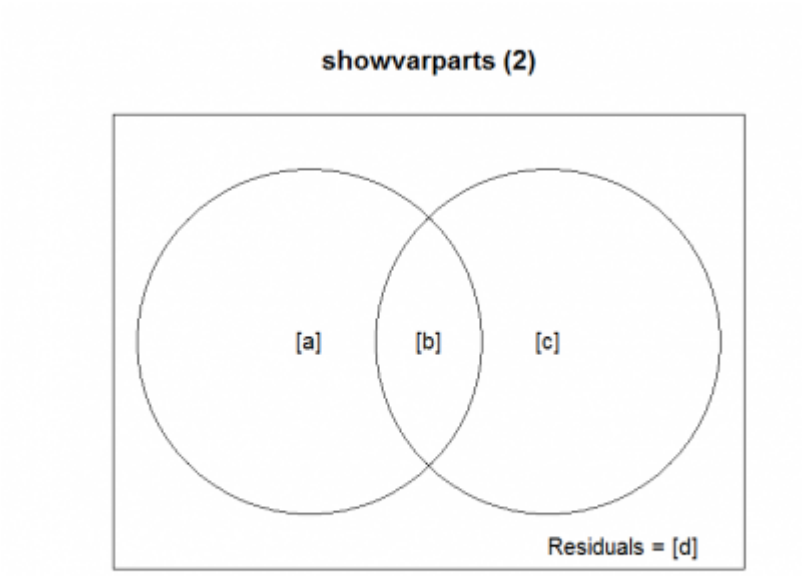
Section: Ordination analysis

Variation partitioning (constrained ordination)

Theory R functions Examples

Note: variation partitioning is sometimes also called ***commonality analysis*** in reference to the *common* (shared) fraction of variation (Kerlinger & Pedhazur 1973). It is also a synonym to ***variance partitioning***[1].

In case we have two or more explanatory variables, one may be interested in variation in species composition explained by each of them. If some of these explanatory variables are correlated, one must expect that variation explained by the first or the other variable cannot be separated - it will be shared.



Venn's diagram, showing variation explained by two environmental variables (or two sets of environmental variables) and coded names of these fractions. Created by function `showvarpart (2)` from library `vegan`.

The way how to approach this problem is variation partitioning, when variation explained by each variable (or set of variables) independently is partitioned into variation attributable purely to given environmental variable, and shared variation attributable to two or more variables.

Variation can be partitioned by individual variables (e.g. variation explained by soil pH vs variation explained by soil Ca) or by groups of variables (e.g. soil variables vs climatic variables).

Results can be visualized using Venn's diagram (see figure on the right). Meaning of the fractions in Venn's diagram is the following[2]:

- [a] - variation explained by variable 1 (conditional (or partial) effect of variable 1, i.e. variation this variable would explain if putting variable 2 as covariable);
- [c] - variation explained by variable 2;
- [b] - shared variation explained by both variables (cannot be decided to which of them should

be attributed, and is a result of correlation between both variables);
- [a+b] - variation explained by variable 1 (independent simple (or marginal) effect of variable 1, i.e. variation this variable would explain if it is as the only explanatory variable in the model);
- [b+c] - variation explained by variable 2;
- [d] - unexplained variation.

If the variation is partitioned among groups with the same number of variables (e.g. two soil and two climatic variables), then the variation explained by each group is comparable without adjustment. However, if groups contain different numbers of variables, variation explained by not adjusted R^2 is not comparable since R^2 tends to increase with the number of explanatory variables. Here, the use of adjusted R^2 is recommended.

[1)]

As to the distinction between *variance* and *variation*, Legendre & Legendre (2012) note: “The term variation, a less technical and looser term than variance, is used because one is partitioning the total sum of squared deviations of y from its mean (total SS). In variation partitioning, there is no need to divide the total SS of y by its degrees of freedom to obtain the variance s^2_y.” The first edition of the book *Multivariate Analysis of Ecological Data using CANOCO* (Lepš & Šmilauer 2003) was using the term *variance partitioning*, while in the second edition (Šmilauer & Lepš 2014), authors adopted the term *variation partitioning*, noting: “It was called **variance** partitioning in the original paper, but we prefer, together with Legendre & Legendre 2012, the more appropriate name referring to *variation*, as we also include unimodal ordination methods in our considerations.”

[2)]

Note that in CANOCO 5, the coding of the fraction follows different logic - [c] is shared variation, and [a] or [b] are partial fractions; meaning of [d] remains the same (unexplained variation).