

Unit-4

Hypothesis Testing / Test of Significance

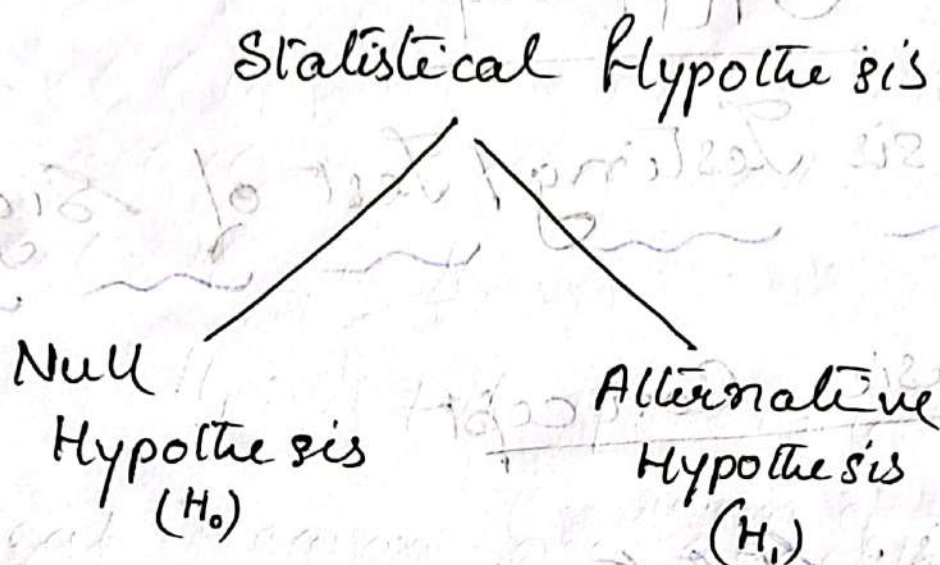
Some Basic Concept

1. Hypothesis: Statistical hypothesis are hypothesis means any statement or assumption about the statistical population or about the population parameter.
For eg: The average percentage of students securing A grade will be much higher in this semester.

Hypothesis testing / Test of Significance

Hypothesis testing or test of significance is an important aspect of sampling theory which enables us to know on the basis of the sample result whether the difference between the statistic & population parameter

2. (ii) whether the difference between the 2 statistics are significant or not.



3. Null Hypothesis - It is a hypothesis of no difference and it is usually denoted by the symbol H_0 . According to Professor Ronald A. Fisher, null hypothesis is a hypothesis which is tested for possible rejection under the assumption that it is true.

Example: If we want to test whether the population mean (μ), has a specified value (μ_0), then the null hypothesis can be set up as follows

$$H_0: \mu = \mu_0$$

4. Alternative hypothesis: A hypothesis which is ^{contradictory} ~~complementary~~ to null hypothesis is called alternative hypothesis. It is a hypothesis of difference & it is denoted by the symbol H_1 . For example: if we have a null hypothesis of the form $H_0: \mu = \mu_0$

$H_0: \mu = \mu_0$, then the corresponding alternative hypothesis could be any one of the following 3 cases

$$H_1: \mu \neq \mu_0$$

or

$$H_1: \mu > \mu_0$$

or

$$H_1: \mu < \mu_0$$

⑤ One Tailed Test

In case of hypothesis testing, if we have only one alternative hypothesis, then it is called one tailed or single tailed test. For example,

$$\text{let, } H_0: \mu = \mu_0$$

against $H_1: \mu > \mu_0$ [Right tailed Test]
or $H_1: \mu < \mu_0$ [Left tailed Test]

6 Two Tailed Test

In case of hypothesis testing, if we have the possibilities of 2 alternatives then it is called 2 tailed test.

$$\text{Let } H_0: \mu = \mu_0$$

$$H_1: \mu \neq \mu_0 \quad [\text{Two Tailed Test}]$$

7 Critical Region or ^{region of rejection} ~~Acceptance~~ region

A region in the sample space which ^{leads to} ~~amounts~~ to the rejection of the null hypothesis is called critical region or region of rejection.

8) Acceptance Region

A region in the sample space which amount to acceptance of the null hypothesis i.e. ' H_0 ' is called acceptance region.

9) Type I error & Type II error

Type I error arises when we reject a true null hypothesis. It is usually denoted by ' α '. In terminology

of Statistical Quality Control, Type I error is popularly known as consumer's risk & producer's risk.

Type II error is an error which arises when we accept a wrong null hypothesis. It is usually denoted by β . In the terminology of Statistical Quality Control, Type II error is known as consumer's risk.

10/ Test Statistic

Test statistic in context of hypothesis testing is a phenomenon whose value helps us to determine whether the null hypothesis is going to be accepted or rejected.

Ex- If t is any statistic, then the test statistic is defined as

$$T = \frac{t - E(t)}{S.E(t)} \sim N(0, 1)$$

level of α

$$EU_1^v = EU_2^v = \dots = EU_n^v = \sigma^v$$

$$\text{or } EU_i^v = \sigma^v$$

11/ Level of Significance } same as Type I error

The probability of rejecting a true null hypothesis is called level of significance. Thus, it stands for the size of type I error or the probability of committing type I error. It is denoted usually by the symbol ' α '.

12/ General procedure of hypothesis Testing

The steps for hypothesis testing -

Step 1 - Determine or set up the null hypothesis (H_0).

Step 2: Set up the corresponding alternative hypothesis (H_1), which will tell us whether we are using one tailed or two tailed test.

Step 3: Here we will fix the level of significance may be at 1% or 5% level. Sometimes the level of

significance can be fixed at 10% level also.

Step-4: Here under the assumption that the (H_0) is true, we will calculate the following test statistic.

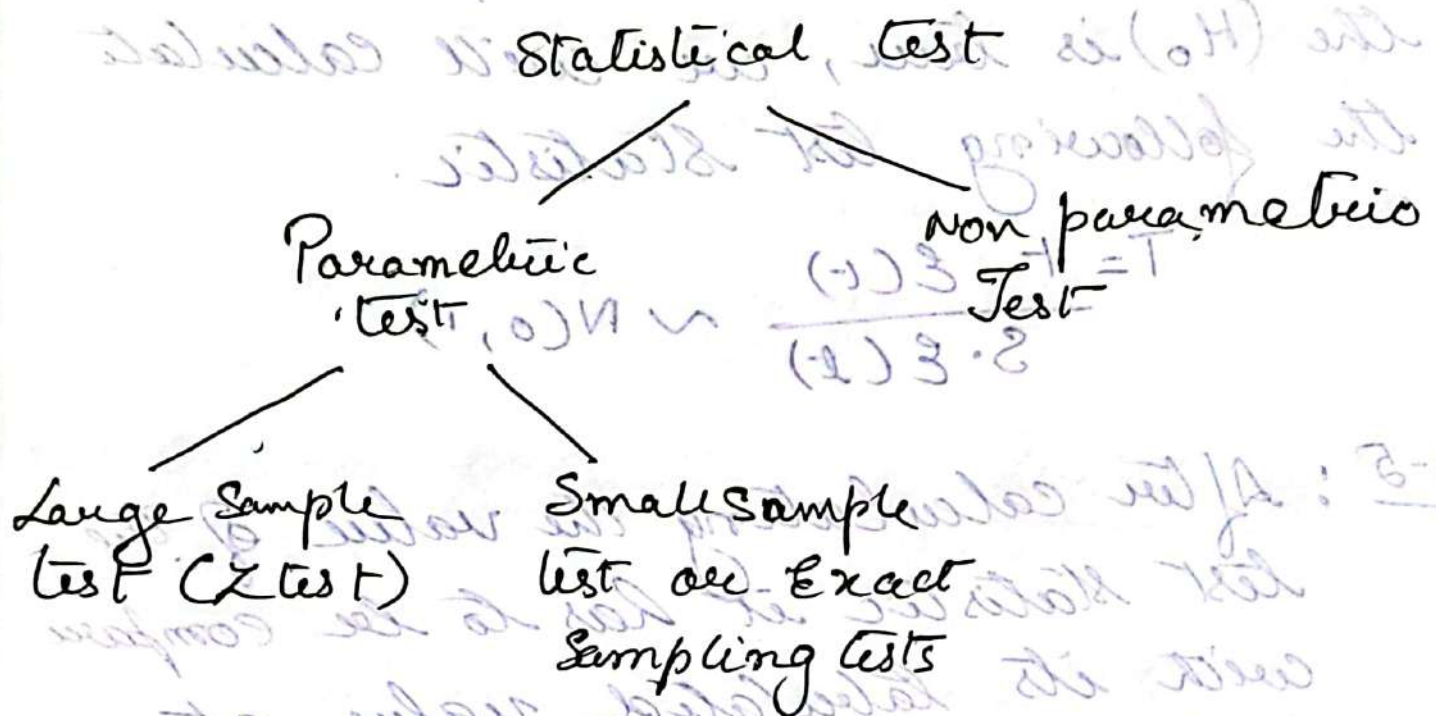
$$T = \frac{\bar{t} - E(\bar{t})}{S.E(\bar{t})} \sim N(0, 1)$$

Step-5: After calculating the value of the test statistic it has to be compared with its tabulated value at a particular level of significance. After comparison if we find

$T_c < T_t$, we may ^{always, we will accept} accept ^{while} the H_0 and conclude that there is no significant difference between the statistic and population parameter.

On the other hand if we find $T_c > T_t$, we will reject the H_0 and conclude that there is significant difference between statistic & population parameter.

always use may' accept ^{while} accepting H_0
because T_c may vary with level of
significant.



= Application of large sample test / Z test
/ T test
T_{au}

- ① Z test is used to test the significance of single population mean.
- ② Z test is used to test the significance of the difference between 2 sample means.
- ③ Z test is used to test the significance

of a single population proportion.

④ Z test is also used to test the significance of the difference betw 2 sample proportions.

* * *

~~However it is to be noted that~~
all the above mention application of Z test are only valid for large test sample i.e $n \geq 30$

Application of T test

① T test is used to test the significance of single population mean, ~~when~~
sample size ' n ' < 30

② T test is used to test the significance of the difference betw 2 sample means

3) T test is used to test the significance of simple correlation coefficient, partial correlation coefficient & multiple correlation

4) It is used to test the significance of regression coefficient.

It is to be noted that these applications are generally valid for small samples i.e. for $n < 30$.

Application of χ^2 test

- ① Chi-square (χ^2) test is used to test the significance of population variance.
- ② χ^2 test is used as a measure of goodness of fit.
- ③ χ^2 test is used to test the independence of attributes.
- ④ It is used to test the homogeneity of correlation coefficient.

However, it is only the 1st application of χ^2 test which falls in the arena of parametric test. The rest 3 applications of χ^2 test are actually non parametric test.

Applications of F test

- ① It is used to test the equality of 2 population variances
- ② It is used to test the overall significance of a regression model
- ③ F test is used to test the significance of sample correlation ratio.
- ④ F test is used to test the linearity of a regression model.
- ⑤ It is also used for testing the equality of several sample means

Table of critical or tabulated values of ~~the~~ for Z test in different circumstances

Critical or tabulated values (Z_r)	Level of significance		
	1%	5%	10%
Two tailed test	2.58	1.96	1.645
Right tailed test	2.33	1.645	1.28
Left Left Left tailed test	-2.33	-1.645	-1.28