

How do you perform an ANOVA with unequal sample sizes?

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May 12, 2024

RECOMMENDED CITATION

stats writer (2024). *How do you perform an ANOVA with unequal sample sizes?*.
PSYCHOLOGICAL SCALES. Retrieved from <https://scales.arabpsychology.com/?p=143747>

ANOVA (Analysis of Variance) is a statistical method used to compare the means of three or more groups. In some cases, the sample sizes of these groups may be unequal, which can affect the accuracy of the results. To perform an ANOVA with unequal sample sizes, the first step is to check the assumption of equal variances among the groups. If this assumption is violated, a modified version of ANOVA, such as Welch's ANOVA, can be used. In this modified version, the group variances are not assumed to be equal, and a different formula is used to calculate the F-statistic. Additionally, post-hoc tests, such as Tukey's test, can be used to determine which specific group means are significantly different from each other. It is important to note that ANOVA with unequal sample sizes requires careful interpretation and may not be as accurate as ANOVA with equal sample sizes. Therefore, it is recommended to try to equalize the sample sizes as much as possible before performing the analysis.

Perform an ANOVA with Unequal Sample Sizes

One question students often have in statistics is:

Is it possible to perform a one-way ANOVA when the sample sizes of each group are not equal?

The short answer:

Yes, you can perform a one-way ANOVA when the sample sizes are not equal. Equal sample sizes is not made in an ANOVA.

However, there are two potential issues to be aware of when performing a one-way ANOVA with unequal sample sizes:

(1) Reduced statistical power.

(2) Reduced robustness to unequal variance.

The following sections explain both of these potential issues in detail.

Issue #1: Reduced Statistical Power

When we use any type of statistical test to compare groups, the statistical power of the test is highest when each group has an equal sample size.

Recall that statistical power refers to the probability that a test will detect some effect when there actually is one.

It can be shown that the greater the differences in sample sizes between the groups, the lower the statistical power of an ANOVA.

This is why researchers typically want equal sample sizes so that they have higher power and thus a greater probability of detecting true differences.

It's certainly possible to perform a one-way ANOVA with unequal sample sizes, but you should be aware that the power of the one-way ANOVA will be reduced.

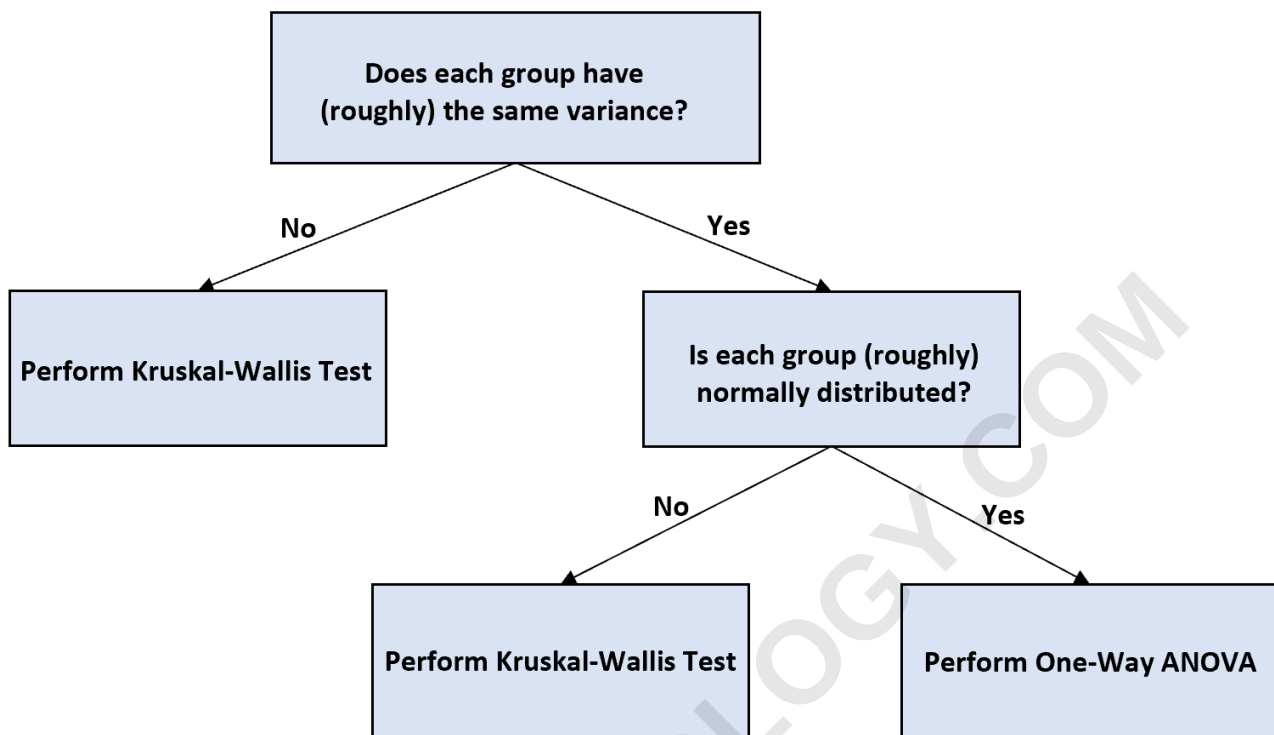
Issue #2: Reduced Robustness to Unequal Variance

One of the assumptions of a one-way ANOVA is that the variance between each group is equal.

In general, a one-way ANOVA is considered to be robust against violations of the equal variances assumption, *but only if each group has the same sample size.*

How to Decide to Use a One-Way ANOVA with Unequal Sample Sizes

If you have unequal sample sizes and you'd like to perform a one-way ANOVA to test for differences between group means, you can use the following flow chart to decide how to proceed:



Here's a brief explanation of the flow chart:

Step 1: Determine if each group has the same variance.

To determine if each group has the same variance, you can use one of two approaches:

Create boxplots for each group and see if the spread of values in each group is roughly equal. Perform a formal statistical test for equal variances like .

If the variances are not equal, perform a , which is considered the non-parametric equivalent to a one-way

ANOVA.

If the variances are equal, proceed to the next step.

Step 2: Determine if each group is normally distributed.

To determine if the values in each group are roughly normally distributed, you can use one of two approaches:

Create histograms or for each group. Perform formal statistical tests like Shapiro-Wilk, Kolmogorov-Smirnov, Jarque-Barre, or D'Agostino-Pearson.

If each group is normally distributed, you can proceed to perform a one-way ANOVA and interpret the results as you would with any ordinary one-way ANOVA.

If each group is not normally distributed, perform a Kruskal-Wallis Test instead.