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Section: Ordination analysis

CA & DCA (unimodal unconstrained ordination)

Theory R functions **Examples** Exercise

Example 1: CA on Ellenberg's Danube meadow dataset

This simple example shows correspondence analysis of Danube meadow dataset, collected by Heinz Ellenberg and used in number of methodological studies. First, import data, initiate vegan library and calculate CA using the function `cca` from vegan:

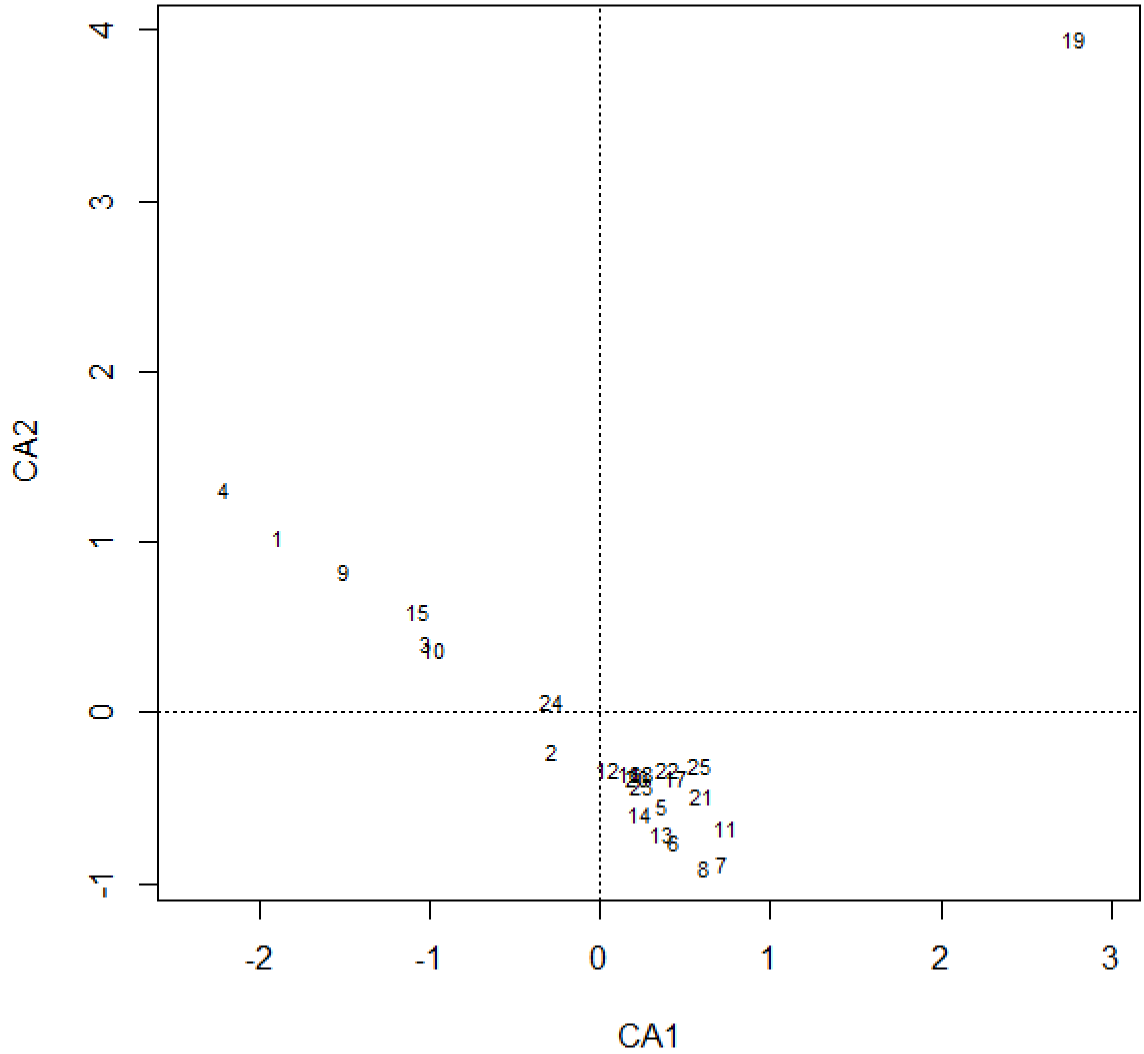
```
danube.spe <- read.delim
('https://raw.githubusercontent.com/zdealveindy/anadat-r/master/data/danube.
spe.txt', row.names = 1)
library (vegan)
CA <- cca (danube.spe)
CA
```

```
Call: cca(X = danube.spe)

              Inertia Rank
Total           3.043
Unconstrained   3.043   24
Inertia is mean squared contingency coefficient

Eigenvalues for unconstrained axes:
   CA1    CA2    CA3    CA4    CA5    CA6    CA7    CA8
0.5718 0.4944 0.2950 0.2472 0.2057 0.1764 0.1528 0.1418
(Showed only 8 of all 24 unconstrained eigenvalues)
```

The total inertia (heterogeneity of the dataset) is 3.043, and the first axis captures 18.8% of total variation in species composition (0.5718 / 3.043 = 0.1879, where 0.5718 is eigenvalue of the first axis CA1, and 3.043 is total inertia).

Ordination diagram reveals the pattern of samples and species in ordination diagram:

```
ordiplot (CA)
```



It is evident that sample 19 is quite different from the rest of data, and correspondence analysis even greatly exaggerates this difference. Here is where the detrending of ordination axes comes as an option (see further, and for DCA on Danube meadow dataset see Exercise 3 below).

Example 2: DCA on Vltava river valley dataset to decide whether linear or unimodal ordination method should be used

To decide whether the compositional data are homogeneous or heterogeneous, respectively (and thus more suitable for linear or unimodal ordination methods, respectively), we may calculate detrended correspondance analysis (DCA) first and check the length of the first ordination axis (in units of S.D.) to decide.

```
vltava.spe <- read.delim
('https://raw.githubusercontent.com/zdealveindy/anadat-r/master/data/vltava-
spe.txt', row.names = 1)
DCA <- decorana (log1p (vltava.spe))
```

```
DCA
```

```
Call: decorana(veg = log1p(vltava.spe))

Detrended correspondence analysis with 26 segments.
Rescaling of axes with 4 iterations.

                  DCA1   DCA2   DCA3   DCA4
Eigenvalues     0.5338 0.3956 0.2488 0.2457
Decorana values 0.5533 0.3677 0.2410 0.1961
Axis lengths    4.5446 3.5426 2.9208 2.9726
```

The length of first axis is 4.5 S.D. units, which means that (according to Lepš & Šmilauer 2003) unimodal ordination methods are preferable.

I won't draw ordination diagram of the result here - since this example is focused only on the decision whether the `vltava` dataset is homogeneous or heterogeneous, it is not relevant here. However, note that the section Ordination diagrams is devoted to drawing ordination diagrams using this dataset.

You may be surprised that you haven't get any **total inertia** values when printing decorana results, although in other software (e.g. CANOCO) these are available, together with percentage variance explained by particular axes. The reason for this is that DCA does not support the concept of total inertia values (also, it produces only four axes, i.e. four eigenvalues). However, you may get total inertia applying correspondence analysis (CA) on your data:

```
cca (log1p (vltava.spe))
```

```
Call: cca(X = log1p(vltava.spe))

              Inertia Rank
Total           7.372
Unconstrained   7.372   96
Inertia is mean squared contingency coefficient

Eigenvalues for unconstrained axes:
   CA1    CA2    CA3    CA4    CA5    CA6    CA7    CA8
0.5533 0.4594 0.4131 0.3083 0.2951 0.2576 0.2147 0.2032
(Showed only 8 of all 96 unconstrained eigenvalues)
```

As you can see, total inertia is 7.372, and if needed, variation captured by particular axes can be calculated as eigenvalue/total inertia (e.g., for the first axis, 0.553/7.372*100 = 7.50%)[1)]

[1)]
However, see this note from Jari Oksanen on this topic, copied from this discussion: *The concept of total inertia does not exist in DCA. Alternative software use the total inertia from other ordination methods such as orthogonal correspondence analysis. Just call cca() for your data to get the total inertia of orthogonal CA. However, that really has no relevance for DCA, although that statistics is commonly used and ritually reported in papers.*

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https://anadat-r.davidzeleny.net/ - **Analysis of community ecology data in R**

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