How can the interpretation of F-values be applied in a two-way ANOVA?

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The F-value is a statistical measure used in a two-way ANOVA (Analysis of Variance) to determine the significance of the interaction between two independent variables. It represents the ratio of the variability between groups to the variability within groups. A high F-value indicates a significant interaction between the two variables, meaning that they have a significant effect on the outcome. This information can be applied to understand the relationship between the variables and how they influence the results of the experiment. It can also be used to determine which specific groups or combinations of groups have a significant impact on the outcome. Overall, the interpretation of F-values in a two-way ANOVA provides valuable insight into the effects of multiple independent variables and their interactions on the dependent variable.

Interpret F-Values in a Two-Way ANOVA

A is used to determine whether or not there is a statistically significant difference between the means of three or more independent groups that have been split on two variables.

Whenever you perform a two-way ANOVA, you will end up with a summary table that looks like the following:

Source	Sum of Squares (SS)	df	Mean Squares (MS)	F	P-value
Factor 1	15.8	1	15.8	11.205	0.0015
Factor 2	505.6	2	252.78	179.087	0.0000
Interaction	13.0	2	6.5	4.609	0.0141
Residuals	76.2	54	1.41		

Each of the F-values in the table are calculated as:

F-value = Mean Squares / Mean Squares Residuals

Each F-value also has a corresponding p-value.

If the p-value is less than a certain threshold (e.g. α = .05) then we conclude that the factor has a statistically significant effect on whatever outcome we're measuring.

The following example shows how to interpret F-values in a two-way ANOVA in practice.

Example: Interpreting F-Values in Two-Way ANOVA

Suppose we want to determine if exercise intensity and gender impact weight loss.

We recruit 30 men and 30 women to participate in an experiment in which we randomly assign 10 of each to follow a program of either no exercise, light exercise, or intense exercise for one month.

We then perform a two-way ANOVA using statistical software and we receive the following output:

Source	Sum of Squares (SS)	df	Mean Squares (MS)	F	P-value
Gender	15.8	1	15.8	11.205	0.0015
Exercise	505.6	2	252.78	179.087	0.0000
Gender * Exercise	13.0	2	6.5	4.609	0.0141

Residuals	76.2	54	1.41		

Here is how to interpret each F-value in the output:

Gender:

The F-value is calculated as MS Gender / MS Residuals = 15.8 / 1.41 = 11.197.The corresponding p-value is .0015.Since this p-value is less than .05, we conclude that gender has a statistically significant effect on weight loss.

Exercise:

The F-value is calculated as MS Exercise / MS Residuals = 252.78 / 1.41 = 179.087.The corresponding p-value is <.0000.Since this p-value is less than .05, we conclude that exercise has a statistically significant effect on weight loss.

Gender * Exercise:

The F-value is calculated as MS Gender * Exercise / MS Residuals = 6.5 / 1.41 = 4.609.The corresponding p-value is .0141.Since this p-value is less than .05, we conclude that the interaction between gender and

exercise has a statistically significant effect on weight loss.

In this particular example, both of the factors (gender and exercise) had a statistically significant effect on the response variable (weight loss) and the interaction between the two factors also had a statistically significant effect on the response variable.

Note: When the interaction effect is statistically significant, you can create an to better understand the interaction between the two factors and visualize exactly how the two factors affect the response variable.

The following tutorials explain how to perform a two-way ANOVA using different statistical software: