\* In the last blog, we have seen the Non-existence of Uniformly Most Powerful Test (with exceptional test), Likelihood Ratio Test and its properties.

Let’s learn more about the Likelihood Ratio Test.

* As we have seen earlier the general approach of Likelihood Ratio Test, but here a question arises that “*How can we apply Likelihood Ratio Test in case of large samples?*”

So here we can understand it better :-

* Suppose we want to test H0 : θ = θ0 where θ0 ϵ Θ, some interval on the real line of the parametric space Θ.

Let 1, 2, ….. , n be a random sample of size n (n > 30) and be the ML estimator of θ0. Then,

λ =

If the first and second derivatives with respect to θ in Θ of the distribution of exist, under H0, -2 is approximately distributed as χ2 with (n - 1) d.f. The test may be performed in the usual manner.

*Now, let’s move towards other Tests.*

***Student’s t-test*** :- Student’s *t* distribution was given first used by W.S. Gosset in the year 1908. The statistician W.S. Gosset is better known by his pseudonym, student. Suppose we want to test H0 : μ = μ0 vs. H1 : μ = μ1 on the basis of a small random sample 1, 2, ….. , n of size n (n > 30) from a normal population. N(μ, σ2) with σ2 unknown for predefined level α.

Obviously it is a two-tailed test.

For testing H0, student’s t statistic is,

*t* = , -

where *s* =

for *i* = 1, 2, n.

***Definition*** :- Student’s *t* is the derivation of estimated mean from its population mean expressed in terms of standard error. The test criteria are; reject H0 if *t* ≥ or -t ≤ , otherwise accept H0.

Further, if one wants to test H0 : μ = μ0 vs. H1 : μ < μ0 or μ > μ0, the test statistic remains the same. The only difference in the test procedure is that the critical value of *t* is only on one side.

In case of H1 : μ > μ0, the test criteria is that reject H0 if *t* ≥ .

* ***Assumptions about t-test*** :- There are five assumptions about *t*-test as given below:

1. The random variable *X* follows normal distribution or the sample is drawn from a normal population.
2. All observations in the sample are independent.
3. The sample size is small, *i*.*e*. less than 30 as a usual practice. Also, the sample should not contain less than five observations.
4. The hypothetical value μ0 of μ is a correct value of population mean.
5. The sample values are correctly measured and recorded.

* ***Properties of t-test*** :- Following are the properties of *t*-test.

1. Student’s *t*-test is a robust test. By a robust test we mean a test which is not vitiated much even if all the assumptions made about the test do not fully hold good.
2. Student’s *t*-test for testing H0 : μ = μ0 vs. H1 : μ = μ1 for an arbitrary σ from a normal population provides a uniformly most powerful unbiased test.

*Let’s understand the test with the help of an example.*

* A manufacturer of dry cells claimed that the life of their cells is 24.0 hours. A sample of 10 cells head mean life of 22.5 hours with standard deviation of 3.0 hours. On the basis of available information, test whether the claim of the manufacturer is correct. [Given : *t*0.05, 9 = 2.2623]
* Assuming that the lifetime of cells is distributed normally. Here we test

H0 : μ = 24 vs. H1 : μ 24

by student’s *t*-test.

*t* =

= 1.5

The calculated value of *t* is less than the tabulated value of *t* since *t*0.05, 9 = 2.2623. Hence, we accept H0, *i.e.*, the claim of manufacturer is correct.

* *While studying the concept, the question may arise that “When do we use paired t-test and how to apply it?”*

Let us consider 2 variables X1 and X2 which are normally distributed and there exists a correlation ρ between them. In practice, the observation are taken on the same item or the items which are paired before taking the observations let the difference between the paired values *X1 – X2* = *d. (X1 - X2)* is distributed with the mean μd and the variance ().

In paired *t*-test, we test H0 : μd = 0 vs. H1 : μd 0. The test based on *n* paired values (, ), (, ), ….. , (, ) is

*t* =

*t* has (n - 1) d.f.

where, *di* = - for *i* = 1, 2, ….., *n*.

= and =

Test criteria is, reject H0 if |*t*| ≥ *t*α, n-1, otherwise accept H0.