Multivariate Statistical Analysis

Homework 7

Lucas Fellmeth, Helen Kafka, Sven Bergmann

04/30/24

Problem 1

The `British_towns` dataset contains distances between 48 British towns.

```
towns <- read.csv(file = "../Data_csv/British_towns.csv")
towns <- subset(towns, select = -V1)
towns <- as.matrix(towns)
rownames(towns) <- colnames(towns)
```

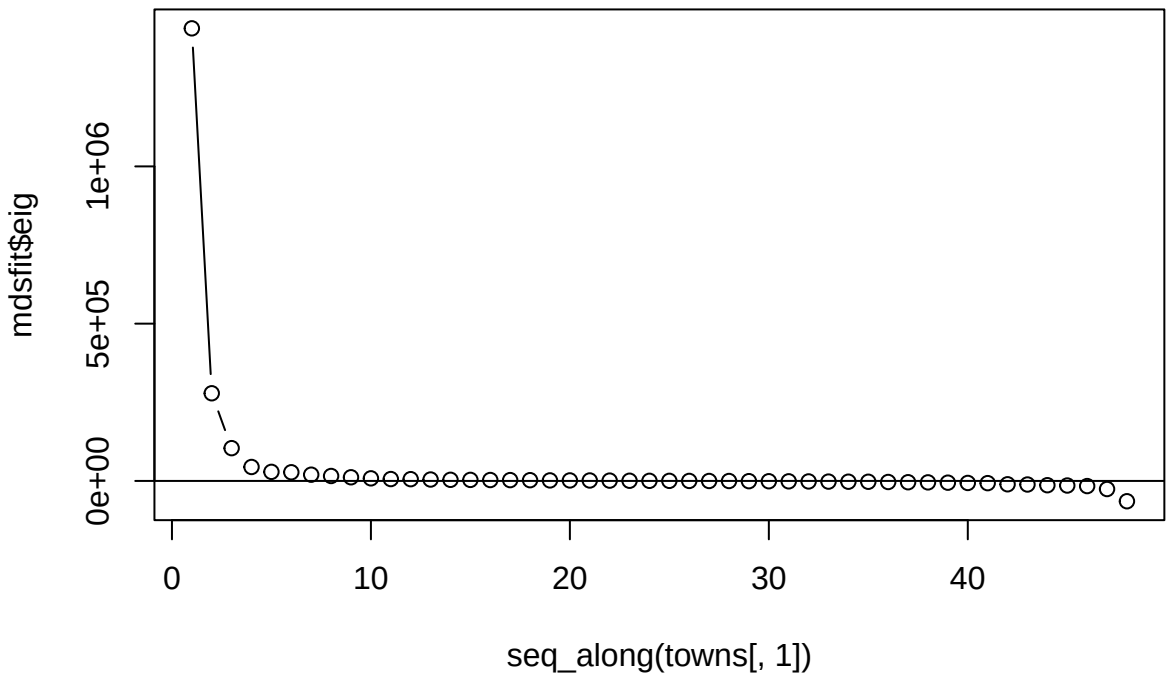
a)

Carry out a metric multidimensional scaling.

```
mdsfit <- cmdscale(d = towns, k = 2, eig = T)
y <- mdsfit$points
```

From a plot of the eigenvalues, does a two-dimensional solution appear reasonable?

```
plot(seq_along(towns[, 1]), mdsfit$eig, type = "b")
abline(h = 0)
```

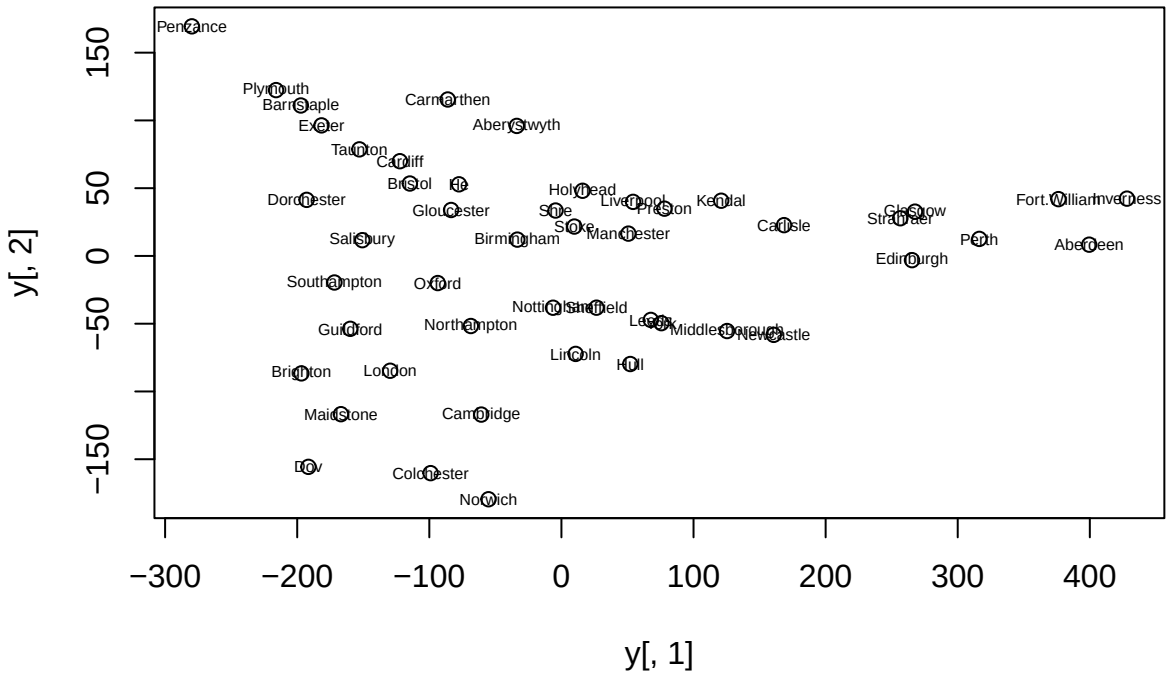


Answer: I think so.

b)

Plot the two-dimensional solution (as a 2D scatterplot) labeling each point by town name.

```
plot(y[, 1], y[, 2])
text(y[, 1], y[, 2], labels = rownames(towns), cex = 0.5)
```



Compare with a map of England. Do they look similar?

Figure 1: Map of british towns

This map is taken from “https://www.britain-visitor.com/images/content_images/british-isles-towns-large.gif”.

Problem 2

Consider the zoo dataset, where 17 variables are observed on 101 animals. Excluding the variable `type`, the other 16 variables are categorical: most of them are yes/no indicators, and `legs` can be seen as a categorical variable too. So, the dissimilarity between animals i and j can be defined as the number of characteristics in which they differ: $\delta_{ij} = \#\{f : x_{ik} \neq x_{jk}\}$. In `R` you can do this as follows: `D <- matrix(nrow=101, ncol=101) for (i in 1:101){ for (j in 1:101){ D[i, j] <- sum(x[i,]!=x[j,]) } }`

```
zoo <- read.csv(file = "../Data_csv/zoo.csv")
```

```
D_zoo <- matrix(nrow = 101, ncol = 101)
for (i in 1:101) {
    for (j in 1:101) {
        D_zoo[i, j] <- sum(zoo[i, ] != zoo[j, ])
    }
}
```

a)

Carry out a two-dimensional multidimensional scaling. Plot the resulting configuration using animal names as labels.

b)

Try to find, if possible, an interpretation for the coordinates, in terms of anatomical or physiological characteristics of the animals.