[FULL] Primer 6 And Permanova User Manual

How to use PRIMER 6 and PERMANOVA+ for multivariate analysis of ecological data

PRIMER 6 is a software package that provides various tools for data exploration, visualisation and analysis of ecological data. PERMANOVA+ is an add-on module for PRIMER 6 that extends the capabilities of resemblance-based methods to handle complex designs, interactions, covariates and gradients. In this article, we will introduce the main features and functions of PRIMER 6 and PERMANOVA+, and provide some examples of how to use them for multivariate analysis of ecological data.

What is PRIMER 6?

PRIMER 6 stands for Plymouth Routines In Multivariate Ecological Research version 6. It is a Windows-based software package that was developed by K.R. Clarke and R.N. Gorley at Plymouth Marine Laboratory, UK. PRIMER 6 allows users to import, manipulate, transform, cluster, ordinate and test multivariate data sets using various methods and measures. PRIMER 6 also offers graphical tools such as histograms, box plots, scatter plots, bubble plots, dendrograms, MDS plots and biplots to visualise the data and the results of the analysis.

What is PERMANOVA+?

PERMANOVA+ stands for PERmutational Multivariate ANalysis Of VAriance plus. It is an add-on module for PRIMER 6 that was developed by M.J. Anderson, R.N. Gorley and K.R. Clarke. PERMANOVA+ enables users to perform multivariate analysis of variance (MANOVA), analysis of covariance (ANCOVA) or multiple regression models for multi-response data based on any resemblance measure. PERMANOVA+ also allows users to model multivariate data in response to continuous variables using distance-based redundancy analysis (dbRDA), perform resemblance-based discriminant analysis using canonical analysis of principal coordinates (CAP), and allocate new samples to existing groups or predict their positions along gradients.

How to use PRIMER 6 and PERMANOVA+?

To use PRIMER 6 and PERMANOVA+, users need to have a valid license and install the software on their computer. Users can download the software from https://www.primer-e.com/our-software/. Users also need to have their data in a suitable format for importing into PRIMER 6. The data should be arranged in a matrix with rows representing samples or observations and columns representing variables or responses. The data can be either quantitative (e.g., abundance, biomass, concentration) or qualitative (e.g., presence/absence, categories). Users can also have additional information about their samples such as sampling dates, locations, treatments or factors in separate files. Once the data are imported into PRIMER 6, users can explore and transform their data using various options in the Data menu. For example, users can check for outliers, normalise or standardise their data, calculate diversity indices or similarity matrices, or perform transformations such as log or square root. Users can also visualise their data using various options in the Graph

menu. For example, users can plot histograms, box plots or scatter plots of their variables, or plot dendrograms or MDS plots of their samples based on similarity matrices. To perform multivariate analysis using PERMANOVA+, users need to activate the module by clicking on the PERMANOVA button in the toolbar of PRIMER 6. Users can then access various options in the PERMANOVA menu. For example, users can perform PERMANOVA to test hypotheses about differences among groups or treatments based on their design matrix, perform dbRDA to model multivariate data in response to continuous variables based on their environmental matrix, perform CAP to classify samples into groups or predict their positions along gradients based on their resemblance matrix, or perform post-hoc tests or pairwise comparisons to further examine the results of their analysis.

Where to find more information?

For more information about PRIMER 6 and PERMANOVA+, users can refer to the following sources:

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