Student *t* test

By
Dr. Asaad Al-Yassen
Assist. Professor of dermato-epidemiology
& occupational health
Department of Community Medicine
University of Basrah

- **One - sample *t* test:** Compare one sample mean versus population mean.
- **Two – sample *t* test:** Compare two samples mean.

When we have to use *t* test?

- When the population standard deviation σ is not known.
- When sample size is small, n < 30.
- It is use only for quantitative data.
- Use to compare between two samples mean.

*****When they have large sample size, the range depends on $\bar{X} \pm 1.96\ SE(\bar{x})$ at 95% confidence interval, while
*****When sample size (n) is small, the width or range will be more. So *t* constant must be change.

$$\bar{X} \pm t\ SE(\bar{x})$$

$$\bar{X} \pm t \frac{sd}{\sqrt{n}}$$

From ***t* table** we can get the appropriate *t* value for various levels of **P** for a given sample size **(n – 1)** what we called **Degree of freedom.**

Degree of freedom: Is the number of values in a study that are free to vary.

One - sample *t* test

- Compare one sample mean versus population mean when σ is unknown.
- The formula for *t* - test is similar in structure to the Z – test, except that in *t* – test used to estimate the standard error from the sample standard deviation instead of population standard deviation.

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

$$t_{n-1} = \frac{|\bar{X} - \mu|}{\frac{sd}{\sqrt{n}}}$$

Steps for calculation of *t* test:

1. State the null hypothesis

2. Calculate the *t* value

3. Calculate the degree of freedom (df = n – 1)

4. stat the critical value (s) from the ((*t* distribution table)).
   at 0.05 and 0.01.

- When sample size is large (**n >120**), the Z – test and *t* – test provide the exact same value and conclusion.

5. Draw a conclusion: Compare the calculated *t* to the critical values from the *t* distribution table to determine significance.

- **If the calculated *t* value is smaller than the critical values.**
The difference between the sample mean and the population mean is likely due to sampling error or chance, so accept the null hypothesis.

$P > 0.05$

- **If the calculated *t* value is equal to or larger than the critical values.**
The difference between the sample mean and the population mean is not likely due to sampling error or chance, so reject the null hypothesis.

$P < 0.05$ or **$P < 0.01$**

Two – samples *t* test

((*t* – test for the difference between two means))

$$t_{n_1 + n_2 - 2} = \frac{| \bar{X}_1 - \bar{X}_2 |}{SE\ (x_1 - x_2)}$$

$$SE_{(x1-x2)} = \sqrt{\left[\frac{(n_1 - 1)\ S_1 + (n_2 - 1)\ S_2}{n_1 + n_2 - 2} \right] \left[\frac{1}{n_1} + \frac{1}{n_2} \right]}$$

or

$$SE_{(x1-x2)} = \text{pooled S} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

$$df = n_1 + n_2 - 2$$

Sample questions:

Example: The mean weight of 9 under nourished 6 years old children was 17.3 Kg. with standard deviation 2.51 Kg. If the weight of 6 years old children in the general population is normally distributed with a mean weight 20.9 Kg. Determine if the weight of this sample is significantly different from the population of 6 years old children.

Key answer to sample questions:

n = 9
$\bar{X}$ = 17.3 Kg.
Sd = 2.51 Kg.
μ = 20.9 Kg.

1.State the null hypothesis: There is no significant difference between the mean weight 6 years old malnourished children and the weight of 6 years old in the general population, and if there is difference is due to chance or sampling error.

2.Calculate the *t* value:

$$t_{n-1} = \frac{|\bar{X} - \mu|}{\dfrac{sd}{\sqrt{n}}}$$

$$t_8 = \frac{|17.3 - 20.9|}{\dfrac{2.51}{\sqrt{9}}} = 4.306$$

3.Calculate the degree of freedom (df)

df = n – 1
= 9 – 1 = 8

4.State the critical values: From the *t* distribution table, the critical values at the 8 degree of freedom are:

df	0.05	0.01
8	**2.31**	**3.36**

Since the calculated *t* value is larger than critical tabulated value at 95% level therefore, the probability to find difference by chance is less than 0.05.

(calculated *t* value > critical tabulated value at 95% level)

so P < 0.05

The calculated *t* value is larger than critical tabulated value at 99.7% level therefore, the probability to find difference by chance is less than 0.01.

(calculated *t* value > critical tabulated value at 99.7% level)

so P < 0.01

5.Conclusion: We reject the null hypothesis at both 95% and 99.7% confidence limit, which means that there is highly significant difference between mean weight of 6 years old malnourished children and the mean weight of 6 years old children in the general population.