

# How to Perform Levene's Test for Equality of Variances in SPSS

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## RECOMMENDED CITATION

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## Understanding the Role of Levene's Test in Statistical Research

In the field of **quantitative research** and **data analysis**, ensuring that your dataset meets the underlying assumptions of a statistical model is paramount for obtaining valid results. One of the most critical assessments is the evaluation of **homogeneity of variance**, which determines if the spread of data points across different groups is relatively equal. To address this, **Levene's Test** serves as an inferential statistic used to assess the equality of variances for a variable calculated for two or more groups. Named after Howard Levene, this test is favored by researchers because it is less sensitive to departures from normality compared to other methods, such as Bartlett's test. This robustness makes it an essential tool for those working with real-world data that may not perfectly follow a **Gaussian distribution**.

The **SPSS** (Statistical Package for the Social Sciences) software suite provides a comprehensive environment for performing this analysis. By utilizing **SPSS**, analysts can quickly determine whether the groups within their study possess equal variances, which is a fundamental requirement for many parametric tests. If the variances are found to be significantly different--a condition known as **heteroscedasticity**--it can lead to increased **Type I error** rates, potentially causing a researcher to incorrectly reject a true **null hypothesis**. Therefore, performing **Levene's Test** is often the first diagnostic step before proceeding to more complex comparisons, such as a **t-test** or an **Analysis of Variance**.

When conducting **Levene's Test**, the software evaluates the **absolute deviation** of each observation from its group mean or median. This mathematical approach allows the test to maintain its power even when the data is skewed. In academic and professional settings, reporting the results of this test is standard practice to demonstrate the rigor of the **statistical methodology**. By following a structured workflow in **data analysis**, researchers can ensure that their findings are grounded in statistically sound assumptions, thereby enhancing the credibility of their conclusions and the overall impact of their research.

## The Critical Importance of the Homogeneity of Variance Assumption

The concept of **homogeneity of variance**, often referred to as **homoscedasticity**, is a pillar of parametric **statistics**. When we perform a **One-Way ANOVA**, we are essentially testing whether the means of several groups are equal. However, the mathematical foundations of **ANOVA** assume that the error **variance** is the same across all groups. If this assumption is violated, the **F-test** becomes unreliable, particularly when group sizes are unequal. **Levene's Test** provides a formal mechanism to verify this assumption, allowing the researcher to decide whether to proceed with standard parametric tests or to employ more robust alternatives like **Welch's ANOVA**.

In practice, **variance** represents the degree to which data points in a distribution are spread out

from the average. If one group in a study has a very high **standard deviation** while another has a very low one, the pooled variance used in standard calculations will be biased. This bias can distort the **p-value**, leading to misleading interpretations of the data. By using **Levene's Test**, we can confirm that the **statistical significance** of our primary analysis is not simply an artifact of unequal dispersions within our subgroups.

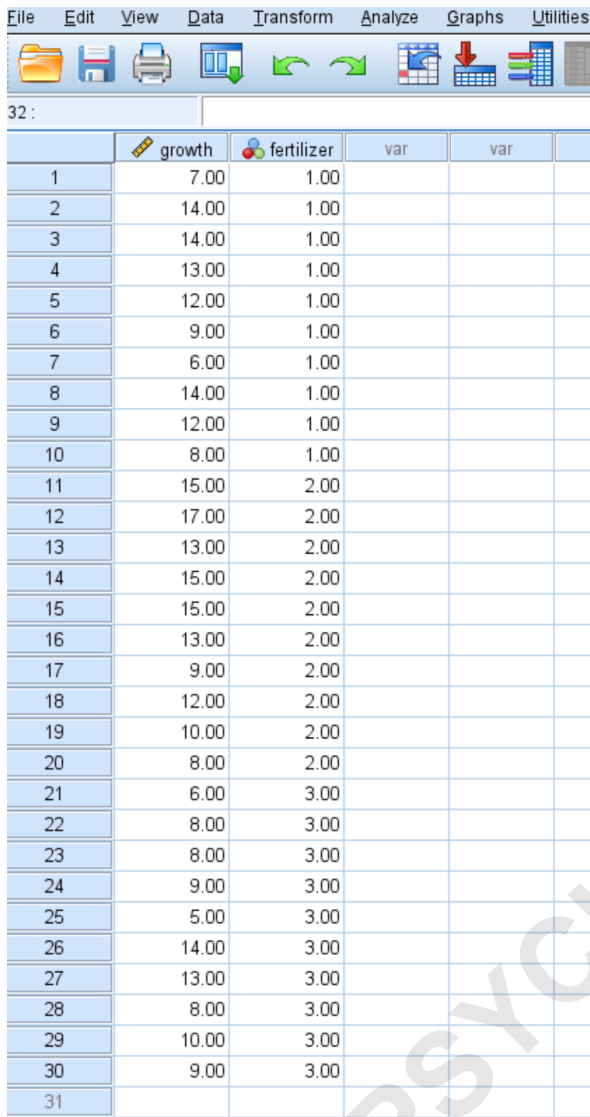
Furthermore, understanding the **null hypothesis** of **Levene's Test** is vital for any analyst. The **null hypothesis** states that the population variances are equal across all groups. Unlike many other tests where we hope to reject the null hypothesis to find a significant effect, in the context of **Levene's Test**, we often hope to fail to reject the null. Failing to reject the null suggests that the assumption of equal **variance** has been met, providing the "green light" to continue with standard comparative analyses. This nuanced understanding of **statistical assumptions** is what separates a thorough analyst from one who merely runs tests without considering data integrity.

## Experimental Design: Evaluating Fertilizer Impact on Plant Growth

To illustrate the practical application of **Levene's Test** in **SPSS**, let us consider a common agricultural research scenario. Suppose a team of researchers is investigating the efficacy of three distinct types of fertilizer on plant growth. Their objective is to determine if these fertilizers lead to different levels of development. To conduct a fair experiment, they randomly select 30 identical plants and divide them into three groups of 10. Each group is treated with a different fertilizer, and at the conclusion of a one-month period, the height of each plant is measured in inches. This setup is a classic example of a single-factor design requiring a **One-Way ANOVA**.

Before the researchers can compare the average growth heights, they must ensure that the **variance** in plant growth is consistent across the three fertilizer groups. If Fertilizer 1 causes highly erratic growth (some plants very tall, some very short) while Fertilizer 2 causes very consistent growth, the comparison of their means might be compromised. The researchers need to perform **Levene's Test** to confirm that the variation within each group is comparable. This ensures that the subsequent **ANOVA** results accurately reflect the impact of the fertilizer rather than differences in group volatility.

The dataset for this experiment is organized in **SPSS** with two primary variables: the dependent variable, which is the amount of growth (measured in inches), and the factor variable, which represents the type of fertilizer applied (coded as 1, 2, or 3). Proper data entry is essential for **SPSS** to recognize the groups correctly. The following screenshot illustrates how the data appears in the **Data View** tab, showing the growth values for each individual plant alongside its corresponding group assignment:



	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				

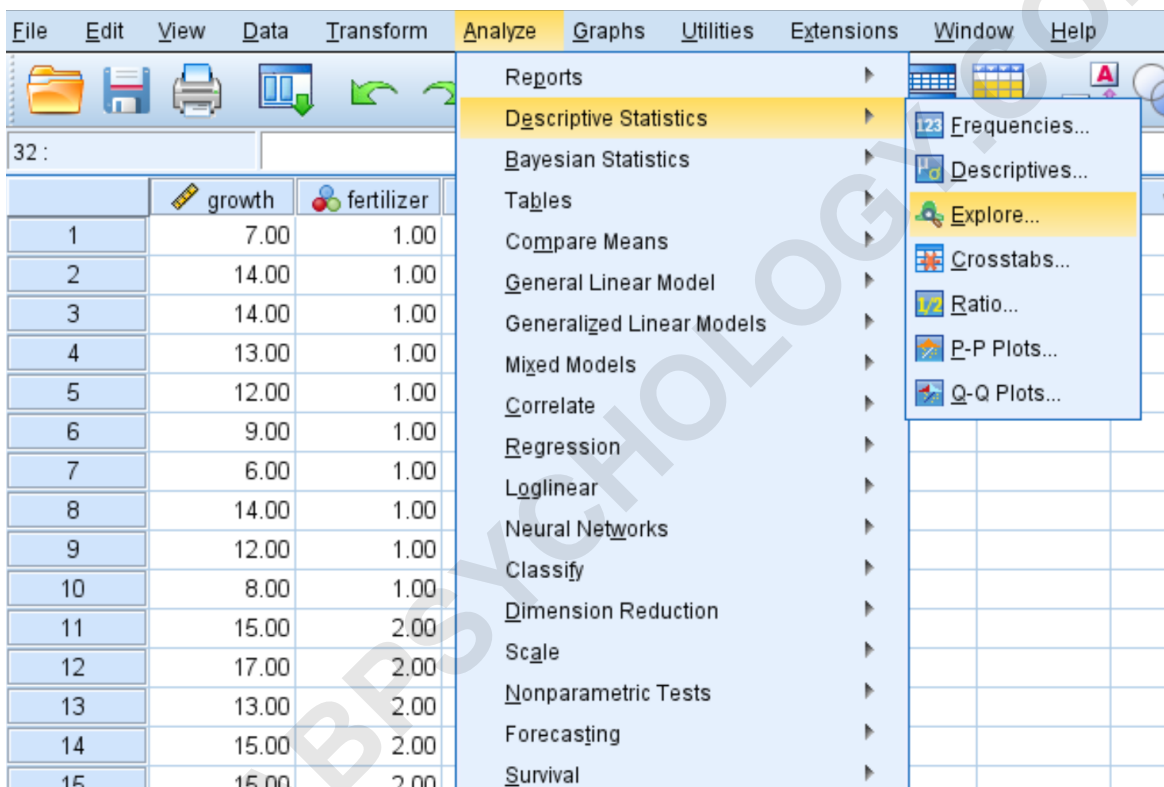
## Navigating the SPSS Interface for Exploratory Data Analysis

To begin the analysis and perform **Levene's Test**, you must first navigate the **SPSS** menu system. While there are multiple ways to generate this test, the **Explore** option within the **Descriptive Statistics** menu is one of the most effective methods because it provides a wealth of diagnostic information alongside the test of **homogeneity of variance**. This approach is highly recommended for researchers who want a deeper understanding of their data's distribution before committing to a specific **statistical test**.

First, ensure your dataset is correctly loaded into the **SPSS Statistics** environment. From the primary menu bar at the top of the screen, click on the **Analyze** tab. This menu contains nearly all the statistical procedures available in the software. From the resulting drop-down list, hover your cursor over **Descriptive Statistics** and then select **Explore** from the side menu. This will open a

new dialog box where you will specify the variables for your analysis. Using the **Explore** command is a best practice in **data analysis** as it allows for the simultaneous calculation of means, medians, **variance**, and normality tests.

The visual workflow for this step is straightforward. By following the **Analyze > Descriptive Statistics > Explore** path, you are accessing a powerful module designed for initial data screening. This step is crucial for identifying **outliers** or data entry errors that could potentially skew the results of **Levene's Test**. The following screenshot highlights the correct menu selections within the **SPSS** interface:



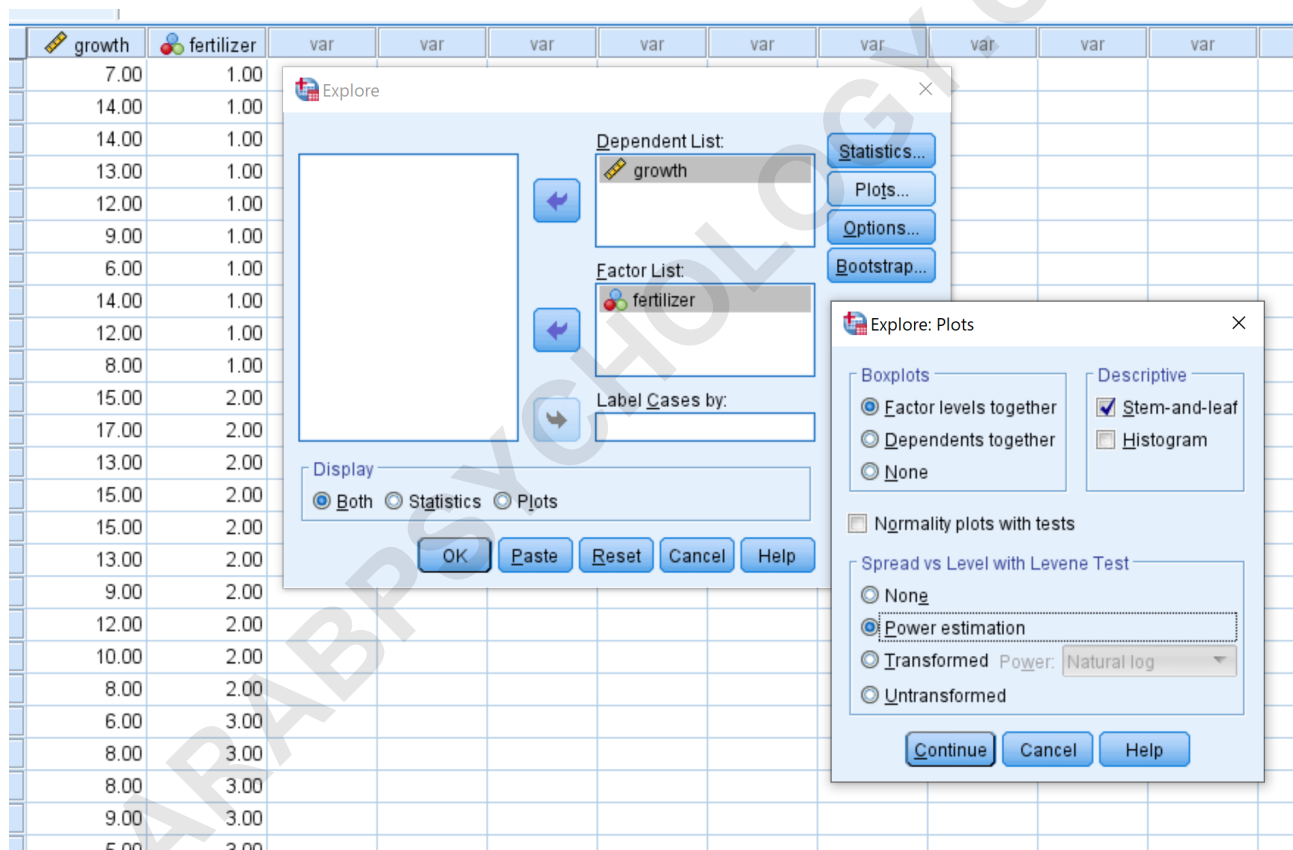
## Configuring Variables and Statistical Plots in the Explore Menu

Once the **Explore** dialog box is open, you must correctly assign your variables to their respective roles. In our fertilizer example, the **dependent variable** is the "growth" of the plants, as this is the outcome we are measuring. You should click on the **growth** variable and drag it into the box labeled **Dependent List**. Next, you must define the groups you wish to compare. Select the **fertilize** variable and drag it into the box labeled **Factor List**. This tells **SPSS** to perform the variance analysis based on the different categories defined by the fertilizer types.

After assigning the variables, you must specify that you want to run **Levene's Test**. On the right side of the **Explore** window, click the **Plots** button. This will open a sub-dialog box containing

various options for visual data representation. Look for the section titled **Spread vs. Level with Levene Test**. To obtain the standard results, ensure that you select the **Power estimation** option. This specific selection triggers **SPSS** to calculate the homogeneity of variance using the **absolute deviations** from the group means. Once you have made this selection, click **Continue** to return to the main dialog, and then click **OK** to execute the procedure.

This configuration is essential because it moves beyond basic descriptive **statistics** and into formal hypothesis testing. By selecting **Power estimation**, you are requesting a robust version of **Levene's Test** that is standard in academic reporting. The **SPSS** interface is designed to be intuitive, but accuracy in these steps is vital for generating the correct output table. The screenshot below provides a visual guide for configuring these specific settings in the **Explore** plots menu:



## Interpreting the Test of Homogeneity of Variances Output

After clicking **OK**, **SPSS** will process the data and generate an output viewer window. Among the various tables produced, the one titled **Test of Homogeneity of Variances** is the most important for our current objective. This table typically provides several versions of **Levene's Test**, including results based on the mean, the median, and the trimmed mean. For most standard research applications, the first row--**Based on Mean**--is the primary focus. This row presents the **F-statistic**,

the degrees of freedom (df), and the **p-value** (labeled as "Sig." in **SPSS**).

### 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

By examining the provided output table, we can see that **Levene's Test** based on the mean yielded a test statistic of **.536**. To understand the significance of this number, we look at the **degrees of freedom**, which are reported as 2 for the numerator (df1) and 27 for the denominator (df2). These values are derived from the number of groups minus one and the total sample size minus the number of groups, respectively. The most critical value in the table, however, is the significance value, which in this instance is **.591**. This number determines whether the differences in **variance** are statistically significant or merely the result of random chance.

It is important to note that the different versions of the test (based on median vs. mean) may yield slightly different **p-values**. The version based on the median is often considered more robust if the data is highly non-normal or contains significant **outliers**. However, in our fertilizer study, the consistency across the different rows in the table provides additional confidence in the result. Understanding how to read this **SPSS** output is a fundamental skill for any researcher, as it validates the subsequent steps of the statistical analysis and ensures the integrity of the overall study.

## Statistical Decisions and Addressing Violations of Equal Variance

The final step in performing **Levene's Test** is reaching a statistical conclusion based on the **p-value**. In most social and natural sciences, an **alpha level** of .05 is used as the threshold for significance. Since our calculated p-value of **.591** is substantially greater than .05, we **fail to reject the null hypothesis**. This indicates that there is no significant difference between the variances of the three fertilizer groups. In simpler terms, we can proceed under the assumption that the groups have equal **variances**, satisfying the prerequisite for a standard **One-Way ANOVA**.

If the **p-value** had been less than .05, we would have concluded that the variances were significantly different. In such a scenario, the assumption of **homoscedasticity** would be violated,

and the results of a standard **ANOVA** might be biased. If this occurs, researchers often turn to **Welch's Test** or perform data transformations (such as log or square root transformations) to stabilize the **variance**. Because our test was non-significant, these extra steps are unnecessary, and we can confidently report that our growth data meets the requirements for parametric testing. The **null hypothesis** of equality remains supported by the evidence.

In conclusion, performing **Levene's Test** in **SPSS** is a vital procedure for ensuring the accuracy of your comparative analyses. By following the **Explore** workflow, interpreting the **F-statistic**, and evaluating the **p-value**, you can verify that your data is suitable for further testing. For our fertilizer study, the result of **.591** allows us to move forward with the knowledge that the three groups are comparable in terms of their internal variation. This rigorous approach to **statistics** ensures that the final conclusions regarding plant growth are both reliable and scientifically sound.

*\*This p-value correspond to an F statistic of .536 with numerator df = 2 and denominator df = 27. This p-value can also be calculated using the **F-distribution** tables or specialized statistical software.*