

# What is an Omnibus Test?

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An Omnibus Test is a statistical method used to determine if there is a significant difference between several groups or treatments. It combines the data from multiple tests into one overall analysis, allowing for a more comprehensive assessment of the data. This type of test is commonly used in scientific research to compare the effectiveness of different treatments or to identify patterns within a dataset. It is also used in quality control and market research to evaluate the performance of multiple products or strategies. The results of an Omnibus Test can help researchers make informed decisions and draw meaningful conclusions from their data.

## What is an Omnibus Test? (Definition & Examples)

**In statistics, an omnibus test is any statistical test that tests for the significance of several parameters in a model at once.**

**For example, suppose we have the following null and alternative hypotheses:**

**$H_0: \mu_1 = \mu_2 = \mu_3 = \dots = \mu_k$  (all the population means are equal)**

**$H_A$ : At least one population mean is different from the rest**

**This is an example of an omnibus test because the null hypothesis contains more than two parameters.**

**If we reject the null hypothesis, we know that at least one of the population means is different from the rest,**

but we don't specifically know which population means are different.

An omnibus test appears most commonly in and .

This tutorial provides an example of an omnibus test in both a one-way ANOVA and a multiple linear regression model.

#### Omnibus Test in a One-Way ANOVA

Suppose a professor wants to know whether three different exam prep programs lead to different exam scores. To test this, he randomly assigns 10 students to use each exam prep program for one month and then administers the same exam to the students in each group.

The exam scores for each group 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      |

To determine if each prep program leads to the same exam scores, he performs a one-way ANOVA using the following null and alternative hypotheses:

$H_0: \mu_1 = \mu_2 = \mu_3$

$H_A$ : At least one exam prep program leads to different mean scores than the rest.

This is an example of an omnibus test because the null hypothesis has more than two parameters.

Using a , he is able to produce the following ANOVA table:

| Source    | SS     | df | MS   | F     | P       |
|-----------|--------|----|------|-------|---------|
| Treatment | 192.2  | 2  | 96.1 | 2.358 | 0.11385 |
| Error     | 1100.6 | 27 | 40.8 |       |         |
| Total     | 1292.8 | 29 |      |       |         |

To determine if he can reject or fail to reject the null hypothesis, he only needs to look at the F test statistic and the corresponding p-value in the table.

The F test statistic is 2.358 and the corresponding p-value is 0.11385. Since this p-value is not less than .05, he fails to reject the null hypothesis.

In other words, he doesn't have sufficient evidence to say that any of the exam prep programs lead to different average exam scores.

**Note:** If the p-value was less than .05, then the professor would reject the null hypothesis. He could then perform to determine exactly which programs produced different average exam scores.

**Omnibus Test in a Multiple Linear Regression Model**

Suppose a professor wants to determine if the number of hours studied and the number of prep exams taken can predict the exam score that a student will receive.

To test this, he collects data for 20 students and fits the following multiple linear regression model:

$$\text{Exam Score} = \beta_0 + \beta_1(\text{hours}) + \beta_2(\text{prep exams})$$

This regression model using the following null and alternative hypotheses:

$$H_0: \beta_1 = \beta_2 = 0$$

$H_A$ : At least one coefficient is not equal to zero.

This is an example of an omnibus test because the null hypothesis is testing if several parameters are equal to zero at once.

The following shows the results of this regression model:

| D                            | E                   | F                     | G             | H              | I                     | J                | K |
|------------------------------|---------------------|-----------------------|---------------|----------------|-----------------------|------------------|---|
| SUMMARY OUTPUT               |                     |                       |               |                |                       |                  |   |
| <i>Regression Statistics</i> |                     |                       |               |                |                       |                  |   |
| Multiple R                   | 0.857               |                       |               |                |                       |                  |   |
| R Square                     | 0.734               |                       |               |                |                       |                  |   |
| Adjusted R Square            | 0.703               |                       |               |                |                       |                  |   |
| Standard Error               | 5.366               |                       |               |                |                       |                  |   |
| Observations                 | 20                  |                       |               |                |                       |                  |   |
| ANOVA                        |                     |                       |               |                |                       |                  |   |
|                              | <i>df</i>           | <i>SS</i>             | <i>MS</i>     | <i>F</i>       | <i>Significance F</i> |                  |   |
| Regression                   | 2                   | 1350.76               | 675.38        | 23.46          | 0.00                  |                  |   |
| Residual                     | 17                  | 489.44                | 28.79         |                |                       |                  |   |
| Total                        | 19                  | 1840.20               |               |                |                       |                  |   |
|                              | <i>Coefficients</i> | <i>Standard Error</i> | <i>t Stat</i> | <i>P-value</i> | <i>Lower 95%</i>      | <i>Upper 95%</i> |   |
| Intercept                    | 67.67               | 2.82                  | 24.03         | 0.00           | 61.73                 | 73.61            |   |
| hours                        | 5.56                | 0.90                  | 6.18          | 0.00           | 3.66                  | 7.45             |   |
| prep_exams                   | -0.60               | 0.91                  | -0.66         | 0.52           | -2.53                 | 1.33             |   |

To determine if he can reject or fail to reject the null hypothesis, he only needs to look at the F test statistic and the corresponding p-value in the table.

The F test statistic is 23.46 and the corresponding p-value is 0.00. Since this p-value is less than .05, he can reject the null hypothesis and conclude that at least one of the model coefficients is not equal to zero.

However, simply rejecting the null hypothesis of this omnibus test doesn't actually tell him which model coefficients are not equal to zero. To determine this, he must look at the p-values for the individual model

**coefficients:**

**P-value of hours: 0.00 P-value of prep exams: 0.52**

**This tells him that hours is a statistically significant predictor of exam score while prep exams is not.**

**Summary**

**Here's a summary of what we learned in this article:**

**An omnibus test is used to test for the significance of several model parameters at once. If we reject the null hypothesis of an omnibus test, we know that at least one model parameter is significant. If we reject the null hypothesis of an ANOVA model, we can use to determine which population means are actually different. If we reject the null hypothesis of a multiple linear regression model, we can look at the p-values for the individual model coefficients to determine which ones are statistically significant.**

**The following tutorials explain how to perform a one-way ANOVA and multiple linear regression in Excel:**