Mgm600-0803b-02 applied managerial decision-making - phase 3 individual project

Profession, Manager

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MGM600-0803B-02 Applied Managerial Decision-Making - Phase 3 Individual Project The chi-square test is conducted to examine whether the standard deviation of a population or sample is equal to the predetermined value of standard deviation. The test can be performed from two perspectives: either as one sided test or two sided test. The two sided test is performed against the alternative hypothesis that the actual standard deviation is greater than or less than the specified value. The one sided test concentrate only on one aspect. The chi-square test can either be one sided or two sided depending on the situation. For instance, while testing new software, we may require an understanding whether the variance of information is greater than the variability of the existing procedure. Thus the chi-square test hypothesis may be described as follows:

Null Hypothesis is represented as H0 where σ = σ0

Alternative Hypothesis is represented as Ha where

Ha: σ less than σ0 (a low one tail test result)

σ greater than σ0 (an upper one tail test result)

σ is not equal to σ0 (a two tailed test result)

The test statistics is calculated by the formula T = (n-1) (s/ σ0)2. The main element of this formula is the ratio s/ σ0 which compares the ratio of the sample standard deviation to the target standard deviation and n is the sample size and s is the sample standard deviation. The more this ratio deviates from 1, the probability of rejecting the null hypothesis increases.

Significance level:

The null hypothesis is rejected when the standard deviation is a specific value σ0 if

T is greater than X2 (a, n-1) for upper one tailed alternative

T is lesser than X2(1-a, n-1) for a lower one tailed alternative

T is lesser than X2 (1-a/2, n-1) for a two tailed test or if

T is greater than X2 (a/2, n-1)

Here X2 (., n-1) is the critical value of the chi-square distribution where n-1 represents the degree of freedom. X2a is considered as the upper critical value and X2 1-a is considered as the lower critical value in the chi-square distribution.

The chi-square test is performed to obtain answer questions like, whether the standard deviation is less than the predetermine value of standard deviation, whether the standard deviation is greater than the predetermine value and whether the standard deviation is equal to the predetermined value (Engineering Statistics Handbook. 1. 3. 5. 8. Chi-Square Test for the Standard Deviation).

The F-test is conducted to check whether the standard deviation of two set of population or sample is equal. Like chi-square test this can either be a two-tailed test or a one-tailed test. The two-tailed version tests against the alternative that the standard deviations is not equal and the one-tailed version tests in one direction, that is the standard deviation from the first population is either greater than or less than the second population’s standard deviation . The option of the test is confirmed by the problem. This is applied in a case while testing a new process and when a firm wish to know if the new method is less variable than the old one. F hypothesis test is represented as follows:

Null Hypothesis is represented as H0: σ = σ0

Alternative Hypothesis is represented as Ha where

Ha: σ less than σ0 (a low one tail test result)

σ greater than σ0 (an upper one tail test result)

σ is not equal to σ0 (a two tailed test result)

Test Statistics, F+ S21 / S22

S21 , S22 are the sample variance. This ratio is compared to the old standard deviation and the amount of deviation represents the unequal variance of the population.

Significance Level

The null hypothesis is rejected if

F is greater than F (a, n1-1, n2-1) for upper on tailed test

F is lesser than F (1-a, n1-1, n2-1) for lower one tailed test

F is lesser than F (1-a/2, n1-2, n2-1) for two tailed test or

F is greater than F (a/2, n1-1, n2-1).

In this F distribution F (a, k-1, n-k) is the critical value. Fa is the upper critical value and Fa-1 is the lower critical value (F-Test for Equality of Two Standard Deviations).

Chi-square distribution can be found out using a statistical experiment where a random sample of size n is taken from a normal population having a standard deviation of σ. It may be assumed that the standard deviation is equal to s. Chi-square can now be calculated with the equation T = [(n - 1) * s2] / σ2. The experiment can be repeated infinite number of times to arrive at a sampling distribution for a chi-square statistics. Chi-square distribution may be defined by the probability density function Y = Y0 * (X2) (v/2 - 1) * e-X2 / 2 . The chi-square distribution has several properties that indicate that the mean of the distribution is equal to the number of degrees of freedom: μ = v. The variance is equal to two times the number of degrees of freedom: σ2 = 2 * v. When the degree of freedom is high, the chi-square curve approaches a normal distribution.

Cumulative Probability and the Chi-Square Distribution

The chi-square distribution is designed in a particular manner that the total is equal to 1. The cumulative probability of a chi-square statistics can be evaluation from the following examples.

For example, the Oyster Battery Corporation has manufactured a cell phone battery. The average charge of the battery is sixty minutes for a single recharge. The standard deviation is calculated at four minutes. A quality control test by the company tested seven randomly selected batteries. The standard deviation of the randomly selected battery is six minutes. The chi-square test for these batteries may be evolved as follows;

Standard deviation of the battery is 4 minutes

Standard deviation of the selected sample is 6 minutes

The number of selected battery is 7

To compute the chi-square statistic, we plug these data in the chi-square equation, as shown below.

T = (n-1) (s/ σ0)2

T = [(7 - 1) * 62] / 42 = 13. 5

where T is the chi-square statistic, n is the sample size, s is the standard deviation of the sample, and σ is the standard deviation of the population.

The problem may be evaluated in a different manner. The battery company conducts a quality control test by selecting seven batteries. The test concludes that the standard deviation is 6 minutes and the chi-square statistics is 13. 5. Even if we follow this method the degrees of freedom equates to n-1 = 7-1 = 6.

The cumulative probability can be calculated by calculating the chi-square statistics and degrees of freedom in the chi-square distribution calculation which gives the result as 0. 96. The result shows that the probability of standard deviation being less than or equal to 6 minutes is 0. 96 times. The result also reveals that the probability that the standard deviation would be greater than 6 minutes is 1 – 0. 96 or 0. 04 times (Stat Trek. Statistics Tutorial: Chi-Square Distribution).

In conclusion chi-square distribution is used to compare the analyzed frequencies to expected frequencies. The selection of menu can be used to measure the probability of chi-square statistics or to find out the critical value of chi-square for a particular probability. The Vice President (Sales) of Widgecorp may be briefed about the qualitative analysis of variance using non-parametric like the chi-square test. The null hypothesis and alternative hypothesis may be calculated according to the formula to arrive at the variance of using the software by the marketing personnel to analyse present performance with expected performance and thereby improve their marketing strategies.

Reference

Engineering Statistics Handbook. 1. 3. 5. 8. Chi-Square Test for the Standard Deviation.

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