

How to Perform Levene's Test in SPSS

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December 26, 2025

RECOMMENDED CITATION

stats writer (2025). *How to Perform Levene's Test in SPSS*. PSYCHOLOGICAL SCALES.
Retrieved from <https://scales.arabpsychology.com/?p=108926>

The Levene's Test, when utilized in statistical software like SPSS, serves as a fundamental procedure for evaluating the assumption of homogeneity of variance. This crucial statistical test is designed to determine if the variances across two or more independent groups are approximately equal. Satisfying the assumption of equal variances (or homoscedasticity) is a prerequisite for many parametric statistical tests, such as Analysis of Variance (ANOVA). Failure to meet this assumption can significantly impact the reliability of subsequent inferential statistical results, often leading to increased Type I or Type II errors.

Performing the test in SPSS requires a methodical approach: data must first be correctly entered and grouped. Subsequently, users navigate through the program's analysis menus, specifically accessing the Explore procedure within Descriptive Statistics, where the option for Levene's Test resides under the Assumptions section. This article provides an exhaustive, step-by-step tutorial on executing Levene's Test accurately within SPSS and interpreting the resulting statistical output to confidently assess variance equality.

Understanding the Role of Levene's Test

The primary purpose of the Levene's Test is to formally test the null hypothesis that the population variances are equal across all comparison groups. When conducting research, particularly experiments involving multiple treatment groups, researchers must ensure that differences in outcomes are due to the treatments themselves, not inherent disparities in data spread. For instance, if groups exhibit highly unequal variance, standard tests like ANOVA become less robust and may produce misleading conclusions.

Many robust statistical methods, including independent samples t-tests and one-way ANOVA, assume that the variance of the dependent variable is the same across the different levels of the independent variable. This specific requirement is known as the assumption of homoscedasticity. By performing Levene's Test, researchers can verify if this assumption holds true for their specific dataset. If the test suggests a violation of homoscedasticity, alternative statistical methods--such as Welch's ANOVA or transformation of the data--must be considered to maintain statistical integrity.

In essence, Levene's Test acts as a diagnostic tool, providing quantitative evidence regarding the distribution characteristics of the data before proceeding to the primary analysis. It provides the foundation necessary for selecting the appropriate inferential statistical test, thereby enhancing the trustworthiness and validity of the research findings.

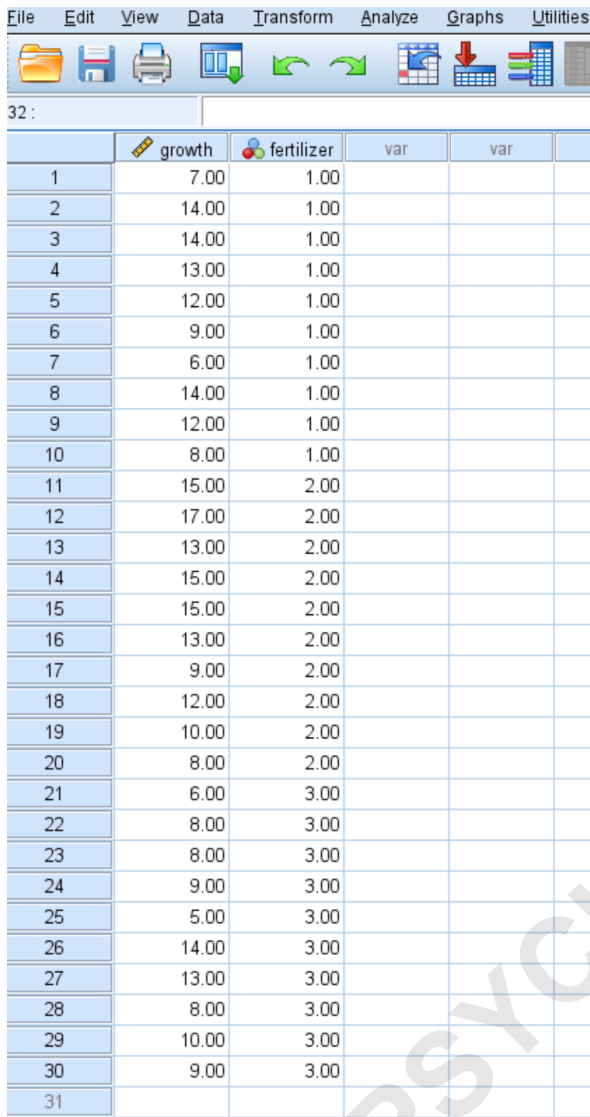
Illustrative Example: Comparing Fertilizer Efficacy

To demonstrate the practical application of Levene's Test in SPSS, consider a common scenario in agricultural research. A team of researchers seeks to determine if three distinct types of fertilizer

(Fertilizer 1, Fertilizer 2, and Fertilizer 3) result in varying levels of plant growth. Crucially, before comparing the average growth produced by the fertilizers, they must check if the variability (variance) in plant growth is consistent across the three treatment groups.

The experimental setup involved randomly selecting 30 plants, which were then divided into three equal groups of 10 plants each. Each group received one of the specified fertilizers. After a predetermined period of one month, the researchers meticulously measured the final height (growth in inches) of every individual plant. This dataset contains two primary variables: the dependent variable, **Growth** (the measured height), and the independent grouping variable, **Fertilizer** (coded as 1, 2, or 3).

The data must be structured in SPSS such that one column contains the measured growth values, and a second column contains the corresponding fertilizer code (the grouping factor). The following figure illustrates how this data is typically structured in the SPSS Data View, showing the recorded growth measurements alongside the assigned fertilizer category for each plant observation:



	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				

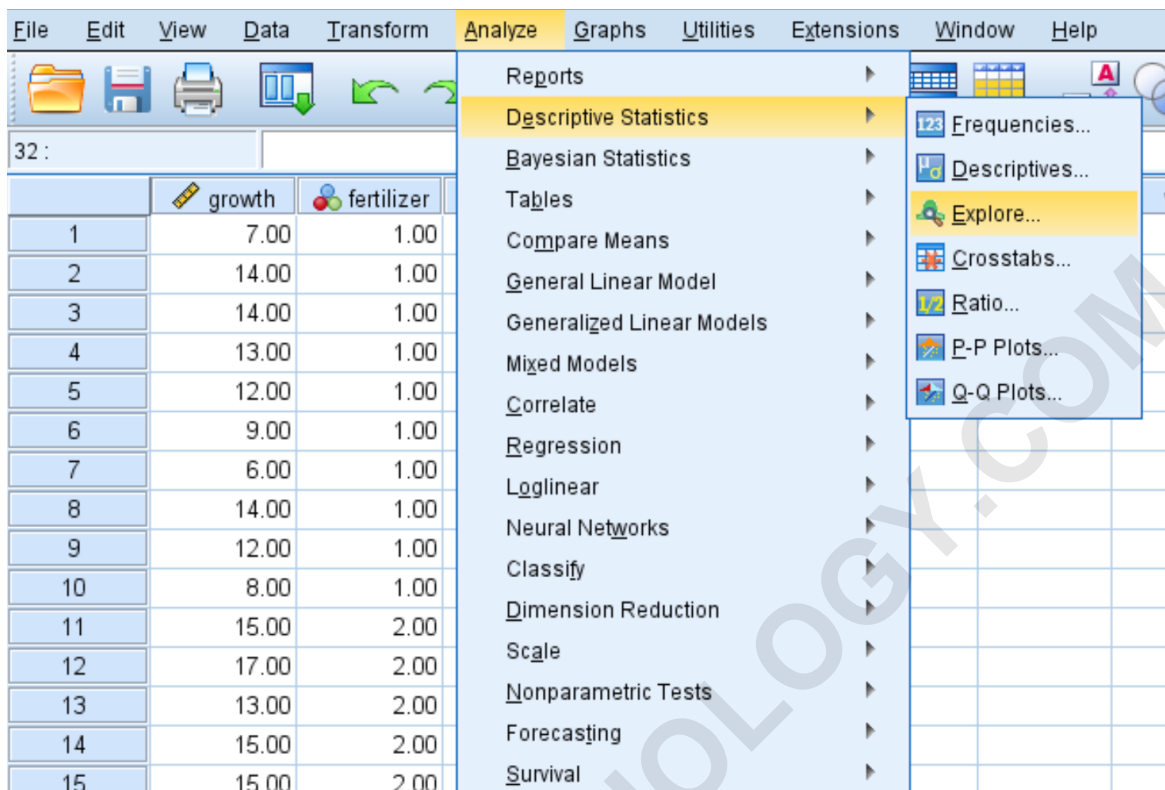
The subsequent steps outline the exact procedure for running Levene's Test using this dataset to determine whether the variances in plant growth are equal across the three fertilizer groups.

Step 1: Accessing the Explore Function in SPSS

The Levene's Test is integrated into the **Explore** function within SPSS, which is primarily used for descriptive statistics and preliminary data assessment. To initiate the test, users must navigate the main menu bar by selecting the following sequence of commands: **Analyze**, then hover over **Descriptive Statistics**, and finally click on **Explore**. This action opens the Explore dialog box, which is the gateway for setting up the necessary variables and options for Levene's Test.

This menu sequence is designed to streamline the process of initial data screening, allowing researchers to quickly assess normality, identify outliers, and test fundamental assumptions like the homogeneity of variance before engaging in more complex inferential testing.

The following screenshot visually confirms the menu path required to access the Explore function:



Step 2: Defining Dependent and Factor Variables

Once the Explore dialog box is open, the researcher must accurately define the roles of the variables in the analysis. The variable whose variance is being compared (in this case, plant height) must be assigned to the **Dependent List**, while the grouping variable (the fertilizer type) must be assigned to the **Factor List**. This setup tells SPSS to compare the variance of the dependent variable across the categories defined by the factor variable.

Specifically, drag the **growth** variable into the box labeled **Dependent List**. Then, drag the categorical variable **fertilize** into the box labeled **Factor List**. After correctly placing the variables, the next critical step is to configure the plot options to ensure the output includes the Levene's Test results. Click on the **Plots** button within the Explore dialog box. In the Plots sub-dialog, ensure that the option for **Power estimation** is selected; this selection guarantees that the required assumption tests, including Levene's Test, are calculated and presented in the output. Once confirmed, click **Continue** to exit the Plots dialog, and finally click **OK** in the main Explore dialog box to execute the analysis and generate the results.

The screenshot shows the SPSS Explore dialog box and its Plots sub-dialog box. The main dialog has 'growth' in the Dependent List and 'fertilizer' in the Factor List. The Plots sub-dialog has 'Factor levels together' selected for Boxplots, 'Stem-and-leaf' checked for Descriptive plots, and 'Power estimation' selected for Spread vs Level with Levene Test. The 'Power' dropdown is set to 'Natural log'.

Step 3: Interpreting the Levene's Test Output

Upon clicking OK, SPSS generates an output file containing several tables. The section of interest for assessing variance homogeneity is typically labeled "Test of Homogeneity of Variance." This table displays the results for four different variations of Levene's Test, based on different measures of central tendency (mean, median, and adjusted median). For most standard applications, researchers focus on the results derived from the mean, which is typically presented in the first row of the table.

The output provides key statistical values necessary for decision-making, including the Levene Statistic (the test statistic) and the corresponding significance value (or p-value). The structure of this critical output table is displayed below:

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

Examining the first row, which reports the test results based on the mean, we find the Levene Test statistic is **0.536**, and the corresponding significance level (p-value) is **0.591**. These two values are essential for the final statistical decision.

Step 4: Making a Decision Based on the P-Value

The interpretation of Levene's Test hinges entirely on comparing the calculated p-value against a predetermined significance level (alpha, usually set at 0.05). The underlying logic operates as follows:

The Null hypothesis (H_0): The variances across the groups are equal (homogeneity of variance is met).

The Alternative hypothesis (H_a): At least one group variance is significantly different from the others (homogeneity of variance is violated).

If the p-value is less than the chosen alpha level (e.g., $p < 0.05$), the researcher would reject the null hypothesis, concluding that the variances are significantly unequal. Conversely, if the p-value is greater than or equal to 0.05, the researcher fails to reject the null hypothesis, concluding that there is insufficient evidence to claim a significant difference in variances.

In this specific example, the calculated p-value (0.591) is substantially larger than the conventional alpha level (0.05). Therefore, we **fail to reject the null hypothesis**. This result indicates that the data does not provide sufficient statistical evidence to suggest that the variance in plant growth differs significantly among the three fertilizer treatments. We conclude that the three groups possess equal variances.

Implications for Further Statistical Analysis

The finding that homogeneity of variance is met is highly significant for subsequent inferential

analyses. If the researchers intend to proceed with a parametric test designed to compare the means of the three groups--such as a One-Way ANOVA--they can confidently use the standard version of that test. This is because the core assumption regarding variance equality has been validated by the Levene's Test results.

Had the Levene's Test yielded a statistically significant result ($p < 0.05$), indicating unequal variances (heteroscedasticity), the researchers would have been obliged to utilize alternative analytical techniques. Such alternatives include running Welch's F-test instead of the standard ANOVA, or applying non-parametric tests which do not require the assumption of variance homogeneity. The Levene's Test thus ensures that the conclusions drawn from the main analysis remain statistically sound and reliable.

Note on Calculation: The reported p-value of 0.591 corresponds to the calculated F statistic of 0.536, with degrees of freedom calculated as numerator $df = 2$ and denominator $df = 27$. This p-value is a direct calculation derived from the F-distribution based on these degrees of freedom.