

ENVIRONMENTAL SAMPLING AND ANALYSIS

WORKSHEET 8: PCA & DISSIMILARITIES

QUESTION 1:

Peet & Loucks (1977) examined the abundances of 8 species of trees (Bur oak, Black oak, White oak, Red oak, American elm, Basswood, Ironwood, Sugar maple) at 10 forest sites in southern Wisconsin, USA. The data (given below) are the mean measurements of canopy cover for eight species of north American trees in 10 samples (quadrats). Note that the species are in rows and the samples are in columns.

| | Quadrat | | | | | | | | | |
|-----------|---------|---|---|---|---|---|---|---|---|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Bur oak | 9 | 8 | 3 | 5 | 6 | 0 | 5 | 0 | 0 | 0 |
| Black oak | 8 | 9 | 8 | 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| White oak | 5 | 4 | 9 | 9 | 7 | 7 | 4 | 6 | 0 | 2 |
| Red Oak | 3 | 4 | 0 | 6 | 9 | 8 | 7 | 6 | 4 | 3 |
| Elm | 2 | 2 | 4 | 5 | 6 | 0 | 5 | 0 | 2 | 5 |
| Basswood | 0 | 0 | 0 | 0 | 2 | 7 | 6 | 6 | 7 | 6 |
| Ironwood | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 4 | 6 | 5 |
| Maple | 0 | 0 | 0 | 0 | 0 | 5 | 4 | 8 | 8 | 9 |

Enter the data into a SYSTAT file with species in rows and quadrats in columns. Save the file. (You will need this tomorrow for MDS.)

For PCA to plot quadrats, we need to re-arrange the data with quadrats in rows and species in columns. You can achieve this by transposing the data (see SYSTAT instruction sheet) and saving the new arrangement as a new file.

Analyse the relationships between the sites in terms of tree species composition.

First, decide if standardisation is warranted.

Next, decide on an appropriate resemblance coefficient.

Then, use SYSTAT to compute a PCA for these data. (see SYSTAT instruction sheet)

- What is the explained variation?
- Do the first two axes adequately explain the variation in the data?
- How many axes are needed to explain most of the variation (use the eigenvalues and a scree plot to decide this).

Examine the scores for each species on each component and plot these scores for the first 2 components, ie. plot PC I against PC II.

- What can you conclude about the relationships between the sites?
- Is there evidence of a gradient in the landscape, reflected in the arrangement of the plots in the ordination?
- How might you interpret independent data for each plot, such as groundwater and soil characteristics, using the ordination?

QUESTION 2:

The following data are the abundances of 3 species of gastropods in 5 quadrats (ranging from high shore marsh, Quadrat 1, to low shore marsh, Quadrat 5) in a saltmarsh. Calculate the Bray-Curtis

(Czekanowski) dissimilarity coefficient and Euclidean distance between all pairs of quadrats using SYSTAT.

| Species | Quadrat | | | | |
|---------------------|---------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| <i>Salinator</i> | 4 | 9 | 9 | 6 | 0 |
| <i>Ophicardelus</i> | 0 | 3 | 4 | 2 | 1 |
| <i>Marinula</i> | 1 | 0 | 1 | 0 | 1 |

- Do the two dissimilarity measures correspond?

Then use the formulae in the notes to calculate the resemblances between three pairs of quadrats by hand. They should give the same answers for the Bray-Curtis measure. Your answers for Euclidean Distance will differ from those calculated by SYSTAT, because it automatically normalises the data. Check your Euclidean Distances against those on the board at the front of the room.

Standardise the data by scaling against the maximum value of each species. Recompute the Euclidean distances.

- Do the relationships appear to change?