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Notes For Students - Lesson 11

T test

Independent sample t test

- We may be interested in knowing if **two population parameters** are significantly different from each other or not.
- We may want to compare the before and after effect of an experiment on two population parameters but performing both the test on one sample itself may lead to carry over effect.

In such a case, we use independent sample t test.

It is used for **experimental** and **observational** purposes.

A teacher wants to compare the performance of two of her classes, section A and section B, in a Maths test.

$\bar{X}_A = 75$ $\quad \sigma_A = 25$ $\quad n = 20$

$\bar{X}_B = 70$ $\quad \sigma_B = 15$ $\quad n = 25$

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Q. What will be the null hypothesis to compare the marks of both sections?

$$H_o : \mu_A = \mu_B$$

Q. What according to you will be the alternate hypothesis to compare the marks of both sections?

a) **Ha** : $\mu_A > \mu_B$

b) **Ha** : $\mu_A < \mu_B$

c) **Ha** : $\mu_A \neq \mu_B$

Q. What will be the Standard Error in independent sample t test?

$$\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

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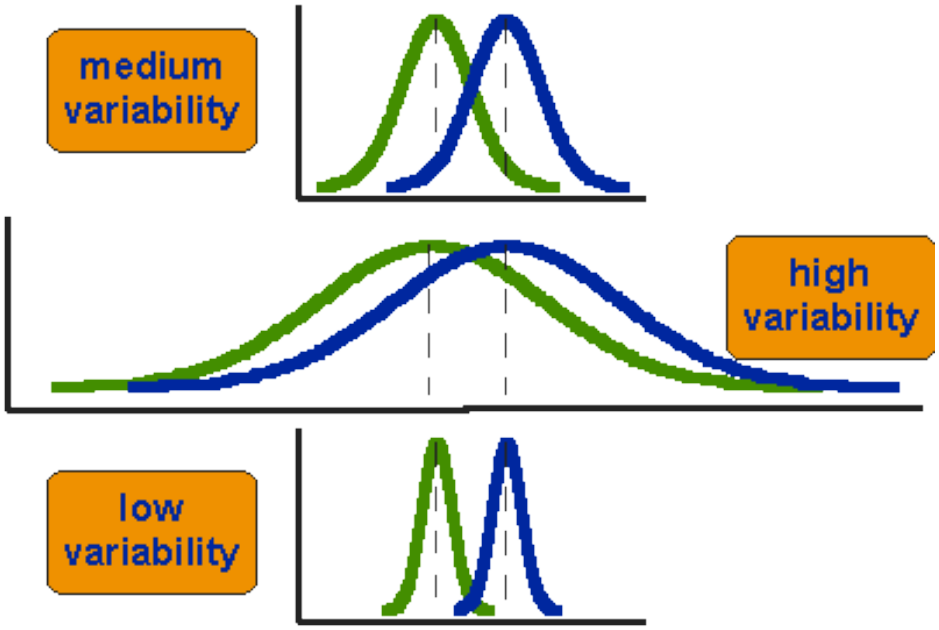

Q. What will be the t statistic value?

$$t = \frac{X_A - X_B}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{\text{Difference between means}}{\text{Standard Error}}$$

$$= 0.78811$$

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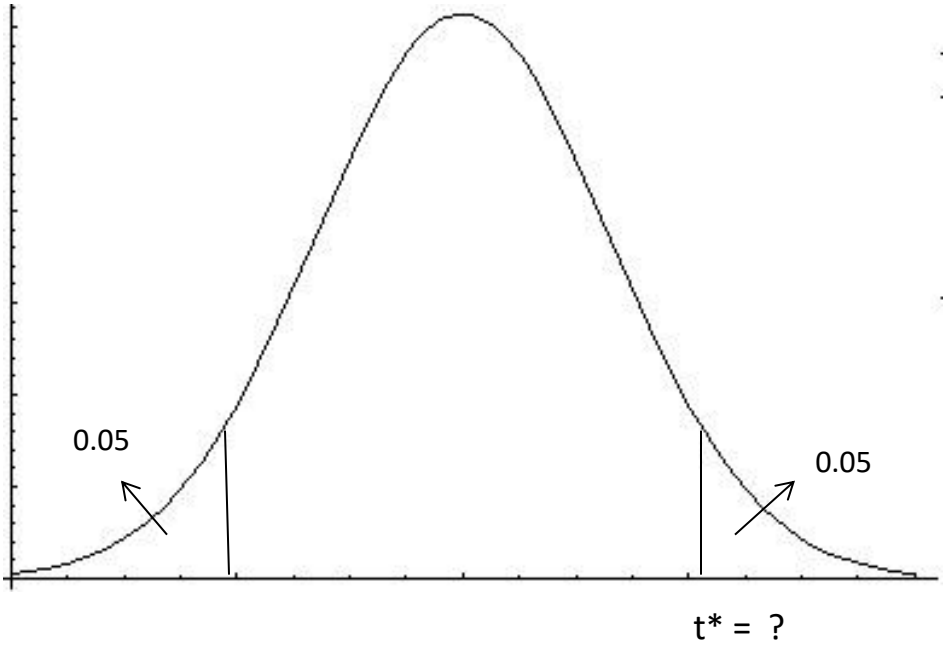
Q. Calculate degrees of freedom?

$$df = (n_1 - 1) + (n_2 - 1)$$

$$= n_1 + n_2 - 2$$

$$= 43$$

Q. What will be the t critical value for the above degrees of freedom and a significance level of 0.05?



$$= 2.0167$$

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Q. Will you reject or retain the null hypothesis?

Reject

Retain

Q. A study wanted to find if the average zinc concentration (mg/l) in bottom water and surface water were different. It selected 6 river locations and following observations were found.

	1	2	3	4	5	6
Bottom water (a)	.43	2.66	.567	.531	.707	.716
Surface water (b)	.415	.238	.390	.410	.605	.609

Q. What is the point estimate for the difference between their means?

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Q. What would be the null and alternate hypothesis?

H_0 : ?

H_a : ?

Q. What is the standard error of differences?

Q. Compute the t statistic value?

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}$$

= ?

Q. What is the t critical value for a significance level of 0.05?

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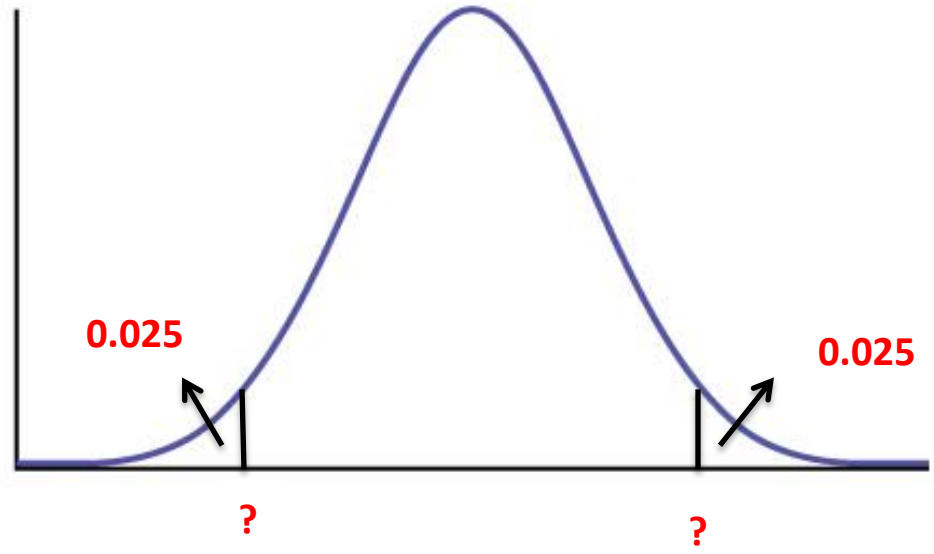
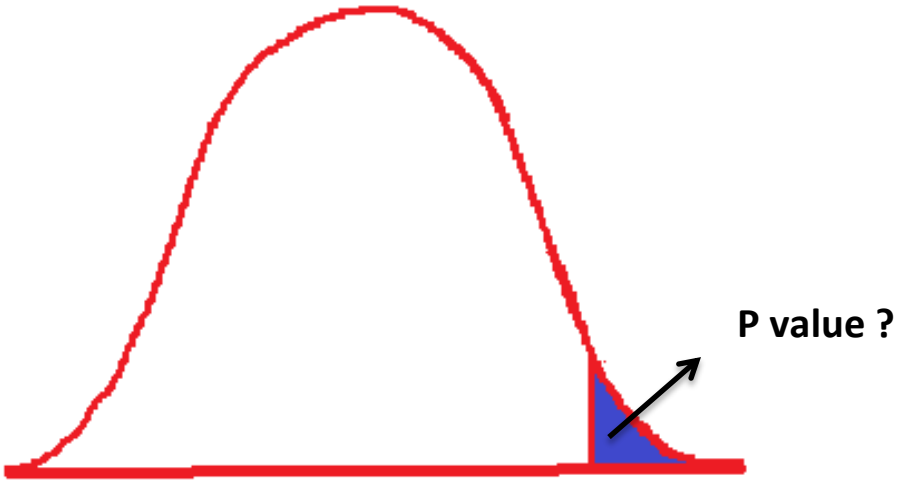


Q. What is the p value?



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Q. Would you reject Ho or do not to reject Ho?

Reject

Do Not Reject

t test in Excel

Enter the data values

Data > Data Analysis > t-test : Two-sample assuming unequal variances

Q. Compute the confidence interval for true population difference?

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A study wants to know if there is significant difference in average riding time to deliver pizza between company A and company B

Delivery time for company A and B are given as follows:

A	B
20.5	20.6
25	16.3
16	18.4
21.7	17.6
20.4	20.8
18.3	
21.9	

Q. What is the mean delivery time for company A and company B?

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Q. What is the point estimate for $\mu_A - \mu_A$?

Q. What is the standard error for company A and company B?

Q. What is the t statistic value for the difference between the delivery times?

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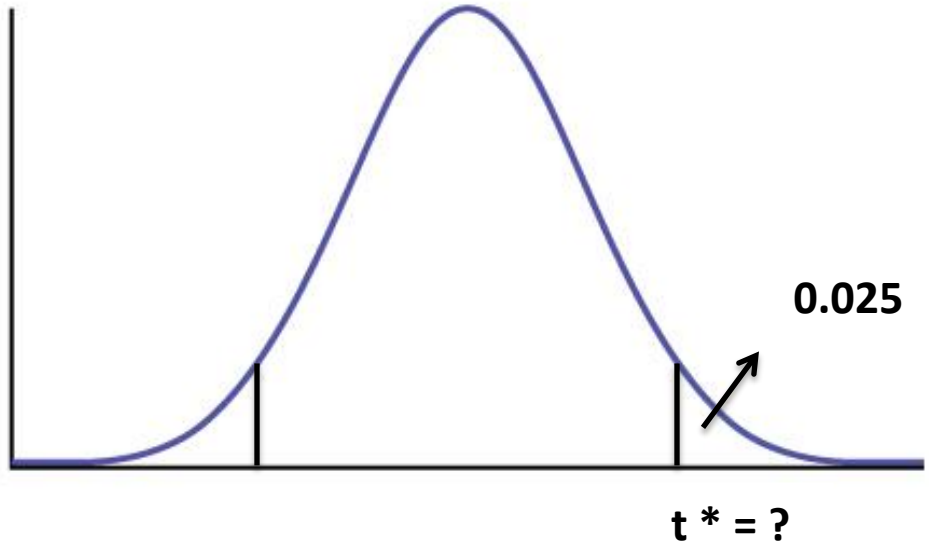
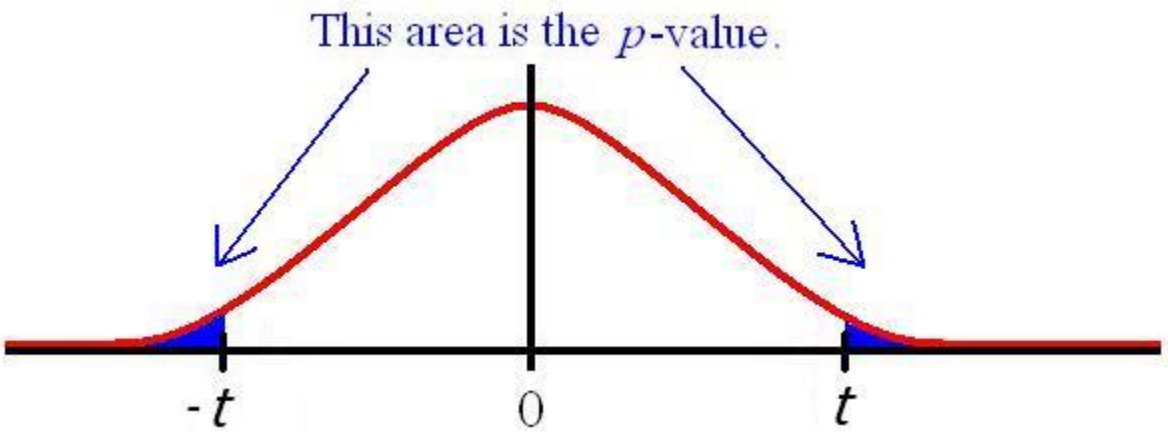
Q. What is the t critical value for a significance level of 0.05?



Q. What is the P value?



Q. Will you reject Ho at a significance level of 0.05?

Yes

No

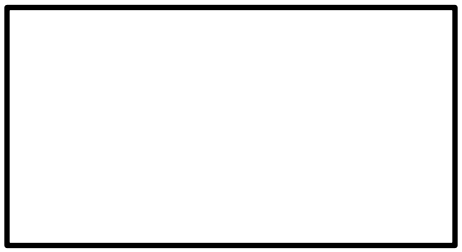
Q. Calculate degrees of freedom.

Q. A company wants to check which kind of anti-dandruff shampoo, aloe vera or lemon, is better to introduce in the market. It has developed both kinds of shampoo for testing. Let's call both of these types as A and L. It tested shampoo A on 10 people while it tested shampoo L on 6 people and asked them to rate out of 100. Their reviews were as follows :

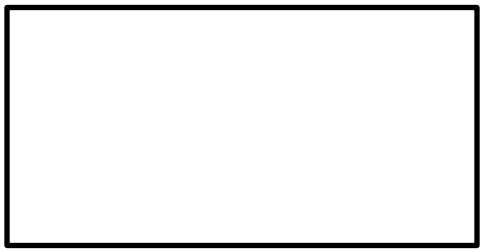
Shampoo A	Shampoo L
56	48
42	54
37	19
29	40

48	30
35	22
53	
20	
45	
50	

Q. Calculate the average rating for shampoo A and shampoo L.



A



B

Q. What would be the null and alternate hypothesis?

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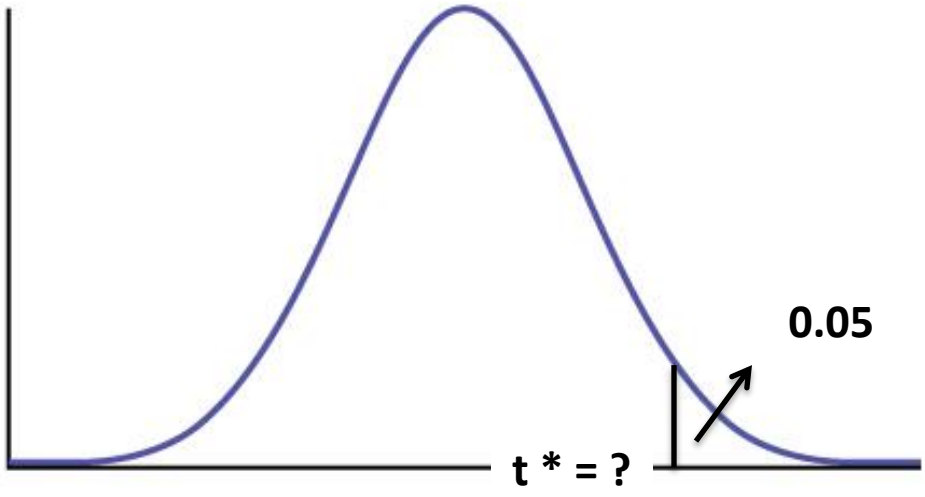
Q. Calculate the t statistic.

Q. Calculate degrees of freedom.

Q. What is the t critical value for a significance level of 0.05?



Q. Would you reject or retain the null hypothesis?

Reject

Retain

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Pooled Variance

$df = n_1 + n_2 - 2$

$$S.E. = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

One sample

$$S^2 = \frac{SS}{df} = \frac{\sum (X_i - \bar{X})^2}{n - 1}$$

Pooled Variance = $$\mathbf{S_p^2 = \frac{(n_1 - 1)\, s_1^2 + (n_2 - 1)\, s_2^2}{n_1 + n_2 - 2}}$$

Pooled Variance = $S_p^2 = \frac{SS_1 + SS_2}{df_1 + df_2}$

To calculate pooled variance in Excel, choose the option t-test : Two-sample assuming equal variances.

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The height (feet) of 10 males and 10 females residing in Delhi was noted. The following data was obtained:

Male	Female
5.5	5
6	5.2
5.10	5.3
5.7	5.5
5.4	5.1
5.8	5.8
5.9	5.4
6	5.2
5.5	5.6
5.6	5.1

SS_{male}

SS_{female}

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$df_1 + df_2$ [ ]

Pooled Variance ?

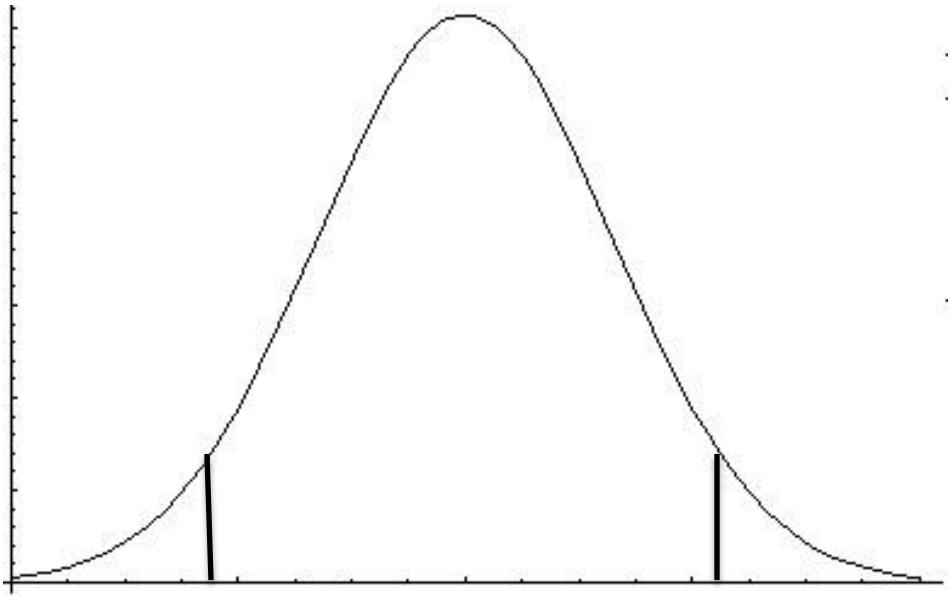
Standard Error $= \sqrt{\frac{S_p^2}{n_1} + \frac{S_p^2}{n_2}}$

$=$?

Calculate the t statistic value

$=$?

What is the t critical value for a significance level of 0.05?



t * = ?

Would you accept or reject the null hypothesis?

Reject

Do Not Reject

Q. The above question tells whether the height differs between two people on the basis of gender. But do you think that height would depend on other factors as well like the following?

Genetics

Nutrition

Exercises

Q. What proportion of difference in height can be attributed to gender?

$$r^2 = \frac{t^2}{t^2 + df}$$