

What is the process for analyzing residuals in an ANOVA model?

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The process for analyzing residuals in an ANOVA (Analysis of Variance) model involves examining the differences between the observed values and the predicted values from the model. This is done by calculating the residuals, which are the differences between the actual values and the predicted values for each data point. The residuals are then examined for patterns or trends, such as non-randomness or unequal variances, which can indicate problems with the ANOVA model. This process helps to assess the validity of the model and identify any outliers or influential data points that may be affecting the results. The analysis of residuals is an important step in interpreting the results of an ANOVA model and ensuring the accuracy of the statistical analysis.

Analyze Residuals in an ANOVA Model

An ANOVA ("analysis of variance") is a type of model that is used to determine whether or not there is a significant difference between the means of three or more independent groups.

Whenever we fit an ANOVA model to a dataset, there will always be residuals - these represent the difference between each individual observation and the mean of the group that the observation came from.

The following example shows how to calculate residuals for an ANOVA model in practice.

Example: Calculating Residuals in ANOVA

Suppose we recruit 90 people to participate in a weight-loss experiment in which we randomly assign 30 people to follow either program A, program B, or program C for

one month.

We can conduct a one-way ANOVA to determine if there is a statistically significant difference between the resulting weight loss from the three programs.

Suppose we calculate the mean weight loss for individuals in each program to be:

Program A: 1.58 pounds Program B: 2.56 pounds Program C: 4.13 pounds

The residuals for the ANOVA model would be the difference between each individual's weight loss and the mean weight loss in their program.

For example, the following table shows how to calculate the residuals for 10 different individuals in the study:

Participant ID	Program Used	Avg. Weight Loss in Program	Weight Loss	Residual
1	A	1.58	2.69	1.11
2	A	1.58	0.79	-0.79
3	A	1.58	1.11	-0.47
4	B	2.56	2.34	-0.22
5	B	2.56	2.99	0.43
6	B	2.56	3.41	0.85
7	C	4.13	3.99	-0.14
8	C	4.13	4.17	0.04
9	C	4.13	4.46	0.33
10	C	4.13	4.01	-0.12

Notice the following pattern:

Individuals who had a value greater than their group mean had a positive residual. Individuals who had a value less than their group mean had a negative residual.

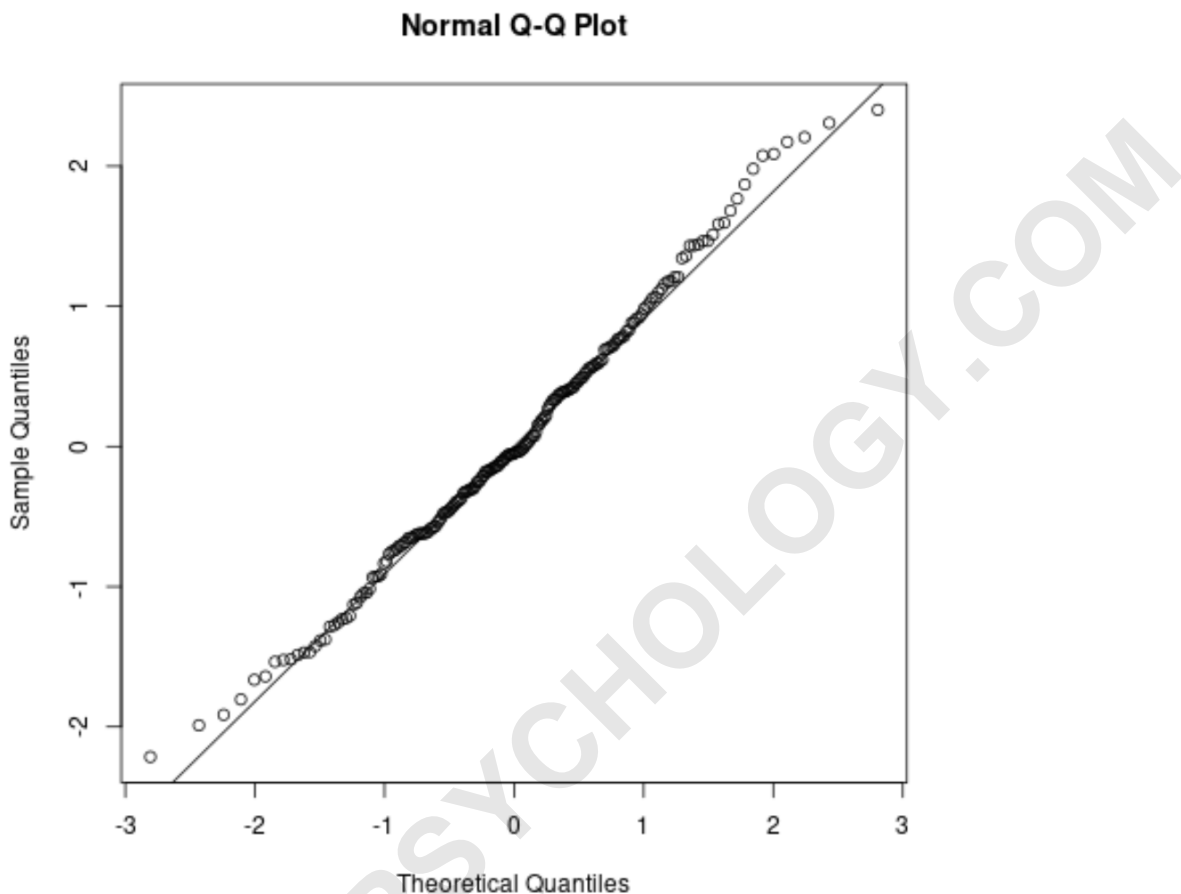
In practice, we would calculate the residuals for all 90 individuals.

How to Use Residuals to Check Normality

One of the is that the residuals are normally distributed.

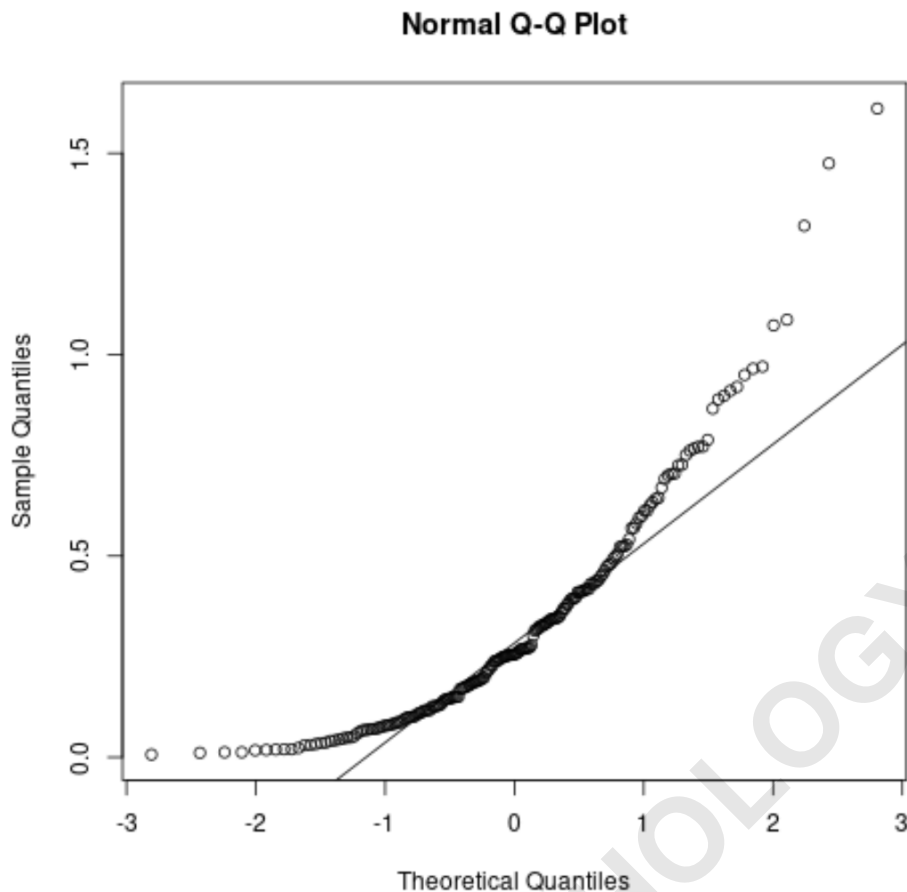
The most common way to check this assumption is by creating a .

Here's what a Q-Q plot would look like for our previous example:



The points deviate a bit from the straight diagonal line on the tail ends, but in general the points fall follow the diagonal line quite well. This tells us that the assumption of normality is likely met.

As reference, here's what a Q-Q plot for non-normally distributed residuals might look like:



The points deviate wildly from the straight diagonal line, which indicates that the residuals are not normally distributed.

Refer to the following tutorials to learn how to create Q-Q plots in different software:

The following articles provide additional information about ANOVA models: