

Tutorial: Cluster Analysis

The package **cluster** is extremely useful and contains most of the methods (for example **diana** and **pam**) discussed in the lecture. Install this package and check it out.

1. Follow the steps outlined in the lecture for clustering the European Employment data in the file **employment.dat** on the course page. Use the first nine variables. Do the clusters correspond to the four categories? Try various linkage methods and construct dendograms.
2. Consider the data set **satimage.txt** in the course data directory. The description is given in the lecture note.
 - (a) Do not use the class variable. Standardise the other variables and perform cluster analysis using different techniques from those in the example, for example SL (single linkage), AL-average linkage, CL-complete linkage. Are they better or worse than the Ward linkage? Is there a difference if K-means is used instead of partitioning around medoids?
 - (b) Construct a silhouette plot for partitioning around medoids (**pam**) with values of K different from 6, for example $K = 7$.
 - (c) Construct a confusion table for **pam** clustering with $K = 7$ clusters. How does it compare with $K = 6$?
 - (d) Run the clustering algorithms for the **satimage.txt** data, but only using the centre pixels (i.e. the variables CC1, CC2, CC3, CC4) of each 3×3 neighbourhood. Compare your results with those obtained from the full data set.
 - (e) There are several R packages that deal with self organising maps. I draw attention to two of them; 1) **som** which can construct Self Organising Maps. and 2) the package **class**, within which there are functions **batchSOM** and **SOM**. Compare these with the **kohonen** package used in the worked example. That is, make a 6×6 hexagonal batch-SOM plot of the Landsat satellite image data. The other packages require specification of parameters where **kohonen** has default settings
3. The data in **primate.scapulae.txt** (and **primate.scapulae.xlsx**) contain indices and angles that are related to scapular shape (shoulder bones of primates), but not to functional meaning. There are 8 variables in the data set. The first five (AD.BD, AD.CD, EA.CD, Dx.CD, SH.ACR) are indices and the last three (EAD, β , γ) are angles. Of the 105 measurements on each variable, 16 were taken on *Hylobates* scapulae, 15 on *Pongo* scapulae, 20 on *Pan* scapulae, 14 on *Gorilla* scapulae, and 40 on *Homo* scapulae. The angle γ was not available for *Homo*.
 - (a) Apply agglomerative and divisive hierarchical methods for clustering the variables using all 5 indices and the 2 angles available for all items. Construct dendograms with single-linkage, average-linkage, complete-linkage and Ward-linkage for the methods.

When an isolated observation appears high enough up in the dendrogram, it becomes a cluster of size one and hence plays the role of an outlier. Which linkage methods give outliers?

- (b) Find the five-cluster solutions for these methods. Construct confusion tables and compute the misclassification rate. Which method gives the lowest rate? Which gives the highest rate?
- 4. Consider the `diabetes.txt` data set. Use all the variables other than the class variable. Try to apply the E-M algorithm. Is the E-M algorithm appropriate here?