Test of significance
((Test of hypothesis))
By

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

What Is a Test of Significance?

A <u>significance test</u> is a formal procedure for comparing observed data with a hypothesis whose truth we want to assess.

The results of a test are expressed in terms of a **probability** that measures **how well the data and hypothesis agree**.

Hypothesis testing mean defining of a **Null hypothesis**.

Null hypothesis---H0 (NH): The hypothesis that is being tested.

The null hypothesis (H0)→ **states or assumes that in the general population there is no significant difference between the population mean and the sample mean and if there is any difference, it is either due to chance or sampling procedure.**

When we begin the test of hypothesis, we assume that the null hypothesis is **true**.

When the distribution of the observations will be approximately normal, with mean **μ** (same as the population mean), and standard deviation the

$$\mathbf{SE(x)} = \frac{\sigma}{\sqrt{n}}$$

If the null hypothesis is **really true**, we would expect the $\bar{x}$ fall within

1.96 SE(x) from the **μ**. If the $\bar{x}$ does not fall " close to **μ ",** then we may reject the null hypothesis.

Level of significance:

It is the maximum probability with which the true Ho was rejected, usually taken as **0.05 or 0.01** to donate for the **5% or 1%** level of significance. But other levels may also be used.

P – value

It's use to assess the **degree of dissimilarity** between two measurements of two sets.
The p – value is a measure of surprise. The smaller p – value the more surprising the result.

If **P > 0.05** --- the result is in significant at 5 %
P < 0.01 ---- the result is highly significant
0.01 < P < 0.05 ---- the result is significant at 5% but not at 1% level.

Types test of significance:

- **One – sample Z – test**: compare one sample mean versus a population mean.
- **One – sample t – test**: compare one sample mean versus a population mean.
- **Two – sample Z – test.**
- **Two – sample t – test.**
- **Chi – squared test.**

Z – test

When we use Z – test?

1. To compare between one sample mean versus population mean when **ơ is known**.
2. When sample size is large, **n** > **30**.
3. To compare between **2 samples mean**.
4. Used for **quantitative** and **qualitative data**.

Information needed for Z – test:

- population mean (**µ**)
- population standard deviation (**ơ**)
- sample mean (**x**)
- sample size (**n**)
- sample size (**n**) and population standard deviation (**ơ**) are used to calculate standard error of mean (**SE(x)**).

Steps:

1. Stat the null hypothesis.
2. Calculate Z value.

$$Z = \frac{|\bar{X} - \mu|}{SE(x)}$$

3. Decision making

Critical values of Z – test	**level of significance**
1.96	0.05
2.58	0.01

At 95 % confidence limit

a. If **Z ≤ 1.96** → No rejection of NH (the difference between the sample mean and population mean is not significant, and the difference was probably because of sample error or by chance, and the probability of finding a difference by chance is > 0.05 (**p > 0.05**) so we **accept the null hypothesis.**

b. If **Z > 1.96** → reject NH (the difference between the sample mean and population mean is significant,(real difference), and the probability of finding a difference by chance is < 0.05 (**p < 0.05**) so we **reject the null hypothesis.**

At 99.7 % confidence limit

a. If **Z ≤ 2.58** → No rejection of NH (the difference between the sample mean and population mean is not significant, and the difference was probably because of sample error or by chance, and the probability of finding a difference by chance is > 0.01 (**p > 0.01**) so we **accept the null hypothesis.**

b. If **Z > 2.58** → reject NH (the difference between the sample mean and population mean is highly significant,(real difference), and the probability of finding a difference by chance is < 0.01 (**p < 0.01**) so we **reject the null hypothesis.**

At 95 % confidence limit

If $Z \leq 1.96$ — **no significant difference**
So accept the null hypothesis

So $p > 0.05$

If $Z > 1.96$ — **significant difference**
So reject the null hypothesis

So $p < 0.05$

Types of Z – test:

1. Z – test for quantitative data:

- **One sample Z – test:** compare one sample mean versus a population mean.

$$Z = \frac{|\bar{X} - \mu|}{SE(x)}$$

$$SE(x) = \frac{\sigma}{\sqrt{n}}$$

- **Two samples Z – test:** compare between two samples mean.

$$Z = \frac{|\bar{X}_1 - \bar{X}_2|}{SE(x_1 - x_2)}$$

$$SE(x_1 - x_2) = \sqrt{\frac{S^2{}_1}{n_1} + \frac{S^2{}_2}{n_2}}$$

2. Z – test for qualitative data (proportion):

- **One sample proportion Z – test:** compare one sample proportion versus a population proportion.

$$Z = \frac{|p - \pi|}{SE(\pi)}$$

$$SE(\pi) = \sqrt{\frac{\pi(1-\pi)}{n}}$$

*** Two samples proportion Z – test:** compare between two samples proportion.

$$Z = \frac{|p_1 - p_2|}{SE(Pp)}$$

$$SE(Pp) = \sqrt{Pp\,(1 - Pp)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

$$Pp = \frac{r_1 + r_2}{n_1 + n_2}$$

$$p_1 = \frac{r_1}{n_1} \qquad\qquad p_2 = \frac{r_2}{n_2}$$