```
R> r1 <- cmdscale(dcols, eig = TRUE)
R> c1 <- cmdscale(drows, eig = TRUE)
R> plot(r1$points, xlim = range(r1$points[,1], c1$points[,1]) * 1.5,
+       ylim = range(r1$points[,1], c1$points[,1]) * 1.5, type = "n",
+       xlab = "Coordinate 1", ylab = "Coordinate 2", lwd = 2)
R> text(r1$points, labels = colnames(teensex), cex = 0.7)
R> text(c1$points, labels = rownames(teensex), cex = 0.7)
R> abline(h = 0, lty = 2)
R> abline(v = 0, lty = 2)
```

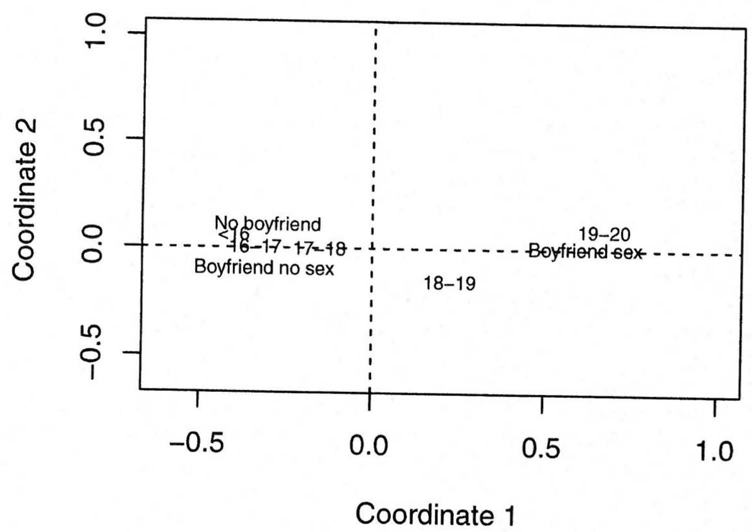

Fig. 4.8. Correspondence analysis for teenage relationship data.

Multidimensional scaling applied to proximity matrices is often useful in uncovering the dimensions on which similarity judgements are made, and correspondence analysis often allows more insight into the pattern of relationships in a contingency table than a simple chi-squared test.

4.8 Exercises

Ex. 4.1 Consider 51 objects $O_1, \ldots, O_{51}$ assumed to be arranged along a straight line with the jth object being located at a point with coordinate j. Define the similarity s_{ij} between object i and object j as

$$s_{ij} = \begin{cases} 9 & \text{if } i = j \\ 8 & \text{if } 1 \le |i-j| \le 3 \\ 7 & \text{if } 4 \le |i-j| \le 6 \\ & \cdots \\ 1 & \text{if } 22 \le |i-j| \le 24 \\ 0 & \text{if } |i-j| \ge 25. \end{cases}$$

Convert these similarities into dissimilarities (δ_{ij}) by using

$$\delta_{ij} = \sqrt{s_{ii} + s_{jj} - 2s_{ij}}$$

and then apply classical multidimensional scaling to the resulting dissimilarity matrix. Explain the shape of the derived two-dimensional solution.

Ex. 4.2 Write an R function to calculate the chi-squared distance matrices for both rows and columns in a two-dimensional contingency table.

Ex. 4.3 In Table 4.7 (from Kaufman and Rousseeuw 1990), the dissimilarity matrix of 18 species of garden flowers is shown. Use some form of multidimensional scaling to investigate which species share common properties.