F- TEST

An ***F*-test** is any statistical test in which the test statistic has an *F*-distribution under the null hypothesis. It is most often used when comparing statistical models that have been fitted to a data set, in order to identify the model that best fits the population from which the data were sampled. Exact "*F*-tests" mainly arise when the models have been fitted to the data using least squares. The name was coined by George W. Snedecor, in honour of Sir Ronald A. Fisher. Fisher initially developed the statistic as the variance ratio in the 1920s.

An "F Test" is a catch-all term for any test that uses the F-distribution. In most cases, when people talk about the F-Test, what they are actually talking about is The *F-Test to Compare Two Variances*. However, the f-statistic is used in a variety of tests including regression analysis, the Chow test and the Scheffe Test (a post-hoc ANOVA test).

General Steps for an F Test:-
For running an F Test, you should use Excel, SPSS, Minitab or some other kind of technology to run the test. Because calculating the F test by hand, including variances, is tedious and time-consuming. Therefore you'll probably make some errors along the way.
If you're running an F Test using technology (for example, an F Test two sample for variances in Excel), the only steps you really need to do are Step 1 and 4 (dealing with the null hypothesis). Technology will calculate Steps 2 and 3 for you.

1. State the null hypothesis and the alternate hypothesis.
2. Calculate the F value. The F Value is calculated using the formula $F = (SSE_1 - SSE_2 / m) / SSE_2 / n\text{-}k$, where SSE = residual sum of squares, m = number of restrictions and k = number of independent variables.
3. Find the F Statistic (the critical value for this test). The F statistic formula is: **F Statistic = variance of the group means / mean of the within group variances.** You can find the F Statistic in the F-Table.
4. Support or Reject the Null Hypothesis.

F Test to Compare Two Variances:-
A **Statistical F Test** uses an F Statistic to compare two variances, s_1 and s_2, by dividing them. The result is always a positive number (because variances are always positive). The equation for comparing two variances with the f-test is: $F = s^2_1 / s^2_2$
If the variances are equal, the ratio of the variances will equal 1. For example, if you had two data sets with a sample 1 (variance of 10) and a sample 2 (variance of 10), the ratio would be 10/10= 1.
You **always** test that the population variances are equal when running an F Test. In other words, you always assume that the variances are equal to 1. Therefore, your null hypothesis will always be that *the variances are equal.*

Assumptions:-

Several **assumptions** are made for the test. Your population **must be approximately normally distributed** (i.e. fit the shape of a bell curve) in order to use the test. Plus, the samples must be independent events. In addition, you'll want to bear in mind a few important points:

- The larger variance should always go in the numerator (the top number) to force the test into a right-tailed test. Right-tailed tests are easier to calculate.
- For two-tailed tests, divide alpha by 2 before finding the right critical value.
- If you are given standard deviations, they must be squared to get the variances.
- If your degrees of freedom aren't listed in the F Table, use the larger critical value. This helps to avoid the possibility of Type I errors.

Common examples of the use of *F*-tests include the study of the following cases:

- The hypothesis that the means of a given set of normally distributed populations, all having the same standard deviation, are equal. This is perhaps the best-known *F*-test, and plays an important role in the analysis of variance (ANOVA).
- The hypothesis that a proposed regression model fits the data well. See Lack-of-fit sum of squares.
- The hypothesis that a data set in a regression analysis follows the simpler of two proposed linear models that are nested within each other.

In addition, some statistical procedures, such as Scheffé's method for multiple comparisons adjustment in linear models, also use F-tests.