test to test our hypothesis. We will make our inferences using 2 ways, by test statistic and p-value The test statistic is calculated as below:

$T_{test}$ = ((sample_mean_1 - sample_mean_2) - ($\mu_1$ - $\mu_0$))/√($s_1$^2/$n_1$ + $s_2$^2/$n_2$)
where $s_1$ = standard deviation of boys playing time, $s_2$ = standard deviation of girls playing time, $n_1$ = sample size of boys, $n_2$ = sample size of girls, sample_mean_1 = mean of boys playing time, sample_mean_2 = mean of girls playing time.
From this, we get our p-value as:

P(T > |t|) = 2*P(T > t)

Also degree of freedom is obtained by : df <- ((A+B)**2)/(A**2/(n1-1) + B**2/(n2-1))

A <- S1**2/n1 , B <- S2**2/n2

**Results**

Below is output of our code:

Test statistic: 3.142338

Test Critical Value: 2.094181

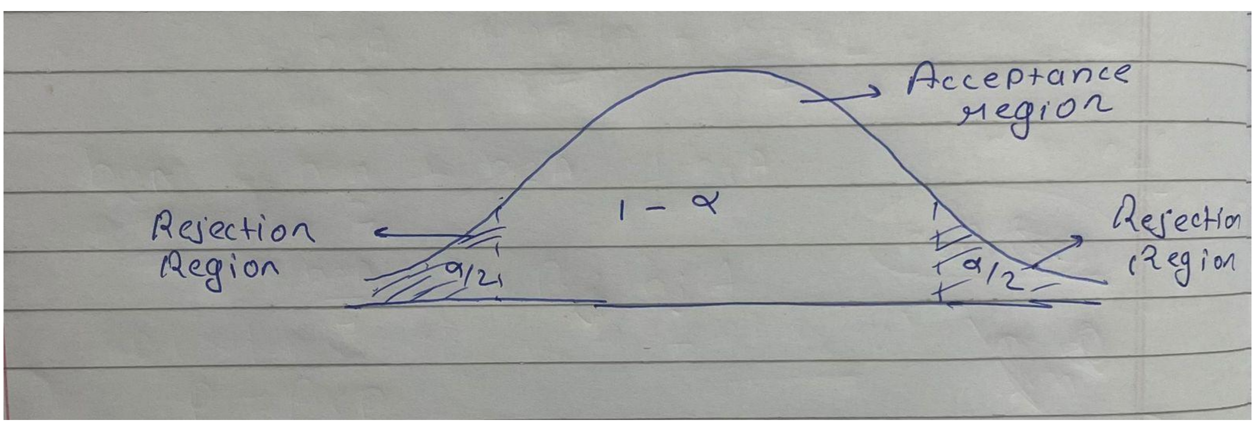
P Value: 0.005402668

**Inference**

As we can see, the test statistic value lies in the rejection region(as inferred from the critical value) Also, our p-value < α = 0.05. Thus, **we reject $H_0$.**

**<u>The playing time average for boys and girls are different.</u>**

| Values | |
|---|---|
| A | 0.0833333333333333 |
| B | 0.0625 |
| df | 18.8461538461538 |
| n1 | 9 |
| n2 | 16 |
| p_value | 0.00540266750741984 |
| S1 | 0.866025403784439 |
| S2 | 1 |
| test_critical_… | 2.09418107746136 |
| test | test_critical_value (numeric , 56 bytes) |
| x1 | 2 |
| x2 | 3.2 |




T(alpha/2) = 2.094181

Q5.

**Hypothesis**

Given $\mu_0$ = mean response time
Let $H_0$ = there is change in weight of children due to Food B.

$H_1$ = there is no change in weight of children due to Food B.

$H_0$: $\mu_1 = \mu_2$ v/s $H_1$: $\mu_1 \neq \mu_2$

**Testing**

Both s.d's are unknown so we use a two-tailed t-test to test our hypothesis. We will make our inferences using 2 ways, by test statistic and p-value The test statistic is calculated as below:

```
test.ans<-t.test(x = FoodA, y = FoodB, paired = TRUE, var.equal=FALSE, alternative = "two.sided")
```

```
test_statistic <- test.ans$statistic
```

From this, we get our p-value as:

$P(T > |t|) = 2*P(T > t)$

**Results**

Below is output of our code:

Test statistic: -4.320494

Test Critical Value: 2.364624

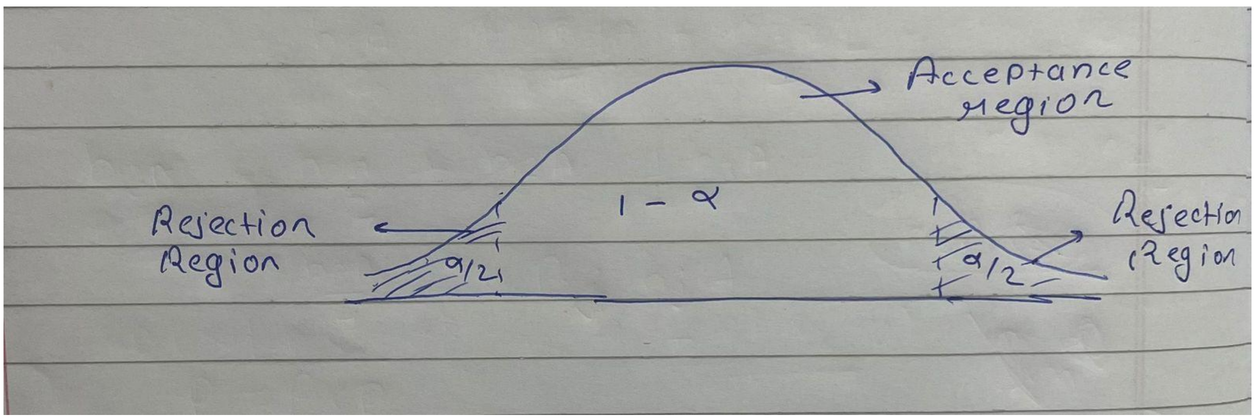
P Value: 0.003478084

**Inference**

As we can see, the test statistic value lies in the rejection region(as inferred from critical value) Also, our p-value < $\alpha$ = 0.05. Thus, **<u>we reject $H_0$</u>**.

**<u>Mean change of weight is not due to Food B.</u>**

| test.ans | List of 10 |
|---|---|
| **Values** | |
| FoodA | num [1:8] 49 53 51 52 47 50 52 53 |
| FoodB | num [1:8] 52 55 52 53 50 54 54 53 |
| n | 8 |
| p_value | 0.00347808426500278 |
| test_critical_… | 2.36462425159278 |
| test_statistic | Named num -4.32 |




T(alpha/2) = 2.364624