

# Learning Guide: Conducting Levene's Test for Equality of Variances in SPSS

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The rigorous application of many advanced [statistical tests](#) relies fundamentally on certain underlying assumptions about the data distribution. One of the most critical assumptions for procedures such as [ANOVA](#) (Analysis of Variance) and t-tests is the assumption of homogeneity of variances, or [homoscedasticity](#). This concept dictates that the variability within each group being compared must be roughly equal. If this assumption is violated, the resulting p-values and confidence intervals derived from these tests may be inaccurate, potentially leading to erroneous conclusions. To formally test this crucial assumption, researchers frequently turn to the **Levene's Test**, a robust statistical procedure designed specifically to assess whether two or more groups exhibit [equal variances](#).

This comprehensive guide provides an expert walkthrough on executing and interpreting **Levene's Test** within the **Statistical Package for the Social Sciences (SPSS)**. We will break down the theoretical necessity of this test, guide you through the necessary data setup, and offer a detailed, step-by-step tutorial on generating and understanding the output tables provided by [SPSS Statistics](#). Understanding how to correctly apply and interpret [Levene's Test](#) is an essential skill for any researcher conducting comparative statistical analysis, ensuring the validity and trustworthiness of their findings.

## Understanding Levene's Test: The Foundation of Homoscedasticity

The core purpose of the [Levene's Test](#) is to determine if the variances of a dependent variable are equal across different categories defined by a factor variable. In simpler terms, it checks if the spread of scores is the same in all groups being compared. The test operates by running an [ANOVA](#) on the absolute differences between each score and the mean (or median) of its group. This approach makes it less sensitive to departures from normality compared to older tests like Bartlett's Test, making Levene's Test the preferred method for variance homogeneity assessment in most practical research scenarios, particularly when data distribution is questionable.

When we assume [equal variances](#), we are essentially pooling the variances across groups to calculate the standard error for comparison tests. If the variances are unequal (a condition known as heteroscedasticity), this pooling process becomes inappropriate, leading to distorted test statistics and potentially invalid inferences. If the test reveals a significant difference in variances, the researcher must employ more conservative statistical methods that do not rely on the assumption of homogeneity, such as adjusted degrees of freedom or non-parametric alternatives, to proceed with the primary hypothesis testing.

The test formulates its hypothesis structure around the concept of equality. The **Null Hypothesis** ([H?](#)) for Levene's Test states that the population variances are equal across all groups. Conversely, the **Alternative Hypothesis** ([H?](#)) posits that at least one group variance is significantly different from the others. The interpretation hinges entirely on the resulting **p-value**,

which indicates the probability of observing the data if the null hypothesis were true.

## Prerequisites and Data Setup in SPSS

Before running [Levene's Test](#) in [SPSS](#), the data must be correctly structured. You need two main types of variables: a quantitative **Dependent Variable** (the measure of interest, typically measured on an interval or ratio scale) and a categorical **Factor Variable** (the grouping variable). The Factor Variable defines the groups whose variances you wish to compare. For instance, in an experimental design, the dependent variable might be 'height' (ratio scale), and the factor variable might be 'treatment group' (nominal scale).

It is crucial that the grouping variable is correctly defined in the Variable View of [SPSS](#), typically as a Nominal or Ordinal measure type, while the dependent variable should be defined as Scale. Errors in defining these measurement scales, although sometimes ignored by SPSS for basic calculations, can lead to confusion and misinterpretation of results, especially when dealing with advanced procedures. Ensuring the data is clean, with no missing values that could skew variance calculations, is also a mandatory prerequisite for robust statistical analysis.

## Example Scenario: Investigating Fertilizer Impact

To illustrate the application of Levene's Test, we will use a common experimental scenario. Imagine a team of agricultural researchers who are interested in determining whether three distinct types of fertilizers (labeled 1, 2, and 3) result in different levels of plant growth. However, before comparing the average growth, they must ensure that the inherent variability in growth across the three fertilizer groups is consistent. A significant difference in variance would suggest that one fertilizer type is far more unpredictable in its effect than the others.

The researchers designed a simple, controlled [example](#) experiment. They randomly selected 30 plants and distributed them equally into three groups, resulting in 10 plants per fertilizer type. Over the course of one month, each group received its assigned fertilizer. At the conclusion of the treatment period, the height of each plant (in inches) was meticulously measured. The resulting dataset in [SPSS](#) contains two columns: one for the measured growth (the dependent variable) and one for the fertilizer type (the factor variable, coded as 1, 2, or 3).

The following visual representation shows how the data should be organized in the Data View of [SPSS](#). Notice the paired structure, where each row represents a single plant observation, linking its measured growth to the specific fertilizer treatment it received. This structure is essential for [Levene's Test](#), which analyzes variance based on these groupings.

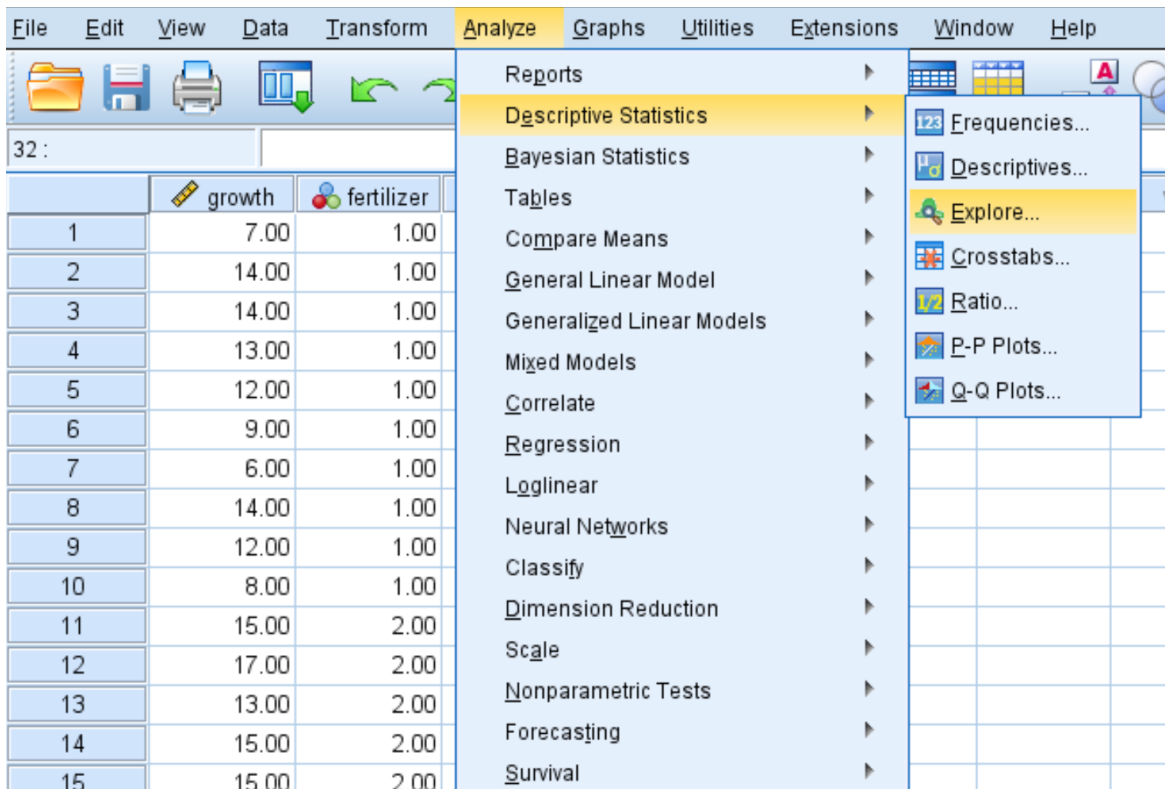
	growth	fertilizer	var	var	
1	7.00	1.00			
2	14.00	1.00			
3	14.00	1.00			
4	13.00	1.00			
5	12.00	1.00			
6	9.00	1.00			
7	6.00	1.00			
8	14.00	1.00			
9	12.00	1.00			
10	8.00	1.00			
11	15.00	2.00			
12	17.00	2.00			
13	13.00	2.00			
14	15.00	2.00			
15	15.00	2.00			
16	13.00	2.00			
17	9.00	2.00			
18	12.00	2.00			
19	10.00	2.00			
20	8.00	2.00			
21	6.00	3.00			
22	8.00	3.00			
23	8.00	3.00			
24	9.00	3.00			
25	5.00	3.00			
26	14.00	3.00			
27	13.00	3.00			
28	8.00	3.00			
29	10.00	3.00			
30	9.00	3.00			
31					

## Step-by-Step Procedure for Running Levene's Test in SPSS

Executing [Levene's Test](#) in [SPSS](#) is straightforward and is typically performed using the **Explore** function, which is nested under the descriptive statistics menu. This function is preferred because it not only calculates the variance test but also provides a wealth of descriptive statistics and graphical tools useful for preliminary data screening. We will use the following detailed steps to determine whether or not the three fertilizer groups exhibit [equal variances](#).

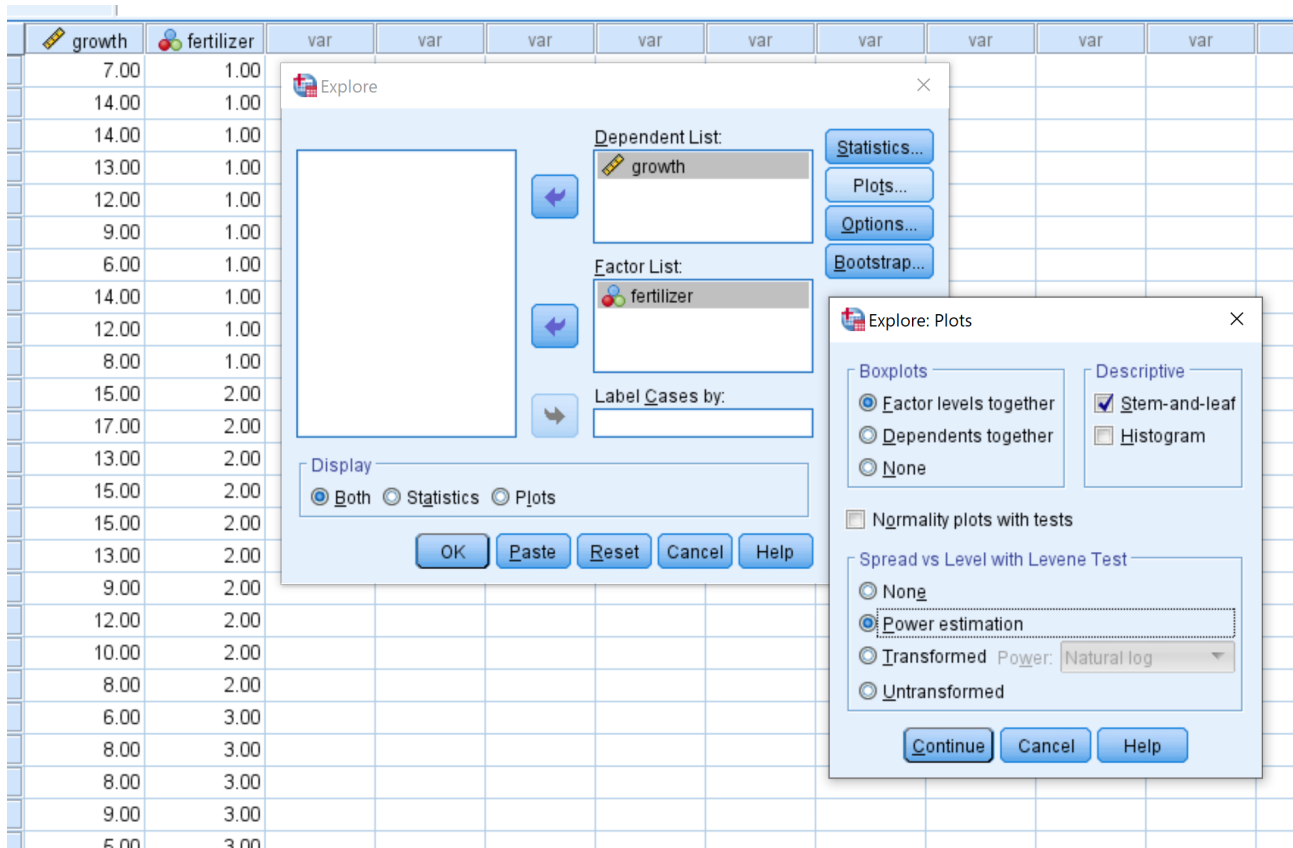
The procedure begins by navigating the main menu structure within [SPSS](#).

**Step 1: Choose the Explore option.** Access the analysis menu by clicking the **Analyze** tab, then selecting **Descriptive Statistics**, and finally choosing **Explore**. This action opens the Explore dialog box, which is the gateway for running the variance homogeneity check.



**Step 2: Fill in the necessary values and configure the plots.** Within the Explore dialog box, you must correctly assign the variables to their respective roles. Drag the quantitative variable, **growth**, into the box labeled **Dependent List**. Next, drag the categorical variable, **fertilizer**, into the box labeled **Factor List**. This tells [SPSS](#) to analyze the variance of growth, categorized by the three levels of fertilizer.

After assigning the variables, click the **Plots** button located on the right side of the dialog box. In the Plots submenu, ensure that under the section titled "Spread vs. Level with Levene Test," the option **Power estimation** is selected. While other options exist (like 'None' or 'Untransformed'), selecting **Power estimation** explicitly requests the [Levene's Test](#) output. Once confirmed, click **Continue** to close the Plots dialog, and then click **OK** in the main Explore dialog box to execute the analysis.



### Interpreting the Results and Making Decisions

Once the procedure is run, [SPSS](#) generates several output tables, but the most critical for this test is the "Test of Homogeneity of Variance" table. This table summarizes the calculations required to assess the null hypothesis of [equal variances](#). It is essential to understand that [Levene's Test](#) can be calculated based on four different measures of central tendency: the mean, the median, the median with adjusted degrees of freedom (df), and the trimmed mean. The most common and robust version, which researchers usually default to, is Levene's Test based on the **Mean**.

**Test of Homogeneity of Variance**

		Levene Statistic	df1	df2	Sig.
growth	Based on Mean	.536	2	27	.591
	Based on Median	.180	2	27	.836
	Based on Median and with adjusted df	.180	2	26.516	.836
	Based on trimmed mean	.496	2	27	.615

Focusing on the first row of the output table, which corresponds to the test based on the mean, we find two key values: the **F-statistic** (or test statistic) and the corresponding **Sig.** value, which is the [p-value](#). In our example, the test statistic is **.536** and the resulting [p-value](#) is **.591**. The decision to reject or fail to reject the [null hypothesis](#) hinges on comparing this [p-value](#) to a predefined significance level, typically alpha ( $\alpha$ ) = .05.

Since the calculated [p-value](#) (.591) is significantly greater than the standard alpha level of .05, we **fail to reject the null hypothesis**. This crucial statistical finding means that we do not possess sufficient statistical evidence to claim that the variance in plant growth is significantly different between the three fertilizer groups. In substantive terms, the variability (or spread) of the data is statistically similar across all groups, confirming the assumption of [equal variances](#). Consequently, the researchers are now justified in proceeding with parametric tests, such as a one-way [ANOVA](#), to compare the means of the groups, knowing that the variance assumption for that test has been successfully met.

## Implications of Violating the Assumption

While our example successfully met the assumption, it is vital for researchers to know the consequences of a significant [Levene's Test](#) result (i.e., a p-value less than .05). A significant result indicates that the assumption of equal variances has been violated (heteroscedasticity is present). This violation severely compromises the validity of standard parametric [statistical tests](#) like the standard independent samples t-test or classical [ANOVA](#), which assume homoscedasticity.

When heteroscedasticity is detected, the researcher must implement corrective measures. For t-tests, the robust alternative is often the use of the **Welch's t-test**, which adjusts the degrees of freedom based on the unequal variances. For [ANOVA](#), similar adjustments are available, such as **Welch's F test** or the **Brown-Forsythe F test**, both of which are designed to be more robust under conditions of unequal variance. [SPSS](#) typically provides these adjusted statistics alongside the standard output when requested, ensuring that statistical integrity is maintained even when ideal assumptions are not met.

In conclusion, conducting [Levene's Test](#) is a necessary due diligence step in comparative analysis. It serves as a gatekeeper, ensuring that the foundational assumption of [equal variances](#) is met before interpreting the results of more complex inferential procedures. Correctly implementing this test in [SPSS](#) and interpreting its **p-value** is crucial for drawing accurate and defensible conclusions from research data.

**Note:** The p-value of .591 corresponds to an F statistic of .536 with numerator  $df = 2$  and denominator  $df = 27$ , calculated using the F-distribution.