F test equation

The F-test calculator compares the equality of two variances.It also validates data normality, checks the test power, identifies outliers, provides formula and solutions, and generates the R syntax.Enter comma , space or Enter after each data value.The one-sample t-test calculator doesn't count empty cells or non-numeric cells.Copy the data, from excel, includes the header, and paste above.When you enter the raw data, the F-test calculator also provides the Shapiro-Wilk normality test result and identifies outliers.one sample t-test step by step calculation F test is a statistical test that is used in hypothesis testing to check whether the variances of two populations or two samples are equal or not. In an f test, the data follows an f distribution. This test uses the f statistic to compare two variances by dividing them. An f test can either be one-tailed or two-tailed depending upon the parameters of the problem. The f value obtained after conducting an f test is used to perform the one-way ANOVA (analysis of variance) test. In this article, we will learn more about an f test, the f statistic, its critical value, formula and how to conduct an f test for hypothesis testing. What is F Test in Statistics? F test is statistics is a test that is performed on an f distribution. A two-tailed f test is used to check whether the variances of the two given samples (or populations) are equal or not. However, if an f test checks whether one population variance is either greater than or lesser than the other, it becomes a one-tailed hypothesis f test. F Test Definition F test can be defined as a test that uses the f test statistic to check whether the variances of two samples (or populations) are equal to the same value. To conduct an f test, the population should follow an f distribution and the samples must be independent events. On conducting the hypothesis test, if the results of the f test are statistically significant then the null hypothesis can be rejected otherwise it cannot be rejected. F Test Formula The f test is used to check the equality of variances using hypothesis testing. The f test formula for different hypothesis tests is given as follows: Left Tailed Test: Null Hypothesis: \(H_{0}\) : \(\sigma_{1}^{2} = \sigma_{2}^{2}\) Alternate Hypothesis: \(H_{1}\) : \(\sigma_{1}^{2} < \sigma_{2}^{2}\) Decision Criteria: If the f statistic < f critical value then reject the null hypothesis Right Tailed test: Null Hypothesis: \(H_{0}\) : \(\sigma_{1}^{2} = \sigma_{2}^{2}\) Alternate Hypothesis: \(H_{1}\) : \(\sigma_{1}^{2} > \sigma_{2}^{2}\) Decision Criteria: If the f test statistic > f test critical value then reject the null hypothesis Two Tailed test: Null Hypothesis: \(H_{0}\) : \(\sigma_{1}^{2} = \sigma_{2}^{2}\) Alternate Hypothesis: \(H_{1}\) : \(\sigma_{1}^{2} ≠ \sigma_{2}^{2}\) Decision Criteria: If the f test statistic > f test critical value then the null hypothesis is rejected F Statistic The f test statistic or simply the f statistic is a value that is compared with the critical value to check if the null hypothesis should be rejected or not. The f test statistic formula is given below: F statistic for large samples: F = \(\frac{\sigma_{1}^{2}}{\sigma_{2}^{2}}\), where \(\sigma_{1}^{2}\) is the variance of the first population and \(\sigma_{2}^{2}\) is the variance of the second population. F statistic for small samples: F = \(\frac{s_{1}^{2}}{s_{2}^{2}}\), where \(s_{1}^{2}\) is the variance of the first sample and \(s_{2}^{2}\) is the variance of the second sample. The selection criteria for the \(\sigma_{1}^{2}\) and \(\sigma_{2}^{2}\) for an f statistic is given below: For a right-tailed and a two-tailed f test, the variance with the greater value will be in the numerator. Thus, the sample corresponding to \(\sigma_{1}^{2}\) will become the first sample. The smaller value variance will be the denominator and belongs to the second sample. For a left-tailed test, the smallest variance becomes the numerator (sample 1) and the highest variance goes in the denominator (sample 2). F Test Critical Value A critical value is a point that a test statistic is compared to in order to decide whether to reject or not to reject the null hypothesis. Graphically, the critical value divides a distribution into the acceptance and rejection regions. If the test statistic falls in the rejection region then the null hypothesis can be rejected otherwise it cannot be rejected. The steps to find the f test critical value at a specific alpha level (or significance level), \(\alpha\), are as follows: Find the degrees of freedom of the first sample. This is done by subtracting 1 from the first sample size. Thus, x = \(n_{1} - 1\). Determine the degrees of freedom of the second sample by subtracting 1 from the sample size. This given y = \(n_{2} - 1\). If it is a right-tailed test then \(\alpha\) is the significance level. For a left-tailed test 1 - \(\alpha\) is the alpha level. However, if it is a two-tailed test then the significance level is given by \(\alpha\) / 2. The F table is used to find the critical value at the required alpha level. The intersection of the x column and the y row in the f table will give the f test critical value. ANOVA F Test The one-way ANOVA is an example of an f test. ANOVA stands for analysis of variance. It is used to check the variability of group means and the associated variability in observations within that group. The F test statistic is used to conduct the ANOVA test. The hypothesis is given as follows: \(H_{0}\): The means of all groups are equal. \(H_{1}\): The means of all groups are not equal. Test Statistic: F = explained variance / unexplained variance Decision rule: If F > F critical value then reject the null hypothesis. To determine the critical value of an ANOVA f test the degrees of freedom are given by \(df_{1}\) = K - 1 and \(df_{1}\) = N - K, where N is the overall sample size and K is the number of groups. F Test vs T-Test F test and t-test are different types of statistical tests used for hypothesis testing depending on the distribution followed by the population data. The table given below outlines the differences between the F test and the t-test. F Test T-Test An F test is a test statistic used to check the equality of variances of two populations The T-test is used when the sample size is small (n < 30) and the population standard deviation is not known. The data follows an F distribution The data follows a Student t-distribution The F test statistic is given as F = \(\frac{\sigma_{1}^{2}}{\sigma_{2}^{2}}\) The t-test statistic for 1 sample is given by t = \(\frac{\overline{x}-\mu}{\frac{s}{\sqrt{n}}}\), where \(\overline{x}\) is the sample mean, \(\mu\) is the population mean, s is the sample standard deviation and n is the sample size. The f test is used for variances. It is used for testing means. Related Articles: Probability and Statistics Data Handling Summary Statistics Important Notes on F Test The f test is a statistical test that is conducted on an F distribution in order to check the equality of variances of two populations. The f test formula for the test statistic is given by F = \(\frac{\sigma_{1}^{2}}{\sigma_{2}^{2}}\). The f critical value is a cut-off value that is used to check whether the null hypothesis can be rejected or not. A one-way ANOVA is an example of an f test that is used to check the variability of group means and the associated variability in the group observations. Example 1: A research team wants to study the effects of a new drug on insomnia. 8 tests were conducted with a variance of 600 initially. After 7 months 6 tests were conducted with a variance of 400. At a significance level of 0.05 was there any improvement in the results after 7 months? Solution: As the variance needs to be compared, the f test needs to be used. \(H_{0}\) : \(s_{1}^{2} = s_{2}^{2}\) \(H_{1}\) : \(s_{1}^{2} > s_{2}^{2}\) \(n_{1}\) = 8, \(n_{2}\) = 6 \(df_{1}\) = 8 - 1 = 7 \(df_{2}\) = 6 - 1 = 5 \(s_{1}^{2}\) = 600, \(s_{2}^{2}\) = 400 The f test formula is given as follows: F = \(\frac{s_{1}^{2}}{s_{2}^{2}}\) = 600 / 400 F = 1.5 Now from the F table the critical value F(0.05, 7, 5) = 4.88 As 1.5 < 4.88, thus, the null hypothesis cannot be rejected and there is not enough evidence to conclude that there was an improvement in insomnia after using the new drug. Answer: Fail to reject the null hypothesis. Example 2: Pizza delivery times of two cities are given below City 1: Number of delivery times observed = 28, Variance = 38 City 2: Number of delivery times observed = 25, Variance = 83 Check if the delivery times of city 1 are lesser than city 2 at a 0.05 alpha level. Solution: This is an example of a left-tailed F test. Thus, the alpha level is 1 - 0.05 = 0.95 \(H_{0}\) : \(s_{1}^{2} = s_{2}^{2}\) \(H_{1}\) : \(s_{1}^{2} < s_{2}^{2}\) As 38 < 83 thus, city 1 will be sample 1 and city 2 is sample 2. \(n_{1}\) = 28, \(n_{2}\) = 25 \(df_{1}\) = 28 - 1 = 27 \(df_{2}\) = 25 - 1 = 24 \(s_{1}^{2}\) = 38, \(s_{2}^{2}\) = 83 F = \(\frac{s_{1}^{2}}{s_{2}^{2}}\) = 38 / 83 F = 0.4578 As an F table for 0.95 alpha level is not available, the critical value is determined as follows: F(0.95, 27, 24) = 1 / F(0.05, 24, 27) F(0.05, 24, 27) = 1.93 F(0.95, 27, 24) = 1 / 1.93 = 0.5181 As 0.4578 < 0.5181, thus, the null hypothesis can be rejected and it can be concluded that there is enough evidence to support the claim that the delivery times in city 1 are less than in city 2. Answer: Reject the null hypothesis Example 3: A toy manufacturer wants to get batteries for toys. A team collected 41 samples from supplier A and the variance was 110 hours. The team also collected 21 samples from supplier B with a variance of 65 hours. At a 0.05 alpha level determine if there is a difference in the variances. Solution: This is an example of a two-tailed F test. Thus, the alpha level is 0.05 / 2 = 0.025 \(H_{0}\) : \(s_{1}^{2} = s_{2}^{2}\) \(H_{1}\) : \(s_{1}^{2} eq s_{2}^{2}\) \(n_{1}\) = 41, \(n_{2}\) = 21 \(df_{1}\) = 41 - 1 = 40 \(df_{2}\) = 21 - 1 = 20 \(s_{1}^{2}\) = 110, \(s_{2}^{2}\) = 65 F = \(\frac{s_{1}^{2}}{s_{2}^{2}}\) = 110 / 65 F = 1.69 Using the F table F(0.025, 40, 20) = 2.287 As 1.69 < 2.287 thus, the null hypothesis cannot be rejected, Answer: Fail to reject the null hypothesis. Show more > go to slidego to slidego to slide Breakdown tough concepts through simple visuals. Math will no longer be a tough subject, especially when you understand the concepts through visualizations. Book a Free Trial Class FAQs on F Test The f test in statistics is used to find whether the variances of two populations are equal or not by using a one-tailed or two-tailed hypothesis test. What is the F Test Formula? The f test formula can be used to find the f statistic. The f test formula is given as follows: F statistic for large samples: F = \(\frac{\sigma_{1}^{2}}{\sigma_{2}^{2}}\) F statistic for small samples: F = \(\frac{s_{1}^{2}}{s_{2}^{2}}\) What is the Decision Criterion for a Right Tailed F Test? The algorithm to set up an right tailed f test hypothesis along with the decision criteria are given as follows: Null Hypothesis: \(H_{0}\) : \(\sigma_{1}^{2} = \sigma_{2}^{2}\) Alternate Hypothesis: \(H_{1}\) : \(\sigma_{1}^{2} > \sigma_{2}^{2}\) Decision Criteria: Reject \(H_{0}\) if the f test statistic > f test critical value. What is the Critical Value for an F Test? The F critical value for an f test can be defined as the cut-off value that is compared with the test statistic to decide if the null hypothesis should be rejected or not. Why is an F Test Used in ANOVA? A one-way ANOVA test uses the f test to compare if there is a difference between the variability of group means and the associated variability of observations of those groups. Can the F statistic in an F Test be Negative? As the f test statistic is the ratio of variances thus, it cannot be negative. This is because the square of a number will always be positive. What is the Difference Between F Test and T-Test? An F test is conducted on an f distribution to determine the equality of variances of two samples. The t-test is performed on a student t distribution when the number of samples is less and the population standard deviation is not known. It is used to compare means. The F Test Formula is a Statistical Formula used to test the significance of differences between two groups of Data. It is often used in research studies to determine whether the difference in the means of two populations is Statistically significant.It is based on the F Statistic, which is a measure of how much variation exists in one group of Data compared to another. Students who are studying for their Statistics course will need to be familiar with this Formula. Our article will provide a detailed explanation of how to use the F Test Formula. It will also provide examples of how to use it in practice.The use of the F Test Formula is a critical step in any research study, and it is important to understand how to use it correctly. You will be able to find the F Test Formula in most Statistics textbooks.What is the Definition of F-Test Statistic Formula?It is a known fact that Statistics is a branch of Mathematics that deals with the collection, classification and representation of Data. The tests that use F - distribution are represented by a single word in Statistics called the F Test. F Test is usually used as a generalized Statement for comparing two variances. F Test Statistic Formula is used in various other tests such as regression analysis, the chow test and Scheffe test. F Tests can be conducted by using several technological aids. However, the manual calculation is a little complex and time-consuming. This article gives an in-detail description of the F Test Formula and its usage.Definition of F-Test FormulaF Test is a test Statistic that has an F distribution under the null hypothesis. It is used in comparing the Statistical model with respect to the available Data set. The name for the test is given in honour of Sir. Ronald A Fisher by George W Snedecor. To perform an F Test using technology, the following aspects are to be taken care of.State the null hypothesis along with the alternative hypothesis.Compute the value of 'F' with the help of the standard Formula.Determine the value of the F Statistic. The ratio of the variance of the group of means to the mean of the within-group variances. As the last step, support or reject the Null hypothesis.F-Test Equation to Compare Two Variances:In Statistics, the F-test Formula is used to compare two variances, say σ1 and σ2, by dividing them. As the variances are always positive, the result will also always be positive. Hence, the F Test equation used to compare two variances is given as:F_value =\[\frac{variance1}{variance2}\]i.e. F_value = \[\frac{\sigma_{1}^{2}}{\sigma_{2}^{2}}\]F Test Formula helps us to compare the variances of two different sets of values. To use F distribution under the null hypothesis, it is important to determine the mean of the two given observations at first and then calculate the variance. \[\sigma ^{2}=\frac{\sum (x-\bar{x})^{2}}{n-1}\]In the above formula, σ2 is the variancex is the values given in a set of datax is the mean of the given Data set n is the total number of values in the Data setWhile running an F Test, it is very important to note that the population variances are equal. In more simple words, it is always assumed that the variances are equal to unity or 1. Therefore, the variances are always equal in the case of the null hypothesis.F Test Statistic Formula AssumptionsF Test equation involves several assumptions. In order to use the F - test Formula, the population should be distributed normally. The samples considered for the test should be independent events. In addition to these, it is also important to consider the following points.Calculation of right-tailed tests is easier. To force the test into a right-tailed test, the larger variance is pushed in the numerator.In the case of two-tailed tests, alpha is divided by two prior to the determination of critical value. Variances are the squares of the standard deviations.If the obtained degree of freedom is not listed in the F table, it is always better to use a larger critical value to decrease the probability of type 1 errors. F-Value Definition: Example ProblemsExample 1: Perform an F Test for the following samples.Sample 1 with variance equal to 109.63 and sample size equal to 41.Sample 2 with variance equal to 65.99 and sample size equal to 21.Solution: Step 1:The hypothesis Statements are written as:H_0: No difference in variances H_a: Difference invariances Step 2: Calculate the value of F critical. In this case, the highest variance is taken as the numerator and the lowest variance in the denominator.F_value = \[\frac{\sigma_{1}^{2}}{\sigma_{2}^{2}}\]F_value = \[\frac{109.63}{65.99}\]F_value = 1.66Step 3:The next step is the calculation of degrees of freedom.The degrees of freedom is calculated as Sample size - 1The degree of freedom for sample 1 is 41 -1 = 40.The degree of freedom for sample 2 is 21 - 1 = 20.Step 4:There is no alpha level described in the question, and hence a standard alpha level of 0.05 is chosen. During the test, the alpha level should be reduced to half the initial value, and hence it becomes 0.025.Step 5:Using the F table, the critical F value is determined with alpha at 0.025. The critical value for (40, 20) at alpha equal to 0.025 is 2.287.Step 6:It is now the time for comparing the calculated value with the standard value in the table. Generally, the null hypothesis is rejected if the calculated value is greater than the table value. In this F value definition example, the calculated value is 1.66, and the table value is 2.287. It is clear from the values that 1.66 < 2.287. Hence, the null hypothesis cannot be rejected.Fun Facts About F-Value Definition:In the case of Statistical calculations where the null hypothesis can be rejected, the F value can be less than 1; however, not exactly equal to zero.The F critical value cannot be exactly equal to zero. If the F value is exactly zero, it indicates that the mean of every sample is exactly the same, and the variance is zero. One of the key points to remember while working with the F Statistic is that the population variances are always considered to be equal. If this condition is not met, the obtained F value might not be correct.The degrees of freedom is taken as the number of samples minus one. In the case of a two-sample problem, there are two samples, and hence it becomes 2 - 1 = 1.When the alpha level is not mentioned in the F Test, the standard value used in most of the cases is equal to 0.05.ConclusionIn case of a problem with two sample Data sets, the F value can be obtained by dividing the larger variance by the smaller one. In order to perform a test at a pre-specified alpha level, it is always better to use standard values from the F table rather than using calculated values. The F value definition example has demonstrated how to calculate the F Statistic along with the relevant steps and interpretation of results. Students can use the F Statistic Formula to understand how it is used for t-test calculations. t-value definition examples are also available on this website. You can download the F table pdf to perform your own calculations. F test is a statistical test that is used in hypothesis testing that determines whether the variances of two samples are equal or not. The article will provide detailed information on f test, f statistic, its calculation, critical value and how to use it to test hypotheses. To understand F test firstly we need to have some basic understanding of F-distribution.F-distributionThe F-distribution is a continuous statistical distribution used to test whether two samples have the same variance. The F-Distribution has two parameters the numerator degrees of freedom (df1) and the denominator degrees of freedom (df2). Formula for F-distribution:\text{f-value} =\frac{sample 1/df 1}{sample 2/df 2} The independent random variables Samples 1 and 2, have a chi-square distribution.The related samples' degrees of freedom are denoted by df1 and df2.Understanding F-TestIn F test the data follows an F distribution. This test uses the F statistic to compare two variances by dividing them. An F test can either be one-tailed or two-tailed depending upon the parameters of the problem. The F value obtained after conducting an F test is used to perform the one-way ANOVA (analysis of variance) test. We can use this test when:The population is normally distributed.The samples are taken at random and are independent samples.Hypothesis Testing Framework for F-test For various hypothesis tests the F test formula is provided as follows:1. Left Tailed Test:Null Hypothesis: H0 : \sigma_{1}^2 = \sigma_{2}^2Alternate Hypothesis: H1 : \sigma_{1}^2 < \sigma_{2}^2Decision-Making Standard: The null hypothesis is to be rejected if the F statistic is less than the F critical value.2. Right Tailed Test:Null Hypothesis: H0 : \sigma_{1}^2 = \sigma_{2}^2Alternate Hypothesis: H1 : \sigma_{1}^2 > \sigma_{2}^2Decision-Making Standard: Dismiss the null hypothesis if the F test statistic is greater than the F test critical value.3. Two Tailed Test: Null Hypothesis: H0 : \sigma_{1}^2 = \sigma_{2}^2Alternate Hypothesis: H1 : \sigma_{1}^2 eq \sigma_{2}^2Decision-Making Standard: When the F test statistic surpasses the F test critical value the null hypothesis is declared invalid.F Test Statistics The F test statistic or simply the F statistic is a value that is compared with the critical value to check if the null hypothesis should be rejected or not. The F test statistic formula is given below:F statistic for large samples: F_{calc}=\frac{\sigma_{1}^{2}}{\sigma_{2}^{2}} where \sigma_{1}^{2} is the variance of the first population and \sigma_{2}^{2} is the variance of the second population.F statistic for small samples: F_{calc}=\frac{s_{1}^{2}}{s_{2}^{2}} where s_{1}^{2} is the variance of the first sample and s_{2}^{2} is the variance of the second sample.Steps to calculate F-TestStep 1: Use Standard deviation (σ1) and find variance (σ2) of the data. (if not already given)Step 2: Determine the null and alternate hypothesis. H0: no difference in variances. H1: difference in variances.Step 3: Find Fcalc using Equation 1 (F-value). NOTE : While calculating Fcalc, divide the larger variance with small variance as it makes calculations easier. Step 4: Find the degrees of freedom of the two samples.Step 5: Find Ftable value using d1 and d2 obtained in Step-4 from the F-distribution table. Take learning rate, α = 0.05 (if not given) Looking up the F-distribution table: In the F-Distribution table as per the given value of α in the question. d1 (Across) = df of the sample with numerator variance. (larger)d2 (Below) = df of the sample with denominator variance. (smaller) Consider the F-Distribution table given below, while performing One-Tailed F-Test.GIVEN: α = 0.05d1 = 2d2 = 3d2 /d112 1161.4199.5218.5119.00310.139.55Then, Ftable = 9.55Step 6: Interpret the results using Fcalc and Ftable. Interpreting the results:If Fcalc < Ftable : Cannot reject null hypothesis. ∴ Variance of two populations are similar. If Fcalc > Ftable : Reject null hypothesis. ∴ Variance of two populations are not similar.Example Problem for calculating F-TestConsider the following example In this we conduct a two-tailed F-Test on the following samples: Sample 1Sample 2σ10.478.12n4121Step 1: The statement of the hypothesis is formatted as:H0: no difference in variances. H1: difference in variances. Step 2: Let's calculated the value of the variances in numerator and denominator as F-value= \frac{\sigma^2_{1}}{\sigma^2_{2}}σ12 = (10.47)2 = 109.63 σ22 = (8.12)2 = 65.99 Fcalc = (109.63 / 65.99) = 1.66Step 3: Now, let's calculate the degree of freedom: Degree of freedom = sample - 1 Here we have Sample 1 = n1 = 41 and Sample 2 = n2 = 21Degree of sample 1 = d1 = (n1 - 1) = (41 – 1) = 40Degree of sample 2 = d2 = (n2 — 1) = (21 – 1) = 20 Step 4: The usual alpha level of 0.05 is selected because the question does not specify an alpha level. The alpha level should be lowered during the test to half of its starting value. Using d1 = 40 and d2 = 20 in the F-Distribution table. (link here) and Take α = 0.05 as it's not given. Since it is a two-tailed F-test then: α = 0.05/2 = 0.025 Step 5: The critical F value is found with alpha at 0.025 using the F table. For (40, 20), the critical value at alpha equal to 0.025 is 2.287. Therefore, Ftable = 2.287Step 6: Since Fcalc < Ftable (1.66 < 2.287): We cannot reject null hypothesis. ∴ Variance of two populations is similar to each other. F-Test is the most often used when comparing statistical models that have been fitted to a data set to identify the model that best fits the population.