

When should a researcher use a one-way ANOVA instead of a two-way ANOVA?

Authored by
stats writer

April 27, 2024

RECOMMENDED CITATION

stats writer (2024). *When should a researcher use a one-way ANOVA instead of a two-way ANOVA?*. PSYCHOLOGICAL SCALES. Retrieved from <https://scales.arabpsychology.com/?p=140202>

A researcher should use a one-way ANOVA when they are interested in comparing the means of three or more groups on a single dependent variable. This is suitable when there is only one independent variable being manipulated. On the other hand, a two-way ANOVA is appropriate when a researcher wants to analyze the effects of two independent variables on a single dependent variable. Therefore, a two-way ANOVA should be used when there are two independent variables being manipulated. In summary, a one-way ANOVA is appropriate for simple experimental designs with one independent variable, while a two-way ANOVA is suitable for more complex designs involving two independent variables.

One-Way vs. Two-Way ANOVA: When to Use Each

An ANOVA, short for "Analysis of Variance", is used to determine whether or not there is a statistically significant difference between the means of three or more independent groups.

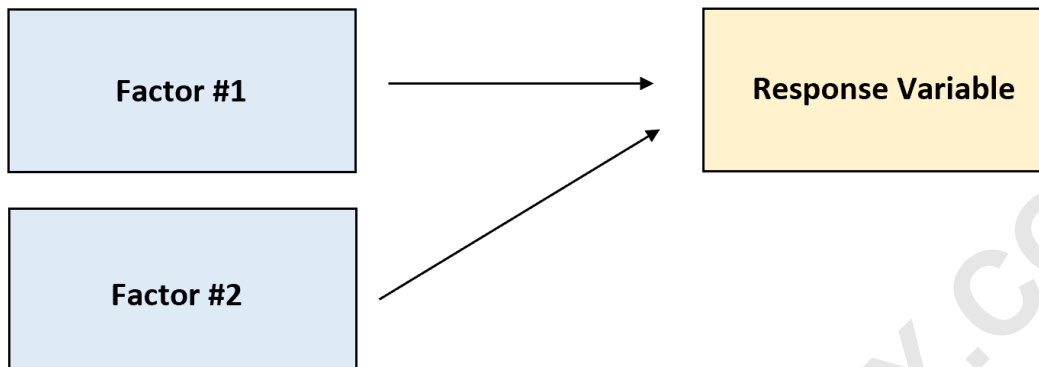
The two most common types of ANOVAs are the one-way ANOVA and the two-way ANOVA.

One-way ANOVA: Used to determine how one factor affects a response variable.



Two-way ANOVA: Used to determine how two factors affect a response variable, and to determine whether or

not there is an interaction between the two factors on the response variable.



The following examples provide an example of how to perform each type of ANOVA.

Example: One-Way ANOVA

Suppose a professor wants to know if three different studying techniques lead to different exam scores. To test this, he recruits 30 students to participate in a study and randomly assigns each one to use one of the three techniques to prepare for an exam. At the end of one month, all of the students take the same test.

The test scores for each student are shown below:

Group 1	Group 2	Group 3
85	91	79
86	92	78
88	93	88
75	85	94
78	87	92
94	84	85
98	82	83
79	88	85
71	95	82
80	96	81

The professor performs a one-way ANOVA and gets the following results:

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Group 1	10	834	83.4	71.15556
Group 2	10	893	89.3	23.12222
Group 3	10	847	84.7	28.01111

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	192.2	2	96.1	2.357532	0.113848	3.354131
Within Groups	1100.6	27	40.76296			
Total	1292.8	29				

The F test statistic is 2.3575 and the corresponding p-value is 0.1138. Since this p-value is not less than .05,

we do not have sufficient evidence to say that the three studying techniques lead to different mean exam scores.

Example: Two-Way ANOVA

Suppose a botanist wants to know whether or not plant growth is influenced by sunlight exposure and watering frequency. She plants 40 seeds and lets them grow for two months under different conditions for sunlight exposure and watering frequency. After two months, she records the height of each plant. The results are shown below:

	Sunlight Exposure			
Watering Frequency	None	Low	Medium	High
Daily	4.8	5	6.4	6.3
	4.4	5.2	6.2	6.4
	3.2	5.6	4.7	5.6
	3.9	4.3	5.5	4.8
	4.4	4.8	5.8	5.8
Weekly	4.4	4.9	5.8	6
	4.2	5.3	6.2	4.9
	3.8	5.7	6.3	4.6
	3.7	5.4	6.5	5.6
	3.9	4.8	5.5	5.5

ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Watering	0.00025	1	0.00025	0.000921	0.975975	4.149097
Sunlight	18.76475	3	6.254917	23.04898	0.000003	2.90112
Interaction	1.01075	3	0.336917	1.241517	0.310898	2.90112
Error	8.684	32	0.271375			
Total	28.45975	39				

Here's how to interpret the results:

The p-value for the interaction between watering frequency and sunlight exposure was 0.310898. This is not statistically significant at alpha level 0.05. The p-value for watering frequency was 0.975975. This is not statistically significant at alpha level 0.05. The p-value for sunlight exposure was 0.000003. This is statistically significant at alpha level 0.05.

These results indicate that sunlight exposure is the only factor that has a statistically significant effect on plant height.

And because there is no interaction effect, the effect of sunlight exposure is consistent across each level of watering frequency. That is, whether a plant is watered daily or weekly has no impact on how sunlight exposure affects a plant.

Practice: Which ANOVA Should You Use?

Use the following practice problems to gain a better understanding of when you should use a one-way or two-way ANOVA.

Problem #1: Farming

A farmer wants to know if three different fertilizers lead to different crop yields. To test this, he sprinkles each type of fertilizer on 10 different fields and measures the total yield at the end of the growing season.

Which type of ANOVA should he use to determine if the different fertilizers lead to different crop yields?

Answer: He should use a one-way ANOVA because there is only one factor he is studying: Fertilizer. A one-way ANOVA can tell him whether or not there is a statistically significant difference in crop yields between the three different types of fertilizer.

Problem #2: Biology

A biologist want to know how different levels of soil (low, medium, high) and watering frequency (weekly,

monthly) impact the growth of a certain plant.

Which type of ANOVA should she use to determine if the different combinations of sunlight exposure and watering frequency lead to different levels of plant growth?

Answer: She should use a two-way ANOVA because there are two factors she is studying: Sunlight exposure and watering frequency. A two-way ANOVA can tell her whether or not different levels of each factor affect plant growth differently and whether or not there is an interaction effect between sunlight and watering frequency on plant growth.

Problem #3: Medication

A medical researcher want to know if four different medications lead to different mean blood pressure reductions in patients. He randomly assigns 20 patients to use each medication for one month, then measure the blood pressure reduction in each patient.

Which type of ANOVA should he use to determine if the four different medications have different effects on

blood pressure reduction?

Answer: He should use a one-way ANOVA because there is only one factor he is studying: Medication type. A one-way ANOVA can tell him whether or not there is a statistically significant difference in mean blood pressure reduction between the four types of medications.

Use the following tutorials to gain a better understanding of the one-way ANOVA:

How to Perform a One-Way ANOVA in R

And use these tutorials to gain a better understanding of the two-way ANOVA: