

# Overview

If you have purchased the PERMANOVA+ add-on, then you will have an additional menu item that allows you to perform a broad range of additional analyses using a suite of routines that are not available in the base PRIMER 7 package, including [PERMANOVA](#), [PERMDISP](#), [PCO](#), [DISTLM/dbRDA](#) and [CAP](#). See the [PERMANOVA+ user manual](#) for details regarding these routines and the underlying methods.

Here, we will run through a quick example of how to set up and run a multi-factor PERMANOVA analysis in PRIMER. **Permutational multivariate analysis of variance** (PERMANOVA) partitions variation in the space of a chosen dissimilarity measure in response to one or more factors in a specified sampling protocol or experimental design ( [Anderson \(2001a\)](#) , [Anderson \(2017\)](#) ). Tests of individual terms in a PERMANOVA model are achieved by constructing correct (pseudo-)  $F$  ratios on the basis of expectations of mean squares (EMS), and p-values are obtained using correct permutation algorithms given the full study design.

Importantly, the PERMANOVA routine in PRIMER allows the user:

- to specify whether factors are **fixed** or **random**,
- to specify whether a factor is **nested** in one or more other factors,
- to test **interaction terms**,
- to include one or more quantitative **covariates** in the analysis,
- to **remove** individual terms from a model or to perform **pooling**,
- to handle correctly:
  - **mixed models**
  - user-specified **contrasts**
  - **BACI designs** (before-after/control-impact),
  - **asymmetrical designs** (e.g., in environmental impact studies),
  - **randomised blocks**,
  - **split plots**,
  - **hierarchical designs**,
  - **repeated measures**,
  - **unbalanced designs** (Type I, II or III sums of squares),
  - ... and more.

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