R Notebook

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Chickadee Pathogen Data Statistical Analysis

TRU 4001 - Biostatistics - Final Project

Introduction

This is a personal notebook which accompanies the final project for Thompson Rivers University's Biology 4001, Biostatistics taught by Professor Iain Pardoe. The submission is a report which in the style of a research paper in biology.

This notebook includes the task requirements, as well as other statistical techniques which may be useful to carry out and document. The notebook shall serve as a general guideline and template for statistical analyses for future work.

1. Problem Definition

Problem Space

Data from nest boxes at 47 mountain chickadee sites was collected to examine microbial community compositions associated with chickadees in urban, semi-urban, and rural environments. DNA sequencing was used to determine the relative abundance of different microbial taxa present in swabs from either chickadee nests or feathers in nest boxes in these three habitat types. Nest boxes were set up to encourage nesting in the sample sites. For the feather data, physical characteristics of the birds were recorded. The data was also used to determine two different measures of microbial species richness (alpha diversity) at each site.

From the description, it appears that we are interested in microbial community compositions, particularly pathogenic bacteria species, and their relationship with features of mountain chickadees.

Type of Problem

- Determine whether the problem is a descriptive study, hypothesis testing, estimation, prediction, etc.

There are various problems in this task, including descriptive studies, hypothesis testing, estimation, and prediction.

Task/Question/Hypothesis

- Clearly Define the questions to be answered or the hypotheses to be tested.
- Make sure all the information needed to answer each question is provided (e.g., for questions that ask you to do a test, state the hypotheses you're testing, the test statistic and p-value obtained from R, the decision based on a significance level of 5%, and the conclusion in the context of the question).

(Graded) --

- Summarize the data in **`ChickadeeData.csv`** numerically.
- Summarize the data in **`ChickadeeData.csv`** graphically.
- Use a two-sample *t*-test to determine whether the mean abundance of bacteria identified as genus *Escherichia/Shigella* differs significantly between nests and feathers. [Consider transforming variable **`EscShi`** and use R function **`t.test`**. Be careful when applying the natural logarithm transformation to data containing zeros since ln(0) is undefined. The usual way around this is to calculate ln(y+1) instead of ln(y).]
- Use a Mann-Whitney U-test (Wilcoxon rank sum test) to determine whether the population distribution of the abundance of bacteria identified as genus *Escherichia/Shigella* differs significantly between nests and feathers. [Use R function **`wilcox.test`**.]
- Use a two-sample *t*-test to determine whether the mean abundance of bacteria identified as genus *Enterococcus* differs significantly between nests and feathers. [Consider transforming variable **`Entero`** and use R function **`t.test`**.]
- Use a Mann-Whitney U-test (Wilcoxon rank sum test) to determine whether the population distribution of the abundance of bacteria identified as genus *Enterococcus* differs significantly between nests and feathers. [Use R function **`wilcox.test`**.]
- Use analysis of variance to determine whether mean pathogen richness is related to habitat. [Use R functions **`lm`** and **`anova`**.]
- Use a Kruskal-Wallis test to determine whether mean pathogen richness is related to habitat. [Use R function **`kruskal.test`**.]
- Use the Tukey-Kramer method to which habitats differ with respect to mean pathogen richness. [Use R functions **`emmeans`** and **`contrast`**.]
- Use contingency table analysis to determine whether community richness on feathers is independent of mountain chickadees sex? [Use R function **`filter`** in the **`dplyr`** package to subset the data frame to retain only feather swabs, then use R functions **`table`** and **`chisq.test`**.]
- Use simple linear regression to determine which of **`WingChord`**, **`BirdWeight`**, **`TailLen`**, or **`TarsusLen`** is most linearly associated with pathogen richness on feathers. [Use R functions **`lm`** and **`summary`**.]
- For the simple linear regression model selected in Question 11, investigate whether there are any outliers. An outlier in the context of linear regression is an observation with an extreme difference between the observed response value and the predicted response value from the model. Use the **`filter`** function to create a new data frame that excludes the most extreme outlier and refit the simple linear regression model. Report the results for the model fit to the data frame excluding the outlier and use this data frame to answer Questions 13-18.
- Find the best multiple linear regression model for predicting pathogen richness on feathers from two predictors out of **`WingChord`**, **`BirdWeight`**, **`TailLen`**, and **`TarsusLen`**. [Use R functions **`lm`** and **`summary`**.]
- Use a two-sample *t*-test to determine whether mean pathogen richness on feathers differs significantly between male and female birds. [Use R function **`t.test`**.]
- Starting from the simple linear regression model in Question 12, use analysis of covariance to investigate whether the linear association in the model differs for male and female birds. [Use R functions **`lm`** and **`summary`**.]
- Apply principal component analysis to the variables **`WingChord`**, **`BirdWeight`**, **`TailLen`**, and **`TarsusLen`**. [Use R functions **`scale`**, **`prcomp`**, and **`summary`**. Also, summarize the principal component loadings and use R function **`fviz_pca_ind`** with argument **`habillage`** to visualize the results and colour the observations by bird sex.]

- Fit a simple linear regression model with response variable **`PathRich`** and predictor variable equal to the first principal component from Question 16. Compare this model with the simple linear regression model in Question 12. [Use R functions **`lm`** and **`summary`**.]

- Fit a multiple linear regression model with response variable **`PathRich`** and predictor variables equal to the first two principal components from Question 16. Compare this model with the multiple linear regression model in Question 13. [Use R functions **`lm`** and **`summary`**.]

- Apply metric multidimensional scaling (MDS) to the dissimilarities data in the **`ChickadeeDissimilarities.csv`** file. [Use R function **`cmdscale`** to perform the metric MDS and use function **`ggplot`** to create a scatterplot that projects the data onto the first two principal coordinates. Then use the **`shape`** aesthetic to first mark the points by **`Habitat`** and then by **`Source`**.] Does the composition of the microbial communities appear to be related to **`Habitat`** or **`Source`**?

- Apply nonmetric multidimensional scaling (NMDS) to the dissimilarities data in the **`ChickadeeDissimilarities.csv`** fi [Use R function **`metaMDS`** to perform the NMDS and use function **`ggplot`** to create a scatterplot that projects the data onto the first two NMDS axes. Then use the **`shape`** aesthetic to first mark the points by **`Habitat`** and then by **`Source`**.] Does the composition of the microbial communities appear to be related to **`Habitat`** or **`Source`**?

---

2. Data Collection and Preprocessing

Data Source

- Identify the sources of data, whether it is from an experiment, survey, existing dataset, etc.

The data in the **`ChickadeeData.csv`** file consist of the following variables:

- **`Site`** = Name of the site
- **`Habitat`** = Whether the nest box is in an urban, semi-urban, or rural habitat
- **`Source`** = Whether the swab was taken from a nest or a feather
- **`EscShi`** = Abundance of pathogenic bacteria identified as genus *Escherichia/Shigella*
- **`Entero`** = Abundance of pathogenic bacteria identified as genus *Enterococcus*
- **`CommRich`** = Categorical measure of alpha diversity equal to "high" if the number of unique bacterial species present in the swab exceeds 400, or equal to "low" otherwise
- **`PathRich`** = Quantitative measure of alpha diversity equal to the number of unique potentially pathogenic bacteria species present in the swab
- **`WingChord`** = Measure of bird wing size (for feather swabs only)
- **`BirdWeight`** = Measure of bird weight (for feather swabs only)
- **`TailLen`** = Measure of bird tail length (for feather swabs only)
- **`TarsusLen`** = Measure of bird tarsus length (for feather swabs only)
- **`BirdSex`** = Sex of the bird (for feather swabs only)

Microbial community composition data for 2607 taxa was also used to calculate Bray Curtis dissimilarities between the 47 sites; these are in the **`ChickadeeDissimilarities.csv`** file.

Data Cleaning

- Preprocess the data to handle missing values, outliers, or other anomalies.

As the dataset was provided as an assignment, no preprocessing is required. However, let us do a basic check for null values:

```
# Read the data
chickadeeData <- read.csv("ChickadeeData.csv")
dissimilaritiesData <- read.csv("ChickadeeDissimilarities.csv")

# Check for Missing Data in the Entire Dataset
sum(is.na(chickadeeData))
```

```
## [1] 85
```

```
# Check for Missing Data Column-wise
colSums(is.na(chickadeeData))
```

```
##       Site    Habitat     Source     EscShi     Entero   CommRich   PathRich
##          0          0          0          0          0          0          0
##  WingChord BirdWeight    TailLen  TarsusLen    BirdSex
##         17         17         17         17         17
```

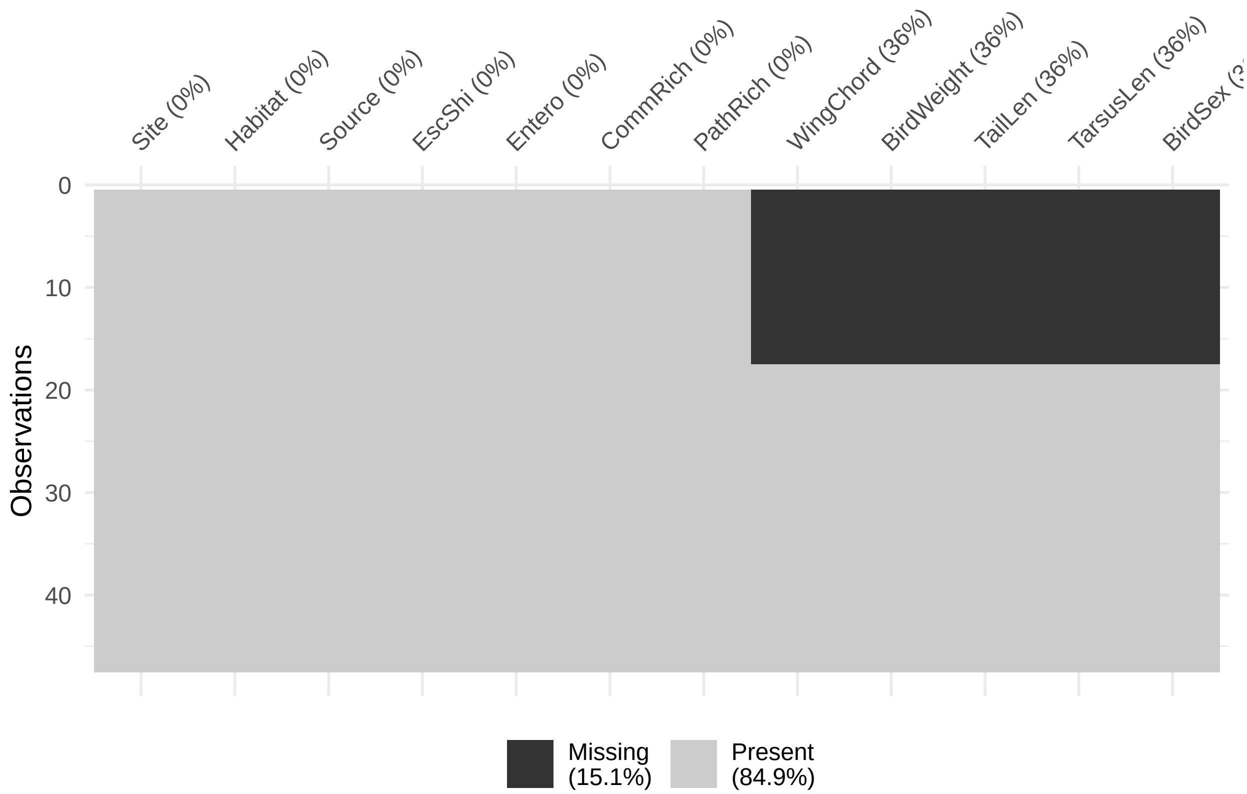
```
# Check for Missing Data Row-wise
rowSums(is.na(chickadeeData))
```

```
##  [1] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [39] 0 0 0 0 0 0 0 0 0
```

```
# Visualizing Missing Data
library(visdat)
```

```
## Warning: package 'visdat' was built under R version 4.3.1
```

```
vis_miss(chickadeeData)
```




```
# Now for dissimilarities data

# Check for Missing Data in the Entire Dataset
sum(is.na(dissimilaritiesData))
```

```
## [1] 0
```

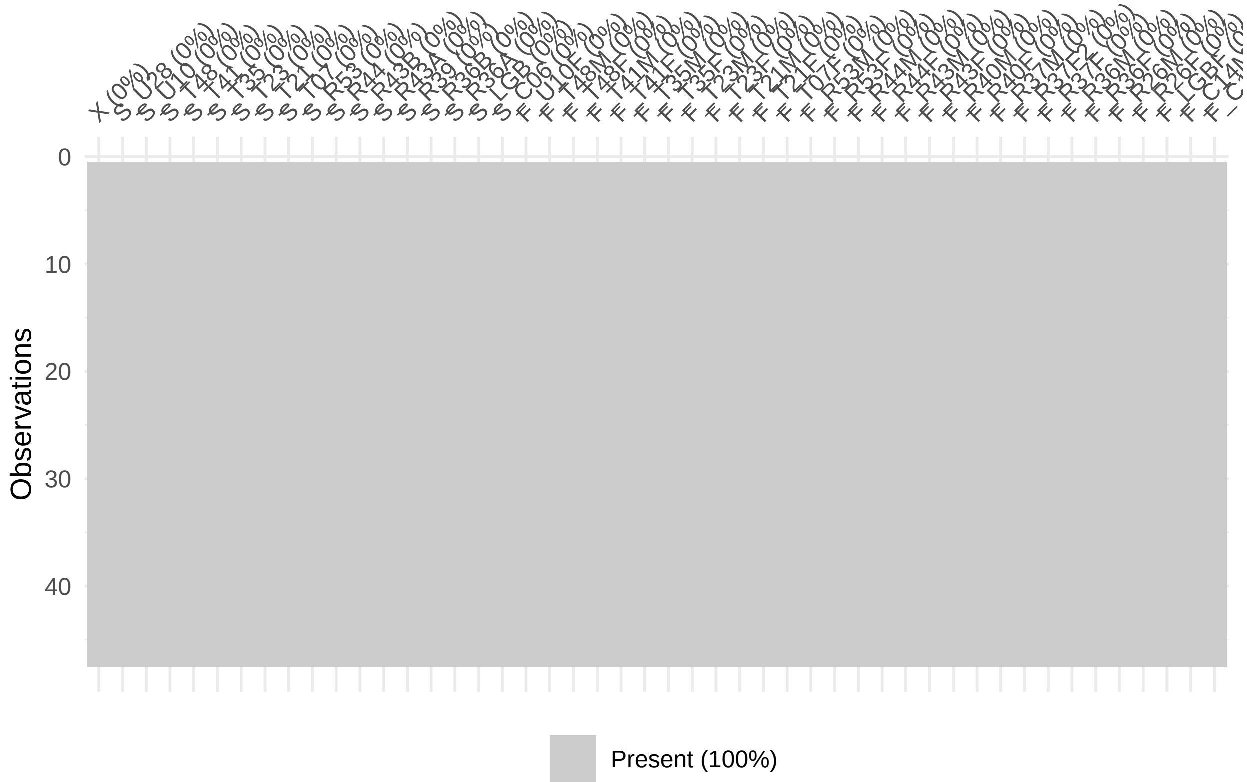
```
# Check for Missing Data Column-wise
colSums(is.na(dissimilaritiesData))
```

```
##       X   S_U28   S_U10   S_T48   S_T41   S_T35   S_T23   S_T21   S_T07   S_R53
##       0       0       0       0       0       0       0       0       0       0
##   S_R44  S_R43B  S_R43A   S_R39  S_R36B  S_R36A   S_LGB   S_C06  F_U10F  F_T48M
##       0       0       0       0       0       0       0       0       0       0
##  F_T48F  F_T41M  F_T41F  F_T35M  F_T35F  F_T23M  F_T23F  F_T21M  F_T21F  F_T07F
##       0       0       0       0       0       0       0       0       0       0
##  F_R53M  F_R53F  F_R44M  F_R44F  F_R43M  F_R43F  F_R40M  F_R40F  F_R37M F_R37F2
##       0       0       0       0       0       0       0       0       0       0
##  F_R37F  F_R36M  F_R36F  F_R26M  F_R26F  F_LGBF  F_C14M  F_C14F
##       0       0       0       0       0       0       0       0
```

```
# Check for Missing Data Row-wise
rowSums(is.na(dissimilaritiesData))
```

```
##  [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [39] 0 0 0 0 0 0 0 0 0
```

```r
# Visualizing Missing Data
vis_miss(dissimilaritiesData)
```



It appears that 15.1% of the chickadee dataset is missing, while there is no null data in the dissimilarities dataset.

For now, we will leave it as we develop a better understanding of the data and the problem.

Experimental Design Considerations

- Designing Effective Experiments: consider (a) reducing bias in estimating and testing treatment effects, and (b) reducing the effects of sampling error.
- Topics in experimental design include randomized controlled trials, control groups, treatment groups, and experimental controls.
- Reduce bias: Use Simultaneous control group, randomization, and blinding.
- Reduce the influence of sampling error: Replication, balance, blocking, and extreme treatments.
- If you can't do experiments: Match and adjust.
- Sample size: Plan for precision, power, and data loss.
- A priori tests or analyses.

Feature Engineering

- Deriving new variables that might be relevant for analysis.

Data Transformation

- Such as normalization, standardization, or logarithmic transformation if required.
- Generally, scaling is required when: variables are measured in different units, When the algorithm is based on distance or gradient, or for interpretability.

3. Exploratory Data Analysis

- Exploratory Data Analysis (EDA) is an essential step in understanding the data, identifying patterns, spotting anomalies, and developing an intuition about the relationships between variables.

Data Inspection

- The first step should be to open and inspect the dataset (even in a spreadsheet). View the first few lines and familiarize yourself with the variable names.

- A good first goal is to find a plot type that clearly and efficiently visualizes the patterns in the data, especially the differences among groups.

Let us open and inspect the data in excel, to get a first glance. The variables and the data are already described in the assignment.

Setup

```
# setwd("C:\\Users\\JP\\Desktop\\RECENT\\Biology\\BIOL 4001 - Biostatistics\\Final")
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 4.3.1
```

```
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 4.3.1
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```r
library(emmeans)
```

```
## Warning: package 'emmeans' was built under R version 4.3.1
```

```r
library(GGally)
```

```
## Warning: package 'GGally' was built under R version 4.3.1

## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2

##
## Attaching package: 'GGally'

## The following object is masked from 'package:emmeans':
##
##     pigs
```

```r
library(factoextra)
```

```
## Warning: package 'factoextra' was built under R version 4.3.1

## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```r
library(ggrepel)
```

```
## Warning: package 'ggrepel' was built under R version 4.3.1
```

```r
library(vegan)
```

```
## Warning: package 'vegan' was built under R version 4.3.1

## Loading required package: permute

## Warning: package 'permute' was built under R version 4.3.1

## Loading required package: lattice

## This is vegan 2.6-4
```

```r
library(Hmisc)
```

```
## Warning: package 'Hmisc' was built under R version 4.3.1

##
## Attaching package: 'Hmisc'
```

```
## The following objects are masked from 'package:dplyr':
##
##     src, summarize

## The following objects are masked from 'package:base':
##
##     format.pval, units
```

```
library(car)
```

```
## Warning: package 'car' was built under R version 4.3.1

## Loading required package: carData

## Warning: package 'carData' was built under R version 4.3.1

##
## Attaching package: 'car'

## The following object is masked from 'package:dplyr':
##
##     recode
```

```
library(pheatmap)
```

```
## Warning: package 'pheatmap' was built under R version 4.3.1
```

```
library(photobiology)
```

```
## Warning: package 'photobiology' was built under R version 4.3.1

## News at https://www.r4photobiology.info/
```

```
library(ggrepel)
library(reshape2)
```

```
## Warning: package 'reshape2' was built under R version 4.3.1
```

```
library(rgl)
```

```
## Warning: package 'rgl' was built under R version 4.3.1
```

```
library(vcd)
```

```
## Warning: package 'vcd' was built under R version 4.3.1

## Loading required package: grid
```

```r
library(ade4)
```

```
## Warning: package 'ade4' was built under R version 4.3.1
```

```r
theme_set(theme_classic())
```

Summary Statistics

- Measures of Central Tendency: Mean, median, and mode.
- Measures of Spread: Variance, standard deviation, range, interquartile range (IQR).
- Measures of Shape: Skewness (asymmetry) and kurtosis (tailedness).
- Percentiles: Quantiles including the quartiles.
- Correlation: Correlation coefficients to measure linear relationships between variables.
- Summary Statistics by Group.
- Summarize the data in **ChickadeeData.csv** numerically.

```r
# Summarize data
summary(chickadeeData)
```

```
##      Site              Habitat              Source              EscShi      
##  Length:47          Length:47          Length:47          Min.   :   0.0  
##  Class :character   Class :character   Class :character   1st Qu.:  25.0  
##  Mode  :character   Mode  :character   Mode  :character   Median : 112.0  
##                                                           Mean   : 577.9  
##                                                           3rd Qu.: 432.5  
##                                                           Max.   :6520.0  
##                                                                           
##      Entero          CommRich            PathRich      WingChord    
##  Min.   :  0.00   Length:47          Min.   :11.0   Min.   :60.00  
##  1st Qu.:  9.00   Class :character   1st Qu.:36.0   1st Qu.:63.00  
##  Median : 20.00   Mode  :character   Median :41.0   Median :65.00  
##  Mean   : 92.74                      Mean   :44.3   Mean   :64.78  
##  3rd Qu.: 48.50                      3rd Qu.:53.5   3rd Qu.:66.75  
##  Max.   :687.00                      Max.   :88.0   Max.   :69.00  
##                                                     NA's   :17     
##    BirdWeight    TailLen         TarsusLen       BirdSex         
##  Min.   :10   Min.   :53.00   Min.   :16.80   Length:47         
##  1st Qu.:11   1st Qu.:55.00   1st Qu.:17.93   Class :character  
##  Median :11   Median :57.00   Median :18.25   Mode  :character  
##  Mean   :12   Mean   :57.23   Mean   :18.25                     
##  3rd Qu.:12   3rd Qu.:60.00   3rd Qu.:18.68                     
##  Max.   :17   Max.   :62.00   Max.   :19.50                     
##  NA's   :17   NA's   :17      NA's   :17                        
```

```r
head(chickadeeData)
```

```
##    Site Habitat Source EscShi Entero CommRich PathRich WingChord BirdWeight
## 1 S_U28   rural   nest     86    557      low       41        NA         NA
## 2 S_U10   rural   nest   1429    546      low       36        NA         NA
## 3 S_T48   rural   nest      0     84      low       31        NA         NA
## 4 S_T41   rural   nest      1     22      low       41        NA         NA
## 5 S_T35   rural   nest    248      4      low       38        NA         NA
## 6 S_T23   rural   nest      8     13      low       31        NA         NA
##   TailLen TarsusLen BirdSex
## 1      NA        NA    <NA>
## 2      NA        NA    <NA>
## 3      NA        NA    <NA>
## 4      NA        NA    <NA>
## 5      NA        NA    <NA>
## 6      NA        NA    <NA>
```

```
# See column names
names(chickadeeData)
```

```
##  [1] "Site"       "Habitat"    "Source"     "EscShi"     "Entero"
##  [6] "CommRich"   "PathRich"   "WingChord"  "BirdWeight" "TailLen"
## [11] "TarsusLen"  "BirdSex"
```

```
# Check unique values of a specific column
unique(chickadeeData$Source)
```

```
## [1] "nest"    "feather"
```

```
# Detailed summary of dataframe
str(chickadeeData)
```

```
## 'data.frame':    47 obs. of  12 variables:
##  $ Site      : chr  "S_U28" "S_U10" "S_T48" "S_T41" ...
##  $ Habitat   : chr  "rural" "rural" "rural" "rural" ...
##  $ Source    : chr  "nest" "nest" "nest" "nest" ...
##  $ EscShi    : int  86 1429 0 1 248 8 14 4 0 4 ...
##  $ Entero    : int  557 546 84 22 4 13 22 20 15 9 ...
##  $ CommRich  : chr  "low" "low" "low" "low" ...
##  $ PathRich  : int  41 36 31 41 38 31 45 48 49 32 ...
##  $ WingChord : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ BirdWeight: int  NA NA NA NA NA NA NA NA NA NA ...
##  $ TailLen   : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ TarsusLen : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ BirdSex   : chr  NA NA NA NA ...
```

```
# Summarize each variable using Hmisc
describe(chickadeeData)
```

```
## chickadeeData
##
##  12  Variables      47  Observations
## --------------------------------------------------------------------------------
```

```
## Site
##        n  missing distinct
##       47        0       47
##
## lowest : F_C14F F_C14M F_LGBF F_R26F F_R26M, highest: S_T35  S_T41  S_T48  S_U10  S_U28
## ---------------------------------------------------------------------------------
## Habitat
##        n  missing distinct
##       47        0        3
##
## Value           rural semi-urban      urban
## Frequency          20         14         13
## Proportion      0.426      0.298      0.277
## ---------------------------------------------------------------------------------
## Source
##        n  missing distinct
##       47        0        2
##
## Value      feather    nest
## Frequency       30      17
## Proportion   0.638   0.362
## ---------------------------------------------------------------------------------
## EscShi
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##       47        0       42        1    577.9    905.8      1.0      3.2
##      .25      .50      .75      .90      .95
##     25.0    112.0    432.5   1348.0   2941.7
##
## Value          0    50   100   150   200   250   300   350   450   850   900
## Frequency     16     6     3     3     3     2     1     1     2     1     1
## Proportion 0.340 0.128 0.064 0.064 0.064 0.043 0.021 0.021 0.043 0.021 0.021
##
## Value       1200  1250  1400  2250  3200  3750  6500
## Frequency      1     2     1     1     1     1     1
## Proportion 0.021 0.043 0.021 0.021 0.021 0.021 0.021
##
## For the frequency table, variable is rounded to the nearest 50
## ---------------------------------------------------------------------------------
## Entero
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##       47        0       32    0.998    92.74    142.4      0.0      1.6
##      .25      .50      .75      .90      .95
##      9.0     20.0     48.5    322.4    553.7
##
## Value          0     5    10    15    20    25    30    35    45    60    80
## Frequency      8     6     7     2     5     2     1     1     4     2     1
## Proportion 0.170 0.128 0.149 0.043 0.106 0.043 0.021 0.021 0.085 0.043 0.021
##
## Value        200   285   370   545   555   615   685
## Frequency      1     2     1     1     1     1     1
## Proportion 0.021 0.043 0.021 0.021 0.021 0.021 0.021
##
## For the frequency table, variable is rounded to the nearest 5
## ---------------------------------------------------------------------------------
```

```
## CommRich
##        n  missing distinct
##       47        0        2
##
## Value       high   low
## Frequency     19    28
## Proportion 0.404 0.596
## ---------------------------------------------------------------------------
## PathRich
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##       47        0       30    0.998     44.3    15.48     24.8     30.0
##      .25      .50      .75      .90      .95
##     36.0     41.0     53.5     59.0     63.0
##
## lowest : 11 17 23 29 30, highest: 58 59 63 66 88
## ---------------------------------------------------------------------------
## WingChord
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##       30       17       10    0.983    64.78    2.599    62.00    62.00
##      .25      .50      .75      .90      .95
##    63.00    65.00    66.75    68.00    68.00
##
## Value      60.00 61.98 62.43 62.97 63.96 64.95 65.94 66.93 67.92 69.00
## Frequency      1     3     1     6     3     4     4     4     3     1
## Proportion 0.033 0.100 0.033 0.200 0.100 0.133 0.133 0.133 0.100 0.033
##
## For the frequency table, variable is rounded to the nearest 0.09
## ---------------------------------------------------------------------------
## BirdWeight
##        n  missing distinct     Info     Mean      Gmd
##       30       17        7    0.899       12    1.802
##
## Value      10.00 10.98 11.96 12.94 14.97 15.95 17.00
## Frequency      3    13     8     1     3     1     1
## Proportion 0.100 0.433 0.267 0.033 0.100 0.033 0.033
##
## For the frequency table, variable is rounded to the nearest 0.07
## ---------------------------------------------------------------------------
## TailLen
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##       30       17       10    0.975    57.23    2.834    54.00    54.00
##      .25      .50      .75      .90      .95
##    55.00    57.00    60.00    60.00    60.55
##
## Value      53.00 53.99 54.98 55.97 56.96 57.95 58.94 59.93 60.92 62.00
## Frequency      1     3     5     4     5     2     1     7     1     1
## Proportion 0.033 0.100 0.167 0.133 0.167 0.067 0.033 0.233 0.033 0.033
##
## For the frequency table, variable is rounded to the nearest 0.09
## ---------------------------------------------------------------------------
## TarsusLen
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##       30       17       17    0.995    18.25   0.7779    16.90    17.08
##      .25      .50      .75      .90      .95
```

```
##    17.92    18.25    18.67    19.00    19.11
##
## Value      16.800 16.881 17.097 17.583 17.880 17.988 18.096 18.177 18.285
## Frequency       1      2      1      1      3      2      3      2      1
## Proportion  0.033  0.067  0.033  0.033  0.100  0.067  0.100  0.067  0.033
##
## Value      18.393 18.474 18.582 18.690 18.879 18.987 19.176 19.500
## Frequency       1      2      3      1      2      3      1      1
## Proportion  0.033  0.067  0.100  0.033  0.067  0.100  0.033  0.033
##
## For the frequency table, variable is rounded to the nearest 0.027
## --------------------------------------------------------------------------------
## BirdSex
##        n  missing distinct
##       30       17        2
##
## Value          F     M
## Frequency     17    13
## Proportion 0.567 0.433
## --------------------------------------------------------------------------------
```

```
# Use a table to display example categorical variable
chickadeeTableEscShi <- table(chickadeeData$EscShi)
chickadeeTableEscShi
```

```
##
##    0    1    2    4    8   14   17   22   28   30   31   33   54   56   61   63
##    2    2    1    2    2    1    1    1    1    1    1    1    1    1    1    1
##   78   86  105  112  113  173  180  191  203  232  248  261  288  305  379  486
##    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    2
##  882  906 1228 1267 1294 1429 2269 3230 3771 6520
##    1    1    1    1    1    1    1    1    1    1
```

```
chickadeeTableEntero <- table(chickadeeData$Entero)
chickadeeTableEntero
```

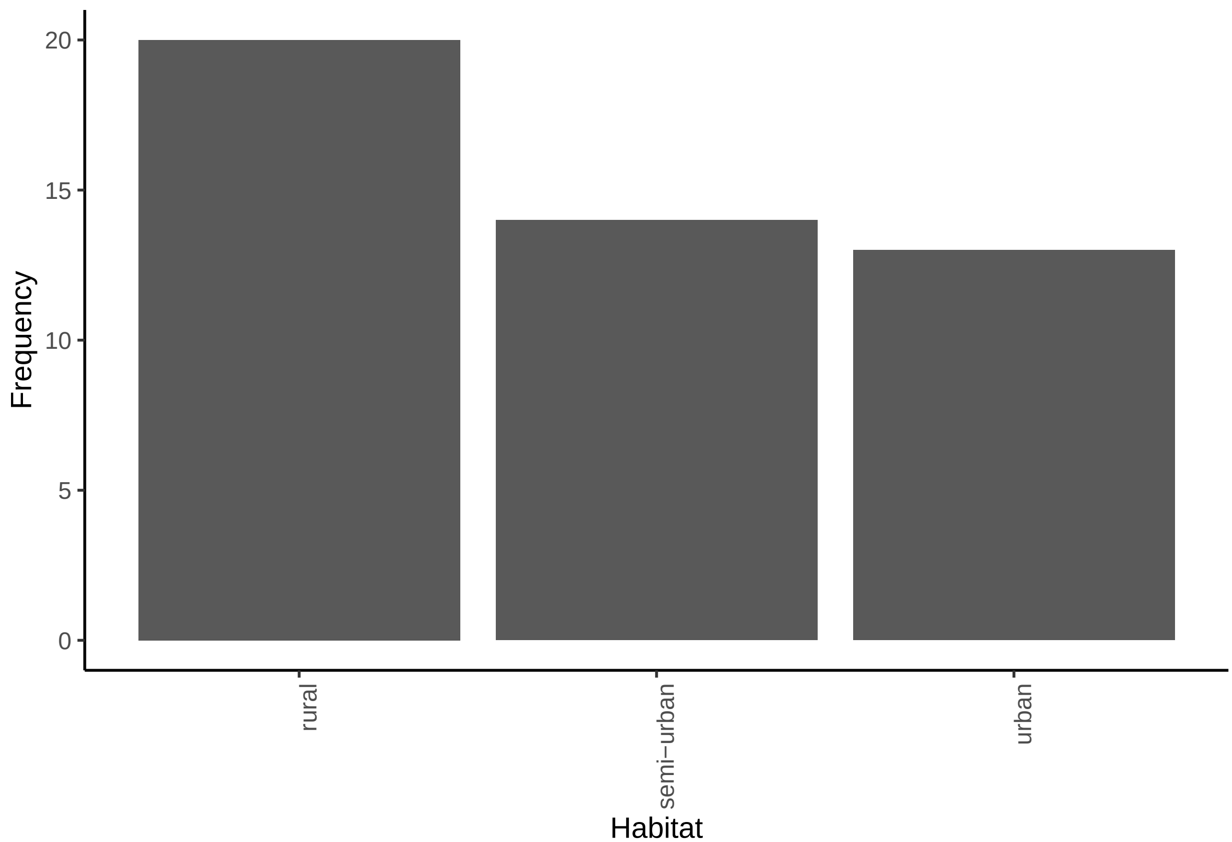
```
##
##   0   1   2   3   4   7   8   9  10  11  12  13  15  19  20  22  28  31  39  45
##   4   1   1   1   1   1   1   4   2   1   1   3   1   1   3   2   2   1   1   2
##  48  49  63  84 202 286 288 374 546 557 615 687
##   1   1   2   1   1   1   1   1   1   1   1   1
```

Visualizations

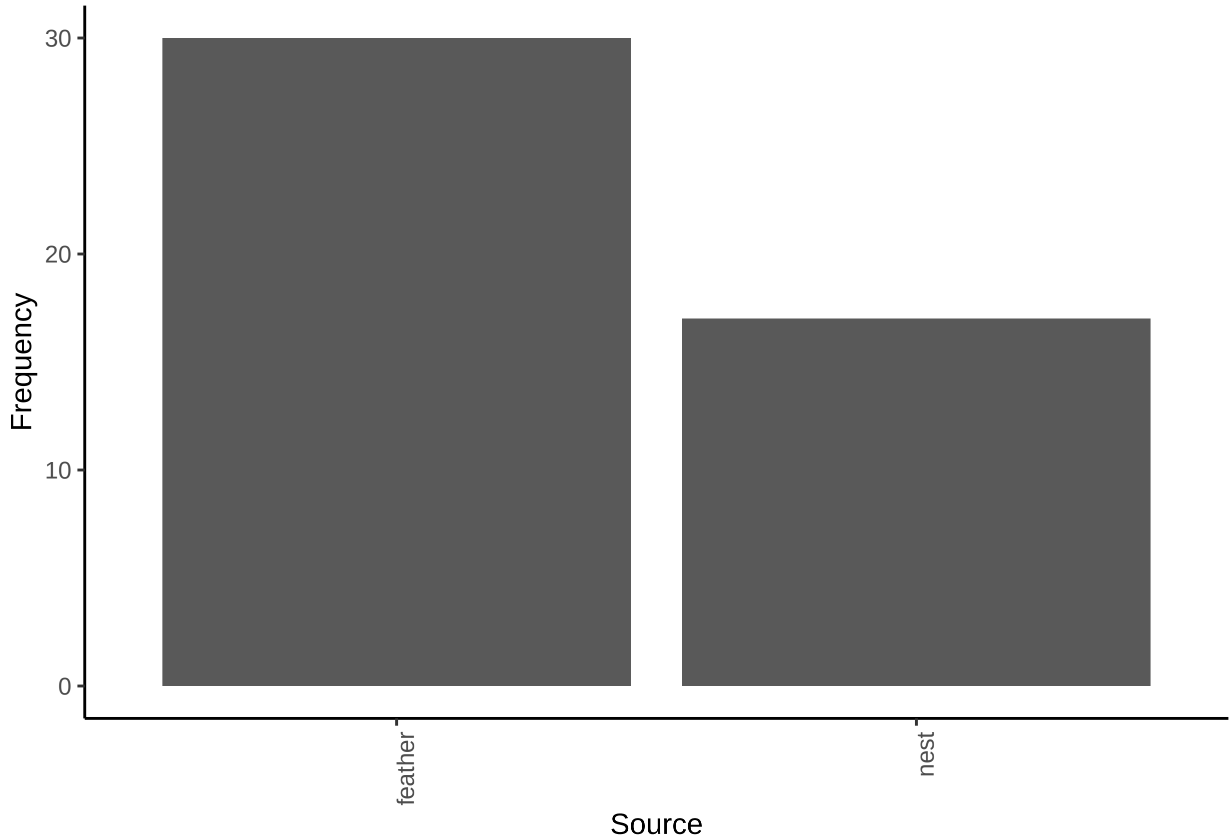
- Histograms: To understand the distribution of a single variable.
- Scatter Plots: To visualize relationships between two continuous variables.
- Box Plots: To see the spread and skewness across categories.
- Heatmaps: For visualizing correlation matrices or two-way frequency tables.
- Pair Plots: A set of scatter plots for all pairs of variables to see relationships and distributions.

- Time Series Plots: If the data is a time series, to visualize trends and seasonality.
- Summarize the data in **ChickadeeData.csv** graphically.

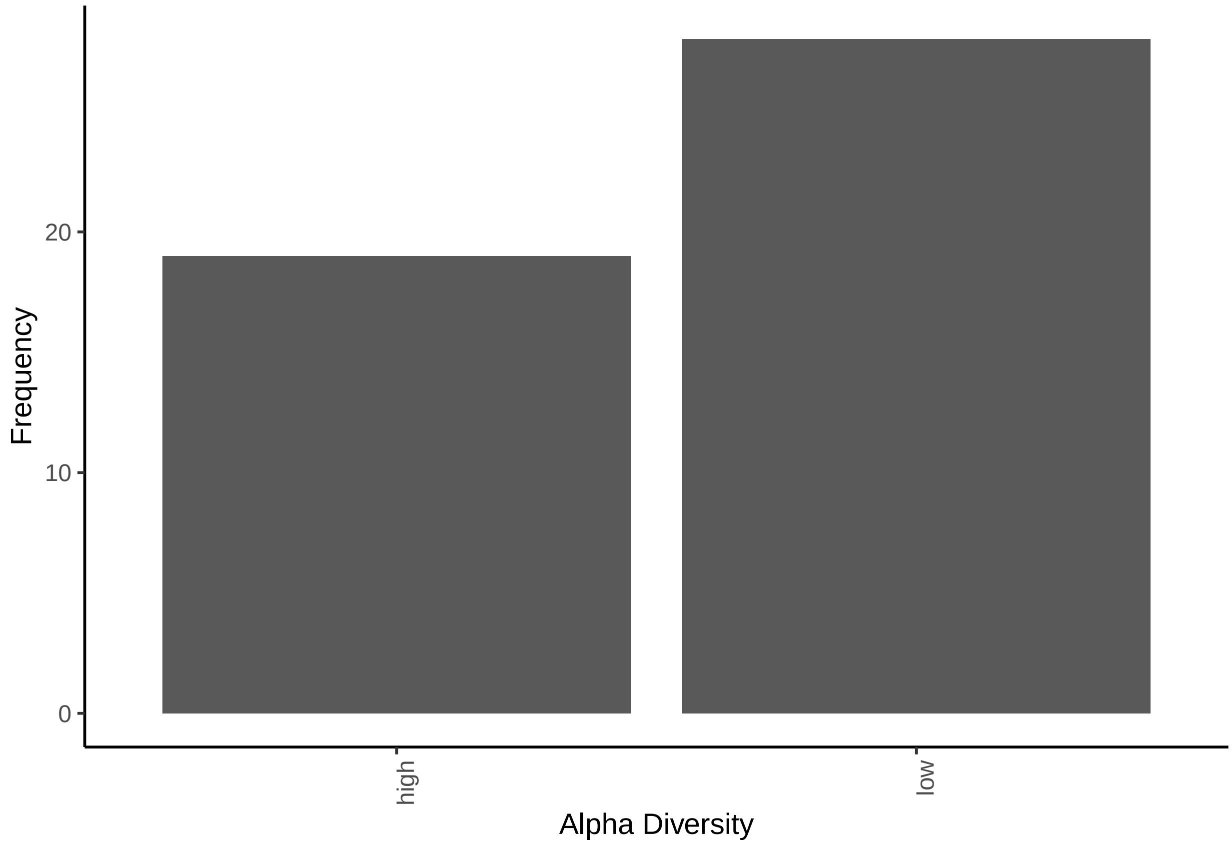
```
# Visualize frequency distributions of single variables

# Bar charts for categorical variables

# Habitat
ggplot(data = chickadeeData, aes(x = Habitat)) +
geom_bar(stat = "count") +
labs(x = "Habitat", y = "Frequency") +
theme(axis.text.x = element_text(angle = 90, hjust = 1))
```



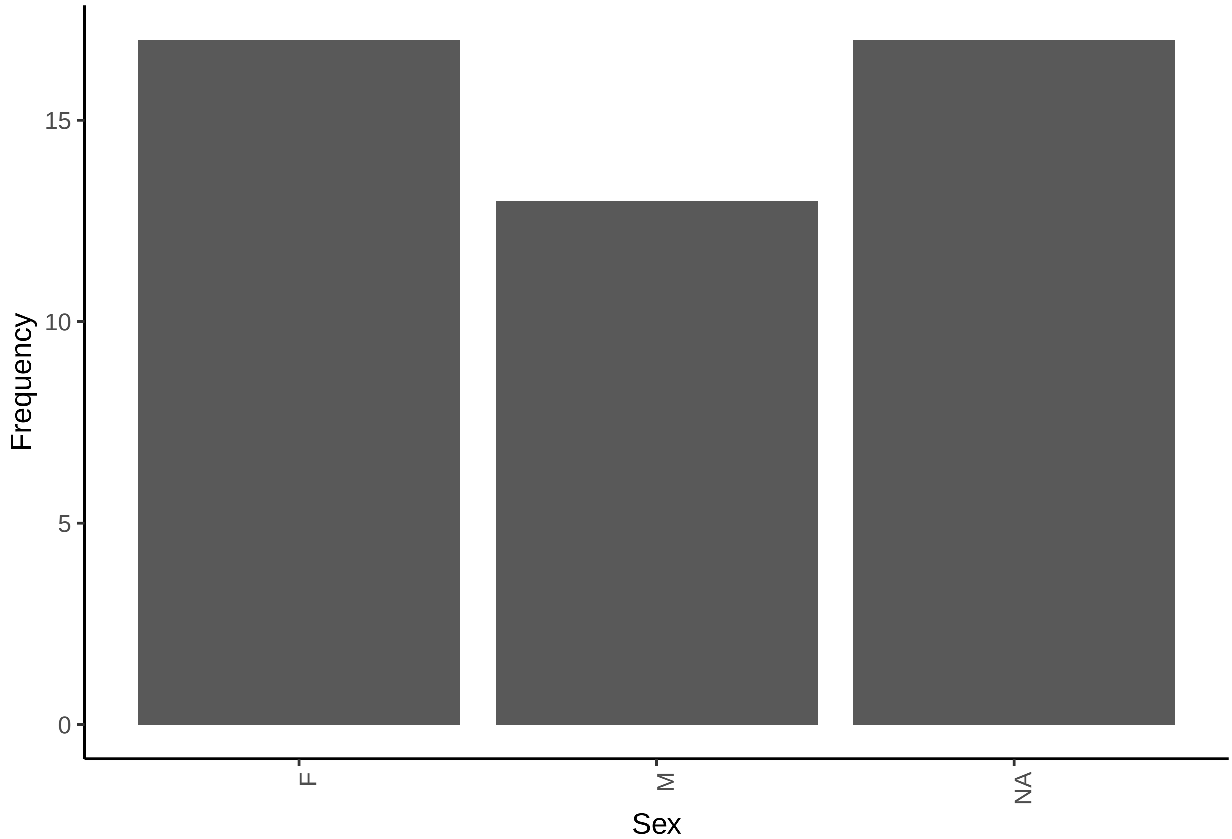

```
# Source
ggplot(data = chickadeeData, aes(x = Source)) +
geom_bar(stat = "count") +
labs(x = "Source", y = "Frequency") +
theme(axis.text.x = element_text(angle = 90, hjust = 1))
```



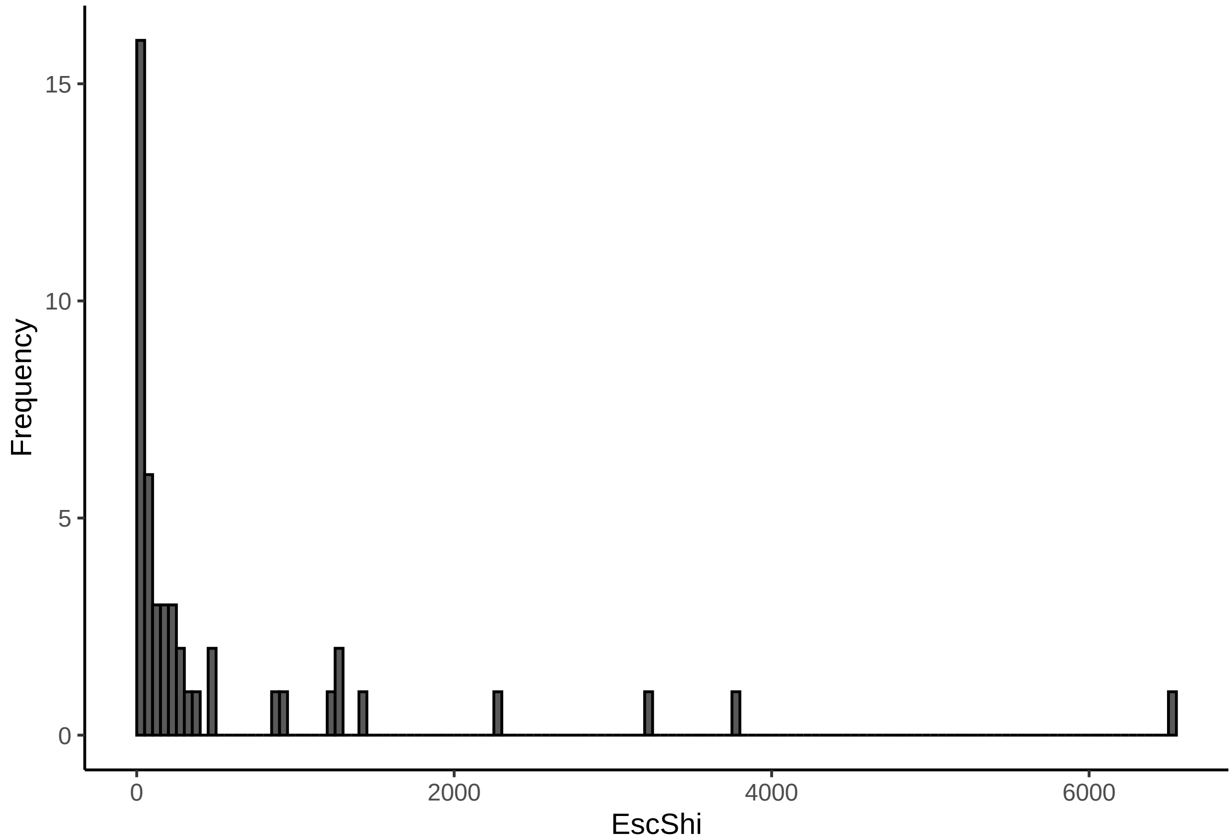

```r
# CommRich
ggplot(data = chickadeeData, aes(x = CommRich)) +
geom_bar(stat = "count") +
labs(x = "Alpha Diversity", y = "Frequency") +
theme(axis.text.x = element_text(angle = 90, hjust = 1))
```



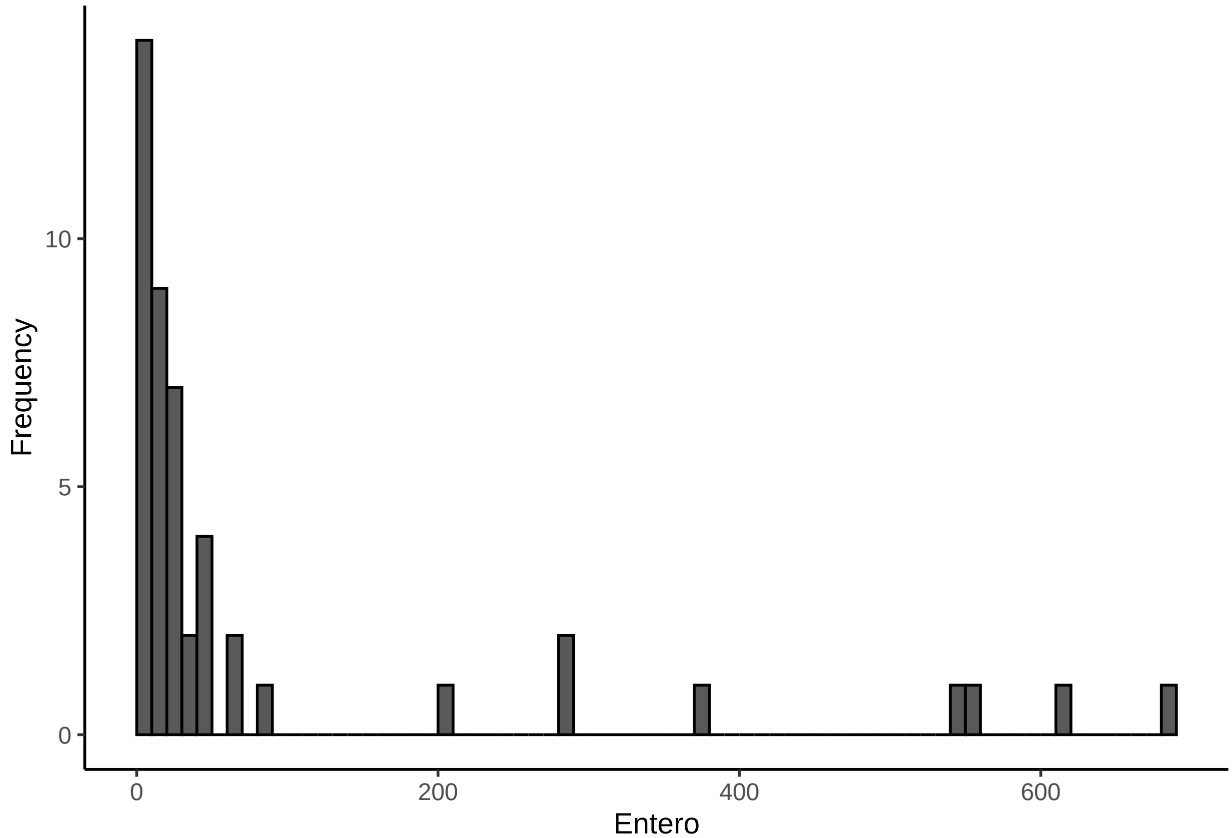

```
# BirdSex
ggplot(data = chickadeeData, aes(x = BirdSex)) +
geom_bar(stat = "count") +
labs(x = "Sex", y = "Frequency") +
theme(axis.text.x = element_text(angle = 90, hjust = 1))
```



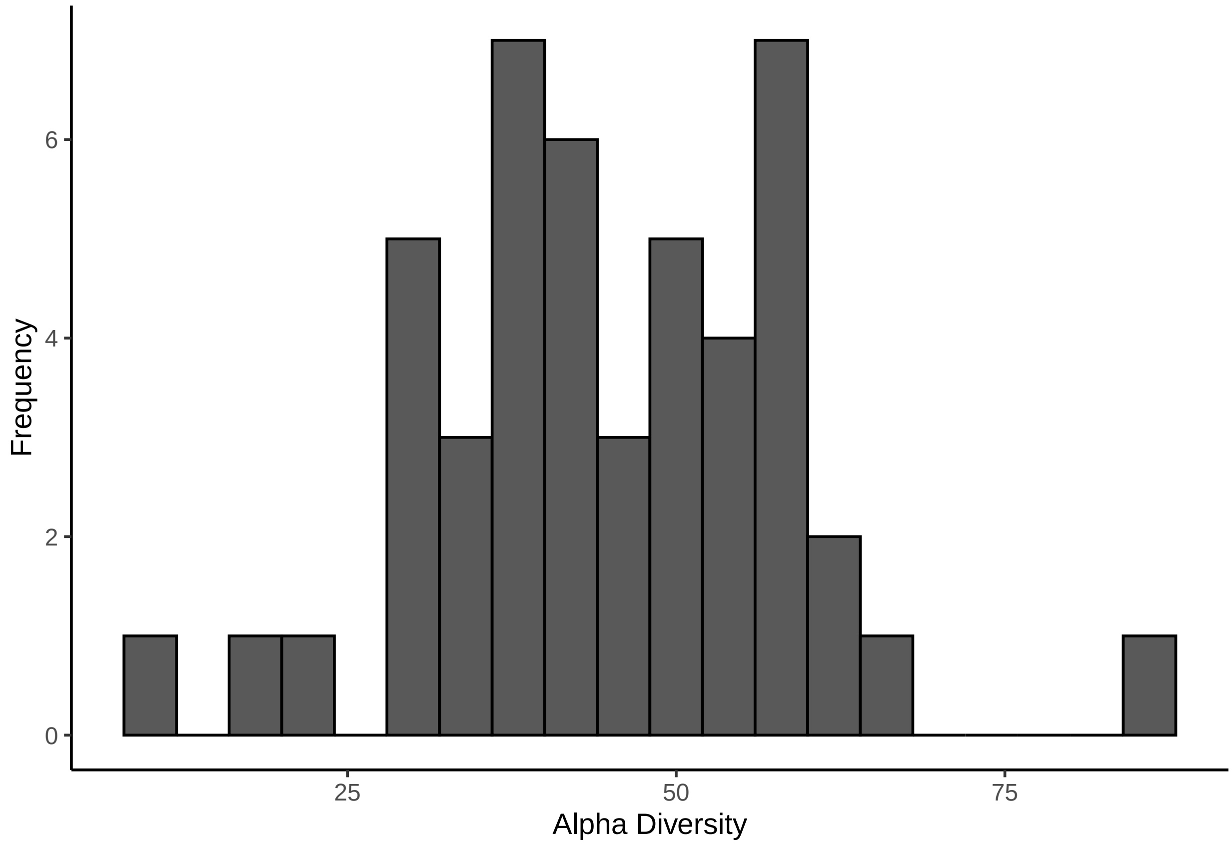

```r
# Histograms for numerical variables

# EscShi
ggplot(data = chickadeeData, aes(x = EscShi)) +
geom_histogram(col = "black", binwidth = 50,
boundary = 0, closed = "left") +
labs(x = "EscShi", y = "Frequency")
```




```
# Entero
ggplot(data = chickadeeData, aes(x = Entero)) +
geom_histogram(col = "black", binwidth = 10,
boundary = 0, closed = "left") +
labs(x = "Entero", y = "Frequency")
```

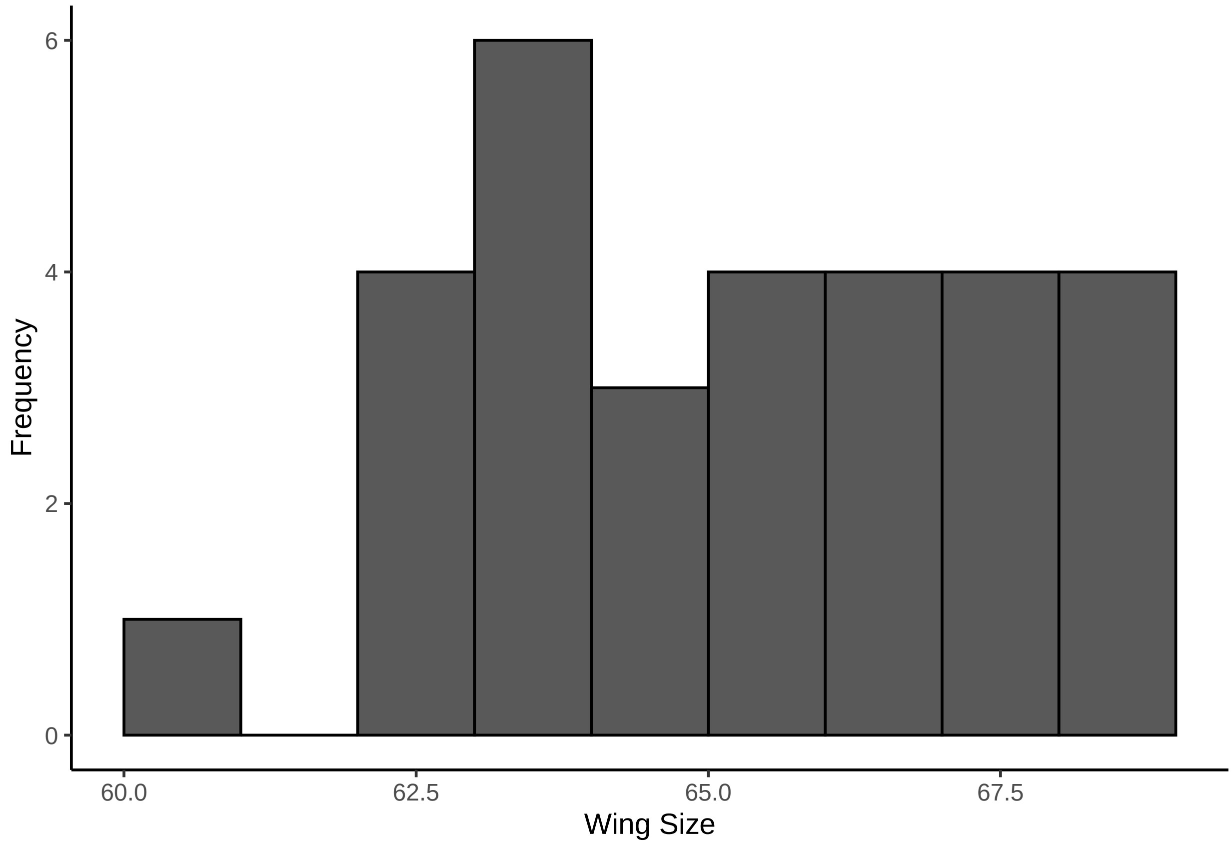



```
# PathRich
ggplot(data = chickadeeData, aes(x = PathRich)) +
geom_histogram(col = "black", binwidth = 4,
boundary = 0, closed = "left") +
labs(x = "Alpha Diversity", y = "Frequency")
```



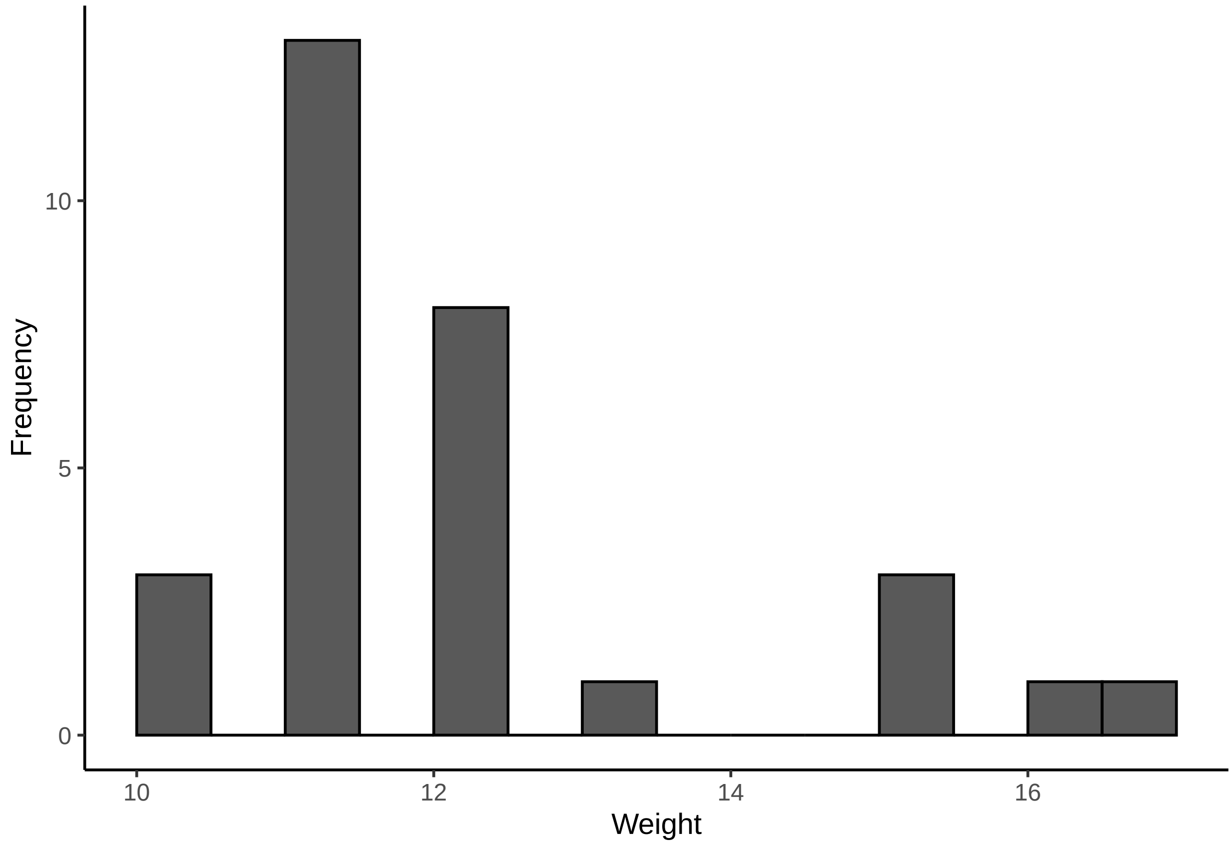

```r
# WingChord
ggplot(data = chickadeeData, aes(x = WingChord)) +
geom_histogram(col = "black", binwidth = 1,
boundary = 0, closed = "left") +
labs(x = "Wing Size", y = "Frequency")
```

```
## Warning: Removed 17 rows containing non-finite values (‘stat_bin()‘).
```



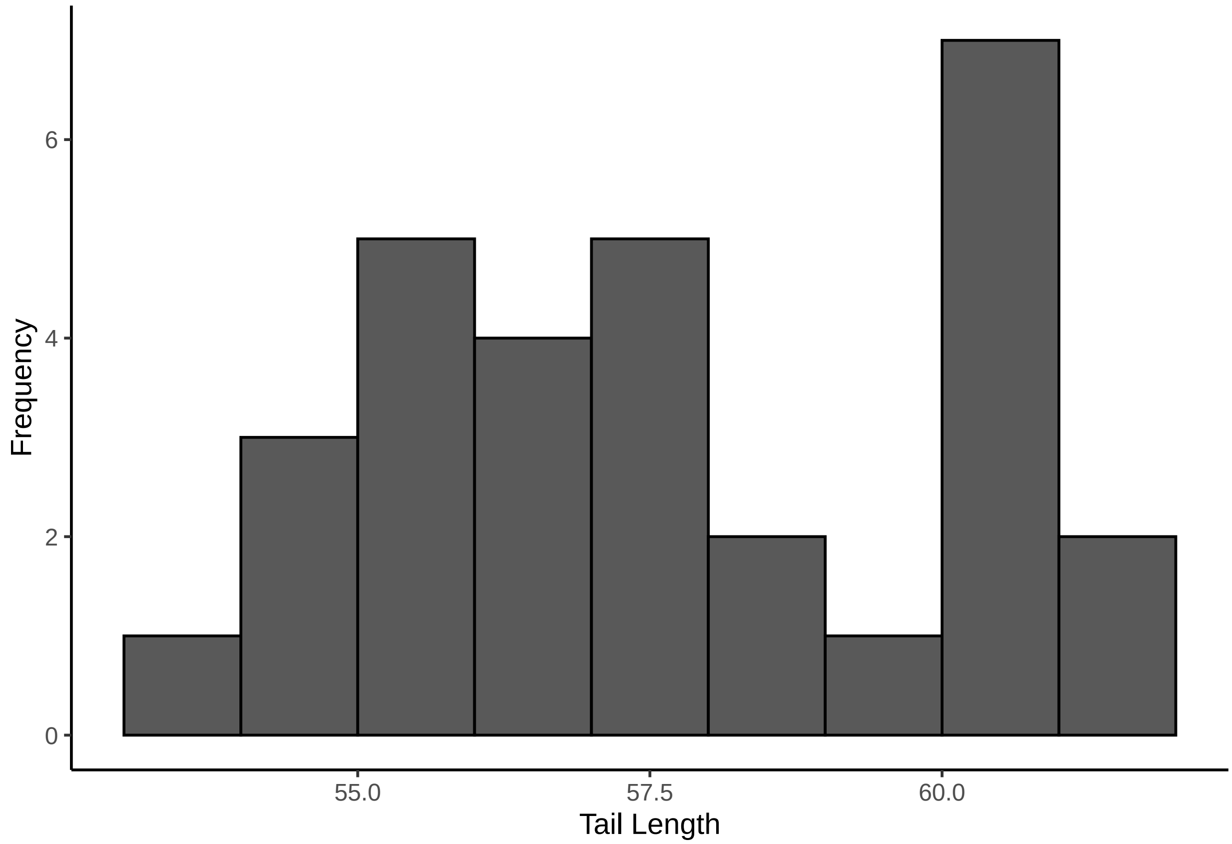

```
# BirdWeight
ggplot(data = chickadeeData, aes(x = BirdWeight)) +
geom_histogram(col = "black", binwidth = 0.5,
boundary = 0, closed = "left") +
labs(x = "Weight", y = "Frequency")
```

```
## Warning: Removed 17 rows containing non-finite values (`stat_bin()`).
```



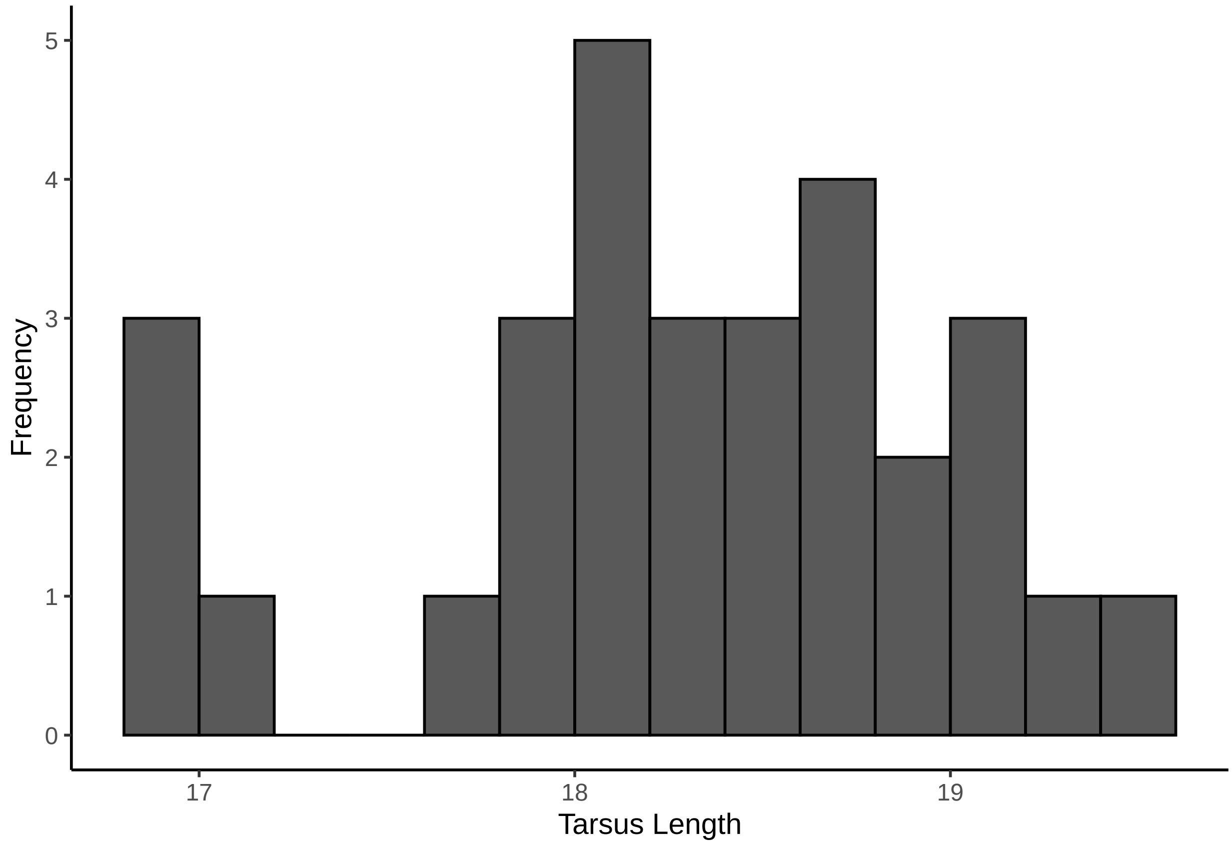

```
# TailLen
ggplot(data = chickadeeData, aes(x = TailLen)) +
geom_histogram(col = "black", binwidth = 1,
boundary = 0, closed = "left") +
labs(x = "Tail Length", y = "Frequency")
```

```
## Warning: Removed 17 rows containing non-finite values (`stat_bin()`).
```



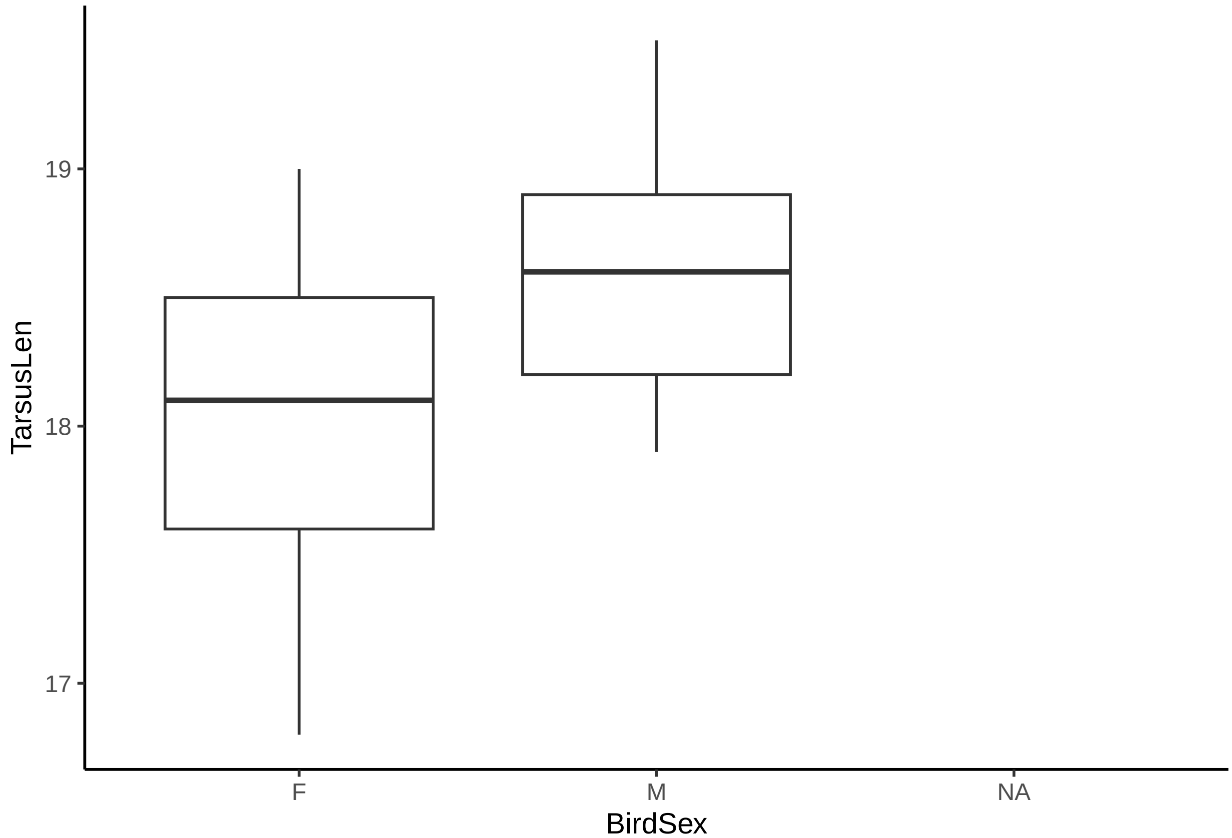

```
# TarsusLen
ggplot(data = chickadeeData, aes(x = TarsusLen)) +
geom_histogram(col = "black", binwidth = 0.2,
boundary = 0, closed = "left") +
labs(x = "Tarsus Length", y = "Frequency")
```

```
## Warning: Removed 17 rows containing non-finite values (`stat_bin()`).
```



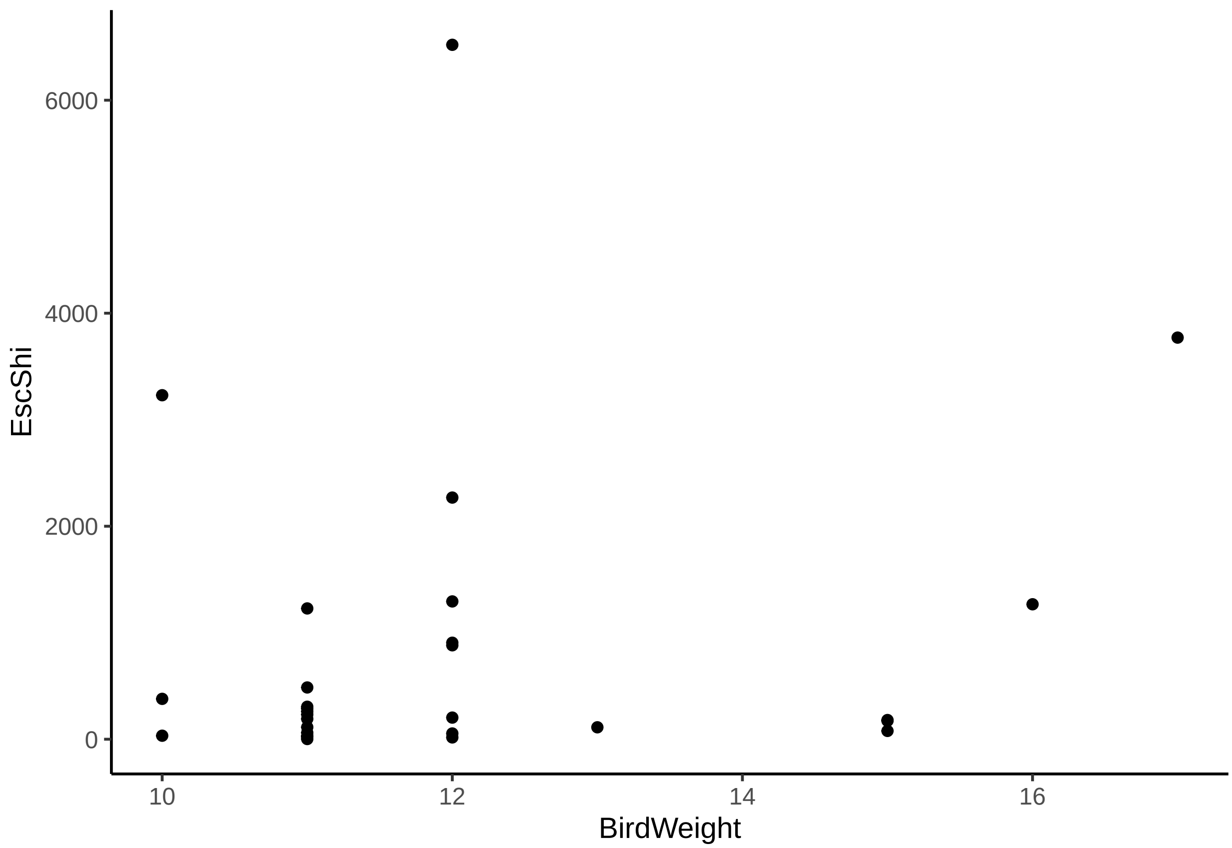

```
# Relationship between 2 variables

# Box Plot for numerical variable vs categorical variable
ggplot(chickadeeData, aes(x=BirdSex, y=TarsusLen)) + geom_boxplot()
```

```
## Warning: Removed 17 rows containing non-finite values (‘stat_boxplot()‘).
```



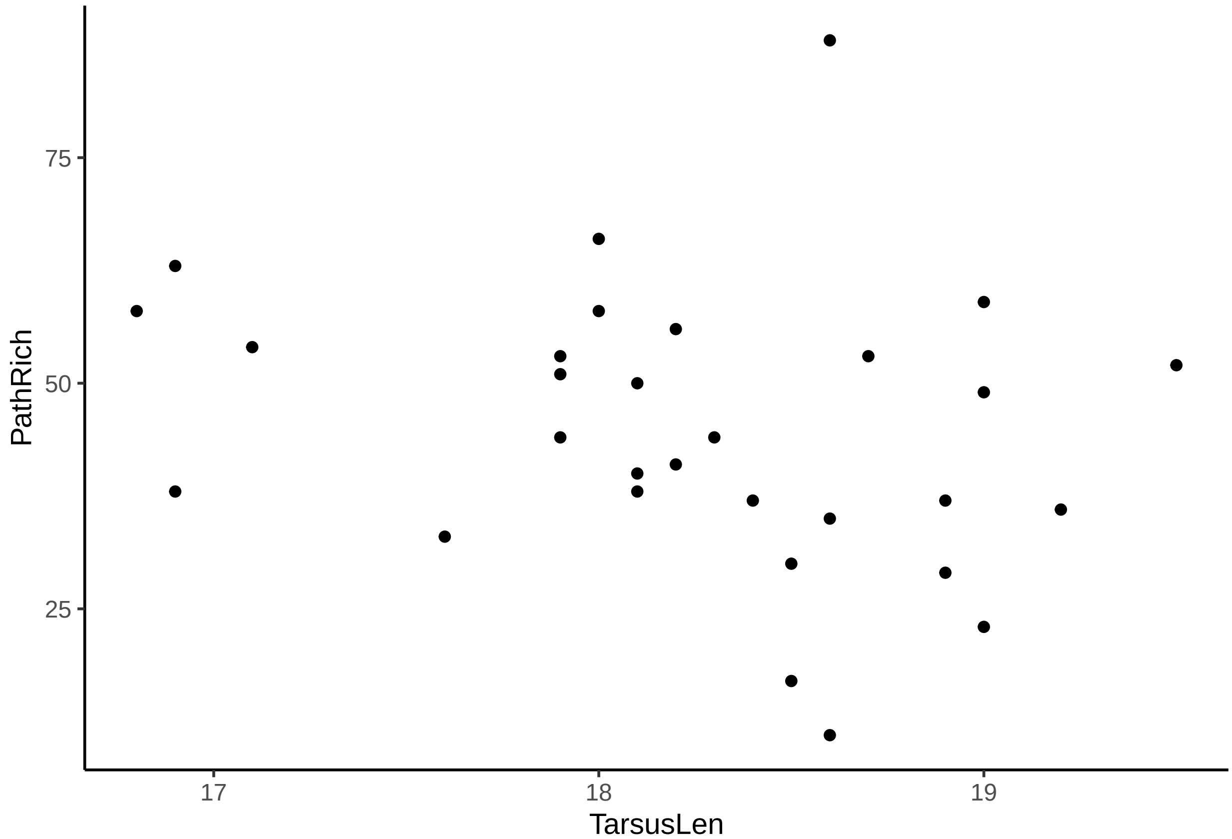

```
# Scatter Plots
ggplot(chickadeeData,
  aes(x = BirdWeight,
  y = EscShi)) +
  geom_point()
```

```
## Warning: Removed 17 rows containing missing values (`geom_point()`).
```



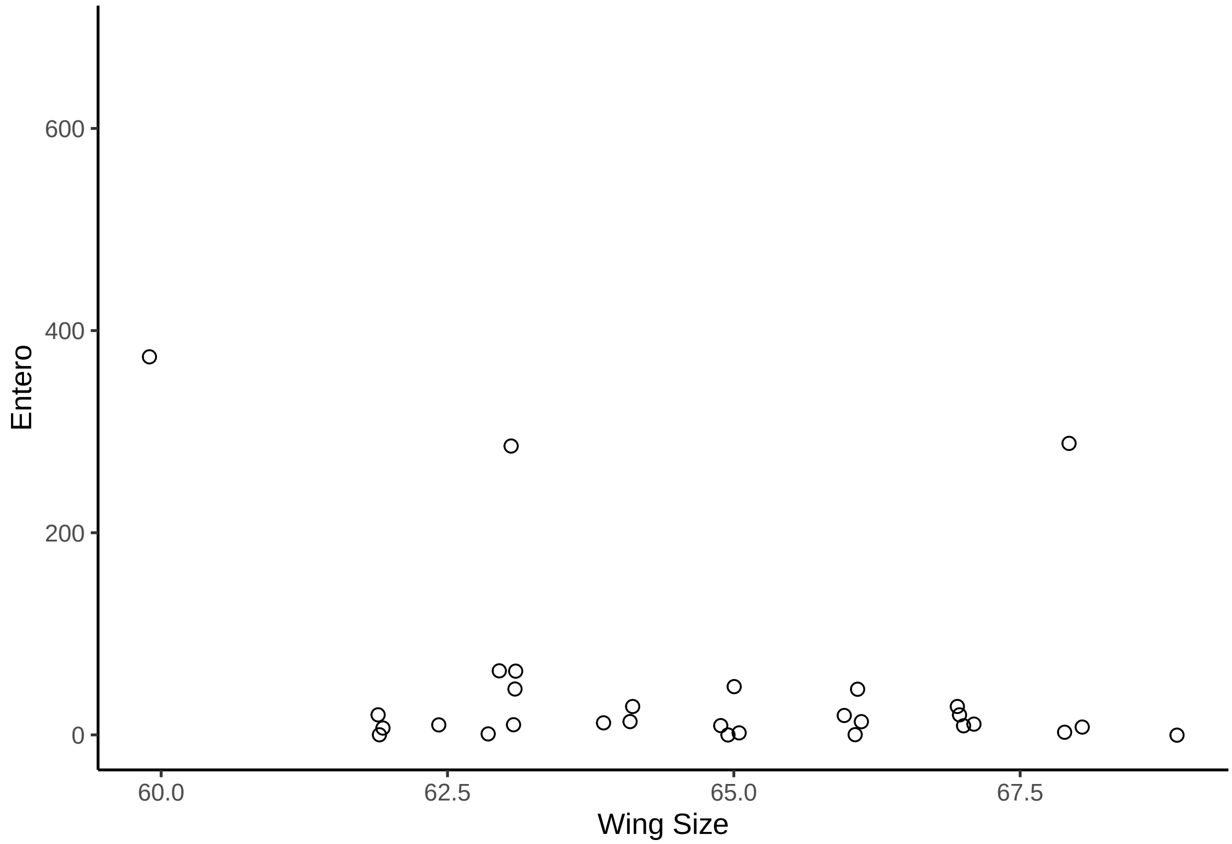

```
ggplot(chickadeeData,
  aes(x = TarsusLen,
  y = PathRich)) +
  geom_point()
```

```
## Warning: Removed 17 rows containing missing values (`geom_point()`).
```




```
# Strip Chart
ggplot (data = chickadeeData, aes(x = WingChord, y = Entero)) +
geom_jitter(shape = 1, size = 2, width = 0.15) +
labs(x = "Wing Size", y = "Entero")
```

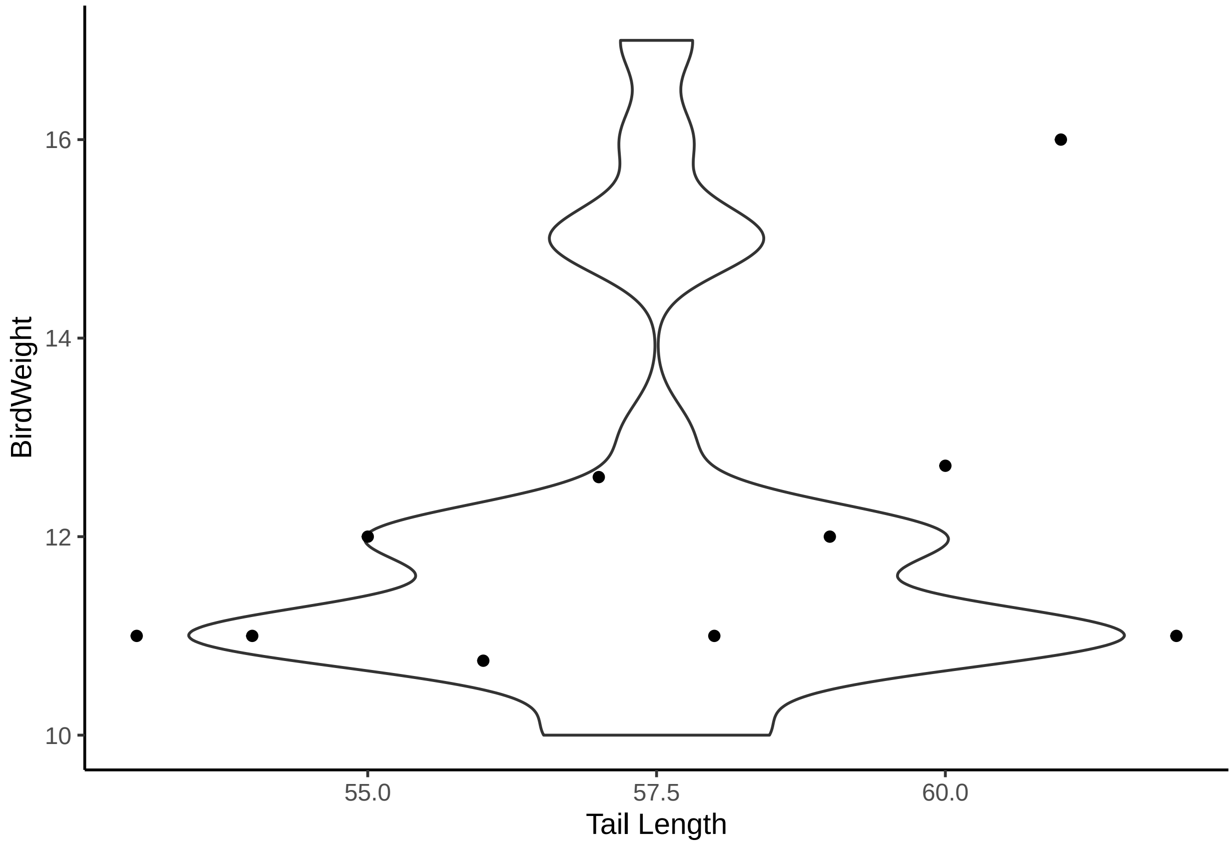
```
## Warning: Removed 17 rows containing missing values (‘geom_point()‘).
```




```r
# Violin Plot
ggplot(data = chickadeeData, aes(y = BirdWeight, x = TailLen)) +
geom_violin() +
labs(x = "Tail Length", y = "BirdWeight") +
stat_summary(fun = mean, geom = "point")
```

```
## Warning: Removed 17 rows containing non-finite values (‘stat_ydensity()‘).
```

```
## Warning: Removed 17 rows containing non-finite values (‘stat_summary()‘).
```



Some initial exploration of the variables have given us some familiarity with the dataset.

Probability (Distributions)

- Explore and identify the probability distributions of variables, obtain probability mass and density functions.
- Common Discrete Probability Distributions: Binomial, Discrete Uniform, Poisson.
- Create probability table for categorical variables.
- Create probability mass functions (pmf) for discrete probability distributions.
- Common Continuous Probability Distributions: Normal, Continuous, Log-Normal, Exponential.
- Create probability density functions (pdf) and/or cumulative density functions (cdf) for continuous probability distributions.
- You can find the expected value and standard deviation of a probability distribution if you have the formula, sample, or probability table of the distribution (which are used in tests below).

Dimensionality Reduction

- Techniques like t-SNE in addition to PCA, MDS or NMDS, especially for visualizing high-dimensional data. Dimensionality reduction reveals the fundamental structure of the data.
- PCA can help to identify groups of variables which are significant, and helps to reduce noise.

- Factor Analysis, where the goal is interpretability. FA assumes that there exists an underlying fundamental structure of the data, or underlying latent variables - called "factors" - that influence the observable variables in the data, but are not directly observable themselves.

Other Techniques

- Missing Value Analysis: Identifying and analyzing missing data.
- Outlier Detection: Methods to detect and analyze unusual observations.
- Categorical Data Analysis: Frequency tables, bar charts, pie charts for categorical variables.
- Multivariate Analysis: Techniques like Principal Component Analysis (PCA) to understand the relationships among multiple variables.
- Cross-Tabulations: Also known as contingency tables; useful for understanding the relationship between two categorical variables.
- Spatial Analysis: If the data has geographical attributes, spatial visualization, and analysis might be essential.
- Text Analysis: If the dataset contains text, basic text mining techniques might be applicable.

Initial Tests

- Normality Tests: Checking if a variable follows a normal distribution.
- Homogeneity of Variances: Testing if the variances are equal across groups.

Relationships

- Correlation: Understand statistical association between variables.
- Covariance: Understanding how two variables change together.
- Regression Analysis/Plots: Simple linear regression to visually understand relationships.
- Effect Size: Understanding the magnitude of relationships between variables.

Contingency Analysis

- Association: Understanding if there is an association between the categories of different variables.
- Independence Testing: Statistical tests like the Chi-Squared Test for Independence can be applied to contingency tables to determine if there is a significant association between the variables.
- Conditional Probabilities: You can calculate conditional probabilities to understand how the probability of one event changes given the knowledge of another event.
- Comparison Across Groups: If you have more than two categorical variables, you can explore how the relationship between two variables may differ across the levels of a third variable.
- Marginal Distribution: You can analyze the marginal distribution of one variable irrespective of the others. This gives insights into the overall distribution of a particular variable.

- Expected Frequencies: In some cases, you might want to compare observed frequencies in the contingency table with expected frequencies under some statistical model. This can give insights into how well a given model fits your data.
- Use contingency table analysis to determine whether community richness on feathers is independent of mountain chickadees sex? [Use R function **filter** in the **dplyr** package to subset the data frame to retain only feather swabs, then use R functions **table** and **chisq.test**.

```
# Confirm the column to be filtered
unique(chickadeeData$Source)
```

```
## [1] "nest"    "feather"
```

```
# Filter df for Source = feather
df_feather <- filter(chickadeeData, Source == 'feather')
df_feather
```

```
##       Site    Habitat  Source EscShi Entero CommRich PathRich WingChord
## 1   F_U10F      rural feather    486    374      low       33      60.0
## 2   F_T48M      rural feather    232     63      low       44      63.0
## 3   F_T48F      rural feather    180     63     high       49      63.0
## 4   F_T41M      rural feather    305     45      low       36      66.0
## 5   F_T41F      rural feather     22     45      low       37      63.0
## 6   F_T35M      rural feather    203      0      low       29      66.0
## 7   F_T35F      rural feather    113      1      low       38      63.0
## 8   F_T23M      rural feather    906      9      low       37      67.0
## 9   F_T23F      rural feather     17     11      low       35      67.0
## 10  F_T21M      rural feather     28     10      low       41      62.5
## 11  F_T21F      rural feather   6520      0      low       23      65.0
## 12  F_T07F      rural feather      2     10      low       40      63.0
## 13  F_R53M      urban feather    288      3     high       56      68.0
## 14  F_R53F      urban feather     61      2     high       58      65.0
## 15  F_R44M semi-urban feather    191     13     high       66      64.0
## 16  F_R44F semi-urban feather     33     20      low       38      62.0
## 17  F_R43M semi-urban feather    882     19     high       88      66.0
## 18  F_R43F semi-urban feather    112     28     high       59      64.0
## 19  F_R40M      urban feather   1267      0      low       11      69.0
## 20  F_R40F      urban feather     78     13     high       54      66.0
## 21  F_R37M semi-urban feather   1294     20     high       52      67.0
## 22 F_R37F2 semi-urban feather   3230      0      low       30      62.0
## 23  F_R37F semi-urban feather    379      7      low       17      62.0
## 24  F_R36M semi-urban feather   1228     28     high       53      67.0
## 25  F_R36F semi-urban feather     31     48      low       51      65.0
## 26  F_R26M      urban feather   3771      8     high       53      68.0
## 27  F_R26F      urban feather    173      9     high       63      65.0
## 28  F_LGBF      urban feather     54     12     high       44      64.0
## 29  F_C14M      urban feather   2269    288     high       58      68.0
## 30  F_C14F      urban feather    261    286      low       50      63.0
##    BirdWeight TailLen TarsusLen BirdSex
## 1          11      53      17.6       F
## 2          11      57      18.3       M
## 3          15      55      19.0       F
## 4          11      56      19.2       M
```

```
## 5          11      56      18.4       F
## 6          12      55      18.9       M
## 7          11      57      18.1       F
## 8          12      60      18.9       M
## 9          12      59      18.6       F
## 10         11      54      18.2       M
## 11         12      57      19.0       F
## 12         11      54      18.1       F
## 13         11      62      18.2       M
## 14         11      56      16.8       F
## 15         11      60      18.0       M
## 16         10      56      16.9       F
## 17         12      60      18.6       M
## 18         13      55      19.0       F
## 19         16      61      18.6       M
## 20         15      60      17.1       F
## 21         12      60      19.5       M
## 22         10      55      18.5       F
## 23         10      55      18.5       F
## 24         11      58      17.9       M
## 25         11      58      17.9       F
## 26         17      57      18.7       M
## 27         15      60      16.9       F
## 28         12      57      17.9       F
## 29         12      60      18.0       M
## 30         11      54      18.1       F
```

```
# Check the order of the categories
chickadeeData$CommRich
```

```
##  [1] "low"  "low"  "low"  "low"  "low"  "low"  "low"  "high" "low"  "low"
## [11] "high" "high" "high" "low"  "low"  "high" "high" "low"  "low"  "high"
## [21] "low"  "low"  "low"  "low"  "low"  "low"  "low"  "low"  "low"  "high"
## [31] "high" "high" "low"  "high" "high" "low"  "high" "high" "low"  "low"
## [41] "high" "low"  "high" "high" "high" "high" "low"
```

```
unique(chickadeeData$CommRich)
```

```
## [1] "low"  "high"
```

```
# They are already ordered

# Order the categories as desired by turning into a factor variable (if needed. This is useful for more
#CommRich_BirdSex_table$CommRich <-
#factor(CommRich_BirdSex_table$CommRich,
#levels = c("low", "high"))

# Create 2x2 Contingency Table for community richness and sex
CommRich_BirdSex_table <- table(df_feather$CommRich, df_feather$BirdSex)
CommRich_BirdSex_table
```

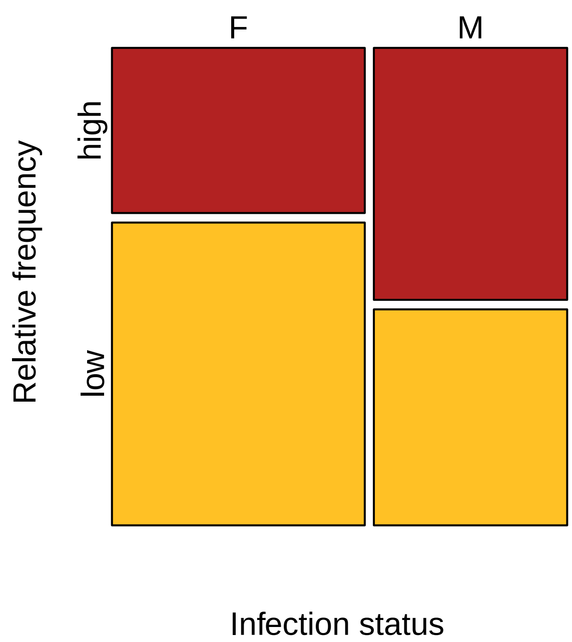
```
##
```

```
##         F  M
##   high  6  7
##   low  11  6
```

```
str(CommRich_BirdSex_table)
```

```
##  'table' int [1:2, 1:2] 6 11 7 6
##  - attr(*, "dimnames")=List of 2
##   ..$ : chr [1:2] "high" "low"
##   ..$ : chr [1:2] "F" "M"
```

```
# Create a mosaic plot to visualize the data
par(pty = "s") # makes a square plot
mosaicplot(t(CommRich_BirdSex_table), col = c("firebrick", "goldenrod1"),
cex.axis = 1, main = "",
sub = "Infection status", ylab = "Relative frequency")
```




```
# Conduct a Chi-squared Test of Independence of Two Categorical Variables
Xsq <- chisq.test(CommRich_BirdSex_table, correct = FALSE)
Xsq
```

```
##
##  Pearson's Chi-squared test
##
## data:  CommRich_BirdSex_table
## X-squared = 1.0325, df = 1, p-value = 0.3096
```

As the p-value is less than the alpha level of 0.05, there is not enough evidence to conclude that there is an association between community richness and bird sex, based on the Chi-squared test of the contingency table analysis. From these results, we would fail to accept the null hypothesis of independence of the variables.

Simply said, there is no reason to assume that the pathogen community richness on feathers would differ due to the birds' sex.

4. Model Specification

Statistical Model

- Choose an appropriate statistical model that aligns with the type of data and research question.

Estimator

- Decide on the method of estimation (e.g., Maximum Likelihood, Least Squares, etc.).

Hyperparameters

- If you're working with models that require hyperparameter tuning, choose the appropriate values or ranges and methods (like grid search or random search).

5. Statistical Inference - Hypothesis Testing (if applicable)

Null and Alternative Hypotheses

- Define the hypotheses to be tested.

Test Statistic

- Decide on the level of significance (e.g., alpha = 0.05).

P-value

- Compute the p-value to determine statistical significance.

Conclusion

- Make a decision to accept or reject the null hypothesis based on the p-value.

Post-Hoc Analysis

- Tests or Analyses that are performed after the initial hypothesis test to explore the data further, especially when the initial test indicates a significant result.

Note that in R, statistical tests are performed through functions and summarized for you, rather than having to manually implement them (while you can calculate them by hand).

The statistician should handle:

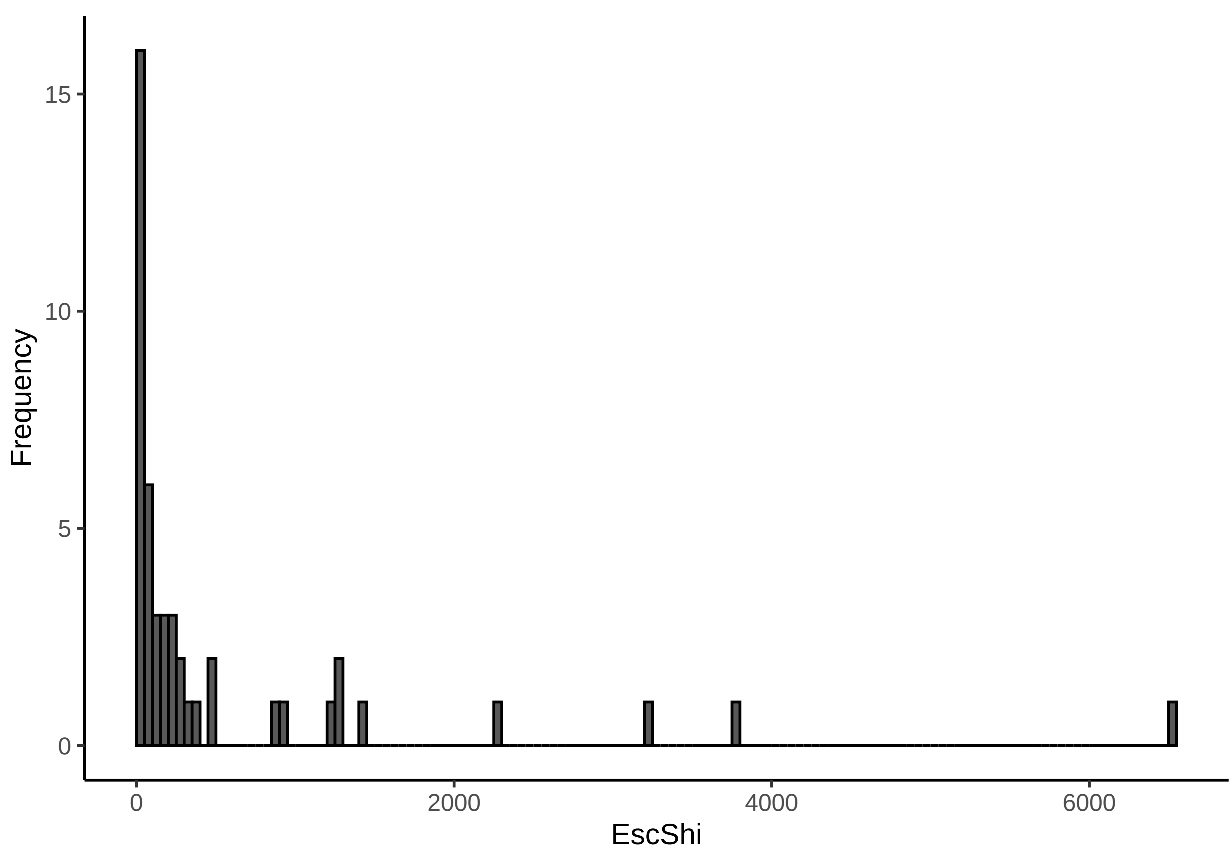
- The interpretation of the tests. A p-value by itself does not "prove" anything.
- Underlying assumptions that built-in functions do not automatically check for.
- Choice of test: ensure that the appropriate test for the data and research question is applied.
- Data pre-processing: the data must be processed such that the test can be ran on it, handling issues like outliers, missing data, or necessary transformations.
- Multiple comparisons: generally, research questions will involve comparing the results of multiple tests on the data, and forming an interpretation.

Let us perform the tests of the assignment.

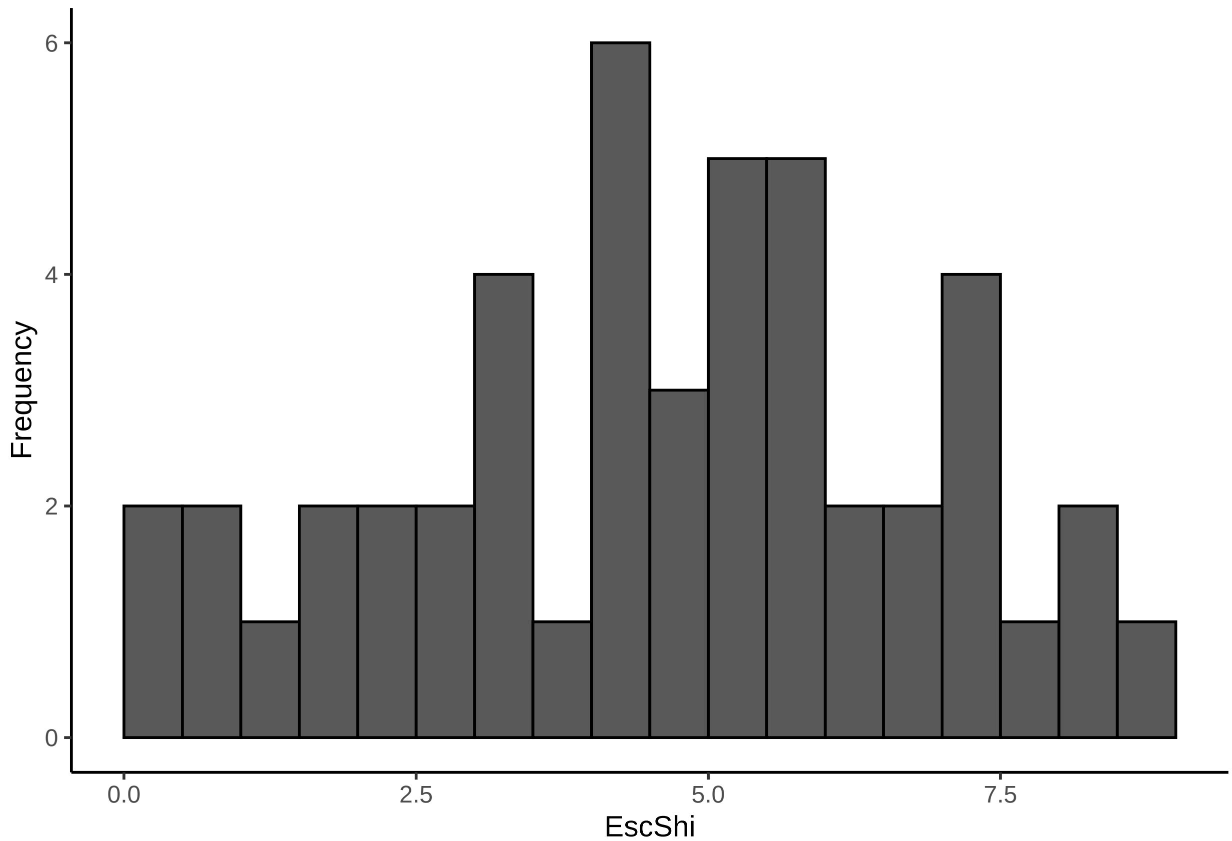
- Use a two-sample *t*-test to determine whether the mean abundance of bacteria identified as genus *Escherichia/Shigella* differs significantly between nests and feathers. [Consider transforming variable **`EscShi`** and use R function **`t.test`**. Be careful when applying the natural logarithm transformation to data containing zeros since ln(0) is undefined. The usual way around this is to calculate ln(y+1) instead of ln(y).]

As we saw above, EscShi data appears to be Log-normal (having a right-skewed distribution), and could benefit from a natural log transformation. Let us visualize this.

```
# EscShi untransformed
ggplot(data = chickadeeData, aes(x = EscShi)) +
geom_histogram(col = "black", binwidth = 50,
boundary = 0, closed = "left") +
labs(x = "EscShi", y = "Frequency")
```



```r
# Natural Log transformation + 1 (to handle zeroes)
EscShi_transformed <- log(chickadeeData$EscShi + 1)

# Transformed EscShi histogram
ggplot(data = chickadeeData, aes(x = EscShi_transformed)) +
geom_histogram(col = "black", binwidth = 0.5,
boundary = 0, closed = "left") +
labs(x = "EscShi", y = "Frequency")
```



The transformed data is indeed easier to visualize. From visual inspection, the distribution appears to be approximately normally distributed. Let us assume that the variance within the groups are equal and perform the t-test.

```r
# Two sample t-test, assuming equal group variance
t.test(EscShi ~ Source, data = chickadeeData, var.equal = TRUE)
```

```
##
##  Two Sample t-test
##
## data:  EscShi by Source
## t = 1.8929, df = 45, p-value = 0.06481
## alternative hypothesis: true difference in means between group feather and group nest is not equal to
## 95 percent confidence interval:
##   -42.94601 1384.83621
## sample estimates:
```

```
## mean in group feather    mean in group nest
##              820.5333             149.5882
```

```r
# Two sample t-test of transformed data, assuming equal group variance
t.test(EscShi_transformed ~ Source, data = chickadeeData, var.equal = TRUE)
```

```
##
##  Two Sample t-test
##
## data:  EscShi_transformed by Source
## t = 4.0756, df = 45, p-value = 0.0001842
## alternative hypothesis: true difference in means between group feather and group nest is not equal to
## 95 percent confidence interval:
##  1.213690 3.585231
## sample estimates:
## mean in group feather    mean in group nest
##              5.425583             3.026123
```

Based on the test, there is evidence to reject the null hypothesis. The test also shows that there is a higher mean abundance of bacteria identified as genus *Escherichia/Shigella* in the feather group.

- Use a Mann-Whitney U-test (Wilcoxon rank sum test) to determine whether the population distribution of the abundance of bacteria identified as genus *Escherichia/Shigella* differs significantly between nests and feathers. [Use R function **`wilcox.test`**.]

As we desire to know if the results of the log-normal test would hold to the original population, we will carry out a Mann-Whitney U-test, which can be used in place of the two-sample t-test when the normal distribution assumption of the two-sample t-test cannot be met.

The Mann–Whitney U-test compares the distributions of two groups. It does not require as many assumptions as the two-sample t-test.

Therefore, we will carry it out on the untransformed data.

```r
# Mann-Whitney U-Test
wilcox.test(EscShi ~ Source, data = chickadeeData)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties
```

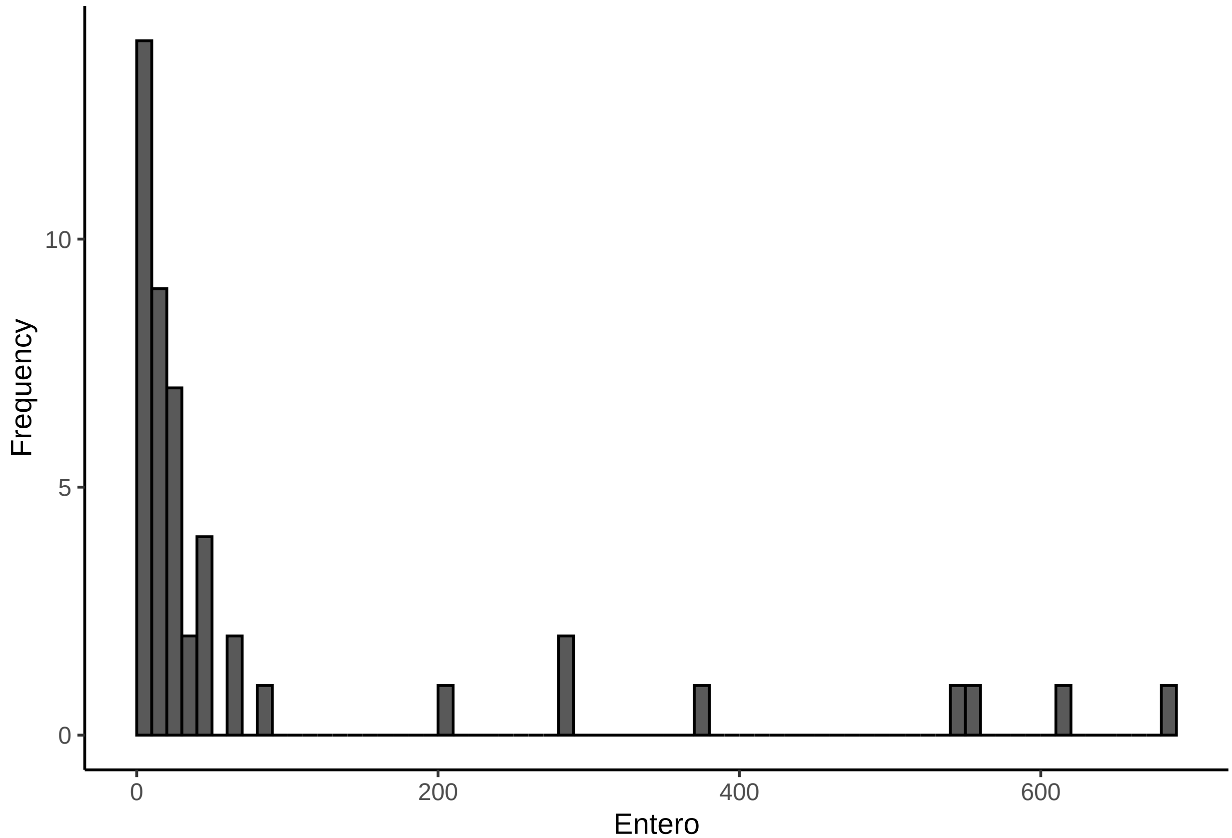
```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  EscShi by Source
## W = 405.5, p-value = 0.0008952
## alternative hypothesis: true location shift is not equal to 0
```

Based on the results of the test, we reject the null hypothesis, and find that there is evidence that the distributions of EscShi abundance between nests and feathers differ significantly.

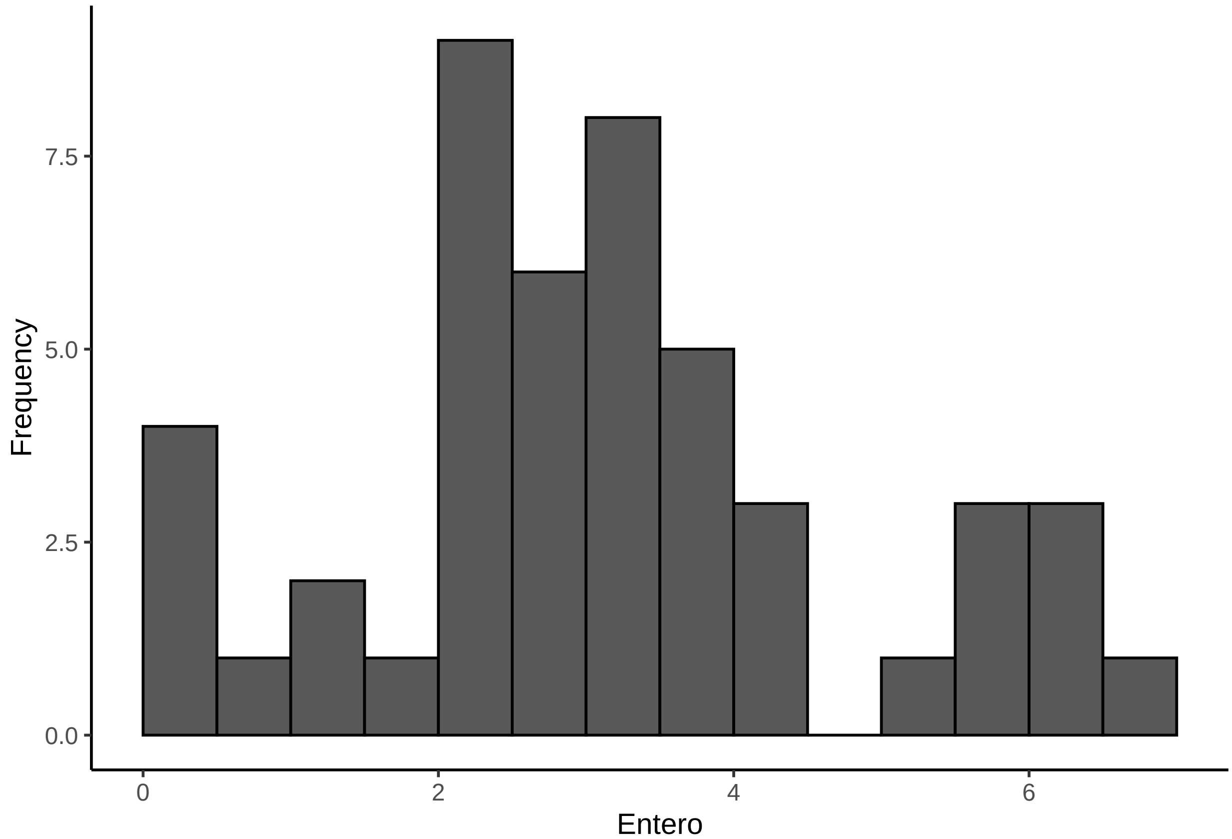
- Use a two-sample *t*-test to determine whether the mean abundance of bacteria identified as genus *Enterococcus* differs significantly between nests and feathers. [Consider transforming variable **`Entero`** and use R function **`t.test`**.]

We repeat the same procedure for genus *Enterococcus* as we did for genus *Escherichia/Shigella*.

```
# Entero untransformed
ggplot(data = chickadeeData, aes(x = Entero)) +
geom_histogram(col = "black", binwidth = 10,
boundary = 0, closed = "left") +
labs(x = "Entero", y = "Frequency")
```




```
# Natural Log transformation + 1 (to handle zeroes)
Entero_transformed <- log(chickadeeData$Entero + 1)

# Transformed Entero histogram
ggplot(data = chickadeeData, aes(x = Entero_transformed)) +
geom_histogram(col = "black", binwidth = 0.5,
boundary = 0, closed = "left") +
labs(x = "Entero", y = "Frequency")
```




```r
# Two sample t-test of transformed data, assuming equal group variance
t.test(Entero_transformed ~ Source, data = chickadeeData, var.equal = TRUE)
```

```
##
##  Two Sample t-test
##
## data:  Entero_transformed by Source
## t = -2.6195, df = 45, p-value = 0.01196
## alternative hypothesis: true difference in means between group feather and group nest is not equal to
## 95 percent confidence interval:
##  -2.2836566 -0.2983701
## sample estimates:
## mean in group feather    mean in group nest
##              2.670757              3.961771
```

Based on the results of the test, we reject the null hypothesis, and find that the mean abundance of *Enterococcus* differs significantly between nests and feathers as well. However, the test shows that there is a higher mean abundance of bacteria identified as genus *Enterococcus* in the nest group.

- Use a Mann-Whitney U-test (Wilcoxon rank sum test) to determine whether the population distribution of the abundance of bacteria identified as genus *Enterococcus* differs significantly between nests and feathers. [Use R function **`wilcox.test`**.]

```r
# Mann-Whitney U-Test
wilcox.test(Entero ~ Source, data = chickadeeData)
```

```
## Warning in wilcox.test.default(x = DATA[[1L]], y = DATA[[2L]], ...): cannot
## compute exact p-value with ties
```

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  Entero by Source
## W = 148, p-value = 0.01826
## alternative hypothesis: true location shift is not equal to 0
```

Based on the results of the test, we reject the null hypothesis, and find that the population distribution of the abundance of *Enterococcus* differs significantly between nests and feathers.

So far, we can interpret that there is a significant difference of the abundance of bacteria between nests and feathers, but there is a higher abundance of *Escherichia/Shigella* in the feather group, while there is a higher abundance of *Enterococcus* in the nest group.

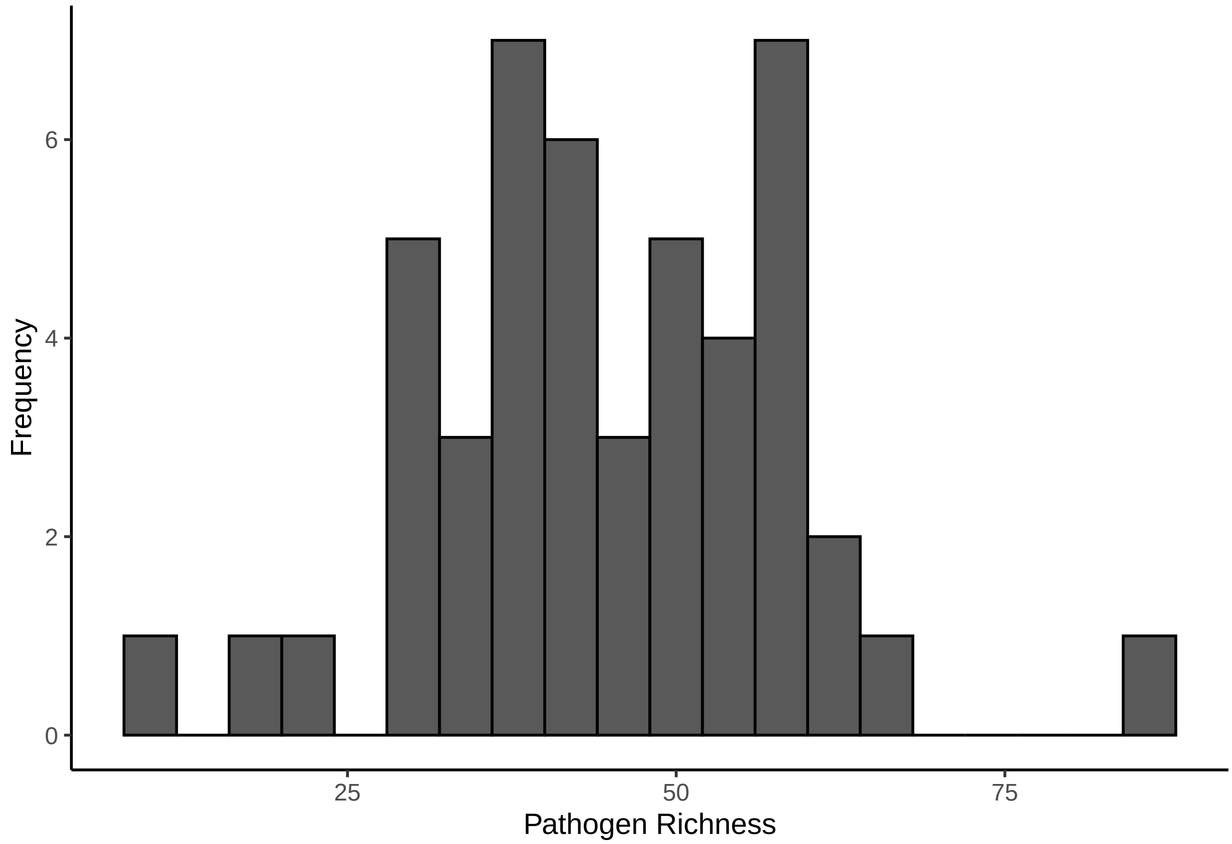
- Use analysis of variance to determine whether mean pathogen richness is related to habitat. [Use R functions **lm** and **anova**.]

Let us first investigate if mean pathogen richness requires transformation.

```r
# Summarize variable
describe(chickadeeData$PathRich)
```

```
## chickadeeData$PathRich
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##       47        0       30    0.998     44.3    15.48     24.8     30.0
##      .25      .50      .75      .90      .95
##     36.0     41.0     53.5     59.0     63.0
##
## lowest : 11 17 23 29 30, highest: 58 59 63 66 88
```

```r
# PathRich
ggplot(data = chickadeeData, aes(x = PathRich)) +
geom_histogram(col = "black", binwidth = 4,
boundary = 0, closed = "left") +
labs(x = "Pathogen Richness", y = "Frequency")
```




```r
# Shapiro-Wilk Test for normality
shapiro.test(chickadeeData$PathRich)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  chickadeeData$PathRich
## W = 0.97451, p-value = 0.389
```

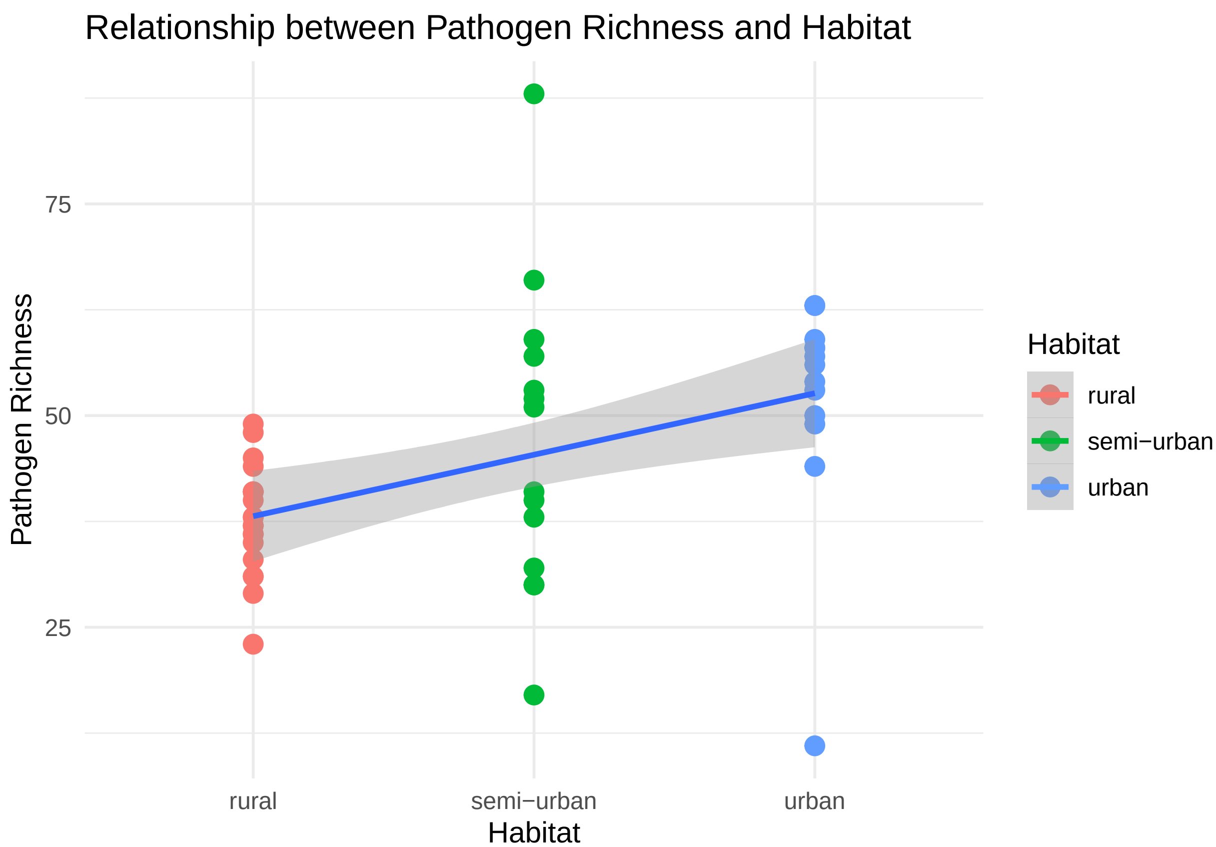
Upon visual inspection, the pathogen richness data does appear to be normally distributed, and we conclude from the Shapiro-Wilk test that there is do significant difference from a normal distribution. Therefore, we will not transform this data.

Let us perform the analysis of variance:

```r
# Scatter Plot with linear model
ggplot(chickadeeData, aes(x=Habitat, y=PathRich)) +
  geom_point(aes(color=Habitat), size=3) +            # Scatter plot
  geom_smooth(method='lm', aes(group=1, color=Habitat)) + # Add a linear fit, colored by Habitat
  labs(title="Relationship between Pathogen Richness and Habitat",
       x="Habitat",
       y="Pathogen Richness") +
  theme_minimal()
```

```
## `geom_smooth()` using formula = 'y ~ x'
```

```
## Warning: The following aesthetics were dropped during statistical transformation: colour
## i This can happen when ggplot fails to infer the correct grouping structure in
##   the data.
## i Did you forget to specify a ‘group‘ aesthetic or to convert a numerical
##   variable into a factor?
```



Upon visual inspection of the linear model, discounting outliers, there does appear to be a linear relationship between pathogen richness and habitat, if we order from rural to urban.

```
# Simple Linear Regression
PathRich_Habitat_Regression <- lm(PathRich ~ Habitat, data = chickadeeData)
summary(PathRich_Habitat_Regression)
```

```
##
## Call:
## lm(formula = PathRich ~ Habitat, data = chickadeeData)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -40.923  -6.182   1.077   6.181  41.286
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)           37.650      2.856  13.181  < 2e-16 ***
## Habitatsemi-urban      9.064      4.451   2.036  0.04777 *
## Habitaturban          14.273      4.551   3.136  0.00305 **
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.77 on 44 degrees of freedom
## Multiple R-squared:  0.1934, Adjusted R-squared:  0.1567
## F-statistic: 5.275 on 2 and 44 DF,  p-value: 0.008844
```

```r
# Calculate a 95% Confidence interval for the slope
# confint(PathRich_Habitat_Regression, level = 0.95)

# ANOVA
anova(PathRich_Habitat_Regression)
```

```
## Analysis of Variance Table
##
## Response: PathRich
##           Df Sum Sq Mean Sq F value   Pr(>F)
## Habitat    2 1721.5  860.75  5.2745 0.008844 **
## Residuals 44 7180.3  163.19
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The linear model confirms this, as the estimates of coefficients increases as we compare habitats. The predictors are statistically significant, as the p values are below the alpha level of 0.05.

The Multiple R-squared tells us the proportion of the variance in the dependent variable that is predictable from the independent variable(s). In this case, it is 19.34%, and while it is not high, it is non-negligible.

The F-statistic tests whether at least one predictor variable has a non-zero coefficient, and the p-value is less than alpha 0.05, meaning that habitat is a significant predictor of pathogen richness.

ANOVA essentially tests whether the model, as a whole, explains a significant amount of the variance in the dependent variable.

The p-value associated with the F-statistic is less than the alpha level of 0.05, meaning that there is a significant effect of habitat on pathogen richness.

Based on these results, we can conclude that mean pathogen richness is related to habitat. The model as a whole is statistically significant, but the Multiple R-squared value suggests that only about 19.34% of the variability in pathogen richness can be explained by habitat, so there may be other factors at play as well.

Thus, there is evidence to support that habitat is a significant predictor of pathogen richness, but it is not the only factor influencing it. Furthermore, as it is implied that habitat is categorized based on human population density, we can infer that pathogen richness increases with human population density.

- Use a Kruskal-Wallis test to determine whether mean pathogen richness is related to habitat. [Use R function **kruskal.test**.]

```r
# Kruskal-Wallis Test
kruskal.test(PathRich ~ Habitat, data = chickadeeData)
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  PathRich by Habitat
## Kruskal-Wallis chi-squared = 13.587, df = 2, p-value = 0.001121
```

The Kruskal-Wallis test is a non-parametric alternative to single factor ANOVA, and is used to test if there are statistically significant differences between the medians of three or more independent groups. Unlike ANOVA, it does not assume a normal distribution of the residuals or homogeneity of variance.

In this case, the p-value associated with the Kruskal-Wallis chi-squared test statistic is below alpha of 0.01, and we can conclude that the differences in the groups are due to random chance. From this conclusion, we have gathered evidence to support the inferences from the linear model.

- Use the Tukey-Kramer method to which habitats differ with respect to mean pathogen richness. [Use R functions **emmeans** and **contrast**.]

```
# Tukey-Kramer test
# Often used as a post-hoc analysis after a one-way ANOVA or Kruskal-Wallis test to determine which spe
pathogenPairs <- emmeans(PathRich_Habitat_Regression, specs = "Habitat")
pathogenUnplanned <- contrast(pathogenPairs, method = "pairwise",
adjust = "tukey")

pathogenUnplanned
```

```
##  contrast             estimate   SE df t.ratio p.value
##  rural - (semi-urban)    -9.06 4.45 44  -2.036  0.1155
##  rural - urban          -14.27 4.55 44  -3.136  0.0084
##  (semi-urban) - urban    -5.21 4.92 44  -1.059  0.5445
##
## P value adjustment: tukey method for comparing a family of 3 estimates
```

Let us interpret each row.

1. Rural vs Semi-Urban: Pathogen richness is lower in rural areas than semi-urban areas, but the p-value is greater than the alpha level of 0.05. This difference is not statistically significant.
2. Rural vs Urban: Pathogen richness is lower in rural areas than urban areas, and the p-value is lower than the alpha level of 0.05. This difference is statistically significant.
3. Semi-Urban vs Urban: Pathogen richness is lower in semi-urban areas than urban areas, but the p-value is greater than the alpha level of 0.05. This difference is not statistically significant.

From the Tukey-Kramer test, we can conclude that pathogen richness is significantly higher in urban areas compared to rural areas, but there are no statistically significant differences in pathogen richness between rural and semi-urban areas, or between semi-urban and urban areas based on this data.

These results support the linear regression model and Kruskal-Wallis test, reinforcing the idea that pathogen richness varies with habitat type.

- Use simple linear regression to determine which of **WingChord**, **BirdWeight**, **TailLen**, or **TarsusLen** is most linearly associated with pathogen richness on feathers. [Use R functions **lm** and **summary**.]

```
# Select the subset df for feathers
summary(df_feather)
```

```
##      Site              Habitat             Source              EscShi
##  Length:30          Length:30          Length:30          Min.   :  2.00
##  Class :character   Class :character   Class :character   1st Qu.:  65.25
##  Mode  :character   Mode  :character   Mode  :character   Median : 217.50
```

```
##                                                           Mean   : 820.53
##                                                           3rd Qu.: 900.00
##                                                           Max.   :6520.00
##      Entero         CommRich           PathRich       WingChord
##  Min.   :  0.00   Length:30          Min.   :11.00   Min.   :60.00
##  1st Qu.:  7.25   Class :character   1st Qu.:36.25   1st Qu.:63.00
##  Median : 12.50   Mode  :character   Median :44.00   Median :65.00
##  Mean   : 47.83                      Mean   :44.77   Mean   :64.78
##  3rd Qu.: 40.75                      3rd Qu.:53.75   3rd Qu.:66.75
##  Max.   :374.00                      Max.   :88.00   Max.   :69.00
##    BirdWeight    TailLen        TarsusLen       BirdSex
##  Min.   :10   Min.   :53.00   Min.   :16.80   Length:30
##  1st Qu.:11   1st Qu.:55.00   1st Qu.:17.93   Class :character
##  Median :11   Median :57.00   Median :18.25   Mode  :character
##  Mean   :12   Mean   :57.23   Mean   :18.25
##  3rd Qu.:12   3rd Qu.:60.00   3rd Qu.:18.68
##  Max.   :17   Max.   :62.00   Max.   :19.50
```

```
unique(df_feather)
```

```
##       Site    Habitat  Source EscShi Entero CommRich PathRich WingChord
## 1   F_U10F      rural feather    486    374      low       33      60.0
## 2   F_T48M      rural feather    232     63      low       44      63.0
## 3   F_T48F      rural feather    180     63     high       49      63.0
## 4   F_T41M      rural feather    305     45      low       36      66.0
## 5   F_T41F      rural feather     22     45      low       37      63.0
## 6   F_T35M      rural feather    203      0      low       29      66.0
## 7   F_T35F      rural feather    113      1      low       38      63.0
## 8   F_T23M      rural feather    906      9      low       37      67.0
## 9   F_T23F      rural feather     17     11      low       35      67.0
## 10  F_T21M      rural feather     28     10      low       41      62.5
## 11  F_T21F      rural feather   6520      0      low       23      65.0
## 12  F_T07F      rural feather      2     10      low       40      63.0
## 13  F_R53M      urban feather    288      3     high       56      68.0
## 14  F_R53F      urban feather     61      2     high       58      65.0
## 15  F_R44M semi-urban feather    191     13     high       66      64.0
## 16  F_R44F semi-urban feather     33     20      low       38      62.0
## 17  F_R43M semi-urban feather    882     19     high       88      66.0
## 18  F_R43F semi-urban feather    112     28     high       59      64.0
## 19  F_R40M      urban feather   1267      0      low       11      69.0
## 20  F_R40F      urban feather     78     13     high       54      66.0
## 21  F_R37M semi-urban feather   1294     20     high       52      67.0
## 22 F_R37F2 semi-urban feather   3230      0      low       30      62.0
## 23  F_R37F semi-urban feather    379      7      low       17      62.0
## 24  F_R36M semi-urban feather   1228     28     high       53      67.0
## 25  F_R36F semi-urban feather     31     48      low       51      65.0
## 26  F_R26M      urban feather   3771      8     high       53      68.0
## 27  F_R26F      urban feather    173      9     high       63      65.0
## 28  F_LGBF      urban feather     54     12     high       44      64.0
## 29  F_C14M      urban feather   2269    288     high       58      68.0
## 30  F_C14F      urban feather    261    286      low       50      63.0
##    BirdWeight TailLen TarsusLen BirdSex
## 1          11      53      17.6       F
## 2          11      57      18.3       M
```

```
## 3          15      55      19.0       F
## 4          11      56      19.2       M
## 5          11      56      18.4       F
## 6          12      55      18.9       M
## 7          11      57      18.1       F
## 8          12      60      18.9       M
## 9          12      59      18.6       F
## 10         11      54      18.2       M
## 11         12      57      19.0       F
## 12         11      54      18.1       F
## 13         11      62      18.2       M
## 14         11      56      16.8       F
## 15         11      60      18.0       M
## 16         10      56      16.9       F
## 17         12      60      18.6       M
## 18         13      55      19.0       F
## 19         16      61      18.6       M
## 20         15      60      17.1       F
## 21         12      60      19.5       M
## 22         10      55      18.5       F
## 23         10      55      18.5       F
## 24         11      58      17.9       M
## 25         11      58      17.9       F
## 26         17      57      18.7       M
## 27         15      60      16.9       F
## 28         12      57      17.9       F
## 29         12      60      18.0       M
## 30         11      54      18.1       F
```

```
# Fit a linear model to each relationship
fit_WingChord <- lm(df_feather$PathRich ~ df_feather$WingChord)
fit_BirdWeight <- lm(df_feather$PathRich ~ df_feather$BirdWeight)
fit_TailLen <- lm(df_feather$PathRich ~ df_feather$TailLen)
fit_TarsusLen <- lm(df_feather$PathRich ~ df_feather$TarsusLen)

# Summarize the fits
summary(fit_WingChord)
```

```
##
## Call:
## lm(formula = df_feather$PathRich ~ df_feather$WingChord)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -39.208  -9.151   0.889   7.422  41.663
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)           -38.829     83.710  -0.464    0.646
## df_feather$WingChord    1.290      1.291   0.999    0.326
##
## Residual standard error: 15.65 on 28 degrees of freedom
## Multiple R-squared:  0.03443,    Adjusted R-squared:  -5.351e-05
## F-statistic: 0.9984 on 1 and 28 DF,  p-value: 0.3262
```

```r
summary(fit_BirdWeight)
```

```
##
## Call:
## lm(formula = df_feather$PathRich ~ df_feather$BirdWeight)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -37.724  -7.775  -0.272   8.725  43.233
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            32.8943    19.7948   1.662    0.108
## df_feather$BirdWeight   0.9894     1.6319   0.606    0.549
##
## Residual standard error: 15.82 on 28 degrees of freedom
## Multiple R-squared:  0.01296,    Adjusted R-squared:  -0.02229
## F-statistic: 0.3676 on 1 and 28 DF,  p-value: 0.5492
```

```r
summary(fit_TailLen)
```

```
##
## Call:
## lm(formula = df_feather$PathRich ~ df_feather$TailLen)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -41.856  -6.229   1.144   8.374  37.291
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)         -78.153     64.848  -1.205   0.2382
## df_feather$TailLen    2.148      1.132   1.897   0.0682 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.99 on 28 degrees of freedom
## Multiple R-squared:  0.1139, Adjusted R-squared:  0.08226
## F-statistic: 3.599 on 1 and 28 DF,  p-value: 0.06816
```

```r
summary(fit_TarsusLen)
```

```
##
## Call:
## lm(formula = df_feather$PathRich ~ df_feather$TarsusLen)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -31.823  -7.761  -1.573  10.140  45.177
##
## Coefficients:
```

```
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)            145.140     76.015   1.909   0.0665 .
## df_feather$TarsusLen    -5.501      4.163  -1.321   0.1971
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.45 on 28 degrees of freedom
## Multiple R-squared:  0.0587, Adjusted R-squared:  0.02508
## F-statistic: 1.746 on 1 and 28 DF,  p-value: 0.1971
```

```r
# Alternatively, fit a multiple linear regression model
fit_all <- lm(PathRich ~ WingChord + BirdWeight + TailLen + TarsusLen, data = df_feather)
summary(fit_all)
```

```
##
## Call:
## lm(formula = PathRich ~ WingChord + BirdWeight + TailLen + TarsusLen,
##     data = df_feather)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -40.510  -7.162   0.677   7.818  39.183
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  26.6554   105.1841   0.253    0.802
## WingChord    -0.3523     2.3143  -0.152    0.880
## BirdWeight    0.3688     1.8250   0.202    0.841
## TailLen       2.2744     1.9022   1.196    0.243
## TarsusLen    -5.1332     4.5403  -1.131    0.269
##
## Residual standard error: 15.35 on 25 degrees of freedom
## Multiple R-squared:  0.1708, Adjusted R-squared:  0.03816
## F-statistic: 1.288 on 4 and 25 DF,  p-value: 0.3015
```

The Highest R-squared value is considered the most linearly associated with the dependent variable, while the variable with the lowest p-value is the most statistically significant predictor of the dependent variable. By using a multiple linear regression model, we cannot compare the R-squared values between each of the fits, so it is preferable to fit each one separately.

Let us inspect the metrics of each fit:

- Wing Chord: Coefficient estimate of 1.290, with a p-value of 0.3262. Multiple R-squared of 0.03443.
- Weight: Coefficient estimate of 0.9894, with a p-value of 0.5492. Multiple R-squared of 0.01296.
- Tail Length: Coefficient estimate of 2.148, with a p-value of 0.06816. Multiple R-squared of 0.1139.
- Tarsus Length: Coefficient estimate of -5.501, with a p-value of 0.1971. Multiple R-squared of 0.0587.

From these tests, none of the results are statistically significant, as the p-values are greater than the alpha level of 0.05. However, Tail length is the most likely to be significant, relative to the other variables, due to its lower p-value. It also has the greatest coefficient estimate, and multiple R-squared value.

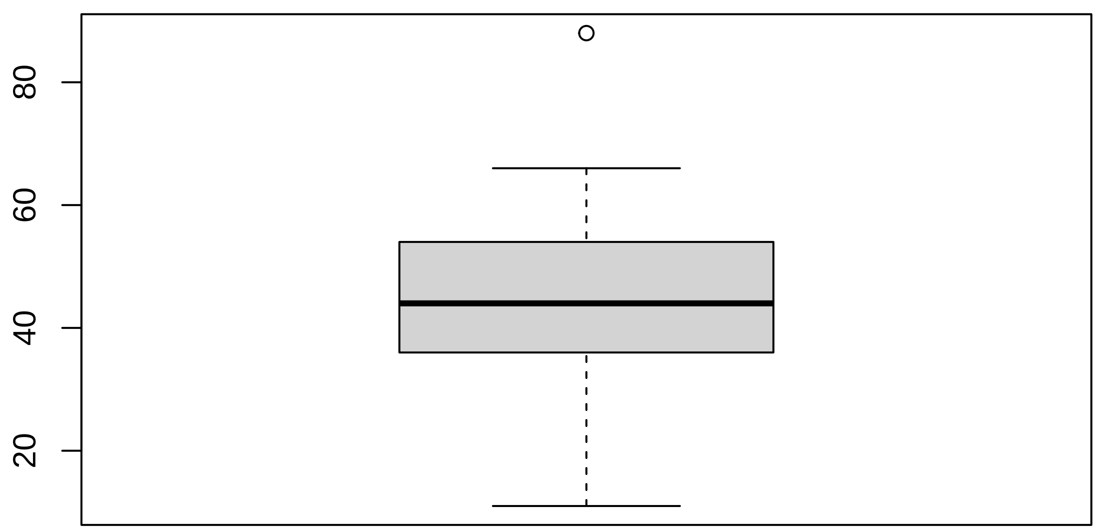
It should be noted that tarsus length is negatively correlated with pathogen richness based on this data, but the p-value is too high to be statistically significant. This however, may guide our intuition for later.

As the multiple linear regression model results in a p-value greater than the alpha level of 0.05, we fail to reject the null hypothesis that the model predictors have no effect on the response variable.

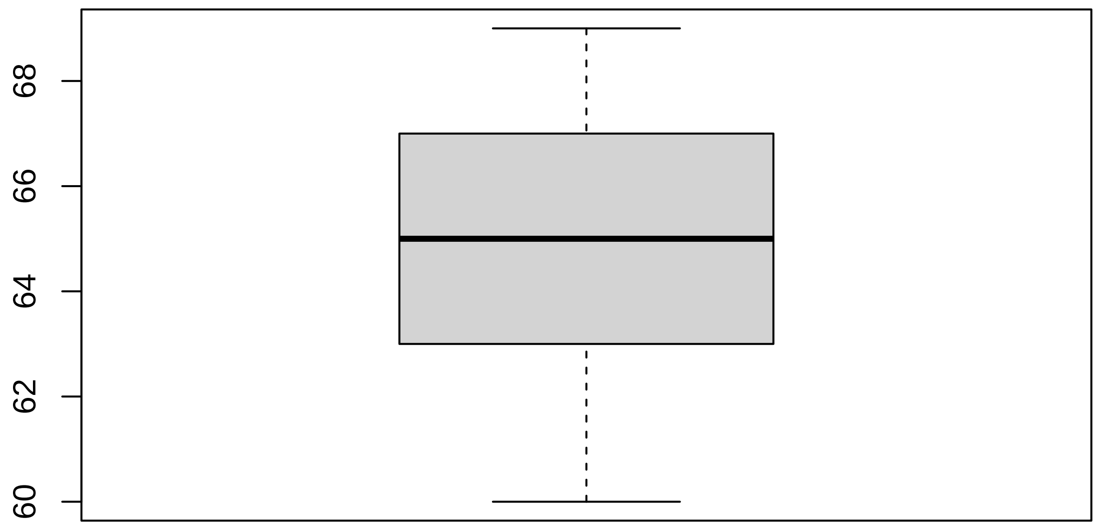
- For the simple linear regression model selected in Question 11, investigate whether there are any outliers. An outlier in the context of linear regression is an observation with an extreme difference between the observed response value and the predicted response value from the model. Use the **`filter`** function to create a new data frame that excludes the most extreme outlier and refit the simple linear regression model. Report the results for the model fit to the data frame excluding the outlier and use this data frame to answer Questions 13-18.

We will now account for outliers in the data:

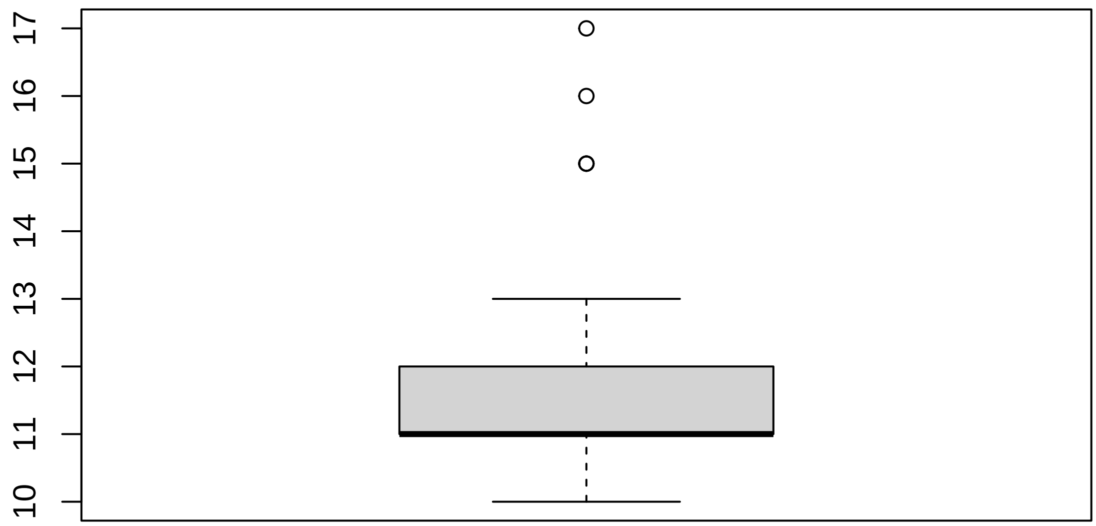
```
# Investigate outliers visually

# Individually
boxplot(df_feather$PathRich) # Outlier > 60
```



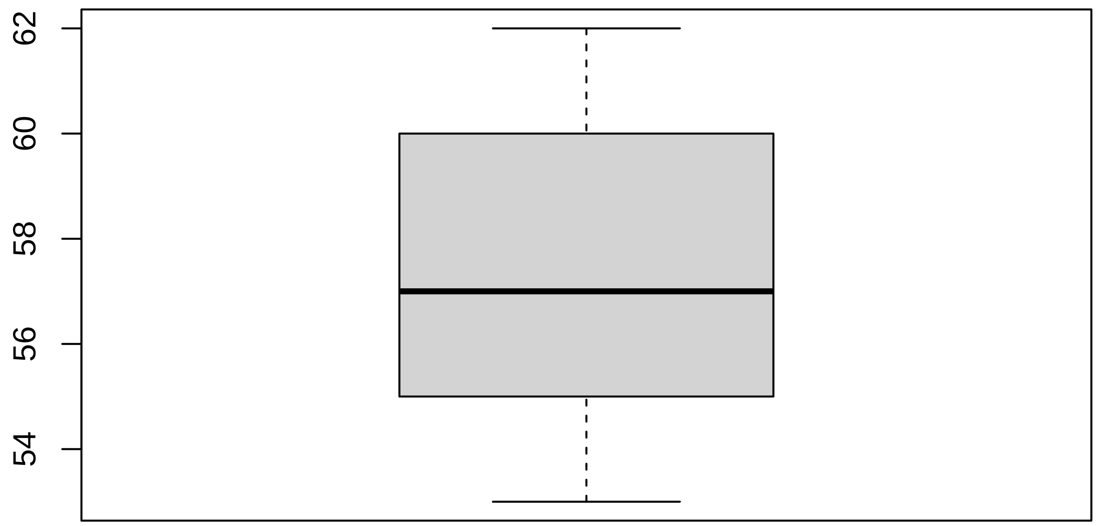

```
boxplot(df_feather$WingChord)
```



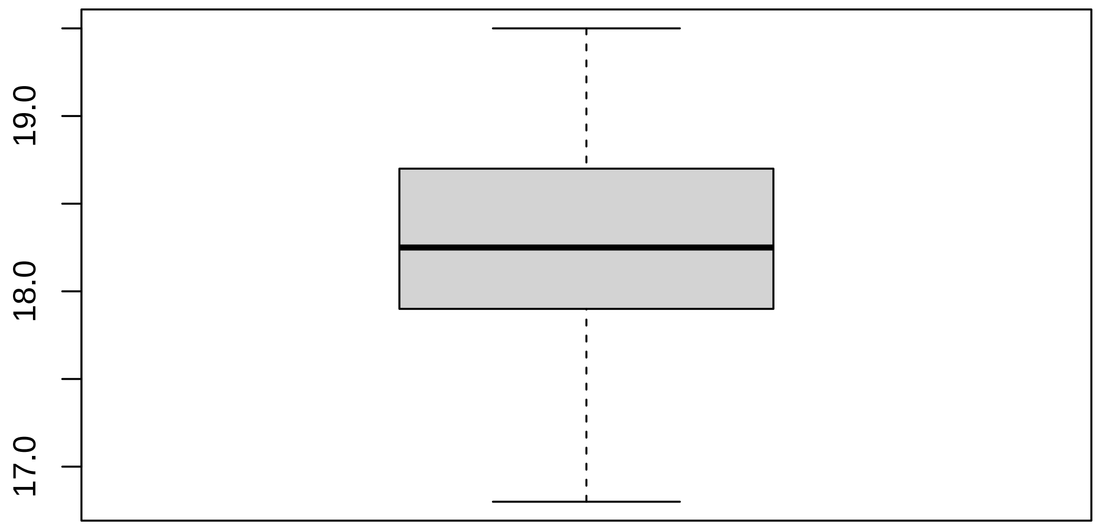

```r
boxplot(df_feather$BirdWeight) # Outliers > 13
```




```
boxplot(df_feather$TailLen)
```

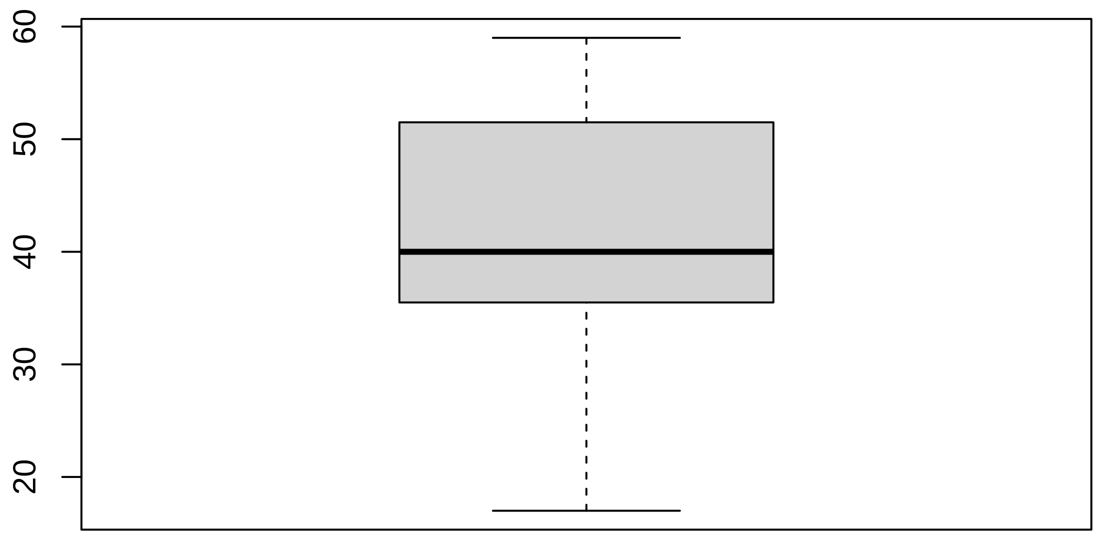



```
boxplot(df_feather$TarsusLen)
```

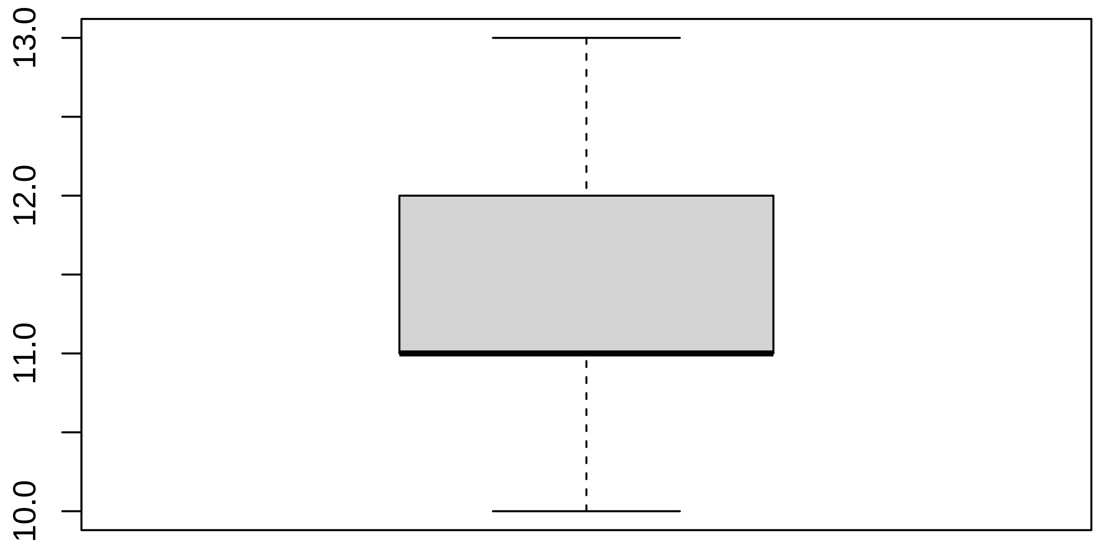


We can see some outliers in PathRich and BirdWeight, based on falling outside of the interquartile range in the boxplots. Let us filter them, then plot the filtered data:

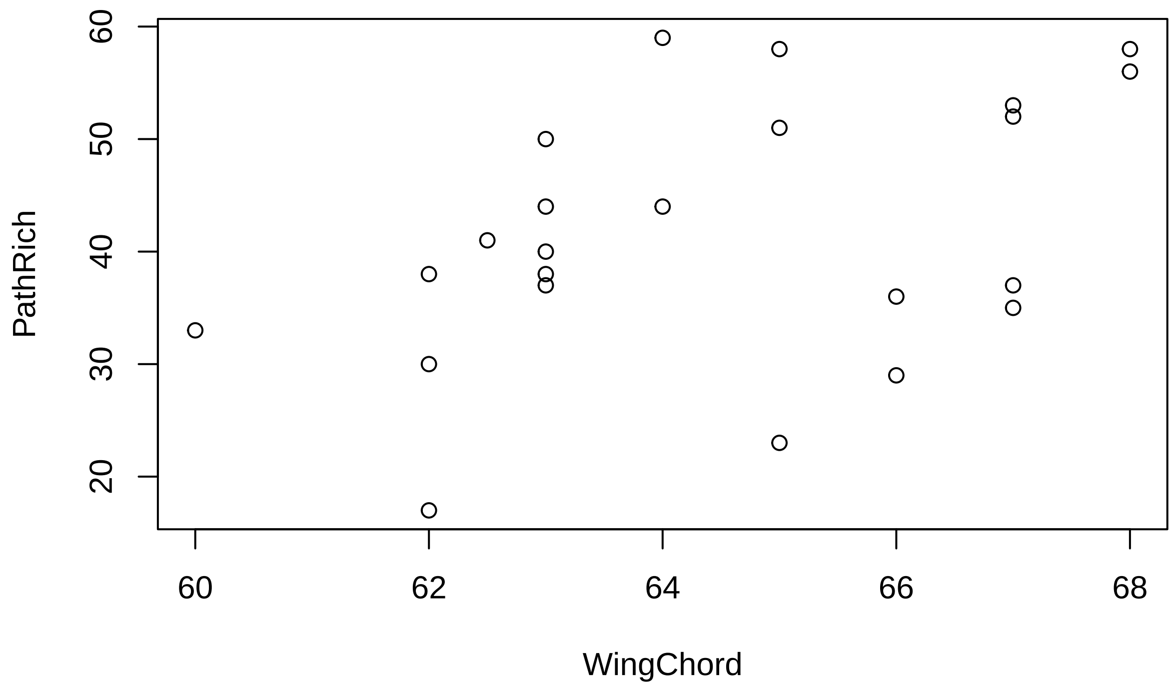
```
# Filter outliers
df_feather <- filter(df_feather, PathRich < 66) # Outlier > 60
df_feather <- filter(df_feather, BirdWeight < 14) # Outlier > 13

# Check if filters were successful
boxplot(df_feather$PathRich) # Outlier > 60
```



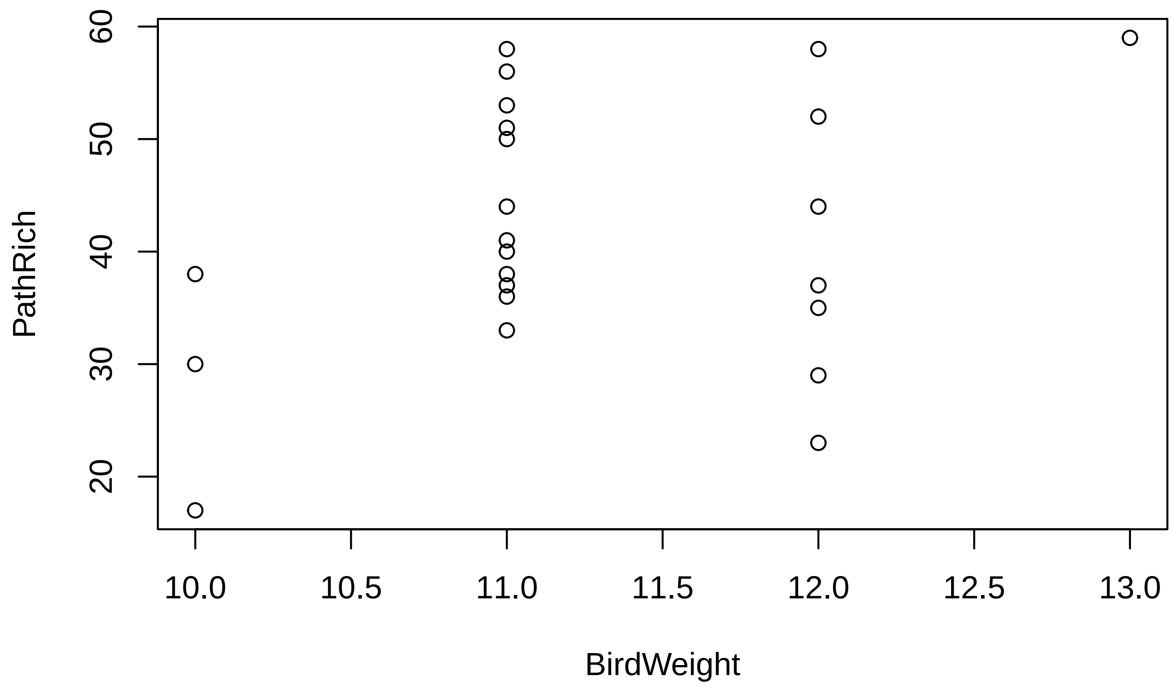

```
boxplot(df_feather$BirdWeight) # Outliers > 13
```



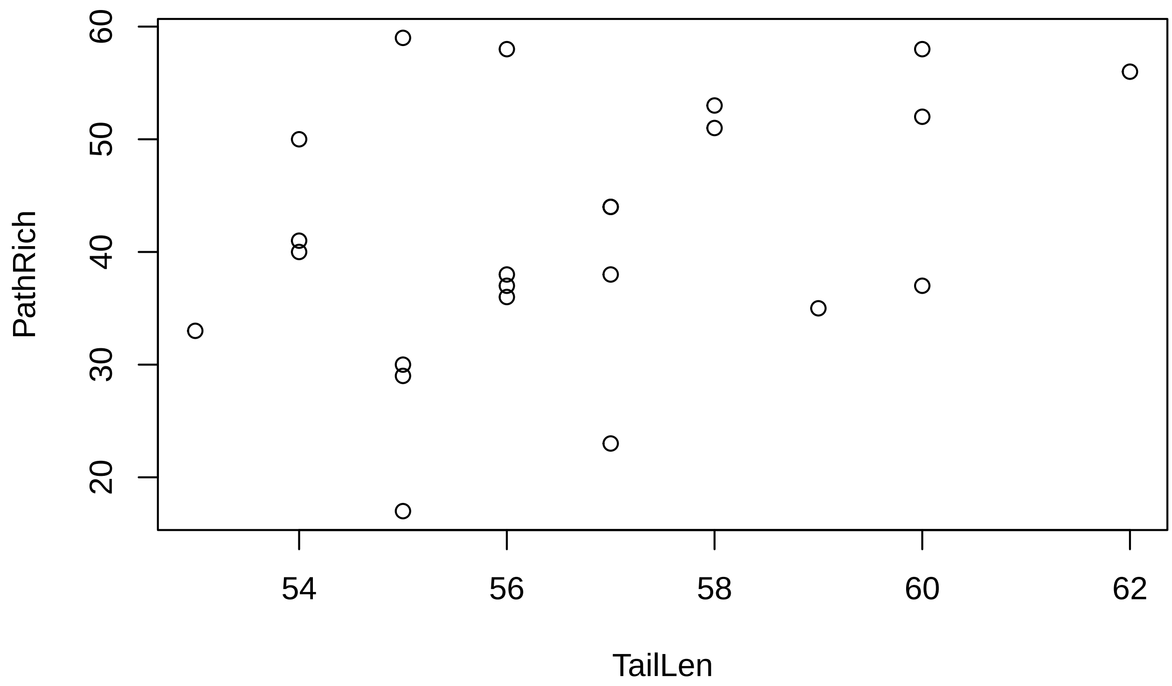

```r
# Check Relationships for more potential outliers
plot(PathRich ~ WingChord, data = df_feather)
```



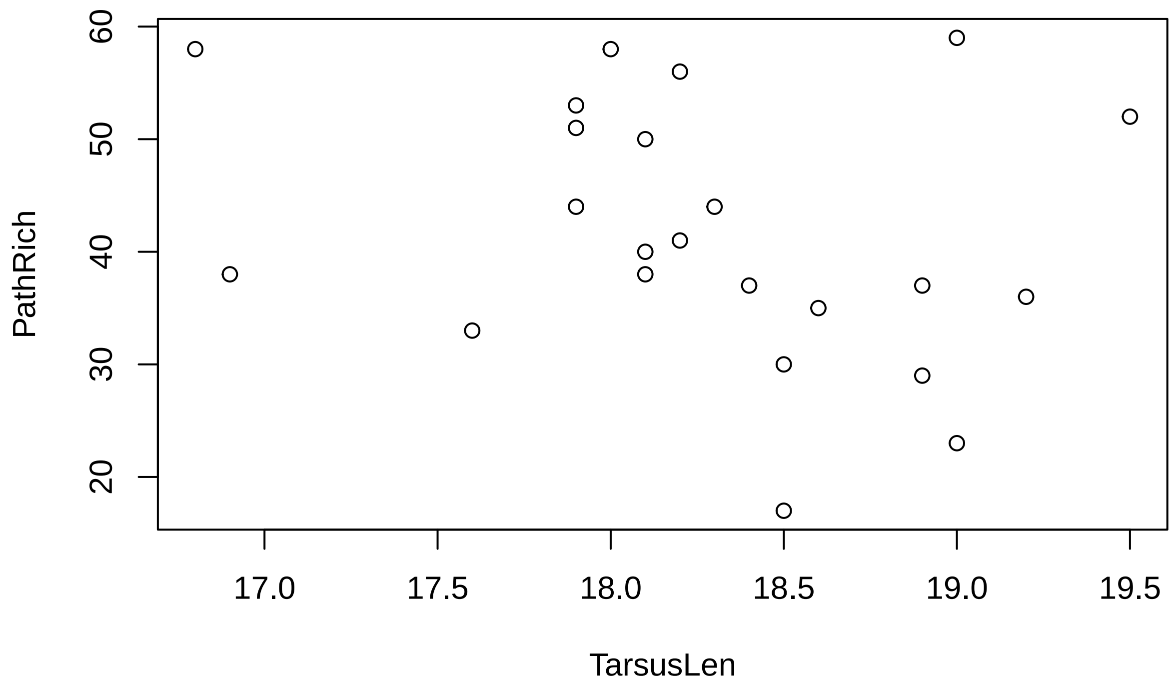

```
plot(PathRich ~ BirdWeight, data = df_feather)
```



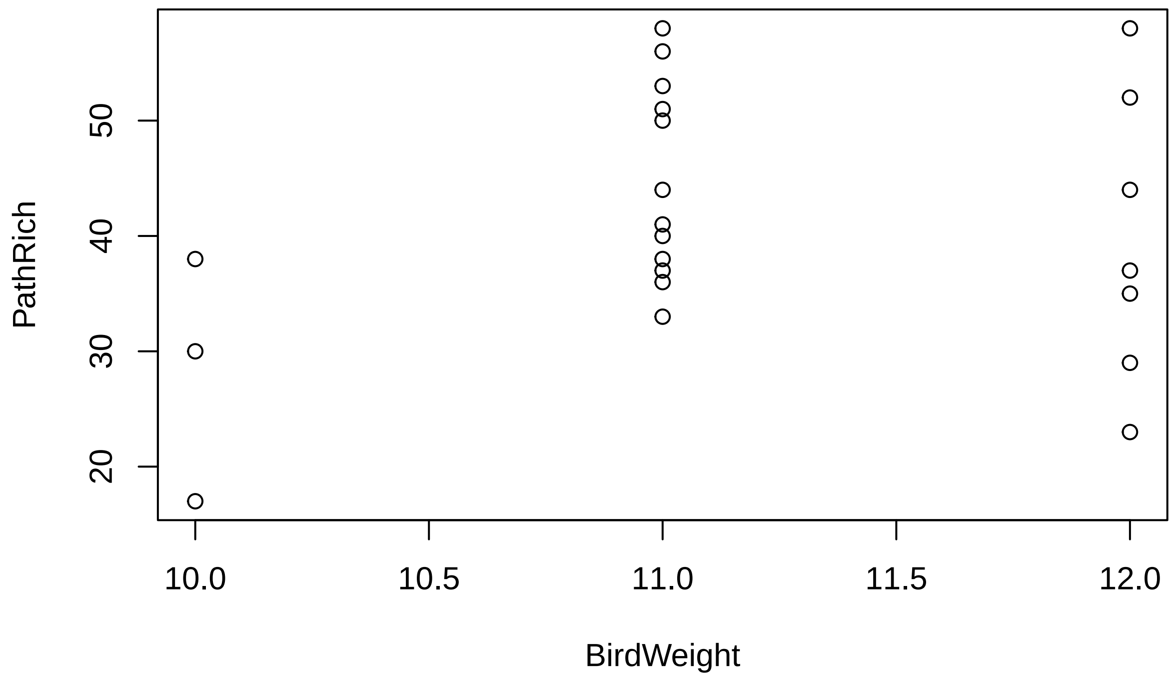

```
plot(PathRich ~ TailLen, data = df_feather)
```




```
plot(PathRich ~ TarsusLen, data = df_feather)
```




```r
# BirdWeight only has 1 value at 13, treat it as an outlier
df_feather <- filter(df_feather, BirdWeight < 12.5)
plot(PathRich ~ BirdWeight, data = df_feather)
```



After removing the outliers, let us fit the linear model once again:

```
# Fit a linear model to each relationship
fit_WingChord <- lm(df_feather$PathRich ~ df_feather$WingChord)
fit_BirdWeight <- lm(df_feather$PathRich ~ df_feather$BirdWeight)
fit_TailLen <- lm(df_feather$PathRich ~ df_feather$TailLen)
fit_TarsusLen <- lm(df_feather$PathRich ~ df_feather$TarsusLen)

# Summarize the fits
summary(fit_WingChord)
```

```
##
## Call:
## lm(formula = df_feather$PathRich ~ df_feather$WingChord)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -19.091  -7.591   2.561   6.420  15.909
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)          -104.8539    62.4870  -1.678   0.1089
## df_feather$WingChord    2.2607     0.9686   2.334   0.0301 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 10.12 on 20 degrees of freedom
## Multiple R-squared:  0.2141, Adjusted R-squared:  0.1748
## F-statistic: 5.448 on 1 and 20 DF,  p-value: 0.03014
```

```
summary(fit_BirdWeight)
```

```
##
## Call:
## lm(formula = df_feather$PathRich ~ df_feather$BirdWeight)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.5000  -7.0000   0.0833   9.3750  17.6667
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)              5.500     41.246   0.133    0.895
## df_feather$BirdWeight    3.167      3.682   0.860    0.400
##
## Residual standard error: 11.21 on 20 degrees of freedom
## Multiple R-squared:  0.03566,    Adjusted R-squared:  -0.01256
## F-statistic: 0.7395 on 1 and 20 DF,  p-value: 0.4
```

```
summary(fit_TailLen)
```

```
##
## Call:
## lm(formula = df_feather$PathRich ~ df_feather$TailLen)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -20.030  -6.124   1.470   5.909  18.782
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)        -83.3272    53.4809  -1.558   0.1349
## df_feather$TailLen   2.1883     0.9412   2.325   0.0307 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.13 on 20 degrees of freedom
## Multiple R-squared:  0.2128, Adjusted R-squared:  0.1734
## F-statistic: 5.405 on 1 and 20 DF,  p-value: 0.03072
```

```
summary(fit_TarsusLen)
```

```
##
## Call:
## lm(formula = df_feather$PathRich ~ df_feather$TarsusLen)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
```

```
## -22.3499  -6.8525  -0.0381   8.0127  18.8869
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)           154.731     64.695   2.392   0.0267 *
## df_feather$TarsusLen   -6.237      3.543  -1.760   0.0936 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.63 on 20 degrees of freedom
## Multiple R-squared:  0.1342, Adjusted R-squared:  0.09088
## F-statistic: 3.099 on 1 and 20 DF,  p-value: 0.09362
```

```r
# Alternatively, fit a multiple linear regression model
fit_all <- lm(PathRich ~ WingChord + BirdWeight + TailLen + TarsusLen, data = df_feather)
summary(fit_all)
```

```
##
## Call:
## lm(formula = PathRich ~ WingChord + BirdWeight + TailLen + TarsusLen,
##     data = df_feather)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -12.671  -5.117   1.243   3.198  14.665
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  15.4010    63.3530   0.243  0.81084
## WingChord     2.5854     1.6562   1.561  0.13694
## BirdWeight    0.8171     3.7004   0.221  0.82786
## TailLen       0.7090     1.3911   0.510  0.61684
## TarsusLen   -10.4426     3.1050  -3.363  0.00369 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.331 on 17 degrees of freedom
## Multiple R-squared:  0.5476, Adjusted R-squared:  0.4412
## F-statistic: 5.144 on 4 and 17 DF,  p-value: 0.006673
```

Excluding the outliers, we find that two variables are statistically significant:

- Wing Chord: Coefficient estimate of 2.260, with a p-value of 0.03014. Multiple R-squared of 0.2141.
- Tail Length: Coefficient estimate of 2.1883, with a p-value of 0.03072. Multiple R-squared of 0.2128.

The multiple linear regression model results in a p-value less than the alpha level of 0.05, therefore we reject the null hypothesis that the model predictors have no effect on the response variable, and conclude that the model as a whole is significant, meaning that there exists predictors that have an effect on the response variable.

- Find the best multiple linear regression model for predicting pathogen richness on feathers from two predictors out of **WingChord**, **BirdWeight**, **TailLen**, and **TarsusLen**. [Use R functions **lm** and **summary**.]

```r
# WingChord + BirdWeight
fit_WingChord_BirdWeight <- lm(PathRich ~ WingChord + BirdWeight, data = df_feather)
summary(fit_WingChord_BirdWeight)
```

```
##
## Call:
## lm(formula = PathRich ~ WingChord + BirdWeight, data = df_feather)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -20.399  -8.294   3.374   6.619  15.109
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -106.802     63.452  -1.683   0.1087
## WingChord      2.790      1.267   2.203   0.0402 *
## BirdWeight    -2.879      4.348  -0.662   0.5159
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.27 on 19 degrees of freedom
## Multiple R-squared:  0.2318, Adjusted R-squared:  0.1509
## F-statistic: 2.867 on 2 and 19 DF,  p-value: 0.08165
```

```r
# WingChord + TailLen
fit_WingChord_TailLen <- lm(PathRich ~ WingChord + TailLen, data = df_feather)
summary(fit_WingChord_TailLen)
```

```
##
## Call:
## lm(formula = PathRich ~ WingChord + TailLen, data = df_feather)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -18.834  -5.858   2.797   5.557  17.347
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -107.154     63.386  -1.690    0.107
## WingChord      1.256      1.739   0.722    0.479
## TailLen        1.181      1.689   0.699    0.493
##
## Residual standard error: 10.25 on 19 degrees of freedom
## Multiple R-squared:  0.2338, Adjusted R-squared:  0.1532
## F-statistic: 2.899 on 2 and 19 DF,  p-value: 0.07965
```

```r
# WingChord + TarsusLen
fit_WingChord_TarsusLen <- lm(PathRich ~ WingChord + TarsusLen, data = df_feather)
summary(fit_WingChord_TarsusLen)
```

```
##
## Call:
```

```
## lm(formula = PathRich ~ WingChord + TarsusLen, data = df_feather)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -13.0403  -4.1876   0.3558   2.7972  15.6981
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  15.9477    59.0703   0.270 0.790087
## WingChord     3.3360     0.8147   4.095 0.000617 ***
## TarsusLen   -10.4184     2.8393  -3.669 0.001630 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.946 on 19 degrees of freedom
## Multiple R-squared:   0.54,  Adjusted R-squared:  0.4916
## F-statistic: 11.15 on 2 and 19 DF,  p-value: 0.000625
```

```r
# BirdWeight + TailLen
fit_BirdWeight_TailLen <- lm(PathRich ~ BirdWeight + TailLen, data = df_feather)
summary(fit_BirdWeight_TailLen)
```

```
##
## Call:
## lm(formula = PathRich ~ BirdWeight + TailLen, data = df_feather)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -20.453  -6.465   1.491   5.986  18.745
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -81.6078    56.8264  -1.436   0.1672
## BirdWeight   -0.4436     3.8317  -0.116   0.9091
## TailLen       2.2454     1.0840   2.071   0.0522 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.39 on 19 degrees of freedom
## Multiple R-squared:  0.2133, Adjusted R-squared:  0.1305
## F-statistic: 2.576 on 2 and 19 DF,  p-value: 0.1024
```

```r
# BirdWeight + TarsusLen
fit_BirdWeight_TarsusLen <- lm(PathRich ~ BirdWeight + TarsusLen, data = df_feather)
summary(fit_BirdWeight_TarsusLen)
```

```
##
## Call:
## lm(formula = PathRich ~ BirdWeight + TarsusLen, data = df_feather)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -16.7225  -6.8188  -0.6157   7.3957  16.9310
```

```
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  131.582     61.670   2.134   0.0461 *
## BirdWeight     7.081      3.610   1.961   0.0647 .
## TarsusLen     -9.307      3.666  -2.539   0.0200 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 9.941 on 19 degrees of freedom
## Multiple R-squared:  0.2799, Adjusted R-squared:  0.2042
## F-statistic: 3.693 on 2 and 19 DF,  p-value: 0.04415
```

```r
# TailLen + TarsusLen
fit_TailLen_TarsusLen <- lm(PathRich ~ TailLen + TarsusLen, data = df_feather)
summary(fit_TailLen_TarsusLen)
```

```
##
## Call:
## lm(formula = PathRich ~ TailLen + TarsusLen, data = df_feather)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -16.8531  -4.5860  -0.1362   5.6269  15.4642
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  41.2383    62.7149   0.658  0.51871
## TailLen       2.7648     0.8283   3.338  0.00346 **
## TarsusLen    -8.6189     2.9728  -2.899  0.00919 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.655 on 19 degrees of freedom
## Multiple R-squared:  0.4542, Adjusted R-squared:  0.3968
## F-statistic: 7.906 on 2 and 19 DF,  p-value: 0.003174
```

We shall compare the results by hand, to determine the models which result in p-values below the alpha level of 0.05, and have the highest Multiple R-squared values, Residual Standard Error, and Adjusted R-Squared values (if necessary).

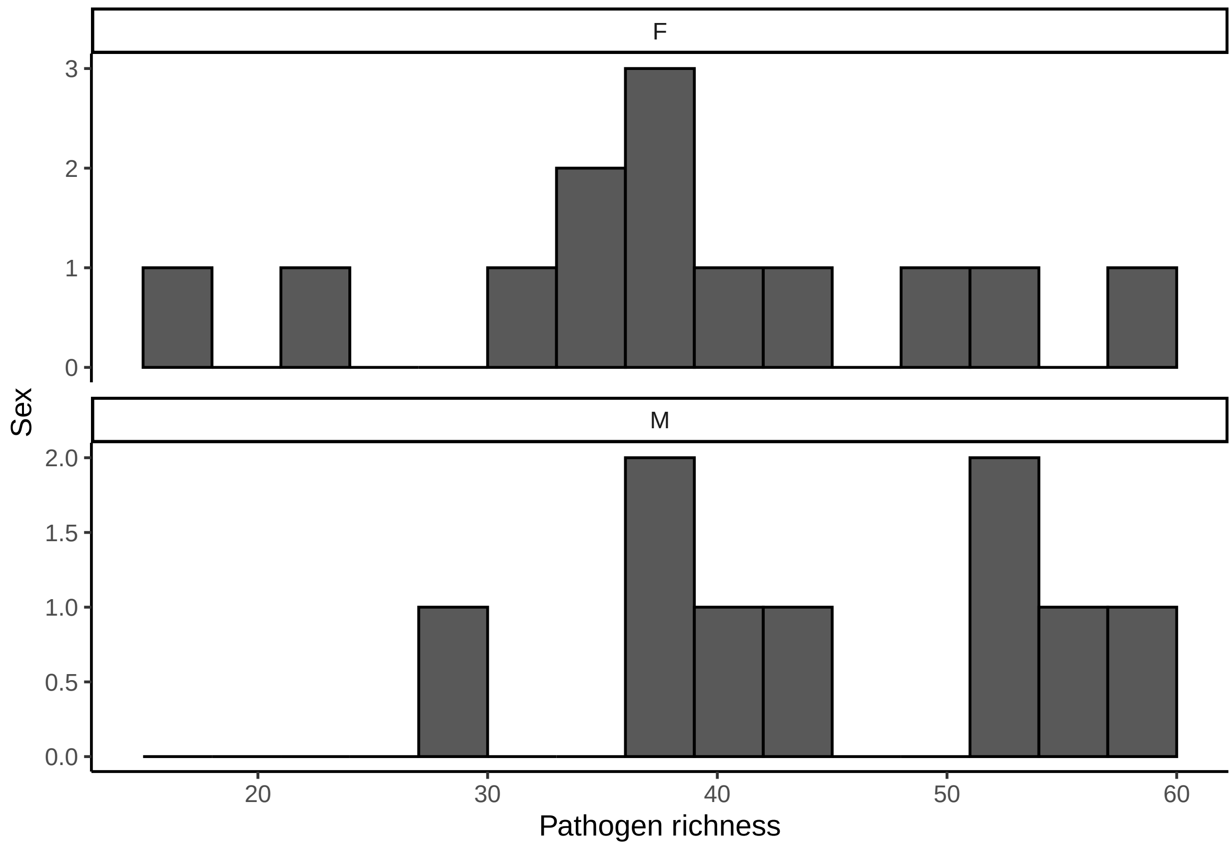
- Wing chord and tarsus length has a p-value less than the alpha level of 0.05. It has an R-squared value of 0.54, Adjusted R-squared of 0.4916, and a RSE of 7.946 on 19 degrees of freedom.
- Bird weight and tarsus length has a p-value less than the alpha level of 0.05. It has an R-squared value of 0.2799, Adjusted R-squared of 0.2042, and a RSE of 9.941 on 19 degrees of freedom.
- Tail length and tarsus length has a p-value less than the alpha level of 0.05. It has an R-squared value of 0.4542, Adjusted R-squared of 0.3968, and a RSE of 8.655 on 19 degrees of freedom.

From these results, the best model for predicting pathogen richness on feathers from two predictors is the wing chord and tarsus length model, based on all three metrics taken into consideration. This is in agreement with the single linear regression model results which suggested wing chord was one of the best predictors.

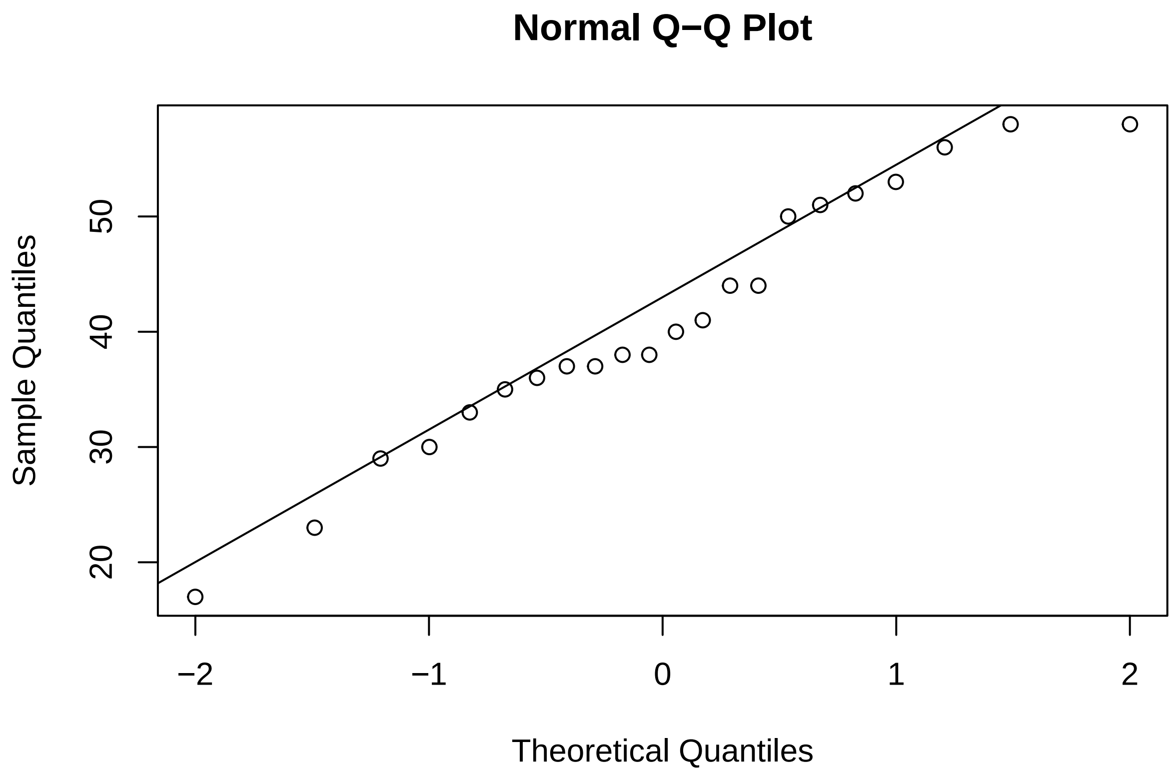
The single linear regression model suggested that tail length as also a significant predictor of pathogen richness on feathers, and the multiple regression model does support this conclusion.

- Use a two-sample t-test to determine whether mean pathogen richness on feathers differs significantly between male and female birds. [Use R function `t.test`.]

```
# Two-sample t-test
# Determine whether the mean of the dependent variable differs significantly between the independent va

# Assess normality and equal variance
ggplot(df_feather, aes(x = PathRich)) +
geom_histogram(col = "black", binwidth = 3,
boundary = 0, closed = "left") +
facet_wrap( ~ BirdSex, ncol = 1, scales = "free_y") +
labs(x = "Pathogen richness", y = "Sex")
```




```
# Q-Q Plot (Quantile-Quantile Plot)
qqnorm(df_feather$PathRich)
qqline(df_feather$PathRich)
```




```r
# Levene's Test to check for equal variance
leveneTest(df_feather$PathRich ~ df_feather$BirdSex) # fail to reject the null hypothesis, suggesting i
```

```
## Warning in leveneTest.default(y = y, group = group, ...): group coerced to
## factor.
```

```
## Levene's Test for Homogeneity of Variance (center = median)
##       Df F value Pr(>F)
## group  1  0.0106 0.9189
##       20
```

```r
# Check for missing values
sum(is.na(df_feather$PathRich)) # none
```

```
## [1] 0
```

```r
# Filter missing values (if there are any)
#featherSub <- filter(df_feather, PathRich != "NA")

# t-test assuming equal variance
t.test(PathRich ~ BirdSex, data = df_feather, var.equal = TRUE)
```

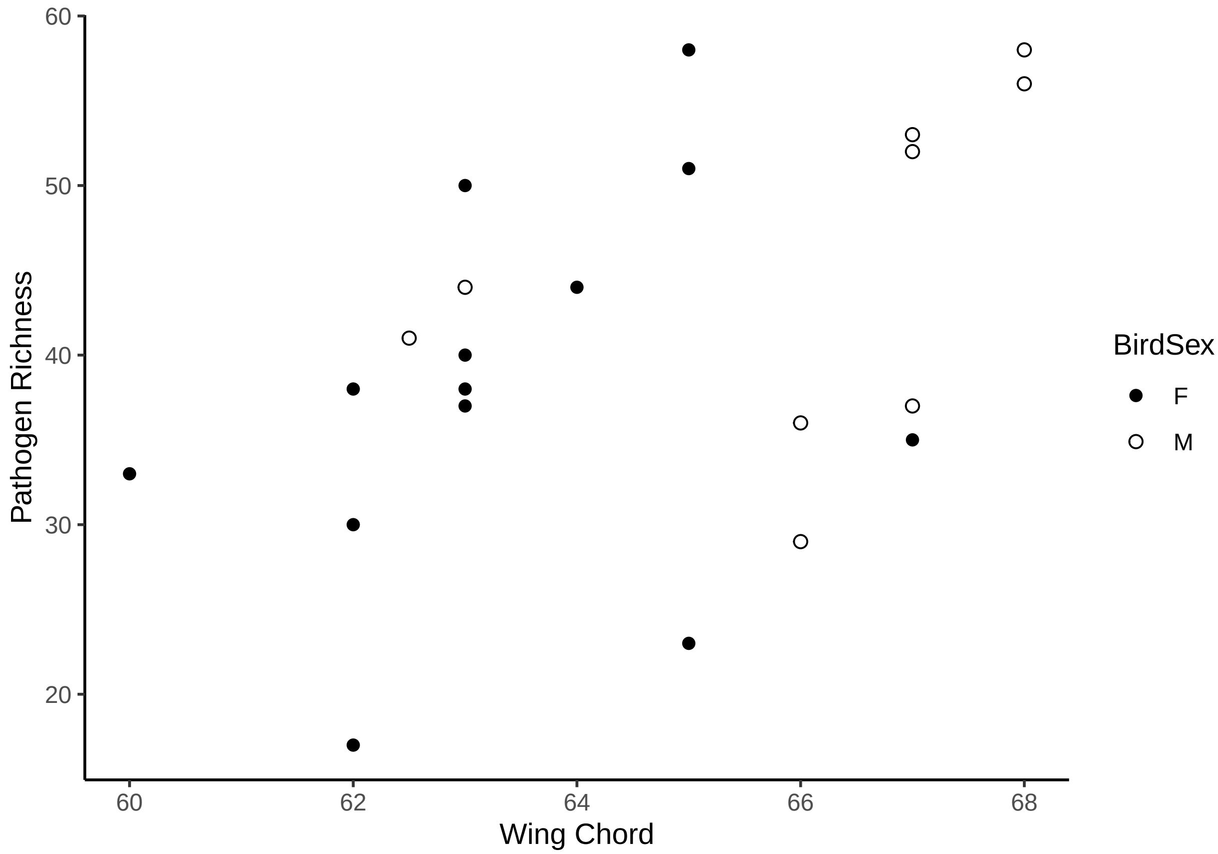
```
##
```

```
##  Two Sample t-test
##
## data:  PathRich by BirdSex
## t = -1.5165, df = 20, p-value = 0.1451
## alternative hypothesis: true difference in means between group F and group M is not equal to 0
## 95 percent confidence interval:
##  -16.892824   2.670602
## sample estimates:
## mean in group F mean in group M
##        38.00000        45.11111
```

From the results of the Two Sample t-test, as the p-value is less than the alpha level of 0.05, we fail to reject the null hypothesis that difference in the means is 0. We conclude that there is no reason to assume a significant difference in the means between sex.

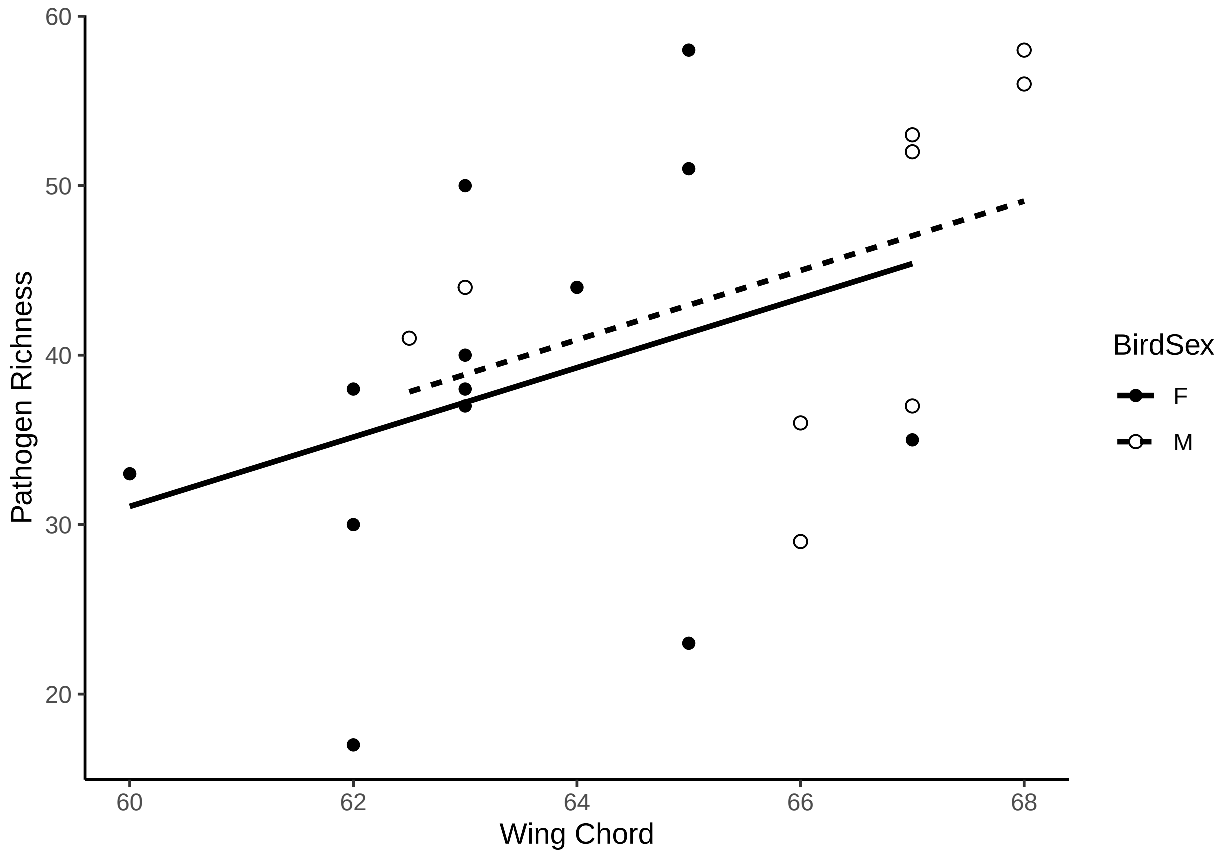
- Starting from the simple linear regression model in Question 12, use analysis of covariance to investigate whether the linear association in the model differs for male and female birds. [Use R functions **`lm`** and **`summary`**.]

```r
# ANCOVA

# Wing Chord

# Scatterplot by Sex
ggplot(df_feather, aes(WingChord, PathRich, shape = BirdSex)) +
geom_point(size = 2) +
scale_shape_manual(values = c(16, 1)) +
labs(x = "Wing Chord", y = "Pathogen Richness")
```




```r
# Fit the main effects model (with no interaction term)
featherNoInteractModel <- lm(PathRich ~ WingChord + BirdSex,
data = df_feather)
df_feather$fit0 <- predict(featherNoInteractModel)
ggplot(df_feather, aes(WingChord, PathRich, colour = BirdSex,
shape = BirdSex, linetype=BirdSex)) +
geom_line(aes(y = fit0), size = 1, color = "black") +
geom_point(size = 2) +
scale_colour_manual(values = c("black", "black")) +
scale_shape_manual(values = c(16, 1)) +
labs(x = "Wing Chord", y = "Pathogen Richness")
```

```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use `linewidth` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```



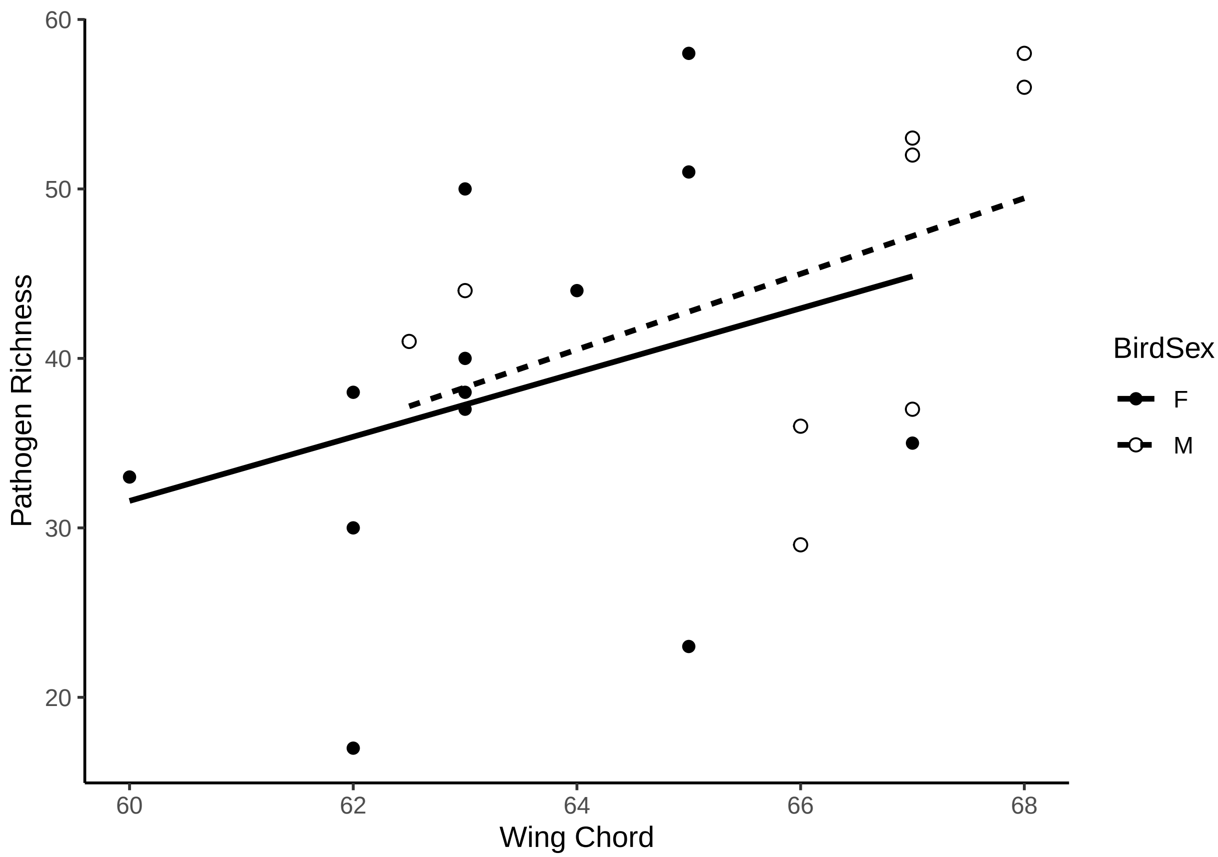

```
summary(featherNoInteractModel)
```

```
##
## Call:
## lm(formula = PathRich ~ WingChord + BirdSex, data = df_feather)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -18.307  -8.040   2.811   5.753  16.693
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -91.744     77.838  -1.179    0.253
## WingChord      2.047      1.227   1.668    0.112
## BirdSexM       1.644      5.562   0.296    0.771
##
## Residual standard error: 10.36 on 19 degrees of freedom
## Multiple R-squared:  0.2177, Adjusted R-squared:  0.1353
## F-statistic: 2.643 on 2 and 19 DF,  p-value: 0.09709
```

```
# Fit the interaction model
featherInteractModel <- lm(PathRich ~ WingChord * BirdSex,
data = df_feather)
ggplot(df_feather, aes(WingChord, PathRich, colour = BirdSex,
shape = BirdSex, linetype=BirdSex)) +
```

```
geom_smooth(method = "lm", size = 1, se = FALSE, col = "black") +
geom_point(size = 2) +
scale_colour_manual(values = c("black", "black")) +
scale_shape_manual(values = c(16, 1)) +
labs(x = "Wing Chord", y = "Pathogen Richness")
```

```
## `geom_smooth()` using formula = 'y ~ x'
```




```
summary(featherInteractModel)
```

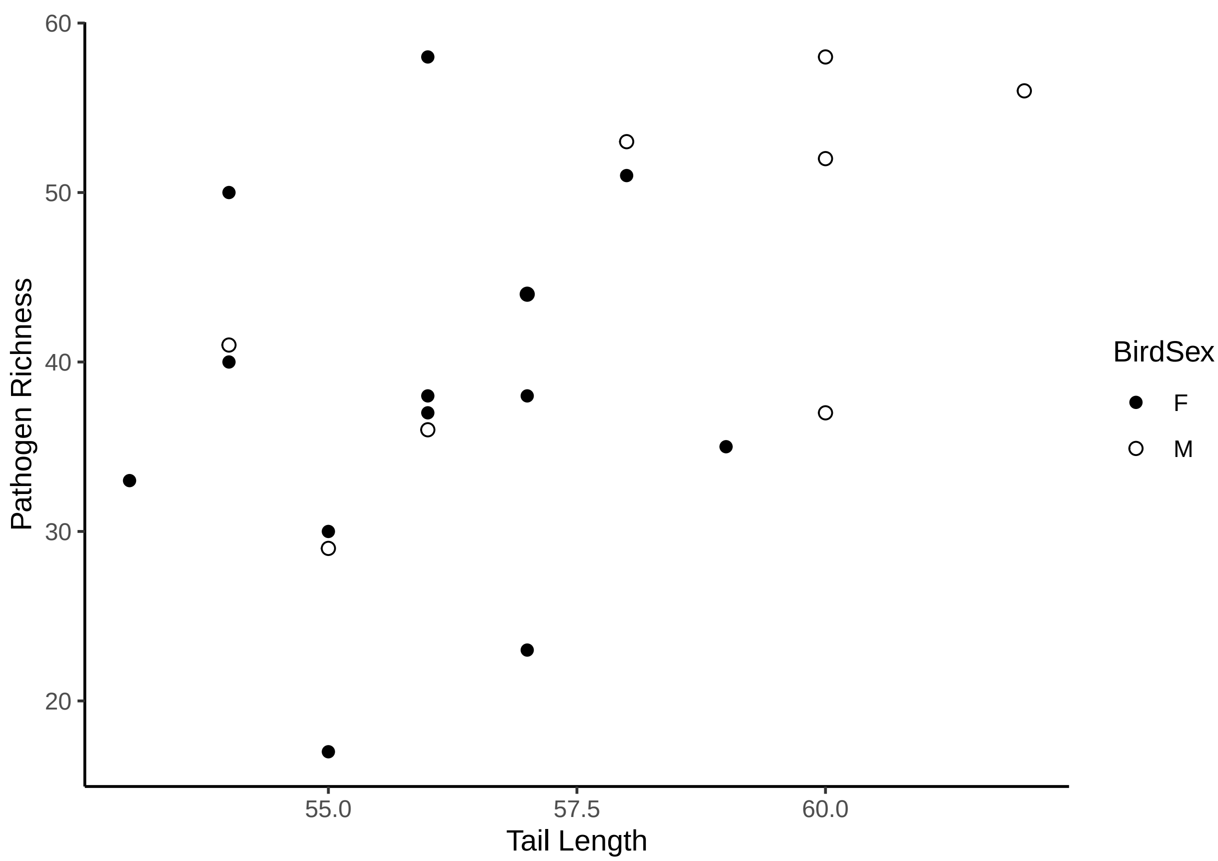
```
##
## Call:
## lm(formula = PathRich ~ WingChord * BirdSex, data = df_feather)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -18.378  -8.085   2.675   5.763  16.941
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)        -82.0315   107.9356  -0.760    0.457
## WingChord            1.8937     1.7022   1.112    0.281
## BirdSexM           -20.3435   164.3029  -0.124    0.903
## WingChord:BirdSexM   0.3391     2.5321   0.134    0.895
```

```
##
## Residual standard error: 10.64 on 18 degrees of freedom
## Multiple R-squared:  0.2185, Adjusted R-squared:  0.0882
## F-statistic: 1.677 on 3 and 18 DF,  p-value: 0.2075
```

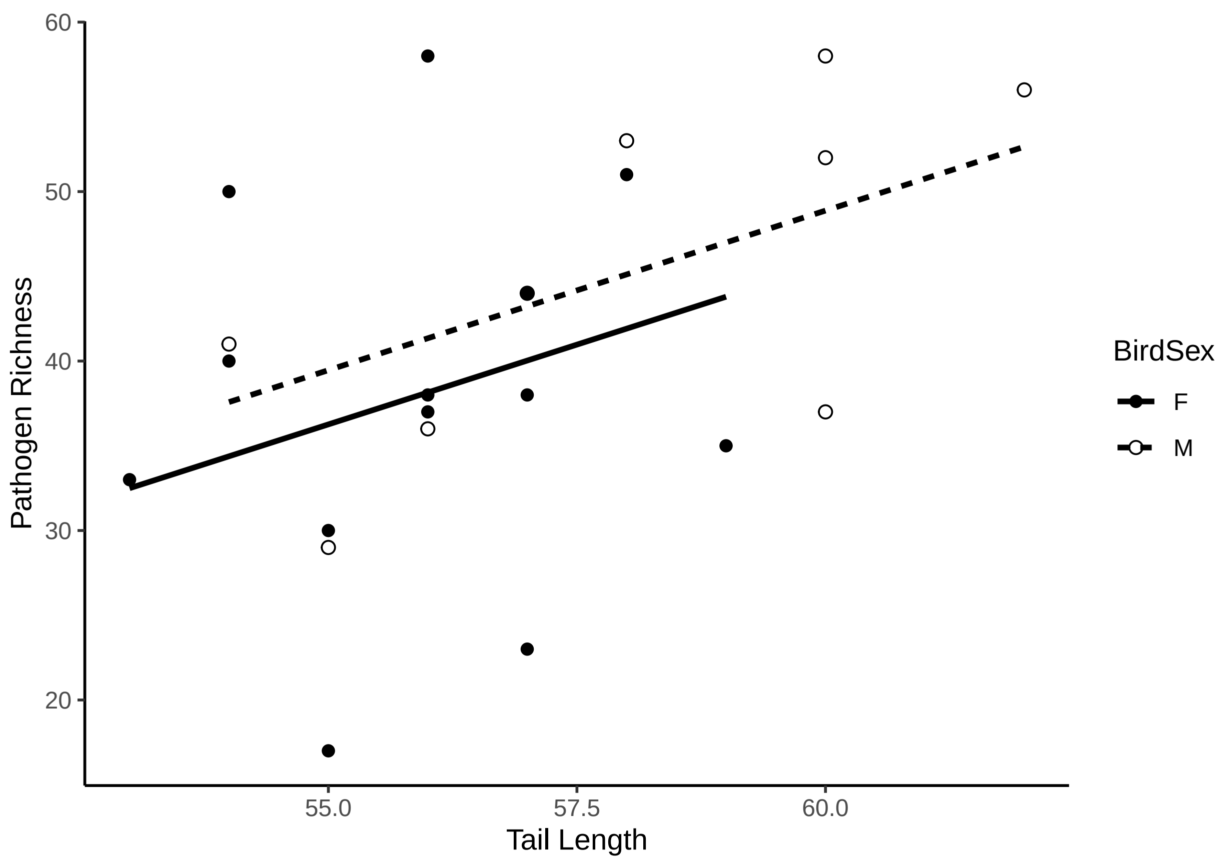
```
# ANOVA table
anova(featherNoInteractModel, featherInteractModel)
```

```
## Analysis of Variance Table
##
## Model 1: PathRich ~ WingChord + BirdSex
## Model 2: PathRich ~ WingChord * BirdSex
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1     19 2040.2
## 2     18 2038.1  1    2.0302 0.0179  0.895
```

```
# No significant difference

# Tail Length
# Scatterplot by Sex
ggplot(df_feather, aes(TailLen, PathRich, shape = BirdSex)) +
geom_point(size = 2) +
scale_shape_manual(values = c(16, 1)) +
labs(x = "Tail Length", y = "Pathogen Richness")
```



```
# Fit the main effects model (with no interaction term)
featherNoInteractModel <- lm(PathRich ~ TailLen + BirdSex,
data = df_feather)
df_feather$fit0 <- predict(featherNoInteractModel)
ggplot(df_feather, aes(TailLen, PathRich, colour = BirdSex,
shape = BirdSex, linetype=BirdSex)) +
geom_line(aes(y = fit0), size = 1, color = "black") +
geom_point(size = 2) +
scale_colour_manual(values = c("black", "black")) +
scale_shape_manual(values = c(16, 1)) +
labs(x = "Tail Length", y = "Pathogen Richness")
```



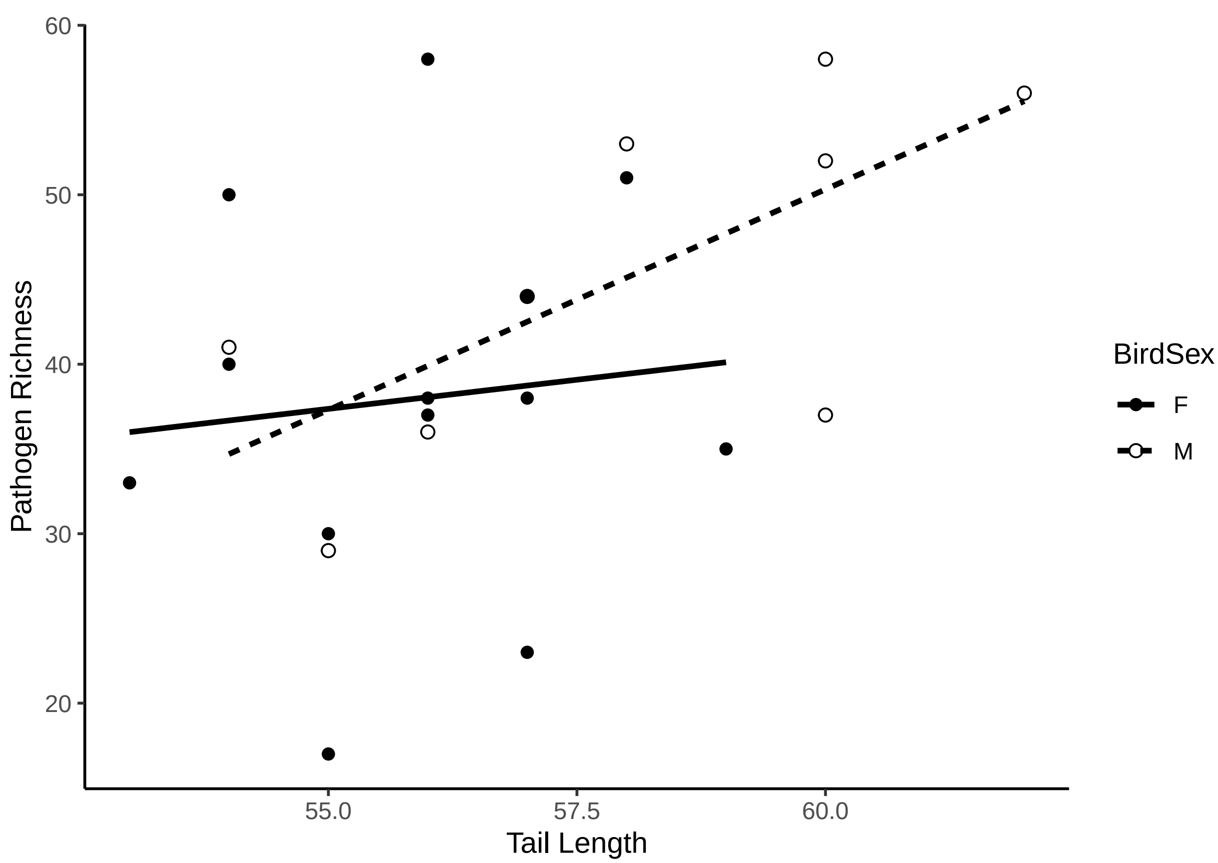

```
summary(featherNoInteractModel)
```

```
##
## Call:
## lm(formula = PathRich ~ TailLen + BirdSex, data = df_feather)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -19.2616  -6.0323   0.6386   5.2092  19.8551
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -67.319     59.727  -1.127   0.2737
```

```
## TailLen        1.883      1.067   1.765   0.0936 .
## BirdSexM       3.200      4.979   0.643   0.5282
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.28 on 19 degrees of freedom
## Multiple R-squared:  0.2295, Adjusted R-squared:  0.1484
## F-statistic:  2.83 on 2 and 19 DF,  p-value: 0.08401
```

```
# Fit the interaction model
featherInteractModel <- lm(PathRich ~ TailLen * BirdSex,
data = df_feather)
ggplot(df_feather, aes(TailLen, PathRich, colour = BirdSex,
shape = BirdSex, linetype=BirdSex)) +
geom_smooth(method = "lm", size = 1, se = FALSE, col = "black") +
geom_point(size = 2) +
scale_colour_manual(values = c("black", "black")) +
scale_shape_manual(values = c(16, 1)) +
labs(x = "Tail Length", y = "Pathogen Richness")
```

```
## `geom_smooth()` using formula = 'y ~ x'
```




```
summary(featherInteractModel)
```

```
##
```

```
## Call:
## lm(formula = PathRich ~ TailLen * BirdSex, data = df_feather)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -20.3656  -4.8120   0.2111   6.0420  19.9471
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)         -0.4317    98.0126  -0.004    0.997
## TailLen              0.6872     1.7519   0.392    0.699
## BirdSexM          -105.4572   125.8369  -0.838    0.413
## TailLen:BirdSexM     1.9162     2.2174   0.864    0.399
##
## Residual standard error: 10.35 on 18 degrees of freedom
## Multiple R-squared:  0.2602, Adjusted R-squared:  0.1369
## F-statistic:  2.11 on 3 and 18 DF,  p-value: 0.1346
```

```
# ANOVA table
anova(featherNoInteractModel, featherInteractModel)
```

```
## Analysis of Variance Table
##
## Model 1: PathRich ~ TailLen + BirdSex
## Model 2: PathRich ~ TailLen * BirdSex
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1     19 2009.3
## 2     18 1929.3  1     80.04 0.7468 0.3989
```

```
# No significant difference
```

Based on the results of the ANCOVA tests, we fail to reject the null hypothesis that there is no difference in the models, and conclude that there is no reason to assume statistically significant differences in linear association between bird sexes.

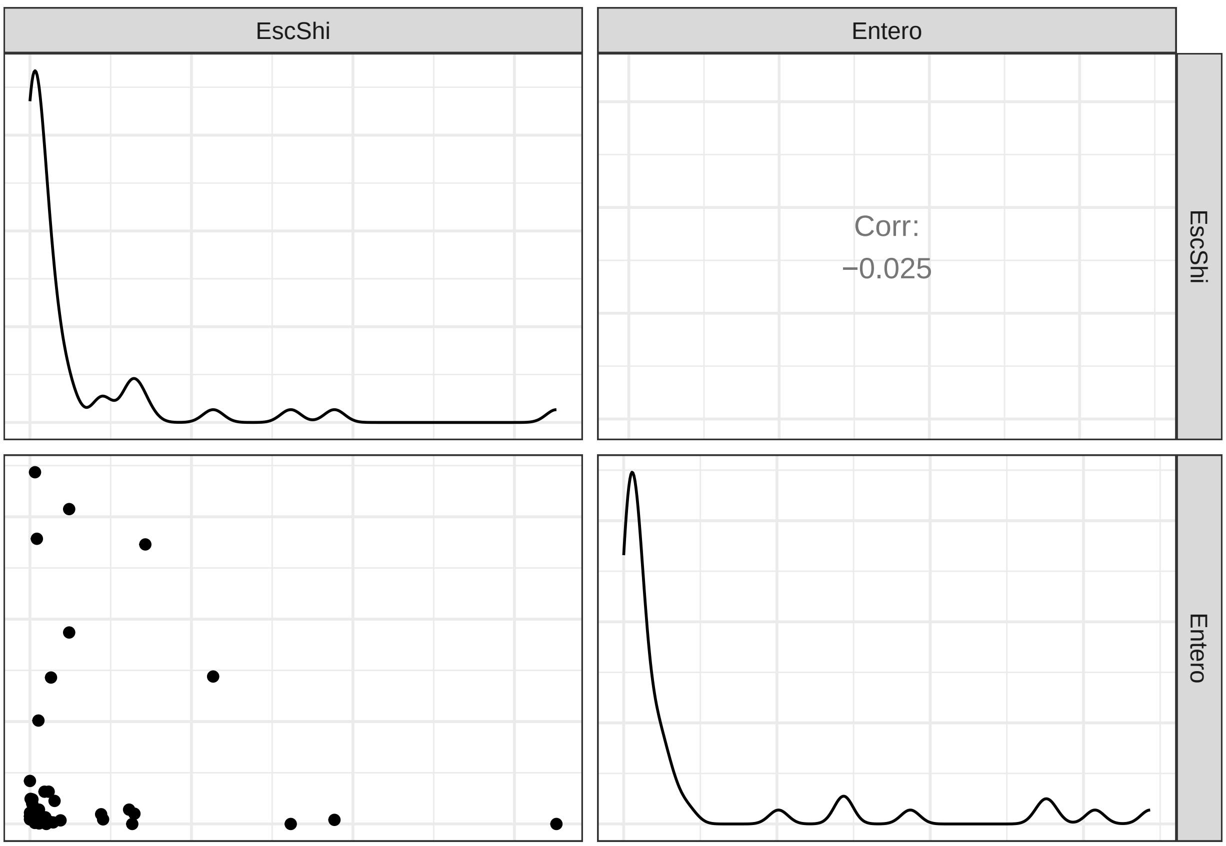
Let us now perform some multivariate methods on the original dataset (feather and nest group) of the pathogen groups:

```
# Correlation matrix

# Select only numeric columns
numeric_data <- select_if(chickadeeData, is.numeric)

# Calculate the correlation matrix
cor_matrix <- cor(numeric_data)
print(cor_matrix)
```

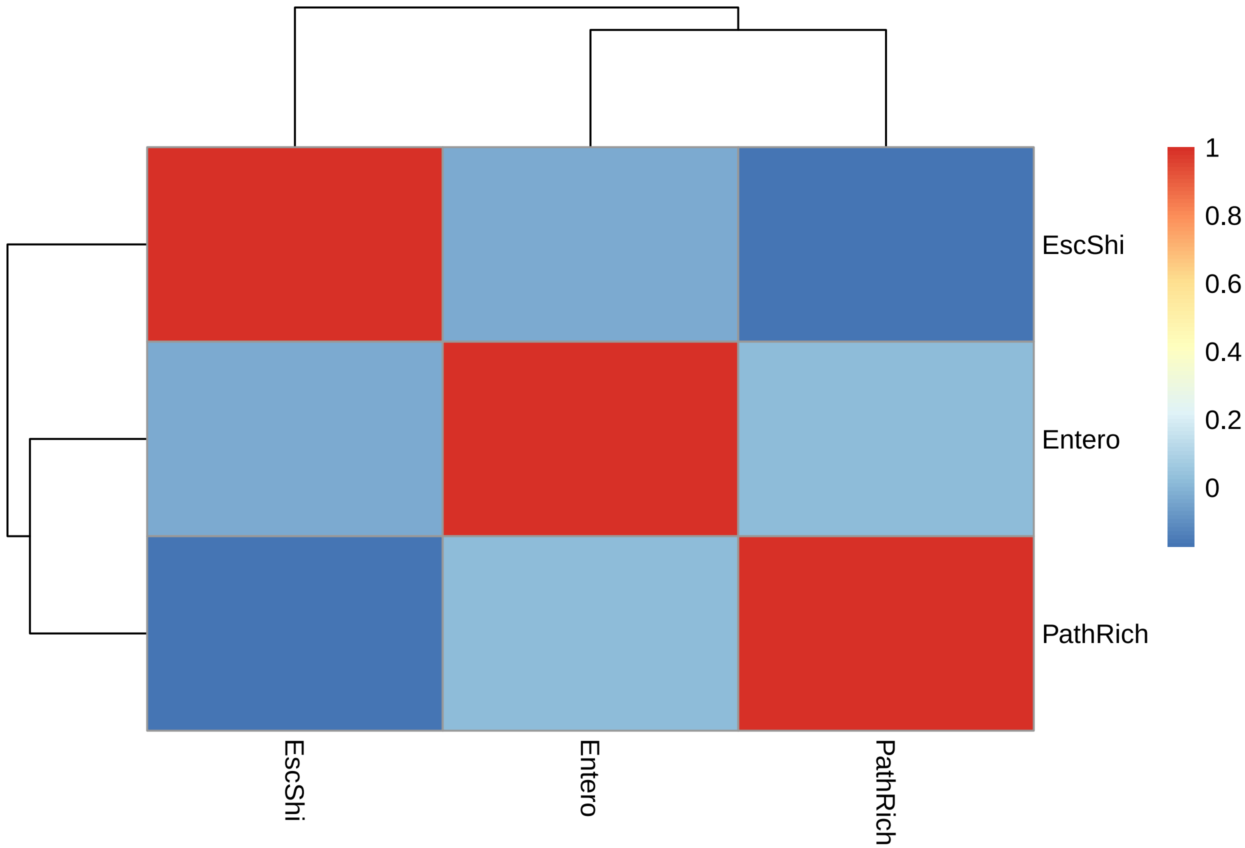
```
##                 EscShi      Entero    PathRich WingChord BirdWeight TailLen
## EscShi      1.00000000 -0.02478671 -0.17554100        NA         NA      NA
## Entero     -0.02478671  1.00000000  0.01885488        NA         NA      NA
## PathRich   -0.17554100  0.01885488  1.00000000        NA         NA      NA
## WingChord           NA          NA          NA         1         NA      NA
## BirdWeight          NA          NA          NA        NA          1      NA
```

```
## TailLen                 NA           NA           NA          NA           NA        1
## TarsusLen               NA           NA           NA          NA           NA       NA
##            TarsusLen
## EscShi            NA
## Entero            NA
## PathRich          NA
## WingChord         NA
## BirdWeight        NA
## TailLen           NA
## TarsusLen          1
```

```
# Pick column pairs

# Scatter plot matrix (pairs)
ggpairs(chickadeeData[, c("EscShi", "Entero")], axisLabels = "none") +
theme_bw()
```




```
# Clustered Heatmap of Correlations between variables
numeric_variables <- chickadeeData[, c("EscShi", "Entero", "PathRich")]
pheatmap(cor(numeric_variables), cell.width = 10, cell.height = 10)
```




```
# Centering and Scaling the Data
apply(numeric_data, 2, mean)
```

```
##     EscShi     Entero   PathRich  WingChord BirdWeight    TailLen  TarsusLen
##   577.85106   92.74468   44.29787         NA         NA         NA         NA
```

```
apply(numeric_data, 2, sd)
```

```
##     EscShi     Entero   PathRich  WingChord BirdWeight    TailLen  TarsusLen
## 1199.91534  176.41952   13.91108         NA         NA         NA         NA
```

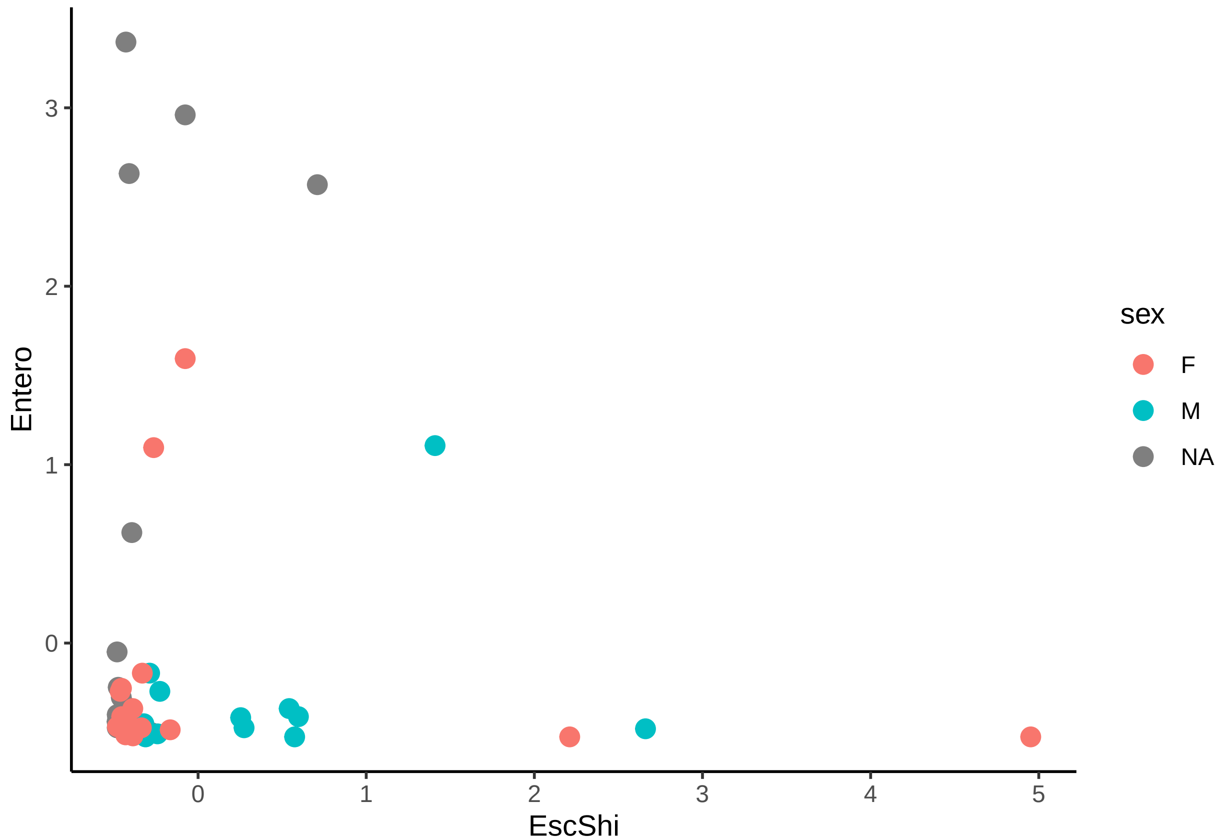
```
scaledBirds <- scale(numeric_data)
apply(numeric_data, 2, mean)
```

```
##     EscShi     Entero   PathRich  WingChord BirdWeight    TailLen  TarsusLen
##   577.85106   92.74468   44.29787         NA         NA         NA         NA
```

```
apply(numeric_data, 2, sd)
```

```
##     EscShi     Entero   PathRich  WingChord BirdWeight    TailLen  TarsusLen
## 1199.91534  176.41952   13.91108         NA         NA         NA         NA
```

```
# Display in scatterplot marked by sex
ggplot(data.frame(scaledBirds, sex = chickadeeData$BirdSex),
aes(x = EscShi, y = Entero, group = sex)) +
geom_point(aes(color = sex), size = 3)
```



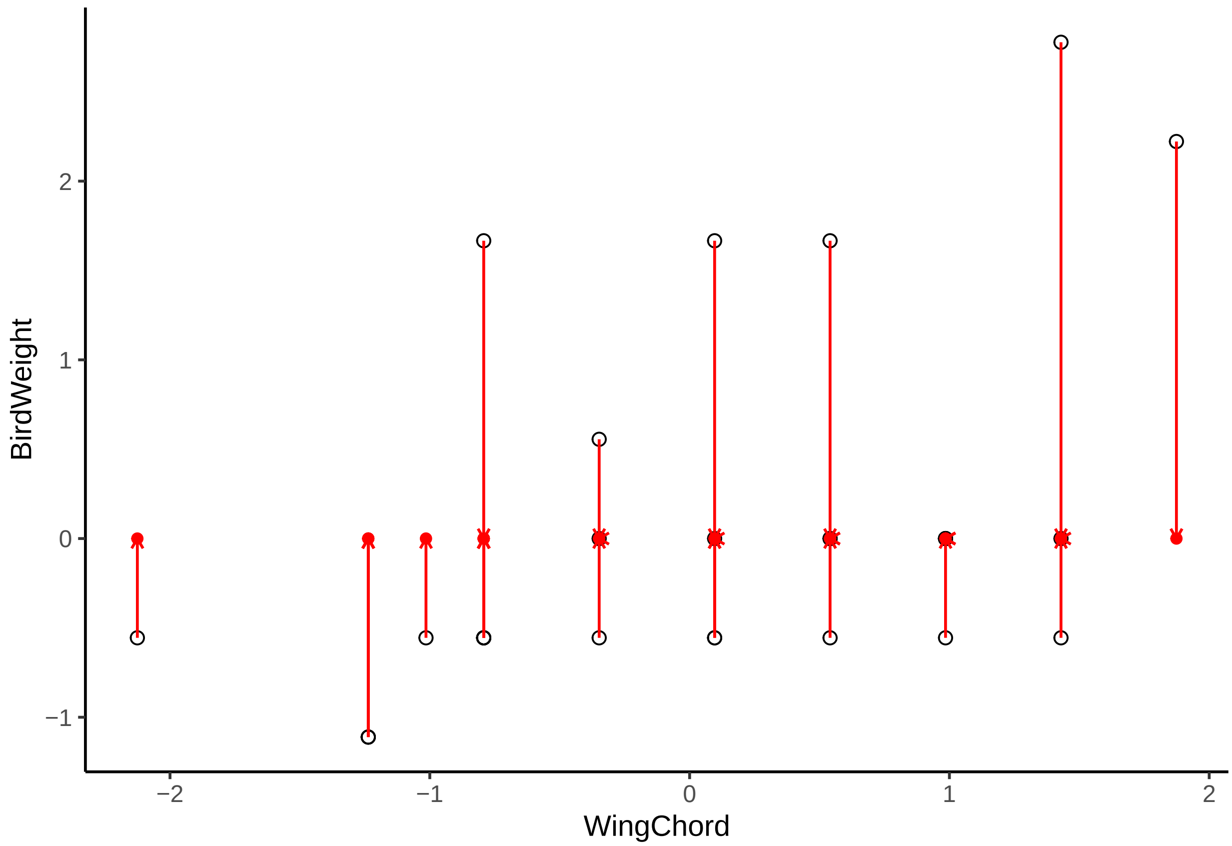
Simply said, we find that the magnitude of correlation between pathogen groups are low.

- Apply principal component analysis to the variables **WingChord**, **BirdWeight**, **TailLen**, and **TarsusLen**. [Use R functions **scale**, **prcomp**, and **summary**. Also, summarize the principal component loadings and use R function **fviz_pca_ind** with argument **habillage** to visualize the results and colour the observations by bird sex.]

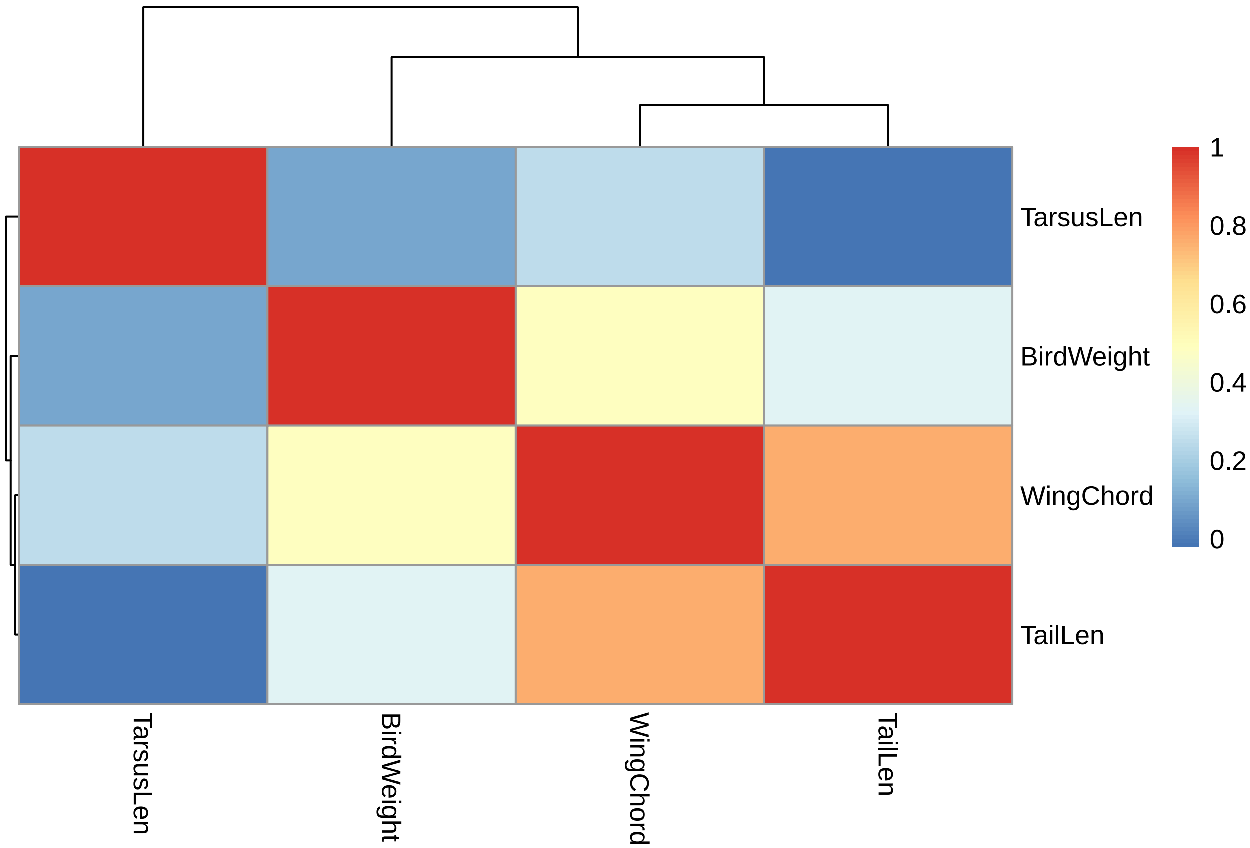
```
# Quick PCA

# Gather the numeric variables
numeric_variables <- chickadeeData[, c("WingChord", "BirdWeight", "TailLen", "TarsusLen")]

scaledBirds <- data.frame(scale(numeric_variables))

ggplot(scaledBirds, aes(x = WingChord, y = BirdWeight)) +
geom_point(size = 2, shape = 21) +
geom_point(aes(y = 0), colour = "red") +
geom_segment(aes(xend = WingChord, yend = 0),
colour = "red",
arrow = arrow(length = unit(0.15, "cm")))
```

```
## Warning: Removed 17 rows containing missing values (`geom_point()`).
## Removed 17 rows containing missing values (`geom_point()`).
```

```
## Warning: Removed 17 rows containing missing values (`geom_segment()`).
```




```r
scaledBirds_clean_rows <- na.omit(scaledBirds)
# clustered heatmap of correlations
pheatmap(cor(scaledBirds_clean_rows), treeheight_row = 0.2)
```




```r
# Perform PCA
pca_result <- prcomp(scaledBirds_clean_rows, center = TRUE, scale. = TRUE)
# center and scale. are usually TRUE for standardized data, but since the data is already scaled, they

summary_pca <- summary(pca_result)
print(summary_pca)
```

```
## Importance of components:
##                           PC1    PC2    PC3     PC4
## Standard deviation     1.4514 1.0062 0.8397 0.41932
## Proportion of Variance 0.5267 0.2531 0.1763 0.04396
## Cumulative Proportion  0.5267 0.7798 0.9560 1.00000
```

```r
# Explain the first 2 principal components (rotation matrix)
pca_result$rotation[, 1:2]
```

```
##                  PC1          PC2
## WingChord  0.6440609  0.025362474
## BirdWeight 0.4700622 -0.009731933
## TailLen    0.5781823 -0.305179586
## TarsusLen  0.1730096  0.951907272
```

```r
pca_result$sdev # standard deviations
```

```
## [1] 1.4514477 1.0061791 0.8396889 0.4193158
```

```
pca_result$sdev^2 # eigenvalues/variances
```

```
## [1] 2.1067004 1.0123965 0.7050774 0.1758258
```

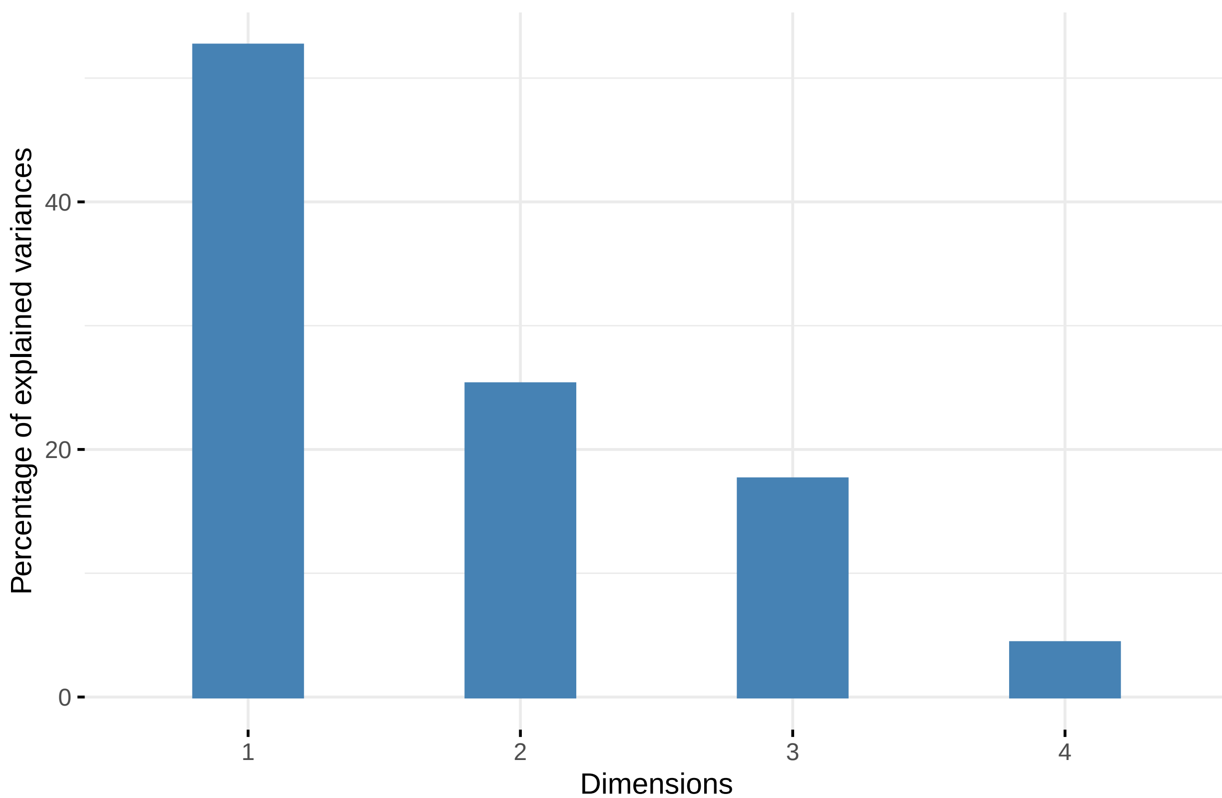
```
pca_result$sdev^2 / sum(pca_result$sdev^2) # proportion of variance
```

```
## [1] 0.52667510 0.25309911 0.17626934 0.04395645
```

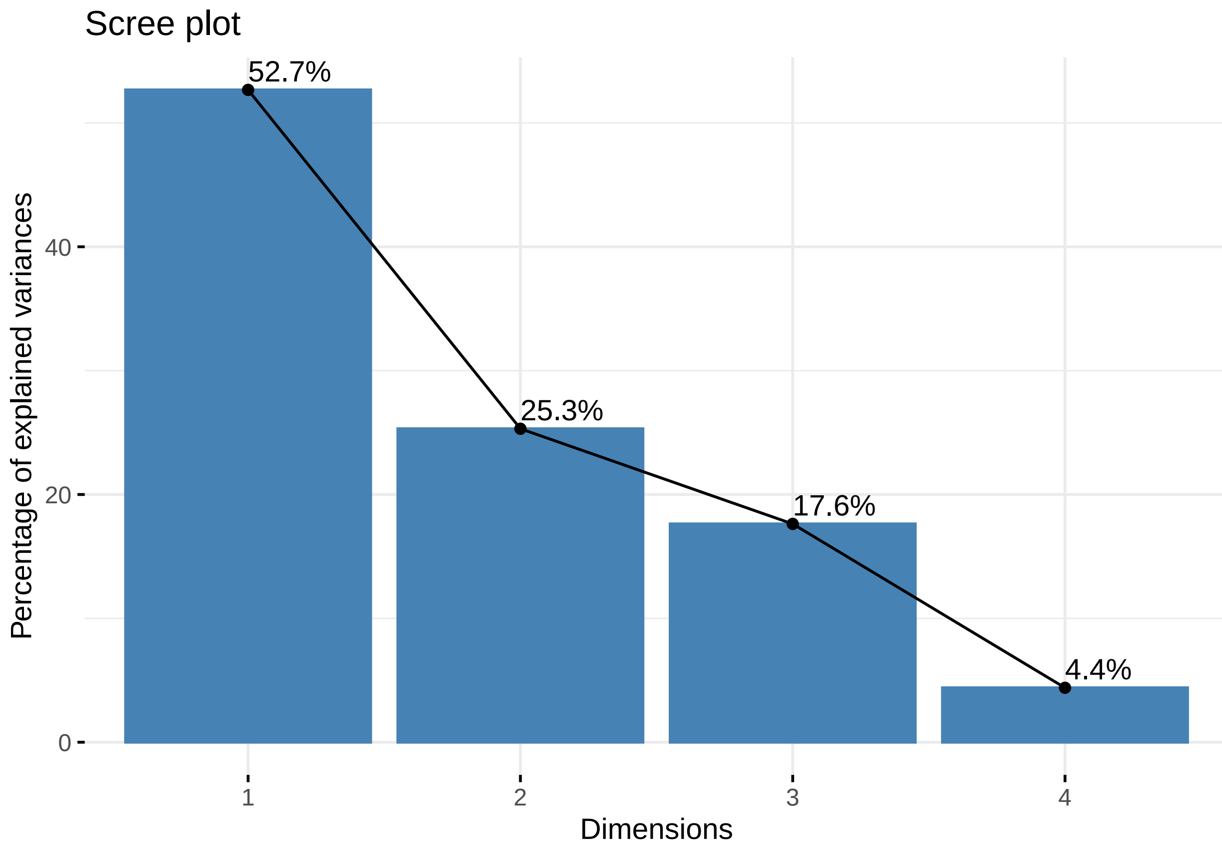
```
get_eig(pca_result) # eigenvalues/variances
```

```
##       eigenvalue variance.percent cumulative.variance.percent
## Dim.1  2.1067004        52.667510                    52.66751
## Dim.2  1.0123965        25.309911                    77.97742
## Dim.3  0.7050774        17.626934                    95.60436
## Dim.4  0.1758258         4.395645                   100.00000
```

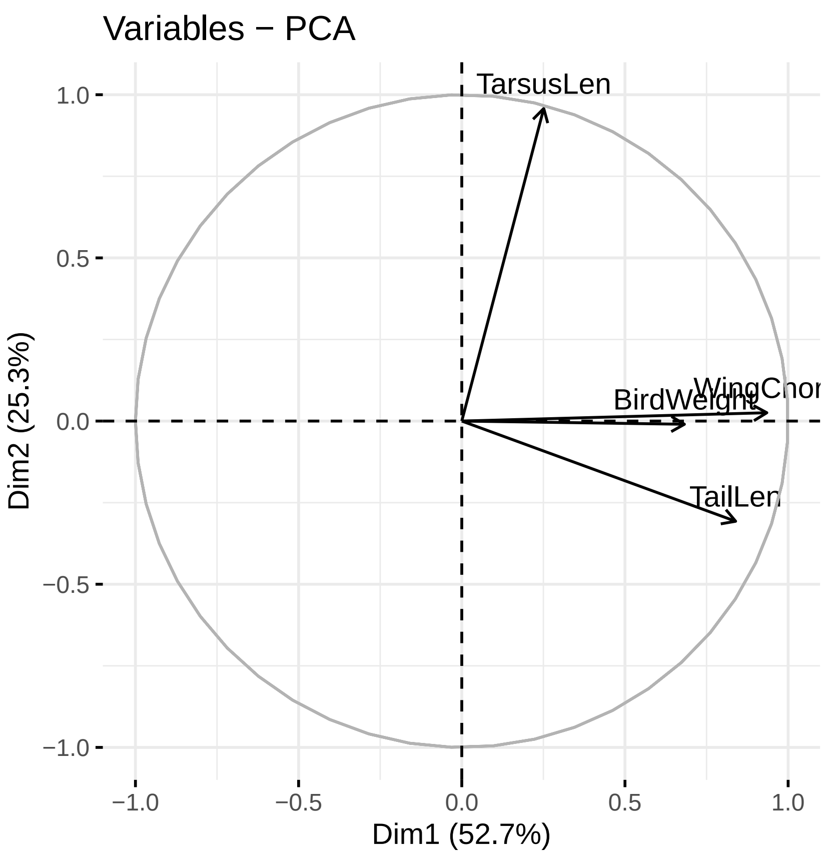
```
fviz_eig(pca_result, geom = "bar", bar_width = 0.4) +
ggtitle("")
```



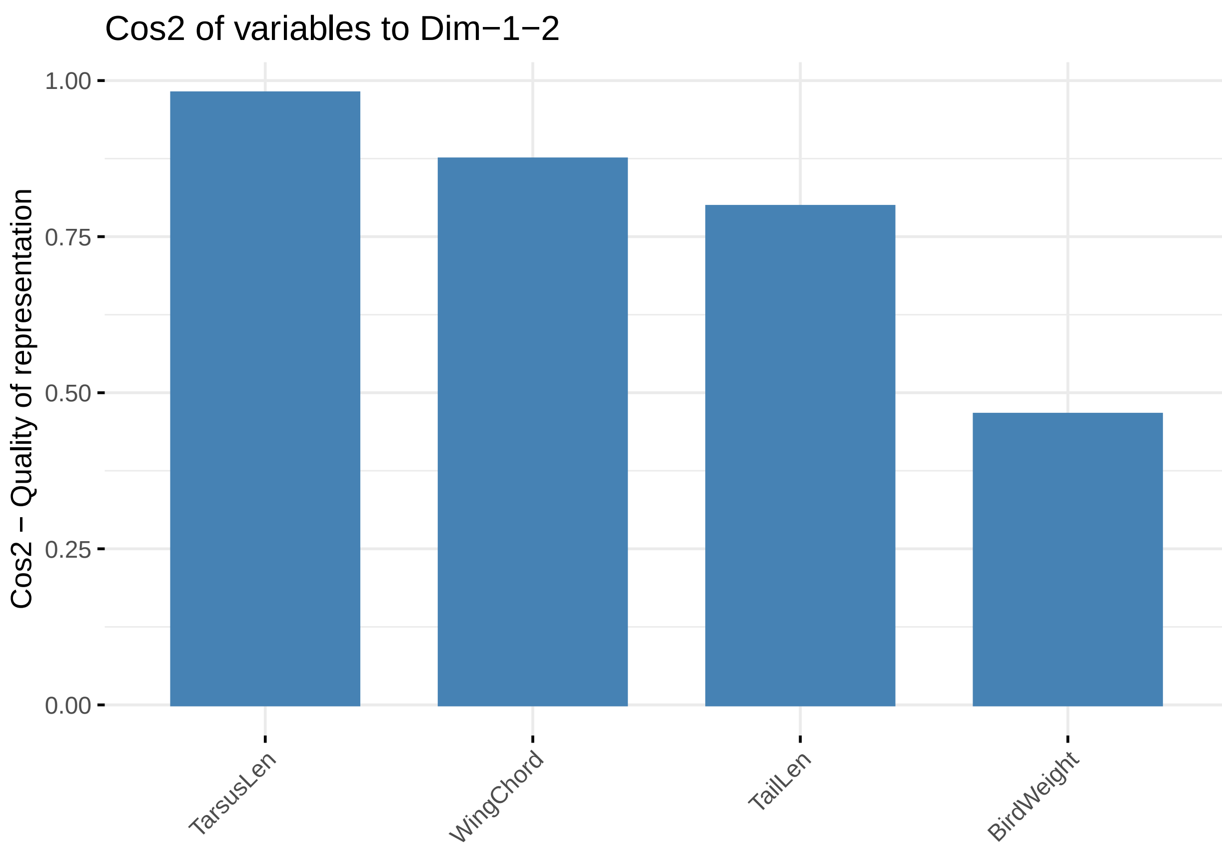

```
# Scree Plot
fviz_eig(pca_result, addlabels = TRUE)
```



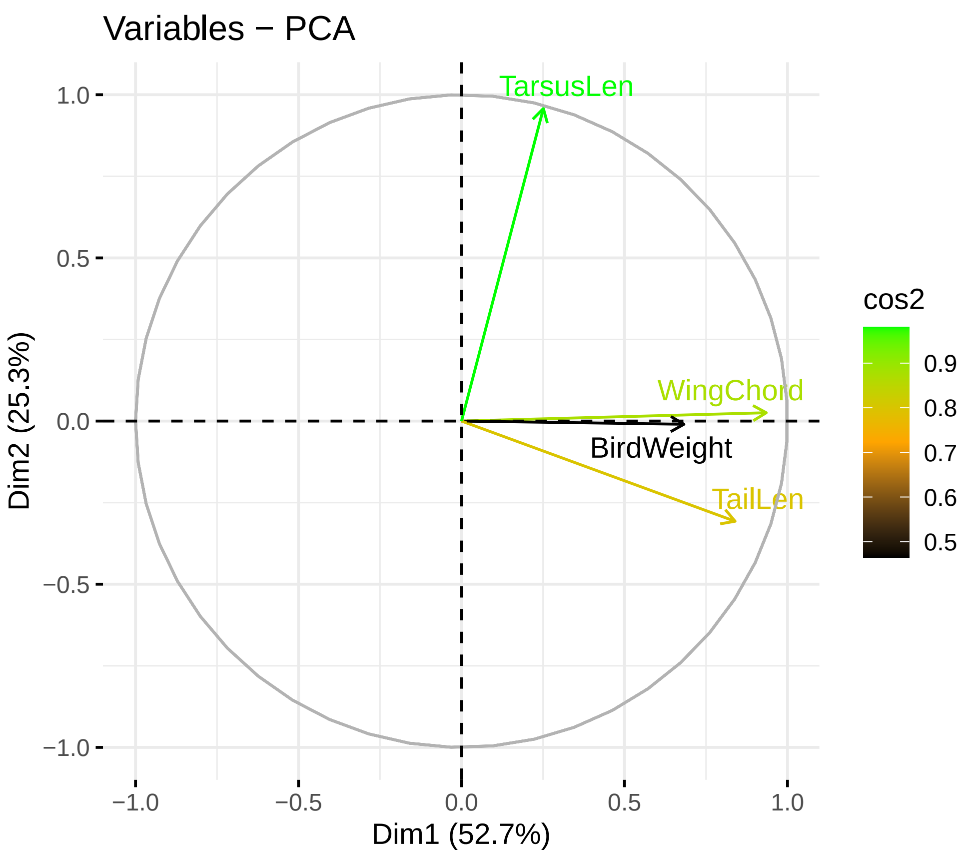

```
# Biplot of attributes
fviz_pca_var(pca_result, col.var = "black")
```



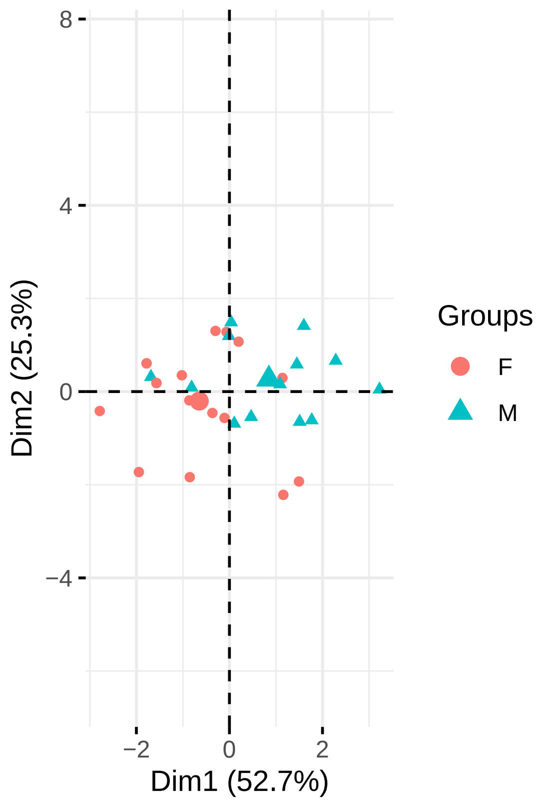

```r
# Contribution of each variable
fviz_cos2(pca_result, choice = "var", axes = 1:2)
```



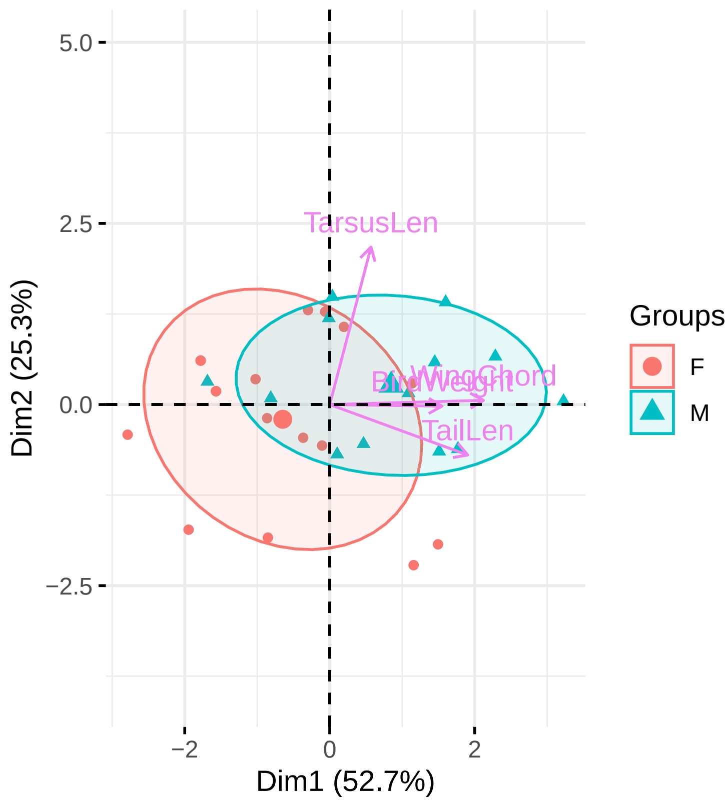

```
# Biplot combined with cos2
fviz_pca_var(pca_result, col.var = "cos2",
             gradient.cols = c("black", "orange", "green"),
             repel = TRUE)
```




```
# PCA Scatter Plot
chickadee_clean_rows <- na.omit(chickadeeData) # we need to ensure the rows are equal from the dataset

fviz_pca_ind(pca_result, habillage = chickadee_clean_rows$BirdSex,
geom = "point") +
ggtitle("") +
ylim(c(-6.5,7.5)) +
coord_fixed()
```



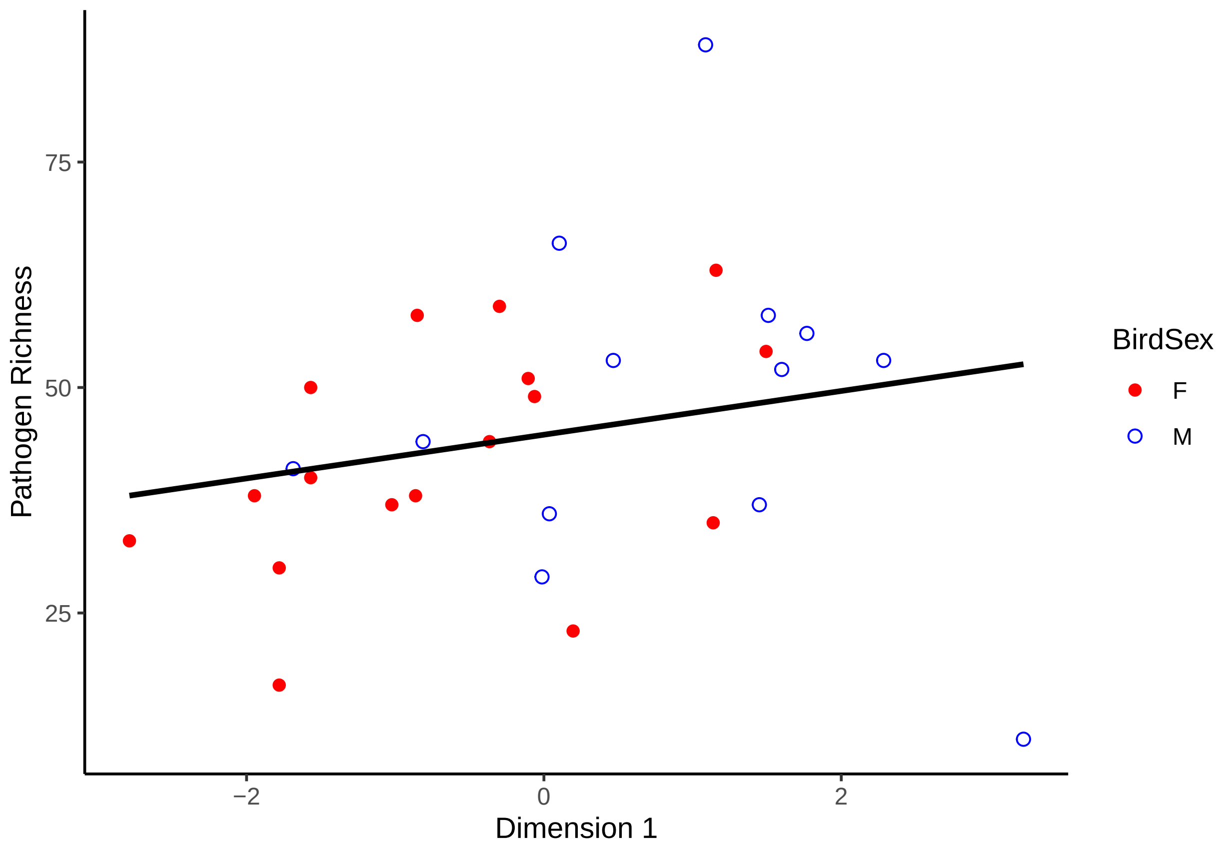

```
# PCA BiPlot
fviz_pca_biplot(pca_result, geom = "point",
habillage = chickadee_clean_rows$BirdSex,
col.var = "violet", addEllipses = TRUE,
ellipse.level = 0.69) +
ggtitle("") +
ylim(c(-4,5)) +
coord_fixed()
```



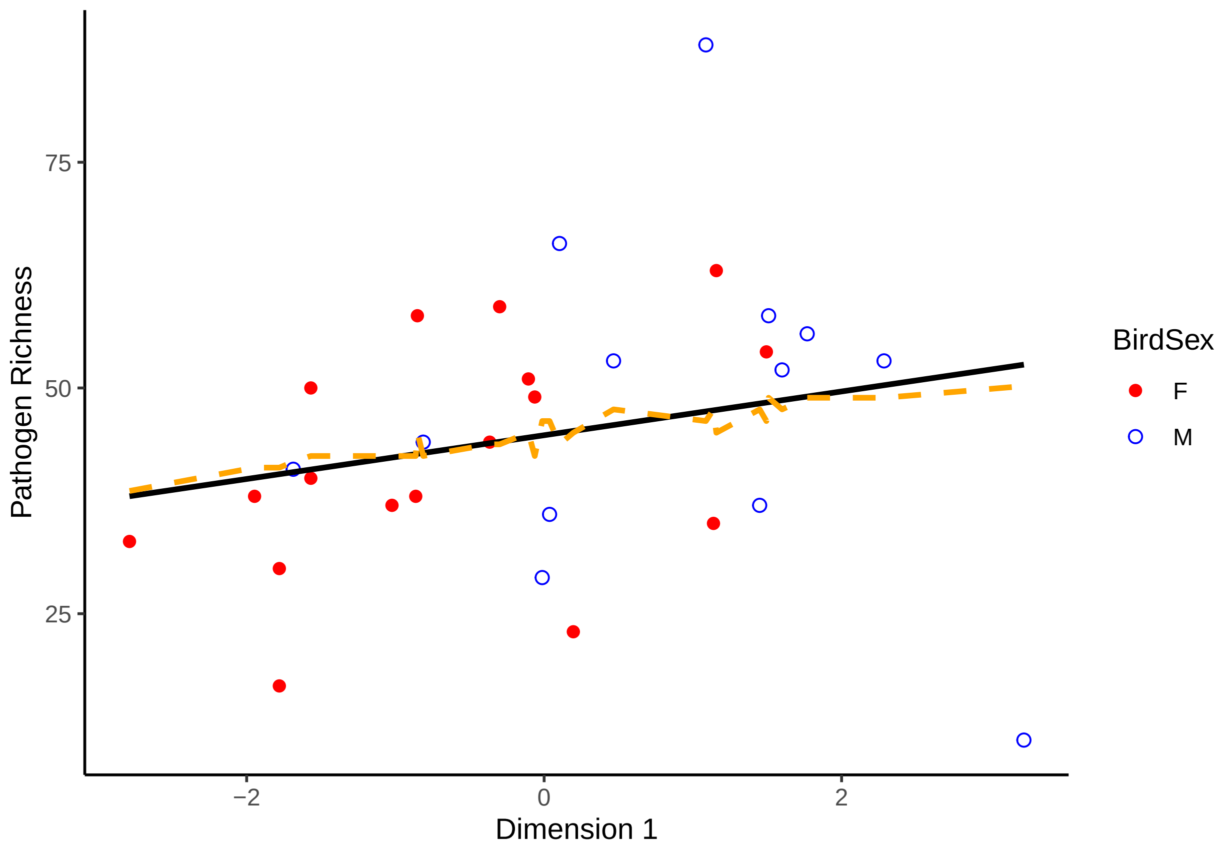
From the biplot of the variables with respect to the principal components, we can observe that the female group is lower in both dimensions, compared to the male group. We see that Tarsus length is least correlated to the other variables, while the other three are positively correlated to each other. Furthermore, we observe that tarsus length, wing chord, and tail length are the top contributors to the principal components.

- Fit a simple linear regression model with response variable **PathRich** and predictor variable equal to the first principal component from Question 16. Compare this model with the simple linear regression model in Question 12. [Use R functions **lm** and **summary**.]

```
# Extract the principal component scores
pc1_scores <- pca_result$x[, 1]
pc2_scores <- pca_result$x[, 2]

# Fit a linear model to each relationship
fit_PC1 <- lm(chickadee_clean_rows$PathRich ~ pc1_scores)

# Make predictions using the linear model
chickadee_clean_rows$pc1_predicted <- predict(fit_PC1, newdata = chickadee_clean_rows)

# Scatterplot by Sex
ggplot(chickadee_clean_rows, aes(x = pc1_scores, y = PathRich)) +
  geom_point(aes(shape = BirdSex, color = BirdSex), size = 2) +
  scale_shape_manual(values = c(16, 1)) +
  geom_line(aes(y = pc1_predicted), size = 1, color = "black") +
  labs(x = "Dimension 1", y = "Pathogen Richness") +
  scale_colour_manual(values = c("red", "blue"))
```




```
# Make predictions using the previous simple linear model
fit_WingChord_cleaned <- lm(chickadee_clean_rows$PathRich ~ chickadee_clean_rows$WingChord)
chickadee_clean_rows$predicted_WingChord <- predict(fit_WingChord_cleaned, newdata = chickadee_clean_ro

# Scatterplot by Sex with both models (along Dimension 1)
ggplot(chickadee_clean_rows, aes(x = pc1_scores, y = PathRich)) +
  geom_point(aes(shape = BirdSex, color = BirdSex), size = 2) +
  scale_shape_manual(values = c(16, 1)) +
  geom_line(aes(y = pc1_predicted), size = 1, color = "black") +
    geom_line(aes(x = pc1_scores, y = predicted_WingChord), size = 1, color = "orange", linetype = "dash
  labs(x = "Dimension 1", y = "Pathogen Richness") +
  scale_colour_manual(values = c("red", "blue"))
```




```
# Summarize the fits
summary(fit_PC1)
```

```
##
## Call:
## lm(formula = chickadee_clean_rows$PathRich ~ pc1_scores)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -41.583  -7.963   0.762   7.064  40.598
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   44.767      2.833  15.801 1.77e-15 ***
## pc1_scores     2.423      1.985   1.221    0.232
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.52 on 28 degrees of freedom
## Multiple R-squared:  0.05052,    Adjusted R-squared:  0.01661
## F-statistic:  1.49 on 1 and 28 DF,  p-value: 0.2324
```

```
summary(fit_WingChord_cleaned)
```

```
##
```

```
## Call:
## lm(formula = chickadee_clean_rows$PathRich ~ chickadee_clean_rows$WingChord)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -39.208  -9.151   0.889   7.422  41.663
##
## Coefficients:
##                                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)                      -38.829     83.710  -0.464    0.646
## chickadee_clean_rows$WingChord     1.290      1.291   0.999    0.326
##
## Residual standard error: 15.65 on 28 degrees of freedom
## Multiple R-squared:  0.03443,    Adjusted R-squared:  -5.351e-05
## F-statistic: 0.9984 on 1 and 28 DF,  p-value: 0.3262
```

```r
summary(fit_WingChord)
```

```
##
## Call:
## lm(formula = df_feather$PathRich ~ df_feather$WingChord)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -19.091  -7.591   2.561   6.420  15.909
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)          -104.8539    62.4870  -1.678   0.1089
## df_feather$WingChord    2.2607     0.9686   2.334   0.0301 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.12 on 20 degrees of freedom
## Multiple R-squared:  0.2141, Adjusted R-squared:  0.1748
## F-statistic: 5.448 on 1 and 20 DF,  p-value: 0.03014
```

The linear model using the first principal component

.. Redo PCA and linear model using df_feather

- Fit a multiple linear regression model with response variable **`PathRich`** and predictor variables equal to the first two principal components from Question 16. Compare this model with the multiple linear regression model in Question 13. [Use R functions **`lm`** and **`summary`**.]

```r
# Extract the principal component scores
pc1_scores <- pca_result$x[, 1]
pc2_scores <- pca_result$x[, 2]

# Fit a linear model to each relationship for principal components
fit_all_PC <- lm(chickadee_clean_rows$PathRich ~ pc1_scores + pc2_scores)

# Compare summaries
summary(fit_all_PC)
```

```
##
## Call:
## lm(formula = chickadee_clean_rows$PathRich ~ pc1_scores + pc2_scores)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -41.346  -7.303   0.812   6.045  41.406
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   44.767      2.717  16.478  1.3e-15 ***
## pc1_scores     2.423      1.904   1.273   0.2139
## pc2_scores    -5.101      2.746  -1.857   0.0742 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.88 on 27 degrees of freedom
## Multiple R-squared:  0.1581, Adjusted R-squared:  0.09574
## F-statistic: 2.535 on 2 and 27 DF,  p-value: 0.09795
```

```
summary(fit_all)
```

```
##
## Call:
## lm(formula = PathRich ~ WingChord + BirdWeight + TailLen + TarsusLen,
##     data = df_feather)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -12.671  -5.117   1.243   3.198  14.665
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  15.4010    63.3530   0.243  0.81084
## WingChord     2.5854     1.6562   1.561  0.13694
## BirdWeight    0.8171     3.7004   0.221  0.82786
## TailLen       0.7090     1.3911   0.510  0.61684
## TarsusLen   -10.4426     3.1050  -3.363  0.00369 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.331 on 17 degrees of freedom
## Multiple R-squared:  0.5476, Adjusted R-squared:  0.4412
## F-statistic: 5.144 on 4 and 17 DF,  p-value: 0.006673
```

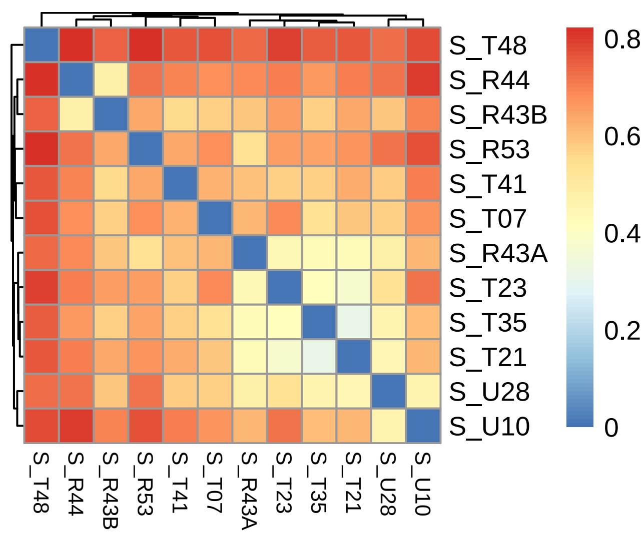
Redo based on df_feather

- Apply metric multidimensional scaling (MDS) to the dissimilarities data in the **`ChickadeeDissimilarities.csv`** file. [Use R function **`cmdscale`** to perform the metric MDS and use function **`ggplot`** to create a scatterplot that projects the data onto the first two principal coordinates. Then use the **`shape`** aesthetic to first mark the points by **`Habitat`** and then by **`Source`**.] Does the composition of the microbial communities appear to be related to **`Habitat`** or **`Source`**?

```r
# Microbial community composition data for 2607 taxa was also used to calculate Bray Curtis dissimilari
distChickadee <- read.csv("ChickadeeDissimilarities.csv", row.names=1)
distChickadee[1:6, 1:6]
```

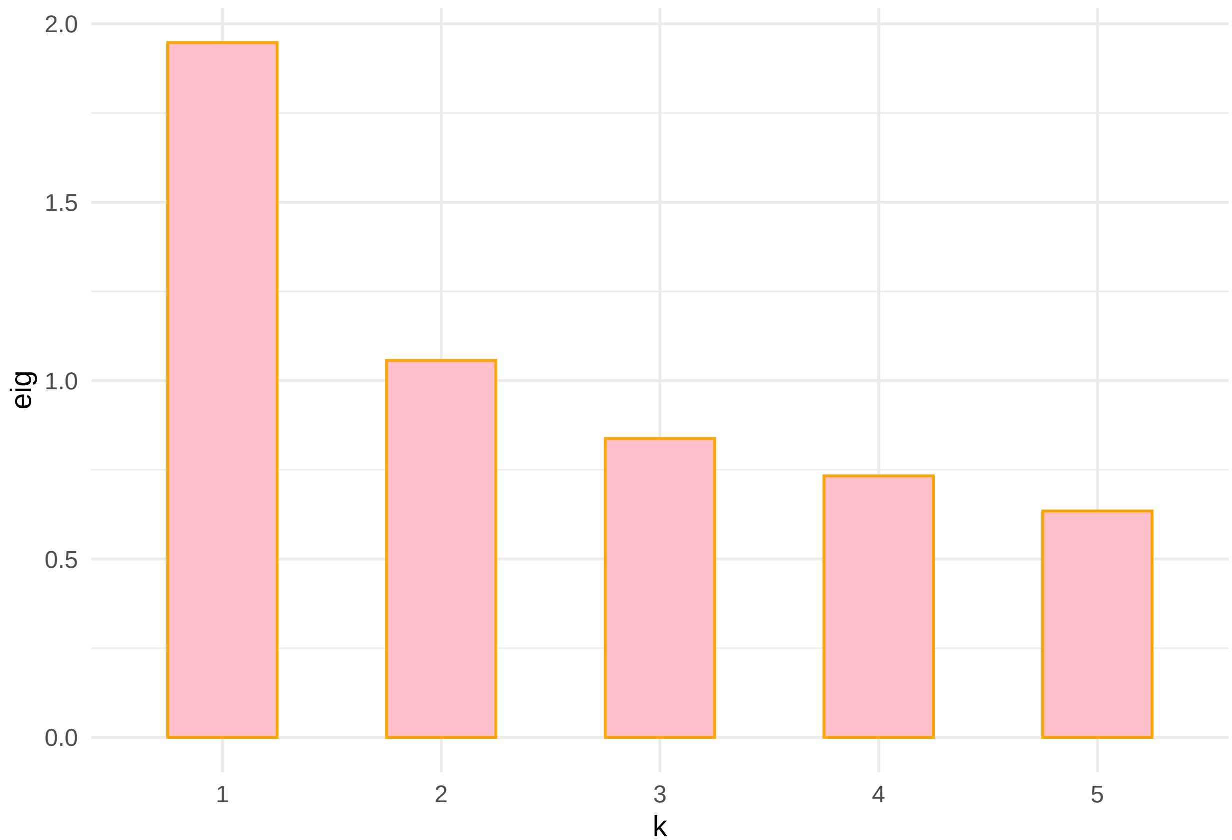
```
##           S_U28     S_U10     S_T48     S_T41     S_T35     S_T23
## S_U28 0.0000000 0.4549776 0.7278924 0.5815247 0.4540807 0.5310314
## S_U10 0.4549776 0.0000000 0.7803587 0.7006278 0.6045740 0.7197309
## S_T48 0.7278924 0.7803587 0.0000000 0.7643946 0.7518386 0.7924664
## S_T41 0.5815247 0.7006278 0.7643946 0.0000000 0.5683408 0.5704036
## S_T35 0.4540807 0.6045740 0.7518386 0.5683408 0.0000000 0.4130942
## S_T23 0.5310314 0.7197309 0.7924664 0.5704036 0.4130942 0.0000000
```

```r
# clustered heatmap
pheatmap(distChickadee[1:12, 1:12], cluster_rows = TRUE,
treeheight_row = 0.0001, treeheight_col = 0.8,
fontsize_col = 8, cellwidth = 13, cellheight = 13)
```

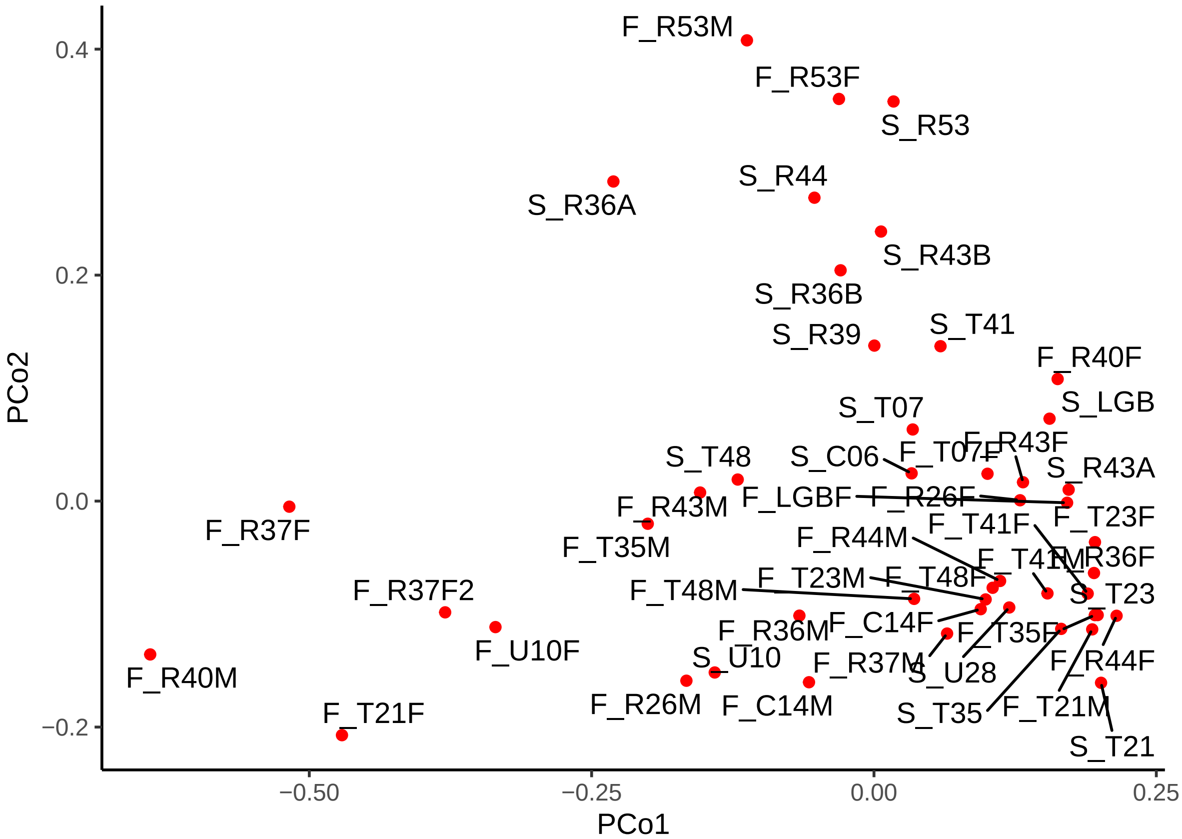



```r
# Classical (metric) multidimensional scaling (MDS), also known as principal coordinates analysis
MDSChickadee <- cmdscale(distChickadee, eig = TRUE)

# Create a plotbar function to plot the eigenvalues in a scree plot.
plotbar <- function(res, m = 9) {
ggplot(data.frame(list(eig = res$eig[seq_len(m)],
k = seq(along = res$eig[seq_len(m)]))),
```

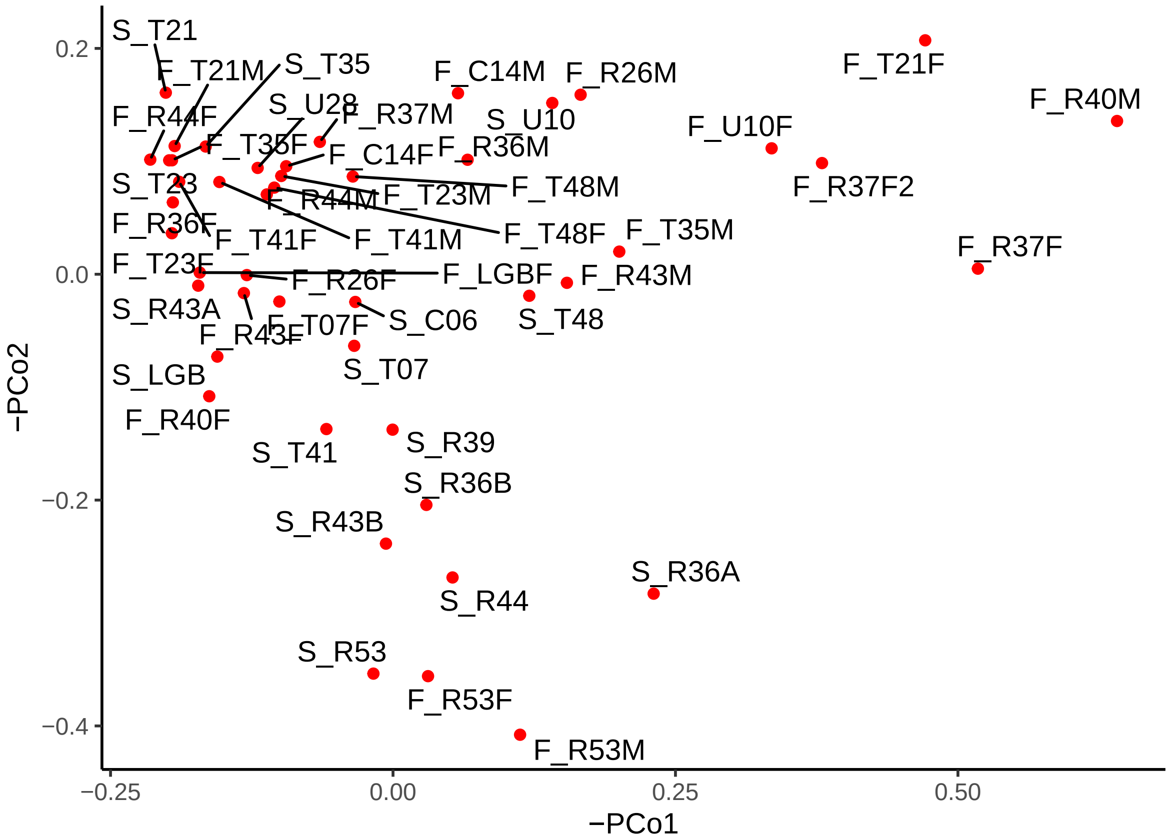
```r
aes(x = k, y = eig)) +
scale_x_discrete("k", limits = factor(seq_len(m))) +
theme_minimal() +
geom_bar(stat="identity", width=0.5, color="orange",
fill="pink")
}

plotbar(MDSChickadee, m = 5)
```




```r
# Project the cities onto the first two coordinates created from the distances.
MDSChick <- data.frame(list(PCo1 = MDSChickadee$points[, 1],
PCo2 = MDSChickadee$points[, 2],
labs = rownames(MDSChickadee$points)))
ggplot(MDSChick, aes(x = PCo1, y = PCo2, label = labs)) +
geom_point(color = "red") +
#xlim(-1950, 2000) +
#ylim(-1150, 1200) +
coord_fixed() +
geom_text_repel(size = 4, max.overlaps = 100)
```




```
#To re-orient the "map" so north is at the top and west is on the left, reverse the signs of the princi
ggplot(MDSChick, aes(x = -PCo1, y = -PCo2, label = labs)) +
geom_point(color = "red") +
coord_fixed() +
geom_text_repel(size = 4, max.overlaps = 100)
```



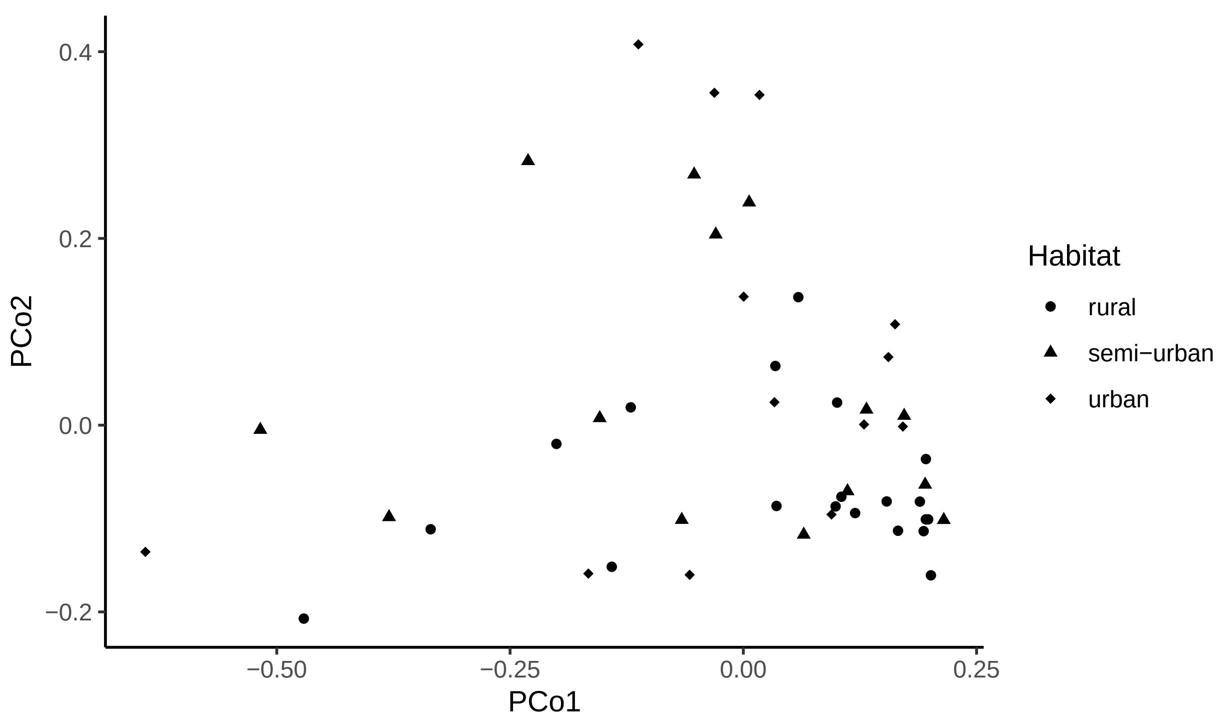

```
# Merge the datasets
MDSChick_merged <- merge(MDSChick, chickadeeData, by.x = "labs", by.y = "Site")
print(MDSChick_merged)
```

```
##       labs          PCo1          PCo2   Habitat  Source EscShi Entero
## 1    F_C14F  0.0945176738 -0.0956366887     urban feather    261    286
## 2    F_C14M -0.0575279670 -0.1603054570     urban feather   2269    288
## 3    F_LGBF  0.1710053413 -0.0014732449     urban feather     54     12
## 4    F_R26F  0.1293637482  0.0007389586     urban feather    173      9
## 5    F_R26M -0.1660559008 -0.1589631739     urban feather   3771      8
## 6    F_R36F  0.1948363956 -0.0636382630 semi-urban feather     31     48
## 7    F_R36M -0.0660126789 -0.1013814758 semi-urban feather   1228     28
## 8    F_R37F -0.5176652570 -0.0049461669 semi-urban feather    379      7
## 9   F_R37F2 -0.3796891196 -0.0984423101 semi-urban feather   3230      0
## 10   F_R37M  0.0647565721 -0.1172100349 semi-urban feather   1294     20
## 11   F_R40F  0.1626247574  0.1080359473     urban feather     78     13
## 12   F_R40M -0.6408373846 -0.1357161329     urban feather   1267      0
## 13   F_R43F  0.1319720024  0.0167027419 semi-urban feather    112     28
## 14   F_R43M -0.1539284826  0.0075834838 semi-urban feather    882     19
## 15   F_R44F  0.2148287227 -0.1014979798 semi-urban feather     33     20
## 16   F_R44M  0.1116849107 -0.0706728572 semi-urban feather    191     13
## 17   F_R53F -0.0309991685  0.3559239560     urban feather     61      2
## 18   F_R53M -0.1124679050  0.4078016917     urban feather    288      3
## 19   F_T07F  0.1005505545  0.0241963920     rural feather      2     10
## 20   F_T21F -0.4710453613 -0.2071537760     rural feather   6520      0
## 21   F_T21M  0.1932527109 -0.1135244212     rural feather     28     10
```

```
## 22  F_T23F  0.1956936234 -0.0363216270      rural feather     17     11
## 23  F_T23M  0.0988841563 -0.0870280597      rural feather    906      9
## 24  F_T35F  0.1956076519 -0.1008927097      rural feather    113      1
## 25  F_T35M -0.2002829223 -0.0200427959      rural feather    203      0
## 26  F_T41F  0.1892287367 -0.0818687660      rural feather     22     45
## 27  F_T41M  0.1536271344 -0.0817013388      rural feather    305     45
## 28  F_T48F  0.1050834309 -0.0767038593      rural feather    180     63
## 29  F_T48M  0.0355450025 -0.0865386214      rural feather    232     63
## 30  F_U10F -0.3351211552 -0.1115072455      rural feather    486    374
## 31   S_C06  0.0333484454  0.0245499265      urban    nest     63    687
## 32   S_LGB  0.1554716109  0.0729537142      urban    nest      1      9
## 33  S_R36A -0.2307061634  0.2828755147 semi-urban    nest    486    615
## 34  S_R36B -0.0295427057  0.2042765470 semi-urban    nest     30     39
## 35   S_R39  0.0003591343  0.1376404078      urban    nest    105    202
## 36  S_R43A  0.1723854677  0.0101228407 semi-urban    nest     56     31
## 37  S_R43B  0.0062437764  0.2385802916 semi-urban    nest      8     49
## 38   S_R44 -0.0527041867  0.2685259001 semi-urban    nest      4      9
## 39   S_R53  0.0173372690  0.3536829110      urban    nest      0     15
## 40   S_T07  0.0343270680  0.0633972164      rural    nest      4     20
## 41   S_T21  0.2010769761 -0.1607999373      rural    nest     14     22
## 42   S_T23  0.1980790405 -0.1008693849      rural    nest      8     13
## 43   S_T35  0.1657871944 -0.1130826741      rural    nest    248      4
## 44   S_T41  0.0589319039  0.1370867488      rural    nest      1     22
## 45   S_T48 -0.1206273343  0.0190762073      rural    nest      0     84
## 46   S_U10 -0.1409891998 -0.1516735419      rural    nest   1429    546
## 47   S_U28  0.1197918807 -0.0941588537      rural    nest     86    557
##    CommRich PathRich WingChord BirdWeight TailLen TarsusLen BirdSex
## 1       low       50      63.0         11      54      18.1       F
## 2      high       58      68.0         12      60      18.0       M
## 3      high       44      64.0         12      57      17.9       F
## 4      high       63      65.0         15      60      16.9       F
## 5      high       53      68.0         17      57      18.7       M
## 6       low       51      65.0         11      58      17.9       F
## 7      high       53      67.0         11      58      17.9       M
## 8       low       17      62.0         10      55      18.5       F
## 9       low       30      62.0         10      55      18.5       F
## 10     high       52      67.0         12      60      19.5       M
## 11     high       54      66.0         15      60      17.1       F
## 12      low       11      69.0         16      61      18.6       M
## 13     high       59      64.0         13      55      19.0       F
## 14     high       88      66.0         12      60      18.6       M
## 15      low       38      62.0         10      56      16.9       F
## 16     high       66      64.0         11      60      18.0       M
## 17     high       58      65.0         11      56      16.8       F
## 18     high       56      68.0         11      62      18.2       M
## 19      low       40      63.0         11      54      18.1       F
## 20      low       23      65.0         12      57      19.0       F
## 21      low       41      62.5         11      54      18.2       M
## 22      low       35      67.0         12      59      18.6       F
## 23      low       37      67.0         12      60      18.9       M
## 24      low       38      63.0         11      57      18.1       F
## 25      low       29      66.0         12      55      18.9       M
## 26      low       37      63.0         11      56      18.4       F
## 27      low       36      66.0         11      56      19.2       M
```

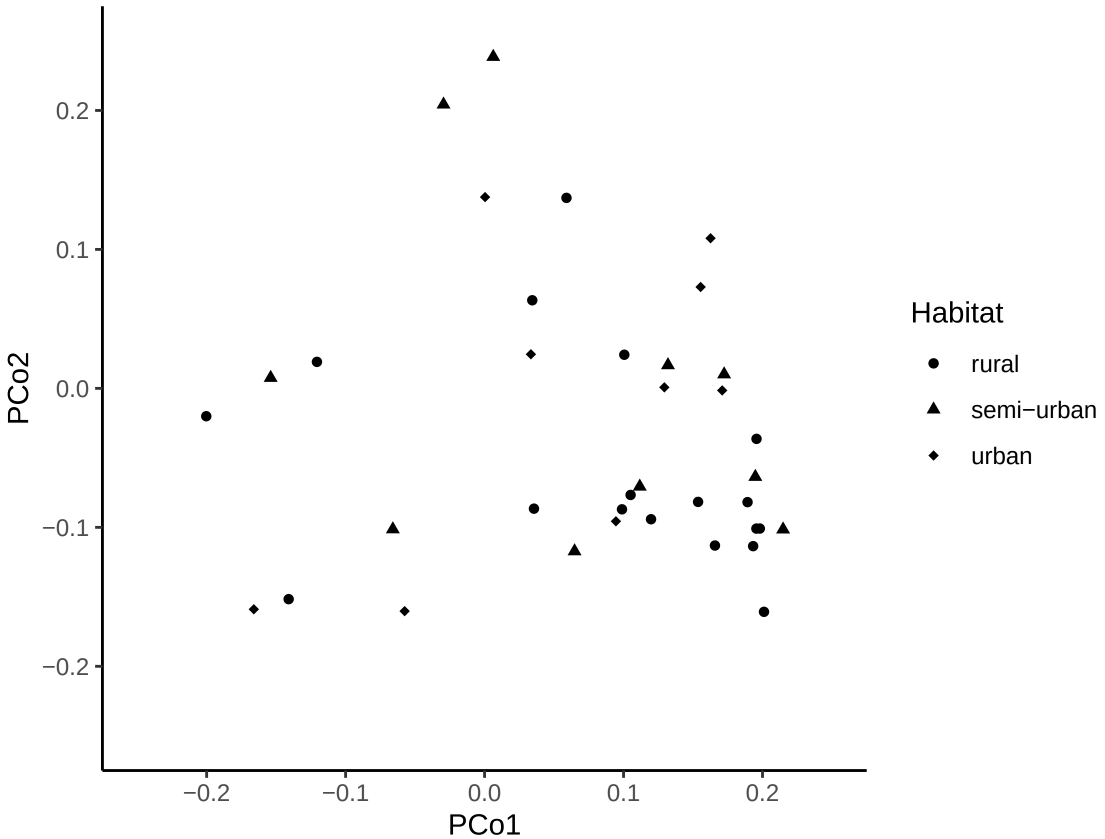
```
## 28    high      49      63.0         15      55      19.0       F
## 29     low      44      63.0         11      57      18.3       M
## 30     low      33      60.0         11      53      17.6       F
## 31    high      63        NA         NA      NA        NA    <NA>
## 32    high      59        NA         NA      NA        NA    <NA>
## 33     low      30        NA         NA      NA        NA    <NA>
## 34     low      41        NA         NA      NA        NA    <NA>
## 35    high      57        NA         NA      NA        NA    <NA>
## 36    high      57        NA         NA      NA        NA    <NA>
## 37    high      40        NA         NA      NA        NA    <NA>
## 38     low      32        NA         NA      NA        NA    <NA>
## 39     low      49        NA         NA      NA        NA    <NA>
## 40    high      48        NA         NA      NA        NA    <NA>
## 41     low      45        NA         NA      NA        NA    <NA>
## 42     low      31        NA         NA      NA        NA    <NA>
## 43     low      38        NA         NA      NA        NA    <NA>
## 44     low      41        NA         NA      NA        NA    <NA>
## 45     low      31        NA         NA      NA        NA    <NA>
## 46     low      36        NA         NA      NA        NA    <NA>
## 47     low      41        NA         NA      NA        NA    <NA>
```

```r
# By Habitat
ggplot(MDSChick_merged, aes(x = PCo1, y = PCo2)) +
  geom_point(aes(shape = Habitat)) +
  coord_fixed() +
  scale_shape_manual(values = c(16, 17, 18))
```

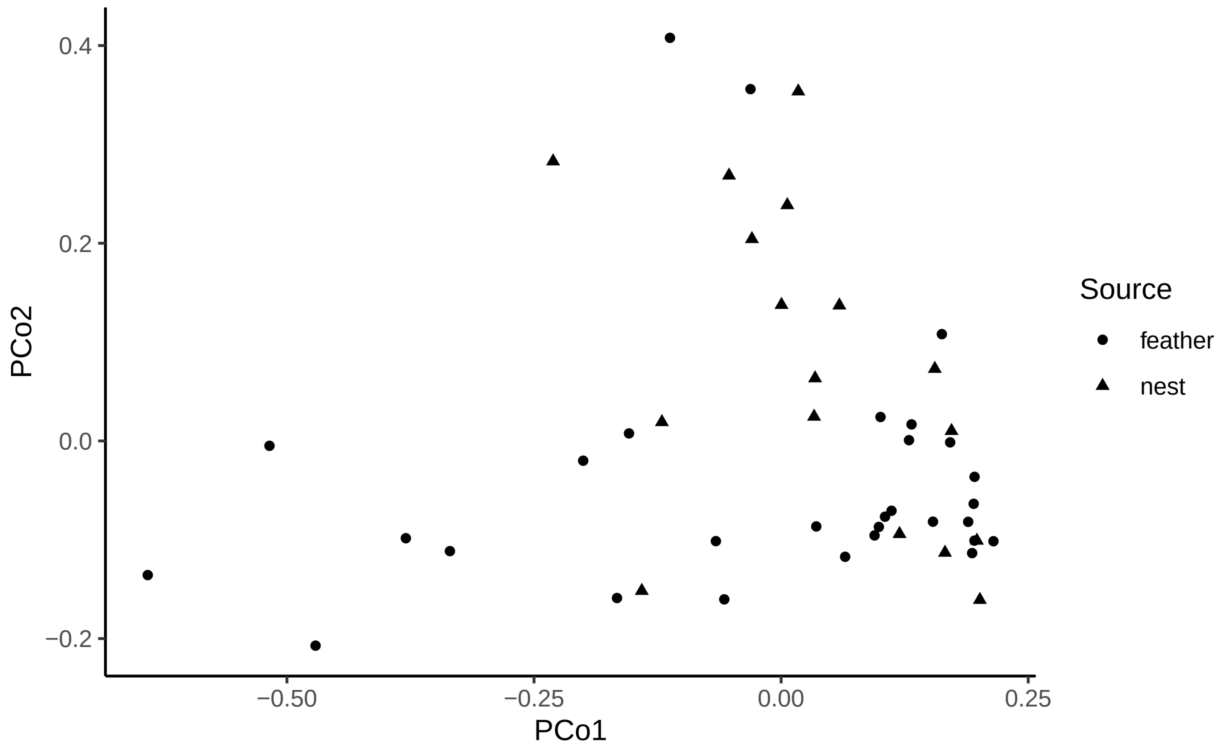


```
# Zoom in
ggplot(MDSChick_merged, aes(x = PCo1, y = PCo2)) +
  geom_point(aes(shape = Habitat)) +
  xlim(-0.25, 0.25) +
  ylim(-0.25, 0.25) +
  coord_fixed() +
  scale_shape_manual(values = c(16, 17, 18))
```

```
## Warning: Removed 10 rows containing missing values (`geom_point()`).
```

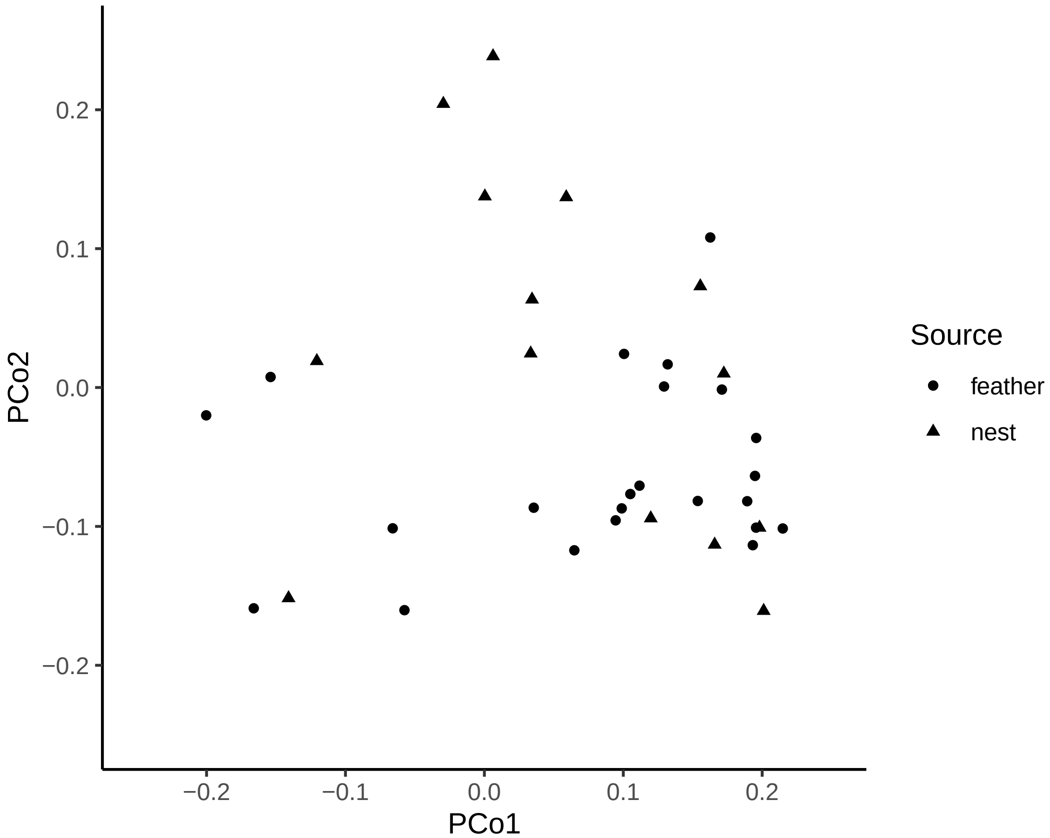



```
# By Source
ggplot(MDSChick_merged, aes(x = PCo1, y = PCo2)) +
  geom_point(aes(shape = Source)) +
  coord_fixed() +
  scale_shape_manual(values = c(16, 17))
```




```
# Zoom in
ggplot(MDSChick_merged, aes(x = PCo1, y = PCo2)) +
  geom_point(aes(shape = Source)) +
  xlim(-0.25, 0.25) +
  ylim(-0.25, 0.25) +
  coord_fixed() +
  scale_shape_manual(values = c(16, 17))
```

```
## Warning: Removed 10 rows containing missing values (`geom_point()`).
```



Upon visual inspection of the MDS, microbial community composition appears to be more closely associated with source.

- Apply nonmetric multidimensional scaling (NMDS) to the dissimilarities data in the **`ChickadeeDissimilarities.csv`** fil [Use R function **`metaMDS`** to perform the NMDS and use function **`ggplot`** to create a scatterplot that projects the data onto the first two NMDS axes. Then use the **`shape`** aesthetic to first mark the points by **`Habitat`** and then by **`Source`**.] Does the composition of the microbial communities appear to be related to **`Habitat`** or **`Source`**?

```
## Run 0 stress 0.1936207
## Run 1 stress 0.5647074
## Run 2 stress 0.2035673
## Run 3 stress 0.5641351
## Run 4 stress 0.2971657
## Run 5 stress 0.5646033
## Run 6 stress 0.2086381
## Run 7 stress 0.280654
## Run 8 stress 0.196976
## Run 9 stress 0.2557251
## Run 10 stress 0.2672601
## Run 11 stress 0.1976366
## Run 12 stress 0.2152374
## Run 13 stress 0.2060222
## Run 14 stress 0.5645978
## Run 15 stress 0.25611
## Run 16 stress 0.279032
```

```
## Run 17 stress 0.1895337
## ... New best solution
## ... Procrustes: rmse 0.02081293  max resid 0.1377031
## Run 18 stress 0.2977377
## Run 19 stress 0.3058941
## Run 20 stress 0.2360432
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1961787
## Run 2 stress 0.2059808
## Run 3 stress 0.2619964
## Run 4 stress 0.2783175
## Run 5 stress 0.3182508
## Run 6 stress 0.2902005
## Run 7 stress 0.2273404
## Run 8 stress 0.2653558
## Run 9 stress 0.3034298
## Run 10 stress 0.3145904
## Run 11 stress 0.2088438
## Run 12 stress 0.2121302
## Run 13 stress 0.3161095
## Run 14 stress 0.3107062
## Run 15 stress 0.2131648
## Run 16 stress 0.2566309
## Run 17 stress 0.3135263
## Run 18 stress 0.2836021
## Run 19 stress 0.2049234
## Run 20 stress 0.1936548
## ... Procrustes: rmse 0.0565503  max resid 0.2897476
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2661285
## Run 2 stress 0.193759
## ... Procrustes: rmse 0.05676987  max resid 0.289648
## Run 3 stress 0.255705
## Run 4 stress 0.2846421
## Run 5 stress 0.2567799
## Run 6 stress 0.1936136
## ... New best solution
## ... Procrustes: rmse 0.0009650626  max resid 0.003831316
## ... Similar to previous best
## Run 7 stress 0.2549996
## Run 8 stress 0.2924318
## Run 9 stress 0.5634524
## Run 10 stress 0.2856236
## Run 11 stress 0.3090742
## Run 12 stress 0.5635364
## Run 13 stress 0.3105046
## Run 14 stress 0.5646349
## Run 15 stress 0.5649054
```

```
## Run 16 stress 0.5649327
## Run 17 stress 0.305137
## Run 18 stress 0.2602828
## Run 19 stress 0.3099696
## Run 20 stress 0.2539002
## *** Best solution repeated 1 times
## Run 0 stress 0.1936207
## Run 1 stress 0.2572866
## Run 2 stress 0.3076011
## Run 3 stress 0.3088584
## Run 4 stress 0.2717634
## Run 5 stress 0.2498167
## Run 6 stress 0.3076746
## Run 7 stress 0.3022483
## Run 8 stress 0.2653816
## Run 9 stress 0.5640836
## Run 10 stress 0.5646035
## Run 11 stress 0.2973889
## Run 12 stress 0.2514749
## Run 13 stress 0.2545098
## Run 14 stress 0.2923379
## Run 15 stress 0.2777332
## Run 16 stress 0.193592
## ... New best solution
## ... Procrustes: rmse 0.001433726  max resid 0.005962368
## ... Similar to previous best
## Run 17 stress 0.2124652
## Run 18 stress 0.2916964
## Run 19 stress 0.295067
## Run 20 stress 0.2552822
## *** Best solution repeated 1 times
## Run 0 stress 0.1936207
## Run 1 stress 0.5630963
## Run 2 stress 0.2963437
## Run 3 stress 0.1950194
## Run 4 stress 0.2564481
## Run 5 stress 0.2940802
## Run 6 stress 0.2203257
## Run 7 stress 0.2818883
## Run 8 stress 0.2927547
## Run 9 stress 0.1895277
## ... New best solution
## ... Procrustes: rmse 0.0208202  max resid 0.1377369
## Run 10 stress 0.1895156
## ... New best solution
## ... Procrustes: rmse 0.0008804279  max resid 0.002947609
## ... Similar to previous best
## Run 11 stress 0.2112113
## Run 12 stress 0.311655
## Run 13 stress 0.2078238
## Run 14 stress 0.189531
## ... Procrustes: rmse 0.001040298  max resid 0.006201119
## ... Similar to previous best
## Run 15 stress 0.3165767
```

```
## Run 16 stress 0.2675825
## Run 17 stress 0.2577657
## Run 18 stress 0.3052127
## Run 19 stress 0.2112217
## Run 20 stress 0.2646656
## *** Best solution repeated 2 times
## Run 0 stress 0.1936207
## Run 1 stress 0.2651604
## Run 2 stress 0.288393
## Run 3 stress 0.2073157
## Run 4 stress 0.2853666
## Run 5 stress 0.5636766
## Run 6 stress 0.2588943
## Run 7 stress 0.2758705
## Run 8 stress 0.3102249
## Run 9 stress 0.2120163
## Run 10 stress 0.2024902
## Run 11 stress 0.2616326
## Run 12 stress 0.2904981
## Run 13 stress 0.2084194
## Run 14 stress 0.2650536
## Run 15 stress 0.2530941
## Run 16 stress 0.5649327
## Run 17 stress 0.3085431
## Run 18 stress 0.5649094
## Run 19 stress 0.1923287
## ... New best solution
## ... Procrustes: rmse 0.03574525  max resid 0.1932855
## Run 20 stress 0.1951353
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1980563
## Run 2 stress 0.2837901
## Run 3 stress 0.214369
## Run 4 stress 0.2528937
## Run 5 stress 0.25829
## Run 6 stress 0.2152394
## Run 7 stress 0.2581653
## Run 8 stress 0.2546947
## Run 9 stress 0.2933818
## Run 10 stress 0.2797116
## Run 11 stress 0.2259647
## Run 12 stress 0.1895131
## ... New best solution
## ... Procrustes: rmse 0.02081072  max resid 0.1376975
## Run 13 stress 0.2938741
## Run 14 stress 0.195807
## Run 15 stress 0.5606333
## Run 16 stress 0.3025304
## Run 17 stress 0.3073866
## Run 18 stress 0.2540453
## Run 19 stress 0.2878671
```

```
## Run 20 stress 0.5644601
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3017465
## Run 2 stress 0.2565042
## Run 3 stress 0.2564078
## Run 4 stress 0.2852362
## Run 5 stress 0.2582516
## Run 6 stress 0.2099844
## Run 7 stress 0.5649327
## Run 8 stress 0.2583047
## Run 9 stress 0.3060389
## Run 10 stress 0.2111964
## Run 11 stress 0.2717984
## Run 12 stress 0.2975204
## Run 13 stress 0.1936664
## ... Procrustes: rmse 0.05650602  max resid 0.2895757
## Run 14 stress 0.3076432
## Run 15 stress 0.3097853
## Run 16 stress 0.5647412
## Run 17 stress 0.1960588
## Run 18 stress 0.1934695
## ... New best solution
## ... Procrustes: rmse 0.05797352  max resid 0.30106
## Run 19 stress 0.264977
## Run 20 stress 0.2695072
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2019717
## Run 2 stress 0.3091759
## Run 3 stress 0.3042596
## Run 4 stress 0.2657358
## Run 5 stress 0.5649327
## Run 6 stress 0.2777478
## Run 7 stress 0.254305
## Run 8 stress 0.2976065
## Run 9 stress 0.1895201
## ... New best solution
## ... Procrustes: rmse 0.02078765  max resid 0.1376542
## Run 10 stress 0.2535727
## Run 11 stress 0.5646509
## Run 12 stress 0.2024231
## Run 13 stress 0.2716004
## Run 14 stress 0.269797
## Run 15 stress 0.2565795
## Run 16 stress 0.3052727
## Run 17 stress 0.2794932
## Run 18 stress 0.193429
## Run 19 stress 0.2892896
## Run 20 stress 0.2796097
## *** Best solution was not repeated -- monoMDS stopping criteria:
```

```
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2044626
## Run 2 stress 0.3074816
## Run 3 stress 0.2078208
## Run 4 stress 0.2567785
## Run 5 stress 0.2803841
## Run 6 stress 0.3081998
## Run 7 stress 0.3036945
## Run 8 stress 0.1936631
## ... Procrustes: rmse 0.05652273  max resid 0.2896285
## Run 9 stress 0.3150279
## Run 10 stress 0.2592647
## Run 11 stress 0.193759
## ... Procrustes: rmse 0.05676714  max resid 0.2896752
## Run 12 stress 0.5643277
## Run 13 stress 0.196052
## Run 14 stress 0.3074485
## Run 15 stress 0.2566973
## Run 16 stress 0.3109792
## Run 17 stress 0.2035255
## Run 18 stress 0.2540246
## Run 19 stress 0.2860726
## Run 20 stress 0.2007331
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2066335
## Run 2 stress 0.1962991
## Run 3 stress 0.2984233
## Run 4 stress 0.5633397
## Run 5 stress 0.5649246
## Run 6 stress 0.2562044
## Run 7 stress 0.2853526
## Run 8 stress 0.2967097
## Run 9 stress 0.3061071
## Run 10 stress 0.2674876
## Run 11 stress 0.2928323
## Run 12 stress 0.1942015
## Run 13 stress 0.2549981
## Run 14 stress 0.2551983
## Run 15 stress 0.5638497
## Run 16 stress 0.3173688
## Run 17 stress 0.2576307
## Run 18 stress 0.307044
## Run 19 stress 0.1975901
## Run 20 stress 0.2902894
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      6: stress ratio > sratmax
##     14: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2131446
```

```
## Run 2 stress 0.257923
## Run 3 stress 0.3190428
## Run 4 stress 0.3185718
## Run 5 stress 0.3044174
## Run 6 stress 0.2540192
## Run 7 stress 0.1976037
## Run 8 stress 0.2076964
## Run 9 stress 0.3140646
## Run 10 stress 0.2574886
## Run 11 stress 0.2911368
## Run 12 stress 0.2111623
## Run 13 stress 0.3141114
## Run 14 stress 0.2582163
## Run 15 stress 0.5642949
## Run 16 stress 0.3106673
## Run 17 stress 0.219084
## Run 18 stress 0.2946625
## Run 19 stress 0.2111391
## Run 20 stress 0.2673777
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2870346
## Run 2 stress 0.2784885
## Run 3 stress 0.3083801
## Run 4 stress 0.2512235
## Run 5 stress 0.1923702
## ... New best solution
## ... Procrustes: rmse 0.03567407  max resid 0.1932651
## Run 6 stress 0.2851012
## Run 7 stress 0.2266909
## Run 8 stress 0.3106509
## Run 9 stress 0.2605979
## Run 10 stress 0.3110823
## Run 11 stress 0.5637249
## Run 12 stress 0.2835021
## Run 13 stress 0.3108578
## Run 14 stress 0.2533994
## Run 15 stress 0.196075
## Run 16 stress 0.3028033
## Run 17 stress 0.3050242
## Run 18 stress 0.2078275
## Run 19 stress 0.255603
## Run 20 stress 0.1986248
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2043273
## Run 2 stress 0.2654231
## Run 3 stress 0.1975921
## Run 4 stress 0.2575857
## Run 5 stress 0.2973739
```

```
## Run 6 stress 0.2988528
## Run 7 stress 0.2059846
## Run 8 stress 0.3188036
## Run 9 stress 0.2819101
## Run 10 stress 0.287865
## Run 11 stress 0.283072
## Run 12 stress 0.2653451
## Run 13 stress 0.5615231
## Run 14 stress 0.5648404
## Run 15 stress 0.194261
## Run 16 stress 0.1984418
## Run 17 stress 0.2576331
## Run 18 stress 0.2728839
## Run 19 stress 0.3095594
## Run 20 stress 0.1990146
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1976137
## Run 2 stress 0.1985593
## Run 3 stress 0.2800011
## Run 4 stress 0.3187138
## Run 5 stress 0.2539772
## Run 6 stress 0.2039126
## Run 7 stress 0.2791682
## Run 8 stress 0.2025584
## Run 9 stress 0.2690906
## Run 10 stress 0.257391
## Run 11 stress 0.5630033
## Run 12 stress 0.3130106
## Run 13 stress 0.2762208
## Run 14 stress 0.3085151
## Run 15 stress 0.27966
## Run 16 stress 0.2609737
## Run 17 stress 0.2056389
## Run 18 stress 0.311762
## Run 19 stress 0.2076281
## Run 20 stress 0.1969803
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5649296
## Run 2 stress 0.2124822
## Run 3 stress 0.5649327
## Run 4 stress 0.5642234
## Run 5 stress 0.5646113
## Run 6 stress 0.2728596
## Run 7 stress 0.5641444
## Run 8 stress 0.3100453
## Run 9 stress 0.3082591
## Run 10 stress 0.2230102
## Run 11 stress 0.2935977
```

```
## Run 12 stress 0.2571707
## Run 13 stress 0.3099874
## Run 14 stress 0.3112801
## Run 15 stress 0.5645044
## Run 16 stress 0.2849185
## Run 17 stress 0.2838738
## Run 18 stress 0.2007108
## Run 19 stress 0.3008838
## Run 20 stress 0.3115053
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2534297
## Run 2 stress 0.2107756
## Run 3 stress 0.2649467
## Run 4 stress 0.2959872
## Run 5 stress 0.2609124
## Run 6 stress 0.2533403
## Run 7 stress 0.2843058
## Run 8 stress 0.5642827
## Run 9 stress 0.205943
## Run 10 stress 0.2076008
## Run 11 stress 0.3099468
## Run 12 stress 0.2852758
## Run 13 stress 0.2591215
## Run 14 stress 0.2077758
## Run 15 stress 0.2649532
## Run 16 stress 0.1982564
## Run 17 stress 0.2571236
## Run 18 stress 0.2802631
## Run 19 stress 0.2078401
## Run 20 stress 0.2559381
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2549785
## Run 2 stress 0.5648932
## Run 3 stress 0.1895455
## ... New best solution
## ... Procrustes: rmse 0.02084346  max resid 0.1377863
## Run 4 stress 0.5647004
## Run 5 stress 0.2898668
## Run 6 stress 0.3080313
## Run 7 stress 0.310734
## Run 8 stress 0.5619688
## Run 9 stress 0.2852456
## Run 10 stress 0.2078319
## Run 11 stress 0.2075993
## Run 12 stress 0.3098631
## Run 13 stress 0.2575423
## Run 14 stress 0.2824918
## Run 15 stress 0.2561465
```

```
## Run 16 stress 0.2937425
## Run 17 stress 0.192361
## Run 18 stress 0.5620138
## Run 19 stress 0.3079442
## Run 20 stress 0.5648791
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      5: stress ratio > sratmax
##     15: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5644041
## Run 2 stress 0.2630967
## Run 3 stress 0.211155
## Run 4 stress 0.3128863
## Run 5 stress 0.3062228
## Run 6 stress 0.2523218
## Run 7 stress 0.3114726
## Run 8 stress 0.2035489
## Run 9 stress 0.2054541
## Run 10 stress 0.2958174
## Run 11 stress 0.1937733
## ... Procrustes: rmse 0.05679356  max resid 0.2898257
## Run 12 stress 0.2541535
## Run 13 stress 0.3067069
## Run 14 stress 0.5648221
## Run 15 stress 0.1990253
## Run 16 stress 0.1895414
## ... New best solution
## ... Procrustes: rmse 0.02084982  max resid 0.1377849
## Run 17 stress 0.1941125
## Run 18 stress 0.3009351
## Run 19 stress 0.1923444
## Run 20 stress 0.2585296
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3069402
## Run 2 stress 0.3015652
## Run 3 stress 0.2565405
## Run 4 stress 0.271715
## Run 5 stress 0.255972
## Run 6 stress 0.3047738
## Run 7 stress 0.1937731
## ... Procrustes: rmse 0.05676509  max resid 0.2896188
## Run 8 stress 0.2541041
## Run 9 stress 0.2076485
## Run 10 stress 0.5644286
## Run 11 stress 0.3017733
## Run 12 stress 0.2672001
## Run 13 stress 0.2904967
## Run 14 stress 0.2529015
## Run 15 stress 0.2526765
## Run 16 stress 0.5648329
## Run 17 stress 0.1990498
```

```
## Run 18 stress 0.3140151
## Run 19 stress 0.2906161
## Run 20 stress 0.255952
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2716273
## Run 2 stress 0.2575387
## Run 3 stress 0.3112136
## Run 4 stress 0.2527634
## Run 5 stress 0.564458
## Run 6 stress 0.2964267
## Run 7 stress 0.2776915
## Run 8 stress 0.25589
## Run 9 stress 0.2076581
## Run 10 stress 0.2791724
## Run 11 stress 0.2287082
## Run 12 stress 0.1904429
## ... New best solution
## ... Procrustes: rmse 0.02141305  max resid 0.136013
## Run 13 stress 0.2559195
## Run 14 stress 0.2652005
## Run 15 stress 0.194277
## Run 16 stress 0.2664499
## Run 17 stress 0.2967845
## Run 18 stress 0.314204
## Run 19 stress 0.2294395
## Run 20 stress 0.2701345
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2910625
## Run 2 stress 0.5645947
## Run 3 stress 0.294881
## Run 4 stress 0.2980341
## Run 5 stress 0.5646836
## Run 6 stress 0.3182874
## Run 7 stress 0.3067576
## Run 8 stress 0.2537855
## Run 9 stress 0.3037269
## Run 10 stress 0.2959071
## Run 11 stress 0.194646
## Run 12 stress 0.25538
## Run 13 stress 0.2797087
## Run 14 stress 0.2852378
## Run 15 stress 0.2535426
## Run 16 stress 0.3065108
## Run 17 stress 0.3104633
## Run 18 stress 0.2700557
## Run 19 stress 0.304831
## Run 20 stress 0.2111727
## *** Best solution was not repeated -- monoMDS stopping criteria:
```

```
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2703449
## Run 2 stress 0.5641889
## Run 3 stress 0.2569333
## Run 4 stress 0.3125804
## Run 5 stress 0.2709873
## Run 6 stress 0.561601
## Run 7 stress 0.27349
## Run 8 stress 0.2598138
## Run 9 stress 0.2818439
## Run 10 stress 0.3042125
## Run 11 stress 0.3052664
## Run 12 stress 0.564584
## Run 13 stress 0.2076771
## Run 14 stress 0.2675365
## Run 15 stress 0.1925476
## ... New best solution
## ... Procrustes: rmse 0.02184434  max resid 0.1322529
## Run 16 stress 0.2647833
## Run 17 stress 0.2296853
## Run 18 stress 0.2745625
## Run 19 stress 0.2717748
## Run 20 stress 0.2665198
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3048134
## Run 2 stress 0.5646946
## Run 3 stress 0.5649326
## Run 4 stress 0.2546761
## Run 5 stress 0.564066
## Run 6 stress 0.5637358
## Run 7 stress 0.3006695
## Run 8 stress 0.5649327
## Run 9 stress 0.3107111
## Run 10 stress 0.1975246
## Run 11 stress 0.3101256
## Run 12 stress 0.1936439
## ... Procrustes: rmse 0.001356181  max resid 0.004323807
## ... Similar to previous best
## Run 13 stress 0.19359
## ... New best solution
## ... Procrustes: rmse 0.00100936  max resid 0.002737936
## ... Similar to previous best
## Run 14 stress 0.3094543
## Run 15 stress 0.231686
## Run 16 stress 0.1976348
## Run 17 stress 0.2508881
## Run 18 stress 0.31684
## Run 19 stress 0.2226187
## Run 20 stress 0.1936549
```

```
## ... Procrustes: rmse 0.05653228  max resid 0.2897065
## *** Best solution repeated 1 times
## Run 0 stress 0.1936207
## Run 1 stress 0.3070188
## Run 2 stress 0.5638831
## Run 3 stress 0.5642622
## Run 4 stress 0.2634188
## Run 5 stress 0.2739461
## Run 6 stress 0.2701232
## Run 7 stress 0.2565117
## Run 8 stress 0.1923111
## ... New best solution
## ... Procrustes: rmse 0.03573408  max resid 0.1932759
## Run 9 stress 0.2862148
## Run 10 stress 0.2016845
## Run 11 stress 0.2249603
## Run 12 stress 0.2893227
## Run 13 stress 0.2914183
## Run 14 stress 0.1934532
## Run 15 stress 0.2632485
## Run 16 stress 0.2811887
## Run 17 stress 0.1895365
## ... New best solution
## ... Procrustes: rmse 0.02985383  max resid 0.1998235
## Run 18 stress 0.1935833
## Run 19 stress 0.2606129
## Run 20 stress 0.2558158
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3025941
## Run 2 stress 0.3090058
## Run 3 stress 0.3001237
## Run 4 stress 0.2575874
## Run 5 stress 0.564692
## Run 6 stress 0.2983058
## Run 7 stress 0.5644619
## Run 8 stress 0.18952
## ... New best solution
## ... Procrustes: rmse 0.02083801  max resid 0.1377047
## Run 9 stress 0.2902512
## Run 10 stress 0.1962858
## Run 11 stress 0.1936581
## Run 12 stress 0.2890517
## Run 13 stress 0.2601564
## Run 14 stress 0.2260567
## Run 15 stress 0.2356362
## Run 16 stress 0.296498
## Run 17 stress 0.2891066
## Run 18 stress 0.2533471
## Run 19 stress 0.2911749
## Run 20 stress 0.2676779
## *** Best solution was not repeated -- monoMDS stopping criteria:
```

```
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2856248
## Run 2 stress 0.2012667
## Run 3 stress 0.2031233
## Run 4 stress 0.2060366
## Run 5 stress 0.5649048
## Run 6 stress 0.2235088
## Run 7 stress 0.2789209
## Run 8 stress 0.19589
## Run 9 stress 0.5636108
## Run 10 stress 0.3112382
## Run 11 stress 0.3067078
## Run 12 stress 0.2062472
## Run 13 stress 0.2918002
## Run 14 stress 0.2593566
## Run 15 stress 0.5643511
## Run 16 stress 0.2554432
## Run 17 stress 0.3142303
## Run 18 stress 0.2582263
## Run 19 stress 0.2109984
## Run 20 stress 0.2932956
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1934407
## ... New best solution
## ... Procrustes: rmse 0.05798972  max resid 0.3011135
## Run 2 stress 0.5648892
## Run 3 stress 0.2550767
## Run 4 stress 0.3079165
## Run 5 stress 0.1895092
## ... New best solution
## ... Procrustes: rmse 0.05473799  max resid 0.2987132
## Run 6 stress 0.2758025
## Run 7 stress 0.3055327
## Run 8 stress 0.2917541
## Run 9 stress 0.5638303
## Run 10 stress 0.312901
## Run 11 stress 0.255676
## Run 12 stress 0.196047
## Run 13 stress 0.2076243
## Run 14 stress 0.2189337
## Run 15 stress 0.5649327
## Run 16 stress 0.2560124
## Run 17 stress 0.5649274
## Run 18 stress 0.2076601
## Run 19 stress 0.212661
## Run 20 stress 0.1961672
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
```

```
## Run 0 stress 0.1936207
## Run 1 stress 0.261645
## Run 2 stress 0.2554032
## Run 3 stress 0.1943135
## Run 4 stress 0.1934322
## ... New best solution
## ... Procrustes: rmse 0.05803059  max resid 0.301162
## Run 5 stress 0.1895277
## ... New best solution
## ... Procrustes: rmse 0.05473977  max resid 0.2987045
## Run 6 stress 0.2581808
## Run 7 stress 0.2628511
## Run 8 stress 0.2097548
## Run 9 stress 0.5643748
## Run 10 stress 0.5605762
## Run 11 stress 0.229153
## Run 12 stress 0.1942022
## Run 13 stress 0.2544001
## Run 14 stress 0.3068631
## Run 15 stress 0.25504
## Run 16 stress 0.3113784
## Run 17 stress 0.3129264
## Run 18 stress 0.5636707
## Run 19 stress 0.3033221
## Run 20 stress 0.5647198
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1908973
## ... New best solution
## ... Procrustes: rmse 0.02195802  max resid 0.135485
## Run 2 stress 0.2870084
## Run 3 stress 0.3116493
## Run 4 stress 0.3079375
## Run 5 stress 0.5648201
## Run 6 stress 0.2864348
## Run 7 stress 0.2784219
## Run 8 stress 0.5646008
## Run 9 stress 0.3038689
## Run 10 stress 0.2604665
## Run 11 stress 0.1946505
## Run 12 stress 0.3028461
## Run 13 stress 0.2199718
## Run 14 stress 0.2810441
## Run 15 stress 0.3087832
## Run 16 stress 0.2091707
## Run 17 stress 0.5648491
## Run 18 stress 0.564646
## Run 19 stress 0.1990473
## Run 20 stress 0.2552349
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
```

```
## Run 1 stress 0.3080012
## Run 2 stress 0.2043572
## Run 3 stress 0.1941959
## Run 4 stress 0.2674819
## Run 5 stress 0.254337
## Run 6 stress 0.1936633
## ... Procrustes: rmse 0.05655827  max resid 0.2896913
## Run 7 stress 0.2715724
## Run 8 stress 0.235287
## Run 9 stress 0.5631213
## Run 10 stress 0.3140683
## Run 11 stress 0.2848094
## Run 12 stress 0.2758004
## Run 13 stress 0.3059867
## Run 14 stress 0.56389
## Run 15 stress 0.2075973
## Run 16 stress 0.1923263
## ... New best solution
## ... Procrustes: rmse 0.03576434  max resid 0.1933181
## Run 17 stress 0.2083378
## Run 18 stress 0.257374
## Run 19 stress 0.2086506
## Run 20 stress 0.2782708
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2564645
## Run 2 stress 0.2285108
## Run 3 stress 0.5641068
## Run 4 stress 0.2739128
## Run 5 stress 0.3014095
## Run 6 stress 0.2146672
## Run 7 stress 0.3027125
## Run 8 stress 0.1990221
## Run 9 stress 0.5649219
## Run 10 stress 0.2549468
## Run 11 stress 0.2551727
## Run 12 stress 0.2093891
## Run 13 stress 0.2043428
## Run 14 stress 0.1976199
## Run 15 stress 0.2914249
## Run 16 stress 0.2207512
## Run 17 stress 0.2750067
## Run 18 stress 0.1950029
## Run 19 stress 0.2083198
## Run 20 stress 0.2987498
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2517183
## Run 2 stress 0.2061178
## Run 3 stress 0.2287492
## Run 4 stress 0.2653801
```

```
## Run 5 stress 0.5647379
## Run 6 stress 0.290148
## Run 7 stress 0.2714129
## Run 8 stress 0.2698692
## Run 9 stress 0.2557073
## Run 10 stress 0.5641222
## Run 11 stress 0.2837582
## Run 12 stress 0.2095668
## Run 13 stress 0.3110465
## Run 14 stress 0.2085827
## Run 15 stress 0.314814
## Run 16 stress 0.5641175
## Run 17 stress 0.2658246
## Run 18 stress 0.3120824
## Run 19 stress 0.2022901
## Run 20 stress 0.1976085
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.288398
## Run 2 stress 0.2603842
## Run 3 stress 0.2801835
## Run 4 stress 0.2898018
## Run 5 stress 0.2182321
## Run 6 stress 0.3003068
## Run 7 stress 0.5649327
## Run 8 stress 0.2533761
## Run 9 stress 0.2959741
## Run 10 stress 0.1895213
## ... New best solution
## ... Procrustes: rmse 0.0208246  max resid 0.1377181
## Run 11 stress 0.256381
## Run 12 stress 0.270173
## Run 13 stress 0.2354834
## Run 14 stress 0.2671954
## Run 15 stress 0.5635704
## Run 16 stress 0.253836
## Run 17 stress 0.2313671
## Run 18 stress 0.2096875
## Run 19 stress 0.5644969
## Run 20 stress 0.2111195
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5648677
## Run 2 stress 0.2080985
## Run 3 stress 0.5483119
## Run 4 stress 0.5643463
## Run 5 stress 0.256893
## Run 6 stress 0.1983042
## Run 7 stress 0.2633473
## Run 8 stress 0.2666349
```

```
## Run 9 stress 0.2093521
## Run 10 stress 0.3122457
## Run 11 stress 0.2043457
## Run 12 stress 0.1934596
## ... New best solution
## ... Procrustes: rmse 0.05805122  max resid 0.3012583
## Run 13 stress 0.3031671
## Run 14 stress 0.2897508
## Run 15 stress 0.288819
## Run 16 stress 0.2620985
## Run 17 stress 0.5642216
## Run 18 stress 0.2556617
## Run 19 stress 0.3065638
## Run 20 stress 0.3144407
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2060002
## Run 2 stress 0.3072397
## Run 3 stress 0.3098167
## Run 4 stress 0.2906091
## Run 5 stress 0.265326
## Run 6 stress 0.3027813
## Run 7 stress 0.2570119
## Run 8 stress 0.3053759
## Run 9 stress 0.2016488
## Run 10 stress 0.3128217
## Run 11 stress 0.1941715
## Run 12 stress 0.2007117
## Run 13 stress 0.1936627
## ... Procrustes: rmse 0.05655975  max resid 0.2897835
## Run 14 stress 0.19233
## ... New best solution
## ... Procrustes: rmse 0.03576235  max resid 0.1933264
## Run 15 stress 0.1976352
## Run 16 stress 0.2701284
## Run 17 stress 0.5648022
## Run 18 stress 0.1923636
## ... Procrustes: rmse 0.001576113  max resid 0.006728324
## ... Similar to previous best
## Run 19 stress 0.5639546
## Run 20 stress 0.5596293
## *** Best solution repeated 1 times
## Run 0 stress 0.1936207
## Run 1 stress 0.1982056
## Run 2 stress 0.255047
## Run 3 stress 0.2848955
## Run 4 stress 0.2114372
## Run 5 stress 0.1955468
## Run 6 stress 0.2671523
## Run 7 stress 0.2556491
## Run 8 stress 0.3031533
## Run 9 stress 0.2555494
```

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## Run 10 stress 0.5643323
## Run 11 stress 0.2653845
## Run 12 stress 0.5631103
## Run 13 stress 0.2252916
## Run 14 stress 0.564827
## Run 15 stress 0.2224506
## Run 16 stress 0.2569728
## Run 17 stress 0.2961754
## Run 18 stress 0.2555731
## Run 19 stress 0.278327
## Run 20 stress 0.2567854
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.194199
## Run 2 stress 0.2909396
## Run 3 stress 0.5642952
## Run 4 stress 0.2889574
## Run 5 stress 0.1960576
## Run 6 stress 0.2713707
## Run 7 stress 0.1936777
## ... Procrustes: rmse 0.05651738  max resid 0.2896274
## Run 8 stress 0.2977051
## Run 9 stress 0.3019443
## Run 10 stress 0.2580937
## Run 11 stress 0.259035
## Run 12 stress 0.2914822
## Run 13 stress 0.2692713
## Run 14 stress 0.2715164
## Run 15 stress 0.2914744
## Run 16 stress 0.2263692
## Run 17 stress 0.1942982
## Run 18 stress 0.1934483
## ... New best solution
## ... Procrustes: rmse 0.05799305  max resid 0.3011198
## Run 19 stress 0.2857725
## Run 20 stress 0.2803109
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2765918
## Run 2 stress 0.1957907
## Run 3 stress 0.2534089
## Run 4 stress 0.3194537
## Run 5 stress 0.2036897
## Run 6 stress 0.5645053
## Run 7 stress 0.1981022
## Run 8 stress 0.2903316
## Run 9 stress 0.5635327
## Run 10 stress 0.3119992
## Run 11 stress 0.2967912
## Run 12 stress 0.2675582
```

```
## Run 13 stress 0.273042
## Run 14 stress 0.2603535
## Run 15 stress 0.3126722
## Run 16 stress 0.2671946
## Run 17 stress 0.2550178
## Run 18 stress 0.3077426
## Run 19 stress 0.1976003
## Run 20 stress 0.2567814
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      5: stress ratio > sratmax
##     15: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.199244
## Run 2 stress 0.1895222
## ... New best solution
## ... Procrustes: rmse 0.02084887  max resid 0.1377667
## Run 3 stress 0.3004603
## Run 4 stress 0.2675552
## Run 5 stress 0.199225
## Run 6 stress 0.2273218
## Run 7 stress 0.2552107
## Run 8 stress 0.2102012
## Run 9 stress 0.205197
## Run 10 stress 0.2996697
## Run 11 stress 0.2126597
## Run 12 stress 0.2825443
## Run 13 stress 0.2669506
## Run 14 stress 0.256953
## Run 15 stress 0.2685508
## Run 16 stress 0.1981715
## Run 17 stress 0.1992012
## Run 18 stress 0.3084832
## Run 19 stress 0.2690854
## Run 20 stress 0.2988473
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1936763
## ... Procrustes: rmse 0.05650557  max resid 0.2895623
## Run 2 stress 0.2645129
## Run 3 stress 0.563959
## Run 4 stress 0.18952
## ... New best solution
## ... Procrustes: rmse 0.02080492  max resid 0.1376749
## Run 5 stress 0.3017705
## Run 6 stress 0.5648949
## Run 7 stress 0.2848475
## Run 8 stress 0.2096015
## Run 9 stress 0.3054689
## Run 10 stress 0.1942013
## Run 11 stress 0.2926379
## Run 12 stress 0.3089875
## Run 13 stress 0.2675495
## Run 14 stress 0.5601763
```

```
## Run 15 stress 0.5639516
## Run 16 stress 0.2971257
## Run 17 stress 0.2852165
## Run 18 stress 0.2718032
## Run 19 stress 0.2076567
## Run 20 stress 0.2700152
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2897463
## Run 2 stress 0.2206267
## Run 3 stress 0.3081344
## Run 4 stress 0.2556637
## Run 5 stress 0.31173
## Run 6 stress 0.2703768
## Run 7 stress 0.2133179
## Run 8 stress 0.5645158
## Run 9 stress 0.5648564
## Run 10 stress 0.2656047
## Run 11 stress 0.2864459
## Run 12 stress 0.1961632
## Run 13 stress 0.2124121
## Run 14 stress 0.2563654
## Run 15 stress 0.2125081
## Run 16 stress 0.2553227
## Run 17 stress 0.2639462
## Run 18 stress 0.2043596
## Run 19 stress 0.1941973
## Run 20 stress 0.208987
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1923023
## ... New best solution
## ... Procrustes: rmse 0.03575039  max resid 0.1933538
## Run 2 stress 0.3108811
## Run 3 stress 0.5645768
## Run 4 stress 0.3086971
## Run 5 stress 0.5644768
## Run 6 stress 0.5637493
## Run 7 stress 0.564927
## Run 8 stress 0.2570062
## Run 9 stress 0.2116079
## Run 10 stress 0.5640412
## Run 11 stress 0.2624097
## Run 12 stress 0.2582486
## Run 13 stress 0.2096425
## Run 14 stress 0.2966992
## Run 15 stress 0.2570739
## Run 16 stress 0.2900006
## Run 17 stress 0.2699293
## Run 18 stress 0.2664274
```

```
## Run 19 stress 0.2551125
## Run 20 stress 0.2571125
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3165061
## Run 2 stress 0.5641872
## Run 3 stress 0.2128047
## Run 4 stress 0.2871221
## Run 5 stress 0.2856924
## Run 6 stress 0.1895169
## ... New best solution
## ... Procrustes: rmse 0.02082788  max resid 0.1377271
## Run 7 stress 0.2623515
## Run 8 stress 0.20098
## Run 9 stress 0.2960756
## Run 10 stress 0.2964866
## Run 11 stress 0.1909129
## Run 12 stress 0.3123687
## Run 13 stress 0.5649327
## Run 14 stress 0.208649
## Run 15 stress 0.2557485
## Run 16 stress 0.5648788
## Run 17 stress 0.3052211
## Run 18 stress 0.310871
## Run 19 stress 0.2634438
## Run 20 stress 0.2051595
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2548422
## Run 2 stress 0.306315
## Run 3 stress 0.309481
## Run 4 stress 0.2498198
## Run 5 stress 0.2059805
## Run 6 stress 0.256243
## Run 7 stress 0.2732189
## Run 8 stress 0.3048692
## Run 9 stress 0.2820109
## Run 10 stress 0.2666557
## Run 11 stress 0.2284895
## Run 12 stress 0.2525919
## Run 13 stress 0.2059772
## Run 14 stress 0.3124345
## Run 15 stress 0.3089682
## Run 16 stress 0.2714662
## Run 17 stress 0.3014815
## Run 18 stress 0.2498208
## Run 19 stress 0.2939288
## Run 20 stress 0.2897649
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
```

```
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1896384
## ... New best solution
## ... Procrustes: rmse 0.02007831  max resid 0.1324644
## Run 2 stress 0.3100171
## Run 3 stress 0.2631069
## Run 4 stress 0.3046619
## Run 5 stress 0.2563546
## Run 6 stress 0.2943225
## Run 7 stress 0.2534081
## Run 8 stress 0.209406
## Run 9 stress 0.2813538
## Run 10 stress 0.3127463
## Run 11 stress 0.564114
## Run 12 stress 0.2802558
## Run 13 stress 0.1976509
## Run 14 stress 0.2017482
## Run 15 stress 0.26696
## Run 16 stress 0.293645
## Run 17 stress 0.3000638
## Run 18 stress 0.2580133
## Run 19 stress 0.2661087
## Run 20 stress 0.2201814
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2013921
## Run 2 stress 0.5640709
## Run 3 stress 0.2049024
## Run 4 stress 0.2562078
## Run 5 stress 0.2544059
## Run 6 stress 0.2653275
## Run 7 stress 0.2610019
## Run 8 stress 0.2244628
## Run 9 stress 0.2631067
## Run 10 stress 0.2050065
## Run 11 stress 0.2150744
## Run 12 stress 0.5641966
## Run 13 stress 0.2095766
## Run 14 stress 0.2081946
## Run 15 stress 0.2653368
## Run 16 stress 0.2839602
## Run 17 stress 0.2982412
## Run 18 stress 0.2997545
## Run 19 stress 0.259529
## Run 20 stress 0.2546622
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2674337
## Run 2 stress 0.2871803
```

```
## Run 3 stress 0.1941128
## ... Procrustes: rmse 0.0036149  max resid 0.02004402
## Run 4 stress 0.2534307
## Run 5 stress 0.2108896
## Run 6 stress 0.2607088
## Run 7 stress 0.2527253
## Run 8 stress 0.2878903
## Run 9 stress 0.2122779
## Run 10 stress 0.3049104
## Run 11 stress 0.2123968
## Run 12 stress 0.2671998
## Run 13 stress 0.2043726
## Run 14 stress 0.564741
## Run 15 stress 0.2609287
## Run 16 stress 0.5647016
## Run 17 stress 0.2671343
## Run 18 stress 0.292144
## Run 19 stress 0.2603188
## Run 20 stress 0.2558245
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2903005
## Run 2 stress 0.3003106
## Run 3 stress 0.2865504
## Run 4 stress 0.2961771
## Run 5 stress 0.2541453
## Run 6 stress 0.2685553
## Run 7 stress 0.3106564
## Run 8 stress 0.308577
## Run 9 stress 0.2200337
## Run 10 stress 0.5636029
## Run 11 stress 0.2322895
## Run 12 stress 0.3117256
## Run 13 stress 0.5641029
## Run 14 stress 0.2550314
## Run 15 stress 0.2848856
## Run 16 stress 0.195683
## Run 17 stress 0.2659978
## Run 18 stress 0.2666291
## Run 19 stress 0.2570843
## Run 20 stress 0.1942021
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2120411
## Run 2 stress 0.3060911
## Run 3 stress 0.2609872
## Run 4 stress 0.2567538
## Run 5 stress 0.2115402
## Run 6 stress 0.5631783
## Run 7 stress 0.2264176
```

```
## Run 8 stress 0.5630289
## Run 9 stress 0.204368
## Run 10 stress 0.5646163
## Run 11 stress 0.2502724
## Run 12 stress 0.2721341
## Run 13 stress 0.2561025
## Run 14 stress 0.2636139
## Run 15 stress 0.2287951
## Run 16 stress 0.2051981
## Run 17 stress 0.1942187
## Run 18 stress 0.2077003
## Run 19 stress 0.2958935
## Run 20 stress 0.2051839
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2717855
## Run 2 stress 0.2648583
## Run 3 stress 0.2502481
## Run 4 stress 0.3151751
## Run 5 stress 0.2629236
## Run 6 stress 0.2890023
## Run 7 stress 0.1991623
## Run 8 stress 0.2611816
## Run 9 stress 0.2967827
## Run 10 stress 0.2176776
## Run 11 stress 0.3016145
## Run 12 stress 0.2599851
## Run 13 stress 0.2932635
## Run 14 stress 0.3073812
## Run 15 stress 0.1934816
## ... New best solution
## ... Procrustes: rmse 0.05797285  max resid 0.3010984
## Run 16 stress 0.3084903
## Run 17 stress 0.2633279
## Run 18 stress 0.2633845
## Run 19 stress 0.1980586
## Run 20 stress 0.5641483
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5647076
## Run 2 stress 0.5649267
## Run 3 stress 0.2834802
## Run 4 stress 0.2675241
## Run 5 stress 0.2120234
## Run 6 stress 0.1976036
## Run 7 stress 0.2560883
## Run 8 stress 0.3077976
## Run 9 stress 0.1991779
## Run 10 stress 0.2579931
## Run 11 stress 0.1991894
```

```
## Run 12 stress 0.563497
## Run 13 stress 0.2076657
## Run 14 stress 0.2043896
## Run 15 stress 0.1923662
## ... New best solution
## ... Procrustes: rmse 0.03615824  max resid 0.1934669
## Run 16 stress 0.3090525
## Run 17 stress 0.2672532
## Run 18 stress 0.2120916
## Run 19 stress 0.3055621
## Run 20 stress 0.1896273
## ... New best solution
## ... Procrustes: rmse 0.02980316  max resid 0.199741
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1896176
## ... New best solution
## ... Procrustes: rmse 0.02004178  max resid 0.1324049
## Run 2 stress 0.3061254
## Run 3 stress 0.2064745
## Run 4 stress 0.2557432
## Run 5 stress 0.2525844
## Run 6 stress 0.31064
## Run 7 stress 0.3078964
## Run 8 stress 0.5645973
## Run 9 stress 0.1896179
## ... Procrustes: rmse 0.0008130278  max resid 0.002667987
## ... Similar to previous best
## Run 10 stress 0.2640748
## Run 11 stress 0.2905565
## Run 12 stress 0.2552949
## Run 13 stress 0.1909194
## Run 14 stress 0.2822488
## Run 15 stress 0.5638188
## Run 16 stress 0.5636198
## Run 17 stress 0.1934574
## Run 18 stress 0.5646513
## Run 19 stress 0.2718729
## Run 20 stress 0.3123567
## *** Best solution repeated 1 times
## Run 0 stress 0.1936207
## Run 1 stress 0.1945224
## Run 2 stress 0.2556368
## Run 3 stress 0.2556853
## Run 4 stress 0.2797065
## Run 5 stress 0.3177768
## Run 6 stress 0.19902
## Run 7 stress 0.2216963
## Run 8 stress 0.1895415
## ... New best solution
## ... Procrustes: rmse 0.02089196  max resid 0.1378106
## Run 9 stress 0.2522724
## Run 10 stress 0.2556859
```

```
## Run 11 stress 0.207662
## Run 12 stress 0.1957115
## Run 13 stress 0.5649327
## Run 14 stress 0.2913681
## Run 15 stress 0.5645604
## Run 16 stress 0.5644768
## Run 17 stress 0.3118683
## Run 18 stress 0.5649327
## Run 19 stress 0.3076695
## Run 20 stress 0.3047647
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5647077
## Run 2 stress 0.1923768
## ... New best solution
## ... Procrustes: rmse 0.03611606  max resid 0.193441
## Run 3 stress 0.3036744
## Run 4 stress 0.2673324
## Run 5 stress 0.2551091
## Run 6 stress 0.2919768
## Run 7 stress 0.1935888
## Run 8 stress 0.2559645
## Run 9 stress 0.5649327
## Run 10 stress 0.2052518
## Run 11 stress 0.1976096
## Run 12 stress 0.1960514
## Run 13 stress 0.2924799
## Run 14 stress 0.2656611
## Run 15 stress 0.5645285
## Run 16 stress 0.2543229
## Run 17 stress 0.2534836
## Run 18 stress 0.2550617
## Run 19 stress 0.3126897
## Run 20 stress 0.2906803
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      5: stress ratio > sratmax
##     15: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2547107
## Run 2 stress 0.2777288
## Run 3 stress 0.5648476
## Run 4 stress 0.2671545
## Run 5 stress 0.5644768
## Run 6 stress 0.1990098
## Run 7 stress 0.2993971
## Run 8 stress 0.2096699
## Run 9 stress 0.2935688
## Run 10 stress 0.3076207
## Run 11 stress 0.1935045
## ... New best solution
## ... Procrustes: rmse 0.05797637  max resid 0.3009255
## Run 12 stress 0.2056322
```

```
## Run 13 stress 0.2043315
## Run 14 stress 0.2671517
## Run 15 stress 0.2557103
## Run 16 stress 0.2984449
## Run 17 stress 0.2896897
## Run 18 stress 0.2140886
## Run 19 stress 0.5643754
## Run 20 stress 0.2551502
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1943809
## Run 2 stress 0.1959807
## Run 3 stress 0.2535981
## Run 4 stress 0.3056287
## Run 5 stress 0.3155708
## Run 6 stress 0.2842381
## Run 7 stress 0.2651552
## Run 8 stress 0.3122532
## Run 9 stress 0.1923311
## ... New best solution
## ... Procrustes: rmse 0.03569748  max resid 0.1932645
## Run 10 stress 0.2875675
## Run 11 stress 0.5642525
## Run 12 stress 0.3165452
## Run 13 stress 0.303552
## Run 14 stress 0.5645649
## Run 15 stress 0.258719
## Run 16 stress 0.3026232
## Run 17 stress 0.2555631
## Run 18 stress 0.1962967
## Run 19 stress 0.273837
## Run 20 stress 0.2059851
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2966676
## Run 2 stress 0.275673
## Run 3 stress 0.2556363
## Run 4 stress 0.3003586
## Run 5 stress 0.3163007
## Run 6 stress 0.5641676
## Run 7 stress 0.2140698
## Run 8 stress 0.1910495
## ... New best solution
## ... Procrustes: rmse 0.02117773  max resid 0.1301032
## Run 9 stress 0.2528872
## Run 10 stress 0.3107585
## Run 11 stress 0.2915245
## Run 12 stress 0.2672603
## Run 13 stress 0.2628306
## Run 14 stress 0.2661186
```

```
## Run 15 stress 0.1910018
## ... New best solution
## ... Procrustes: rmse 0.002101061  max resid 0.009784261
## ... Similar to previous best
## Run 16 stress 0.1976038
## Run 17 stress 0.3164652
## Run 18 stress 0.2649498
## Run 19 stress 0.25729
## Run 20 stress 0.2573151
## *** Best solution repeated 1 times
## Run 0 stress 0.1936207
## Run 1 stress 0.3035188
## Run 2 stress 0.209275
## Run 3 stress 0.26431
## Run 4 stress 0.5649236
## Run 5 stress 0.2129125
## Run 6 stress 0.2043453
## Run 7 stress 0.2112071
## Run 8 stress 0.3060677
## Run 9 stress 0.2566503
## Run 10 stress 0.2502632
## Run 11 stress 0.2081318
## Run 12 stress 0.5591174
## Run 13 stress 0.2849154
## Run 14 stress 0.189528
## ... New best solution
## ... Procrustes: rmse 0.02084311  max resid 0.137754
## Run 15 stress 0.2643584
## Run 16 stress 0.3005653
## Run 17 stress 0.193672
## Run 18 stress 0.2035594
## Run 19 stress 0.2508879
## Run 20 stress 0.2931967
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5649037
## Run 2 stress 0.2936281
## Run 3 stress 0.5633948
## Run 4 stress 0.2858456
## Run 5 stress 0.255812
## Run 6 stress 0.2342529
## Run 7 stress 0.5647752
## Run 8 stress 0.2976169
## Run 9 stress 0.2653245
## Run 10 stress 0.3072347
## Run 11 stress 0.2563788
## Run 12 stress 0.2562126
## Run 13 stress 0.2884322
## Run 14 stress 0.1942032
## Run 15 stress 0.2595196
## Run 16 stress 0.2043344
## Run 17 stress 0.1951183
```

```
## Run 18 stress 0.2547898
## Run 19 stress 0.1976148
## Run 20 stress 0.2569522
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.203971
## Run 2 stress 0.1949403
## Run 3 stress 0.2530718
## Run 4 stress 0.2989718
## Run 5 stress 0.1923574
## ... New best solution
## ... Procrustes: rmse 0.03612006  max resid 0.193375
## Run 6 stress 0.2766759
## Run 7 stress 0.2661141
## Run 8 stress 0.3106795
## Run 9 stress 0.5649049
## Run 10 stress 0.2111479
## Run 11 stress 0.2890556
## Run 12 stress 0.2542804
## Run 13 stress 0.2631043
## Run 14 stress 0.2571266
## Run 15 stress 0.2042386
## Run 16 stress 0.1990348
## Run 17 stress 0.2878127
## Run 18 stress 0.2701224
## Run 19 stress 0.3085202
## Run 20 stress 0.1990514
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2043993
## Run 2 stress 0.2624053
## Run 3 stress 0.2855338
## Run 4 stress 0.2793983
## Run 5 stress 0.2880935
## Run 6 stress 0.5646844
## Run 7 stress 0.2061663
## Run 8 stress 0.3026927
## Run 9 stress 0.1950416
## Run 10 stress 0.2314371
## Run 11 stress 0.3073646
## Run 12 stress 0.2227074
## Run 13 stress 0.2530833
## Run 14 stress 0.283814
## Run 15 stress 0.5636165
## Run 16 stress 0.3063242
## Run 17 stress 0.2843652
## Run 18 stress 0.300286
## Run 19 stress 0.3132569
## Run 20 stress 0.2170862
## *** Best solution was not repeated -- monoMDS stopping criteria:
```

```
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2933956
## Run 2 stress 0.3047024
## Run 3 stress 0.2965487
## Run 4 stress 0.2024687
## Run 5 stress 0.3069151
## Run 6 stress 0.2998358
## Run 7 stress 0.3032917
## Run 8 stress 0.2855231
## Run 9 stress 0.5647043
## Run 10 stress 0.3029389
## Run 11 stress 0.5634048
## Run 12 stress 0.2738656
## Run 13 stress 0.2547164
## Run 14 stress 0.1895319
## ... New best solution
## ... Procrustes: rmse 0.02081386  max resid 0.1377008
## Run 15 stress 0.5639746
## Run 16 stress 0.2949801
## Run 17 stress 0.2175241
## Run 18 stress 0.2576082
## Run 19 stress 0.1973799
## Run 20 stress 0.2776611
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2649726
## Run 2 stress 0.311588
## Run 3 stress 0.267269
## Run 4 stress 0.2825318
## Run 5 stress 0.1939929
## ... Procrustes: rmse 0.00300203  max resid 0.014918
## Run 6 stress 0.1934772
## ... New best solution
## ... Procrustes: rmse 0.0579506  max resid 0.3009986
## Run 7 stress 0.1942595
## Run 8 stress 0.2620917
## Run 9 stress 0.2803742
## Run 10 stress 0.2262077
## Run 11 stress 0.2600969
## Run 12 stress 0.2734665
## Run 13 stress 0.3006777
## Run 14 stress 0.2645988
## Run 15 stress 0.1991174
## Run 16 stress 0.3030037
## Run 17 stress 0.3065638
## Run 18 stress 0.5647926
## Run 19 stress 0.3140211
## Run 20 stress 0.193667
## ... Procrustes: rmse 0.002605235  max resid 0.01275281
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
```

```
## Run 0 stress 0.1936207
## Run 1 stress 0.2525713
## Run 2 stress 0.3056188
## Run 3 stress 0.2043433
## Run 4 stress 0.2526133
## Run 5 stress 0.3167281
## Run 6 stress 0.5642277
## Run 7 stress 0.2646264
## Run 8 stress 0.2231813
## Run 9 stress 0.3102842
## Run 10 stress 0.3068257
## Run 11 stress 0.3062894
## Run 12 stress 0.5637346
## Run 13 stress 0.2561203
## Run 14 stress 0.2804239
## Run 15 stress 0.2965426
## Run 16 stress 0.2701659
## Run 17 stress 0.2603325
## Run 18 stress 0.2718123
## Run 19 stress 0.1994414
## Run 20 stress 0.1991573
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3100846
## Run 2 stress 0.2889841
## Run 3 stress 0.2043985
## Run 4 stress 0.2738793
## Run 5 stress 0.318156
## Run 6 stress 0.2601287
## Run 7 stress 0.3126736
## Run 8 stress 0.2807671
## Run 9 stress 0.2684297
## Run 10 stress 0.2978882
## Run 11 stress 0.1957842
## Run 12 stress 0.2716326
## Run 13 stress 0.5646759
## Run 14 stress 0.1976065
## Run 15 stress 0.3085183
## Run 16 stress 0.2792166
## Run 17 stress 0.1994262
## Run 18 stress 0.3116146
## Run 19 stress 0.2035564
## Run 20 stress 0.5649327
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2586037
## Run 2 stress 0.2628937
## Run 3 stress 0.2164329
## Run 4 stress 0.2534135
## Run 5 stress 0.3080191
```

```
## Run 6 stress 0.2581931
## Run 7 stress 0.1976411
## Run 8 stress 0.2913296
## Run 9 stress 0.2993939
## Run 10 stress 0.1895441
## ... New best solution
## ... Procrustes: rmse 0.02081274  max resid 0.1377639
## Run 11 stress 0.2560167
## Run 12 stress 0.2948556
## Run 13 stress 0.2061874
## Run 14 stress 0.2231266
## Run 15 stress 0.2573709
## Run 16 stress 0.283844
## Run 17 stress 0.2849089
## Run 18 stress 0.5634389
## Run 19 stress 0.5649304
## Run 20 stress 0.2007854
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5649327
## Run 2 stress 0.2671282
## Run 3 stress 0.2649049
## Run 4 stress 0.2620613
## Run 5 stress 0.5633481
## Run 6 stress 0.2361367
## Run 7 stress 0.5648333
## Run 8 stress 0.309138
## Run 9 stress 0.2060053
## Run 10 stress 0.1934487
## ... New best solution
## ... Procrustes: rmse 0.05798866  max resid 0.3010822
## Run 11 stress 0.2666176
## Run 12 stress 0.2059828
## Run 13 stress 0.264961
## Run 14 stress 0.2024275
## Run 15 stress 0.3094264
## Run 16 stress 0.2541702
## Run 17 stress 0.2559919
## Run 18 stress 0.2849768
## Run 19 stress 0.2076022
## Run 20 stress 0.2727461
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2611223
## Run 2 stress 0.2880889
## Run 3 stress 0.193655
## ... Procrustes: rmse 0.001473868  max resid 0.005973698
## ... Similar to previous best
## Run 4 stress 0.3089667
## Run 5 stress 0.2549531
```

```
## Run 6 stress 0.5587539
## Run 7 stress 0.1934404
## ... New best solution
## ... Procrustes: rmse 0.05802625  max resid 0.3011731
## Run 8 stress 0.3032117
## Run 9 stress 0.2641052
## Run 10 stress 0.5647642
## Run 11 stress 0.2717921
## Run 12 stress 0.2839096
## Run 13 stress 0.2587634
## Run 14 stress 0.2340512
## Run 15 stress 0.5637003
## Run 16 stress 0.2094063
## Run 17 stress 0.3106479
## Run 18 stress 0.1923282
## ... New best solution
## ... Procrustes: rmse 0.04635026  max resid 0.3070926
## Run 19 stress 0.2077615
## Run 20 stress 0.3090367
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2838957
## Run 2 stress 0.1976004
## Run 3 stress 0.2696152
## Run 4 stress 0.564786
## Run 5 stress 0.3019392
## Run 6 stress 0.3055347
## Run 7 stress 0.2940276
## Run 8 stress 0.2692614
## Run 9 stress 0.255254
## Run 10 stress 0.1895257
## ... New best solution
## ... Procrustes: rmse 0.02088196  max resid 0.1377926
## Run 11 stress 0.2228425
## Run 12 stress 0.1969796
## Run 13 stress 0.5631659
## Run 14 stress 0.2124497
## Run 15 stress 0.2541939
## Run 16 stress 0.5647833
## Run 17 stress 0.3038288
## Run 18 stress 0.254991
## Run 19 stress 0.196081
## Run 20 stress 0.5639102
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3012111
## Run 2 stress 0.2043407
## Run 3 stress 0.3183471
## Run 4 stress 0.2594723
## Run 5 stress 0.5643161
```

```
## Run 6 stress 0.5644824
## Run 7 stress 0.2692777
## Run 8 stress 0.2742202
## Run 9 stress 0.5612617
## Run 10 stress 0.5572148
## Run 11 stress 0.1934356
## ... New best solution
## ... Procrustes: rmse 0.05801235  max resid 0.3011504
## Run 12 stress 0.2549167
## Run 13 stress 0.3133555
## Run 14 stress 0.2973614
## Run 15 stress 0.1949786
## Run 16 stress 0.2555895
## Run 17 stress 0.2996658
## Run 18 stress 0.207653
## Run 19 stress 0.2701184
## Run 20 stress 0.2991063
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2586597
## Run 2 stress 0.3070456
## Run 3 stress 0.269545
## Run 4 stress 0.200064
## Run 5 stress 0.314494
## Run 6 stress 0.2123681
## Run 7 stress 0.2862474
## Run 8 stress 0.2699592
## Run 9 stress 0.3071159
## Run 10 stress 0.224183
## Run 11 stress 0.2996183
## Run 12 stress 0.2909852
## Run 13 stress 0.3120339
## Run 14 stress 0.2893858
## Run 15 stress 0.2716961
## Run 16 stress 0.235159
## Run 17 stress 0.1942319
## Run 18 stress 0.2553832
## Run 19 stress 0.2805855
## Run 20 stress 0.1994009
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2639739
## Run 2 stress 0.5633121
## Run 3 stress 0.2553596
## Run 4 stress 0.2559612
## Run 5 stress 0.2797036
## Run 6 stress 0.2754185
## Run 7 stress 0.255433
## Run 8 stress 0.3055844
## Run 9 stress 0.2797244
```

```
## Run 10 stress 0.213777
## Run 11 stress 0.2893754
## Run 12 stress 0.2522676
## Run 13 stress 0.267433
## Run 14 stress 0.3028769
## Run 15 stress 0.254653
## Run 16 stress 0.2570181
## Run 17 stress 0.5642622
## Run 18 stress 0.2563552
## Run 19 stress 0.254753
## Run 20 stress 0.5638375
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1977014
## Run 2 stress 0.2136166
## Run 3 stress 0.5627461
## Run 4 stress 0.254255
## Run 5 stress 0.2970647
## Run 6 stress 0.2308787
## Run 7 stress 0.2939834
## Run 8 stress 0.307419
## Run 9 stress 0.3145159
## Run 10 stress 0.3029438
## Run 11 stress 0.2695001
## Run 12 stress 0.1895147
## ... New best solution
## ... Procrustes: rmse 0.0208175  max resid 0.1376956
## Run 13 stress 0.3076207
## Run 14 stress 0.3113248
## Run 15 stress 0.3093626
## Run 16 stress 0.3011556
## Run 17 stress 0.2941656
## Run 18 stress 0.2717171
## Run 19 stress 0.2636366
## Run 20 stress 0.1976041
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5639084
## Run 2 stress 0.232897
## Run 3 stress 0.2528833
## Run 4 stress 0.2556982
## Run 5 stress 0.2969601
## Run 6 stress 0.1923103
## ... New best solution
## ... Procrustes: rmse 0.03572985  max resid 0.1933615
## Run 7 stress 0.2671283
## Run 8 stress 0.5645108
## Run 9 stress 0.2121923
## Run 10 stress 0.2565026
## Run 11 stress 0.288132
## Run 12 stress 0.5644172
```

```
## Run 13 stress 0.3078359
## Run 14 stress 0.2585714
## Run 15 stress 0.3096744
## Run 16 stress 0.2535322
## Run 17 stress 0.2555603
## Run 18 stress 0.3008045
## Run 19 stress 0.2955511
## Run 20 stress 0.1895389
## ... New best solution
## ... Procrustes: rmse 0.02982194  max resid 0.1998569
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3121255
## Run 2 stress 0.2699884
## Run 3 stress 0.1975861
## Run 4 stress 0.208824
## Run 5 stress 0.2546558
## Run 6 stress 0.5640688
## Run 7 stress 0.2576425
## Run 8 stress 0.2582335
## Run 9 stress 0.2934192
## Run 10 stress 0.5639172
## Run 11 stress 0.2861656
## Run 12 stress 0.2829554
## Run 13 stress 0.1947633
## Run 14 stress 0.5648794
## Run 15 stress 0.2013665
## Run 16 stress 0.2975886
## Run 17 stress 0.3111686
## Run 18 stress 0.2954077
## Run 19 stress 0.2524392
## Run 20 stress 0.3132229
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.564807
## Run 2 stress 0.2562534
## Run 3 stress 0.2820416
## Run 4 stress 0.194495
## Run 5 stress 0.2531219
## Run 6 stress 0.2590599
## Run 7 stress 0.252654
## Run 8 stress 0.209159
## Run 9 stress 0.298161
## Run 10 stress 0.207625
## Run 11 stress 0.2089289
## Run 12 stress 0.2745125
## Run 13 stress 0.2553617
## Run 14 stress 0.2923378
## Run 15 stress 0.3093955
## Run 16 stress 0.2716999
```

```
## Run 17 stress 0.1976056
## Run 18 stress 0.2552321
## Run 19 stress 0.2882894
## Run 20 stress 0.2076017
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1990495
## Run 2 stress 0.265322
## Run 3 stress 0.2669271
## Run 4 stress 0.2081271
## Run 5 stress 0.2642644
## Run 6 stress 0.3155113
## Run 7 stress 0.304966
## Run 8 stress 0.2779078
## Run 9 stress 0.1958025
## Run 10 stress 0.2882222
## Run 11 stress 0.3075709
## Run 12 stress 0.2939094
## Run 13 stress 0.1895272
## ... New best solution
## ... Procrustes: rmse 0.02083236  max resid 0.1377333
## Run 14 stress 0.2740452
## Run 15 stress 0.2007041
## Run 16 stress 0.1934814
## Run 17 stress 0.1991918
## Run 18 stress 0.2556193
## Run 19 stress 0.3092195
## Run 20 stress 0.3115825
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2549799
## Run 2 stress 0.2713953
## Run 3 stress 0.3030589
## Run 4 stress 0.3054126
## Run 5 stress 0.2570955
## Run 6 stress 0.1976355
## Run 7 stress 0.2795848
## Run 8 stress 0.2834952
## Run 9 stress 0.2946146
## Run 10 stress 0.5649327
## Run 11 stress 0.2555658
## Run 12 stress 0.5389826
## Run 13 stress 0.3049516
## Run 14 stress 0.5631818
## Run 15 stress 0.2739279
## Run 16 stress 0.3100313
## Run 17 stress 0.5642125
## Run 18 stress 0.255002
## Run 19 stress 0.2577929
## Run 20 stress 0.5649278
```

```
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3008895
## Run 2 stress 0.193581
## ... New best solution
## ... Procrustes: rmse 0.001100707  max resid 0.004339651
## ... Similar to previous best
## Run 3 stress 0.1990503
## Run 4 stress 0.2076036
## Run 5 stress 0.2552894
## Run 6 stress 0.193452
## ... New best solution
## ... Procrustes: rmse 0.05805928  max resid 0.3012975
## Run 7 stress 0.3023718
## Run 8 stress 0.2898209
## Run 9 stress 0.1944499
## Run 10 stress 0.3165568
## Run 11 stress 0.3012893
## Run 12 stress 0.1963119
## Run 13 stress 0.2663123
## Run 14 stress 0.5648937
## Run 15 stress 0.255522
## Run 16 stress 0.2555185
## Run 17 stress 0.5638918
## Run 18 stress 0.2076472
## Run 19 stress 0.3074692
## Run 20 stress 0.2076162
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2124929
## Run 2 stress 0.3043969
## Run 3 stress 0.2569018
## Run 4 stress 0.1936539
## ... Procrustes: rmse 0.05655462  max resid 0.2897281
## Run 5 stress 0.3112113
## Run 6 stress 0.3108364
## Run 7 stress 0.1923815
## ... New best solution
## ... Procrustes: rmse 0.03564969  max resid 0.1932361
## Run 8 stress 0.2594104
## Run 9 stress 0.3005763
## Run 10 stress 0.2895015
## Run 11 stress 0.2868294
## Run 12 stress 0.1895284
## ... New best solution
## ... Procrustes: rmse 0.02979077  max resid 0.1998372
## Run 13 stress 0.2112208
## Run 14 stress 0.3006055
## Run 15 stress 0.2964556
## Run 16 stress 0.2060222
```

```
## Run 17 stress 0.5490891
## Run 18 stress 0.3001246
## Run 19 stress 0.2597388
## Run 20 stress 0.2049713
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3102024
## Run 2 stress 0.2124417
## Run 3 stress 0.2749465
## Run 4 stress 0.3084348
## Run 5 stress 0.2009426
## Run 6 stress 0.2581744
## Run 7 stress 0.3116298
## Run 8 stress 0.5635541
## Run 9 stress 0.3127117
## Run 10 stress 0.256019
## Run 11 stress 0.2576668
## Run 12 stress 0.2914409
## Run 13 stress 0.2963802
## Run 14 stress 0.3149037
## Run 15 stress 0.3182511
## Run 16 stress 0.311748
## Run 17 stress 0.3001017
## Run 18 stress 0.1942
## Run 19 stress 0.295313
## Run 20 stress 0.2218935
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      5: stress ratio > sratmax
##     15: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2139952
## Run 2 stress 0.2649079
## Run 3 stress 0.2556855
## Run 4 stress 0.2863521
## Run 5 stress 0.2250702
## Run 6 stress 0.2915913
## Run 7 stress 0.2810035
## Run 8 stress 0.5612463
## Run 9 stress 0.2190942
## Run 10 stress 0.2605939
## Run 11 stress 0.2970426
## Run 12 stress 0.2352065
## Run 13 stress 0.5643345
## Run 14 stress 0.2143984
## Run 15 stress 0.5633558
## Run 16 stress 0.1976418
## Run 17 stress 0.2673844
## Run 18 stress 0.5647582
## Run 19 stress 0.2621944
## Run 20 stress 0.3078523
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
```

```
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3124297
## Run 2 stress 0.2554882
## Run 3 stress 0.2718493
## Run 4 stress 0.2054747
## Run 5 stress 0.2910307
## Run 6 stress 0.564341
## Run 7 stress 0.1941995
## Run 8 stress 0.2914275
## Run 9 stress 0.2893184
## Run 10 stress 0.1936527
## ... Procrustes: rmse 0.001360679  max resid 0.005941188
## ... Similar to previous best
## Run 11 stress 0.2128986
## Run 12 stress 0.2599145
## Run 13 stress 0.1944141
## Run 14 stress 0.2578129
## Run 15 stress 0.292849
## Run 16 stress 0.2078253
## Run 17 stress 0.2287399
## Run 18 stress 0.2078257
## Run 19 stress 0.2977391
## Run 20 stress 0.2570373
## *** Best solution repeated 1 times
## Run 0 stress 0.1936207
## Run 1 stress 0.2108572
## Run 2 stress 0.2279017
## Run 3 stress 0.5631412
## Run 4 stress 0.3059305
## Run 5 stress 0.3056533
## Run 6 stress 0.562739
## Run 7 stress 0.1960683
## Run 8 stress 0.3046794
## Run 9 stress 0.3101602
## Run 10 stress 0.2568971
## Run 11 stress 0.2923461
## Run 12 stress 0.2729777
## Run 13 stress 0.5636056
## Run 14 stress 0.5648835
## Run 15 stress 0.3083149
## Run 16 stress 0.1895126
## ... New best solution
## ... Procrustes: rmse 0.02081239  max resid 0.1376683
## Run 17 stress 0.2704086
## Run 18 stress 0.2535251
## Run 19 stress 0.5647491
## Run 20 stress 0.2983698
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5648746
## Run 2 stress 0.2043548
## Run 3 stress 0.3063438
```

```
## Run 4 stress 0.1936846
## ... Procrustes: rmse 0.05651677  max resid 0.2897056
## Run 5 stress 0.2007203
## Run 6 stress 0.1942668
## Run 7 stress 0.2012985
## Run 8 stress 0.2975972
## Run 9 stress 0.5649164
## Run 10 stress 0.2654305
## Run 11 stress 0.2576767
## Run 12 stress 0.2571133
## Run 13 stress 0.2739704
## Run 14 stress 0.2861247
## Run 15 stress 0.2232999
## Run 16 stress 0.2713676
## Run 17 stress 0.254271
## Run 18 stress 0.2662837
## Run 19 stress 0.2686117
## Run 20 stress 0.5649118
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.1895321
## ... New best solution
## ... Procrustes: rmse 0.02085678  max resid 0.1377602
## Run 2 stress 0.1960456
## Run 3 stress 0.5626896
## Run 4 stress 0.2076474
## Run 5 stress 0.2794928
## Run 6 stress 0.3079632
## Run 7 stress 0.2959657
## Run 8 stress 0.2528695
## Run 9 stress 0.564669
## Run 10 stress 0.1946574
## Run 11 stress 0.307122
## Run 12 stress 0.3023824
## Run 13 stress 0.2283077
## Run 14 stress 0.2961942
## Run 15 stress 0.196097
## Run 16 stress 0.2077743
## Run 17 stress 0.1956908
## Run 18 stress 0.3076072
## Run 19 stress 0.2870281
## Run 20 stress 0.2957275
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5641178
## Run 2 stress 0.2556943
## Run 3 stress 0.1895264
## ... New best solution
## ... Procrustes: rmse 0.0207753  max resid 0.1376594
## Run 4 stress 0.2675574
```

```
## Run 5 stress 0.2672102
## Run 6 stress 0.193656
## Run 7 stress 0.2692675
## Run 8 stress 0.2176482
## Run 9 stress 0.1960875
## Run 10 stress 0.2095869
## Run 11 stress 0.2704263
## Run 12 stress 0.2144166
## Run 13 stress 0.314463
## Run 14 stress 0.3101628
## Run 15 stress 0.2572099
## Run 16 stress 0.5647318
## Run 17 stress 0.3023348
## Run 18 stress 0.2717052
## Run 19 stress 0.2741605
## Run 20 stress 0.3080184
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2718616
## Run 2 stress 0.281077
## Run 3 stress 0.3108615
## Run 4 stress 0.2873402
## Run 5 stress 0.1956141
## Run 6 stress 0.2830783
## Run 7 stress 0.5607302
## Run 8 stress 0.2092781
## Run 9 stress 0.5637816
## Run 10 stress 0.3148576
## Run 11 stress 0.210982
## Run 12 stress 0.2058667
## Run 13 stress 0.2155713
## Run 14 stress 0.2744524
## Run 15 stress 0.2949075
## Run 16 stress 0.2546333
## Run 17 stress 0.2977607
## Run 18 stress 0.3114
## Run 19 stress 0.1977194
## Run 20 stress 0.2872239
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2878585
## Run 2 stress 0.2144635
## Run 3 stress 0.5645881
## Run 4 stress 0.2968805
## Run 5 stress 0.2231116
## Run 6 stress 0.2546534
## Run 7 stress 0.2078235
## Run 8 stress 0.3108813
## Run 9 stress 0.3123266
## Run 10 stress 0.302858
## Run 11 stress 0.3133437
```

```
## Run 12 stress 0.5632959
## Run 13 stress 0.2976526
## Run 14 stress 0.294639
## Run 15 stress 0.2559826
## Run 16 stress 0.1940525
## ... Procrustes: rmse 0.003695147  max resid 0.01986637
## Run 17 stress 0.2645651
## Run 18 stress 0.2567881
## Run 19 stress 0.256393
## Run 20 stress 0.3190528
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2526452
## Run 2 stress 0.5590001
## Run 3 stress 0.2861077
## Run 4 stress 0.252508
## Run 5 stress 0.1936145
## ... New best solution
## ... Procrustes: rmse 0.001101262  max resid 0.00460676
## ... Similar to previous best
## Run 6 stress 0.2062275
## Run 7 stress 0.3060534
## Run 8 stress 0.2661091
## Run 9 stress 0.2545553
## Run 10 stress 0.1923554
## ... New best solution
## ... Procrustes: rmse 0.03612182  max resid 0.1933828
## Run 11 stress 0.2589645
## Run 12 stress 0.3099759
## Run 13 stress 0.280254
## Run 14 stress 0.1923567
## ... Procrustes: rmse 0.0005342507  max resid 0.002135409
## ... Similar to previous best
## Run 15 stress 0.3006996
## Run 16 stress 0.3076513
## Run 17 stress 0.1935192
## Run 18 stress 0.2740751
## Run 19 stress 0.3157198
## Run 20 stress 0.2794018
## *** Best solution repeated 1 times
## Run 0 stress 0.1936207
## Run 1 stress 0.3048533
## Run 2 stress 0.3105654
## Run 3 stress 0.5647553
## Run 4 stress 0.2859261
## Run 5 stress 0.2595552
## Run 6 stress 0.268606
## Run 7 stress 0.2933447
## Run 8 stress 0.2776669
## Run 9 stress 0.1942957
## Run 10 stress 0.1934909
## ... New best solution
```

```
## ... Procrustes: rmse 0.05800254  max resid 0.3010821
## Run 11 stress 0.2092003
## Run 12 stress 0.2582063
## Run 13 stress 0.1923777
## ... New best solution
## ... Procrustes: rmse 0.04638732  max resid 0.3070606
## Run 14 stress 0.56374
## Run 15 stress 0.5643554
## Run 16 stress 0.1895369
## ... New best solution
## ... Procrustes: rmse 0.02987663  max resid 0.2000967
## Run 17 stress 0.2577956
## Run 18 stress 0.2076593
## Run 19 stress 0.2858533
## Run 20 stress 0.3120411
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3079908
## Run 2 stress 0.257503
## Run 3 stress 0.211222
## Run 4 stress 0.5647865
## Run 5 stress 0.2023045
## Run 6 stress 0.5601417
## Run 7 stress 0.2803792
## Run 8 stress 0.5649327
## Run 9 stress 0.2571567
## Run 10 stress 0.2973948
## Run 11 stress 0.2652078
## Run 12 stress 0.2336076
## Run 13 stress 0.3007594
## Run 14 stress 0.298735
## Run 15 stress 0.2012923
## Run 16 stress 0.305783
## Run 17 stress 0.3074663
## Run 18 stress 0.3016732
## Run 19 stress 0.2061883
## Run 20 stress 0.2048118
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.2569016
## Run 2 stress 0.2984756
## Run 3 stress 0.2049244
## Run 4 stress 0.2092676
## Run 5 stress 0.2852153
## Run 6 stress 0.1962974
## Run 7 stress 0.2511365
## Run 8 stress 0.2795074
## Run 9 stress 0.2978023
## Run 10 stress 0.1934557
## ... New best solution
```

```
## ... Procrustes: rmse 0.05798621  max resid 0.3010504
## Run 11 stress 0.1961625
## Run 12 stress 0.2940124
## Run 13 stress 0.1940543
## Run 14 stress 0.3078481
## Run 15 stress 0.1980514
## Run 16 stress 0.2531862
## Run 17 stress 0.3070678
## Run 18 stress 0.1896106
## ... New best solution
## ... Procrustes: rmse 0.05463783  max resid 0.2983955
## Run 19 stress 0.2604997
## Run 20 stress 0.280363
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5565414
## Run 2 stress 0.197637
## Run 3 stress 0.2529983
## Run 4 stress 0.5634269
## Run 5 stress 0.3074515
## Run 6 stress 0.2595217
## Run 7 stress 0.263745
## Run 8 stress 0.2589679
## Run 9 stress 0.2534269
## Run 10 stress 0.1960749
## Run 11 stress 0.2869961
## Run 12 stress 0.2174469
## Run 13 stress 0.1944099
## Run 14 stress 0.1895392
## ... New best solution
## ... Procrustes: rmse 0.02079423  max resid 0.1376875
## Run 15 stress 0.204432
## Run 16 stress 0.3139893
## Run 17 stress 0.2610245
## Run 18 stress 0.2557811
## Run 19 stress 0.2007239
## Run 20 stress 0.2979408
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3091661
## Run 2 stress 0.1994137
## Run 3 stress 0.264481
## Run 4 stress 0.2796383
## Run 5 stress 0.3149818
## Run 6 stress 0.2143159
## Run 7 stress 0.2912962
## Run 8 stress 0.2969864
## Run 9 stress 0.305568
## Run 10 stress 0.2958111
## Run 11 stress 0.2095736
```

```
## Run 12 stress 0.2880725
## Run 13 stress 0.2591182
## Run 14 stress 0.2961875
## Run 15 stress 0.3021528
## Run 16 stress 0.2238852
## Run 17 stress 0.3076666
## Run 18 stress 0.3146388
## Run 19 stress 0.2326759
## Run 20 stress 0.2969579
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      5: stress ratio > sratmax
##     15: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3057016
## Run 2 stress 0.2550341
## Run 3 stress 0.3106451
## Run 4 stress 0.2804464
## Run 5 stress 0.2126997
## Run 6 stress 0.5639227
## Run 7 stress 0.2637519
## Run 8 stress 0.307328
## Run 9 stress 0.2880595
## Run 10 stress 0.1909311
## ... New best solution
## ... Procrustes: rmse 0.02181523  max resid 0.1353572
## Run 11 stress 0.2892363
## Run 12 stress 0.3156615
## Run 13 stress 0.2852701
## Run 14 stress 0.5641245
## Run 15 stress 0.3053972
## Run 16 stress 0.1984958
## Run 17 stress 0.5645397
## Run 18 stress 0.1895132
## ... New best solution
## ... Procrustes: rmse 0.008651715  max resid 0.05682656
## Run 19 stress 0.1960598
## Run 20 stress 0.1895214
## ... Procrustes: rmse 0.0007307209  max resid 0.002991406
## ... Similar to previous best
## *** Best solution repeated 1 times
## Run 0 stress 0.1936207
## Run 1 stress 0.2631762
## Run 2 stress 0.2527772
## Run 3 stress 0.3121003
## Run 4 stress 0.293012
## Run 5 stress 0.1979513
## Run 6 stress 0.5616562
## Run 7 stress 0.2804474
## Run 8 stress 0.3086593
## Run 9 stress 0.2632634
## Run 10 stress 0.3023892
## Run 11 stress 0.1990722
## Run 12 stress 0.1923021
## ... New best solution
```

```
## ... Procrustes: rmse 0.03576712  max resid 0.1933391
## Run 13 stress 0.3039352
## Run 14 stress 0.197362
## Run 15 stress 0.3034355
## Run 16 stress 0.2888675
## Run 17 stress 0.3027359
## Run 18 stress 0.2265279
## Run 19 stress 0.3049386
## Run 20 stress 0.1940325
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.3006947
## Run 2 stress 0.2540495
## Run 3 stress 0.2598312
## Run 4 stress 0.3084941
## Run 5 stress 0.2948122
## Run 6 stress 0.2636042
## Run 7 stress 0.5647821
## Run 8 stress 0.2803939
## Run 9 stress 0.1973989
## Run 10 stress 0.3044041
## Run 11 stress 0.2701112
## Run 12 stress 0.307932
## Run 13 stress 0.3140323
## Run 14 stress 0.3157703
## Run 15 stress 0.3120434
## Run 16 stress 0.1992145
## Run 17 stress 0.2577406
## Run 18 stress 0.2752257
## Run 19 stress 0.2796981
## Run 20 stress 0.3133277
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: stress ratio > sratmax
##     16: scale factor of the gradient < sfgrmin
## Run 0 stress 0.1936207
## Run 1 stress 0.5645142
## Run 2 stress 0.195016
## Run 3 stress 0.1942014
## Run 4 stress 0.3085255
## Run 5 stress 0.2121772
## Run 6 stress 0.5633047
## Run 7 stress 0.256679
## Run 8 stress 0.2674908
## Run 9 stress 0.2288132
## Run 10 stress 0.2571495
## Run 11 stress 0.5635757
## Run 12 stress 0.3041249
## Run 13 stress 0.3042205
## Run 14 stress 0.2076668
## Run 15 stress 0.3071728
## Run 16 stress 0.1990057
## Run 17 stress 0.2567575
```

```
## Run 18 stress 0.1969771
## Run 19 stress 0.1996239
## Run 20 stress 0.308511
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Run 0 stress 0.144726
## Run 1 stress 0.1511823
## Run 2 stress 0.1524413
## Run 3 stress 0.1498826
## Run 4 stress 0.149582
## Run 5 stress 0.1529097
## Run 6 stress 0.1490429
## Run 7 stress 0.1450975
## ... Procrustes: rmse 0.01844957  max resid 0.09703175
## Run 8 stress 0.1535976
## Run 9 stress 0.1503044
## Run 10 stress 0.1468502
## Run 11 stress 0.1454382
## Run 12 stress 0.1455221
## Run 13 stress 0.1511813
## Run 14 stress 0.1436746
## ... New best solution
## ... Procrustes: rmse 0.06135225  max resid 0.2507553
## Run 15 stress 0.1466006
## Run 16 stress 0.1517286
## Run 17 stress 0.1498201
## Run 18 stress 0.14983
## Run 19 stress 0.147348
## Run 20 stress 0.1507526
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1491595
## Run 2 stress 0.1469305
## Run 3 stress 0.1456629
## Run 4 stress 0.1494682
## Run 5 stress 0.1525947
## Run 6 stress 0.1432544
## ... New best solution
## ... Procrustes: rmse 0.06305542  max resid 0.2551524
## Run 7 stress 0.1519472
## Run 8 stress 0.1494739
## Run 9 stress 0.1439975
## Run 10 stress 0.1527035
## Run 11 stress 0.1451661
## Run 12 stress 0.1433565
## ... Procrustes: rmse 0.02552031  max resid 0.08347503
## Run 13 stress 0.1497527
## Run 14 stress 0.1507655
## Run 15 stress 0.1448489
## Run 16 stress 0.1443484
## Run 17 stress 0.1527198
## Run 18 stress 0.1446959
## Run 19 stress 0.1444563
```

```
## Run 20 stress 0.1494021
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1473294
## Run 2 stress 0.1494019
## Run 3 stress 0.1445432
## ... New best solution
## ... Procrustes: rmse 0.01613003  max resid 0.073103
## Run 4 stress 0.1516637
## Run 5 stress 0.1469106
## Run 6 stress 0.156072
## Run 7 stress 0.1502684
## Run 8 stress 0.1486722
## Run 9 stress 0.1514355
## Run 10 stress 0.1420314
## ... New best solution
## ... Procrustes: rmse 0.05572991  max resid 0.2526302
## Run 11 stress 0.1501529
## Run 12 stress 0.1437881
## Run 13 stress 0.157219
## Run 14 stress 0.1422031
## ... Procrustes: rmse 0.006232486  max resid 0.03161366
## Run 15 stress 0.1522393
## Run 16 stress 0.1531555
## Run 17 stress 0.1504047
## Run 18 stress 0.1490517
## Run 19 stress 0.1443021
## Run 20 stress 0.1494312
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: no. of iterations >= maxit
##     16: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1528344
## Run 2 stress 0.1498827
## Run 3 stress 0.1419826
## ... New best solution
## ... Procrustes: rmse 0.05431317  max resid 0.2596387
## Run 4 stress 0.1490089
## Run 5 stress 0.1424438
## ... Procrustes: rmse 0.01168009  max resid 0.0633018
## Run 6 stress 0.1511547
## Run 7 stress 0.1513253
## Run 8 stress 0.1448492
## Run 9 stress 0.1478621
## Run 10 stress 0.1494685
## Run 11 stress 0.1456286
## Run 12 stress 0.1487746
## Run 13 stress 0.1540357
## Run 14 stress 0.1519007
## Run 15 stress 0.1525843
## Run 16 stress 0.1542725
## Run 17 stress 0.1469107
```

```
## Run 18 stress 0.1522325
## Run 19 stress 0.1540138
## Run 20 stress 0.1454001
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1427146
## ... New best solution
## ... Procrustes: rmse 0.06016976  max resid 0.2601922
## Run 2 stress 0.146964
## Run 3 stress 0.1503994
## Run 4 stress 0.1491566
## Run 5 stress 0.1509031
## Run 6 stress 0.1434711
## Run 7 stress 0.1424444
## ... New best solution
## ... Procrustes: rmse 0.0294303  max resid 0.09199351
## Run 8 stress 0.1436667
## Run 9 stress 0.1522768
## Run 10 stress 0.1516588
## Run 11 stress 0.150153
## Run 12 stress 0.1494022
## Run 13 stress 0.1450974
## Run 14 stress 0.1449298
## Run 15 stress 0.150689
## Run 16 stress 0.1426496
## ... Procrustes: rmse 0.01879384  max resid 0.07816865
## Run 17 stress 0.1500548
## Run 18 stress 0.1502269
## Run 19 stress 0.401309
## Run 20 stress 0.143557
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1510811
## Run 2 stress 0.1460702
## Run 3 stress 0.1450709
## ... Procrustes: rmse 0.06266524  max resid 0.2566908
## Run 4 stress 0.1468666
## Run 5 stress 0.1504553
## Run 6 stress 0.1424441
## ... New best solution
## ... Procrustes: rmse 0.05331081  max resid 0.2561529
## Run 7 stress 0.142444
## ... New best solution
## ... Procrustes: rmse 7.266708e-05  max resid 0.000344175
## ... Similar to previous best
## Run 8 stress 0.1497954
## Run 9 stress 0.1520959
## Run 10 stress 0.1455905
## Run 11 stress 0.1436667
## Run 12 stress 0.1444192
```

```
## Run 13 stress 0.1423064
## ... New best solution
## ... Procrustes: rmse 0.004530311  max resid 0.02454495
## Run 14 stress 0.1491574
## Run 15 stress 0.1427147
## ... Procrustes: rmse 0.02779379  max resid 0.08745723
## Run 16 stress 0.1466014
## Run 17 stress 0.1512198
## Run 18 stress 0.1510127
## Run 19 stress 0.1422039
## ... New best solution
## ... Procrustes: rmse 0.009671281  max resid 0.05545777
## Run 20 stress 0.1446952
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1514825
## Run 2 stress 0.1445764
## ... New best solution
## ... Procrustes: rmse 0.02745889  max resid 0.104679
## Run 3 stress 0.1510444
## Run 4 stress 0.1437686
## ... New best solution
## ... Procrustes: rmse 0.04713324  max resid 0.1620111
## Run 5 stress 0.1510106
## Run 6 stress 0.1423442
## ... New best solution
## ... Procrustes: rmse 0.03188171  max resid 0.1001194
## Run 7 stress 0.144301
## Run 8 stress 0.148118
## Run 9 stress 0.1427146
## ... Procrustes: rmse 0.01230868  max resid 0.07792507
## Run 10 stress 0.1425269
## ... Procrustes: rmse 0.02723299  max resid 0.09413194
## Run 11 stress 0.1472113
## Run 12 stress 0.1469216
## Run 13 stress 0.1428752
## Run 14 stress 0.1424439
## ... Procrustes: rmse 0.02436073  max resid 0.08682465
## Run 15 stress 0.1494021
## Run 16 stress 0.1501528
## Run 17 stress 0.1451669
## Run 18 stress 0.1498198
## Run 19 stress 0.1451378
## Run 20 stress 0.1451112
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1472199
## Run 2 stress 0.1422926
## ... New best solution
## ... Procrustes: rmse 0.05684477  max resid 0.2564703
## Run 3 stress 0.1427148
```

```
## ... Procrustes: rmse 0.01317582  max resid 0.07823975
## Run 4 stress 0.1454983
## Run 5 stress 0.1466011
## Run 6 stress 0.1427149
## ... Procrustes: rmse 0.01307509  max resid 0.07759638
## Run 7 stress 0.153182
## Run 8 stress 0.1447623
## Run 9 stress 0.1472654
## Run 10 stress 0.1493358
## Run 11 stress 0.1489961
## Run 12 stress 0.1445435
## Run 13 stress 0.1559991
## Run 14 stress 0.1454765
## Run 15 stress 0.150155
## Run 16 stress 0.3982651
## Run 17 stress 0.1494688
## Run 18 stress 0.1549358
## Run 19 stress 0.1541662
## Run 20 stress 0.152011
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1451502
## ... Procrustes: rmse 0.03796898  max resid 0.1156515
## Run 2 stress 0.1490869
## Run 3 stress 0.1427216
## ... New best solution
## ... Procrustes: rmse 0.05796771  max resid 0.2542726
## Run 4 stress 0.1494019
## Run 5 stress 0.1499454
## Run 6 stress 0.1419477
## ... New best solution
## ... Procrustes: rmse 0.01754372  max resid 0.09203411
## Run 7 stress 0.148087
## Run 8 stress 0.153522
## Run 9 stress 0.1446041
## Run 10 stress 0.1473231
## Run 11 stress 0.1426497
## Run 12 stress 0.1445102
## Run 13 stress 0.1432214
## Run 14 stress 0.1449115
## Run 15 stress 0.1493593
## Run 16 stress 0.1457936
## Run 17 stress 0.1444509
## Run 18 stress 0.1519055
## Run 19 stress 0.1492181
## Run 20 stress 0.1499146
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1466016
## Run 2 stress 0.1510811
```

```
## Run 3 stress 0.1551386
## Run 4 stress 0.1502674
## Run 5 stress 0.1493189
## Run 6 stress 0.1445435
## ... New best solution
## ... Procrustes: rmse 0.01623736  max resid 0.07374207
## Run 7 stress 0.1419477
## ... New best solution
## ... Procrustes: rmse 0.05569899  max resid 0.2458759
## Run 8 stress 0.1437515
## Run 9 stress 0.1438211
## Run 10 stress 0.1427455
## Run 11 stress 0.1531907
## Run 12 stress 0.1497575
## Run 13 stress 0.1501347
## Run 14 stress 0.1491594
## Run 15 stress 0.153032
## Run 16 stress 0.1449116
## Run 17 stress 0.1469306
## Run 18 stress 0.1420319
## ... Procrustes: rmse 0.00832786  max resid 0.05284699
## Run 19 stress 0.1497526
## Run 20 stress 0.1491906
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1494798
## Run 2 stress 0.1502992
## Run 3 stress 0.1539373
## Run 4 stress 0.1443017
## ... New best solution
## ... Procrustes: rmse 0.01930126  max resid 0.07670442
## Run 5 stress 0.1422647
## ... New best solution
## ... Procrustes: rmse 0.05039003  max resid 0.2349775
## Run 6 stress 0.1522561
## Run 7 stress 0.1525955
## Run 8 stress 0.1579707
## Run 9 stress 0.1537157
## Run 10 stress 0.1419228
## ... New best solution
## ... Procrustes: rmse 0.0126192  max resid 0.08061286
## Run 11 stress 0.1528509
## Run 12 stress 0.1469105
## Run 13 stress 0.1450631
## Run 14 stress 0.142444
## Run 15 stress 0.1422545
## ... Procrustes: rmse 0.01086719  max resid 0.06951359
## Run 16 stress 0.1438629
## Run 17 stress 0.1528244
## Run 18 stress 0.1507189
## Run 19 stress 0.1498789
## Run 20 stress 0.1448493
```

```
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1465376
## Run 2 stress 0.1469105
## Run 3 stress 0.1533019
## Run 4 stress 0.1423443
## ... New best solution
## ... Procrustes: rmse 0.05716861  max resid 0.2557047
## Run 5 stress 0.1501932
## Run 6 stress 0.1525825
## Run 7 stress 0.1434963
## Run 8 stress 0.1469101
## Run 9 stress 0.1561667
## Run 10 stress 0.1493937
## Run 11 stress 0.1451989
## Run 12 stress 0.1494022
## Run 13 stress 0.1524419
## Run 14 stress 0.1445105
## Run 15 stress 0.1493624
## Run 16 stress 0.1498295
## Run 17 stress 0.1534738
## Run 18 stress 0.1469638
## Run 19 stress 0.1419825
## ... New best solution
## ... Procrustes: rmse 0.01854127  max resid 0.07472936
## Run 20 stress 0.1507551
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1486063
## Run 2 stress 0.142444
## ... New best solution
## ... Procrustes: rmse 0.05337727  max resid 0.2566991
## Run 3 stress 0.1495837
## Run 4 stress 0.1448489
## Run 5 stress 0.1419768
## ... New best solution
## ... Procrustes: rmse 0.01719269  max resid 0.08496282
## Run 6 stress 0.1443483
## Run 7 stress 0.1535638
## Run 8 stress 0.1507815
## Run 9 stress 0.1458897
## Run 10 stress 0.1487745
## Run 11 stress 0.1466017
## Run 12 stress 0.1512882
## Run 13 stress 0.152721
## Run 14 stress 0.1513226
## Run 15 stress 0.151128
## Run 16 stress 0.1494019
## Run 17 stress 0.1475529
## Run 18 stress 0.1419826
```

```
## ... Procrustes: rmse 0.008938355  max resid 0.05333827
## Run 19 stress 0.1420314
## ... Procrustes: rmse 0.008705418  max resid 0.05231663
## Run 20 stress 0.150719
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1525518
## Run 2 stress 0.1469305
## Run 3 stress 0.1419825
## ... New best solution
## ... Procrustes: rmse 0.05431317  max resid 0.2596741
## Run 4 stress 0.1486079
## Run 5 stress 0.1526341
## Run 6 stress 0.1532359
## Run 7 stress 0.1559328
## Run 8 stress 0.1529504
## Run 9 stress 0.1543445
## Run 10 stress 0.1444187
## Run 11 stress 0.1445992
## Run 12 stress 0.1457158
## Run 13 stress 0.1511543
## Run 14 stress 0.1468381
## Run 15 stress 0.1540955
## Run 16 stress 0.1497463
## Run 17 stress 0.1436881
## Run 18 stress 0.1466015
## Run 19 stress 0.1473293
## Run 20 stress 0.1528888
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1419222
## ... New best solution
## ... Procrustes: rmse 0.05539011  max resid 0.2572223
## Run 2 stress 0.1495381
## Run 3 stress 0.1446876
## Run 4 stress 0.1494694
## Run 5 stress 0.1423056
## ... Procrustes: rmse 0.01409724  max resid 0.0635618
## Run 6 stress 0.1432537
## Run 7 stress 0.1447103
## Run 8 stress 0.1501527
## Run 9 stress 0.1500608
## Run 10 stress 0.1489261
## Run 11 stress 0.1444516
## Run 12 stress 0.1460132
## Run 13 stress 0.1527743
## Run 14 stress 0.1424438
## Run 15 stress 0.1446184
## Run 16 stress 0.1473294
## Run 17 stress 0.1451127
## Run 18 stress 0.145643
```

```
## Run 19 stress 0.1500998
## Run 20 stress 0.153134
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      6: no. of iterations >= maxit
##     13: stress ratio > sratmax
##      1: scale factor of the gradient < sfgrmin
## Run 0 stress 0.144726
## Run 1 stress 0.1424439
## ... New best solution
## ... Procrustes: rmse 0.05344185  max resid 0.256783
## Run 2 stress 0.1484122
## Run 3 stress 0.1504003
## Run 4 stress 0.1508079
## Run 5 stress 0.1473794
## Run 6 stress 0.14282
## ... Procrustes: rmse 0.03012728  max resid 0.09476589
## Run 7 stress 0.1568859
## Run 8 stress 0.1521954
## Run 9 stress 0.1524552
## Run 10 stress 0.1535576
## Run 11 stress 0.1530955
## Run 12 stress 0.1444502
## Run 13 stress 0.1466013
## Run 14 stress 0.1499667
## Run 15 stress 0.1469304
## Run 16 stress 0.1468668
## Run 17 stress 0.1432527
## Run 18 stress 0.1426495
## ... Procrustes: rmse 0.01881551  max resid 0.07840227
## Run 19 stress 0.1438668
## Run 20 stress 0.1494021
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1500573
## Run 2 stress 0.1419225
## ... New best solution
## ... Procrustes: rmse 0.05522637  max resid 0.2563786
## Run 3 stress 0.1509029
## Run 4 stress 0.1497531
## Run 5 stress 0.1437939
## Run 6 stress 0.4020887
## Run 7 stress 0.1492566
## Run 8 stress 0.151102
## Run 9 stress 0.1508991
## Run 10 stress 0.1443682
## Run 11 stress 0.1445428
## Run 12 stress 0.1427225
## Run 13 stress 0.1525516
## Run 14 stress 0.1511543
## Run 15 stress 0.151209
## Run 16 stress 0.1433815
## Run 17 stress 0.144599
```

```
## Run 18 stress 0.1488223
## Run 19 stress 0.1512088
## Run 20 stress 0.1575124
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: no. of iterations >= maxit
##     16: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.143253
## ... New best solution
## ... Procrustes: rmse 0.0630979  max resid 0.2553688
## Run 2 stress 0.1540086
## Run 3 stress 0.1528893
## Run 4 stress 0.1423065
## ... New best solution
## ... Procrustes: rmse 0.0334915  max resid 0.1010075
## Run 5 stress 0.1439978
## Run 6 stress 0.1522574
## Run 7 stress 0.1491258
## Run 8 stress 0.1520866
## Run 9 stress 0.1533283
## Run 10 stress 0.1422645
## ... New best solution
## ... Procrustes: rmse 0.01026841  max resid 0.05596202
## Run 11 stress 0.1455222
## Run 12 stress 0.1447096
## Run 13 stress 0.1432929
## Run 14 stress 0.143969
## Run 15 stress 0.1442882
## Run 16 stress 0.1426997
## ... Procrustes: rmse 0.02606457  max resid 0.08858153
## Run 17 stress 0.1445648
## Run 18 stress 0.1434297
## Run 19 stress 0.151966
## Run 20 stress 0.1509038
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      6: no. of iterations >= maxit
##     14: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1451769
## ... Procrustes: rmse 0.02382223  max resid 0.1031971
## Run 2 stress 0.149469
## Run 3 stress 0.1427218
## ... New best solution
## ... Procrustes: rmse 0.05799173  max resid 0.2544346
## Run 4 stress 0.1446303
## Run 5 stress 0.1456632
## Run 6 stress 0.1508831
## Run 7 stress 0.1529855
## Run 8 stress 0.144912
## Run 9 stress 0.1514253
## Run 10 stress 0.1431523
## ... Procrustes: rmse 0.01504159  max resid 0.09483529
## Run 11 stress 0.1490146
## Run 12 stress 0.1432213
```

```
## ... Procrustes: rmse 0.03015563  max resid 0.07866942
## Run 13 stress 0.1442751
## Run 14 stress 0.1532326
## Run 15 stress 0.1446912
## Run 16 stress 0.144457
## Run 17 stress 0.1528949
## Run 18 stress 0.1507455
## Run 19 stress 0.1466011
## Run 20 stress 0.1466023
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      5: no. of iterations >= maxit
##     15: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1493601
## Run 2 stress 0.153032
## Run 3 stress 0.1449847
## ... Procrustes: rmse 0.02362928  max resid 0.103521
## Run 4 stress 0.1427147
## ... New best solution
## ... Procrustes: rmse 0.06018832  max resid 0.260326
## Run 5 stress 0.1533534
## Run 6 stress 0.1539642
## Run 7 stress 0.1530374
## Run 8 stress 0.1469417
## Run 9 stress 0.1511982
## Run 10 stress 0.1433212
## Run 11 stress 0.143928
## Run 12 stress 0.1487855
## Run 13 stress 0.1456535
## Run 14 stress 0.1469299
## Run 15 stress 0.1442735
## Run 16 stress 0.1498292
## Run 17 stress 0.1422646
## ... New best solution
## ... Procrustes: rmse 0.02631498  max resid 0.08741137
## Run 18 stress 0.1479748
## Run 19 stress 0.1475089
## Run 20 stress 0.1512089
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1438362
## ... New best solution
## ... Procrustes: rmse 0.06092634  max resid 0.2525317
## Run 2 stress 0.1511543
## Run 3 stress 0.1450395
## Run 4 stress 0.1427146
## ... New best solution
## ... Procrustes: rmse 0.02092725  max resid 0.09341866
## Run 5 stress 0.1426748
## ... New best solution
## ... Procrustes: rmse 0.01822962  max resid 0.08103507
## Run 6 stress 0.1475624
## Run 7 stress 0.1428749
```

```
## ... Procrustes: rmse 0.02534004  max resid 0.08854214
## Run 8 stress 0.1422647
## ... New best solution
## ... Procrustes: rmse 0.01520413  max resid 0.07366554
## Run 9 stress 0.1491952
## Run 10 stress 0.1460889
## Run 11 stress 0.1490066
## Run 12 stress 0.152297
## Run 13 stress 0.1511546
## Run 14 stress 0.1475371
## Run 15 stress 0.1513124
## Run 16 stress 0.1508431
## Run 17 stress 0.1491652
## Run 18 stress 0.1526371
## Run 19 stress 0.1498005
## Run 20 stress 0.1501768
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1439791
## ... New best solution
## ... Procrustes: rmse 0.05774483  max resid 0.2454188
## Run 2 stress 0.1424172
## ... New best solution
## ... Procrustes: rmse 0.02533873  max resid 0.09420086
## Run 3 stress 0.152765
## Run 4 stress 0.1469301
## Run 5 stress 0.1519793
## Run 6 stress 0.1512916
## Run 7 stress 0.1497526
## Run 8 stress 0.144556
## Run 9 stress 0.1495818
## Run 10 stress 0.1540933
## Run 11 stress 0.1453772
## Run 12 stress 0.1472597
## Run 13 stress 0.1448586
## Run 14 stress 0.1493593
## Run 15 stress 0.1432265
## Run 16 stress 0.1496199
## Run 17 stress 0.1475041
## Run 18 stress 0.1450397
## Run 19 stress 0.1428096
## ... Procrustes: rmse 0.01392692  max resid 0.07908777
## Run 20 stress 0.4020656
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1557627
## Run 2 stress 0.1491561
## Run 3 stress 0.1527744
## Run 4 stress 0.1451283
## ... Procrustes: rmse 0.01836676  max resid 0.09724417
```

```
## Run 5 stress 0.1508081
## Run 6 stress 0.1423055
## ... New best solution
## ... Procrustes: rmse 0.05407601  max resid 0.2585814
## Run 7 stress 0.1443719
## Run 8 stress 0.1498838
## Run 9 stress 0.1532814
## Run 10 stress 0.1419827
## ... New best solution
## ... Procrustes: rmse 0.009171103  max resid 0.05544768
## Run 11 stress 0.1466011
## Run 12 stress 0.1541852
## Run 13 stress 0.1423065
## ... Procrustes: rmse 0.009428467  max resid 0.0567781
## Run 14 stress 0.15271
## Run 15 stress 0.1498409
## Run 16 stress 0.1444442
## Run 17 stress 0.150156
## Run 18 stress 0.1434005
## Run 19 stress 0.1419828
## ... Procrustes: rmse 0.0004476099  max resid 0.001464273
## ... Similar to previous best
## Run 20 stress 0.1504371
## *** Best solution repeated 1 times
## Run 0 stress 0.144726
## Run 1 stress 0.1501832
## Run 2 stress 0.1469308
## Run 3 stress 0.1432267
## ... New best solution
## ... Procrustes: rmse 0.06448195  max resid 0.2447982
## Run 4 stress 0.1498408
## Run 5 stress 0.145663
## Run 6 stress 0.1494433
## Run 7 stress 0.1450711
## Run 8 stress 0.1479183
## Run 9 stress 0.1512116
## Run 10 stress 0.1426997
## ... New best solution
## ... Procrustes: rmse 0.02632724  max resid 0.09765303
## Run 11 stress 0.1491586
## Run 12 stress 0.157034
## Run 13 stress 0.1512919
## Run 14 stress 0.1424301
## ... New best solution
## ... Procrustes: rmse 0.01321574  max resid 0.07875864
## Run 15 stress 0.1497525
## Run 16 stress 0.1447003
## Run 17 stress 0.1445998
## Run 18 stress 0.1531879
## Run 19 stress 0.1528625
## Run 20 stress 0.1423131
## ... New best solution
## ... Procrustes: rmse 0.004781492  max resid 0.02161235
## *** Best solution was not repeated -- monoMDS stopping criteria:
```

```
##     20: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1527536
## Run 2 stress 0.1495246
## Run 3 stress 0.1468575
## Run 4 stress 0.1479037
## Run 5 stress 0.1512798
## Run 6 stress 0.1529496
## Run 7 stress 0.1455495
## Run 8 stress 0.1484428
## Run 9 stress 0.147601
## Run 10 stress 0.1543107
## Run 11 stress 0.1452009
## ... Procrustes: rmse 0.04026954  max resid 0.117426
## Run 12 stress 0.1424444
## ... New best solution
## ... Procrustes: rmse 0.05325101  max resid 0.2558455
## Run 13 stress 0.1490941
## Run 14 stress 0.4020893
## Run 15 stress 0.1501529
## Run 16 stress 0.1547614
## Run 17 stress 0.1445955
## Run 18 stress 0.1535611
## Run 19 stress 0.1495839
## Run 20 stress 0.1528958
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1424438
## ... New best solution
## ... Procrustes: rmse 0.05335312  max resid 0.2564422
## Run 2 stress 0.1426748
## ... Procrustes: rmse 0.01894751  max resid 0.07846294
## Run 3 stress 0.1439535
## Run 4 stress 0.1521005
## Run 5 stress 0.1473397
## Run 6 stress 0.1519799
## Run 7 stress 0.1475539
## Run 8 stress 0.1496963
## Run 9 stress 0.1479879
## Run 10 stress 0.1497477
## Run 11 stress 0.1433027
## Run 12 stress 0.1422035
## ... New best solution
## ... Procrustes: rmse 0.009874631  max resid 0.06230313
## Run 13 stress 0.1451116
## Run 14 stress 0.1494018
## Run 15 stress 0.1498238
## Run 16 stress 0.1524243
## Run 17 stress 0.1521284
## Run 18 stress 0.1427416
## Run 19 stress 0.1422645
## ... Procrustes: rmse 0.00308064  max resid 0.01889308
```

```
## Run 20 stress 0.1458045
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1469077
## Run 2 stress 0.1428754
## ... New best solution
## ... Procrustes: rmse 0.05470899  max resid 0.2505855
## Run 3 stress 0.1423441
## ... New best solution
## ... Procrustes: rmse 0.02986224  max resid 0.09658195
## Run 4 stress 0.151607
## Run 5 stress 0.1490619
## Run 6 stress 0.1433211
## Run 7 stress 0.1547138
## Run 8 stress 0.1451199
## Run 9 stress 0.1446951
## Run 10 stress 0.1507074
## Run 11 stress 0.1438357
## Run 12 stress 0.1493342
## Run 13 stress 0.1505462
## Run 14 stress 0.1427411
## ... Procrustes: rmse 0.0116084  max resid 0.07475366
## Run 15 stress 0.1431803
## Run 16 stress 0.1426492
## ... Procrustes: rmse 0.01240708  max resid 0.07561371
## Run 17 stress 0.1420508
## ... New best solution
## ... Procrustes: rmse 0.01739684  max resid 0.07258914
## Run 18 stress 0.1507188
## Run 19 stress 0.1424439
## ... Procrustes: rmse 0.01219381  max resid 0.06388836
## Run 20 stress 0.1522435
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: no. of iterations >= maxit
##     16: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1528444
## Run 2 stress 0.1419825
## ... New best solution
## ... Procrustes: rmse 0.05437051  max resid 0.2599688
## Run 3 stress 0.1546792
## Run 4 stress 0.1475511
## Run 5 stress 0.1446964
## Run 6 stress 0.1501926
## Run 7 stress 0.1541013
## Run 8 stress 0.149882
## Run 9 stress 0.1544818
## Run 10 stress 0.1508396
## Run 11 stress 0.1481828
## Run 12 stress 0.1447686
## Run 13 stress 0.144849
## Run 14 stress 0.1530973
```

```
## Run 15 stress 0.1484499
## Run 16 stress 0.1497633
## Run 17 stress 0.1497525
## Run 18 stress 0.1441439
## Run 19 stress 0.1465739
## Run 20 stress 0.1451379
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.143213
## ... New best solution
## ... Procrustes: rmse 0.06134356  max resid 0.2584255
## Run 2 stress 0.152487
## Run 3 stress 0.1468578
## Run 4 stress 0.1475623
## Run 5 stress 0.149582
## Run 6 stress 0.1419826
## ... New best solution
## ... Procrustes: rmse 0.0273741  max resid 0.09504633
## Run 7 stress 0.1494019
## Run 8 stress 0.1507182
## Run 9 stress 0.1419477
## ... New best solution
## ... Procrustes: rmse 0.009050614  max resid 0.05287978
## Run 10 stress 0.1419223
## ... New best solution
## ... Procrustes: rmse 0.002905922  max resid 0.01788007
## Run 11 stress 0.1494692
## Run 12 stress 0.1525957
## Run 13 stress 0.1488394
## Run 14 stress 0.1494573
## Run 15 stress 0.1426956
## Run 16 stress 0.1457072
## Run 17 stress 0.1512765
## Run 18 stress 0.1451113
## Run 19 stress 0.144696
## Run 20 stress 0.1524938
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1498307
## Run 2 stress 0.1432543
## ... New best solution
## ... Procrustes: rmse 0.0630669  max resid 0.2552517
## Run 3 stress 0.1507686
## Run 4 stress 0.1511114
## Run 5 stress 0.1547231
## Run 6 stress 0.1450395
## Run 7 stress 0.1432525
## ... New best solution
## ... Procrustes: rmse 0.0008542762  max resid 0.003257899
## ... Similar to previous best
```

```
## Run 8 stress 0.402089
## Run 9 stress 0.1472105
## Run 10 stress 0.1517196
## Run 11 stress 0.1513015
## Run 12 stress 0.1498294
## Run 13 stress 0.143356
## ... Procrustes: rmse 0.02554393  max resid 0.08388539
## Run 14 stress 0.1441353
## Run 15 stress 0.1427217
## ... New best solution
## ... Procrustes: rmse 0.02473117  max resid 0.09526335
## Run 16 stress 0.1507081
## Run 17 stress 0.145519
## Run 18 stress 0.1445099
## Run 19 stress 0.1494649
## Run 20 stress 0.1440555
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1476041
## Run 2 stress 0.1436664
## ... New best solution
## ... Procrustes: rmse 0.06099333  max resid 0.2444402
## Run 3 stress 0.1501528
## Run 4 stress 0.1478306
## Run 5 stress 0.1528913
## Run 6 stress 0.1438564
## ... Procrustes: rmse 0.01921344  max resid 0.09556732
## Run 7 stress 0.1427413
## ... New best solution
## ... Procrustes: rmse 0.02932355  max resid 0.09487012
## Run 8 stress 0.1536055
## Run 9 stress 0.1544965
## Run 10 stress 0.1526277
## Run 11 stress 0.141948
## ... New best solution
## ... Procrustes: rmse 0.01912488  max resid 0.07270569
## Run 12 stress 0.1422645
## ... Procrustes: rmse 0.01240193  max resid 0.08032355
## Run 13 stress 0.1495102
## Run 14 stress 0.1456939
## Run 15 stress 0.148191
## Run 16 stress 0.1422031
## ... Procrustes: rmse 0.01296339  max resid 0.08061299
## Run 17 stress 0.1444642
## Run 18 stress 0.1458024
## Run 19 stress 0.1428096
## Run 20 stress 0.1419223
## ... New best solution
## ... Procrustes: rmse 0.002907502  max resid 0.01788108
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
```

```
## Run 0 stress 0.144726
## Run 1 stress 0.1419225
## ... New best solution
## ... Procrustes: rmse 0.05523258  max resid 0.256413
## Run 2 stress 0.1498006
## Run 3 stress 0.1438629
## Run 4 stress 0.1498906
## Run 5 stress 0.1501839
## Run 6 stress 0.1502664
## Run 7 stress 0.1512826
## Run 8 stress 0.1508834
## Run 9 stress 0.1531225
## Run 10 stress 0.144465
## Run 11 stress 0.149273
## Run 12 stress 0.1477972
## Run 13 stress 0.1427148
## Run 14 stress 0.1525806
## Run 15 stress 0.1446952
## Run 16 stress 0.1446044
## Run 17 stress 0.1443487
## Run 18 stress 0.1446112
## Run 19 stress 0.1542347
## Run 20 stress 0.1507745
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      5: no. of iterations >= maxit
##     15: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1491559
## Run 2 stress 0.1520225
## Run 3 stress 0.1508886
## Run 4 stress 0.1468665
## Run 5 stress 0.1518218
## Run 6 stress 0.1523456
## Run 7 stress 0.1499143
## Run 8 stress 0.1444194
## ... New best solution
## ... Procrustes: rmse 0.007216353  max resid 0.03775055
## Run 9 stress 0.1444194
## ... New best solution
## ... Procrustes: rmse 6.948981e-05  max resid 0.000336754
## ... Similar to previous best
## Run 10 stress 0.14459
## ... Procrustes: rmse 0.01070557  max resid 0.06424464
## Run 11 stress 0.1507334
## Run 12 stress 0.1450601
## Run 13 stress 0.1468386
## Run 14 stress 0.1427217
## ... New best solution
## ... Procrustes: rmse 0.05754587  max resid 0.2500373
## Run 15 stress 0.1426997
## ... New best solution
## ... Procrustes: rmse 0.02797882  max resid 0.0866969
## Run 16 stress 0.1539665
## Run 17 stress 0.1537655
```

```
## Run 18 stress 0.1473297
## Run 19 stress 0.1520126
## Run 20 stress 0.1501527
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.14565
## Run 2 stress 0.150152
## Run 3 stress 0.1474934
## Run 4 stress 0.149584
## Run 5 stress 0.1520126
## Run 6 stress 0.1454456
## Run 7 stress 0.14943
## Run 8 stress 0.1428095
## ... New best solution
## ... Procrustes: rmse 0.05983047  max resid 0.2611199
## Run 9 stress 0.1445656
## Run 10 stress 0.1486244
## Run 11 stress 0.1528308
## Run 12 stress 0.1447114
## Run 13 stress 0.1436731
## Run 14 stress 0.1540295
## Run 15 stress 0.1509205
## Run 16 stress 0.1507335
## Run 17 stress 0.1514778
## Run 18 stress 0.1536785
## Run 19 stress 0.1462892
## Run 20 stress 0.1469299
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1476388
## Run 2 stress 0.141977
## ... New best solution
## ... Procrustes: rmse 0.05541465  max resid 0.2574871
## Run 3 stress 0.150153
## Run 4 stress 0.1474332
## Run 5 stress 0.1512609
## Run 6 stress 0.1482565
## Run 7 stress 0.1523691
## Run 8 stress 0.1450713
## Run 9 stress 0.1427147
## Run 10 stress 0.1494465
## Run 11 stress 0.1533413
## Run 12 stress 0.1476005
## Run 13 stress 0.1457002
## Run 14 stress 0.1446007
## Run 15 stress 0.1424444
## ... Procrustes: rmse 0.01749693  max resid 0.08467991
## Run 16 stress 0.1539086
## Run 17 stress 0.1512314
## Run 18 stress 0.1424812
## Run 19 stress 0.1453242
```

```
## Run 20 stress 0.1451659
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      6: no. of iterations >= maxit
##     14: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1509531
## Run 2 stress 0.1519469
## Run 3 stress 0.1419478
## ... New best solution
## ... Procrustes: rmse 0.05540017  max resid 0.2574806
## Run 4 stress 0.1422543
## ... Procrustes: rmse 0.01158874  max resid 0.07116533
## Run 5 stress 0.1423441
## ... Procrustes: rmse 0.01581045  max resid 0.07140489
## Run 6 stress 0.1482739
## Run 7 stress 0.1441456
## Run 8 stress 0.1475661
## Run 9 stress 0.1461415
## Run 10 stress 0.4005059
## Run 11 stress 0.150636
## Run 12 stress 0.1521327
## Run 13 stress 0.1446962
## Run 14 stress 0.1526334
## Run 15 stress 0.1493937
## Run 16 stress 0.1506184
## Run 17 stress 0.1510759
## Run 18 stress 0.1466008
## Run 19 stress 0.1469637
## Run 20 stress 0.1520394
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1498371
## Run 2 stress 0.1454069
## Run 3 stress 0.1509929
## Run 4 stress 0.1501542
## Run 5 stress 0.1527935
## Run 6 stress 0.1427148
## ... New best solution
## ... Procrustes: rmse 0.06002992  max resid 0.259466
## Run 7 stress 0.1419767
## ... New best solution
## ... Procrustes: rmse 0.0216252  max resid 0.0856116
## Run 8 stress 0.1444192
## Run 9 stress 0.1472101
## Run 10 stress 0.1497819
## Run 11 stress 0.1440943
## Run 12 stress 0.1521433
## Run 13 stress 0.1497827
## Run 14 stress 0.1525525
## Run 15 stress 0.1454025
## Run 16 stress 0.1453886
## Run 17 stress 0.1497485
```

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## Run 18 stress 0.1445996
## Run 19 stress 0.1473291
## Run 20 stress 0.1445561
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1539084
## Run 2 stress 0.1431721
## ... New best solution
## ... Procrustes: rmse 0.06367017  max resid 0.2458741
## Run 3 stress 0.1499288
## Run 4 stress 0.1426998
## ... New best solution
## ... Procrustes: rmse 0.02553066  max resid 0.09797813
## Run 5 stress 0.1435568
## Run 6 stress 0.1498911
## Run 7 stress 0.1508157
## Run 8 stress 0.1524001
## Run 9 stress 0.1510403
## Run 10 stress 0.152114
## Run 11 stress 0.1444507
## Run 12 stress 0.1452016
## Run 13 stress 0.1419479
## ... New best solution
## ... Procrustes: rmse 0.02208138  max resid 0.08594137
## Run 14 stress 0.1437267
## Run 15 stress 0.1501682
## Run 16 stress 0.1510602
## Run 17 stress 0.1422548
## ... Procrustes: rmse 0.01205858  max resid 0.07389207
## Run 18 stress 0.1516382
## Run 19 stress 0.1531518
## Run 20 stress 0.1446121
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1548637
## Run 2 stress 0.1493588
## Run 3 stress 0.142444
## ... New best solution
## ... Procrustes: rmse 0.05341552  max resid 0.2568712
## Run 4 stress 0.152875
## Run 5 stress 0.1495841
## Run 6 stress 0.1447453
## Run 7 stress 0.1512919
## Run 8 stress 0.1500842
## Run 9 stress 0.1460752
## Run 10 stress 0.1426745
## ... Procrustes: rmse 0.01877909  max resid 0.07837544
## Run 11 stress 0.1427148
## ... Procrustes: rmse 0.02913296  max resid 0.09247538
## Run 12 stress 0.1502994
```

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## Run 13 stress 0.1493709
## Run 14 stress 0.1423443
## ... New best solution
## ... Procrustes: rmse 0.02409256  max resid 0.08707719
## Run 15 stress 0.1423443
## ... Procrustes: rmse 4.997009e-05  max resid 0.0001680163
## ... Similar to previous best
## Run 16 stress 0.1456937
## Run 17 stress 0.1524411
## Run 18 stress 0.1525464
## Run 19 stress 0.1501681
## Run 20 stress 0.147225
## *** Best solution repeated 1 times
## Run 0 stress 0.144726
## Run 1 stress 0.1461263
## Run 2 stress 0.1450396
## ... Procrustes: rmse 0.01890229  max resid 0.09654396
## Run 3 stress 0.146601
## Run 4 stress 0.1527662
## Run 5 stress 0.1444498
## ... New best solution
## ... Procrustes: rmse 0.01523184  max resid 0.0578424
## Run 6 stress 0.1498298
## Run 7 stress 0.1529242
## Run 8 stress 0.1490091
## Run 9 stress 0.1451667
## Run 10 stress 0.1527379
## Run 11 stress 0.1428315
## ... New best solution
## ... Procrustes: rmse 0.05435325  max resid 0.2300873
## Run 12 stress 0.145241
## Run 13 stress 0.1526554
## Run 14 stress 0.1516148
## Run 15 stress 0.1499666
## Run 16 stress 0.1446942
## Run 17 stress 0.1428318
## ... Procrustes: rmse 0.0003234702  max resid 0.001153804
## ... Similar to previous best
## Run 18 stress 0.152325
## Run 19 stress 0.1480878
## Run 20 stress 0.1469306
## *** Best solution repeated 1 times
## Run 0 stress 0.144726
## Run 1 stress 0.1491641
## Run 2 stress 0.1423441
## ... New best solution
## ... Procrustes: rmse 0.05727235  max resid 0.2562477
## Run 3 stress 0.1419478
## ... New best solution
## ... Procrustes: rmse 0.01573886  max resid 0.07121765
## Run 4 stress 0.1456897
## Run 5 stress 0.1446001
## Run 6 stress 0.1498838
## Run 7 stress 0.1507716
```

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## Run 8 stress 0.1476543
## Run 9 stress 0.1512799
## Run 10 stress 0.145166
## Run 11 stress 0.1446001
## Run 12 stress 0.1501919
## Run 13 stress 0.149362
## Run 14 stress 0.1527248
## Run 15 stress 0.1538922
## Run 16 stress 0.1446176
## Run 17 stress 0.152332
## Run 18 stress 0.1508459
## Run 19 stress 0.1526688
## Run 20 stress 0.1457773
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      5: no. of iterations >= maxit
##     15: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1495407
## Run 2 stress 0.1460702
## Run 3 stress 0.146602
## Run 4 stress 0.149945
## Run 5 stress 0.1449117
## ... Procrustes: rmse 0.06693372  max resid 0.2455691
## Run 6 stress 0.1424439
## ... New best solution
## ... Procrustes: rmse 0.053302  max resid 0.2561618
## Run 7 stress 0.1526174
## Run 8 stress 0.1506817
## Run 9 stress 0.1419477
## ... New best solution
## ... Procrustes: rmse 0.0176647  max resid 0.08566794
## Run 10 stress 0.1466014
## Run 11 stress 0.1508997
## Run 12 stress 0.145886
## Run 13 stress 0.1445097
## Run 14 stress 0.1428751
## Run 15 stress 0.1451665
## Run 16 stress 0.1500382
## Run 17 stress 0.1445643
## Run 18 stress 0.1534086
## Run 19 stress 0.1512798
## Run 20 stress 0.1518625
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1422645
## ... New best solution
## ... Procrustes: rmse 0.05335403  max resid 0.2582102
## Run 2 stress 0.150754
## Run 3 stress 0.1427147
## ... Procrustes: rmse 0.02630758  max resid 0.08849942
## Run 4 stress 0.1498628
## Run 5 stress 0.1487746
```

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## Run 6 stress 0.1511906
## Run 7 stress 0.1487741
## Run 8 stress 0.1424442
## ... Procrustes: rmse 0.01025475  max resid 0.06067048
## Run 9 stress 0.1473295
## Run 10 stress 0.1444508
## Run 11 stress 0.1454982
## Run 12 stress 0.1508829
## Run 13 stress 0.1424443
## ... Procrustes: rmse 0.01068627  max resid 0.06361288
## Run 14 stress 0.1424446
## ... Procrustes: rmse 0.01070081  max resid 0.06374848
## Run 15 stress 0.1496885
## Run 16 stress 0.1446996
## Run 17 stress 0.1469102
## Run 18 stress 0.1514509
## Run 19 stress 0.1501529
## Run 20 stress 0.1422548
## ... New best solution
## ... Procrustes: rmse 0.01677755  max resid 0.08512841
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1507603
## Run 2 stress 0.1494632
## Run 3 stress 0.1466014
## Run 4 stress 0.1501675
## Run 5 stress 0.1541645
## Run 6 stress 0.1431712
## ... New best solution
## ... Procrustes: rmse 0.06362575  max resid 0.2457293
## Run 7 stress 0.1523276
## Run 8 stress 0.1521013
## Run 9 stress 0.144419
## Run 10 stress 0.1494735
## Run 11 stress 0.1510597
## Run 12 stress 0.1543242
## Run 13 stress 0.1497528
## Run 14 stress 0.1419825
## ... New best solution
## ... Procrustes: rmse 0.03711736  max resid 0.1046833
## Run 15 stress 0.1433238
## Run 16 stress 0.1496224
## Run 17 stress 0.1452089
## Run 18 stress 0.1526099
## Run 19 stress 0.1431801
## Run 20 stress 0.1475591
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1443801
## ... New best solution
```

```
## ... Procrustes: rmse 0.01684201  max resid 0.05468631
## Run 2 stress 0.1527025
## Run 3 stress 0.153058
## Run 4 stress 0.1492938
## Run 5 stress 0.151043
## Run 6 stress 0.1426748
## ... New best solution
## ... Procrustes: rmse 0.04806212  max resid 0.2359563
## Run 7 stress 0.1442407
## Run 8 stress 0.1502292
## Run 9 stress 0.1446979
## Run 10 stress 0.1481795
## Run 11 stress 0.142695
## ... Procrustes: rmse 0.005718214  max resid 0.0291886
## Run 12 stress 0.14205
## ... New best solution
## ... Procrustes: rmse 0.01482826  max resid 0.07202383
## Run 13 stress 0.1466018
## Run 14 stress 0.1504786
## Run 15 stress 0.1469102
## Run 16 stress 0.1444504
## Run 17 stress 0.15261
## Run 18 stress 0.1494693
## Run 19 stress 0.1516147
## Run 20 stress 0.1512613
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1490929
## Run 2 stress 0.1448491
## ... Procrustes: rmse 0.06681647  max resid 0.2449572
## Run 3 stress 0.1448491
## ... Procrustes: rmse 0.0667919  max resid 0.2448153
## Run 4 stress 0.1527196
## Run 5 stress 0.1439331
## ... New best solution
## ... Procrustes: rmse 0.05216739  max resid 0.239141
## Run 6 stress 0.1438172
## ... New best solution
## ... Procrustes: rmse 0.009653677  max resid 0.04883104
## Run 7 stress 0.144658
## Run 8 stress 0.1555918
## Run 9 stress 0.1494691
## Run 10 stress 0.1511021
## Run 11 stress 0.1427226
## ... New best solution
## ... Procrustes: rmse 0.01869974  max resid 0.08780688
## Run 12 stress 0.1424441
## ... New best solution
## ... Procrustes: rmse 0.01928822  max resid 0.07844343
## Run 13 stress 0.1445356
## Run 14 stress 0.1524011
## Run 15 stress 0.1506105
```

```
## Run 16 stress 0.1528017
## Run 17 stress 0.1451378
## Run 18 stress 0.1447016
## Run 19 stress 0.145462
## Run 20 stress 0.152937
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1455041
## Run 2 stress 0.1536686
## Run 3 stress 0.152763
## Run 4 stress 0.1448405
## ... Procrustes: rmse 0.002526438  max resid 0.01455439
## Run 5 stress 0.1497619
## Run 6 stress 0.1500861
## Run 7 stress 0.4020859
## Run 8 stress 0.1428095
## ... New best solution
## ... Procrustes: rmse 0.05982456  max resid 0.2610917
## Run 9 stress 0.1526361
## Run 10 stress 0.1450606
## Run 11 stress 0.1524123
## Run 12 stress 0.1455219
## Run 13 stress 0.1445432
## Run 14 stress 0.1450973
## Run 15 stress 0.1510106
## Run 16 stress 0.1445626
## Run 17 stress 0.1419226
## ... New best solution
## ... Procrustes: rmse 0.02163653  max resid 0.08660331
## Run 18 stress 0.1445995
## Run 19 stress 0.1509027
## Run 20 stress 0.1427218
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: no. of iterations >= maxit
##     16: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.150268
## Run 2 stress 0.1528283
## Run 3 stress 0.1534351
## Run 4 stress 0.1451665
## ... Procrustes: rmse 0.05870804  max resid 0.2513269
## Run 5 stress 0.1444641
## ... New best solution
## ... Procrustes: rmse 0.01498146  max resid 0.05486491
## Run 6 stress 0.1437685
## ... New best solution
## ... Procrustes: rmse 0.05450037  max resid 0.2253828
## Run 7 stress 0.1511743
## Run 8 stress 0.1475038
## Run 9 stress 0.1500373
## Run 10 stress 0.1431714
## ... New best solution
```

```
## ... Procrustes: rmse 0.01480235  max resid 0.09318079
## Run 11 stress 0.1508467
## Run 12 stress 0.1488758
## Run 13 stress 0.1512912
## Run 14 stress 0.150718
## Run 15 stress 0.1533219
## Run 16 stress 0.1490876
## Run 17 stress 0.1473292
## Run 18 stress 0.1436733
## Run 19 stress 0.1512376
## Run 20 stress 0.1507819
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1446225
## ... New best solution
## ... Procrustes: rmse 0.003268547  max resid 0.01760426
## Run 2 stress 0.1492865
## Run 3 stress 0.1509351
## Run 4 stress 0.1422036
## ... New best solution
## ... Procrustes: rmse 0.05310795  max resid 0.2570715
## Run 5 stress 0.1541091
## Run 6 stress 0.1454609
## Run 7 stress 0.1514503
## Run 8 stress 0.147373
## Run 9 stress 0.1490539
## Run 10 stress 0.1494018
## Run 11 stress 0.1451811
## Run 12 stress 0.151935
## Run 13 stress 0.1497427
## Run 14 stress 0.1520123
## Run 15 stress 0.1504253
## Run 16 stress 0.1444184
## Run 17 stress 0.1426996
## ... Procrustes: rmse 0.02619267  max resid 0.08906202
## Run 18 stress 0.1475738
## Run 19 stress 0.1556634
## Run 20 stress 0.1476558
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: no. of iterations >= maxit
##     16: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1426493
## ... New best solution
## ... Procrustes: rmse 0.05525519  max resid 0.2590656
## Run 2 stress 0.1494028
## Run 3 stress 0.1424439
## ... New best solution
## ... Procrustes: rmse 0.01876851  max resid 0.07854445
## Run 4 stress 0.1495426
## Run 5 stress 0.1508318
## Run 6 stress 0.1501404
```

```
## Run 7 stress 0.1499449
## Run 8 stress 0.15295
## Run 9 stress 0.1471201
## Run 10 stress 0.145715
## Run 11 stress 0.1520642
## Run 12 stress 0.1508157
## Run 13 stress 0.1468667
## Run 14 stress 0.1468668
## Run 15 stress 0.1428316
## ... Procrustes: rmse 0.0288287  max resid 0.0929125
## Run 16 stress 0.1532535
## Run 17 stress 0.1518693
## Run 18 stress 0.1498292
## Run 19 stress 0.1497527
## Run 20 stress 0.1498835
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1530559
## Run 2 stress 0.1510646
## Run 3 stress 0.1422649
## ... New best solution
## ... Procrustes: rmse 0.05316951  max resid 0.2573684
## Run 4 stress 0.14938
## Run 5 stress 0.1424439
## ... Procrustes: rmse 0.01032703  max resid 0.06097071
## Run 6 stress 0.1490075
## Run 7 stress 0.1445999
## Run 8 stress 0.1514807
## Run 9 stress 0.1494376
## Run 10 stress 0.1507644
## Run 11 stress 0.1488365
## Run 12 stress 0.1531143
## Run 13 stress 0.1495681
## Run 14 stress 0.1502289
## Run 15 stress 0.1445565
## Run 16 stress 0.1511023
## Run 17 stress 0.1494158
## Run 18 stress 0.1469638
## Run 19 stress 0.1503819
## Run 20 stress 0.1538923
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: no. of iterations >= maxit
##     16: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1456999
## Run 2 stress 0.1452683
## Run 3 stress 0.150017
## Run 4 stress 0.1551167
## Run 5 stress 0.1447701
## ... Procrustes: rmse 0.02109776  max resid 0.09965027
## Run 6 stress 0.1450508
## ... Procrustes: rmse 0.005329462  max resid 0.02345299
```

```
## Run 7 stress 0.1499449
## Run 8 stress 0.1426494
## ... New best solution
## ... Procrustes: rmse 0.05490352  max resid 0.2574577
## Run 9 stress 0.1427146
## ... Procrustes: rmse 0.01835955  max resid 0.08160374
## Run 10 stress 0.1445104
## Run 11 stress 0.151779
## Run 12 stress 0.1533355
## Run 13 stress 0.1469096
## Run 14 stress 0.1498953
## Run 15 stress 0.1497383
## Run 16 stress 0.1455252
## Run 17 stress 0.1528747
## Run 18 stress 0.1434962
## Run 19 stress 0.1422037
## ... New best solution
## ... Procrustes: rmse 0.01499131  max resid 0.07410286
## Run 20 stress 0.1523468
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1514778
## Run 2 stress 0.1469643
## Run 3 stress 0.1443707
## ... New best solution
## ... Procrustes: rmse 0.01603398  max resid 0.05543289
## Run 4 stress 0.1458204
## Run 5 stress 0.1514535
## Run 6 stress 0.1442751
## ... New best solution
## ... Procrustes: rmse 0.05208949  max resid 0.218252
## Run 7 stress 0.151301
## Run 8 stress 0.1448489
## Run 9 stress 0.1426956
## ... New best solution
## ... Procrustes: rmse 0.02791999  max resid 0.09435072
## Run 10 stress 0.1465405
## Run 11 stress 0.1494019
## Run 12 stress 0.152494
## Run 13 stress 0.1472894
## Run 14 stress 0.1527415
## Run 15 stress 0.1422032
## ... New best solution
## ... Procrustes: rmse 0.01100414  max resid 0.04637551
## Run 16 stress 0.1451113
## Run 17 stress 0.149915
## Run 18 stress 0.1475519
## Run 19 stress 0.1535857
## Run 20 stress 0.1526947
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
```

```
## Run 0 stress 0.144726
## Run 1 stress 0.1443838
## ... New best solution
## ... Procrustes: rmse 0.02168516  max resid 0.07726839
## Run 2 stress 0.1424439
## ... New best solution
## ... Procrustes: rmse 0.04776496  max resid 0.2186404
## Run 3 stress 0.1496956
## Run 4 stress 0.1538807
## Run 5 stress 0.1467408
## Run 6 stress 0.1495819
## Run 7 stress 0.1450328
## Run 8 stress 0.1460701
## Run 9 stress 0.1456473
## Run 10 stress 0.144544
## Run 11 stress 0.1466016
## Run 12 stress 0.1455814
## Run 13 stress 0.1469306
## Run 14 stress 0.1494135
## Run 15 stress 0.1446006
## Run 16 stress 0.1497529
## Run 17 stress 0.1451378
## Run 18 stress 0.1504175
## Run 19 stress 0.15276
## Run 20 stress 0.153324
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1502983
## Run 2 stress 0.1419477
## ... New best solution
## ... Procrustes: rmse 0.0553494  max resid 0.2571564
## Run 3 stress 0.1490513
## Run 4 stress 0.1446359
## Run 5 stress 0.1445996
## Run 6 stress 0.1522047
## Run 7 stress 0.1468668
## Run 8 stress 0.1446305
## Run 9 stress 0.1423441
## ... Procrustes: rmse 0.01575157  max resid 0.07128603
## Run 10 stress 0.1484859
## Run 11 stress 0.1456629
## Run 12 stress 0.149424
## Run 13 stress 0.1479959
## Run 14 stress 0.1419825
## ... Procrustes: rmse 0.009133033  max resid 0.05320123
## Run 15 stress 0.1469309
## Run 16 stress 0.1445432
## Run 17 stress 0.1503255
## Run 18 stress 0.1448489
## Run 19 stress 0.1423049
## ... Procrustes: rmse 0.01450582  max resid 0.06358356
## Run 20 stress 0.1452
```

```
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.4020912
## Run 2 stress 0.1420321
## ... New best solution
## ... Procrustes: rmse 0.05432925  max resid 0.259965
## Run 3 stress 0.1506178
## Run 4 stress 0.151789
## Run 5 stress 0.1419224
## ... New best solution
## ... Procrustes: rmse 0.008646466  max resid 0.05273821
## Run 6 stress 0.1481982
## Run 7 stress 0.1490915
## Run 8 stress 0.1419223
## ... New best solution
## ... Procrustes: rmse 0.0003368559  max resid 0.001278883
## ... Similar to previous best
## Run 9 stress 0.1486088
## Run 10 stress 0.1539044
## Run 11 stress 0.1526053
## Run 12 stress 0.1478844
## Run 13 stress 0.1445556
## Run 14 stress 0.1422644
## ... Procrustes: rmse 0.01255932  max resid 0.07984081
## Run 15 stress 0.147324
## Run 16 stress 0.1538193
## Run 17 stress 0.1466017
## Run 18 stress 0.1426996
## Run 19 stress 0.1423444
## ... Procrustes: rmse 0.01592665  max resid 0.07236442
## Run 20 stress 0.1469314
## *** Best solution repeated 1 times
## Run 0 stress 0.144726
## Run 1 stress 0.1533204
## Run 2 stress 0.1474931
## Run 3 stress 0.1458177
## Run 4 stress 0.1424171
## ... New best solution
## ... Procrustes: rmse 0.05639002  max resid 0.2596979
## Run 5 stress 0.1497527
## Run 6 stress 0.1514636
## Run 7 stress 0.1578822
## Run 8 stress 0.1458698
## Run 9 stress 0.1495821
## Run 10 stress 0.1473713
## Run 11 stress 0.1444493
## Run 12 stress 0.1446982
## Run 13 stress 0.1445141
## Run 14 stress 0.1463649
## Run 15 stress 0.1472027
## Run 16 stress 0.1496036
## Run 17 stress 0.1494696
```

```
## Run 18 stress 0.1445432
## Run 19 stress 0.1447042
## Run 20 stress 0.1509031
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1454273
## Run 2 stress 0.1433817
## ... New best solution
## ... Procrustes: rmse 0.06172477  max resid 0.2562938
## Run 3 stress 0.1436236
## ... Procrustes: rmse 0.02178098  max resid 0.09228427
## Run 4 stress 0.1511143
## Run 5 stress 0.1419224
## ... New best solution
## ... Procrustes: rmse 0.02762907  max resid 0.0960477
## Run 6 stress 0.1491126
## Run 7 stress 0.1468386
## Run 8 stress 0.1493519
## Run 9 stress 0.1508468
## Run 10 stress 0.1518258
## Run 11 stress 0.151377
## Run 12 stress 0.1447636
## Run 13 stress 0.1504982
## Run 14 stress 0.1469304
## Run 15 stress 0.1431804
## Run 16 stress 0.1501711
## Run 17 stress 0.1454896
## Run 18 stress 0.1528232
## Run 19 stress 0.1495243
## Run 20 stress 0.144599
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1458938
## Run 2 stress 0.1426997
## ... New best solution
## ... Procrustes: rmse 0.06007652  max resid 0.2599145
## Run 3 stress 0.1486843
## Run 4 stress 0.144455
## Run 5 stress 0.1501094
## Run 6 stress 0.1419826
## ... New best solution
## ... Procrustes: rmse 0.02452834  max resid 0.08707543
## Run 7 stress 0.1498825
## Run 8 stress 0.1445562
## Run 9 stress 0.1508929
## Run 10 stress 0.1450974
## Run 11 stress 0.1468667
## Run 12 stress 0.1420516
## ... Procrustes: rmse 0.002338469  max resid 0.01419162
## Run 13 stress 0.1457159
```

```
## Run 14 stress 0.1444187
## Run 15 stress 0.1513069
## Run 16 stress 0.1501527
## Run 17 stress 0.1419826
## ... New best solution
## ... Procrustes: rmse 7.487632e-05  max resid 0.0003001551
## ... Similar to previous best
## Run 18 stress 0.152492
## Run 19 stress 0.1446001
## Run 20 stress 0.1512447
## *** Best solution repeated 1 times
## Run 0 stress 0.144726
## Run 1 stress 0.1502947
## Run 2 stress 0.1428317
## ... New best solution
## ... Procrustes: rmse 0.05966174  max resid 0.2600553
## Run 3 stress 0.1474058
## Run 4 stress 0.1498825
## Run 5 stress 0.1528534
## Run 6 stress 0.148459
## Run 7 stress 0.1445434
## Run 8 stress 0.1469307
## Run 9 stress 0.1442399
## Run 10 stress 0.1528227
## Run 11 stress 0.1423443
## ... New best solution
## ... Procrustes: rmse 0.01245471  max resid 0.07819935
## Run 12 stress 0.1512919
## Run 13 stress 0.3981804
## Run 14 stress 0.1506289
## Run 15 stress 0.1531915
## Run 16 stress 0.1453425
## Run 17 stress 0.1520226
## Run 18 stress 0.1517882
## Run 19 stress 0.1452605
## Run 20 stress 0.1487747
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1504869
## Run 2 stress 0.1466014
## Run 3 stress 0.1494699
## Run 4 stress 0.142392
## ... New best solution
## ... Procrustes: rmse 0.05707454  max resid 0.2568769
## Run 5 stress 0.1497617
## Run 6 stress 0.1490623
## Run 7 stress 0.1422922
## ... New best solution
## ... Procrustes: rmse 0.004097957  max resid 0.01514688
## Run 8 stress 0.1446935
## Run 9 stress 0.1494284
## Run 10 stress 0.1523359
```

```
## Run 11 stress 0.1536636
## Run 12 stress 0.142332
## ... Procrustes: rmse 0.003117451  max resid 0.01503091
## Run 13 stress 0.1419225
## ... New best solution
## ... Procrustes: rmse 0.01487106  max resid 0.07200613
## Run 14 stress 0.1511828
## Run 15 stress 0.1494018
## Run 16 stress 0.1499449
## Run 17 stress 0.1523604
## Run 18 stress 0.1454507
## Run 19 stress 0.1512106
## Run 20 stress 0.147551
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1428199
## ... New best solution
## ... Procrustes: rmse 0.06075606  max resid 0.2609378
## Run 2 stress 0.1519659
## Run 3 stress 0.1490065
## Run 4 stress 0.1475058
## Run 5 stress 0.157891
## Run 6 stress 0.1433454
## Run 7 stress 0.144612
## Run 8 stress 0.1539552
## Run 9 stress 0.1499149
## Run 10 stress 0.1526268
## Run 11 stress 0.1439041
## Run 12 stress 0.1526203
## Run 13 stress 0.1451666
## Run 14 stress 0.1507462
## Run 15 stress 0.1501924
## Run 16 stress 0.1454399
## Run 17 stress 0.1444193
## Run 18 stress 0.1431711
## ... Procrustes: rmse 0.0257463  max resid 0.09675334
## Run 19 stress 0.1504702
## Run 20 stress 0.1541638
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1444508
## ... New best solution
## ... Procrustes: rmse 0.01512941  max resid 0.05787757
## Run 2 stress 0.1519768
## Run 3 stress 0.1432932
## ... New best solution
## ... Procrustes: rmse 0.05244762  max resid 0.2331512
## Run 4 stress 0.1472103
## Run 5 stress 0.1530994
## Run 6 stress 0.1423442
```

```
## ... New best solution
## ... Procrustes: rmse 0.01665784  max resid 0.07437657
## Run 7 stress 0.1456633
## Run 8 stress 0.1438358
## Run 9 stress 0.1533115
## Run 10 stress 0.1523414
## Run 11 stress 0.1419479
## ... New best solution
## ... Procrustes: rmse 0.01575016  max resid 0.07146374
## Run 12 stress 0.1557368
## Run 13 stress 0.1472
## Run 14 stress 0.1523002
## Run 15 stress 0.1486663
## Run 16 stress 0.1445095
## Run 17 stress 0.1496962
## Run 18 stress 0.1510397
## Run 19 stress 0.1519805
## Run 20 stress 0.1433028
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1434229
## ... New best solution
## ... Procrustes: rmse 0.06313204  max resid 0.2571212
## Run 2 stress 0.1509553
## Run 3 stress 0.143537
## ... Procrustes: rmse 0.007327597  max resid 0.03796563
## Run 4 stress 0.1499449
## Run 5 stress 0.1504314
## Run 6 stress 0.1547169
## Run 7 stress 0.1477148
## Run 8 stress 0.1451784
## Run 9 stress 0.1419827
## ... New best solution
## ... Procrustes: rmse 0.03155505  max resid 0.10062
## Run 10 stress 0.1543398
## Run 11 stress 0.1548774
## Run 12 stress 0.149402
## Run 13 stress 0.1460706
## Run 14 stress 0.150983
## Run 15 stress 0.1520286
## Run 16 stress 0.1423441
## ... Procrustes: rmse 0.01851898  max resid 0.07460205
## Run 17 stress 0.1432243
## Run 18 stress 0.1422645
## ... Procrustes: rmse 0.005874011  max resid 0.03020956
## Run 19 stress 0.1511543
## Run 20 stress 0.1508836
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1426494
## ... New best solution
```

```
## ... Procrustes: rmse 0.05488701  max resid 0.2573776
## Run 2 stress 0.1432445
## Run 3 stress 0.1498294
## Run 4 stress 0.1469102
## Run 5 stress 0.1522408
## Run 6 stress 0.1495739
## Run 7 stress 0.152916
## Run 8 stress 0.1439871
## Run 9 stress 0.1509529
## Run 10 stress 0.1443013
## Run 11 stress 0.1472047
## Run 12 stress 0.1446211
## Run 13 stress 0.1432525
## Run 14 stress 0.1529496
## Run 15 stress 0.1449118
## Run 16 stress 0.1510558
## Run 17 stress 0.1512609
## Run 18 stress 0.1433127
## Run 19 stress 0.1441517
## Run 20 stress 0.1419912
## ... New best solution
## ... Procrustes: rmse 0.01558679  max resid 0.07299943
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1520732
## Run 2 stress 0.1478306
## Run 3 stress 0.1497599
## Run 4 stress 0.1479359
## Run 5 stress 0.1517227
## Run 6 stress 0.1419825
## ... New best solution
## ... Procrustes: rmse 0.05435642  max resid 0.2599052
## Run 7 stress 0.1497527
## Run 8 stress 0.1423447
## ... Procrustes: rmse 0.01860825  max resid 0.07451815
## Run 9 stress 0.1504404
## Run 10 stress 0.144708
## Run 11 stress 0.1451291
## Run 12 stress 0.1532719
## Run 13 stress 0.1475627
## Run 14 stress 0.1423318
## ... Procrustes: rmse 0.01660718  max resid 0.07211826
## Run 15 stress 0.1468575
## Run 16 stress 0.1468787
## Run 17 stress 0.150431
## Run 18 stress 0.1469069
## Run 19 stress 0.1494024
## Run 20 stress 0.1536839
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
```

```
## Run 1 stress 0.1447699
## ... Procrustes: rmse 0.02111288  max resid 0.0996917
## Run 2 stress 0.1498828
## Run 3 stress 0.1419769
## ... New best solution
## ... Procrustes: rmse 0.05546176  max resid 0.2577319
## Run 4 stress 0.1530489
## Run 5 stress 0.1419769
## ... New best solution
## ... Procrustes: rmse 0.0002789469  max resid 0.001214322
## ... Similar to previous best
## Run 6 stress 0.1469202
## Run 7 stress 0.14938
## Run 8 stress 0.1487742
## Run 9 stress 0.1433297
## Run 10 stress 0.1469644
## Run 11 stress 0.1456288
## Run 12 stress 0.1451115
## Run 13 stress 0.1524921
## Run 14 stress 0.1432132
## Run 15 stress 0.1603508
## Run 16 stress 0.1428095
## Run 17 stress 0.1465291
## Run 18 stress 0.1496963
## Run 19 stress 0.1442408
## Run 20 stress 0.1503001
## *** Best solution repeated 1 times
## Run 0 stress 0.144726
## Run 1 stress 0.1493938
## Run 2 stress 0.1525444
## Run 3 stress 0.1507688
## Run 4 stress 0.1443832
## ... New best solution
## ... Procrustes: rmse 0.02181456  max resid 0.07742085
## Run 5 stress 0.1476195
## Run 6 stress 0.1553456
## Run 7 stress 0.1493968
## Run 8 stress 0.146601
## Run 9 stress 0.144761
## ... Procrustes: rmse 0.02409946  max resid 0.0795153
## Run 10 stress 0.1432543
## ... New best solution
## ... Procrustes: rmse 0.0518675  max resid 0.2243391
## Run 11 stress 0.1473483
## Run 12 stress 0.1521187
## Run 13 stress 0.1450397
## Run 14 stress 0.1431804
## ... New best solution
## ... Procrustes: rmse 0.02923331  max resid 0.09829765
## Run 15 stress 0.1544882
## Run 16 stress 0.1440557
## Run 17 stress 0.1533371
## Run 18 stress 0.1508459
## Run 19 stress 0.1473306
```

```
## Run 20 stress 0.1470016
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1523835
## Run 2 stress 0.1448278
## ... Procrustes: rmse 0.008667426  max resid 0.04973907
## Run 3 stress 0.1528125
## Run 4 stress 0.1501958
## Run 5 stress 0.1427217
## ... New best solution
## ... Procrustes: rmse 0.05797177  max resid 0.254321
## Run 6 stress 0.142265
## ... New best solution
## ... Procrustes: rmse 0.02181335  max resid 0.08835265
## Run 7 stress 0.1423129
## ... Procrustes: rmse 0.01988855  max resid 0.08264628
## Run 8 stress 0.1494022
## Run 9 stress 0.1524386
## Run 10 stress 0.14962
## Run 11 stress 0.1501527
## Run 12 stress 0.1445559
## Run 13 stress 0.1500372
## Run 14 stress 0.1425102
## ... Procrustes: rmse 0.02399943  max resid 0.08856002
## Run 15 stress 0.1472025
## Run 16 stress 0.1422644
## ... New best solution
## ... Procrustes: rmse 0.0004021395  max resid 0.001799314
## ... Similar to previous best
## Run 17 stress 0.1491583
## Run 18 stress 0.144549
## Run 19 stress 0.1445428
## Run 20 stress 0.1499385
## *** Best solution repeated 1 times
## Run 0 stress 0.144726
## Run 1 stress 0.1466018
## Run 2 stress 0.1495228
## Run 3 stress 0.1448489
## ... Procrustes: rmse 0.0668547  max resid 0.2452901
## Run 4 stress 0.1445097
## ... New best solution
## ... Procrustes: rmse 0.009190712  max resid 0.03839532
## Run 5 stress 0.1504736
## Run 6 stress 0.1496956
## Run 7 stress 0.1466009
## Run 8 stress 0.1494026
## Run 9 stress 0.1451381
## Run 10 stress 0.1473861
## Run 11 stress 0.1532329
## Run 12 stress 0.1426753
## ... New best solution
## ... Procrustes: rmse 0.05387249  max resid 0.2536595
```

```
## Run 13 stress 0.1490043
## Run 14 stress 0.1432213
## Run 15 stress 0.1493335
## Run 16 stress 0.150153
## Run 17 stress 0.1501927
## Run 18 stress 0.1432265
## Run 19 stress 0.1487363
## Run 20 stress 0.1481266
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1520873
## Run 2 stress 0.1446937
## ... New best solution
## ... Procrustes: rmse 0.009506282  max resid 0.04094406
## Run 3 stress 0.1428199
## ... New best solution
## ... Procrustes: rmse 0.05954407  max resid 0.2531269
## Run 4 stress 0.1419222
## ... New best solution
## ... Procrustes: rmse 0.02321374  max resid 0.08833403
## Run 5 stress 0.1522332
## Run 6 stress 0.1537267
## Run 7 stress 0.1522582
## Run 8 stress 0.1486729
## Run 9 stress 0.1468669
## Run 10 stress 0.1502943
## Run 11 stress 0.1504258
## Run 12 stress 0.1523289
## Run 13 stress 0.1422543
## ... Procrustes: rmse 0.01101281  max resid 0.07062998
## Run 14 stress 0.1444494
## Run 15 stress 0.144543
## Run 16 stress 0.144301
## Run 17 stress 0.1437965
## Run 18 stress 0.1495163
## Run 19 stress 0.1546796
## Run 20 stress 0.1423042
## ... Procrustes: rmse 0.01353781  max resid 0.06243799
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1494018
## Run 2 stress 0.1494021
## Run 3 stress 0.1448491
## ... Procrustes: rmse 0.06682681  max resid 0.2450146
## Run 4 stress 0.1443852
## ... New best solution
## ... Procrustes: rmse 0.02150737  max resid 0.07705123
## Run 5 stress 0.1515158
## Run 6 stress 0.1507552
## Run 7 stress 0.1469416
## Run 8 stress 0.1444657
```

```
## ... Procrustes: rmse 0.01327487  max resid 0.05915818
## Run 9 stress 0.1445101
## ... Procrustes: rmse 0.01999721  max resid 0.08168617
## Run 10 stress 0.149402
## Run 11 stress 0.1447697
## ... Procrustes: rmse 0.02577733  max resid 0.09008249
## Run 12 stress 0.1456633
## Run 13 stress 0.1474511
## Run 14 stress 0.1422579
## ... New best solution
## ... Procrustes: rmse 0.04904673  max resid 0.2219831
## Run 15 stress 0.1497477
## Run 16 stress 0.1508999
## Run 17 stress 0.1529183
## Run 18 stress 0.1501931
## Run 19 stress 0.1508393
## Run 20 stress 0.1502788
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1419827
## ... New best solution
## ... Procrustes: rmse 0.05428506  max resid 0.2595096
## Run 2 stress 0.1450342
## Run 3 stress 0.1419477
## ... New best solution
## ... Procrustes: rmse 0.009013792  max resid 0.05275216
## Run 4 stress 0.1419477
## ... New best solution
## ... Procrustes: rmse 6.344269e-05  max resid 0.0002630735
## ... Similar to previous best
## Run 5 stress 0.1445995
## Run 6 stress 0.1499149
## Run 7 stress 0.1514724
## Run 8 stress 0.1497484
## Run 9 stress 0.1419222
## ... New best solution
## ... Procrustes: rmse 0.002904874  max resid 0.01787501
## Run 10 stress 0.152098
## Run 11 stress 0.1445107
## Run 12 stress 0.1468573
## Run 13 stress 0.1422547
## ... Procrustes: rmse 0.01153551  max resid 0.07390982
## Run 14 stress 0.1466013
## Run 15 stress 0.1444495
## Run 16 stress 0.1497578
## Run 17 stress 0.1472566
## Run 18 stress 0.1427217
## Run 19 stress 0.152349
## Run 20 stress 0.1443471
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
```

```
## Run 0 stress 0.144726
## Run 1 stress 0.1514789
## Run 2 stress 0.1499988
## Run 3 stress 0.1531777
## Run 4 stress 0.1473295
## Run 5 stress 0.1424441
## ... New best solution
## ... Procrustes: rmse 0.05344848  max resid 0.2567957
## Run 6 stress 0.1432531
## Run 7 stress 0.146867
## Run 8 stress 0.1445646
## Run 9 stress 0.1426757
## ... Procrustes: rmse 0.01911298  max resid 0.07868994
## Run 10 stress 0.1518085
## Run 11 stress 0.1445559
## Run 12 stress 0.1469306
## Run 13 stress 0.1428098
## ... Procrustes: rmse 0.02868084  max resid 0.09335061
## Run 14 stress 0.1519889
## Run 15 stress 0.1468671
## Run 16 stress 0.1519002
## Run 17 stress 0.1579067
## Run 18 stress 0.1443013
## Run 19 stress 0.1496802
## Run 20 stress 0.1521096
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1522665
## Run 2 stress 0.1457857
## Run 3 stress 0.1471977
## Run 4 stress 0.1547571
## Run 5 stress 0.1433564
## ... New best solution
## ... Procrustes: rmse 0.05890987  max resid 0.2601559
## Run 6 stress 0.1445432
## Run 7 stress 0.145166
## Run 8 stress 0.1419478
## ... New best solution
## ... Procrustes: rmse 0.01846581  max resid 0.08582893
## Run 9 stress 0.1434294
## Run 10 stress 0.1493607
## Run 11 stress 0.1522521
## Run 12 stress 0.1497614
## Run 13 stress 0.1444233
## Run 14 stress 0.1456898
## Run 15 stress 0.1491577
## Run 16 stress 0.153715
## Run 17 stress 0.150196
## Run 18 stress 0.1428316
## Run 19 stress 0.1479219
## Run 20 stress 0.1475536
## *** Best solution was not repeated -- monoMDS stopping criteria:
```

```
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1449995
## ... Procrustes: rmse 0.004835628  max resid 0.02215833
## Run 2 stress 0.1462735
## Run 3 stress 0.1487764
## Run 4 stress 0.1476008
## Run 5 stress 0.1497527
## Run 6 stress 0.1450714
## ... Procrustes: rmse 0.06243156  max resid 0.2551347
## Run 7 stress 0.1491212
## Run 8 stress 0.1451671
## ... Procrustes: rmse 0.05880045  max resid 0.2515668
## Run 9 stress 0.1479894
## Run 10 stress 0.1455688
## Run 11 stress 0.1518164
## Run 12 stress 0.1539021
## Run 13 stress 0.1532818
## Run 14 stress 0.1423441
## ... New best solution
## ... Procrustes: rmse 0.057346  max resid 0.2566109
## Run 15 stress 0.145387
## Run 16 stress 0.1435858
## Run 17 stress 0.1523991
## Run 18 stress 0.1445097
## Run 19 stress 0.1428096
## ... Procrustes: rmse 0.01257633  max resid 0.07813726
## Run 20 stress 0.15294
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      5: no. of iterations >= maxit
##     15: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1527551
## Run 2 stress 0.1508299
## Run 3 stress 0.1466012
## Run 4 stress 0.1423855
## ... New best solution
## ... Procrustes: rmse 0.05397901  max resid 0.2588495
## Run 5 stress 0.1497524
## Run 6 stress 0.1423047
## ... New best solution
## ... Procrustes: rmse 0.003079606  max resid 0.01885577
## Run 7 stress 0.1549638
## Run 8 stress 0.15047
## Run 9 stress 0.1501527
## Run 10 stress 0.1419828
## ... New best solution
## ... Procrustes: rmse 0.008862839  max resid 0.05378758
## Run 11 stress 0.1496181
## Run 12 stress 0.1516177
## Run 13 stress 0.1468576
## Run 14 stress 0.1496022
## Run 15 stress 0.1462897
```

```
## Run 16 stress 0.1422677
## ... Procrustes: rmse 0.00613029  max resid 0.03201777
## Run 17 stress 0.1512382
## Run 18 stress 0.1449449
## Run 19 stress 0.1475532
## Run 20 stress 0.1422543
## ... Procrustes: rmse 0.01335653  max resid 0.06969973
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1432855
## ... New best solution
## ... Procrustes: rmse 0.05914934  max resid 0.2534346
## Run 2 stress 0.1522729
## Run 3 stress 0.1469112
## Run 4 stress 0.1472602
## Run 5 stress 0.1502929
## Run 6 stress 0.1497613
## Run 7 stress 0.1419825
## ... New best solution
## ... Procrustes: rmse 0.02383063  max resid 0.07456555
## Run 8 stress 0.1514453
## Run 9 stress 0.149989
## Run 10 stress 0.1509566
## Run 11 stress 0.1443007
## Run 12 stress 0.1422922
## ... Procrustes: rmse 0.01757685  max resid 0.07395622
## Run 13 stress 0.1525713
## Run 14 stress 0.1523418
## Run 15 stress 0.4020644
## Run 16 stress 0.153036
## Run 17 stress 0.1455187
## Run 18 stress 0.1419827
## ... Procrustes: rmse 0.0001174066  max resid 0.0004952326
## ... Similar to previous best
## Run 19 stress 0.14243
## ... Procrustes: rmse 0.01802928  max resid 0.07292489
## Run 20 stress 0.1498984
## *** Best solution repeated 1 times
## Run 0 stress 0.144726
## Run 1 stress 0.1499449
## Run 2 stress 0.1426996
## ... New best solution
## ... Procrustes: rmse 0.06021647  max resid 0.2606324
## Run 3 stress 0.1469306
## Run 4 stress 0.1509162
## Run 5 stress 0.1474496
## Run 6 stress 0.1536247
## Run 7 stress 0.1497686
## Run 8 stress 0.1452055
## Run 9 stress 0.1419829
## ... New best solution
## ... Procrustes: rmse 0.0245503  max resid 0.08679873
```

```
## Run 10 stress 0.1451659
## Run 11 stress 0.1432214
## Run 12 stress 0.1498442
## Run 13 stress 0.1512098
## Run 14 stress 0.1523012
## Run 15 stress 0.1444504
## Run 16 stress 0.1433236
## Run 17 stress 0.1466015
## Run 18 stress 0.1422544
## ... Procrustes: rmse 0.01340042  max resid 0.06948468
## Run 19 stress 0.1503004
## Run 20 stress 0.1491814
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1543297
## Run 2 stress 0.149582
## Run 3 stress 0.1497479
## Run 4 stress 0.147505
## Run 5 stress 0.1446958
## ... New best solution
## ... Procrustes: rmse 0.01001164  max resid 0.0446395
## Run 6 stress 0.1494021
## Run 7 stress 0.1428198
## ... New best solution
## ... Procrustes: rmse 0.05959398  max resid 0.2527957
## Run 8 stress 0.1444196
## Run 9 stress 0.1501229
## Run 10 stress 0.1529004
## Run 11 stress 0.147639
## Run 12 stress 0.1451113
## Run 13 stress 0.1522356
## Run 14 stress 0.1497524
## Run 15 stress 0.1432219
## ... Procrustes: rmse 0.01292087  max resid 0.07834902
## Run 16 stress 0.1422547
## ... New best solution
## ... Procrustes: rmse 0.02644586  max resid 0.0885179
## Run 17 stress 0.1522808
## Run 18 stress 0.1497475
## Run 19 stress 0.1432131
## Run 20 stress 0.1432222
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1444643
## ... New best solution
## ... Procrustes: rmse 0.01492529  max resid 0.05484316
## Run 2 stress 0.1453119
## Run 3 stress 0.1561113
## Run 4 stress 0.1420317
## ... New best solution
```

```
## ... Procrustes: rmse 0.05010558  max resid 0.2390144
## Run 5 stress 0.1423441
## ... Procrustes: rmse 0.01839958  max resid 0.07343451
## Run 6 stress 0.1533349
## Run 7 stress 0.1427217
## Run 8 stress 0.1521819
## Run 9 stress 0.1486719
## Run 10 stress 0.1512658
## Run 11 stress 0.1494682
## Run 12 stress 0.150153
## Run 13 stress 0.1469302
## Run 14 stress 0.1523418
## Run 15 stress 0.1446943
## Run 16 stress 0.1579479
## Run 17 stress 0.1473293
## Run 18 stress 0.1436666
## Run 19 stress 0.1426493
## Run 20 stress 0.1444193
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1466006
## Run 2 stress 0.1473731
## Run 3 stress 0.1522344
## Run 4 stress 0.1443009
## ... New best solution
## ... Procrustes: rmse 0.01958744  max resid 0.0772939
## Run 5 stress 0.1490962
## Run 6 stress 0.1478968
## Run 7 stress 0.1526088
## Run 8 stress 0.145387
## Run 9 stress 0.1422923
## ... New best solution
## ... Procrustes: rmse 0.04953821  max resid 0.2340322
## Run 10 stress 0.1509099
## Run 11 stress 0.1512383
## Run 12 stress 0.1490954
## Run 13 stress 0.3998786
## Run 14 stress 0.1475927
## Run 15 stress 0.1445431
## Run 16 stress 0.1502994
## Run 17 stress 0.1472569
## Run 18 stress 0.1475332
## Run 19 stress 0.1501917
## Run 20 stress 0.150952
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1501835
## Run 2 stress 0.1432242
## ... New best solution
## ... Procrustes: rmse 0.06459023  max resid 0.2455047
```

```
## Run 3 stress 0.1450713
## Run 4 stress 0.1472441
## Run 5 stress 0.1510309
## Run 6 stress 0.1576067
## Run 7 stress 0.1433213
## ... Procrustes: rmse 0.008277287  max resid 0.05128839
## Run 8 stress 0.149732
## Run 9 stress 0.1444486
## Run 10 stress 0.1445104
## Run 11 stress 0.1469071
## Run 12 stress 0.1504386
## Run 13 stress 0.14564
## Run 14 stress 0.1419828
## ... New best solution
## ... Procrustes: rmse 0.03846811  max resid 0.1055414
## Run 15 stress 0.1494749
## Run 16 stress 0.1437881
## Run 17 stress 0.1512912
## Run 18 stress 0.1503695
## Run 19 stress 0.1433107
## Run 20 stress 0.1491218
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1511547
## Run 2 stress 0.1503916
## Run 3 stress 0.1428753
## ... New best solution
## ... Procrustes: rmse 0.05517676  max resid 0.2529242
## Run 4 stress 0.1516177
## Run 5 stress 0.1537061
## Run 6 stress 0.1530141
## Run 7 stress 0.1444651
## Run 8 stress 0.1466014
## Run 9 stress 0.1437878
## Run 10 stress 0.1556618
## Run 11 stress 0.1422922
## ... New best solution
## ... Procrustes: rmse 0.02916059  max resid 0.0958884
## Run 12 stress 0.1547608
## Run 13 stress 0.1450711
## Run 14 stress 0.1420516
## ... New best solution
## ... Procrustes: rmse 0.0163872  max resid 0.07202929
## Run 15 stress 0.1455174
## Run 16 stress 0.1494289
## Run 17 stress 0.1469308
## Run 18 stress 0.1515916
## Run 19 stress 0.15076
## Run 20 stress 0.146013
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
```

```
## Run 0 stress 0.144726
## Run 1 stress 0.1426997
## ... New best solution
## ... Procrustes: rmse 0.06020774  max resid 0.2606481
## Run 2 stress 0.1476569
## Run 3 stress 0.1432445
## Run 4 stress 0.1516068
## Run 5 stress 0.152301
## Run 6 stress 0.1535219
## Run 7 stress 0.145206
## Run 8 stress 0.1498875
## Run 9 stress 0.1427413
## ... Procrustes: rmse 0.017683  max resid 0.08078474
## Run 10 stress 0.1435014
## Run 11 stress 0.1493944
## Run 12 stress 0.1514734
## Run 13 stress 0.3975822
## Run 14 stress 0.1522576
## Run 15 stress 0.1527117
## Run 16 stress 0.1441436
## Run 17 stress 0.149748
## Run 18 stress 0.1428752
## ... Procrustes: rmse 0.03362006  max resid 0.0968986
## Run 19 stress 0.1426996
## ... New best solution
## ... Procrustes: rmse 7.257329e-05  max resid 0.0002561386
## ... Similar to previous best
## Run 20 stress 0.1428315
## ... Procrustes: rmse 0.0038064  max resid 0.01787935
## *** Best solution repeated 1 times
## Run 0 stress 0.144726
## Run 1 stress 0.1493836
## Run 2 stress 0.1511213
## Run 3 stress 0.1493622
## Run 4 stress 0.1419772
## ... New best solution
## ... Procrustes: rmse 0.05519722  max resid 0.2564068
## Run 5 stress 0.1519124
## Run 6 stress 0.147559
## Run 7 stress 0.1469634
## Run 8 stress 0.1527774
## Run 9 stress 0.1497094
## Run 10 stress 0.1422546
## ... Procrustes: rmse 0.01181637  max resid 0.0731036
## Run 11 stress 0.1428755
## Run 12 stress 0.1439728
## Run 13 stress 0.1537227
## Run 14 stress 0.1497598
## Run 15 stress 0.1445891
## Run 16 stress 0.1527363
## Run 17 stress 0.1447
## Run 18 stress 0.1531113
## Run 19 stress 0.1472071
## Run 20 stress 0.1507607
```

```
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1516208
## Run 2 stress 0.1493907
## Run 3 stress 0.1437999
## ... New best solution
## ... Procrustes: rmse 0.0627745  max resid 0.2490059
## Run 4 stress 0.1510596
## Run 5 stress 0.1445106
## Run 6 stress 0.1439211
## ... Procrustes: rmse 0.02548336  max resid 0.09271319
## Run 7 stress 0.1494688
## Run 8 stress 0.1466012
## Run 9 stress 0.1447609
## Run 10 stress 0.1427151
## ... New best solution
## ... Procrustes: rmse 0.02753036  max resid 0.09988553
## Run 11 stress 0.1525295
## Run 12 stress 0.1545888
## Run 13 stress 0.1494022
## Run 14 stress 0.1466007
## Run 15 stress 0.1493619
## Run 16 stress 0.1535617
## Run 17 stress 0.14691
## Run 18 stress 0.1520272
## Run 19 stress 0.1422645
## ... New best solution
## ... Procrustes: rmse 0.02623742  max resid 0.08690191
## Run 20 stress 0.1521266
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1446458
## ... New best solution
## ... Procrustes: rmse 0.003491515  max resid 0.01693695
## Run 2 stress 0.1520216
## Run 3 stress 0.145071
## ... Procrustes: rmse 0.06321519  max resid 0.2601157
## Run 4 stress 0.1419477
## ... New best solution
## ... Procrustes: rmse 0.05609344  max resid 0.2609923
## Run 5 stress 0.1538318
## Run 6 stress 0.1447702
## Run 7 stress 0.1479357
## Run 8 stress 0.1598333
## Run 9 stress 0.1493799
## Run 10 stress 0.149066
## Run 11 stress 0.144613
## Run 12 stress 0.153153
## Run 13 stress 0.1449125
## Run 14 stress 0.1523122
## Run 15 stress 0.1476384
```

```
## Run 16 stress 0.1490588
## Run 17 stress 0.144451
## Run 18 stress 0.1483505
## Run 19 stress 0.1491199
## Run 20 stress 0.1533829
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      7: no. of iterations >= maxit
##     13: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1499667
## Run 2 stress 0.1422542
## ... New best solution
## ... Procrustes: rmse 0.05574561  max resid 0.2563656
## Run 3 stress 0.1492819
## Run 4 stress 0.1494021
## Run 5 stress 0.1456894
## Run 6 stress 0.1469101
## Run 7 stress 0.1446997
## Run 8 stress 0.1504712
## Run 9 stress 0.1453761
## Run 10 stress 0.1466007
## Run 11 stress 0.1493834
## Run 12 stress 0.154176
## Run 13 stress 0.1422553
## ... Procrustes: rmse 0.0009008652  max resid 0.004586013
## ... Similar to previous best
## Run 14 stress 0.1437051
## Run 15 stress 0.1466011
## Run 16 stress 0.1523416
## Run 17 stress 0.1513636
## Run 18 stress 0.1494025
## Run 19 stress 0.1514781
## Run 20 stress 0.1419226
## ... New best solution
## ... Procrustes: rmse 0.01129156  max resid 0.0726734
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1419479
## ... New best solution
## ... Procrustes: rmse 0.05528123  max resid 0.256808
## Run 2 stress 0.1443491
## Run 3 stress 0.1419479
## ... New best solution
## ... Procrustes: rmse 4.291296e-05  max resid 0.0001806784
## ... Similar to previous best
## Run 4 stress 0.1526357
## Run 5 stress 0.1450401
## Run 6 stress 0.1445812
## Run 7 stress 0.1465396
## Run 8 stress 0.145269
## Run 9 stress 0.1491333
## Run 10 stress 0.1490439
```

```
## Run 11 stress 0.1466013
## Run 12 stress 0.1501917
## Run 13 stress 0.1444506
## Run 14 stress 0.1469303
## Run 15 stress 0.1495841
## Run 16 stress 0.1442393
## Run 17 stress 0.1427218
## Run 18 stress 0.1444195
## Run 19 stress 0.1509458
## Run 20 stress 0.1547583
## *** Best solution repeated 1 times
## Run 0 stress 0.144726
## Run 1 stress 0.14693
## Run 2 stress 0.151612
## Run 3 stress 0.1533455
## Run 4 stress 0.1451378
## ... Procrustes: rmse 0.06196423  max resid 0.2506911
## Run 5 stress 0.1495387
## Run 6 stress 0.1469631
## Run 7 stress 0.1493828
## Run 8 stress 0.1442713
## ... New best solution
## ... Procrustes: rmse 0.01307551  max resid 0.05517594
## Run 9 stress 0.1445102
## ... Procrustes: rmse 0.01273103  max resid 0.05687393
## Run 10 stress 0.1487992
## Run 11 stress 0.15468
## Run 12 stress 0.1424438
## ... New best solution
## ... Procrustes: rmse 0.04812753  max resid 0.2330947
## Run 13 stress 0.1499666
## Run 14 stress 0.1419771
## ... New best solution
## ... Procrustes: rmse 0.01731221  max resid 0.0850017
## Run 15 stress 0.1468571
## Run 16 stress 0.1458005
## Run 17 stress 0.1535493
## Run 18 stress 0.1435538
## Run 19 stress 0.1501711
## Run 20 stress 0.1446
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1532532
## Run 2 stress 0.15652
## Run 3 stress 0.1511146
## Run 4 stress 0.1432933
## ... New best solution
## ... Procrustes: rmse 0.05826777  max resid 0.263754
## Run 5 stress 0.1505706
## Run 6 stress 0.1477947
## Run 7 stress 0.1439586
## Run 8 stress 0.1524622
```

```
## Run 9 stress 0.1481674
## Run 10 stress 0.1452005
## Run 11 stress 0.1445098
## Run 12 stress 0.1423322
## ... New best solution
## ... Procrustes: rmse 0.01657303  max resid 0.07423146
## Run 13 stress 0.1530869
## Run 14 stress 0.1528463
## Run 15 stress 0.1501526
## Run 16 stress 0.1443009
## Run 17 stress 0.1497524
## Run 18 stress 0.1444643
## Run 19 stress 0.143222
## Run 20 stress 0.1460125
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1427414
## ... New best solution
## ... Procrustes: rmse 0.05513909  max resid 0.2564005
## Run 2 stress 0.1522973
## Run 3 stress 0.1490058
## Run 4 stress 0.1450545
## Run 5 stress 0.1527411
## Run 6 stress 0.1423043
## ... New best solution
## ... Procrustes: rmse 0.01893203  max resid 0.07842609
## Run 7 stress 0.1499196
## Run 8 stress 0.1520133
## Run 9 stress 0.1446971
## Run 10 stress 0.1468666
## Run 11 stress 0.1453116
## Run 12 stress 0.1523004
## Run 13 stress 0.1469877
## Run 14 stress 0.1423832
## ... Procrustes: rmse 0.01836849  max resid 0.06458098
## Run 15 stress 0.15468
## Run 16 stress 0.1479003
## Run 17 stress 0.1512507
## Run 18 stress 0.1521896
## Run 19 stress 0.1490091
## Run 20 stress 0.144849
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1494021
## Run 2 stress 0.1512986
## Run 3 stress 0.1464124
## Run 4 stress 0.1557876
## Run 5 stress 0.1427148
## ... New best solution
## ... Procrustes: rmse 0.06003361  max resid 0.2594936
```

```
## Run 6 stress 0.1560696
## Run 7 stress 0.1420503
## ... New best solution
## ... Procrustes: rmse 0.02383319  max resid 0.08680821
## Run 8 stress 0.1448491
## Run 9 stress 0.1419853
## ... New best solution
## ... Procrustes: rmse 0.002352969  max resid 0.01443933
## Run 10 stress 0.1455689
## Run 11 stress 0.1469107
## Run 12 stress 0.1534453
## Run 13 stress 0.147434
## Run 14 stress 0.1495023
## Run 15 stress 0.1529136
## Run 16 stress 0.142313
## ... Procrustes: rmse 0.01758975  max resid 0.07405486
## Run 17 stress 0.1492697
## Run 18 stress 0.14956
## Run 19 stress 0.1503805
## Run 20 stress 0.1524065
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      4: no. of iterations >= maxit
##     16: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1426996
## ... New best solution
## ... Procrustes: rmse 0.06015415  max resid 0.2603738
## Run 2 stress 0.1498368
## Run 3 stress 0.1494686
## Run 4 stress 0.1495044
## Run 5 stress 0.1469305
## Run 6 stress 0.1507428
## Run 7 stress 0.1451658
## Run 8 stress 0.1443019
## Run 9 stress 0.151847
## Run 10 stress 0.1466006
## Run 11 stress 0.1451449
## Run 12 stress 0.1446902
## Run 13 stress 0.145138
## Run 14 stress 0.1451383
## Run 15 stress 0.1475039
## Run 16 stress 0.1527208
## Run 17 stress 0.1428096
## ... Procrustes: rmse 0.003350954  max resid 0.0179638
## Run 18 stress 0.1443483
## Run 19 stress 0.1510498
## Run 20 stress 0.1502055
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      3: no. of iterations >= maxit
##     17: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.147381
## Run 2 stress 0.1477942
## Run 3 stress 0.1526786
```

```
## Run 4 stress 0.1419222
## ... New best solution
## ... Procrustes: rmse 0.05537944  max resid 0.2571658
## Run 5 stress 0.146601
## Run 6 stress 0.1504116
## Run 7 stress 0.1619387
## Run 8 stress 0.146602
## Run 9 stress 0.1426996
## Run 10 stress 0.1426505
## Run 11 stress 0.1481987
## Run 12 stress 0.1443019
## Run 13 stress 0.1495404
## Run 14 stress 0.1535455
## Run 15 stress 0.1495723
## Run 16 stress 0.1499195
## Run 17 stress 0.1478966
## Run 18 stress 0.1447022
## Run 19 stress 0.1518537
## Run 20 stress 0.1513262
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1466007
## Run 2 stress 0.1456953
## Run 3 stress 0.1447613
## ... Procrustes: rmse 0.009905936  max resid 0.05025304
## Run 4 stress 0.1433563
## ... New best solution
## ... Procrustes: rmse 0.05892674  max resid 0.2600139
## Run 5 stress 0.1472108
## Run 6 stress 0.1521821
## Run 7 stress 0.1478959
## Run 8 stress 0.1469104
## Run 9 stress 0.1446978
## Run 10 stress 0.1522891
## Run 11 stress 0.1530597
## Run 12 stress 0.1521355
## Run 13 stress 0.1427147
## ... New best solution
## ... Procrustes: rmse 0.02066542  max resid 0.08283313
## Run 14 stress 0.1445903
## Run 15 stress 0.1490885
## Run 16 stress 0.1515273
## Run 17 stress 0.1469305
## Run 18 stress 0.1445557
## Run 19 stress 0.14938
## Run 20 stress 0.1535616
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     18: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.142875
## ... New best solution
```

```
## ... Procrustes: rmse 0.05488683  max resid 0.2514705
## Run 2 stress 0.1445556
## Run 3 stress 0.1461022
## Run 4 stress 0.1510432
## Run 5 stress 0.1481632
## Run 6 stress 0.1422033
## ... New best solution
## ... Procrustes: rmse 0.01903018  max resid 0.08756682
## Run 7 stress 0.1469641
## Run 8 stress 0.1419825
## ... New best solution
## ... Procrustes: rmse 0.00518602  max resid 0.030853
## Run 9 stress 0.1489917
## Run 10 stress 0.1444509
## Run 11 stress 0.1498007
## Run 12 stress 0.142715
## Run 13 stress 0.1481981
## Run 14 stress 0.1446045
## Run 15 stress 0.1466014
## Run 16 stress 0.1424443
## ... Procrustes: rmse 0.01179852  max resid 0.06435356
## Run 17 stress 0.1516559
## Run 18 stress 0.1526369
## Run 19 stress 0.1528932
## Run 20 stress 0.1468384
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     17: stress ratio > sratmax
##      1: scale factor of the gradient < sfgrmin
## Run 0 stress 0.144726
## Run 1 stress 0.1500366
## Run 2 stress 0.1529045
## Run 3 stress 0.1490089
## Run 4 stress 0.1486879
## Run 5 stress 0.1454861
## Run 6 stress 0.1494572
## Run 7 stress 0.1501919
## Run 8 stress 0.1447618
## ... Procrustes: rmse 0.009649141  max resid 0.0514124
## Run 9 stress 0.1439534
## ... New best solution
## ... Procrustes: rmse 0.05932847  max resid 0.2570804
## Run 10 stress 0.1444505
## ... Procrustes: rmse 0.0570018  max resid 0.249171
## Run 11 stress 0.151292
## Run 12 stress 0.1419477
## ... New best solution
## ... Procrustes: rmse 0.02913464  max resid 0.09409254
## Run 13 stress 0.1584609
## Run 14 stress 0.1506837
## Run 15 stress 0.1448491
## Run 16 stress 0.1434346
## Run 17 stress 0.1432245
## Run 18 stress 0.1493938
```

```
## Run 19 stress 0.1519471
## Run 20 stress 0.149582
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     20: stress ratio > sratmax
## Run 0 stress 0.144726
## Run 1 stress 0.1513514
## Run 2 stress 0.1524019
## Run 3 stress 0.1501544
## Run 4 stress 0.1480576
## Run 5 stress 0.1428316
## ... New best solution
## ... Procrustes: rmse 0.05968585  max resid 0.2601775
## Run 6 stress 0.1502289
## Run 7 stress 0.151287
## Run 8 stress 0.1428095
## ... New best solution
## ... Procrustes: rmse 0.001963067  max resid 0.009884548
## ... Similar to previous best
## Run 9 stress 0.1493527
## Run 10 stress 0.1530309
## Run 11 stress 0.1436732
## Run 12 stress 0.1472072
## Run 13 stress 0.4020737
## Run 14 stress 0.145932
## Run 15 stress 0.1486799
## Run 16 stress 0.1423052
## ... New best solution
## ... Procrustes: rmse 0.02686754  max resid 0.08845834
## Run 17 stress 0.1478846
## Run 18 stress 0.1423071
## ... Procrustes: rmse 0.0006224015  max resid 0.002932854
## ... Similar to previous best
## Run 19 stress 0.1449117
## Run 20 stress 0.1524119
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.12009
## Run 2 stress 0.1134997
## ... Procrustes: rmse 0.00198996  max resid 0.01011592
## Run 3 stress 0.1162762
## Run 4 stress 0.1119458
## ... New best solution
## ... Procrustes: rmse 0.04767084  max resid 0.2604967
## Run 5 stress 0.112059
## ... Procrustes: rmse 0.02214554  max resid 0.08239148
## Run 6 stress 0.1120127
## ... Procrustes: rmse 0.01838721  max resid 0.06771879
## Run 7 stress 0.1162396
## Run 8 stress 0.1119645
## ... Procrustes: rmse 0.003051432  max resid 0.0113328
## Run 9 stress 0.1148312
## Run 10 stress 0.1122296
## ... Procrustes: rmse 0.01816713  max resid 0.07019106
## Run 11 stress 0.1187657
```

```
## Run 12 stress 0.1135344
## Run 13 stress 0.1206406
## Run 14 stress 0.1178628
## Run 15 stress 0.1183854
## Run 16 stress 0.1134992
## Run 17 stress 0.1135006
## Run 18 stress 0.1194075
## Run 19 stress 0.1166392
## Run 20 stress 0.1199105
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1134995
## ... Procrustes: rmse 0.001595292  max resid 0.005973486
## ... Similar to previous best
## Run 2 stress 0.1134984
## ... New best solution
## ... Procrustes: rmse 0.000731438  max resid 0.003963426
## ... Similar to previous best
## Run 3 stress 0.1135262
## ... Procrustes: rmse 0.004188829  max resid 0.01730177
## Run 4 stress 0.1168393
## Run 5 stress 0.1162377
## Run 6 stress 0.1120571
## ... New best solution
## ... Procrustes: rmse 0.04331245  max resid 0.2122025
## Run 7 stress 0.1154943
## Run 8 stress 0.1119677
## ... New best solution
## ... Procrustes: rmse 0.02206927  max resid 0.08218608
## Run 9 stress 0.1146623
## Run 10 stress 0.1138565
## Run 11 stress 0.1131786
## Run 12 stress 0.1135024
## Run 13 stress 0.1119367
## ... New best solution
## ... Procrustes: rmse 0.01037235  max resid 0.03774199
## Run 14 stress 0.1119917
## ... Procrustes: rmse 0.003845456  max resid 0.02302946
## Run 15 stress 0.113215
## Run 16 stress 0.1131994
## Run 17 stress 0.1120662
## ... Procrustes: rmse 0.01581553  max resid 0.05949206
## Run 18 stress 0.1208208
## Run 19 stress 0.1129515
## Run 20 stress 0.1131625
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1134989
## ... New best solution
## ... Procrustes: rmse 0.001093561  max resid 0.003450971
```

```
## ... Similar to previous best
## Run 2 stress 0.113499
## ... Procrustes: rmse 0.0002789105  max resid 0.0008378241
## ... Similar to previous best
## Run 3 stress 0.1131873
## ... New best solution
## ... Procrustes: rmse 0.054135  max resid 0.2911662
## Run 4 stress 0.1119899
## ... New best solution
## ... Procrustes: rmse 0.01644718  max resid 0.09455269
## Run 5 stress 0.1119968
## ... Procrustes: rmse 0.01542941  max resid 0.05512459
## Run 6 stress 0.1194636
## Run 7 stress 0.1148289
## Run 8 stress 0.1134983
## Run 9 stress 0.1119662
## ... New best solution
## ... Procrustes: rmse 0.01915646  max resid 0.07090714
## Run 10 stress 0.1119906
## ... Procrustes: rmse 0.008509018  max resid 0.02796812
## Run 11 stress 0.1168425
## Run 12 stress 0.1148317
## Run 13 stress 0.1134987
## Run 14 stress 0.1148038
## Run 15 stress 0.113503
## Run 16 stress 0.1132301
## Run 17 stress 0.1119806
## ... Procrustes: rmse 0.001831658  max resid 0.006821218
## ... Similar to previous best
## Run 18 stress 0.113151
## Run 19 stress 0.1135033
## Run 20 stress 0.1194161
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1119642
## ... New best solution
## ... Procrustes: rmse 0.04896063  max resid 0.2689107
## Run 2 stress 0.1120186
## ... Procrustes: rmse 0.02185865  max resid 0.08079067
## Run 3 stress 0.1132484
## Run 4 stress 0.1121064
## ... Procrustes: rmse 0.01029603  max resid 0.04059375
## Run 5 stress 0.1138408
## Run 6 stress 0.1132534
## Run 7 stress 0.1119991
## ... Procrustes: rmse 0.02007706  max resid 0.07406263
## Run 8 stress 0.1120536
## ... Procrustes: rmse 0.0246409  max resid 0.09173352
## Run 9 stress 0.1134995
## Run 10 stress 0.1134994
## Run 11 stress 0.1134987
## Run 12 stress 0.1147952
## Run 13 stress 0.1201582
## Run 14 stress 0.111958
```

```
## ... New best solution
## ... Procrustes: rmse 0.0008791809  max resid 0.003301283
## ... Similar to previous best
## Run 15 stress 0.1119424
## ... New best solution
## ... Procrustes: rmse 0.003017296  max resid 0.01116534
## Run 16 stress 0.1121347
## ... Procrustes: rmse 0.02598587  max resid 0.09829684
## Run 17 stress 0.1154699
## Run 18 stress 0.1119658
## ... Procrustes: rmse 0.01253668  max resid 0.04603243
## Run 19 stress 0.1122396
## ... Procrustes: rmse 0.01391393  max resid 0.05549062
## Run 20 stress 0.1203307
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1157749
## Run 2 stress 0.1119493
## ... New best solution
## ... Procrustes: rmse 0.04797029  max resid 0.2625387
## Run 3 stress 0.1135733
## Run 4 stress 0.1183083
## Run 5 stress 0.1131927
## Run 6 stress 0.1131764
## Run 7 stress 0.1193695
## Run 8 stress 0.1119485
## ... New best solution
## ... Procrustes: rmse 0.000952459  max resid 0.003490743
## ... Similar to previous best
## Run 9 stress 0.1132106
## Run 10 stress 0.1200894
## Run 11 stress 0.1132055
## Run 12 stress 0.1119416
## ... New best solution
## ... Procrustes: rmse 0.008684361  max resid 0.03183416
## Run 13 stress 0.1171765
## Run 14 stress 0.1199128
## Run 15 stress 0.1119563
## ... Procrustes: rmse 0.01079174  max resid 0.03979424
## Run 16 stress 0.1198948
## Run 17 stress 0.1120003
## ... Procrustes: rmse 0.003852254  max resid 0.02250697
## Run 18 stress 0.1121042
## ... Procrustes: rmse 0.01678032  max resid 0.06471658
## Run 19 stress 0.1125347
## Run 20 stress 0.1119364
## ... New best solution
## ... Procrustes: rmse 0.005739966  max resid 0.02061146
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.1134992
```

```
## Run 1 stress 0.11351
## ... Procrustes: rmse 0.00262269  max resid 0.01069276
## Run 2 stress 0.1120028
## ... New best solution
## ... Procrustes: rmse 0.04457769  max resid 0.2319071
## Run 3 stress 0.1119783
## ... New best solution
## ... Procrustes: rmse 0.005995113  max resid 0.02438199
## Run 4 stress 0.1119359
## ... New best solution
## ... Procrustes: rmse 0.01143189  max resid 0.04183949
## Run 5 stress 0.1119985
## ... Procrustes: rmse 0.007131318  max resid 0.02219434
## Run 6 stress 0.1148179
## Run 7 stress 0.1119422
## ... Procrustes: rmse 0.002689519  max resid 0.01036307
## Run 8 stress 0.1119566
## ... Procrustes: rmse 0.005487626  max resid 0.02063979
## Run 9 stress 0.1192675
## Run 10 stress 0.1126618
## Run 11 stress 0.1194083
## Run 12 stress 0.1135011
## Run 13 stress 0.1119414
## ... Procrustes: rmse 0.002455888  max resid 0.009388851
## ... Similar to previous best
## Run 14 stress 0.1119566
## ... Procrustes: rmse 0.005485851  max resid 0.0206357
## Run 15 stress 0.1181465
## Run 16 stress 0.1183395
## Run 17 stress 0.1135003
## Run 18 stress 0.1134997
## Run 19 stress 0.1120217
## ... Procrustes: rmse 0.01202905  max resid 0.04568786
## Run 20 stress 0.111943
## ... Procrustes: rmse 0.005861062  max resid 0.02108298
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1119438
## ... New best solution
## ... Procrustes: rmse 0.04749032  max resid 0.2592859
## Run 2 stress 0.1148289
## Run 3 stress 0.1120025
## ... Procrustes: rmse 0.01699356  max resid 0.06249793
## Run 4 stress 0.1132053
## Run 5 stress 0.1119545
## ... Procrustes: rmse 0.01121301  max resid 0.04112271
## Run 6 stress 0.1154146
## Run 7 stress 0.111941
## ... New best solution
## ... Procrustes: rmse 0.0007006445  max resid 0.00267162
## ... Similar to previous best
## Run 8 stress 0.1120113
## ... Procrustes: rmse 0.01711958  max resid 0.06287724
## Run 9 stress 0.1120165
```

```
## ... Procrustes: rmse 0.01759663  max resid 0.06466978
## Run 10 stress 0.1128516
## Run 11 stress 0.1135243
## Run 12 stress 0.1166378
## Run 13 stress 0.113499
## Run 14 stress 0.1132076
## Run 15 stress 0.1135003
## Run 16 stress 0.1119672
## ... Procrustes: rmse 0.003852954  max resid 0.01438345
## Run 17 stress 0.1201552
## Run 18 stress 0.1176189
## Run 19 stress 0.1119422
## ... Procrustes: rmse 0.000280138  max resid 0.00111352
## ... Similar to previous best
## Run 20 stress 0.112015
## ... Procrustes: rmse 0.0173934  max resid 0.06390351
## *** Best solution repeated 2 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1119645
## ... New best solution
## ... Procrustes: rmse 0.04350734  max resid 0.2245556
## Run 2 stress 0.1119687
## ... Procrustes: rmse 0.0167266  max resid 0.06206774
## Run 3 stress 0.1131525
## Run 4 stress 0.1220245
## Run 5 stress 0.113525
## Run 6 stress 0.1197548
## Run 7 stress 0.1135723
## Run 8 stress 0.1134995
## Run 9 stress 0.1120321
## ... Procrustes: rmse 0.02193264  max resid 0.08160943
## Run 10 stress 0.1196749
## Run 11 stress 0.1119545
## ... New best solution
## ... Procrustes: rmse 0.01465793  max resid 0.05422348
## Run 12 stress 0.1135008
## Run 13 stress 0.1120099
## ... Procrustes: rmse 0.01364446  max resid 0.04789605
## Run 14 stress 0.1131897
## Run 15 stress 0.1120253
## ... Procrustes: rmse 0.02098016  max resid 0.0775031
## Run 16 stress 0.1194093
## Run 17 stress 0.1135049
## Run 18 stress 0.1177675
## Run 19 stress 0.1120189
## ... Procrustes: rmse 0.01504826  max resid 0.05323042
## Run 20 stress 0.1132567
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1119476
## ... New best solution
## ... Procrustes: rmse 0.04783394  max resid 0.2616255
```

```
## Run 2 stress 0.1172412
## Run 3 stress 0.1200096
## Run 4 stress 0.1119647
## ... Procrustes: rmse 0.01359942  max resid 0.04998023
## Run 5 stress 0.1120167
## ... Procrustes: rmse 0.01900049  max resid 0.07002632
## Run 6 stress 0.1174951
## Run 7 stress 0.1193157
## Run 8 stress 0.1135061
## Run 9 stress 0.1148277
## Run 10 stress 0.1119686
## ... Procrustes: rmse 0.003211522  max resid 0.01197531
## Run 11 stress 0.1182308
## Run 12 stress 0.114834
## Run 13 stress 0.1120438
## ... Procrustes: rmse 0.009612095  max resid 0.03685379
## Run 14 stress 0.1162338
## Run 15 stress 0.1134991
## Run 16 stress 0.1135143
## Run 17 stress 0.1122173
## ... Procrustes: rmse 0.03030824  max resid 0.1156589
## Run 18 stress 0.1174625
## Run 19 stress 0.1120364
## ... Procrustes: rmse 0.009007028  max resid 0.03464092
## Run 20 stress 0.1120532
## ... Procrustes: rmse 0.0221449  max resid 0.08229287
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     18: no. of iterations >= maxit
##      2: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.111971
## ... New best solution
## ... Procrustes: rmse 0.04918205  max resid 0.2702939
## Run 2 stress 0.1148453
## Run 3 stress 0.1205792
## Run 4 stress 0.1119854
## ... Procrustes: rmse 0.01749198  max resid 0.06451815
## Run 5 stress 0.1119438
## ... New best solution
## ... Procrustes: rmse 0.004242409  max resid 0.01578492
## Run 6 stress 0.1141965
## Run 7 stress 0.1119646
## ... Procrustes: rmse 0.00357553  max resid 0.01329015
## Run 8 stress 0.1164395
## Run 9 stress 0.1119877
## ... Procrustes: rmse 0.01533473  max resid 0.05640609
## Run 10 stress 0.1179954
## Run 11 stress 0.1119554
## ... Procrustes: rmse 0.002361623  max resid 0.008736351
## ... Similar to previous best
## Run 12 stress 0.1121096
## ... Procrustes: rmse 0.02467793  max resid 0.09278278
## Run 13 stress 0.1156217
## Run 14 stress 0.1199401
```

```
## Run 15 stress 0.116757
## Run 16 stress 0.111992
## ... Procrustes: rmse 0.004491739  max resid 0.02124905
## Run 17 stress 0.1131891
## Run 18 stress 0.1220927
## Run 19 stress 0.1198286
## Run 20 stress 0.1120018
## ... Procrustes: rmse 0.01041189  max resid 0.03535749
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1132028
## ... New best solution
## ... Procrustes: rmse 0.04847829  max resid 0.251895
## Run 2 stress 0.1162335
## Run 3 stress 0.1119855
## ... New best solution
## ... Procrustes: rmse 0.01801985  max resid 0.09672605
## Run 4 stress 0.1135004
## Run 5 stress 0.1119695
## ... New best solution
## ... Procrustes: rmse 0.01929632  max resid 0.07176375
## Run 6 stress 0.1204124
## Run 7 stress 0.1148261
## Run 8 stress 0.1134986
## Run 9 stress 0.1120074
## ... Procrustes: rmse 0.003732266  max resid 0.01404406
## Run 10 stress 0.1257839
## Run 11 stress 0.1135007
## Run 12 stress 0.1131592
## Run 13 stress 0.1120524
## ... Procrustes: rmse 0.0250319  max resid 0.093209
## Run 14 stress 0.1200907
## Run 15 stress 0.1148085
## Run 16 stress 0.1119384
## ... New best solution
## ... Procrustes: rmse 0.005807038  max resid 0.02148495
## Run 17 stress 0.1150659
## Run 18 stress 0.1183393
## Run 19 stress 0.111967
## ... Procrustes: rmse 0.005490577  max resid 0.02033971
## Run 20 stress 0.1119443
## ... Procrustes: rmse 0.001705016  max resid 0.006228027
## ... Similar to previous best
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1192721
## Run 2 stress 0.1201576
## Run 3 stress 0.1119381
## ... New best solution
## ... Procrustes: rmse 0.044835  max resid 0.2385766
## Run 4 stress 0.1201329
## Run 5 stress 0.1120793
## ... Procrustes: rmse 0.0145833  max resid 0.05553392
## Run 6 stress 0.1119497
```

```
## ... Procrustes: rmse 0.008467473  max resid 0.03111256
## Run 7 stress 0.1137129
## Run 8 stress 0.1168795
## Run 9 stress 0.1133348
## Run 10 stress 0.1194635
## Run 11 stress 0.1119566
## ... Procrustes: rmse 0.004271928  max resid 0.01571845
## Run 12 stress 0.1151604
## Run 13 stress 0.1134991
## Run 14 stress 0.1197453
## Run 15 stress 0.1204127
## Run 16 stress 0.1119874
## ... Procrustes: rmse 0.008239482  max resid 0.03030317
## Run 17 stress 0.1123598
## ... Procrustes: rmse 0.02557895  max resid 0.09650802
## Run 18 stress 0.1158112
## Run 19 stress 0.1134997
## Run 20 stress 0.1133048
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1119998
## ... New best solution
## ... Procrustes: rmse 0.04469802  max resid 0.2335473
## Run 2 stress 0.1134999
## Run 3 stress 0.1119655
## ... New best solution
## ... Procrustes: rmse 0.005154994  max resid 0.02331729
## Run 4 stress 0.1138012
## Run 5 stress 0.1121104
## ... Procrustes: rmse 0.02546952  max resid 0.0947546
## Run 6 stress 0.111997
## ... Procrustes: rmse 0.005593313  max resid 0.02333222
## Run 7 stress 0.1119753
## ... Procrustes: rmse 0.001370474  max resid 0.005065498
## ... Similar to previous best
## Run 8 stress 0.1182288
## Run 9 stress 0.1119437
## ... New best solution
## ... Procrustes: rmse 0.01276825  max resid 0.04714022
## Run 10 stress 0.1119681
## ... Procrustes: rmse 0.004037602  max resid 0.01503488
## Run 11 stress 0.1120658
## ... Procrustes: rmse 0.02202786  max resid 0.08198929
## Run 12 stress 0.1154724
## Run 13 stress 0.1204137
## Run 14 stress 0.1120187
## ... Procrustes: rmse 0.008607951  max resid 0.03259918
## Run 15 stress 0.1179041
## Run 16 stress 0.1120457
## ... Procrustes: rmse 0.02076917  max resid 0.07697765
## Run 17 stress 0.1119566
## ... Procrustes: rmse 0.01146818  max resid 0.04210769
```

```
## Run 18 stress 0.1132404
## Run 19 stress 0.1136055
## Run 20 stress 0.1154595
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1181985
## Run 2 stress 0.1135565
## ... Procrustes: rmse 0.007879306  max resid 0.03049034
## Run 3 stress 0.1182273
## Run 4 stress 0.1194081
## Run 5 stress 0.1183407
## Run 6 stress 0.1147941
## Run 7 stress 0.1121074
## ... New best solution
## ... Procrustes: rmse 0.05363646  max resid 0.2945547
## Run 8 stress 0.1119592
## ... New best solution
## ... Procrustes: rmse 0.02521874  max resid 0.09293968
## Run 9 stress 0.1194078
## Run 10 stress 0.1155943
## Run 11 stress 0.119931
## Run 12 stress 0.1256791
## Run 13 stress 0.1119834
## ... Procrustes: rmse 0.01757036  max resid 0.06538181
## Run 14 stress 0.1134989
## Run 15 stress 0.1131903
## Run 16 stress 0.1131763
## Run 17 stress 0.1150873
## Run 18 stress 0.1119694
## ... Procrustes: rmse 0.01606846  max resid 0.05961147
## Run 19 stress 0.1137884
## Run 20 stress 0.1134989
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     12: no. of iterations >= maxit
##      8: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.112059
## ... New best solution
## ... Procrustes: rmse 0.04322629  max resid 0.2046804
## Run 2 stress 0.1121081
## ... Procrustes: rmse 0.002338835  max resid 0.009536669
## ... Similar to previous best
## Run 3 stress 0.1188411
## Run 4 stress 0.1135023
## Run 5 stress 0.1120514
## ... New best solution
## ... Procrustes: rmse 0.02759539  max resid 0.1034861
## Run 6 stress 0.1159004
## Run 7 stress 0.1134996
## Run 8 stress 0.1204134
## Run 9 stress 0.1134999
## Run 10 stress 0.1119749
```

```
## ... New best solution
## ... Procrustes: rmse 0.02023938  max resid 0.07368241
## Run 11 stress 0.1131654
## Run 12 stress 0.1142097
## Run 13 stress 0.1255736
## Run 14 stress 0.1135005
## Run 15 stress 0.1134985
## Run 16 stress 0.1120314
## ... Procrustes: rmse 0.005798947  max resid 0.02225591
## Run 17 stress 0.1119436
## ... New best solution
## ... Procrustes: rmse 0.01401975  max resid 0.05184003
## Run 18 stress 0.1192932
## Run 19 stress 0.1134994
## Run 20 stress 0.112055
## ... Procrustes: rmse 0.0170937  max resid 0.0628493
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1123462
## ... New best solution
## ... Procrustes: rmse 0.04538526  max resid 0.2421219
## Run 2 stress 0.1135066
## Run 3 stress 0.1120097
## ... New best solution
## ... Procrustes: rmse 0.009312234  max resid 0.03153305
## Run 4 stress 0.1120789
## ... Procrustes: rmse 0.005877532  max resid 0.02361223
## Run 5 stress 0.1134986
## Run 6 stress 0.1156343
## Run 7 stress 0.1119567
## ... New best solution
## ... Procrustes: rmse 0.02003934  max resid 0.07443794
## Run 8 stress 0.1194078
## Run 9 stress 0.1120002
## ... Procrustes: rmse 0.01912454  max resid 0.07047879
## Run 10 stress 0.1165131
## Run 11 stress 0.11245
## ... Procrustes: rmse 0.02400956  max resid 0.09086412
## Run 12 stress 0.1120009
## ... Procrustes: rmse 0.004928738  max resid 0.01867805
## Run 13 stress 0.1132811
## Run 14 stress 0.1141548
## Run 15 stress 0.1134997
## Run 16 stress 0.113499
## Run 17 stress 0.1120095
## ... Procrustes: rmse 0.02001861  max resid 0.07379817
## Run 18 stress 0.1154859
## Run 19 stress 0.1134987
## Run 20 stress 0.1119932
## ... Procrustes: rmse 0.00261671  max resid 0.009749843
## ... Similar to previous best
## *** Best solution repeated 1 times
```

```
## Run 0 stress 0.1134992
## Run 1 stress 0.1240112
## Run 2 stress 0.1177129
## Run 3 stress 0.1119937
## ... New best solution
## ... Procrustes: rmse 0.0503759  max resid 0.2773224
## Run 4 stress 0.1198843
## Run 5 stress 0.1204129
## Run 6 stress 0.1134999
## Run 7 stress 0.1148372
## Run 8 stress 0.1120362
## ... Procrustes: rmse 0.003486026  max resid 0.01357529
## Run 9 stress 0.1131473
## Run 10 stress 0.1135285
## Run 11 stress 0.1204151
## Run 12 stress 0.1120245
## ... Procrustes: rmse 0.02394081  max resid 0.08876587
## Run 13 stress 0.1198966
## Run 14 stress 0.112006
## ... Procrustes: rmse 0.001216359  max resid 0.003894006
## ... Similar to previous best
## Run 15 stress 0.1134999
## Run 16 stress 0.1133497
## Run 17 stress 0.1148001
## Run 18 stress 0.1120628
## ... Procrustes: rmse 0.02778755  max resid 0.10393
## Run 19 stress 0.115713
## Run 20 stress 0.1134165
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1134987
## ... New best solution
## ... Procrustes: rmse 0.001585675  max resid 0.007897241
## ... Similar to previous best
## Run 2 stress 0.1134193
## ... New best solution
## ... Procrustes: rmse 0.04997588  max resid 0.2060797
## Run 3 stress 0.1194089
## Run 4 stress 0.1197311
## Run 5 stress 0.1201314
## Run 6 stress 0.1135279
## ... Procrustes: rmse 0.04907185  max resid 0.2033078
## Run 7 stress 0.1134996
## ... Procrustes: rmse 0.04980876  max resid 0.2057728
## Run 8 stress 0.1194081
## Run 9 stress 0.1132059
## ... New best solution
## ... Procrustes: rmse 0.02389322  max resid 0.0943725
## Run 10 stress 0.1119675
## ... New best solution
## ... Procrustes: rmse 0.01944371  max resid 0.1027608
## Run 11 stress 0.111973
## ... Procrustes: rmse 0.0006629884  max resid 0.002504519
## ... Similar to previous best
```

```
## Run 12 stress 0.1131479
## Run 13 stress 0.1119358
## ... New best solution
## ... Procrustes: rmse 0.007126019  max resid 0.02618987
## Run 14 stress 0.1131765
## Run 15 stress 0.1131886
## Run 16 stress 0.1119455
## ... Procrustes: rmse 0.003310043  max resid 0.01199913
## Run 17 stress 0.1135549
## Run 18 stress 0.1195812
## Run 19 stress 0.1134991
## Run 20 stress 0.1120274
## ... Procrustes: rmse 0.01255459  max resid 0.04721223
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     12: no. of iterations >= maxit
##      8: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.112017
## ... New best solution
## ... Procrustes: rmse 0.04405722  max resid 0.2258232
## Run 2 stress 0.1121661
## ... Procrustes: rmse 0.005276416  max resid 0.02190408
## Run 3 stress 0.1119409
## ... New best solution
## ... Procrustes: rmse 0.005600476  max resid 0.02272955
## Run 4 stress 0.1167368
## Run 5 stress 0.1119372
## ... New best solution
## ... Procrustes: rmse 0.00142609  max resid 0.005144853
## ... Similar to previous best
## Run 6 stress 0.120312
## Run 7 stress 0.1134986
## Run 8 stress 0.1119717
## ... Procrustes: rmse 0.01131279  max resid 0.04196854
## Run 9 stress 0.1196628
## Run 10 stress 0.1135004
## Run 11 stress 0.1120082
## ... Procrustes: rmse 0.01083505  max resid 0.03971624
## Run 12 stress 0.1119351
## ... New best solution
## ... Procrustes: rmse 0.00196765  max resid 0.007201497
## ... Similar to previous best
## Run 13 stress 0.1199195
## Run 14 stress 0.1119808
## ... Procrustes: rmse 0.009921878  max resid 0.0363687
## Run 15 stress 0.1119424
## ... Procrustes: rmse 0.004576726  max resid 0.01683996
## Run 16 stress 0.1148314
## Run 17 stress 0.1134983
## Run 18 stress 0.1183083
## Run 19 stress 0.115459
## Run 20 stress 0.1203961
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
```

```
## Run 1 stress 0.1119602
## ... New best solution
## ... Procrustes: rmse 0.04872259  max resid 0.2674454
## Run 2 stress 0.1120673
## ... Procrustes: rmse 0.02506339  max resid 0.09351242
## Run 3 stress 0.1120847
## ... Procrustes: rmse 0.02590359  max resid 0.09700468
## Run 4 stress 0.1119505
## ... New best solution
## ... Procrustes: rmse 0.01346263  max resid 0.04951332
## Run 5 stress 0.1135416
## Run 6 stress 0.1119525
## ... Procrustes: rmse 0.0122155  max resid 0.04510609
## Run 7 stress 0.1134865
## Run 8 stress 0.1180229
## Run 9 stress 0.1127481
## Run 10 stress 0.1120709
## ... Procrustes: rmse 0.02191162  max resid 0.08033636
## Run 11 stress 0.1181933
## Run 12 stress 0.1119647
## ... Procrustes: rmse 0.01406651  max resid 0.05208041
## Run 13 stress 0.1179157
## Run 14 stress 0.1134992
## Run 15 stress 0.1119453
## ... New best solution
## ... Procrustes: rmse 0.01088325  max resid 0.0401288
## Run 16 stress 0.1135358
## Run 17 stress 0.1134986
## Run 18 stress 0.1135038
## Run 19 stress 0.114833
## Run 20 stress 0.1134995
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1203999
## Run 2 stress 0.1148285
## Run 3 stress 0.1133203
## ... New best solution
## ... Procrustes: rmse 0.0474269  max resid 0.2136426
## Run 4 stress 0.1119494
## ... New best solution
## ... Procrustes: rmse 0.02076011  max resid 0.09041786
## Run 5 stress 0.1162813
## Run 6 stress 0.1121863
## ... Procrustes: rmse 0.01869017  max resid 0.0732445
## Run 7 stress 0.1119365
## ... New best solution
## ... Procrustes: rmse 0.007612765  max resid 0.02792384
## Run 8 stress 0.1148256
## Run 9 stress 0.1119852
## ... Procrustes: rmse 0.008509497  max resid 0.03175362
## Run 10 stress 0.1202824
## Run 11 stress 0.1204209
```

```
## Run 12 stress 0.1132001
## Run 13 stress 0.1119523
## ... Procrustes: rmse 0.004458866  max resid 0.01647143
## Run 14 stress 0.1119637
## ... Procrustes: rmse 0.006177732  max resid 0.0228976
## Run 15 stress 0.1120407
## ... Procrustes: rmse 0.01626947  max resid 0.05977187
## Run 16 stress 0.1134989
## Run 17 stress 0.1180244
## Run 18 stress 0.1139509
## Run 19 stress 0.1134992
## Run 20 stress 0.1139667
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.113499
## ... New best solution
## ... Procrustes: rmse 0.001718758  max resid 0.00860223
## ... Similar to previous best
## Run 2 stress 0.1134996
## ... Procrustes: rmse 0.0004649115  max resid 0.001960359
## ... Similar to previous best
## Run 3 stress 0.112004
## ... New best solution
## ... Procrustes: rmse 0.04495786  max resid 0.2305433
## Run 4 stress 0.1120823
## ... Procrustes: rmse 0.01414676  max resid 0.05191234
## Run 5 stress 0.114808
## Run 6 stress 0.1119417
## ... New best solution
## ... Procrustes: rmse 0.004130429  max resid 0.02256525
## Run 7 stress 0.1174048
## Run 8 stress 0.1192462
## Run 9 stress 0.1120979
## ... Procrustes: rmse 0.01627318  max resid 0.062681
## Run 10 stress 0.1168471
## Run 11 stress 0.1119565
## ... Procrustes: rmse 0.01093814  max resid 0.04033702
## Run 12 stress 0.1131893
## Run 13 stress 0.1135006
## Run 14 stress 0.1149597
## Run 15 stress 0.1194087
## Run 16 stress 0.1156714
## Run 17 stress 0.1203542
## Run 18 stress 0.1121131
## ... Procrustes: rmse 0.01549688  max resid 0.06066364
## Run 19 stress 0.1146319
## Run 20 stress 0.1135491
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1134994
```

```
## ... Procrustes: rmse 0.0004044916  max resid 0.001582549
## ... Similar to previous best
## Run 2 stress 0.1119358
## ... New best solution
## ... Procrustes: rmse 0.04546522  max resid 0.2442366
## Run 3 stress 0.1119437
## ... Procrustes: rmse 0.005689723  max resid 0.02126718
## Run 4 stress 0.1120036
## ... Procrustes: rmse 0.01248577  max resid 0.04689033
## Run 5 stress 0.1134991
## Run 6 stress 0.1120357
## ... Procrustes: rmse 0.01448767  max resid 0.05346809
## Run 7 stress 0.1135187
## Run 8 stress 0.1203988
## Run 9 stress 0.1120043
## ... Procrustes: rmse 0.006068407  max resid 0.02397379
## Run 10 stress 0.1154493
## Run 11 stress 0.1135002
## Run 12 stress 0.1121935
## ... Procrustes: rmse 0.02374065  max resid 0.09062623
## Run 13 stress 0.1173954
## Run 14 stress 0.1120676
## ... Procrustes: rmse 0.01695263  max resid 0.06365756
## Run 15 stress 0.1120038
## ... Procrustes: rmse 0.01308551  max resid 0.04886319
## Run 16 stress 0.1119696
## ... Procrustes: rmse 0.007786709  max resid 0.0282522
## Run 17 stress 0.1120209
## ... Procrustes: rmse 0.01318005  max resid 0.04819848
## Run 18 stress 0.1120466
## ... Procrustes: rmse 0.01538034  max resid 0.05714988
## Run 19 stress 0.1119634
## ... Procrustes: rmse 0.009088122  max resid 0.03394244
## Run 20 stress 0.1201346
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1139227
## ... Procrustes: rmse 0.06296227  max resid 0.3235967
## Run 2 stress 0.1120137
## ... New best solution
## ... Procrustes: rmse 0.04289312  max resid 0.2116197
## Run 3 stress 0.1134989
## Run 4 stress 0.1189792
## Run 5 stress 0.1148265
## Run 6 stress 0.1135001
## Run 7 stress 0.1131809
## Run 8 stress 0.1194088
## Run 9 stress 0.1120215
## ... Procrustes: rmse 0.0007436589  max resid 0.002912907
## ... Similar to previous best
## Run 10 stress 0.1188212
## Run 11 stress 0.1120595
```

```
## ... Procrustes: rmse 0.003796705  max resid 0.01522936
## Run 12 stress 0.1131782
## Run 13 stress 0.1120468
## ... Procrustes: rmse 0.002964949  max resid 0.01183996
## Run 14 stress 0.1120305
## ... Procrustes: rmse 0.001539411  max resid 0.006074847
## ... Similar to previous best
## Run 15 stress 0.1119831
## ... New best solution
## ... Procrustes: rmse 0.02352226  max resid 0.08786907
## Run 16 stress 0.1119712
## ... New best solution
## ... Procrustes: rmse 0.001504545  max resid 0.005672914
## ... Similar to previous best
## Run 17 stress 0.1119887
## ... Procrustes: rmse 0.0196726  max resid 0.07264936
## Run 18 stress 0.1194686
## Run 19 stress 0.1135225
## Run 20 stress 0.1162313
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1204114
## Run 2 stress 0.1196113
## Run 3 stress 0.1163774
## Run 4 stress 0.1119416
## ... New best solution
## ... Procrustes: rmse 0.04723514  max resid 0.2575533
## Run 5 stress 0.1134983
## Run 6 stress 0.1120262
## ... Procrustes: rmse 0.01862584  max resid 0.06859512
## Run 7 stress 0.1132112
## Run 8 stress 0.1200335
## Run 9 stress 0.1121554
## ... Procrustes: rmse 0.02684385  max resid 0.1018708
## Run 10 stress 0.1202417
## Run 11 stress 0.1175946
## Run 12 stress 0.1176149
## Run 13 stress 0.1120266
## ... Procrustes: rmse 0.01848917  max resid 0.06806521
## Run 14 stress 0.1204127
## Run 15 stress 0.1137586
## Run 16 stress 0.1134994
## Run 17 stress 0.1127162
## Run 18 stress 0.1119799
## ... Procrustes: rmse 0.005953377  max resid 0.02233286
## Run 19 stress 0.1162347
## Run 20 stress 0.1197244
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1183135
## Run 2 stress 0.1169634
## Run 3 stress 0.1120055
```

```
## ... New best solution
## ... Procrustes: rmse 0.04442344  max resid 0.2304348
## Run 4 stress 0.1132295
## Run 5 stress 0.1212641
## Run 6 stress 0.112079
## ... Procrustes: rmse 0.01340484  max resid 0.04915684
## Run 7 stress 0.1135202
## Run 8 stress 0.1119495
## ... New best solution
## ... Procrustes: rmse 0.01235764  max resid 0.04317491
## Run 9 stress 0.1148372
## Run 10 stress 0.1120015
## ... Procrustes: rmse 0.006025473  max resid 0.02257575
## Run 11 stress 0.1148227
## Run 12 stress 0.1132842
## Run 13 stress 0.1148266
## Run 14 stress 0.115643
## Run 15 stress 0.111969
## ... Procrustes: rmse 0.01420199  max resid 0.05221545
## Run 16 stress 0.1119971
## ... Procrustes: rmse 0.004758106  max resid 0.01783644
## Run 17 stress 0.1120286
## ... Procrustes: rmse 0.02056176  max resid 0.0759651
## Run 18 stress 0.1148043
## Run 19 stress 0.1199311
## Run 20 stress 0.120386
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.111957
## ... New best solution
## ... Procrustes: rmse 0.04848101  max resid 0.2658673
## Run 2 stress 0.11339
## Run 3 stress 0.1131891
## Run 4 stress 0.1119497
## ... New best solution
## ... Procrustes: rmse 0.001083399  max resid 0.003991757
## ... Similar to previous best
## Run 5 stress 0.1119354
## ... New best solution
## ... Procrustes: rmse 0.006822905  max resid 0.02530229
## Run 6 stress 0.1135039
## Run 7 stress 0.1192342
## Run 8 stress 0.1155574
## Run 9 stress 0.1140753
## Run 10 stress 0.1122075
## ... Procrustes: rmse 0.009412458  max resid 0.03209583
## Run 11 stress 0.1119578
## ... Procrustes: rmse 0.008111576  max resid 0.03014937
## Run 12 stress 0.1223155
## Run 13 stress 0.1120141
## ... Procrustes: rmse 0.01390381  max resid 0.05235496
## Run 14 stress 0.111957
```

```
## ... Procrustes: rmse 0.008003949  max resid 0.02975185
## Run 15 stress 0.1135068
## Run 16 stress 0.1119506
## ... Procrustes: rmse 0.006991999  max resid 0.02599452
## Run 17 stress 0.1194292
## Run 18 stress 0.1192866
## Run 19 stress 0.1119569
## ... Procrustes: rmse 0.00800215  max resid 0.02973933
## Run 20 stress 0.1119754
## ... Procrustes: rmse 0.008028552  max resid 0.02980994
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     19: no. of iterations >= maxit
##      1: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1134988
## ... New best solution
## ... Procrustes: rmse 0.001222207  max resid 0.004714345
## ... Similar to previous best
## Run 2 stress 0.1121203
## ... New best solution
## ... Procrustes: rmse 0.05437982  max resid 0.2957163
## Run 3 stress 0.114924
## Run 4 stress 0.1120733
## ... New best solution
## ... Procrustes: rmse 0.03570641  max resid 0.1341912
## Run 5 stress 0.114822
## Run 6 stress 0.1192574
## Run 7 stress 0.1204126
## Run 8 stress 0.114128
## Run 9 stress 0.1218179
## Run 10 stress 0.1120747
## ... Procrustes: rmse 0.000117953  max resid 0.0004544336
## ... Similar to previous best
## Run 11 stress 0.1132222
## Run 12 stress 0.1120133
## ... New best solution
## ... Procrustes: rmse 0.005104528  max resid 0.02052608
## Run 13 stress 0.1134995
## Run 14 stress 0.1131907
## Run 15 stress 0.1120322
## ... Procrustes: rmse 0.001769378  max resid 0.006967339
## ... Similar to previous best
## Run 16 stress 0.1196751
## Run 17 stress 0.1154858
## Run 18 stress 0.1135969
## Run 19 stress 0.1188525
## Run 20 stress 0.1204122
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1121051
## ... New best solution
## ... Procrustes: rmse 0.05194457  max resid 0.2856885
## Run 2 stress 0.1131568
## Run 3 stress 0.112116
```

```
## ... Procrustes: rmse 0.03477081  max resid 0.1315683
## Run 4 stress 0.1119708
## ... New best solution
## ... Procrustes: rmse 0.02375307  max resid 0.08773417
## Run 5 stress 0.1241052
## Run 6 stress 0.1119439
## ... New best solution
## ... Procrustes: rmse 0.01361199  max resid 0.05030297
## Run 7 stress 0.1120183
## ... Procrustes: rmse 0.008469198  max resid 0.03140988
## Run 8 stress 0.1202471
## Run 9 stress 0.1131522
## Run 10 stress 0.1162356
## Run 11 stress 0.1199036
## Run 12 stress 0.1154333
## Run 13 stress 0.111969
## ... Procrustes: rmse 0.004056947  max resid 0.01510929
## Run 14 stress 0.1119486
## ... Procrustes: rmse 0.01022475  max resid 0.03751268
## Run 15 stress 0.1120224
## ... Procrustes: rmse 0.008992436  max resid 0.03411088
## Run 16 stress 0.1119973
## ... Procrustes: rmse 0.009609335  max resid 0.03223541
## Run 17 stress 0.1120211
## ... Procrustes: rmse 0.01877532  max resid 0.06920548
## Run 18 stress 0.1154395
## Run 19 stress 0.1197103
## Run 20 stress 0.1119654
## ... Procrustes: rmse 0.003625877  max resid 0.01348123
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1134989
## ... New best solution
## ... Procrustes: rmse 0.001665608  max resid 0.008213298
## ... Similar to previous best
## Run 2 stress 0.1176213
## Run 3 stress 0.1134987
## ... New best solution
## ... Procrustes: rmse 0.0002169421  max resid 0.0007799542
## ... Similar to previous best
## Run 4 stress 0.1119965
## ... New best solution
## ... Procrustes: rmse 0.05098238  max resid 0.2774085
## Run 5 stress 0.1135424
## Run 6 stress 0.112089
## ... Procrustes: rmse 0.006259943  max resid 0.02340352
## Run 7 stress 0.1119415
## ... New best solution
## ... Procrustes: rmse 0.00737126  max resid 0.02759635
## Run 8 stress 0.1148363
## Run 9 stress 0.1135018
## Run 10 stress 0.1119522
```

```
## ... Procrustes: rmse 0.002307755  max resid 0.008547825
## ... Similar to previous best
## Run 11 stress 0.1218376
## Run 12 stress 0.1135495
## Run 13 stress 0.1119686
## ... Procrustes: rmse 0.0123337  max resid 0.04527405
## Run 14 stress 0.1120662
## ... Procrustes: rmse 0.02171777  max resid 0.08086453
## Run 15 stress 0.119306
## Run 16 stress 0.1120281
## ... Procrustes: rmse 0.01878115  max resid 0.06927656
## Run 17 stress 0.1119468
## ... Procrustes: rmse 0.001261811  max resid 0.004674044
## ... Similar to previous best
## Run 18 stress 0.1173083
## Run 19 stress 0.1154615
## Run 20 stress 0.117702
## *** Best solution repeated 2 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1119585
## ... New best solution
## ... Procrustes: rmse 0.04857759  max resid 0.2665511
## Run 2 stress 0.1120663
## ... Procrustes: rmse 0.02475644  max resid 0.09238711
## Run 3 stress 0.1183607
## Run 4 stress 0.1135453
## Run 5 stress 0.1120452
## ... Procrustes: rmse 0.007699718  max resid 0.02812344
## Run 6 stress 0.1135111
## Run 7 stress 0.1119356
## ... New best solution
## ... Procrustes: rmse 0.008311325  max resid 0.03090171
## Run 8 stress 0.1120522
## ... Procrustes: rmse 0.01587197  max resid 0.05930009
## Run 9 stress 0.1131478
## Run 10 stress 0.1175359
## Run 11 stress 0.1135003
## Run 12 stress 0.116547
## Run 13 stress 0.1169937
## Run 14 stress 0.1134997
## Run 15 stress 0.112001
## ... Procrustes: rmse 0.005512152  max resid 0.02215832
## Run 16 stress 0.1200901
## Run 17 stress 0.1203991
## Run 18 stress 0.1194079
## Run 19 stress 0.1120237
## ... Procrustes: rmse 0.0145073  max resid 0.05404646
## Run 20 stress 0.1194087
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1119477
## ... New best solution
```

```
## ... Procrustes: rmse 0.04784845  max resid 0.261721
## Run 2 stress 0.1180233
## Run 3 stress 0.11321
## Run 4 stress 0.1134988
## Run 5 stress 0.1120248
## ... Procrustes: rmse 0.008337403  max resid 0.03169631
## Run 6 stress 0.1195321
## Run 7 stress 0.1134998
## Run 8 stress 0.1135064
## Run 9 stress 0.1120011
## ... Procrustes: rmse 0.01123125  max resid 0.03856971
## Run 10 stress 0.1119801
## ... Procrustes: rmse 0.01552846  max resid 0.05716077
## Run 11 stress 0.1135318
## Run 12 stress 0.1135594
## Run 13 stress 0.1138897
## Run 14 stress 0.113511
## Run 15 stress 0.1194024
## Run 16 stress 0.1119444
## ... New best solution
## ... Procrustes: rmse 0.001104873  max resid 0.004079095
## ... Similar to previous best
## Run 17 stress 0.1201308
## Run 18 stress 0.1241047
## Run 19 stress 0.120241
## Run 20 stress 0.1188468
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1191303
## Run 2 stress 0.1184397
## Run 3 stress 0.1204457
## Run 4 stress 0.1137372
## ... Procrustes: rmse 0.01658397  max resid 0.07134853
## Run 5 stress 0.1120386
## ... New best solution
## ... Procrustes: rmse 0.04299023  max resid 0.2073297
## Run 6 stress 0.1184171
## Run 7 stress 0.111943
## ... New best solution
## ... Procrustes: rmse 0.0197503  max resid 0.07353368
## Run 8 stress 0.111943
## ... Procrustes: rmse 0.0003165795  max resid 0.001124888
## ... Similar to previous best
## Run 9 stress 0.1182521
## Run 10 stress 0.1120614
## ... Procrustes: rmse 0.02075068  max resid 0.07700017
## Run 11 stress 0.1119975
## ... Procrustes: rmse 0.00909066  max resid 0.03019637
## Run 12 stress 0.1202356
## Run 13 stress 0.1119547
## ... Procrustes: rmse 0.002610832  max resid 0.009667708
## ... Similar to previous best
## Run 14 stress 0.117496
## Run 15 stress 0.1199103
```

```
## Run 16 stress 0.1119712
## ... Procrustes: rmse 0.01312812  max resid 0.04822374
## Run 17 stress 0.1148313
## Run 18 stress 0.111942
## ... New best solution
## ... Procrustes: rmse 0.008061935  max resid 0.02997031
## Run 19 stress 0.1119702
## ... Procrustes: rmse 0.01277822  max resid 0.04775225
## Run 20 stress 0.1134995
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1176415
## Run 2 stress 0.1120146
## ... New best solution
## ... Procrustes: rmse 0.04293285  max resid 0.2161424
## Run 3 stress 0.1179026
## Run 4 stress 0.111943
## ... New best solution
## ... Procrustes: rmse 0.01577406  max resid 0.05836287
## Run 5 stress 0.1119516
## ... Procrustes: rmse 0.00177965  max resid 0.00657905
## ... Similar to previous best
## Run 6 stress 0.1135146
## Run 7 stress 0.1136248
## Run 8 stress 0.1182304
## Run 9 stress 0.1235935
## Run 10 stress 0.1156401
## Run 11 stress 0.1120975
## ... Procrustes: rmse 0.02355819  max resid 0.08821448
## Run 12 stress 0.1120215
## ... Procrustes: rmse 0.01332796  max resid 0.04663639
## Run 13 stress 0.1196448
## Run 14 stress 0.1135292
## Run 15 stress 0.111946
## ... Procrustes: rmse 0.0007033682  max resid 0.002593253
## ... Similar to previous best
## Run 16 stress 0.1197314
## Run 17 stress 0.1120898
## ... Procrustes: rmse 0.02351382  max resid 0.08819275
## Run 18 stress 0.1200907
## Run 19 stress 0.1134998
## Run 20 stress 0.1119742
## ... Procrustes: rmse 0.004925295  max resid 0.0183746
## *** Best solution repeated 2 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1197535
## Run 2 stress 0.1132068
## ... New best solution
## ... Procrustes: rmse 0.0490443  max resid 0.2559863
## Run 3 stress 0.1120051
## ... New best solution
## ... Procrustes: rmse 0.01997113  max resid 0.09721211
```

```
## Run 4 stress 0.1134989
## Run 5 stress 0.1134991
## Run 6 stress 0.1120892
## ... Procrustes: rmse 0.007046196  max resid 0.02831684
## Run 7 stress 0.1119458
## ... New best solution
## ... Procrustes: rmse 0.01770618  max resid 0.06560391
## Run 8 stress 0.1135163
## Run 9 stress 0.1119411
## ... New best solution
## ... Procrustes: rmse 0.001162058  max resid 0.004306661
## ... Similar to previous best
## Run 10 stress 0.1131453
## Run 11 stress 0.1119435
## ... Procrustes: rmse 0.000647303  max resid 0.00239388
## ... Similar to previous best
## Run 12 stress 0.1134991
## Run 13 stress 0.1204143
## Run 14 stress 0.1131862
## Run 15 stress 0.1120003
## ... Procrustes: rmse 0.00955813  max resid 0.03199759
## Run 16 stress 0.1135477
## Run 17 stress 0.1134991
## Run 18 stress 0.1162341
## Run 19 stress 0.1121343
## ... Procrustes: rmse 0.01533695  max resid 0.053447
## Run 20 stress 0.1147996
## *** Best solution repeated 2 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1121603
## ... New best solution
## ... Procrustes: rmse 0.04496343  max resid 0.196196
## Run 2 stress 0.1154816
## Run 3 stress 0.1188433
## Run 4 stress 0.1119667
## ... New best solution
## ... Procrustes: rmse 0.01557873  max resid 0.06145442
## Run 5 stress 0.1120093
## ... Procrustes: rmse 0.004785785  max resid 0.01802485
## Run 6 stress 0.1153263
## Run 7 stress 0.1134997
## Run 8 stress 0.1135001
## Run 9 stress 0.1121009
## ... Procrustes: rmse 0.02602314  max resid 0.1002939
## Run 10 stress 0.1119727
## ... Procrustes: rmse 0.01748052  max resid 0.0649375
## Run 11 stress 0.1134987
## Run 12 stress 0.1200419
## Run 13 stress 0.1119355
## ... New best solution
## ... Procrustes: rmse 0.007895131  max resid 0.02957011
## Run 14 stress 0.1136436
## Run 15 stress 0.1119463
## ... Procrustes: rmse 0.005790456  max resid 0.02081137
```

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## Run 16 stress 0.1133289
## Run 17 stress 0.1119987
## ... Procrustes: rmse 0.005399785  max resid 0.02195331
## Run 18 stress 0.1148303
## Run 19 stress 0.1128668
## Run 20 stress 0.1119799
## ... Procrustes: rmse 0.009530473  max resid 0.03551985
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1135
## ... Procrustes: rmse 0.002107503  max resid 0.01101555
## Run 2 stress 0.1120462
## ... New best solution
## ... Procrustes: rmse 0.05227245  max resid 0.2874677
## Run 3 stress 0.1134991
## Run 4 stress 0.1136441
## Run 5 stress 0.1135113
## Run 6 stress 0.1131874
## Run 7 stress 0.1120051
## ... New best solution
## ... Procrustes: rmse 0.002941051  max resid 0.01160942
## Run 8 stress 0.1120954
## ... Procrustes: rmse 0.0311647  max resid 0.1177301
## Run 9 stress 0.1163906
## Run 10 stress 0.1119986
## ... New best solution
## ... Procrustes: rmse 0.01716012  max resid 0.06185808
## Run 11 stress 0.1134987
## Run 12 stress 0.113921
## Run 13 stress 0.1131878
## Run 14 stress 0.1200513
## Run 15 stress 0.1134997
## Run 16 stress 0.1168153
## Run 17 stress 0.1148356
## Run 18 stress 0.113553
## Run 19 stress 0.1156353
## Run 20 stress 0.1121826
## ... Procrustes: rmse 0.02597228  max resid 0.09574217
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1133684
## ... New best solution
## ... Procrustes: rmse 0.04860359  max resid 0.2102819
## Run 2 stress 0.1135241
## ... Procrustes: rmse 0.04971581  max resid 0.2066532
## Run 3 stress 0.1148249
## Run 4 stress 0.1119972
## ... New best solution
## ... Procrustes: rmse 0.01982999  max resid 0.09979632
## Run 5 stress 0.1119691
```

```
## ... New best solution
## ... Procrustes: rmse 0.003256865  max resid 0.01221769
## Run 6 stress 0.11378
## Run 7 stress 0.1196323
## Run 8 stress 0.1134992
## Run 9 stress 0.1134997
## Run 10 stress 0.1119652
## ... New best solution
## ... Procrustes: rmse 0.01686127  max resid 0.06256849
## Run 11 stress 0.1195452
## Run 12 stress 0.1134994
## Run 13 stress 0.1204132
## Run 14 stress 0.1119828
## ... Procrustes: rmse 0.00158033  max resid 0.005954598
## ... Similar to previous best
## Run 15 stress 0.1120271
## ... Procrustes: rmse 0.02255663  max resid 0.08347842
## Run 16 stress 0.1129479
## Run 17 stress 0.1194955
## Run 18 stress 0.1120277
## ... Procrustes: rmse 0.02275949  max resid 0.08425862
## Run 19 stress 0.1150018
## Run 20 stress 0.1135148
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1119593
## ... New best solution
## ... Procrustes: rmse 0.04863222  max resid 0.2668912
## Run 2 stress 0.1119699
## ... Procrustes: rmse 0.001448672  max resid 0.005453561
## ... Similar to previous best
## Run 3 stress 0.1133416
## Run 4 stress 0.1188314
## Run 5 stress 0.1120253
## ... Procrustes: rmse 0.02176557  max resid 0.08046314
## Run 6 stress 0.1120377
## ... Procrustes: rmse 0.007026332  max resid 0.02538517
## Run 7 stress 0.1119999
## ... Procrustes: rmse 0.01936771  max resid 0.07140077
## Run 8 stress 0.1204141
## Run 9 stress 0.1131659
## Run 10 stress 0.1200906
## Run 11 stress 0.113679
## Run 12 stress 0.1204133
## Run 13 stress 0.1135178
## Run 14 stress 0.1120292
## ... Procrustes: rmse 0.02208001  max resid 0.08168005
## Run 15 stress 0.1169904
## Run 16 stress 0.1135001
## Run 17 stress 0.1119435
## ... New best solution
## ... Procrustes: rmse 0.01180626  max resid 0.04339445
## Run 18 stress 0.1135018
## Run 19 stress 0.1199031
```

```
## Run 20 stress 0.1119372
## ... New best solution
## ... Procrustes: rmse 0.006710189  max resid 0.02432965
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1129736
## ... New best solution
## ... Procrustes: rmse 0.04675451  max resid 0.2385752
## Run 2 stress 0.1145236
## Run 3 stress 0.1122153
## ... New best solution
## ... Procrustes: rmse 0.03180644  max resid 0.1114524
## Run 4 stress 0.1134997
## Run 5 stress 0.1135056
## Run 6 stress 0.1119449
## ... New best solution
## ... Procrustes: rmse 0.0268516  max resid 0.1001371
## Run 7 stress 0.1131529
## Run 8 stress 0.118024
## Run 9 stress 0.120072
## Run 10 stress 0.1120582
## ... Procrustes: rmse 0.01264642  max resid 0.04835769
## Run 11 stress 0.1119555
## ... Procrustes: rmse 0.01079408  max resid 0.03980563
## Run 12 stress 0.1131506
## Run 13 stress 0.1119408
## ... New best solution
## ... Procrustes: rmse 0.008536675  max resid 0.03137762
## Run 14 stress 0.1120644
## ... Procrustes: rmse 0.01221613  max resid 0.04468373
## Run 15 stress 0.117301
## Run 16 stress 0.1185134
## Run 17 stress 0.1201415
## Run 18 stress 0.1134991
## Run 19 stress 0.1120355
## ... Procrustes: rmse 0.009967705  max resid 0.03453803
## Run 20 stress 0.1131536
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1145572
## Run 2 stress 0.1132115
## ... New best solution
## ... Procrustes: rmse 0.04721016  max resid 0.2377578
## Run 3 stress 0.1119431
## ... New best solution
## ... Procrustes: rmse 0.02038121  max resid 0.1064862
## Run 4 stress 0.1119525
## ... Procrustes: rmse 0.001924554  max resid 0.007077882
## ... Similar to previous best
## Run 5 stress 0.1180366
```

```
## Run 6 stress 0.1174061
## Run 7 stress 0.1120497
## ... Procrustes: rmse 0.02068217  max resid 0.07683767
## Run 8 stress 0.1184361
## Run 9 stress 0.1134747
## Run 10 stress 0.1135052
## Run 11 stress 0.1119903
## ... Procrustes: rmse 0.006435506  max resid 0.02218067
## Run 12 stress 0.114899
## Run 13 stress 0.1204176
## Run 14 stress 0.1162318
## Run 15 stress 0.1134517
## Run 16 stress 0.1120331
## ... Procrustes: rmse 0.01464983  max resid 0.05179475
## Run 17 stress 0.1120949
## ... Procrustes: rmse 0.02381246  max resid 0.08928425
## Run 18 stress 0.1134991
## Run 19 stress 0.1119392
## ... New best solution
## ... Procrustes: rmse 0.001141398  max resid 0.00426994
## ... Similar to previous best
## Run 20 stress 0.1159791
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1137036
## ... Procrustes: rmse 0.01367004  max resid 0.05831408
## Run 2 stress 0.1120697
## ... New best solution
## ... Procrustes: rmse 0.04328991  max resid 0.2036283
## Run 3 stress 0.1203984
## Run 4 stress 0.1204216
## Run 5 stress 0.1134987
## Run 6 stress 0.1119442
## ... New best solution
## ... Procrustes: rmse 0.02238354  max resid 0.08398958
## Run 7 stress 0.1134996
## Run 8 stress 0.1135002
## Run 9 stress 0.1135409
## Run 10 stress 0.1220136
## Run 11 stress 0.1197331
## Run 12 stress 0.1120104
## ... Procrustes: rmse 0.0118918  max resid 0.04093607
## Run 13 stress 0.1146094
## Run 14 stress 0.1119458
## ... Procrustes: rmse 0.009661991  max resid 0.03533036
## Run 15 stress 0.1134993
## Run 16 stress 0.1137931
## Run 17 stress 0.1120096
## ... Procrustes: rmse 0.0177815  max resid 0.06534197
## Run 18 stress 0.1134986
## Run 19 stress 0.1135001
## Run 20 stress 0.1120767
## ... Procrustes: rmse 0.02305255  max resid 0.08601022
## *** Best solution was not repeated -- monoMDS stopping criteria:
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```
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1148348
## Run 2 stress 0.1119356
## ... New best solution
## ... Procrustes: rmse 0.04591822  max resid 0.2480439
## Run 3 stress 0.1119967
## ... Procrustes: rmse 0.006157075  max resid 0.02171335
## Run 4 stress 0.1119828
## ... Procrustes: rmse 0.009240607  max resid 0.03458319
## Run 5 stress 0.1120935
## ... Procrustes: rmse 0.02048083  max resid 0.0769867
## Run 6 stress 0.1134942
## Run 7 stress 0.1120452
## ... Procrustes: rmse 0.01426256  max resid 0.05437296
## Run 8 stress 0.1119469
## ... Procrustes: rmse 0.004477839  max resid 0.01669344
## Run 9 stress 0.1156136
## Run 10 stress 0.1201307
## Run 11 stress 0.1119601
## ... Procrustes: rmse 0.006692684  max resid 0.02493716
## Run 12 stress 0.1120403
## ... Procrustes: rmse 0.01678134  max resid 0.0617783
## Run 13 stress 0.1119552
## ... Procrustes: rmse 0.005589992  max resid 0.02082029
## Run 14 stress 0.1148322
## Run 15 stress 0.1148324
## Run 16 stress 0.1173609
## Run 17 stress 0.1120006
## ... Procrustes: rmse 0.006907823  max resid 0.02186742
## Run 18 stress 0.1120063
## ... Procrustes: rmse 0.007950948  max resid 0.02514784
## Run 19 stress 0.119872
## Run 20 stress 0.1195933
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1134988
## ... New best solution
## ... Procrustes: rmse 0.0006104491  max resid 0.002811201
## ... Similar to previous best
## Run 2 stress 0.1163579
## Run 3 stress 0.1220763
## Run 4 stress 0.1134983
## ... New best solution
## ... Procrustes: rmse 0.000451179  max resid 0.002220242
## ... Similar to previous best
## Run 5 stress 0.1200736
## Run 6 stress 0.1134994
## ... Procrustes: rmse 0.0009732075  max resid 0.004648248
## ... Similar to previous best
## Run 7 stress 0.1120583
```

```
## ... New best solution
## ... Procrustes: rmse 0.04345959  max resid 0.2052523
## Run 8 stress 0.1131511
## Run 9 stress 0.1120859
## ... Procrustes: rmse 0.00206626  max resid 0.008485543
## ... Similar to previous best
## Run 10 stress 0.1120031
## ... New best solution
## ... Procrustes: rmse 0.004975828  max resid 0.01968356
## Run 11 stress 0.1134992
## Run 12 stress 0.111947
## ... New best solution
## ... Procrustes: rmse 0.01769314  max resid 0.06555484
## Run 13 stress 0.1204117
## Run 14 stress 0.1156763
## Run 15 stress 0.1119973
## ... Procrustes: rmse 0.001533066  max resid 0.005381613
## ... Similar to previous best
## Run 16 stress 0.1119354
## ... New best solution
## ... Procrustes: rmse 0.00398913  max resid 0.01470148
## Run 17 stress 0.1119732
## ... Procrustes: rmse 0.007949713  max resid 0.02955269
## Run 18 stress 0.112032
## ... Procrustes: rmse 0.01647071  max resid 0.0606322
## Run 19 stress 0.1135038
## Run 20 stress 0.1119926
## ... Procrustes: rmse 0.01276718  max resid 0.04683211
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1186077
## Run 2 stress 0.1119724
## ... New best solution
## ... Procrustes: rmse 0.04941024  max resid 0.271666
## Run 3 stress 0.1119974
## ... Procrustes: rmse 0.002483256  max resid 0.00907274
## ... Similar to previous best
## Run 4 stress 0.113499
## Run 5 stress 0.1132929
## Run 6 stress 0.1131484
## Run 7 stress 0.1181029
## Run 8 stress 0.1150206
## Run 9 stress 0.1202687
## Run 10 stress 0.1156805
## Run 11 stress 0.112069
## ... Procrustes: rmse 0.02648509  max resid 0.09903269
## Run 12 stress 0.1162384
## Run 13 stress 0.1135001
## Run 14 stress 0.1119674
## ... New best solution
## ... Procrustes: rmse 0.0007709705  max resid 0.002883509
## ... Similar to previous best
```

```
## Run 15 stress 0.117644
## Run 16 stress 0.1168636
## Run 17 stress 0.113611
## Run 18 stress 0.1121135
## ... Procrustes: rmse 0.0286048  max resid 0.1079865
## Run 19 stress 0.1199131
## Run 20 stress 0.1131519
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1132135
## ... New best solution
## ... Procrustes: rmse 0.05482702  max resid 0.2984532
## Run 2 stress 0.112069
## ... New best solution
## ... Procrustes: rmse 0.03568977  max resid 0.1170074
## Run 3 stress 0.1135931
## Run 4 stress 0.1135008
## Run 5 stress 0.1200921
## Run 6 stress 0.1133448
## Run 7 stress 0.1183456
## Run 8 stress 0.1162609
## Run 9 stress 0.113499
## Run 10 stress 0.1195772
## Run 11 stress 0.1203008
## Run 12 stress 0.1163319
## Run 13 stress 0.1135372
## Run 14 stress 0.1119504
## ... New best solution
## ... Procrustes: rmse 0.01237779  max resid 0.04764178
## Run 15 stress 0.1135028
## Run 16 stress 0.1153333
## Run 17 stress 0.1126156
## Run 18 stress 0.1165917
## Run 19 stress 0.1148262
## Run 20 stress 0.1134993
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1120492
## ... New best solution
## ... Procrustes: rmse 0.04308892  max resid 0.2058307
## Run 2 stress 0.1154719
## Run 3 stress 0.1167664
## Run 4 stress 0.1119448
## ... New best solution
## ... Procrustes: rmse 0.02123954  max resid 0.07941731
## Run 5 stress 0.1199121
## Run 6 stress 0.1204402
## Run 7 stress 0.1154353
## Run 8 stress 0.1134998
## Run 9 stress 0.1134997
## Run 10 stress 0.1201579
## Run 11 stress 0.1132685
```

```
## Run 12 stress 0.1120721
## ... Procrustes: rmse 0.0118617  max resid 0.04572365
## Run 13 stress 0.1131513
## Run 14 stress 0.113501
## Run 15 stress 0.1119533
## ... Procrustes: rmse 0.001683348  max resid 0.006227615
## ... Similar to previous best
## Run 16 stress 0.1119962
## ... Procrustes: rmse 0.01112534  max resid 0.03984804
## Run 17 stress 0.1120008
## ... Procrustes: rmse 0.01704864  max resid 0.06273139
## Run 18 stress 0.1134982
## Run 19 stress 0.1134697
## Run 20 stress 0.1119911
## ... Procrustes: rmse 0.006274045  max resid 0.02344205
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1194077
## Run 2 stress 0.1134993
## ... Procrustes: rmse 0.0005500217  max resid 0.002783708
## ... Similar to previous best
## Run 3 stress 0.1135297
## ... Procrustes: rmse 0.004732372  max resid 0.01974978
## Run 4 stress 0.1135008
## ... Procrustes: rmse 0.0008438911  max resid 0.003513142
## ... Similar to previous best
## Run 5 stress 0.1131899
## ... New best solution
## ... Procrustes: rmse 0.05407913  max resid 0.2936426
## Run 6 stress 0.1120018
## ... New best solution
## ... Procrustes: rmse 0.03045628  max resid 0.08987107
## Run 7 stress 0.1135698
## Run 8 stress 0.1119612
## ... New best solution
## ... Procrustes: rmse 0.01991355  max resid 0.07396071
## Run 9 stress 0.1119784
## ... Procrustes: rmse 0.002092324  max resid 0.007887856
## ... Similar to previous best
## Run 10 stress 0.1119983
## ... Procrustes: rmse 0.0195758  max resid 0.07214821
## Run 11 stress 0.1197588
## Run 12 stress 0.1203962
## Run 13 stress 0.1135048
## Run 14 stress 0.1119897
## ... Procrustes: rmse 0.01871997  max resid 0.06900059
## Run 15 stress 0.1122588
## ... Procrustes: rmse 0.01361042  max resid 0.05665771
## Run 16 stress 0.1119692
## ... Procrustes: rmse 0.001040487  max resid 0.003940679
## ... Similar to previous best
## Run 17 stress 0.1120382
## ... Procrustes: rmse 0.02122423  max resid 0.07827557
## Run 18 stress 0.1119631
```

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## ... Procrustes: rmse 0.0002177657  max resid 0.0008345921
## ... Similar to previous best
## Run 19 stress 0.113793
## Run 20 stress 0.1134998
## *** Best solution repeated 3 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1120197
## ... New best solution
## ... Procrustes: rmse 0.04287394  max resid 0.2104289
## Run 2 stress 0.1122217
## ... Procrustes: rmse 0.03126914  max resid 0.1127579
## Run 3 stress 0.1194079
## Run 4 stress 0.1134996
## Run 5 stress 0.1194076
## Run 6 stress 0.1135007
## Run 7 stress 0.1200342
## Run 8 stress 0.1134991
## Run 9 stress 0.1148308
## Run 10 stress 0.1169883
## Run 11 stress 0.1119922
## ... New best solution
## ... Procrustes: rmse 0.01264838  max resid 0.044265
## Run 12 stress 0.1182521
## Run 13 stress 0.1201503
## Run 14 stress 0.1119851
## ... New best solution
## ... Procrustes: rmse 0.01142257  max resid 0.03931218
## Run 15 stress 0.1120139
## ... Procrustes: rmse 0.02149311  max resid 0.07939158
## Run 16 stress 0.1134992
## Run 17 stress 0.1119542
## ... New best solution
## ... Procrustes: rmse 0.001831807  max resid 0.006734371
## ... Similar to previous best
## Run 18 stress 0.1241039
## Run 19 stress 0.1191348
## Run 20 stress 0.1135004
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1120926
## ... New best solution
## ... Procrustes: rmse 0.04373093  max resid 0.2016685
## Run 2 stress 0.1204148
## Run 3 stress 0.1194079
## Run 4 stress 0.1171047
## Run 5 stress 0.1184715
## Run 6 stress 0.1134985
## Run 7 stress 0.1120437
## ... New best solution
## ... Procrustes: rmse 0.003769618  max resid 0.01531833
## Run 8 stress 0.1135342
## Run 9 stress 0.1176502
## Run 10 stress 0.1201577
## Run 11 stress 0.1194084
```

```
## Run 12 stress 0.1148392
## Run 13 stress 0.1119908
## ... New best solution
## ... Procrustes: rmse 0.01560118  max resid 0.05659151
## Run 14 stress 0.1181705
## Run 15 stress 0.113524
## Run 16 stress 0.1119905
## ... New best solution
## ... Procrustes: rmse 0.0008629589  max resid 0.004212838
## ... Similar to previous best
## Run 17 stress 0.1135783
## Run 18 stress 0.1201967
## Run 19 stress 0.119408
## Run 20 stress 0.1121132
## ... Procrustes: rmse 0.02104204  max resid 0.07751376
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1154956
## Run 2 stress 0.1201637
## Run 3 stress 0.1255862
## Run 4 stress 0.1119357
## ... New best solution
## ... Procrustes: rmse 0.04531557  max resid 0.2431223
## Run 5 stress 0.1220773
## Run 6 stress 0.1119622
## ... Procrustes: rmse 0.00672461  max resid 0.0244487
## Run 7 stress 0.1186359
## Run 8 stress 0.1204164
## Run 9 stress 0.111967
## ... Procrustes: rmse 0.007367776  max resid 0.02682797
## Run 10 stress 0.1123252
## ... Procrustes: rmse 0.02413072  max resid 0.09802761
## Run 11 stress 0.120071
## Run 12 stress 0.1119529
## ... Procrustes: rmse 0.007565224  max resid 0.02810577
## Run 13 stress 0.1154031
## Run 14 stress 0.120413
## Run 15 stress 0.1134998
## Run 16 stress 0.1137311
## Run 17 stress 0.1134995
## Run 18 stress 0.1198955
## Run 19 stress 0.1180537
## Run 20 stress 0.1132076
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1131877
## ... New best solution
## ... Procrustes: rmse 0.05387052  max resid 0.29183
## Run 2 stress 0.1196648
## Run 3 stress 0.1194077
## Run 4 stress 0.1212639
## Run 5 stress 0.1183812
```

```
## Run 6 stress 0.1134987
## ... Procrustes: rmse 0.05396858  max resid 0.2921483
## Run 7 stress 0.1119886
## ... New best solution
## ... Procrustes: rmse 0.02895515  max resid 0.08875179
## Run 8 stress 0.1120861
## ... Procrustes: rmse 0.008587624  max resid 0.0340968
## Run 9 stress 0.1135456
## Run 10 stress 0.1119578
## ... New best solution
## ... Procrustes: rmse 0.01801045  max resid 0.06683333
## Run 11 stress 0.1188422
## Run 12 stress 0.1119973
## ... Procrustes: rmse 0.004438105  max resid 0.01683147
## Run 13 stress 0.1204141
## Run 14 stress 0.1134997
## Run 15 stress 0.1120031
## ... Procrustes: rmse 0.01315308  max resid 0.0459413
## Run 16 stress 0.1132371
## Run 17 stress 0.1123678
## ... Procrustes: rmse 0.0144294  max resid 0.0512194
## Run 18 stress 0.1119631
## ... Procrustes: rmse 0.0006081659  max resid 0.002270366
## ... Similar to previous best
## Run 19 stress 0.1138489
## Run 20 stress 0.112049
## ... Procrustes: rmse 0.02348266  max resid 0.087265
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1157082
## Run 2 stress 0.1201594
## Run 3 stress 0.1120585
## ... New best solution
## ... Procrustes: rmse 0.04321345  max resid 0.2047723
## Run 4 stress 0.1182864
## Run 5 stress 0.1197723
## Run 6 stress 0.1119675
## ... New best solution
## ... Procrustes: rmse 0.008979678  max resid 0.0349094
## Run 7 stress 0.1131639
## Run 8 stress 0.113499
## Run 9 stress 0.1134998
## Run 10 stress 0.1119493
## ... New best solution
## ... Procrustes: rmse 0.0142926  max resid 0.052863
## Run 11 stress 0.1154345
## Run 12 stress 0.113513
## Run 13 stress 0.1119922
## ... Procrustes: rmse 0.005372275  max resid 0.0200789
## Run 14 stress 0.1120706
## ... Procrustes: rmse 0.02361154  max resid 0.0878027
## Run 15 stress 0.1156158
## Run 16 stress 0.1135564
## Run 17 stress 0.1119639
```

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## ... Procrustes: rmse 0.002303095  max resid 0.008569214
## ... Similar to previous best
## Run 18 stress 0.1197417
## Run 19 stress 0.1119442
## ... New best solution
## ... Procrustes: rmse 0.01033398  max resid 0.03795316
## Run 20 stress 0.1198849
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1120046
## ... New best solution
## ... Procrustes: rmse 0.04449264  max resid 0.2309547
## Run 2 stress 0.1180957
## Run 3 stress 0.1135473
## Run 4 stress 0.1121012
## ... Procrustes: rmse 0.01528553  max resid 0.0566639
## Run 5 stress 0.1119886
## ... New best solution
## ... Procrustes: rmse 0.006673242  max resid 0.02468337
## Run 6 stress 0.1120988
## ... Procrustes: rmse 0.0284232  max resid 0.1089811
## Run 7 stress 0.117729
## Run 8 stress 0.1119937
## ... Procrustes: rmse 0.02205715  max resid 0.0823409
## Run 9 stress 0.1119821
## ... New best solution
## ... Procrustes: rmse 0.0008268266  max resid 0.003083458
## ... Similar to previous best
## Run 10 stress 0.1173347
## Run 11 stress 0.1204136
## Run 12 stress 0.1169138
## Run 13 stress 0.1119459
## ... New best solution
## ... Procrustes: rmse 0.005423168  max resid 0.01996091
## Run 14 stress 0.1162719
## Run 15 stress 0.1212649
## Run 16 stress 0.1120349
## ... Procrustes: rmse 0.005641491  max resid 0.02800211
## Run 17 stress 0.1135315
## Run 18 stress 0.1177627
## Run 19 stress 0.1133226
## Run 20 stress 0.1183477
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     19: no. of iterations >= maxit
##      1: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1120015
## ... New best solution
## ... Procrustes: rmse 0.04460369  max resid 0.2324415
## Run 2 stress 0.1120467
## ... Procrustes: rmse 0.0117373  max resid 0.04122522
## Run 3 stress 0.1134985
```

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## Run 4 stress 0.113537
## Run 5 stress 0.1120277
## ... Procrustes: rmse 0.01057458  max resid 0.03627907
## Run 6 stress 0.1120897
## ... Procrustes: rmse 0.01498844  max resid 0.05516126
## Run 7 stress 0.113499
## Run 8 stress 0.111988
## ... New best solution
## ... Procrustes: rmse 0.01631608  max resid 0.05871694
## Run 9 stress 0.1119643
## ... New best solution
## ... Procrustes: rmse 0.003160126  max resid 0.01186352
## Run 10 stress 0.1120552
## ... Procrustes: rmse 0.00811992  max resid 0.03168784
## Run 11 stress 0.1167505
## Run 12 stress 0.1133565
## Run 13 stress 0.1162657
## Run 14 stress 0.11928
## Run 15 stress 0.1195915
## Run 16 stress 0.1120743
## ... Procrustes: rmse 0.02555856  max resid 0.09558108
## Run 17 stress 0.1204011
## Run 18 stress 0.1119465
## ... New best solution
## ... Procrustes: rmse 0.0026381  max resid 0.00973212
## ... Similar to previous best
## Run 19 stress 0.1154838
## Run 20 stress 0.1132063
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1120258
## ... New best solution
## ... Procrustes: rmse 0.05169787  max resid 0.2851836
## Run 2 stress 0.1119991
## ... New best solution
## ... Procrustes: rmse 0.01868704  max resid 0.06727055
## Run 3 stress 0.1151309
## Run 4 stress 0.1200524
## Run 5 stress 0.1197815
## Run 6 stress 0.1158901
## Run 7 stress 0.1119654
## ... New best solution
## ... Procrustes: rmse 0.01336199  max resid 0.0471969
## Run 8 stress 0.1132778
## Run 9 stress 0.1148026
## Run 10 stress 0.112071
## ... Procrustes: rmse 0.02574808  max resid 0.0957073
## Run 11 stress 0.1135434
## Run 12 stress 0.1148301
## Run 13 stress 0.1120868
## ... Procrustes: rmse 0.02699458  max resid 0.1012998
## Run 14 stress 0.1131644
## Run 15 stress 0.1134997
## Run 16 stress 0.1176216
```

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## Run 17 stress 0.1135005
## Run 18 stress 0.1202328
## Run 19 stress 0.1119681
## ... Procrustes: rmse 0.0003563228  max resid 0.001332716
## ... Similar to previous best
## Run 20 stress 0.1163669
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.117593
## Run 2 stress 0.1134987
## ... New best solution
## ... Procrustes: rmse 0.001551547  max resid 0.007422138
## ... Similar to previous best
## Run 3 stress 0.1119604
## ... New best solution
## ... Procrustes: rmse 0.04399896  max resid 0.2256092
## Run 4 stress 0.1135018
## Run 5 stress 0.1119596
## ... New best solution
## ... Procrustes: rmse 0.0144363  max resid 0.05338027
## Run 6 stress 0.1120277
## ... Procrustes: rmse 0.02152758  max resid 0.07956476
## Run 7 stress 0.1135359
## Run 8 stress 0.1195791
## Run 9 stress 0.1131482
## Run 10 stress 0.1142091
## Run 11 stress 0.1204137
## Run 12 stress 0.1133742
## Run 13 stress 0.119444
## Run 14 stress 0.1131559
## Run 15 stress 0.1119597
## ... Procrustes: rmse 0.0005744182  max resid 0.00206053
## ... Similar to previous best
## Run 16 stress 0.111944
## ... New best solution
## ... Procrustes: rmse 0.002308263  max resid 0.008504571
## ... Similar to previous best
## Run 17 stress 0.1148286
## Run 18 stress 0.1135291
## Run 19 stress 0.1134994
## Run 20 stress 0.1199101
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1131502
## ... New best solution
## ... Procrustes: rmse 0.04890095  max resid 0.260414
## Run 2 stress 0.1162488
## Run 3 stress 0.1134996
## ... Procrustes: rmse 0.0491723  max resid 0.2599786
## Run 4 stress 0.1119809
## ... New best solution
## ... Procrustes: rmse 0.01841462  max resid 0.08827276
## Run 5 stress 0.1135242
## Run 6 stress 0.1173669
```

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## Run 7 stress 0.1137076
## Run 8 stress 0.1154981
## Run 9 stress 0.1119424
## ... New best solution
## ... Procrustes: rmse 0.006125266  max resid 0.0225621
## Run 10 stress 0.1134998
## Run 11 stress 0.1119586
## ... Procrustes: rmse 0.01142733  max resid 0.04217252
## Run 12 stress 0.1162321
## Run 13 stress 0.1136611
## Run 14 stress 0.1119577
## ... Procrustes: rmse 0.003060915  max resid 0.01123158
## Run 15 stress 0.1135006
## Run 16 stress 0.120091
## Run 17 stress 0.1134993
## Run 18 stress 0.1119569
## ... Procrustes: rmse 0.002821265  max resid 0.01035354
## Run 19 stress 0.1135621
## Run 20 stress 0.1136162
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1134995
## ... Procrustes: rmse 0.001868793  max resid 0.01004581
## Run 2 stress 0.1132039
## ... New best solution
## ... Procrustes: rmse 0.05442194  max resid 0.2961622
## Run 3 stress 0.1131939
## ... New best solution
## ... Procrustes: rmse 0.005864269  max resid 0.03413341
## Run 4 stress 0.1212324
## Run 5 stress 0.1135078
## ... Procrustes: rmse 0.05443994  max resid 0.2947701
## Run 6 stress 0.1154717
## Run 7 stress 0.1158174
## Run 8 stress 0.1203147
## Run 9 stress 0.111971
## ... New best solution
## ... Procrustes: rmse 0.01729953  max resid 0.09165844
## Run 10 stress 0.1119596
## ... New best solution
## ... Procrustes: rmse 0.001410579  max resid 0.005312179
## ... Similar to previous best
## Run 11 stress 0.1119564
## ... New best solution
## ... Procrustes: rmse 0.0005785116  max resid 0.00213434
## ... Similar to previous best
## Run 12 stress 0.11194
## ... New best solution
## ... Procrustes: rmse 0.003401782  max resid 0.01263385
## Run 13 stress 0.1119914
## ... Procrustes: rmse 0.007583742  max resid 0.02842608
## Run 14 stress 0.1119519
```

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## ... Procrustes: rmse 0.002730968  max resid 0.01016213
## Run 15 stress 0.1174992
## Run 16 stress 0.1163146
## Run 17 stress 0.1135628
## Run 18 stress 0.1120614
## ... Procrustes: rmse 0.01102802  max resid 0.04060093
## Run 19 stress 0.1134997
## Run 20 stress 0.1149916
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1119354
## ... New best solution
## ... Procrustes: rmse 0.04594404  max resid 0.248369
## Run 2 stress 0.1134991
## Run 3 stress 0.1198089
## Run 4 stress 0.1128419
## Run 5 stress 0.1119945
## ... Procrustes: rmse 0.005522473  max resid 0.02210968
## Run 6 stress 0.1120112
## ... Procrustes: rmse 0.01390956  max resid 0.0507379
## Run 7 stress 0.1119568
## ... Procrustes: rmse 0.006373682  max resid 0.02392847
## Run 8 stress 0.1212639
## Run 9 stress 0.1120093
## ... Procrustes: rmse 0.01382479  max resid 0.05042438
## Run 10 stress 0.1119917
## ... Procrustes: rmse 0.004021322  max resid 0.02361255
## Run 11 stress 0.1120946
## ... Procrustes: rmse 0.02042676  max resid 0.07689412
## Run 12 stress 0.1134996
## Run 13 stress 0.1161618
## Run 14 stress 0.1119947
## ... Procrustes: rmse 0.004206288  max resid 0.02150034
## Run 15 stress 0.1119379
## ... Procrustes: rmse 0.003337888  max resid 0.0117507
## Run 16 stress 0.1204138
## Run 17 stress 0.1119724
## ... Procrustes: rmse 0.009796692  max resid 0.03559549
## Run 18 stress 0.1134992
## Run 19 stress 0.1132023
## Run 20 stress 0.1140215
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     10: no. of iterations >= maxit
##     10: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1131477
## ... New best solution
## ... Procrustes: rmse 0.05108517  max resid 0.2765421
## Run 2 stress 0.1134988
## ... Procrustes: rmse 0.05137299  max resid 0.2767069
## Run 3 stress 0.11197
## ... New best solution
```

```
## ... Procrustes: rmse 0.01561509  max resid 0.09470933
## Run 4 stress 0.1197402
## Run 5 stress 0.1204343
## Run 6 stress 0.1119601
## ... New best solution
## ... Procrustes: rmse 0.01624671  max resid 0.06006473
## Run 7 stress 0.1120052
## ... Procrustes: rmse 0.004174829  max resid 0.02337852
## Run 8 stress 0.1173939
## Run 9 stress 0.1201376
## Run 10 stress 0.1135643
## Run 11 stress 0.1119692
## ... Procrustes: rmse 0.001314426  max resid 0.004998872
## ... Similar to previous best
## Run 12 stress 0.1134997
## Run 13 stress 0.1134988
## Run 14 stress 0.1173554
## Run 15 stress 0.1177086
## Run 16 stress 0.1157599
## Run 17 stress 0.1134983
## Run 18 stress 0.1119979
## ... Procrustes: rmse 0.004955011  max resid 0.02326258
## Run 19 stress 0.1197703
## Run 20 stress 0.1197795
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1134992
## ... New best solution
## ... Procrustes: rmse 0.00175276  max resid 0.0082065
## ... Similar to previous best
## Run 2 stress 0.1135335
## ... Procrustes: rmse 0.005288703  max resid 0.02324313
## Run 3 stress 0.1194079
## Run 4 stress 0.113575
## ... Procrustes: rmse 0.009022477  max resid 0.03442799
## Run 5 stress 0.1194077
## Run 6 stress 0.1184024
## Run 7 stress 0.1205185
## Run 8 stress 0.1120425
## ... New best solution
## ... Procrustes: rmse 0.04330625  max resid 0.2060873
## Run 9 stress 0.1141256
## Run 10 stress 0.1182772
## Run 11 stress 0.1148062
## Run 12 stress 0.1149061
## Run 13 stress 0.1120877
## ... Procrustes: rmse 0.003478814  max resid 0.01414664
## Run 14 stress 0.1119618
## ... New best solution
## ... Procrustes: rmse 0.02353494  max resid 0.08810939
## Run 15 stress 0.1131466
## Run 16 stress 0.1171888
## Run 17 stress 0.1134992
## Run 18 stress 0.111997
```

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## ... Procrustes: rmse 0.01246443  max resid 0.04342204
## Run 19 stress 0.1134995
## Run 20 stress 0.1119949
## ... Procrustes: rmse 0.003536938  max resid 0.01340685
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     12: no. of iterations >= maxit
##      8: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1154932
## Run 2 stress 0.1145579
## Run 3 stress 0.1199005
## Run 4 stress 0.1119908
## ... New best solution
## ... Procrustes: rmse 0.04587784  max resid 0.2435519
## Run 5 stress 0.1239552
## Run 6 stress 0.1136091
## Run 7 stress 0.112141
## ... Procrustes: rmse 0.02105308  max resid 0.07649446
## Run 8 stress 0.1194079
## Run 9 stress 0.111991
## ... Procrustes: rmse 0.01122501  max resid 0.03816305
## Run 10 stress 0.1134992
## Run 11 stress 0.1188376
## Run 12 stress 0.1193722
## Run 13 stress 0.1119443
## ... New best solution
## ... Procrustes: rmse 0.005385801  max resid 0.02406485
## Run 14 stress 0.112071
## ... Procrustes: rmse 0.01354011  max resid 0.05177143
## Run 15 stress 0.1119974
## ... Procrustes: rmse 0.003730779  max resid 0.02258823
## Run 16 stress 0.1120261
## ... Procrustes: rmse 0.01813154  max resid 0.06736893
## Run 17 stress 0.1135259
## Run 18 stress 0.1135001
## Run 19 stress 0.1159252
## Run 20 stress 0.1131512
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1170343
## Run 2 stress 0.1172445
## Run 3 stress 0.1135013
## ... Procrustes: rmse 0.002423946  max resid 0.01302573
## Run 4 stress 0.1216224
## Run 5 stress 0.1194377
## Run 6 stress 0.1119975
## ... New best solution
## ... Procrustes: rmse 0.04488543  max resid 0.235095
## Run 7 stress 0.1119974
## ... New best solution
## ... Procrustes: rmse 0.0001984666  max resid 0.001053794
## ... Similar to previous best
```

```
## Run 8 stress 0.1173297
## Run 9 stress 0.1119714
## ... New best solution
## ... Procrustes: rmse 0.01339063  max resid 0.04733784
## Run 10 stress 0.1120113
## ... Procrustes: rmse 0.02178538  max resid 0.08051001
## Run 11 stress 0.1134989
## Run 12 stress 0.1176628
## Run 13 stress 0.1131995
## Run 14 stress 0.1135446
## Run 15 stress 0.1134991
## Run 16 stress 0.1148258
## Run 17 stress 0.1180241
## Run 18 stress 0.1120377
## ... Procrustes: rmse 0.02401711  max resid 0.08918887
## Run 19 stress 0.118253
## Run 20 stress 0.1180241
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1148047
## Run 2 stress 0.1154411
## Run 3 stress 0.1199117
## Run 4 stress 0.1119925
## ... New best solution
## ... Procrustes: rmse 0.05030706  max resid 0.2768028
## Run 5 stress 0.1120612
## ... Procrustes: rmse 0.004552722  max resid 0.01569497
## Run 6 stress 0.1121991
## ... Procrustes: rmse 0.03230448  max resid 0.1226427
## Run 7 stress 0.1119554
## ... New best solution
## ... Procrustes: rmse 0.01751206  max resid 0.06476354
## Run 8 stress 0.1148286
## Run 9 stress 0.1134988
## Run 10 stress 0.1195081
## Run 11 stress 0.1150529
## Run 12 stress 0.1119689
## ... Procrustes: rmse 0.01513457  max resid 0.05608429
## Run 13 stress 0.1119552
## ... New best solution
## ... Procrustes: rmse 0.01324579  max resid 0.04894723
## Run 14 stress 0.113527
## Run 15 stress 0.118415
## Run 16 stress 0.1148221
## Run 17 stress 0.1120094
## ... Procrustes: rmse 0.01970463  max resid 0.0726525
## Run 18 stress 0.1120723
## ... Procrustes: rmse 0.02472535  max resid 0.09238186
## Run 19 stress 0.1119568
## ... Procrustes: rmse 0.0002359282  max resid 0.0008572887
## ... Similar to previous best
## Run 20 stress 0.1119411
```

```
## ... New best solution
## ... Procrustes: rmse 0.01056864  max resid 0.03879557
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.114844
## Run 2 stress 0.1135296
## ... Procrustes: rmse 0.004724815  max resid 0.01970348
## Run 3 stress 0.1162293
## Run 4 stress 0.1144877
## Run 5 stress 0.1119731
## ... New best solution
## ... Procrustes: rmse 0.04945018  max resid 0.2718641
## Run 6 stress 0.1132192
## Run 7 stress 0.1155046
## Run 8 stress 0.1121156
## ... Procrustes: rmse 0.009560087  max resid 0.03856149
## Run 9 stress 0.1135465
## Run 10 stress 0.1183638
## Run 11 stress 0.1199033
## Run 12 stress 0.1120482
## ... Procrustes: rmse 0.02528997  max resid 0.09417688
## Run 13 stress 0.1134234
## Run 14 stress 0.1120195
## ... Procrustes: rmse 0.01766149  max resid 0.06331574
## Run 15 stress 0.111992
## ... Procrustes: rmse 0.008164201  max resid 0.02688524
## Run 16 stress 0.1204176
## Run 17 stress 0.1192507
## Run 18 stress 0.116266
## Run 19 stress 0.1119374
## ... New best solution
## ... Procrustes: rmse 0.006716675  max resid 0.02531243
## Run 20 stress 0.1135054
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.119763
## Run 2 stress 0.1134991
## ... New best solution
## ... Procrustes: rmse 0.001491609  max resid 0.006191516
## ... Similar to previous best
## Run 3 stress 0.1120073
## ... New best solution
## ... Procrustes: rmse 0.04316487  max resid 0.2126724
## Run 4 stress 0.11206
## ... Procrustes: rmse 0.003870433  max resid 0.01541053
## Run 5 stress 0.1185237
## Run 6 stress 0.1119477
## ... New best solution
## ... Procrustes: rmse 0.007676784  max resid 0.02850421
## Run 7 stress 0.1135003
```

```
## Run 8 stress 0.1120179
## ... Procrustes: rmse 0.008664838  max resid 0.03235896
## Run 9 stress 0.115353
## Run 10 stress 0.1133397
## Run 11 stress 0.1135345
## Run 12 stress 0.1125391
## Run 13 stress 0.1135847
## Run 14 stress 0.1205045
## Run 15 stress 0.1120393
## ... Procrustes: rmse 0.003758069  max resid 0.01485789
## Run 16 stress 0.1119582
## ... Procrustes: rmse 0.0126204  max resid 0.04662468
## Run 17 stress 0.1173926
## Run 18 stress 0.1135866
## Run 19 stress 0.1119874
## ... Procrustes: rmse 0.004821475  max resid 0.01762745
## Run 20 stress 0.1178777
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1120437
## ... New best solution
## ... Procrustes: rmse 0.04303381  max resid 0.2065678
## Run 2 stress 0.1124519
## ... Procrustes: rmse 0.04056749  max resid 0.155124
## Run 3 stress 0.1120198
## ... New best solution
## ... Procrustes: rmse 0.002156099  max resid 0.008637449
## ... Similar to previous best
## Run 4 stress 0.1199654
## Run 5 stress 0.1119914
## ... New best solution
## ... Procrustes: rmse 0.002856312  max resid 0.01101041
## Run 6 stress 0.1148232
## Run 7 stress 0.1134991
## Run 8 stress 0.1134998
## Run 9 stress 0.1135346
## Run 10 stress 0.1120241
## ... Procrustes: rmse 0.003229455  max resid 0.01229495
## Run 11 stress 0.1134989
## Run 12 stress 0.1202393
## Run 13 stress 0.1241049
## Run 14 stress 0.1131987
## Run 15 stress 0.1119951
## ... Procrustes: rmse 0.000396231  max resid 0.001533652
## ... Similar to previous best
## Run 16 stress 0.1120026
## ... Procrustes: rmse 0.0230265  max resid 0.08594637
## Run 17 stress 0.1188392
## Run 18 stress 0.1120392
## ... Procrustes: rmse 0.004607793  max resid 0.01802604
## Run 19 stress 0.1119448
## ... New best solution
```

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## ... Procrustes: rmse 0.01606355  max resid 0.05924017
## Run 20 stress 0.1119395
## ... New best solution
## ... Procrustes: rmse 0.001400239  max resid 0.005103718
## ... Similar to previous best
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1134993
## ... Procrustes: rmse 0.0004968375  max resid 0.001527258
## ... Similar to previous best
## Run 2 stress 0.116285
## Run 3 stress 0.1152204
## Run 4 stress 0.1156715
## Run 5 stress 0.118026
## Run 6 stress 0.1119606
## ... New best solution
## ... Procrustes: rmse 0.04362458  max resid 0.2263926
## Run 7 stress 0.1138588
## Run 8 stress 0.1134983
## Run 9 stress 0.1119595
## ... New best solution
## ... Procrustes: rmse 0.01469696  max resid 0.05438194
## Run 10 stress 0.1119622
## ... Procrustes: rmse 0.0004188498  max resid 0.001559364
## ... Similar to previous best
## Run 11 stress 0.1135009
## Run 12 stress 0.112066
## ... Procrustes: rmse 0.02488819  max resid 0.09286975
## Run 13 stress 0.1119429
## ... New best solution
## ... Procrustes: rmse 0.01169178  max resid 0.04297886
## Run 14 stress 0.1204184
## Run 15 stress 0.1204129
## Run 16 stress 0.1134999
## Run 17 stress 0.1204117
## Run 18 stress 0.1189948
## Run 19 stress 0.1119615
## ... Procrustes: rmse 0.01076666  max resid 0.03970722
## Run 20 stress 0.1119811
## ... Procrustes: rmse 0.01432327  max resid 0.05318369
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1131573
## ... New best solution
## ... Procrustes: rmse 0.05205524  max resid 0.283288
## Run 2 stress 0.111947
## ... New best solution
## ... Procrustes: rmse 0.01585515  max resid 0.09165357
## Run 3 stress 0.1120274
## ... Procrustes: rmse 0.008529192  max resid 0.03132196
## Run 4 stress 0.117743
## Run 5 stress 0.1136853
```

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## Run 6 stress 0.1119926
## ... Procrustes: rmse 0.01668026  max resid 0.06137633
## Run 7 stress 0.1196087
## Run 8 stress 0.1135445
## Run 9 stress 0.1148411
## Run 10 stress 0.1201344
## Run 11 stress 0.1135225
## Run 12 stress 0.1119492
## ... Procrustes: rmse 0.0004020287  max resid 0.001450004
## ... Similar to previous best
## Run 13 stress 0.1119411
## ... New best solution
## ... Procrustes: rmse 0.001363134  max resid 0.005050166
## ... Similar to previous best
## Run 14 stress 0.1120047
## ... Procrustes: rmse 0.008363494  max resid 0.03148418
## Run 15 stress 0.1120202
## ... Procrustes: rmse 0.01777417  max resid 0.06543819
## Run 16 stress 0.1134997
## Run 17 stress 0.1131683
## Run 18 stress 0.1198553
## Run 19 stress 0.1119402
## ... New best solution
## ... Procrustes: rmse 0.0003376702  max resid 0.001381266
## ... Similar to previous best
## Run 20 stress 0.1119498
## ... Procrustes: rmse 0.002288432  max resid 0.008677868
## ... Similar to previous best
## *** Best solution repeated 2 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1134988
## ... New best solution
## ... Procrustes: rmse 0.001169687  max resid 0.004012134
## ... Similar to previous best
## Run 2 stress 0.1134989
## ... Procrustes: rmse 0.001039639  max resid 0.002670335
## ... Similar to previous best
## Run 3 stress 0.1120079
## ... New best solution
## ... Procrustes: rmse 0.04445686  max resid 0.2283688
## Run 4 stress 0.1194206
## Run 5 stress 0.1199427
## Run 6 stress 0.111943
## ... New best solution
## ... Procrustes: rmse 0.0114598  max resid 0.0396279
## Run 7 stress 0.118228
## Run 8 stress 0.1119355
## ... New best solution
## ... Procrustes: rmse 0.005184285  max resid 0.01944491
## Run 9 stress 0.1199416
## Run 10 stress 0.111984
## ... Procrustes: rmse 0.01107627  max resid 0.04162503
## Run 11 stress 0.1136325
## Run 12 stress 0.120397
```

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## Run 13 stress 0.1134996
## Run 14 stress 0.1119921
## ... Procrustes: rmse 0.004512679  max resid 0.02331635
## Run 15 stress 0.1119418
## ... Procrustes: rmse 0.004796825  max resid 0.01804128
## Run 16 stress 0.111957
## ... Procrustes: rmse 0.007766005  max resid 0.029087
## Run 17 stress 0.113329
## Run 18 stress 0.1148282
## Run 19 stress 0.1176171
## Run 20 stress 0.1120454
## ... Procrustes: rmse 0.0157891  max resid 0.06013107
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     11: no. of iterations >= maxit
##      9: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1131787
## ... New best solution
## ... Procrustes: rmse 0.05349493  max resid 0.29137
## Run 2 stress 0.1202425
## Run 3 stress 0.1120127
## ... New best solution
## ... Procrustes: rmse 0.02969121  max resid 0.08879756
## Run 4 stress 0.1163018
## Run 5 stress 0.1120587
## ... Procrustes: rmse 0.004057037  max resid 0.01622852
## Run 6 stress 0.1120345
## ... Procrustes: rmse 0.002031359  max resid 0.00804426
## ... Similar to previous best
## Run 7 stress 0.1194671
## Run 8 stress 0.1119691
## ... New best solution
## ... Procrustes: rmse 0.02194352  max resid 0.08176362
## Run 9 stress 0.112059
## ... Procrustes: rmse 0.02561413  max resid 0.09557703
## Run 10 stress 0.113543
## Run 11 stress 0.1119621
## ... New best solution
## ... Procrustes: rmse 0.01644338  max resid 0.06064154
## Run 12 stress 0.1134994
## Run 13 stress 0.1120376
## ... Procrustes: rmse 0.008049787  max resid 0.03077139
## Run 14 stress 0.1201593
## Run 15 stress 0.1120038
## ... Procrustes: rmse 0.004408934  max resid 0.0233709
## Run 16 stress 0.1241045
## Run 17 stress 0.1119523
## ... New best solution
## ... Procrustes: rmse 0.01405177  max resid 0.05195798
## Run 18 stress 0.1119984
## ... Procrustes: rmse 0.01798573  max resid 0.06622539
## Run 19 stress 0.1134993
## Run 20 stress 0.1119702
## ... Procrustes: rmse 0.00256466  max resid 0.009618399
```

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## ... Similar to previous best
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1119461
## ... New best solution
## ... Procrustes: rmse 0.04770394  max resid 0.2608518
## Run 2 stress 0.1119864
## ... Procrustes: rmse 0.01548877  max resid 0.05685331
## Run 3 stress 0.1135449
## Run 4 stress 0.1131894
## Run 5 stress 0.112021
## ... Procrustes: rmse 0.01392343  max resid 0.04874693
## Run 6 stress 0.1134988
## Run 7 stress 0.1201212
## Run 8 stress 0.1154602
## Run 9 stress 0.1134009
## Run 10 stress 0.1204211
## Run 11 stress 0.1187037
## Run 12 stress 0.1134995
## Run 13 stress 0.1131963
## Run 14 stress 0.1119567
## ... Procrustes: rmse 0.0120966  max resid 0.0442603
## Run 15 stress 0.119409
## Run 16 stress 0.1121624
## ... Procrustes: rmse 0.02819653  max resid 0.107199
## Run 17 stress 0.1120183
## ... Procrustes: rmse 0.01899995  max resid 0.06988712
## Run 18 stress 0.1200904
## Run 19 stress 0.1199164
## Run 20 stress 0.1154179
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1197456
## Run 2 stress 0.1119693
## ... New best solution
## ... Procrustes: rmse 0.04337696  max resid 0.2228348
## Run 3 stress 0.1201567
## Run 4 stress 0.111983
## ... Procrustes: rmse 0.001683465  max resid 0.006318781
## ... Similar to previous best
## Run 5 stress 0.115483
## Run 6 stress 0.1194114
## Run 7 stress 0.1205368
## Run 8 stress 0.1119542
## ... New best solution
## ... Procrustes: rmse 0.01506109  max resid 0.05572823
## Run 9 stress 0.114835
## Run 10 stress 0.1162278
## Run 11 stress 0.1135199
## Run 12 stress 0.1119588
## ... Procrustes: rmse 0.001032225  max resid 0.003798403
## ... Similar to previous best
```

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## Run 13 stress 0.1148496
## Run 14 stress 0.1148999
## Run 15 stress 0.1120717
## ... Procrustes: rmse 0.02423026  max resid 0.09049124
## Run 16 stress 0.1196076
## Run 17 stress 0.1194551
## Run 18 stress 0.1134296
## Run 19 stress 0.1135001
## Run 20 stress 0.111999
## ... Procrustes: rmse 0.01157158  max resid 0.03997414
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1166932
## Run 2 stress 0.1135343
## ... Procrustes: rmse 0.005273962  max resid 0.02197728
## Run 3 stress 0.1135003
## ... Procrustes: rmse 0.0007088373  max resid 0.002740798
## ... Similar to previous best
## Run 4 stress 0.1135802
## ... Procrustes: rmse 0.009495612  max resid 0.0373983
## Run 5 stress 0.112054
## ... New best solution
## ... Procrustes: rmse 0.0521186  max resid 0.2867217
## Run 6 stress 0.1119622
## ... New best solution
## ... Procrustes: rmse 0.02258183  max resid 0.08440694
## Run 7 stress 0.1134997
## Run 8 stress 0.117076
## Run 9 stress 0.1119563
## ... New best solution
## ... Procrustes: rmse 0.001008533  max resid 0.003848445
## ... Similar to previous best
## Run 10 stress 0.118324
## Run 11 stress 0.1119815
## ... Procrustes: rmse 0.01678966  max resid 0.06262927
## Run 12 stress 0.1148126
## Run 13 stress 0.1120816
## ... Procrustes: rmse 0.02357888  max resid 0.09006852
## Run 14 stress 0.1161687
## Run 15 stress 0.1131684
## Run 16 stress 0.1119485
## ... New best solution
## ... Procrustes: rmse 0.01233987  max resid 0.04576901
## Run 17 stress 0.1119623
## ... Procrustes: rmse 0.01338186  max resid 0.04917214
## Run 18 stress 0.1173916
## Run 19 stress 0.1189178
## Run 20 stress 0.1119996
## ... Procrustes: rmse 0.01092822  max resid 0.03735781
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1133377
```

```
## ... New best solution
## ... Procrustes: rmse 0.04790344  max resid 0.2132201
## Run 2 stress 0.1134994
## ... Procrustes: rmse 0.04820166  max resid 0.2132623
## Run 3 stress 0.1134997
## ... Procrustes: rmse 0.04827741  max resid 0.2140839
## Run 4 stress 0.1119571
## ... New best solution
## ... Procrustes: rmse 0.03103069  max resid 0.1074537
## Run 5 stress 0.1268478
## Run 6 stress 0.120413
## Run 7 stress 0.1131415
## Run 8 stress 0.1119784
## ... Procrustes: rmse 0.01670212  max resid 0.06149363
## Run 9 stress 0.1194094
## Run 10 stress 0.1134996
## Run 11 stress 0.1220043
## Run 12 stress 0.1154339
## Run 13 stress 0.1120285
## ... Procrustes: rmse 0.02125543  max resid 0.07959879
## Run 14 stress 0.1120471
## ... Procrustes: rmse 0.02303284  max resid 0.08552158
## Run 15 stress 0.1134986
## Run 16 stress 0.1133353
## Run 17 stress 0.1120039
## ... Procrustes: rmse 0.01932163  max resid 0.07119655
## Run 18 stress 0.1120478
## ... Procrustes: rmse 0.02287108  max resid 0.08485365
## Run 19 stress 0.1194284
## Run 20 stress 0.1178667
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1134989
## ... New best solution
## ... Procrustes: rmse 0.001609685  max resid 0.008163129
## ... Similar to previous best
## Run 2 stress 0.111971
## ... New best solution
## ... Procrustes: rmse 0.04385919  max resid 0.223146
## Run 3 stress 0.1119866
## ... Procrustes: rmse 0.001808198  max resid 0.006902646
## ... Similar to previous best
## Run 4 stress 0.1135609
## Run 5 stress 0.1135645
## Run 6 stress 0.1119662
## ... New best solution
## ... Procrustes: rmse 0.01726515  max resid 0.06417132
## Run 7 stress 0.111954
## ... New best solution
## ... Procrustes: rmse 0.01487099  max resid 0.05476588
## Run 8 stress 0.111954
## ... New best solution
```

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## ... Procrustes: rmse 0.01313255  max resid 0.04851985
## Run 9 stress 0.1135858
## Run 10 stress 0.1119793
## ... Procrustes: rmse 0.01653917  max resid 0.06092806
## Run 11 stress 0.1119976
## ... Procrustes: rmse 0.01148225  max resid 0.03965651
## Run 12 stress 0.1120702
## ... Procrustes: rmse 0.009954026  max resid 0.03859927
## Run 13 stress 0.1196867
## Run 14 stress 0.1119422
## ... New best solution
## ... Procrustes: rmse 0.00242003  max resid 0.008801481
## ... Similar to previous best
## Run 15 stress 0.1119792
## ... Procrustes: rmse 0.01418384  max resid 0.05226265
## Run 16 stress 0.1119768
## ... Procrustes: rmse 0.01390473  max resid 0.05123112
## Run 17 stress 0.1179182
## Run 18 stress 0.1194086
## Run 19 stress 0.1181256
## Run 20 stress 0.1119672
## ... Procrustes: rmse 0.004297553  max resid 0.015848
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1135078
## ... Procrustes: rmse 0.003030713  max resid 0.01032813
## Run 2 stress 0.114841
## Run 3 stress 0.1200789
## Run 4 stress 0.1194075
## Run 5 stress 0.1134992
## ... Procrustes: rmse 0.00184865  max resid 0.009822425
## ... Similar to previous best
## Run 6 stress 0.1119516
## ... New best solution
## ... Procrustes: rmse 0.04783276  max resid 0.2617093
## Run 7 stress 0.1119512
## ... New best solution
## ... Procrustes: rmse 0.01161873  max resid 0.04265747
## Run 8 stress 0.113929
## Run 9 stress 0.1134991
## Run 10 stress 0.1155233
## Run 11 stress 0.1197635
## Run 12 stress 0.1169804
## Run 13 stress 0.1134994
## Run 14 stress 0.1135
## Run 15 stress 0.1141551
## Run 16 stress 0.1148432
## Run 17 stress 0.1119488
## ... New best solution
## ... Procrustes: rmse 0.01172267  max resid 0.04326324
## Run 18 stress 0.1119564
## ... Procrustes: rmse 0.001223047  max resid 0.004508838
## ... Similar to previous best
## Run 19 stress 0.1204113
```

```
## Run 20 stress 0.1119824
## ... Procrustes: rmse 0.004532939  max resid 0.0170047
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1120083
## ... New best solution
## ... Procrustes: rmse 0.04442128  max resid 0.2295684
## Run 2 stress 0.1133475
## Run 3 stress 0.1119581
## ... New best solution
## ... Procrustes: rmse 0.004010268  max resid 0.02420991
## Run 4 stress 0.1162345
## Run 5 stress 0.1119795
## ... Procrustes: rmse 0.004049141  max resid 0.01484909
## Run 6 stress 0.1119659
## ... Procrustes: rmse 0.002318283  max resid 0.008458651
## ... Similar to previous best
## Run 7 stress 0.1122305
## ... Procrustes: rmse 0.02717528  max resid 0.09871411
## Run 8 stress 0.1134997
## Run 9 stress 0.1199528
## Run 10 stress 0.1119805
## ... Procrustes: rmse 0.004040168  max resid 0.01482074
## Run 11 stress 0.1173679
## Run 12 stress 0.1134993
## Run 13 stress 0.1178393
## Run 14 stress 0.1161137
## Run 15 stress 0.1121848
## ... Procrustes: rmse 0.02694808  max resid 0.1062571
## Run 16 stress 0.120429
## Run 17 stress 0.1119426
## ... New best solution
## ... Procrustes: rmse 0.01035338  max resid 0.03812047
## Run 18 stress 0.1120589
## ... Procrustes: rmse 0.01143374  max resid 0.04189231
## Run 19 stress 0.1135002
## Run 20 stress 0.123279
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1138827
## ... Procrustes: rmse 0.04965738  max resid 0.2522654
## Run 2 stress 0.1120887
## ... New best solution
## ... Procrustes: rmse 0.04366639  max resid 0.2016734
## Run 3 stress 0.1119418
## ... New best solution
## ... Procrustes: rmse 0.0232306  max resid 0.0877328
## Run 4 stress 0.1119401
## ... New best solution
## ... Procrustes: rmse 0.007587151  max resid 0.02781707
## Run 5 stress 0.1119671
## ... Procrustes: rmse 0.01195551  max resid 0.04425279
```

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## Run 6 stress 0.1120356
## ... Procrustes: rmse 0.01782601  max resid 0.06601226
## Run 7 stress 0.11315
## Run 8 stress 0.113313
## Run 9 stress 0.1153761
## Run 10 stress 0.1120241
## ... Procrustes: rmse 0.006472027  max resid 0.02285896
## Run 11 stress 0.1119631
## ... Procrustes: rmse 0.0114338  max resid 0.04226947
## Run 12 stress 0.1120564
## ... Procrustes: rmse 0.01370939  max resid 0.05169121
## Run 13 stress 0.1188518
## Run 14 stress 0.1119509
## ... Procrustes: rmse 0.002501157  max resid 0.009158627
## ... Similar to previous best
## Run 15 stress 0.1119577
## ... Procrustes: rmse 0.01004206  max resid 0.03704506
## Run 16 stress 0.1199543
## Run 17 stress 0.1121587
## ... Procrustes: rmse 0.01992283  max resid 0.07718272
## Run 18 stress 0.1119731
## ... Procrustes: rmse 0.01266792  max resid 0.04696462
## Run 19 stress 0.1119463
## ... Procrustes: rmse 0.001626713  max resid 0.005953337
## ... Similar to previous best
## Run 20 stress 0.1168668
## *** Best solution repeated 2 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1135691
## ... Procrustes: rmse 0.008951513  max resid 0.03398611
## Run 2 stress 0.1119614
## ... New best solution
## ... Procrustes: rmse 0.0487986  max resid 0.2679129
## Run 3 stress 0.1205284
## Run 4 stress 0.1131868
## Run 5 stress 0.1119693
## ... Procrustes: rmse 0.001005782  max resid 0.003638565
## ... Similar to previous best
## Run 6 stress 0.1156821
## Run 7 stress 0.1131834
## Run 8 stress 0.113197
## Run 9 stress 0.1119384
## ... New best solution
## ... Procrustes: rmse 0.004752974  max resid 0.01752019
## Run 10 stress 0.1136021
## Run 11 stress 0.1194085
## Run 12 stress 0.1201491
## Run 13 stress 0.1132892
## Run 14 stress 0.1148285
## Run 15 stress 0.1173913
## Run 16 stress 0.1119641
## ... Procrustes: rmse 0.01109109  max resid 0.04073591
## Run 17 stress 0.1119473
## ... Procrustes: rmse 0.002418718  max resid 0.008880023
```

```
## ... Similar to previous best
## Run 18 stress 0.1194083
## Run 19 stress 0.1148369
## Run 20 stress 0.1181967
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1176959
## Run 2 stress 0.1134988
## ... New best solution
## ... Procrustes: rmse 0.00110301  max resid 0.003813197
## ... Similar to previous best
## Run 3 stress 0.1119372
## ... New best solution
## ... Procrustes: rmse 0.04696055  max resid 0.2533841
## Run 4 stress 0.1120133
## ... Procrustes: rmse 0.01037022  max resid 0.03487836
## Run 5 stress 0.1175602
## Run 6 stress 0.1134121
## Run 7 stress 0.1120511
## ... Procrustes: rmse 0.0190912  max resid 0.07055353
## Run 8 stress 0.1119705
## ... Procrustes: rmse 0.01135185  max resid 0.04141799
## Run 9 stress 0.1199186
## Run 10 stress 0.1119689
## ... Procrustes: rmse 0.01093214  max resid 0.03985806
## Run 11 stress 0.1119403
## ... Procrustes: rmse 0.00128404  max resid 0.004925689
## ... Similar to previous best
## Run 12 stress 0.1163103
## Run 13 stress 0.1119536
## ... Procrustes: rmse 0.004145904  max resid 0.0155898
## Run 14 stress 0.111944
## ... Procrustes: rmse 0.002279988  max resid 0.008661556
## ... Similar to previous best
## Run 15 stress 0.1136508
## Run 16 stress 0.1119352
## ... New best solution
## ... Procrustes: rmse 0.002997854  max resid 0.0105095
## Run 17 stress 0.1132992
## Run 18 stress 0.113499
## Run 19 stress 0.1119374
## ... Procrustes: rmse 0.003142617  max resid 0.0114371
## Run 20 stress 0.113669
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1132444
## ... New best solution
## ... Procrustes: rmse 0.0473021  max resid 0.2334638
## Run 2 stress 0.1194094
## Run 3 stress 0.1137457
## Run 4 stress 0.1134991
## ... Procrustes: rmse 0.04762361  max resid 0.2337795
```

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## Run 5 stress 0.1134987
## ... Procrustes: rmse 0.04736105  max resid 0.2332578
## Run 6 stress 0.1119476
## ... New best solution
## ... Procrustes: rmse 0.02334343  max resid 0.1086389
## Run 7 stress 0.1194111
## Run 8 stress 0.1119586
## ... Procrustes: rmse 0.012705  max resid 0.04666581
## Run 9 stress 0.1200086
## Run 10 stress 0.11988
## Run 11 stress 0.1134999
## Run 12 stress 0.11207
## ... Procrustes: rmse 0.005321524  max resid 0.01482306
## Run 13 stress 0.1120124
## ... Procrustes: rmse 0.01875715  max resid 0.06910917
## Run 14 stress 0.1156205
## Run 15 stress 0.1176151
## Run 16 stress 0.1131605
## Run 17 stress 0.1183327
## Run 18 stress 0.1148277
## Run 19 stress 0.1199672
## Run 20 stress 0.1135955
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1177539
## Run 2 stress 0.1184012
## Run 3 stress 0.1120204
## ... New best solution
## ... Procrustes: rmse 0.04290602  max resid 0.2110624
## Run 4 stress 0.1120651
## ... Procrustes: rmse 0.002246239  max resid 0.009107727
## ... Similar to previous best
## Run 5 stress 0.1119698
## ... New best solution
## ... Procrustes: rmse 0.005348657  max resid 0.02024182
## Run 6 stress 0.1134991
## Run 7 stress 0.111999
## ... Procrustes: rmse 0.002545106  max resid 0.009413668
## ... Similar to previous best
## Run 8 stress 0.1153701
## Run 9 stress 0.1119658
## ... New best solution
## ... Procrustes: rmse 0.01663756  max resid 0.06145907
## Run 10 stress 0.1119515
## ... New best solution
## ... Procrustes: rmse 0.001987458  max resid 0.007568255
## ... Similar to previous best
## Run 11 stress 0.1134995
## Run 12 stress 0.1135014
## Run 13 stress 0.119856
## Run 14 stress 0.1132318
## Run 15 stress 0.1171468
```

```
## Run 16 stress 0.1134995
## Run 17 stress 0.1131511
## Run 18 stress 0.1200559
## Run 19 stress 0.1120703
## ... Procrustes: rmse 0.02386119  max resid 0.08902129
## Run 20 stress 0.1119966
## ... Procrustes: rmse 0.01778518  max resid 0.06548999
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1119742
## ... New best solution
## ... Procrustes: rmse 0.04950433  max resid 0.2721724
## Run 2 stress 0.114703
## Run 3 stress 0.1134984
## Run 4 stress 0.1119721
## ... New best solution
## ... Procrustes: rmse 0.0183469  max resid 0.06779395
## Run 5 stress 0.1131469
## Run 6 stress 0.1119922
## ... Procrustes: rmse 0.02008266  max resid 0.0749223
## Run 7 stress 0.1119743
## ... Procrustes: rmse 0.01835096  max resid 0.0682744
## Run 8 stress 0.1182337
## Run 9 stress 0.115695
## Run 10 stress 0.113335
## Run 11 stress 0.1119874
## ... Procrustes: rmse 0.01966496  max resid 0.07335457
## Run 12 stress 0.1119759
## ... Procrustes: rmse 0.000478352  max resid 0.00176893
## ... Similar to previous best
## Run 13 stress 0.1119553
## ... New best solution
## ... Procrustes: rmse 0.01588649  max resid 0.05882704
## Run 14 stress 0.1182175
## Run 15 stress 0.1135114
## Run 16 stress 0.1135136
## Run 17 stress 0.1196075
## Run 18 stress 0.1119535
## ... New best solution
## ... Procrustes: rmse 0.013254  max resid 0.04866616
## Run 19 stress 0.1180229
## Run 20 stress 0.1119554
## ... Procrustes: rmse 0.01313859  max resid 0.04854302
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1120166
## ... New best solution
## ... Procrustes: rmse 0.04287729  max resid 0.2110091
## Run 2 stress 0.1200333
## Run 3 stress 0.1148352
## Run 4 stress 0.1197487
## Run 5 stress 0.1120218
```

```
## ... Procrustes: rmse 0.02648697  max resid 0.09877131
## Run 6 stress 0.1119398
## ... New best solution
## ... Procrustes: rmse 0.01726218  max resid 0.06394813
## Run 7 stress 0.112002
## ... Procrustes: rmse 0.01588569  max resid 0.05839838
## Run 8 stress 0.1241048
## Run 9 stress 0.1133386
## Run 10 stress 0.1148424
## Run 11 stress 0.1120056
## ... Procrustes: rmse 0.01601685  max resid 0.05889042
## Run 12 stress 0.119603
## Run 13 stress 0.1135001
## Run 14 stress 0.1119487
## ... Procrustes: rmse 0.002173535  max resid 0.008027288
## ... Similar to previous best
## Run 15 stress 0.1131882
## Run 16 stress 0.1119976
## ... Procrustes: rmse 0.01544755  max resid 0.0567703
## Run 17 stress 0.1204119
## Run 18 stress 0.1169894
## Run 19 stress 0.1134988
## Run 20 stress 0.1134992
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1131884
## ... New best solution
## ... Procrustes: rmse 0.05394254  max resid 0.2927554
## Run 2 stress 0.1119534
## ... New best solution
## ... Procrustes: rmse 0.01771976  max resid 0.09118855
## Run 3 stress 0.1119609
## ... Procrustes: rmse 0.001170558  max resid 0.004477939
## ... Similar to previous best
## Run 4 stress 0.1134991
## Run 5 stress 0.1194084
## Run 6 stress 0.1134995
## Run 7 stress 0.1135174
## Run 8 stress 0.1120282
## ... Procrustes: rmse 0.007553527  max resid 0.02895876
## Run 9 stress 0.1120044
## ... Procrustes: rmse 0.00575679  max resid 0.02196199
## Run 10 stress 0.1135233
## Run 11 stress 0.1199161
## Run 12 stress 0.1194094
## Run 13 stress 0.1174145
## Run 14 stress 0.1204216
## Run 15 stress 0.1173161
## Run 16 stress 0.1162764
## Run 17 stress 0.1194258
## Run 18 stress 0.1170644
## Run 19 stress 0.1199126
## Run 20 stress 0.1135014
## *** Best solution repeated 1 times
```

```
## Run 0 stress 0.1134992
## Run 1 stress 0.113535
## ... Procrustes: rmse 0.005483973  max resid 0.0228942
## Run 2 stress 0.1148343
## Run 3 stress 0.1120503
## ... New best solution
## ... Procrustes: rmse 0.04310623  max resid 0.2056763
## Run 4 stress 0.1134989
## Run 5 stress 0.1119992
## ... New best solution
## ... Procrustes: rmse 0.004736952  max resid 0.01874378
## Run 6 stress 0.111947
## ... New best solution
## ... Procrustes: rmse 0.007738352  max resid 0.02852703
## Run 7 stress 0.1119853
## ... Procrustes: rmse 0.01494271  max resid 0.05552344
## Run 8 stress 0.1155405
## Run 9 stress 0.1200311
## Run 10 stress 0.1119437
## ... New best solution
## ... Procrustes: rmse 0.0001312442  max resid 0.0005107993
## ... Similar to previous best
## Run 11 stress 0.1183159
## Run 12 stress 0.1225567
## Run 13 stress 0.111993
## ... Procrustes: rmse 0.004337523  max resid 0.02398446
## Run 14 stress 0.113499
## Run 15 stress 0.1133316
## Run 16 stress 0.1119878
## ... Procrustes: rmse 0.004421495  max resid 0.01619523
## Run 17 stress 0.1132345
## Run 18 stress 0.1138852
## Run 19 stress 0.1148073
## Run 20 stress 0.116231
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1124251
## ... New best solution
## ... Procrustes: rmse 0.05744001  max resid 0.3040774
## Run 2 stress 0.1120057
## ... New best solution
## ... Procrustes: rmse 0.0371467  max resid 0.1519056
## Run 3 stress 0.1119771
## ... New best solution
## ... Procrustes: rmse 0.00321527  max resid 0.01212364
## Run 4 stress 0.119685
## Run 5 stress 0.1158821
## Run 6 stress 0.1164286
## Run 7 stress 0.1154511
## Run 8 stress 0.1119932
## ... Procrustes: rmse 0.001926402  max resid 0.007240779
## ... Similar to previous best
## Run 9 stress 0.1120633
## ... Procrustes: rmse 0.008264802  max resid 0.03237425
```

```
## Run 10 stress 0.1201838
## Run 11 stress 0.1134994
## Run 12 stress 0.1119847
## ... Procrustes: rmse 0.0009920914  max resid 0.003713439
## ... Similar to previous best
## Run 13 stress 0.1194459
## Run 14 stress 0.1119622
## ... New best solution
## ... Procrustes: rmse 0.001850194  max resid 0.006834696
## ... Similar to previous best
## Run 15 stress 0.1135
## Run 16 stress 0.1135438
## Run 17 stress 0.1202979
## Run 18 stress 0.1148366
## Run 19 stress 0.1119985
## ... Procrustes: rmse 0.005059308  max resid 0.02326505
## Run 20 stress 0.1148415
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1120364
## ... New best solution
## ... Procrustes: rmse 0.05181567  max resid 0.2850927
## Run 2 stress 0.1120275
## ... New best solution
## ... Procrustes: rmse 0.02841657  max resid 0.1055675
## Run 3 stress 0.1134989
## Run 4 stress 0.1137308
## Run 5 stress 0.112043
## ... Procrustes: rmse 0.001392001  max resid 0.005621782
## ... Similar to previous best
## Run 6 stress 0.118112
## Run 7 stress 0.1203971
## Run 8 stress 0.1121467
## ... Procrustes: rmse 0.03253967  max resid 0.1222891
## Run 9 stress 0.1182654
## Run 10 stress 0.1120177
## ... New best solution
## ... Procrustes: rmse 0.01676549  max resid 0.06208198
## Run 11 stress 0.1120037
## ... New best solution
## ... Procrustes: rmse 0.006144306  max resid 0.02104032
## Run 12 stress 0.1119553
## ... New best solution
## ... Procrustes: rmse 0.002730397  max resid 0.01535824
## Run 13 stress 0.1119934
## ... Procrustes: rmse 0.01032026  max resid 0.03557096
## Run 14 stress 0.113501
## Run 15 stress 0.1119492
## ... New best solution
## ... Procrustes: rmse 0.001066115  max resid 0.003933851
## ... Similar to previous best
## Run 16 stress 0.1120025
## ... Procrustes: rmse 0.01172105  max resid 0.04047281
## Run 17 stress 0.1119698
```

```
## ... Procrustes: rmse 0.01455131  max resid 0.05352374
## Run 18 stress 0.1197985
## Run 19 stress 0.1181775
## Run 20 stress 0.1197726
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1134992
## ... New best solution
## ... Procrustes: rmse 0.001757776  max resid 0.00967018
## ... Similar to previous best
## Run 2 stress 0.1132173
## ... New best solution
## ... Procrustes: rmse 0.04893287  max resid 0.2497398
## Run 3 stress 0.1134993
## ... Procrustes: rmse 0.04837349  max resid 0.2500213
## Run 4 stress 0.1182189
## Run 5 stress 0.1120861
## ... New best solution
## ... Procrustes: rmse 0.02257188  max resid 0.09426973
## Run 6 stress 0.1135309
## Run 7 stress 0.1134996
## Run 8 stress 0.1156049
## Run 9 stress 0.1120201
## ... New best solution
## ... Procrustes: rmse 0.005390825  max resid 0.02176544
## Run 10 stress 0.114214
## Run 11 stress 0.1131906
## Run 12 stress 0.1203771
## Run 13 stress 0.1194125
## Run 14 stress 0.1134988
## Run 15 stress 0.1168136
## Run 16 stress 0.113188
## Run 17 stress 0.1204709
## Run 18 stress 0.1136751
## Run 19 stress 0.1201298
## Run 20 stress 0.1194078
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1134989
## ... New best solution
## ... Procrustes: rmse 0.001711174  max resid 0.009045741
## ... Similar to previous best
## Run 2 stress 0.1135024
## ... Procrustes: rmse 0.001533205  max resid 0.004779423
## ... Similar to previous best
## Run 3 stress 0.1120491
## ... New best solution
## ... Procrustes: rmse 0.04352301  max resid 0.2054245
## Run 4 stress 0.1134033
## Run 5 stress 0.1173933
## Run 6 stress 0.1204407
## Run 7 stress 0.1135039
```

```
## Run 8 stress 0.1119363
## ... New best solution
## ... Procrustes: rmse 0.01523165  max resid 0.05693224
## Run 9 stress 0.1195934
## Run 10 stress 0.1220807
## Run 11 stress 0.1131557
## Run 12 stress 0.1121355
## ... Procrustes: rmse 0.01990734  max resid 0.07610256
## Run 13 stress 0.1134996
## Run 14 stress 0.111951
## ... Procrustes: rmse 0.007583634  max resid 0.0280856
## Run 15 stress 0.1120528
## ... Procrustes: rmse 0.01552281  max resid 0.05817935
## Run 16 stress 0.1202106
## Run 17 stress 0.1119505
## ... Procrustes: rmse 0.004485497  max resid 0.01628618
## Run 18 stress 0.118405
## Run 19 stress 0.1162752
## Run 20 stress 0.1120147
## ... Procrustes: rmse 0.01227073  max resid 0.04505059
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1135002
## ... Procrustes: rmse 0.002114617  max resid 0.01031354
## Run 2 stress 0.1132352
## ... New best solution
## ... Procrustes: rmse 0.05656754  max resid 0.3057706
## Run 3 stress 0.1119504
## ... New best solution
## ... Procrustes: rmse 0.03015803  max resid 0.09053839
## Run 4 stress 0.1119547
## ... Procrustes: rmse 0.01260801  max resid 0.04657287
## Run 5 stress 0.1172062
## Run 6 stress 0.1148317
## Run 7 stress 0.1137074
## Run 8 stress 0.1134992
## Run 9 stress 0.1154012
## Run 10 stress 0.1119448
## ... New best solution
## ... Procrustes: rmse 0.01077588  max resid 0.0397271
## Run 11 stress 0.11544
## Run 12 stress 0.111958
## ... Procrustes: rmse 0.002378862  max resid 0.008809107
## ... Similar to previous best
## Run 13 stress 0.1197018
## Run 14 stress 0.1134995
## Run 15 stress 0.1181458
## Run 16 stress 0.115776
## Run 17 stress 0.1166541
## Run 18 stress 0.1119759
## ... Procrustes: rmse 0.01443051  max resid 0.05305124
## Run 19 stress 0.1214397
```

```
## Run 20 stress 0.1133588
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1134994
## ... Procrustes: rmse 0.001907749  max resid 0.01008704
## Run 2 stress 0.1131869
## ... New best solution
## ... Procrustes: rmse 0.05386965  max resid 0.29336
## Run 3 stress 0.1120611
## ... New best solution
## ... Procrustes: rmse 0.03349515  max resid 0.1067258
## Run 4 stress 0.1119709
## ... New best solution
## ... Procrustes: rmse 0.02594885  max resid 0.09778727
## Run 5 stress 0.1155209
## Run 6 stress 0.1204132
## Run 7 stress 0.1134991
## Run 8 stress 0.1157462
## Run 9 stress 0.1119447
## ... New best solution
## ... Procrustes: rmse 0.004143275  max resid 0.01543834
## Run 10 stress 0.1119845
## ... Procrustes: rmse 0.01538865  max resid 0.05662272
## Run 11 stress 0.1119738
## ... Procrustes: rmse 0.004381458  max resid 0.01634338
## Run 12 stress 0.1134997
## Run 13 stress 0.1134989
## Run 14 stress 0.1120232
## ... Procrustes: rmse 0.01391838  max resid 0.04889837
## Run 15 stress 0.1119889
## ... Procrustes: rmse 0.005868298  max resid 0.02198001
## Run 16 stress 0.1194095
## Run 17 stress 0.1135001
## Run 18 stress 0.1135051
## Run 19 stress 0.1131723
## Run 20 stress 0.1120035
## ... Procrustes: rmse 0.01730478  max resid 0.06367673
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1158318
## Run 2 stress 0.1120566
## ... New best solution
## ... Procrustes: rmse 0.04316983  max resid 0.2056588
## Run 3 stress 0.1119557
## ... New best solution
## ... Procrustes: rmse 0.0102281  max resid 0.03921016
## Run 4 stress 0.1134996
## Run 5 stress 0.1134992
## Run 6 stress 0.1135272
## Run 7 stress 0.1120143
## ... Procrustes: rmse 0.006489621  max resid 0.02429321
## Run 8 stress 0.1119925
```

```
## ... Procrustes: rmse 0.004707861  max resid 0.0174843
## Run 9 stress 0.1194075
## Run 10 stress 0.1131851
## Run 11 stress 0.1196201
## Run 12 stress 0.1119592
## ... Procrustes: rmse 0.0005552582  max resid 0.002029859
## ... Similar to previous best
## Run 13 stress 0.1134986
## Run 14 stress 0.1191785
## Run 15 stress 0.1154845
## Run 16 stress 0.1120378
## ... Procrustes: rmse 0.009031094  max resid 0.0343779
## Run 17 stress 0.1134982
## Run 18 stress 0.1154195
## Run 19 stress 0.1135
## Run 20 stress 0.1166161
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
## Run 1 stress 0.1120072
## ... New best solution
## ... Procrustes: rmse 0.05095703  max resid 0.2804736
## Run 2 stress 0.1132004
## Run 3 stress 0.1198087
## Run 4 stress 0.1120166
## ... Procrustes: rmse 0.02033578  max resid 0.07380487
## Run 5 stress 0.1120161
## ... Procrustes: rmse 0.001004806  max resid 0.004933255
## ... Similar to previous best
## Run 6 stress 0.1120851
## ... Procrustes: rmse 0.03069593  max resid 0.1157469
## Run 7 stress 0.1156294
## Run 8 stress 0.1197491
## Run 9 stress 0.1119759
## ... New best solution
## ... Procrustes: rmse 0.02179554  max resid 0.08096404
## Run 10 stress 0.1175193
## Run 11 stress 0.1119364
## ... New best solution
## ... Procrustes: rmse 0.0116683  max resid 0.04310881
## Run 12 stress 0.1136414
## Run 13 stress 0.1135
## Run 14 stress 0.1198117
## Run 15 stress 0.1119651
## ... Procrustes: rmse 0.010208  max resid 0.03749427
## Run 16 stress 0.111944
## ... Procrustes: rmse 0.002638679  max resid 0.009637465
## ... Similar to previous best
## Run 17 stress 0.1177178
## Run 18 stress 0.1119603
## ... Procrustes: rmse 0.005529609  max resid 0.02036101
## Run 19 stress 0.1216756
## Run 20 stress 0.1176405
## *** Best solution repeated 1 times
## Run 0 stress 0.1134992
```

```
## Run 1 stress 0.1135555
## ... Procrustes: rmse 0.006145885  max resid 0.02319895
## Run 2 stress 0.1120115
## ... New best solution
## ... Procrustes: rmse 0.04288138  max resid 0.2120452
## Run 3 stress 0.1134997
## Run 4 stress 0.1131899
## Run 5 stress 0.1155269
## Run 6 stress 0.1119438
## ... New best solution
## ... Procrustes: rmse 0.01781864  max resid 0.06599562
## Run 7 stress 0.1119473
## ... Procrustes: rmse 0.0006198382  max resid 0.002243488
## ... Similar to previous best
## Run 8 stress 0.111957
## ... Procrustes: rmse 0.01149427  max resid 0.04214745
## Run 9 stress 0.1148234
## Run 10 stress 0.1120665
## ... Procrustes: rmse 0.02223569  max resid 0.0828213
## Run 11 stress 0.1194101
## Run 12 stress 0.1183752
## Run 13 stress 0.1131652
## Run 14 stress 0.1183604
## Run 15 stress 0.1129202
## Run 16 stress 0.1135585
## Run 17 stress 0.1154745
## Run 18 stress 0.1135
## Run 19 stress 0.1154563
## Run 20 stress 0.1119436
## ... New best solution
## ... Procrustes: rmse 0.008992097  max resid 0.03293884
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1135174
## ... Procrustes: rmse 0.003317045  max resid 0.01259921
## Run 2 stress 0.1119607
## ... New best solution
## ... Procrustes: rmse 0.04361731  max resid 0.2259429
## Run 3 stress 0.1120055
## ... Procrustes: rmse 0.005275033  max resid 0.01974536
## Run 4 stress 0.1134984
## Run 5 stress 0.1135339
## Run 6 stress 0.1120128
## ... Procrustes: rmse 0.005947742  max resid 0.0223463
## Run 7 stress 0.1197372
## Run 8 stress 0.1119931
## ... Procrustes: rmse 0.004007344  max resid 0.0149315
## Run 9 stress 0.1119555
## ... New best solution
## ... Procrustes: rmse 0.01439056  max resid 0.05321717
## Run 10 stress 0.1180794
## Run 11 stress 0.1153711
```

```
## Run 12 stress 0.1120055
## ... Procrustes: rmse 0.01330941  max resid 0.04658203
## Run 13 stress 0.1135289
## Run 14 stress 0.1155064
## Run 15 stress 0.1119515
## ... New best solution
## ... Procrustes: rmse 0.0006739094  max resid 0.002482442
## ... Similar to previous best
## Run 16 stress 0.1175074
## Run 17 stress 0.1136255
## Run 18 stress 0.1120395
## ... Procrustes: rmse 0.02178593  max resid 0.08070914
## Run 19 stress 0.1135507
## Run 20 stress 0.1119439
## ... New best solution
## ... Procrustes: rmse 0.01066806  max resid 0.03918482
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     19: no. of iterations >= maxit
##      1: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1195977
## Run 2 stress 0.1119723
## ... New best solution
## ... Procrustes: rmse 0.04333847  max resid 0.2220339
## Run 3 stress 0.1133593
## Run 4 stress 0.1119807
## ... Procrustes: rmse 0.001038394  max resid 0.0038916
## ... Similar to previous best
## Run 5 stress 0.1131844
## Run 6 stress 0.1133199
## Run 7 stress 0.1220889
## Run 8 stress 0.1133498
## Run 9 stress 0.111985
## ... Procrustes: rmse 0.0194636  max resid 0.07251654
## Run 10 stress 0.1199311
## Run 11 stress 0.1119487
## ... New best solution
## ... Procrustes: rmse 0.003635759  max resid 0.01337722
## Run 12 stress 0.1120222
## ... Procrustes: rmse 0.008912243  max resid 0.03343736
## Run 13 stress 0.1119796
## ... Procrustes: rmse 0.01396483  max resid 0.05166079
## Run 14 stress 0.1121043
## ... Procrustes: rmse 0.01510574  max resid 0.05872841
## Run 15 stress 0.1132944
## Run 16 stress 0.1152482
## Run 17 stress 0.1128816
## Run 18 stress 0.1119687
## ... Procrustes: rmse 0.01422411  max resid 0.05267737
## Run 19 stress 0.1194535
## Run 20 stress 0.1120641
## ... Procrustes: rmse 0.02103588  max resid 0.07757766
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     18: no. of iterations >= maxit
```

```
##      2: stress ratio > sratmax
## Run 0 stress 0.1134992
## Run 1 stress 0.1199298
## Run 2 stress 0.1148504
## Run 3 stress 0.1135005
## ... Procrustes: rmse 0.0006934737  max resid 0.003459227
## ... Similar to previous best
## Run 4 stress 0.1134989
## ... New best solution
## ... Procrustes: rmse 0.001457768  max resid 0.006031631
## ... Similar to previous best
## Run 5 stress 0.1134999
## ... Procrustes: rmse 0.0007769084  max resid 0.004429084
## ... Similar to previous best
## Run 6 stress 0.1150116
## Run 7 stress 0.1120309
## ... New best solution
## ... Procrustes: rmse 0.04306545  max resid 0.2075808
## Run 8 stress 0.1204166
## Run 9 stress 0.1135004
## Run 10 stress 0.1199288
## Run 11 stress 0.1135015
## Run 12 stress 0.1119394
## ... New best solution
## ... Procrustes: rmse 0.01836274  max resid 0.06832866
## Run 13 stress 0.1135436
## Run 14 stress 0.1134987
## Run 15 stress 0.1119431
## ... Procrustes: rmse 0.001121454  max resid 0.003920498
## ... Similar to previous best
## Run 16 stress 0.1119539
## ... Procrustes: rmse 0.00328766  max resid 0.01196196
## Run 17 stress 0.1134998
## Run 18 stress 0.1196851
## Run 19 stress 0.1162545
## Run 20 stress 0.119903
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09230349
## ... Procrustes: rmse 0.009699862  max resid 0.04612277
## Run 2 stress 0.09268837
## Run 3 stress 0.09392845
## Run 4 stress 0.09228336
## ... Procrustes: rmse 0.008332401  max resid 0.04051994
## Run 5 stress 0.09293294
## Run 6 stress 0.09132973
## ... New best solution
## ... Procrustes: rmse 0.05003244  max resid 0.1575159
## Run 7 stress 0.09129374
## ... New best solution
## ... Procrustes: rmse 0.02598905  max resid 0.09143914
## Run 8 stress 0.09236297
## Run 9 stress 0.09255317
## Run 10 stress 0.09145174
```

```
## ... Procrustes: rmse 0.01854242  max resid 0.0555602
## Run 11 stress 0.09118548
## ... New best solution
## ... Procrustes: rmse 0.01327162  max resid 0.05599261
## Run 12 stress 0.09156081
## ... Procrustes: rmse 0.07304599  max resid 0.2318097
## Run 13 stress 0.09167684
## ... Procrustes: rmse 0.02748435  max resid 0.09384103
## Run 14 stress 0.09140434
## ... Procrustes: rmse 0.02500777  max resid 0.1309731
## Run 15 stress 0.09153613
## ... Procrustes: rmse 0.07242231  max resid 0.2354288
## Run 16 stress 0.09153837
## ... Procrustes: rmse 0.07294138  max resid 0.2345441
## Run 17 stress 0.09118624
## ... Procrustes: rmse 0.0004852103  max resid 0.002596006
## ... Similar to previous best
## Run 18 stress 0.0914063
## ... Procrustes: rmse 0.04102699  max resid 0.2142835
## Run 19 stress 0.09243213
## Run 20 stress 0.09488449
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09134426
## ... New best solution
## ... Procrustes: rmse 0.04945094  max resid 0.1582112
## Run 2 stress 0.09118781
## ... New best solution
## ... Procrustes: rmse 0.0135723  max resid 0.04305841
## Run 3 stress 0.09309754
## Run 4 stress 0.09153787
## ... Procrustes: rmse 0.07167878  max resid 0.2115423
## Run 5 stress 0.09233495
## Run 6 stress 0.09184896
## Run 7 stress 0.09135987
## ... Procrustes: rmse 0.01308411  max resid 0.04402789
## Run 8 stress 0.09118578
## ... New best solution
## ... Procrustes: rmse 0.001087134  max resid 0.004877939
## ... Similar to previous best
## Run 9 stress 0.0930086
## Run 10 stress 0.09239287
## Run 11 stress 0.09215203
## Run 12 stress 0.09207644
## Run 13 stress 0.0915385
## ... Procrustes: rmse 0.07147757  max resid 0.2088198
## Run 14 stress 0.09117891
## ... New best solution
## ... Procrustes: rmse 0.003182641  max resid 0.01193927
## Run 15 stress 0.09155635
## ... Procrustes: rmse 0.07108863  max resid 0.2157438
## Run 16 stress 0.09208625
## Run 17 stress 0.09233367
## Run 18 stress 0.09238891
```

```
## Run 19 stress 0.09139433
## ... Procrustes: rmse 0.04330461  max resid 0.2280538
## Run 20 stress 0.09153772
## ... Procrustes: rmse 0.07206868  max resid 0.2213734
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09166094
## ... New best solution
## ... Procrustes: rmse 0.06698799  max resid 0.2863262
## Run 2 stress 0.09275864
## Run 3 stress 0.091374
## ... New best solution
## ... Procrustes: rmse 0.05349473  max resid 0.3167
## Run 4 stress 0.09135407
## ... New best solution
## ... Procrustes: rmse 0.02800402  max resid 0.1355906
## Run 5 stress 0.09136478
## ... Procrustes: rmse 0.02106916  max resid 0.08478735
## Run 6 stress 0.09122283
## ... New best solution
## ... Procrustes: rmse 0.02869196  max resid 0.1506125
## Run 7 stress 0.09153589
## ... Procrustes: rmse 0.07019246  max resid 0.1984025
## Run 8 stress 0.09314534
## Run 9 stress 0.09154276
## ... Procrustes: rmse 0.07068292  max resid 0.1983623
## Run 10 stress 0.09138275
## ... Procrustes: rmse 0.03304007  max resid 0.1772447
## Run 11 stress 0.09118257
## ... New best solution
## ... Procrustes: rmse 0.005946791  max resid 0.03034545
## Run 12 stress 0.09234417
## Run 13 stress 0.09207511
## Run 14 stress 0.09154326
## ... Procrustes: rmse 0.07211344  max resid 0.2213937
## Run 15 stress 0.09156056
## ... Procrustes: rmse 0.07186175  max resid 0.2131379
## Run 16 stress 0.09234211
## Run 17 stress 0.09210007
## Run 18 stress 0.0915353
## ... Procrustes: rmse 0.07178071  max resid 0.2176993
## Run 19 stress 0.09310618
## Run 20 stress 0.09223647
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09153479
## ... New best solution
## ... Procrustes: rmse 0.0386345  max resid 0.09129015
## Run 2 stress 0.09153442
## ... New best solution
```

```
## ... Procrustes: rmse 0.001695873  max resid 0.006711928
## ... Similar to previous best
## Run 3 stress 0.09278812
## Run 4 stress 0.09158224
## ... Procrustes: rmse 0.005312242  max resid 0.02301816
## Run 5 stress 0.09231082
## Run 6 stress 0.09143741
## ... New best solution
## ... Procrustes: rmse 0.07290003  max resid 0.2380766
## Run 7 stress 0.09291795
## Run 8 stress 0.09153413
## ... Procrustes: rmse 0.0724978  max resid 0.2385636
## Run 9 stress 0.09142189
## ... New best solution
## ... Procrustes: rmse 0.02119692  max resid 0.09254102
## Run 10 stress 0.09235559
## Run 11 stress 0.09145739
## ... Procrustes: rmse 0.0399853  max resid 0.2070516
## Run 12 stress 0.09223998
## Run 13 stress 0.09155628
## ... Procrustes: rmse 0.04213917  max resid 0.2114311
## Run 14 stress 0.0915631
## ... Procrustes: rmse 0.0701911  max resid 0.2476015
## Run 15 stress 0.09143111
## ... Procrustes: rmse 0.001822451  max resid 0.007923138
## ... Similar to previous best
## Run 16 stress 0.09310475
## Run 17 stress 0.09222284
## Run 18 stress 0.09122513
## ... New best solution
## ... Procrustes: rmse 0.03806029  max resid 0.2000394
## Run 19 stress 0.09119182
## ... New best solution
## ... Procrustes: rmse 0.003814484  max resid 0.01723117
## Run 20 stress 0.09334381
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09153492
## ... New best solution
## ... Procrustes: rmse 0.03904216  max resid 0.0940987
## Run 2 stress 0.09234438
## Run 3 stress 0.09239133
## Run 4 stress 0.09286648
## Run 5 stress 0.09153479
## ... New best solution
## ... Procrustes: rmse 0.002324898  max resid 0.008332871
## ... Similar to previous best
## Run 6 stress 0.09214346
## Run 7 stress 0.09119573
## ... New best solution
## ... Procrustes: rmse 0.07111558  max resid 0.2056989
## Run 8 stress 0.09126324
```

```
## ... Procrustes: rmse 0.005817231  max resid 0.03063896
## Run 9 stress 0.09153517
## ... Procrustes: rmse 0.07118342  max resid 0.2089644
## Run 10 stress 0.09425778
## Run 11 stress 0.09346008
## Run 12 stress 0.09285876
## Run 13 stress 0.09122297
## ... Procrustes: rmse 0.003045135  max resid 0.01526084
## Run 14 stress 0.09153456
## ... Procrustes: rmse 0.07118133  max resid 0.2090067
## Run 15 stress 0.09435677
## Run 16 stress 0.0923877
## Run 17 stress 0.0915016
## ... Procrustes: rmse 0.05237831  max resid 0.2895864
## Run 18 stress 0.09153374
## ... Procrustes: rmse 0.07107024  max resid 0.2065838
## Run 19 stress 0.09137428
## ... Procrustes: rmse 0.04428249  max resid 0.2288523
## Run 20 stress 0.0940324
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09309049
## Run 2 stress 0.09146881
## ... New best solution
## ... Procrustes: rmse 0.06359564  max resid 0.2275564
## Run 3 stress 0.09506747
## Run 4 stress 0.09145067
## ... New best solution
## ... Procrustes: rmse 0.01096805  max resid 0.03400816
## Run 5 stress 0.09174689
## ... Procrustes: rmse 0.02354034  max resid 0.1086599
## Run 6 stress 0.09119291
## ... New best solution
## ... Procrustes: rmse 0.04200553  max resid 0.2227314
## Run 7 stress 0.09286256
## Run 8 stress 0.09153808
## ... Procrustes: rmse 0.07157206  max resid 0.2088672
## Run 9 stress 0.0921613
## Run 10 stress 0.09207501
## Run 11 stress 0.09309391
## Run 12 stress 0.09309119
## Run 13 stress 0.09147973
## ... Procrustes: rmse 0.05167672  max resid 0.2808229
## Run 14 stress 0.09126666
## ... Procrustes: rmse 0.01920434  max resid 0.09625026
## Run 15 stress 0.09153932
## ... Procrustes: rmse 0.0716318  max resid 0.2095043
## Run 16 stress 0.09153607
## ... Procrustes: rmse 0.07154285  max resid 0.211767
## Run 17 stress 0.09302324
## Run 18 stress 0.09282515
## Run 19 stress 0.0913597
```

```
## ... Procrustes: rmse 0.0360673  max resid 0.174982
## Run 20 stress 0.09136103
## ... Procrustes: rmse 0.04065365  max resid 0.204759
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09260094
## ... Procrustes: rmse 0.04023116  max resid 0.2041367
## Run 2 stress 0.09309992
## Run 3 stress 0.09244607
## ... Procrustes: rmse 0.0613173  max resid 0.2442852
## Run 4 stress 0.09137271
## ... New best solution
## ... Procrustes: rmse 0.05764001  max resid 0.2027846
## Run 5 stress 0.09228277
## Run 6 stress 0.09493048
## Run 7 stress 0.09309221
## Run 8 stress 0.09153558
## ... Procrustes: rmse 0.07482779  max resid 0.2874454
## Run 9 stress 0.09153715
## ... Procrustes: rmse 0.07478946  max resid 0.2484555
## Run 10 stress 0.0911958
## ... New best solution
## ... Procrustes: rmse 0.04114424  max resid 0.2088596
## Run 11 stress 0.09208708
## Run 12 stress 0.09257039
## Run 13 stress 0.09153914
## ... Procrustes: rmse 0.07146615  max resid 0.2072963
## Run 14 stress 0.09234578
## Run 15 stress 0.09153699
## ... Procrustes: rmse 0.0713407  max resid 0.2061012
## Run 16 stress 0.0915879
## ... Procrustes: rmse 0.07062551  max resid 0.2047133
## Run 17 stress 0.09153601
## ... Procrustes: rmse 0.07126179  max resid 0.2100441
## Run 18 stress 0.09144034
## ... Procrustes: rmse 0.04950214  max resid 0.2683996
## Run 19 stress 0.09161432
## ... Procrustes: rmse 0.04926163  max resid 0.2755365
## Run 20 stress 0.09136337
## ... Procrustes: rmse 0.03652063  max resid 0.1777805
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09122753
## ... New best solution
## ... Procrustes: rmse 0.05611356  max resid 0.1677852
## Run 2 stress 0.09248961
## Run 3 stress 0.09309615
## Run 4 stress 0.0915343
## ... Procrustes: rmse 0.07371483  max resid 0.2419532
## Run 5 stress 0.09309769
```

```
## Run 6 stress 0.09309148
## Run 7 stress 0.09335648
## Run 8 stress 0.09238983
## Run 9 stress 0.09309684
## Run 10 stress 0.09239323
## Run 11 stress 0.09153722
## ... Procrustes: rmse 0.07413623  max resid 0.2445292
## Run 12 stress 0.09154431
## ... Procrustes: rmse 0.07433676  max resid 0.2444915
## Run 13 stress 0.09469803
## Run 14 stress 0.09153746
## ... Procrustes: rmse 0.07412342  max resid 0.2441831
## Run 15 stress 0.09195724
## Run 16 stress 0.09422679
## Run 17 stress 0.09238356
## Run 18 stress 0.09281004
## Run 19 stress 0.09153469
## ... Procrustes: rmse 0.07350309  max resid 0.2422657
## Run 20 stress 0.09154663
## ... Procrustes: rmse 0.07339519  max resid 0.2396613
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09154713
## ... New best solution
## ... Procrustes: rmse 0.06626427  max resid 0.2272933
## Run 2 stress 0.09133898
## ... New best solution
## ... Procrustes: rmse 0.04038558  max resid 0.2158687
## Run 3 stress 0.09167157
## ... Procrustes: rmse 0.06718885  max resid 0.2110283
## Run 4 stress 0.0919252
## Run 5 stress 0.09137095
## ... Procrustes: rmse 0.03310996  max resid 0.1766119
## Run 6 stress 0.09280931
## Run 7 stress 0.09153508
## ... Procrustes: rmse 0.06906131  max resid 0.2230902
## Run 8 stress 0.09117983
## ... New best solution
## ... Procrustes: rmse 0.01381903  max resid 0.04352877
## Run 9 stress 0.09138609
## ... Procrustes: rmse 0.02762008  max resid 0.1449807
## Run 10 stress 0.09235673
## Run 11 stress 0.09177254
## Run 12 stress 0.09228874
## Run 13 stress 0.09146914
## ... Procrustes: rmse 0.04659203  max resid 0.2483676
## Run 14 stress 0.09118376
## ... Procrustes: rmse 0.001853446  max resid 0.009631184
## ... Similar to previous best
## Run 15 stress 0.09124834
## ... Procrustes: rmse 0.01487215  max resid 0.07450225
## Run 16 stress 0.09144891
```

```
## ... Procrustes: rmse 0.04775584  max resid 0.2569582
## Run 17 stress 0.09517711
## Run 18 stress 0.09153444
## ... Procrustes: rmse 0.07192582  max resid 0.220487
## Run 19 stress 0.09140062
## ... Procrustes: rmse 0.04461927  max resid 0.2348691
## Run 20 stress 0.09170829
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.0915349
## ... New best solution
## ... Procrustes: rmse 0.03899498  max resid 0.09397727
## Run 2 stress 0.09236185
## Run 3 stress 0.09153754
## ... Procrustes: rmse 0.002169021  max resid 0.007292274
## ... Similar to previous best
## Run 4 stress 0.09154276
## ... Procrustes: rmse 0.003351964  max resid 0.009687291
## ... Similar to previous best
## Run 5 stress 0.0914072
## ... New best solution
## ... Procrustes: rmse 0.06750574  max resid 0.2023548
## Run 6 stress 0.0917057
## ... Procrustes: rmse 0.06672064  max resid 0.187918
## Run 7 stress 0.09135594
## ... New best solution
## ... Procrustes: rmse 0.02855528  max resid 0.156344
## Run 8 stress 0.09238325
## Run 9 stress 0.0911887
## ... New best solution
## ... Procrustes: rmse 0.03032472  max resid 0.1367204
## Run 10 stress 0.09309238
## Run 11 stress 0.09122713
## ... Procrustes: rmse 0.01538965  max resid 0.07839807
## Run 12 stress 0.0922815
## Run 13 stress 0.09147129
## ... Procrustes: rmse 0.04008477  max resid 0.2148172
## Run 14 stress 0.09119045
## ... Procrustes: rmse 0.0004071231  max resid 0.001949751
## ... Similar to previous best
## Run 15 stress 0.09153821
## ... Procrustes: rmse 0.07171673  max resid 0.2108013
## Run 16 stress 0.09296221
## Run 17 stress 0.09154101
## ... Procrustes: rmse 0.07182181  max resid 0.211502
## Run 18 stress 0.09266533
## Run 19 stress 0.09158016
## ... Procrustes: rmse 0.02960549  max resid 0.09625633
## Run 20 stress 0.09148202
## ... Procrustes: rmse 0.0501546  max resid 0.2769534
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09143794
## ... New best solution
```

```
## ... Procrustes: rmse 0.06236195  max resid 0.2154077
## Run 2 stress 0.09207087
## Run 3 stress 0.09154242
## ... Procrustes: rmse 0.02597077  max resid 0.1177296
## Run 4 stress 0.09153437
## ... Procrustes: rmse 0.07068268  max resid 0.2480741
## Run 5 stress 0.09248247
## Run 6 stress 0.09143273
## ... New best solution
## ... Procrustes: rmse 0.02042484  max resid 0.07722692
## Run 7 stress 0.09118921
## ... New best solution
## ... Procrustes: rmse 0.04116176  max resid 0.2164962
## Run 8 stress 0.0932468
## Run 9 stress 0.09154448
## ... Procrustes: rmse 0.07328691  max resid 0.2408386
## Run 10 stress 0.09206392
## Run 11 stress 0.09153514
## ... Procrustes: rmse 0.07238701  max resid 0.2364582
## Run 12 stress 0.09155996
## ... Procrustes: rmse 0.07215375  max resid 0.2315162
## Run 13 stress 0.09259425
## Run 14 stress 0.09242392
## Run 15 stress 0.0915335
## ... Procrustes: rmse 0.07266929  max resid 0.2376027
## Run 16 stress 0.09335078
## Run 17 stress 0.09135121
## ... Procrustes: rmse 0.01327272  max resid 0.04413819
## Run 18 stress 0.09236998
## Run 19 stress 0.09309248
## Run 20 stress 0.09309167
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09165868
## ... New best solution
## ... Procrustes: rmse 0.04227745  max resid 0.1633258
## Run 2 stress 0.0913703
## ... New best solution
## ... Procrustes: rmse 0.04292724  max resid 0.225016
## Run 3 stress 0.09228959
## Run 4 stress 0.09153792
## ... Procrustes: rmse 0.07462003  max resid 0.2493209
## Run 5 stress 0.09153394
## ... Procrustes: rmse 0.07442743  max resid 0.2483183
## Run 6 stress 0.09141327
## ... Procrustes: rmse 0.01237309  max resid 0.06621521
## Run 7 stress 0.09118926
## ... New best solution
## ... Procrustes: rmse 0.03933391  max resid 0.1944573
## Run 8 stress 0.09286153
## Run 9 stress 0.09119318
## ... Procrustes: rmse 0.0007499478  max resid 0.003571259
```

```
## ... Similar to previous best
## Run 10 stress 0.09242107
## Run 11 stress 0.09311793
## Run 12 stress 0.09420301
## Run 13 stress 0.09142291
## ... Procrustes: rmse 0.04848658  max resid 0.2614651
## Run 14 stress 0.09302168
## Run 15 stress 0.09483962
## Run 16 stress 0.09134154
## ... Procrustes: rmse 0.02581658  max resid 0.1104348
## Run 17 stress 0.09285911
## Run 18 stress 0.09256832
## Run 19 stress 0.09424416
## Run 20 stress 0.09153936
## ... Procrustes: rmse 0.07173014  max resid 0.2115258
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09262887
## ... Procrustes: rmse 0.01990405  max resid 0.07771118
## Run 2 stress 0.09208984
## ... New best solution
## ... Procrustes: rmse 0.03868626  max resid 0.08771329
## Run 3 stress 0.09196667
## ... New best solution
## ... Procrustes: rmse 0.05715658  max resid 0.1717701
## Run 4 stress 0.09239094
## ... Procrustes: rmse 0.05693285  max resid 0.2892031
## Run 5 stress 0.09140385
## ... New best solution
## ... Procrustes: rmse 0.04755644  max resid 0.1973201
## Run 6 stress 0.09123158
## ... New best solution
## ... Procrustes: rmse 0.03609427  max resid 0.1936798
## Run 7 stress 0.09248178
## Run 8 stress 0.09163524
## ... Procrustes: rmse 0.06961542  max resid 0.1907732
## Run 9 stress 0.09229541
## Run 10 stress 0.09169879
## ... Procrustes: rmse 0.02313736  max resid 0.06588515
## Run 11 stress 0.09141519
## ... Procrustes: rmse 0.05048197  max resid 0.2757011
## Run 12 stress 0.09286458
## Run 13 stress 0.09207661
## Run 14 stress 0.09146789
## ... Procrustes: rmse 0.05309373  max resid 0.2946604
## Run 15 stress 0.09118056
## ... New best solution
## ... Procrustes: rmse 0.01033607  max resid 0.05174058
## Run 16 stress 0.09311715
## Run 17 stress 0.09238342
## Run 18 stress 0.09156196
## ... Procrustes: rmse 0.07206369  max resid 0.2245885
## Run 19 stress 0.09493594
## Run 20 stress 0.09291813
```

```
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09119985
## ... New best solution
## ... Procrustes: rmse 0.0552397  max resid 0.1631794
## Run 2 stress 0.09235877
## Run 3 stress 0.09309391
## Run 4 stress 0.09136962
## ... Procrustes: rmse 0.03344534  max resid 0.16251
## Run 5 stress 0.09117893
## ... New best solution
## ... Procrustes: rmse 0.007447167  max resid 0.03750694
## Run 6 stress 0.09297747
## Run 7 stress 0.09269704
## Run 8 stress 0.09153525
## ... Procrustes: rmse 0.07236488  max resid 0.222818
## Run 9 stress 0.09211938
## Run 10 stress 0.09156009
## ... Procrustes: rmse 0.0720898  max resid 0.2193884
## Run 11 stress 0.09238064
## Run 12 stress 0.09120109
## ... Procrustes: rmse 0.006110491  max resid 0.03110556
## Run 13 stress 0.09236377
## Run 14 stress 0.09155669
## ... Procrustes: rmse 0.07321729  max resid 0.2281357
## Run 15 stress 0.09212149
## Run 16 stress 0.09220232
## Run 17 stress 0.09160094
## ... Procrustes: rmse 0.07121294  max resid 0.2129866
## Run 18 stress 0.0911905
## ... Procrustes: rmse 0.004696111  max resid 0.02400159
## Run 19 stress 0.09144342
## ... Procrustes: rmse 0.01660178  max resid 0.05701157
## Run 20 stress 0.09228232
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     18: no. of iterations >= maxit
##      2: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09119329
## ... New best solution
## ... Procrustes: rmse 0.05503629  max resid 0.1625207
## Run 2 stress 0.09310473
## Run 3 stress 0.09207727
## Run 4 stress 0.09286885
## Run 5 stress 0.09132502
## ... Procrustes: rmse 0.01312586  max resid 0.04270039
## Run 6 stress 0.09119526
## ... Procrustes: rmse 0.01158785  max resid 0.05875102
## Run 7 stress 0.09153467
## ... Procrustes: rmse 0.0727942  max resid 0.2374766
## Run 8 stress 0.09245547
## Run 9 stress 0.0923436
```

```
## Run 10 stress 0.09170284
## Run 11 stress 0.09119505
## ... Procrustes: rmse 0.01152542  max resid 0.05874722
## Run 12 stress 0.09254463
## Run 13 stress 0.09136045
## ... Procrustes: rmse 0.03126186  max resid 0.1486568
## Run 14 stress 0.09140119
## ... Procrustes: rmse 0.01791757  max resid 0.07033651
## Run 15 stress 0.09237357
## Run 16 stress 0.09153414
## ... Procrustes: rmse 0.07264009  max resid 0.2387864
## Run 17 stress 0.0924789
## Run 18 stress 0.09242683
## Run 19 stress 0.09142649
## ... Procrustes: rmse 0.04080397  max resid 0.2136652
## Run 20 stress 0.09152924
## ... Procrustes: rmse 0.02463324  max resid 0.09437587
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09153788
## ... New best solution
## ... Procrustes: rmse 0.03870767  max resid 0.09219963
## Run 2 stress 0.09153686
## ... New best solution
## ... Procrustes: rmse 0.0003142146  max resid 0.001393591
## ... Similar to previous best
## Run 3 stress 0.09286091
## Run 4 stress 0.09132407
## ... New best solution
## ... Procrustes: rmse 0.07039931  max resid 0.237408
## Run 5 stress 0.09144586
## ... Procrustes: rmse 0.03862202  max resid 0.2198525
## Run 6 stress 0.09133015
## ... Procrustes: rmse 0.006076279  max resid 0.03303206
## Run 7 stress 0.09129474
## ... New best solution
## ... Procrustes: rmse 0.02261041  max resid 0.09882982
## Run 8 stress 0.09153771
## ... Procrustes: rmse 0.06939115  max resid 0.1863222
## Run 9 stress 0.09149484
## ... Procrustes: rmse 0.05622173  max resid 0.3185882
## Run 10 stress 0.09720721
## Run 11 stress 0.09156585
## ... Procrustes: rmse 0.06888418  max resid 0.1834611
## Run 12 stress 0.09328875
## Run 13 stress 0.09246153
## Run 14 stress 0.09309368
## Run 15 stress 0.09141082
## ... Procrustes: rmse 0.01619386  max resid 0.04435262
## Run 16 stress 0.09384218
## Run 17 stress 0.09154625
## ... Procrustes: rmse 0.06935402  max resid 0.1896248
```

```
## Run 18 stress 0.09146459
## ... Procrustes: rmse 0.05514612  max resid 0.3102741
## Run 19 stress 0.09137967
## ... Procrustes: rmse 0.03627358  max resid 0.193845
## Run 20 stress 0.09139999
## ... Procrustes: rmse 0.03752716  max resid 0.1999774
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09119999
## ... New best solution
## ... Procrustes: rmse 0.05446631  max resid 0.1608909
## Run 2 stress 0.09138283
## ... Procrustes: rmse 0.03550087  max resid 0.1799574
## Run 3 stress 0.09237241
## Run 4 stress 0.09240367
## Run 5 stress 0.091354
## ... Procrustes: rmse 0.01424598  max resid 0.04826345
## Run 6 stress 0.09345763
## Run 7 stress 0.09144234
## ... Procrustes: rmse 0.01840172  max resid 0.05414728
## Run 8 stress 0.09207643
## Run 9 stress 0.09118463
## ... New best solution
## ... Procrustes: rmse 0.01061261  max resid 0.0519115
## Run 10 stress 0.09280183
## Run 11 stress 0.09153638
## ... Procrustes: rmse 0.07179597  max resid 0.2136711
## Run 12 stress 0.09427962
## Run 13 stress 0.09238018
## Run 14 stress 0.09120535
## ... Procrustes: rmse 0.00337987  max resid 0.01680851
## Run 15 stress 0.09237709
## Run 16 stress 0.09135312
## ... Procrustes: rmse 0.01236819  max resid 0.06086802
## Run 17 stress 0.09138852
## ... Procrustes: rmse 0.014087  max resid 0.0458401
## Run 18 stress 0.0914513
## ... Procrustes: rmse 0.03728995  max resid 0.2000393
## Run 19 stress 0.09422303
## Run 20 stress 0.09118398
## ... New best solution
## ... Procrustes: rmse 0.001859725  max resid 0.005134571
## ... Similar to previous best
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09153511
## ... New best solution
## ... Procrustes: rmse 0.03809771  max resid 0.09038578
## Run 2 stress 0.09237426
## Run 3 stress 0.09145343
## ... New best solution
## ... Procrustes: rmse 0.06966327  max resid 0.2465972
```

```
## Run 4 stress 0.09309096
## Run 5 stress 0.09142433
## ... New best solution
## ... Procrustes: rmse 0.04330946  max resid 0.2257639
## Run 6 stress 0.09119243
## ... New best solution
## ... Procrustes: rmse 0.01140665  max resid 0.0376598
## Run 7 stress 0.09207362
## Run 8 stress 0.09153537
## ... Procrustes: rmse 0.07132474  max resid 0.2115054
## Run 9 stress 0.09140876
## ... Procrustes: rmse 0.047786  max resid 0.2566804
## Run 10 stress 0.09309902
## Run 11 stress 0.09292369
## Run 12 stress 0.09309183
## Run 13 stress 0.09309114
## Run 14 stress 0.09153421
## ... Procrustes: rmse 0.07109533  max resid 0.2095114
## Run 15 stress 0.09153662
## ... Procrustes: rmse 0.07135397  max resid 0.2080641
## Run 16 stress 0.09154662
## ... Procrustes: rmse 0.07160667  max resid 0.2160408
## Run 17 stress 0.09154253
## ... Procrustes: rmse 0.07163942  max resid 0.2115135
## Run 18 stress 0.09211915
## Run 19 stress 0.0923651
## Run 20 stress 0.09232154
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     10: no. of iterations >= maxit
##     10: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09207639
## ... New best solution
## ... Procrustes: rmse 0.005023845  max resid 0.02323928
## Run 2 stress 0.09137763
## ... New best solution
## ... Procrustes: rmse 0.05871961  max resid 0.1965528
## Run 3 stress 0.09156458
## ... Procrustes: rmse 0.0731662  max resid 0.2434556
## Run 4 stress 0.09235941
## Run 5 stress 0.09118918
## ... New best solution
## ... Procrustes: rmse 0.03630242  max resid 0.1819747
## Run 6 stress 0.09155054
## ... Procrustes: rmse 0.07354579  max resid 0.2403934
## Run 7 stress 0.09331564
## Run 8 stress 0.09127479
## ... Procrustes: rmse 0.01653266  max resid 0.08623063
## Run 9 stress 0.09953973
## Run 10 stress 0.09153426
## ... Procrustes: rmse 0.0724702  max resid 0.2344486
## Run 11 stress 0.09146762
## ... Procrustes: rmse 0.04376592  max resid 0.2338407
## Run 12 stress 0.09229667
```

```
## Run 13 stress 0.09150395
## ... Procrustes: rmse 0.04511964  max resid 0.2424448
## Run 14 stress 0.09309205
## Run 15 stress 0.09139517
## ... Procrustes: rmse 0.03853043  max resid 0.1973645
## Run 16 stress 0.09266814
## Run 17 stress 0.09229681
## Run 18 stress 0.0921641
## Run 19 stress 0.09158559
## ... Procrustes: rmse 0.04796172  max resid 0.2587722
## Run 20 stress 0.0930959
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     18: no. of iterations >= maxit
##      2: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09118553
## ... New best solution
## ... Procrustes: rmse 0.0546008  max resid 0.158648
## Run 2 stress 0.09289315
## Run 3 stress 0.09124306
## ... Procrustes: rmse 0.006241313  max resid 0.02781182
## Run 4 stress 0.09153435
## ... Procrustes: rmse 0.07161867  max resid 0.2150407
## Run 5 stress 0.091182
## ... New best solution
## ... Procrustes: rmse 0.000933814  max resid 0.004641016
## ... Similar to previous best
## Run 6 stress 0.0913959
## ... Procrustes: rmse 0.04508966  max resid 0.2378179
## Run 7 stress 0.09136365
## ... Procrustes: rmse 0.01286204  max resid 0.04431223
## Run 8 stress 0.09272562
## Run 9 stress 0.09240524
## Run 10 stress 0.09285666
## Run 11 stress 0.0912651
## ... Procrustes: rmse 0.01772591  max resid 0.09030793
## Run 12 stress 0.09120695
## ... Procrustes: rmse 0.004141368  max resid 0.0175047
## Run 13 stress 0.0913521
## ... Procrustes: rmse 0.02766814  max resid 0.121032
## Run 14 stress 0.09154172
## ... Procrustes: rmse 0.07136819  max resid 0.2114442
## Run 15 stress 0.09156157
## ... Procrustes: rmse 0.07170732  max resid 0.2126058
## Run 16 stress 0.09338501
## Run 17 stress 0.0925903
## Run 18 stress 0.09122031
## ... Procrustes: rmse 0.00551433  max resid 0.02792083
## Run 19 stress 0.09209616
## Run 20 stress 0.0915377
## ... Procrustes: rmse 0.07197915  max resid 0.216514
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09133386
```

```
## ... New best solution
## ... Procrustes: rmse 0.05103459  max resid 0.1651429
## Run 2 stress 0.09135932
## ... Procrustes: rmse 0.0187826  max resid 0.09659651
## Run 3 stress 0.09165206
## ... Procrustes: rmse 0.06945472  max resid 0.246152
## Run 4 stress 0.09138771
## ... Procrustes: rmse 0.02728627  max resid 0.1486268
## Run 5 stress 0.09449532
## Run 6 stress 0.0914246
## ... Procrustes: rmse 0.03159862  max resid 0.1756052
## Run 7 stress 0.09157133
## ... Procrustes: rmse 0.03790527  max resid 0.2148284
## Run 8 stress 0.09311215
## Run 9 stress 0.09169716
## ... Procrustes: rmse 0.02803787  max resid 0.1348713
## Run 10 stress 0.09309001
## Run 11 stress 0.09286788
## Run 12 stress 0.09141508
## ... Procrustes: rmse 0.03013584  max resid 0.1681265
## Run 13 stress 0.09118307
## ... New best solution
## ... Procrustes: rmse 0.02226631  max resid 0.0879743
## Run 14 stress 0.09286434
## Run 15 stress 0.09177417
## Run 16 stress 0.09153649
## ... Procrustes: rmse 0.07147597  max resid 0.2118631
## Run 17 stress 0.09136269
## ... Procrustes: rmse 0.0399394  max resid 0.2003505
## Run 18 stress 0.0940626
## Run 19 stress 0.0915512
## ... Procrustes: rmse 0.07223412  max resid 0.2153992
## Run 20 stress 0.09310434
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09296592
## Run 2 stress 0.09154563
## ... New best solution
## ... Procrustes: rmse 0.03872252  max resid 0.09162409
## Run 3 stress 0.09119937
## ... New best solution
## ... Procrustes: rmse 0.07133479  max resid 0.2063366
## Run 4 stress 0.09412377
## Run 5 stress 0.09324371
## Run 6 stress 0.09121773
## ... Procrustes: rmse 0.01570618  max resid 0.08133866
## Run 7 stress 0.09118922
## ... New best solution
## ... Procrustes: rmse 0.001642312  max resid 0.008280801
## ... Similar to previous best
## Run 8 stress 0.09144312
## ... Procrustes: rmse 0.03585532  max resid 0.1924614
```

```
## Run 9 stress 0.09126413
## ... Procrustes: rmse 0.006240522  max resid 0.02296259
## Run 10 stress 0.0931132
## Run 11 stress 0.09141251
## ... Procrustes: rmse 0.03221885  max resid 0.1705933
## Run 12 stress 0.09143812
## ... Procrustes: rmse 0.03576399  max resid 0.1921445
## Run 13 stress 0.09153576
## ... Procrustes: rmse 0.07164061  max resid 0.2113658
## Run 14 stress 0.09230608
## Run 15 stress 0.09171299
## Run 16 stress 0.09140033
## ... Procrustes: rmse 0.04671529  max resid 0.2481993
## Run 17 stress 0.09160489
## ... Procrustes: rmse 0.07095813  max resid 0.2051417
## Run 18 stress 0.09118406
## ... New best solution
## ... Procrustes: rmse 0.001196717  max resid 0.005793771
## ... Similar to previous best
## Run 19 stress 0.09124552
## ... Procrustes: rmse 0.01627255  max resid 0.0828795
## Run 20 stress 0.09153566
## ... Procrustes: rmse 0.07182885  max resid 0.214901
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09155717
## ... New best solution
## ... Procrustes: rmse 0.03906421  max resid 0.09273589
## Run 2 stress 0.09153535
## ... New best solution
## ... Procrustes: rmse 0.00584677  max resid 0.02021768
## Run 3 stress 0.09287399
## Run 4 stress 0.0911846
## ... New best solution
## ... Procrustes: rmse 0.07168748  max resid 0.2179369
## Run 5 stress 0.09153787
## ... Procrustes: rmse 0.07184215  max resid 0.2181661
## Run 6 stress 0.09118864
## ... Procrustes: rmse 0.001055402  max resid 0.005190818
## ... Similar to previous best
## Run 7 stress 0.09207365
## Run 8 stress 0.09154658
## ... Procrustes: rmse 0.0712563  max resid 0.2094999
## Run 9 stress 0.09153893
## ... Procrustes: rmse 0.07132903  max resid 0.2100434
## Run 10 stress 0.09526222
## Run 11 stress 0.09143595
## ... Procrustes: rmse 0.0479032  max resid 0.257739
## Run 12 stress 0.09310596
## Run 13 stress 0.0911854
## ... Procrustes: rmse 0.001771269  max resid 0.008279379
## ... Similar to previous best
## Run 14 stress 0.09137747
## ... Procrustes: rmse 0.01614769  max resid 0.047855
```

```
## Run 15 stress 0.09230672
## Run 16 stress 0.09309279
## Run 17 stress 0.09153601
## ... Procrustes: rmse 0.07186434  max resid 0.2156356
## Run 18 stress 0.09135572
## ... Procrustes: rmse 0.02940052  max resid 0.1316821
## Run 19 stress 0.09137243
## ... Procrustes: rmse 0.03926007  max resid 0.1930676
## Run 20 stress 0.09141404
## ... Procrustes: rmse 0.04724164  max resid 0.2527102
## *** Best solution repeated 2 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09119625
## ... New best solution
## ... Procrustes: rmse 0.05499692  max resid 0.1621795
## Run 2 stress 0.09287045
## Run 3 stress 0.09216523
## Run 4 stress 0.09135787
## ... Procrustes: rmse 0.02873078  max resid 0.1320184
## Run 5 stress 0.09257812
## Run 6 stress 0.09241025
## Run 7 stress 0.09142491
## ... Procrustes: rmse 0.02473094  max resid 0.1315993
## Run 8 stress 0.09142221
## ... Procrustes: rmse 0.03452647  max resid 0.1731896
## Run 9 stress 0.09228852
## Run 10 stress 0.09255733
## Run 11 stress 0.09235558
## Run 12 stress 0.09249556
## Run 13 stress 0.09151203
## ... Procrustes: rmse 0.04459765  max resid 0.239571
## Run 14 stress 0.09118667
## ... New best solution
## ... Procrustes: rmse 0.002172733  max resid 0.01032862
## Run 15 stress 0.09280009
## Run 16 stress 0.09142451
## ... Procrustes: rmse 0.02695674  max resid 0.1426255
## Run 17 stress 0.09184773
## Run 18 stress 0.0911915
## ... Procrustes: rmse 0.009394159  max resid 0.04745289
## Run 19 stress 0.09232841
## Run 20 stress 0.09239946
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09407653
## Run 2 stress 0.09309117
## Run 3 stress 0.09143103
## ... New best solution
## ... Procrustes: rmse 0.0613958  max resid 0.2189433
## Run 4 stress 0.09389104
## Run 5 stress 0.09155011
## ... Procrustes: rmse 0.07023775  max resid 0.2480468
```

```
## Run 6 stress 0.09177313
## ... Procrustes: rmse 0.04669518  max resid 0.2222545
## Run 7 stress 0.09501189
## Run 8 stress 0.09286124
## Run 9 stress 0.09120461
## ... New best solution
## ... Procrustes: rmse 0.03756061  max resid 0.2010849
## Run 10 stress 0.09236422
## Run 11 stress 0.09431183
## Run 12 stress 0.09236504
## Run 13 stress 0.09128922
## ... Procrustes: rmse 0.006112568  max resid 0.03156627
## Run 14 stress 0.09325839
## Run 15 stress 0.09207779
## Run 16 stress 0.09212418
## Run 17 stress 0.0941592
## Run 18 stress 0.09314731
## Run 19 stress 0.09153406
## ... Procrustes: rmse 0.07053323  max resid 0.2030234
## Run 20 stress 0.09144989
## ... Procrustes: rmse 0.03485424  max resid 0.181972
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09119281
## ... New best solution
## ... Procrustes: rmse 0.05451797  max resid 0.1580887
## Run 2 stress 0.09118762
## ... New best solution
## ... Procrustes: rmse 0.0008568388  max resid 0.004286362
## ... Similar to previous best
## Run 3 stress 0.09234515
## Run 4 stress 0.09208198
## Run 5 stress 0.09118502
## ... New best solution
## ... Procrustes: rmse 0.0006134324  max resid 0.003094191
## ... Similar to previous best
## Run 6 stress 0.09236496
## Run 7 stress 0.09244713
## Run 8 stress 0.09155974
## ... Procrustes: rmse 0.07120239  max resid 0.2105621
## Run 9 stress 0.09143979
## ... Procrustes: rmse 0.03634247  max resid 0.1913075
## Run 10 stress 0.09239104
## Run 11 stress 0.093091
## Run 12 stress 0.09172199
## Run 13 stress 0.09239211
## Run 14 stress 0.09136761
## ... Procrustes: rmse 0.01793459  max resid 0.0502237
## Run 15 stress 0.09236716
## Run 16 stress 0.09153614
## ... Procrustes: rmse 0.0717738  max resid 0.2166253
## Run 17 stress 0.09235784
```

```
## Run 18 stress 0.09153354
## ... Procrustes: rmse 0.07156748  max resid 0.2143252
## Run 19 stress 0.09153419
## ... Procrustes: rmse 0.07154413  max resid 0.2150401
## Run 20 stress 0.09133291
## ... Procrustes: rmse 0.02228149  max resid 0.08858618
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09248938
## ... Procrustes: rmse 0.02340629  max resid 0.07500723
## Run 2 stress 0.09207709
## ... New best solution
## ... Procrustes: rmse 0.005051024  max resid 0.02326169
## Run 3 stress 0.09133086
## ... New best solution
## ... Procrustes: rmse 0.05334145  max resid 0.1641609
## Run 4 stress 0.09286129
## Run 5 stress 0.09118181
## ... New best solution
## ... Procrustes: rmse 0.01221876  max resid 0.06211484
## Run 6 stress 0.09153396
## ... Procrustes: rmse 0.07151177  max resid 0.2146964
## Run 7 stress 0.09123067
## ... Procrustes: rmse 0.006518446  max resid 0.03282457
## Run 8 stress 0.09235753
## Run 9 stress 0.09118428
## ... Procrustes: rmse 0.0007386139  max resid 0.003744805
## ... Similar to previous best
## Run 10 stress 0.09209145
## Run 11 stress 0.09153582
## ... Procrustes: rmse 0.07197587  max resid 0.2176604
## Run 12 stress 0.09143121
## ... Procrustes: rmse 0.04751451  max resid 0.2553854
## Run 13 stress 0.09309773
## Run 14 stress 0.09120656
## ... Procrustes: rmse 0.004339583  max resid 0.0216487
## Run 15 stress 0.09144385
## ... Procrustes: rmse 0.04848885  max resid 0.2618374
## Run 16 stress 0.09135444
## ... Procrustes: rmse 0.01350845  max resid 0.0442453
## Run 17 stress 0.091537
## ... Procrustes: rmse 0.07197424  max resid 0.2170871
## Run 18 stress 0.09153426
## ... Procrustes: rmse 0.0717628  max resid 0.2176216
## Run 19 stress 0.09309265
## Run 20 stress 0.09153397
## ... Procrustes: rmse 0.07181677  max resid 0.2158551
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09239075
## ... Procrustes: rmse 0.03265796  max resid 0.1607561
## Run 2 stress 0.09231849
## ... Procrustes: rmse 0.01150228  max resid 0.05387226
## Run 3 stress 0.09207281
```

```
## ... New best solution
## ... Procrustes: rmse 0.006591831  max resid 0.02878989
## Run 4 stress 0.09145301
## ... New best solution
## ... Procrustes: rmse 0.06048594  max resid 0.2147219
## Run 5 stress 0.09153704
## ... Procrustes: rmse 0.07215287  max resid 0.2400249
## Run 6 stress 0.09223323
## Run 7 stress 0.09136148
## ... New best solution
## ... Procrustes: rmse 0.02026807  max resid 0.1122791
## Run 8 stress 0.09209447
## Run 9 stress 0.09158844
## ... Procrustes: rmse 0.07217503  max resid 0.2689595
## Run 10 stress 0.09291614
## Run 11 stress 0.09153486
## ... Procrustes: rmse 0.07234652  max resid 0.270142
## Run 12 stress 0.09348409
## Run 13 stress 0.09153764
## ... Procrustes: rmse 0.07310768  max resid 0.2754066
## Run 14 stress 0.09156
## ... Procrustes: rmse 0.07210388  max resid 0.2684862
## Run 15 stress 0.09135993
## ... New best solution
## ... Procrustes: rmse 0.006856014  max resid 0.02910177
## Run 16 stress 0.09153621
## ... Procrustes: rmse 0.07452596  max resid 0.2935792
## Run 17 stress 0.09119048
## ... New best solution
## ... Procrustes: rmse 0.03722955  max resid 0.1810207
## Run 18 stress 0.09156199
## ... Procrustes: rmse 0.07145136  max resid 0.2064355
## Run 19 stress 0.09153455
## ... Procrustes: rmse 0.07145503  max resid 0.2116572
## Run 20 stress 0.09154246
## ... Procrustes: rmse 0.07175013  max resid 0.2092185
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     11: no. of iterations >= maxit
##      9: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09153092
## ... New best solution
## ... Procrustes: rmse 0.04465475  max resid 0.1629249
## Run 2 stress 0.09147921
## ... New best solution
## ... Procrustes: rmse 0.05106173  max resid 0.3023506
## Run 3 stress 0.0937944
## Run 4 stress 0.09157145
## ... Procrustes: rmse 0.07047368  max resid 0.2345724
## Run 5 stress 0.09153747
## ... Procrustes: rmse 0.07257075  max resid 0.2369794
## Run 6 stress 0.0920727
## Run 7 stress 0.09234417
## Run 8 stress 0.09207298
```

```
## Run 9 stress 0.09309019
## Run 10 stress 0.09234858
## Run 11 stress 0.09207946
## Run 12 stress 0.09156274
## ... Procrustes: rmse 0.07192945  max resid 0.2362659
## Run 13 stress 0.09241754
## Run 14 stress 0.09118099
## ... New best solution
## ... Procrustes: rmse 0.0484918  max resid 0.2638691
## Run 15 stress 0.09118261
## ... Procrustes: rmse 0.0005635638  max resid 0.002445686
## ... Similar to previous best
## Run 16 stress 0.09119202
## ... Procrustes: rmse 0.008235479  max resid 0.04176559
## Run 17 stress 0.09231673
## Run 18 stress 0.09238309
## Run 19 stress 0.09255626
## Run 20 stress 0.09123093
## ... Procrustes: rmse 0.01063681  max resid 0.05787526
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09156648
## ... New best solution
## ... Procrustes: rmse 0.03950559  max resid 0.09543913
## Run 2 stress 0.09338297
## Run 3 stress 0.0913265
## ... New best solution
## ... Procrustes: rmse 0.07153755  max resid 0.2479347
## Run 4 stress 0.09118975
## ... New best solution
## ... Procrustes: rmse 0.01405712  max resid 0.0424397
## Run 5 stress 0.09217881
## Run 6 stress 0.09136237
## ... Procrustes: rmse 0.03270164  max resid 0.1587027
## Run 7 stress 0.09282941
## Run 8 stress 0.0928909
## Run 9 stress 0.09154404
## ... Procrustes: rmse 0.07304714  max resid 0.2360096
## Run 10 stress 0.09118449
## ... New best solution
## ... Procrustes: rmse 0.008818648  max resid 0.04402819
## Run 11 stress 0.09153843
## ... Procrustes: rmse 0.07196477  max resid 0.2166824
## Run 12 stress 0.09156041
## ... Procrustes: rmse 0.07136673  max resid 0.2083912
## Run 13 stress 0.09247815
## Run 14 stress 0.09154955
## ... Procrustes: rmse 0.07120517  max resid 0.2087452
## Run 15 stress 0.09153691
## ... Procrustes: rmse 0.0718084  max resid 0.213359
## Run 16 stress 0.09232207
## Run 17 stress 0.09276634
## Run 18 stress 0.09210945
## Run 19 stress 0.09232444
```

```
## Run 20 stress 0.09141536
## ... Procrustes: rmse 0.02993572  max resid 0.1552728
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.0923882
## ... Procrustes: rmse 0.05407933  max resid 0.2361096
## Run 2 stress 0.09137975
## ... New best solution
## ... Procrustes: rmse 0.06072905  max resid 0.2180406
## Run 3 stress 0.09179935
## ... Procrustes: rmse 0.07086294  max resid 0.2423548
## Run 4 stress 0.09136988
## ... New best solution
## ... Procrustes: rmse 0.001732865  max resid 0.008738782
## ... Similar to previous best
## Run 5 stress 0.09155884
## ... Procrustes: rmse 0.07290059  max resid 0.2448172
## Run 6 stress 0.09134079
## ... New best solution
## ... Procrustes: rmse 0.02181986  max resid 0.1171547
## Run 7 stress 0.0930914
## Run 8 stress 0.0915625
## ... Procrustes: rmse 0.07085366  max resid 0.2544044
## Run 9 stress 0.09153612
## ... Procrustes: rmse 0.07168068  max resid 0.2592808
## Run 10 stress 0.09136435
## ... Procrustes: rmse 0.02033444  max resid 0.1078225
## Run 11 stress 0.09225969
## Run 12 stress 0.09215009
## Run 13 stress 0.09136049
## ... Procrustes: rmse 0.01795663  max resid 0.09385088
## Run 14 stress 0.09223377
## Run 15 stress 0.09138871
## ... Procrustes: rmse 0.02477944  max resid 0.1352511
## Run 16 stress 0.09319727
## Run 17 stress 0.0915594
## ... Procrustes: rmse 0.07098902  max resid 0.2562254
## Run 18 stress 0.09149473
## ... Procrustes: rmse 0.02742486  max resid 0.1479258
## Run 19 stress 0.09309244
## Run 20 stress 0.09142567
## ... Procrustes: rmse 0.02469709  max resid 0.1342153
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09146279
## ... New best solution
## ... Procrustes: rmse 0.06251988  max resid 0.22181
## Run 2 stress 0.09119617
## ... New best solution
## ... Procrustes: rmse 0.03464792  max resid 0.1808562
```

```
## Run 3 stress 0.09227331
## Run 4 stress 0.09258917
## Run 5 stress 0.09118393
## ... New best solution
## ... Procrustes: rmse 0.008866308  max resid 0.04540616
## Run 6 stress 0.09221701
## Run 7 stress 0.09134464
## ... Procrustes: rmse 0.02577793  max resid 0.108477
## Run 8 stress 0.0915336
## ... Procrustes: rmse 0.07155746  max resid 0.2147072
## Run 9 stress 0.09321832
## Run 10 stress 0.09153482
## ... Procrustes: rmse 0.07140958  max resid 0.2109756
## Run 11 stress 0.09234335
## Run 12 stress 0.09525809
## Run 13 stress 0.09123071
## ... Procrustes: rmse 0.005626666  max resid 0.02397746
## Run 14 stress 0.09153377
## ... Procrustes: rmse 0.07170196  max resid 0.2153848
## Run 15 stress 0.09229585
## Run 16 stress 0.09153397
## ... Procrustes: rmse 0.07170039  max resid 0.2154608
## Run 17 stress 0.09316172
## Run 18 stress 0.09123724
## ... Procrustes: rmse 0.01528847  max resid 0.07972861
## Run 19 stress 0.09207869
## Run 20 stress 0.09163736
## ... Procrustes: rmse 0.02418137  max resid 0.06829662
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09117919
## ... New best solution
## ... Procrustes: rmse 0.0550652  max resid 0.1608456
## Run 2 stress 0.09121132
## ... Procrustes: rmse 0.006891245  max resid 0.03493971
## Run 3 stress 0.09153478
## ... Procrustes: rmse 0.07225748  max resid 0.2222547
## Run 4 stress 0.09121025
## ... Procrustes: rmse 0.009747871  max resid 0.04766895
## Run 5 stress 0.09155681
## ... Procrustes: rmse 0.07310083  max resid 0.225631
## Run 6 stress 0.09207968
## Run 7 stress 0.09154294
## ... Procrustes: rmse 0.07265575  max resid 0.223706
## Run 8 stress 0.09238624
## Run 9 stress 0.09237042
## Run 10 stress 0.09230878
## Run 11 stress 0.09309298
## Run 12 stress 0.09143931
## ... Procrustes: rmse 0.0468598  max resid 0.2502302
## Run 13 stress 0.09153588
## ... Procrustes: rmse 0.07208495  max resid 0.2237308
```

```
## Run 14 stress 0.091186
## ... Procrustes: rmse 0.005217072  max resid 0.02493027
## Run 15 stress 0.09179039
## Run 16 stress 0.09160535
## ... Procrustes: rmse 0.03569503  max resid 0.186844
## Run 17 stress 0.09139705
## ... Procrustes: rmse 0.02816372  max resid 0.1447055
## Run 18 stress 0.09151625
## ... Procrustes: rmse 0.04986205  max resid 0.2719068
## Run 19 stress 0.09237151
## Run 20 stress 0.09146218
## ... Procrustes: rmse 0.0190928  max resid 0.05344659
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09242635
## ... Procrustes: rmse 0.04500833  max resid 0.2058902
## Run 2 stress 0.09162485
## ... New best solution
## ... Procrustes: rmse 0.06425518  max resid 0.2548605
## Run 3 stress 0.09119668
## ... New best solution
## ... Procrustes: rmse 0.05247708  max resid 0.2909856
## Run 4 stress 0.09225978
## Run 5 stress 0.09233034
## Run 6 stress 0.09155505
## ... Procrustes: rmse 0.07145074  max resid 0.2067477
## Run 7 stress 0.09153648
## ... Procrustes: rmse 0.07125823  max resid 0.207764
## Run 8 stress 0.09156
## ... Procrustes: rmse 0.07060032  max resid 0.2021051
## Run 9 stress 0.09228001
## Run 10 stress 0.09288683
## Run 11 stress 0.09139768
## ... Procrustes: rmse 0.03187268  max resid 0.1687236
## Run 12 stress 0.09230386
## Run 13 stress 0.09153451
## ... Procrustes: rmse 0.07084246  max resid 0.2044639
## Run 14 stress 0.09123342
## ... Procrustes: rmse 0.003512515  max resid 0.0178045
## Run 15 stress 0.09219839
## Run 16 stress 0.0925239
## Run 17 stress 0.09139548
## ... Procrustes: rmse 0.04694096  max resid 0.2505901
## Run 18 stress 0.09153576
## ... Procrustes: rmse 0.07122323  max resid 0.2097122
## Run 19 stress 0.09332067
## Run 20 stress 0.09154021
## ... Procrustes: rmse 0.07131596  max resid 0.206955
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
```

```
## Run 1 stress 0.09125542
## ... New best solution
## ... Procrustes: rmse 0.0537158  max resid 0.1610454
## Run 2 stress 0.09140554
## ... Procrustes: rmse 0.03722067  max resid 0.1970754
## Run 3 stress 0.09240566
## Run 4 stress 0.09144111
## ... Procrustes: rmse 0.03997908  max resid 0.2168146
## Run 5 stress 0.09286124
## Run 6 stress 0.09120748
## ... New best solution
## ... Procrustes: rmse 0.01819899  max resid 0.09586409
## Run 7 stress 0.09153728
## ... Procrustes: rmse 0.07382001  max resid 0.2479882
## Run 8 stress 0.0920752
## Run 9 stress 0.09161621
## ... Procrustes: rmse 0.07276415  max resid 0.2347106
## Run 10 stress 0.09143465
## ... Procrustes: rmse 0.02441562  max resid 0.1273801
## Run 11 stress 0.09227625
## Run 12 stress 0.09210214
## Run 13 stress 0.0930901
## Run 14 stress 0.09236204
## Run 15 stress 0.09153917
## ... Procrustes: rmse 0.07344373  max resid 0.2413672
## Run 16 stress 0.09144358
## ... Procrustes: rmse 0.02467824  max resid 0.1300333
## Run 17 stress 0.0915608
## ... Procrustes: rmse 0.07256749  max resid 0.2355527
## Run 18 stress 0.09120799
## ... Procrustes: rmse 0.01319865  max resid 0.06375806
## Run 19 stress 0.0913462
## ... Procrustes: rmse 0.01514818  max resid 0.04515579
## Run 20 stress 0.09146458
## ... Procrustes: rmse 0.04152743  max resid 0.2170261
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09190359
## ... New best solution
## ... Procrustes: rmse 0.03991855  max resid 0.09479269
## Run 2 stress 0.09119516
## ... New best solution
## ... Procrustes: rmse 0.07118709  max resid 0.2145925
## Run 3 stress 0.09155957
## ... Procrustes: rmse 0.07080773  max resid 0.204645
## Run 4 stress 0.09177247
## Run 5 stress 0.09236797
## Run 6 stress 0.09155944
## ... Procrustes: rmse 0.07077467  max resid 0.202043
## Run 7 stress 0.09214111
## Run 8 stress 0.09239327
## Run 9 stress 0.09233223
```

```
## Run 10 stress 0.09338124
## Run 11 stress 0.09156516
## ... Procrustes: rmse 0.07096466  max resid 0.2013777
## Run 12 stress 0.09275684
## Run 13 stress 0.09153612
## ... Procrustes: rmse 0.07131709  max resid 0.2069144
## Run 14 stress 0.09125324
## ... Procrustes: rmse 0.005133541  max resid 0.02659875
## Run 15 stress 0.09155936
## ... Procrustes: rmse 0.07079085  max resid 0.2020922
## Run 16 stress 0.09132665
## ... Procrustes: rmse 0.02548681  max resid 0.1327007
## Run 17 stress 0.09154692
## ... Procrustes: rmse 0.07154907  max resid 0.2068844
## Run 18 stress 0.09153493
## ... Procrustes: rmse 0.07123554  max resid 0.2100629
## Run 19 stress 0.09124196
## ... Procrustes: rmse 0.004233064  max resid 0.02170797
## Run 20 stress 0.09142235
## ... Procrustes: rmse 0.03400466  max resid 0.1804143
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09143792
## ... New best solution
## ... Procrustes: rmse 0.06183573  max resid 0.2203032
## Run 2 stress 0.09140334
## ... New best solution
## ... Procrustes: rmse 0.005218359  max resid 0.0270215
## Run 3 stress 0.09140581
## ... Procrustes: rmse 0.001645912  max resid 0.00393095
## ... Similar to previous best
## Run 4 stress 0.09136193
## ... New best solution
## ... Procrustes: rmse 0.00521655  max resid 0.02572178
## Run 5 stress 0.0932816
## Run 6 stress 0.09153361
## ... Procrustes: rmse 0.07319381  max resid 0.2531723
## Run 7 stress 0.09119663
## ... New best solution
## ... Procrustes: rmse 0.02870119  max resid 0.1511041
## Run 8 stress 0.09136792
## ... Procrustes: rmse 0.02919933  max resid 0.1554225
## Run 9 stress 0.09119027
## ... New best solution
## ... Procrustes: rmse 0.001222216  max resid 0.006157431
## ... Similar to previous best
## Run 10 stress 0.09143342
## ... Procrustes: rmse 0.04869229  max resid 0.2634306
## Run 11 stress 0.09207979
## Run 12 stress 0.09153379
## ... Procrustes: rmse 0.07122848  max resid 0.2093241
## Run 13 stress 0.0929534
```

```
## Run 14 stress 0.09138617
## ... Procrustes: rmse 0.04470386  max resid 0.2339901
## Run 15 stress 0.09130599
## ... Procrustes: rmse 0.008812673  max resid 0.03780802
## Run 16 stress 0.09139733
## ... Procrustes: rmse 0.02982402  max resid 0.1622606
## Run 17 stress 0.09123569
## ... Procrustes: rmse 0.004991763  max resid 0.02556271
## Run 18 stress 0.09154542
## ... Procrustes: rmse 0.05315576  max resid 0.2955331
## Run 19 stress 0.09135834
## ... Procrustes: rmse 0.03922737  max resid 0.1958463
## Run 20 stress 0.09147475
## ... Procrustes: rmse 0.03691235  max resid 0.2006429
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09139168
## ... New best solution
## ... Procrustes: rmse 0.05836953  max resid 0.1996997
## Run 2 stress 0.09145295
## ... Procrustes: rmse 0.01665355  max resid 0.04508534
## Run 3 stress 0.09153695
## ... Procrustes: rmse 0.07458932  max resid 0.2467357
## Run 4 stress 0.09118568
## ... New best solution
## ... Procrustes: rmse 0.04226545  max resid 0.2167036
## Run 5 stress 0.09129439
## ... Procrustes: rmse 0.009325615  max resid 0.04842328
## Run 6 stress 0.09207256
## Run 7 stress 0.09134296
## ... Procrustes: rmse 0.02565691  max resid 0.1091318
## Run 8 stress 0.09168588
## Run 9 stress 0.09479984
## Run 10 stress 0.09153361
## ... Procrustes: rmse 0.0714396  max resid 0.2136311
## Run 11 stress 0.09135948
## ... Procrustes: rmse 0.03622604  max resid 0.1767033
## Run 12 stress 0.09229549
## Run 13 stress 0.09136797
## ... Procrustes: rmse 0.04188747  max resid 0.213719
## Run 14 stress 0.09134032
## ... Procrustes: rmse 0.02459178  max resid 0.1052741
## Run 15 stress 0.09153671
## ... Procrustes: rmse 0.07180208  max resid 0.2151269
## Run 16 stress 0.09246339
## Run 17 stress 0.09336824
## Run 18 stress 0.09235974
## Run 19 stress 0.09286039
## Run 20 stress 0.09121728
## ... Procrustes: rmse 0.004184244  max resid 0.01705545
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     12: no. of iterations >= maxit
##      8: stress ratio > sratmax
## Run 0 stress 0.09216961
```

```
## Run 1 stress 0.09128497
## ... New best solution
## ... Procrustes: rmse 0.05329511  max resid 0.1616291
## Run 2 stress 0.09153372
## ... Procrustes: rmse 0.06914208  max resid 0.1860905
## Run 3 stress 0.09153635
## ... Procrustes: rmse 0.06939283  max resid 0.18689
## Run 4 stress 0.09156308
## ... Procrustes: rmse 0.06923753  max resid 0.1834593
## Run 5 stress 0.09139449
## ... Procrustes: rmse 0.01329125  max resid 0.04345122
## Run 6 stress 0.09207259
## Run 7 stress 0.09153437
## ... Procrustes: rmse 0.06911194  max resid 0.1844274
## Run 8 stress 0.09153744
## ... Procrustes: rmse 0.06946304  max resid 0.1879867
## Run 9 stress 0.09153964
## ... Procrustes: rmse 0.06910381  max resid 0.1878572
## Run 10 stress 0.09123638
## ... New best solution
## ... Procrustes: rmse 0.004990511  max resid 0.02106021
## Run 11 stress 0.09153333
## ... Procrustes: rmse 0.07068974  max resid 0.1939686
## Run 12 stress 0.09117999
## ... New best solution
## ... Procrustes: rmse 0.01105754  max resid 0.05186276
## Run 13 stress 0.09462276
## Run 14 stress 0.09207516
## Run 15 stress 0.09525233
## Run 16 stress 0.09146559
## ... Procrustes: rmse 0.03156706  max resid 0.1678547
## Run 17 stress 0.09153486
## ... Procrustes: rmse 0.07206487  max resid 0.2271101
## Run 18 stress 0.09172438
## Run 19 stress 0.09134646
## ... Procrustes: rmse 0.02215999  max resid 0.0851403
## Run 20 stress 0.09235072
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     11: no. of iterations >= maxit
##      9: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09246628
## ... Procrustes: rmse 0.05905901  max resid 0.2505936
## Run 2 stress 0.09142648
## ... New best solution
## ... Procrustes: rmse 0.06202058  max resid 0.2186215
## Run 3 stress 0.09155893
## ... Procrustes: rmse 0.06851544  max resid 0.2467178
## Run 4 stress 0.09286264
## Run 5 stress 0.09208089
## Run 6 stress 0.09233835
## Run 7 stress 0.09418287
## Run 8 stress 0.09221376
## Run 9 stress 0.09234159
```

```
## Run 10 stress 0.09138701
## ... New best solution
## ... Procrustes: rmse 0.005346789  max resid 0.02757691
## Run 11 stress 0.09320125
## Run 12 stress 0.09141242
## ... Procrustes: rmse 0.004358965  max resid 0.02163717
## Run 13 stress 0.09156113
## ... Procrustes: rmse 0.07090875  max resid 0.2504894
## Run 14 stress 0.09248129
## Run 15 stress 0.09154464
## ... Procrustes: rmse 0.07119318  max resid 0.2512422
## Run 16 stress 0.09431837
## Run 17 stress 0.09156255
## ... Procrustes: rmse 0.07074873  max resid 0.2506042
## Run 18 stress 0.09153455
## ... Procrustes: rmse 0.07154376  max resid 0.2513054
## Run 19 stress 0.09207479
## Run 20 stress 0.09136216
## ... New best solution
## ... Procrustes: rmse 0.01710788  max resid 0.0536996
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09520639
## Run 2 stress 0.09157612
## ... New best solution
## ... Procrustes: rmse 0.03652441  max resid 0.08915239
## Run 3 stress 0.09142249
## ... New best solution
## ... Procrustes: rmse 0.07281252  max resid 0.2492431
## Run 4 stress 0.09154412
## ... Procrustes: rmse 0.07038271  max resid 0.2482811
## Run 5 stress 0.09212947
## Run 6 stress 0.09237702
## Run 7 stress 0.09138097
## ... New best solution
## ... Procrustes: rmse 0.01474908  max resid 0.04902692
## Run 8 stress 0.09137218
## ... New best solution
## ... Procrustes: rmse 0.006523379  max resid 0.03090945
## Run 9 stress 0.09153597
## ... Procrustes: rmse 0.07489694  max resid 0.2863524
## Run 10 stress 0.09236903
## Run 11 stress 0.09149488
## ... Procrustes: rmse 0.01798753  max resid 0.04779634
## Run 12 stress 0.0911969
## ... New best solution
## ... Procrustes: rmse 0.04093899  max resid 0.2056044
## Run 13 stress 0.09155104
## ... Procrustes: rmse 0.07205032  max resid 0.2124299
## Run 14 stress 0.09120021
## ... Procrustes: rmse 0.001946722  max resid 0.008757073
## ... Similar to previous best
```

```
## Run 15 stress 0.09261655
## Run 16 stress 0.09429655
## Run 17 stress 0.091179
## ... New best solution
## ... Procrustes: rmse 0.003570695  max resid 0.01629998
## Run 18 stress 0.09286065
## Run 19 stress 0.09506537
## Run 20 stress 0.09145014
## ... Procrustes: rmse 0.0473261  max resid 0.2545355
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09303779
## Run 2 stress 0.09135963
## ... New best solution
## ... Procrustes: rmse 0.05846632  max resid 0.2135363
## Run 3 stress 0.09407522
## Run 4 stress 0.09286152
## Run 5 stress 0.09267147
## Run 6 stress 0.09150373
## ... Procrustes: rmse 0.01795211  max resid 0.09715139
## Run 7 stress 0.09334783
## Run 8 stress 0.0913678
## ... Procrustes: rmse 0.00363887  max resid 0.01943989
## Run 9 stress 0.09248114
## Run 10 stress 0.09118671
## ... New best solution
## ... Procrustes: rmse 0.03945231  max resid 0.1971428
## Run 11 stress 0.09153668
## ... Procrustes: rmse 0.07179713  max resid 0.2149206
## Run 12 stress 0.09136828
## ... Procrustes: rmse 0.02682958  max resid 0.1413615
## Run 13 stress 0.09148439
## ... Procrustes: rmse 0.01815606  max resid 0.04969097
## Run 14 stress 0.0914085
## ... Procrustes: rmse 0.04688797  max resid 0.2500624
## Run 15 stress 0.09119716
## ... Procrustes: rmse 0.001837512  max resid 0.009156081
## ... Similar to previous best
## Run 16 stress 0.0913622
## ... Procrustes: rmse 0.04070267  max resid 0.2057246
## Run 17 stress 0.09253261
## Run 18 stress 0.09153428
## ... Procrustes: rmse 0.07137607  max resid 0.2095186
## Run 19 stress 0.09141154
## ... Procrustes: rmse 0.0472443  max resid 0.2526377
## Run 20 stress 0.09153353
## ... Procrustes: rmse 0.07149809  max resid 0.211571
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09118837
## ... New best solution
## ... Procrustes: rmse 0.05464203  max resid 0.1584453
```

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## Run 2 stress 0.09209487
## Run 3 stress 0.0928603
## Run 4 stress 0.09141409
## ... Procrustes: rmse 0.04754066  max resid 0.2549358
## Run 5 stress 0.09237736
## Run 6 stress 0.09273968
## Run 7 stress 0.09153655
## ... Procrustes: rmse 0.07127762  max resid 0.2076947
## Run 8 stress 0.09234117
## Run 9 stress 0.09235556
## Run 10 stress 0.09133303
## ... Procrustes: rmse 0.01422763  max resid 0.04146796
## Run 11 stress 0.09153661
## ... Procrustes: rmse 0.07170373  max resid 0.2132362
## Run 12 stress 0.09119981
## ... Procrustes: rmse 0.001764223  max resid 0.008871883
## ... Similar to previous best
## Run 13 stress 0.09244214
## Run 14 stress 0.09209673
## Run 15 stress 0.09243484
## Run 16 stress 0.09157996
## ... Procrustes: rmse 0.05340538  max resid 0.2993968
## Run 17 stress 0.09236886
## Run 18 stress 0.0914148
## ... Procrustes: rmse 0.04761847  max resid 0.2556037
## Run 19 stress 0.09172375
## Run 20 stress 0.09139422
## ... Procrustes: rmse 0.01375894  max resid 0.04574612
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09245515
## ... Procrustes: rmse 0.01469849  max resid 0.05556691
## Run 2 stress 0.09153759
## ... New best solution
## ... Procrustes: rmse 0.03894731  max resid 0.0932167
## Run 3 stress 0.09142084
## ... New best solution
## ... Procrustes: rmse 0.07043077  max resid 0.2485462
## Run 4 stress 0.09406047
## Run 5 stress 0.0917537
## ... Procrustes: rmse 0.07231485  max resid 0.2566294
## Run 6 stress 0.09236957
## Run 7 stress 0.09117909
## ... New best solution
## ... Procrustes: rmse 0.03133798  max resid 0.167261
## Run 8 stress 0.09239661
## Run 9 stress 0.09309118
## Run 10 stress 0.09429742
## Run 11 stress 0.09220014
## Run 12 stress 0.09153558
## ... Procrustes: rmse 0.07221192  max resid 0.2237343
## Run 13 stress 0.09146956
## ... Procrustes: rmse 0.04808875  max resid 0.2613525
## Run 14 stress 0.09483317
```

```
## Run 15 stress 0.09118116
## ... Procrustes: rmse 0.003484767  max resid 0.0184723
## Run 16 stress 0.09473775
## Run 17 stress 0.09233728
## Run 18 stress 0.09154174
## ... Procrustes: rmse 0.07238978  max resid 0.2217039
## Run 19 stress 0.09474974
## Run 20 stress 0.09136025
## ... Procrustes: rmse 0.03731753  max resid 0.1836127
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09236732
## ... Procrustes: rmse 0.05685582  max resid 0.2277733
## Run 2 stress 0.09153547
## ... New best solution
## ... Procrustes: rmse 0.0379853  max resid 0.09013342
## Run 3 stress 0.09281638
## Run 4 stress 0.09233743
## Run 5 stress 0.09155139
## ... Procrustes: rmse 0.0058018  max resid 0.02128382
## Run 6 stress 0.0919215
## ... Procrustes: rmse 0.05650063  max resid 0.1649212
## Run 7 stress 0.09233054
## Run 8 stress 0.09410643
## Run 9 stress 0.09238024
## Run 10 stress 0.0916162
## ... Procrustes: rmse 0.004436364  max resid 0.01169912
## Run 11 stress 0.09209931
## Run 12 stress 0.09211322
## Run 13 stress 0.09287629
## Run 14 stress 0.09156221
## ... Procrustes: rmse 0.006125668  max resid 0.01912034
## Run 15 stress 0.09118775
## ... New best solution
## ... Procrustes: rmse 0.07237584  max resid 0.2336262
## Run 16 stress 0.09118214
## ... New best solution
## ... Procrustes: rmse 0.007326963  max resid 0.0373873
## Run 17 stress 0.09207531
## Run 18 stress 0.09309227
## Run 19 stress 0.09153476
## ... Procrustes: rmse 0.07148513  max resid 0.2152611
## Run 20 stress 0.09137106
## ... Procrustes: rmse 0.04098253  max resid 0.2090026
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09158969
## ... New best solution
## ... Procrustes: rmse 0.04319866  max resid 0.1631233
## Run 2 stress 0.09151226
```

```
## ... New best solution
## ... Procrustes: rmse 0.05382839  max resid 0.3176562
## Run 3 stress 0.09234717
## Run 4 stress 0.09309635
## Run 5 stress 0.09140489
## ... New best solution
## ... Procrustes: rmse 0.008925486  max resid 0.04639293
## Run 6 stress 0.09153866
## ... Procrustes: rmse 0.07212078  max resid 0.2406615
## Run 7 stress 0.092072
## Run 8 stress 0.09118538
## ... New best solution
## ... Procrustes: rmse 0.04656933  max resid 0.2479311
## Run 9 stress 0.09229804
## Run 10 stress 0.09440403
## Run 11 stress 0.09118636
## ... Procrustes: rmse 0.0002700136  max resid 0.001286796
## ... Similar to previous best
## Run 12 stress 0.09235717
## Run 13 stress 0.09141671
## ... Procrustes: rmse 0.03327221  max resid 0.1768745
## Run 14 stress 0.09143537
## ... Procrustes: rmse 0.03586746  max resid 0.1909391
## Run 15 stress 0.09212459
## Run 16 stress 0.09258936
## Run 17 stress 0.09159465
## ... Procrustes: rmse 0.07082328  max resid 0.2072511
## Run 18 stress 0.09245423
## Run 19 stress 0.09156155
## ... Procrustes: rmse 0.07158003  max resid 0.2101252
## Run 20 stress 0.09207965
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09212657
## ... New best solution
## ... Procrustes: rmse 0.003758247  max resid 0.01216851
## Run 2 stress 0.09153552
## ... New best solution
## ... Procrustes: rmse 0.03931365  max resid 0.09900428
## Run 3 stress 0.09123362
## ... New best solution
## ... Procrustes: rmse 0.07353948  max resid 0.2563634
## Run 4 stress 0.09207363
## Run 5 stress 0.09154063
## ... Procrustes: rmse 0.07432951  max resid 0.2587706
## Run 6 stress 0.09149851
## ... Procrustes: rmse 0.0241797  max resid 0.1287069
## Run 7 stress 0.09141332
## ... Procrustes: rmse 0.019391  max resid 0.1030193
## Run 8 stress 0.09228521
## Run 9 stress 0.09117926
## ... New best solution
## ... Procrustes: rmse 0.01245268  max resid 0.06191923
## Run 10 stress 0.09284556
```

```
## Run 11 stress 0.09444177
## Run 12 stress 0.09153459
## ... Procrustes: rmse 0.07198946  max resid 0.2221509
## Run 13 stress 0.09241695
## Run 14 stress 0.09120024
## ... Procrustes: rmse 0.004969231  max resid 0.02520853
## Run 15 stress 0.09146159
## ... Procrustes: rmse 0.03519364  max resid 0.1919497
## Run 16 stress 0.09124226
## ... Procrustes: rmse 0.01413868  max resid 0.07059112
## Run 17 stress 0.09233263
## Run 18 stress 0.09153486
## ... Procrustes: rmse 0.07182833  max resid 0.2172439
## Run 19 stress 0.09210549
## Run 20 stress 0.09207428
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.0915372
## ... New best solution
## ... Procrustes: rmse 0.03864098  max resid 0.09161403
## Run 2 stress 0.09143147
## ... New best solution
## ... Procrustes: rmse 0.07194574  max resid 0.2380321
## Run 3 stress 0.09144954
## ... Procrustes: rmse 0.02216229  max resid 0.08668628
## Run 4 stress 0.09117938
## ... New best solution
## ... Procrustes: rmse 0.04624078  max resid 0.2458964
## Run 5 stress 0.09220219
## Run 6 stress 0.09156216
## ... Procrustes: rmse 0.07222311  max resid 0.2181621
## Run 7 stress 0.09294122
## Run 8 stress 0.09244214
## Run 9 stress 0.09286242
## Run 10 stress 0.09156867
## ... Procrustes: rmse 0.07274897  max resid 0.2177917
## Run 11 stress 0.0920787
## Run 12 stress 0.09119792
## ... Procrustes: rmse 0.007541496  max resid 0.03793293
## Run 13 stress 0.09240154
## Run 14 stress 0.09392764
## Run 15 stress 0.09249636
## Run 16 stress 0.09207507
## Run 17 stress 0.0928047
## Run 18 stress 0.09137137
## ... Procrustes: rmse 0.0139018  max resid 0.04562055
## Run 19 stress 0.09443443
## Run 20 stress 0.09144268
## ... Procrustes: rmse 0.03277753  max resid 0.174713
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
```

```
## Run 0 stress 0.09216961
## Run 1 stress 0.09154456
## ... New best solution
## ... Procrustes: rmse 0.03817242  max resid 0.09055957
## Run 2 stress 0.09124623
## ... New best solution
## ... Procrustes: rmse 0.07000917  max resid 0.1924571
## Run 3 stress 0.09310189
## Run 4 stress 0.09139637
## ... Procrustes: rmse 0.04981648  max resid 0.2696485
## Run 5 stress 0.09214735
## Run 6 stress 0.09155415
## ... Procrustes: rmse 0.07021603  max resid 0.1915907
## Run 7 stress 0.09234536
## Run 8 stress 0.09227852
## Run 9 stress 0.09279368
## Run 10 stress 0.09286156
## Run 11 stress 0.09163535
## ... Procrustes: rmse 0.06902399  max resid 0.1820715
## Run 12 stress 0.09129031
## ... Procrustes: rmse 0.002810285  max resid 0.01340843
## Run 13 stress 0.09147914
## ... Procrustes: rmse 0.03616067  max resid 0.2027005
## Run 14 stress 0.09152569
## ... Procrustes: rmse 0.04232577  max resid 0.2301048
## Run 15 stress 0.09309629
## Run 16 stress 0.0915451
## ... Procrustes: rmse 0.07029163  max resid 0.193313
## Run 17 stress 0.09159777
## ... Procrustes: rmse 0.05664415  max resid 0.321794
## Run 18 stress 0.09252551
## Run 19 stress 0.09232196
## Run 20 stress 0.09309277
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09184542
## ... New best solution
## ... Procrustes: rmse 0.03714382  max resid 0.1623476
## Run 2 stress 0.09235386
## Run 3 stress 0.0913937
## ... New best solution
## ... Procrustes: rmse 0.04938567  max resid 0.2644377
## Run 4 stress 0.09117833
## ... New best solution
## ... Procrustes: rmse 0.042838  max resid 0.2212889
## Run 5 stress 0.09147244
## ... Procrustes: rmse 0.04556671  max resid 0.2419734
## Run 6 stress 0.09135955
## ... Procrustes: rmse 0.03529894  max resid 0.1698382
## Run 7 stress 0.09226469
## Run 8 stress 0.09309413
## Run 9 stress 0.0913946
```

```
## ... Procrustes: rmse 0.02732124  max resid 0.1427148
## Run 10 stress 0.09286137
## Run 11 stress 0.09155245
## ... Procrustes: rmse 0.02258946  max resid 0.06561987
## Run 12 stress 0.09240189
## Run 13 stress 0.09143444
## ... Procrustes: rmse 0.04608795  max resid 0.2455212
## Run 14 stress 0.09153754
## ... Procrustes: rmse 0.07246111  max resid 0.2232178
## Run 15 stress 0.0951076
## Run 16 stress 0.09212321
## Run 17 stress 0.09143606
## ... Procrustes: rmse 0.04614376  max resid 0.2461147
## Run 18 stress 0.09118151
## ... Procrustes: rmse 0.002565383  max resid 0.01312344
## Run 19 stress 0.0912189
## ... Procrustes: rmse 0.007597839  max resid 0.03814246
## Run 20 stress 0.09256403
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09156393
## ... New best solution
## ... Procrustes: rmse 0.03784964  max resid 0.0907996
## Run 2 stress 0.09286364
## Run 3 stress 0.09158044
## ... Procrustes: rmse 0.005224333  max resid 0.01627891
## Run 4 stress 0.09238702
## Run 5 stress 0.09178147
## ... Procrustes: rmse 0.06017053  max resid 0.1683936
## Run 6 stress 0.09118716
## ... New best solution
## ... Procrustes: rmse 0.07154656  max resid 0.2097476
## Run 7 stress 0.09233136
## Run 8 stress 0.09502989
## Run 9 stress 0.09286984
## Run 10 stress 0.0915957
## ... Procrustes: rmse 0.070648  max resid 0.203922
## Run 11 stress 0.09309125
## Run 12 stress 0.09258805
## Run 13 stress 0.09137089
## ... Procrustes: rmse 0.04190107  max resid 0.2134298
## Run 14 stress 0.09228916
## Run 15 stress 0.09241829
## Run 16 stress 0.09153496
## ... Procrustes: rmse 0.07165139  max resid 0.213669
## Run 17 stress 0.0915485
## ... Procrustes: rmse 0.07194063  max resid 0.2123561
## Run 18 stress 0.09407608
## Run 19 stress 0.09149061
## ... Procrustes: rmse 0.05073127  max resid 0.2784486
## Run 20 stress 0.0912512
## ... Procrustes: rmse 0.005878086  max resid 0.03012943
```

```
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09239522
## ... Procrustes: rmse 0.05962001  max resid 0.2339166
## Run 2 stress 0.09122676
## ... New best solution
## ... Procrustes: rmse 0.05393734  max resid 0.1604577
## Run 3 stress 0.09233515
## Run 4 stress 0.09153685
## ... Procrustes: rmse 0.07051682  max resid 0.1986274
## Run 5 stress 0.09238322
## Run 6 stress 0.09154036
## ... Procrustes: rmse 0.07063798  max resid 0.1993629
## Run 7 stress 0.09133807
## ... Procrustes: rmse 0.01538377  max resid 0.04739938
## Run 8 stress 0.09335472
## Run 9 stress 0.09240771
## Run 10 stress 0.09235029
## Run 11 stress 0.09153524
## ... Procrustes: rmse 0.07043834  max resid 0.1989029
## Run 12 stress 0.09153764
## ... Procrustes: rmse 0.0705038  max resid 0.1979017
## Run 13 stress 0.09309078
## Run 14 stress 0.09153759
## ... Procrustes: rmse 0.07053687  max resid 0.1990097
## Run 15 stress 0.09414852
## Run 16 stress 0.09118749
## ... New best solution
## ... Procrustes: rmse 0.004715435  max resid 0.02417082
## Run 17 stress 0.09142378
## ... Procrustes: rmse 0.03375013  max resid 0.1798738
## Run 18 stress 0.09323451
## Run 19 stress 0.09153476
## ... Procrustes: rmse 0.07157701  max resid 0.2141219
## Run 20 stress 0.09244729
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09154012
## ... New best solution
## ... Procrustes: rmse 0.03854067  max resid 0.09101304
## Run 2 stress 0.09204922
## Run 3 stress 0.09286081
## Run 4 stress 0.09118532
## ... New best solution
## ... Procrustes: rmse 0.07173443  max resid 0.2131551
## Run 5 stress 0.09243585
## Run 6 stress 0.0915796
## ... Procrustes: rmse 0.0709023  max resid 0.2131529
## Run 7 stress 0.09286244
## Run 8 stress 0.09222359
```

```
## Run 9 stress 0.09153642
## ... Procrustes: rmse 0.07182091  max resid 0.2151743
## Run 10 stress 0.09218806
## Run 11 stress 0.0921356
## Run 12 stress 0.09153453
## ... Procrustes: rmse 0.07166693  max resid 0.2137104
## Run 13 stress 0.09204829
## Run 14 stress 0.09153981
## ... Procrustes: rmse 0.07162782  max resid 0.2103544
## Run 15 stress 0.0913252
## ... Procrustes: rmse 0.01666593  max resid 0.04776827
## Run 16 stress 0.09238515
## Run 17 stress 0.09156352
## ... Procrustes: rmse 0.07160877  max resid 0.2100535
## Run 18 stress 0.09512867
## Run 19 stress 0.0920635
## Run 20 stress 0.09117869
## ... New best solution
## ... Procrustes: rmse 0.004245689  max resid 0.02145063
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09135996
## ... New best solution
## ... Procrustes: rmse 0.04954808  max resid 0.159927
## Run 2 stress 0.09286606
## Run 3 stress 0.09233184
## Run 4 stress 0.09147507
## ... Procrustes: rmse 0.04040259  max resid 0.2229597
## Run 5 stress 0.09155419
## ... Procrustes: rmse 0.06812888  max resid 0.2070995
## Run 6 stress 0.0923501
## Run 7 stress 0.09333376
## Run 8 stress 0.09118315
## ... New best solution
## ... Procrustes: rmse 0.01279119  max resid 0.04414024
## Run 9 stress 0.09153509
## ... Procrustes: rmse 0.07161898  max resid 0.2166248
## Run 10 stress 0.09139663
## ... Procrustes: rmse 0.04543405  max resid 0.2399085
## Run 11 stress 0.09211273
## Run 12 stress 0.09138998
## ... Procrustes: rmse 0.02949489  max resid 0.1543861
## Run 13 stress 0.09236295
## Run 14 stress 0.09207718
## Run 15 stress 0.09135999
## ... Procrustes: rmse 0.03789014  max resid 0.1865444
## Run 16 stress 0.09309397
## Run 17 stress 0.0916287
## ... Procrustes: rmse 0.02400175  max resid 0.06976892
## Run 18 stress 0.09156985
## ... Procrustes: rmse 0.0530357  max resid 0.2940312
## Run 19 stress 0.09157003
```

```
## ... Procrustes: rmse 0.07203489  max resid 0.2179329
## Run 20 stress 0.09238223
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09208707
## ... New best solution
## ... Procrustes: rmse 0.01181268  max resid 0.0498848
## Run 2 stress 0.09283252
## Run 3 stress 0.09309336
## Run 4 stress 0.09118711
## ... New best solution
## ... Procrustes: rmse 0.05197826  max resid 0.1608477
## Run 5 stress 0.09145161
## ... Procrustes: rmse 0.04341174  max resid 0.2310417
## Run 6 stress 0.09228449
## Run 7 stress 0.09267222
## Run 8 stress 0.09138283
## ... Procrustes: rmse 0.03728003  max resid 0.1881885
## Run 9 stress 0.0928626
## Run 10 stress 0.09118742
## ... Procrustes: rmse 0.008731878  max resid 0.04400201
## Run 11 stress 0.0911833
## ... New best solution
## ... Procrustes: rmse 0.007753819  max resid 0.03904453
## Run 12 stress 0.09342987
## Run 13 stress 0.09138904
## ... Procrustes: rmse 0.04351168  max resid 0.2266264
## Run 14 stress 0.09227606
## Run 15 stress 0.09139982
## ... Procrustes: rmse 0.04583997  max resid 0.2428666
## Run 16 stress 0.09153707
## ... Procrustes: rmse 0.07182857  max resid 0.2141137
## Run 17 stress 0.09133408
## ... Procrustes: rmse 0.02199742  max resid 0.08798342
## Run 18 stress 0.09170875
## Run 19 stress 0.09424803
## Run 20 stress 0.09238592
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09154247
## ... New best solution
## ... Procrustes: rmse 0.03957325  max resid 0.09730866
## Run 2 stress 0.09153619
## ... New best solution
## ... Procrustes: rmse 0.001211167  max resid 0.005219945
## ... Similar to previous best
## Run 3 stress 0.09145162
## ... New best solution
## ... Procrustes: rmse 0.06993267  max resid 0.2475012
## Run 4 stress 0.09134513
```

```
## ... New best solution
## ... Procrustes: rmse 0.02331621  max resid 0.09266053
## Run 5 stress 0.09234577
## Run 6 stress 0.09231652
## Run 7 stress 0.09153485
## ... Procrustes: rmse 0.07056533  max resid 0.2520435
## Run 8 stress 0.0924961
## Run 9 stress 0.09239722
## Run 10 stress 0.09151679
## ... Procrustes: rmse 0.02751286  max resid 0.1491714
## Run 11 stress 0.09143749
## ... Procrustes: rmse 0.02889509  max resid 0.1610217
## Run 12 stress 0.09234071
## Run 13 stress 0.09153673
## ... Procrustes: rmse 0.07118886  max resid 0.2554407
## Run 14 stress 0.09240636
## Run 15 stress 0.09270149
## Run 16 stress 0.09246328
## Run 17 stress 0.09142413
## ... Procrustes: rmse 0.03421712  max resid 0.1659415
## Run 18 stress 0.09147525
## ... Procrustes: rmse 0.02484813  max resid 0.1107284
## Run 19 stress 0.09136405
## ... Procrustes: rmse 0.02043783  max resid 0.1091898
## Run 20 stress 0.09558337
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09236686
## ... Procrustes: rmse 0.04665776  max resid 0.1760898
## Run 2 stress 0.09154384
## ... New best solution
## ... Procrustes: rmse 0.06522803  max resid 0.234351
## Run 3 stress 0.09309289
## Run 4 stress 0.09120106
## ... New best solution
## ... Procrustes: rmse 0.03873704  max resid 0.2059734
## Run 5 stress 0.09153651
## ... Procrustes: rmse 0.07124974  max resid 0.2078743
## Run 6 stress 0.09310525
## Run 7 stress 0.09118158
## ... New best solution
## ... Procrustes: rmse 0.009071551  max resid 0.0459812
## Run 8 stress 0.09210157
## Run 9 stress 0.09153629
## ... Procrustes: rmse 0.07274753  max resid 0.2339491
## Run 10 stress 0.09309102
## Run 11 stress 0.09323254
## Run 12 stress 0.09522726
## Run 13 stress 0.09158309
## ... Procrustes: rmse 0.07189324  max resid 0.2224193
## Run 14 stress 0.09166797
## ... Procrustes: rmse 0.0272319  max resid 0.09482625
```

```
## Run 15 stress 0.09309234
## Run 16 stress 0.09148454
## ... Procrustes: rmse 0.02080349  max resid 0.08277398
## Run 17 stress 0.0913857
## ... Procrustes: rmse 0.01566351  max resid 0.04679194
## Run 18 stress 0.09121812
## ... Procrustes: rmse 0.01085764  max resid 0.05507284
## Run 19 stress 0.09135966
## ... Procrustes: rmse 0.03084477  max resid 0.1428788
## Run 20 stress 0.09152441
## ... Procrustes: rmse 0.03245232  max resid 0.171925
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09153388
## ... New best solution
## ... Procrustes: rmse 0.0387228  max resid 0.09205192
## Run 2 stress 0.09153951
## ... Procrustes: rmse 0.001355762  max resid 0.0064006
## ... Similar to previous best
## Run 3 stress 0.09235392
## Run 4 stress 0.09129188
## ... New best solution
## ... Procrustes: rmse 0.0743588  max resid 0.2728319
## Run 5 stress 0.09236699
## Run 6 stress 0.09309286
## Run 7 stress 0.09156012
## ... Procrustes: rmse 0.07403355  max resid 0.2669991
## Run 8 stress 0.09153976
## ... Procrustes: rmse 0.07429929  max resid 0.2728638
## Run 9 stress 0.09153814
## ... Procrustes: rmse 0.07489696  max resid 0.2554381
## Run 10 stress 0.09135936
## ... Procrustes: rmse 0.01926833  max resid 0.07446905
## Run 11 stress 0.09288249
## Run 12 stress 0.09232273
## Run 13 stress 0.09153942
## ... Procrustes: rmse 0.0744103  max resid 0.2548777
## Run 14 stress 0.09122045
## ... New best solution
## ... Procrustes: rmse 0.02535499  max resid 0.1295413
## Run 15 stress 0.09138604
## ... Procrustes: rmse 0.04770523  max resid 0.2526427
## Run 16 stress 0.09154206
## ... Procrustes: rmse 0.07096976  max resid 0.1997107
## Run 17 stress 0.09185666
## Run 18 stress 0.09325309
## Run 19 stress 0.09153595
## ... Procrustes: rmse 0.04389315  max resid 0.2431034
## Run 20 stress 0.09153462
## ... Procrustes: rmse 0.07042185  max resid 0.1968044
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
```

```
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09154101
## ... New best solution
## ... Procrustes: rmse 0.03878244  max resid 0.0921737
## Run 2 stress 0.09119778
## ... New best solution
## ... Procrustes: rmse 0.07139458  max resid 0.2075212
## Run 3 stress 0.09263072
## Run 4 stress 0.09142092
## ... Procrustes: rmse 0.01498509  max resid 0.04629656
## Run 5 stress 0.09143714
## ... Procrustes: rmse 0.01403485  max resid 0.04624588
## Run 6 stress 0.09136752
## ... Procrustes: rmse 0.02825938  max resid 0.1164001
## Run 7 stress 0.09321503
## Run 8 stress 0.09243758
## Run 9 stress 0.09210161
## Run 10 stress 0.09286924
## Run 11 stress 0.09286184
## Run 12 stress 0.09133688
## ... Procrustes: rmse 0.02647087  max resid 0.1399162
## Run 13 stress 0.09141938
## ... Procrustes: rmse 0.03495893  max resid 0.1886347
## Run 14 stress 0.09332136
## Run 15 stress 0.09121762
## ... Procrustes: rmse 0.002259817  max resid 0.01100231
## Run 16 stress 0.0926741
## Run 17 stress 0.09211364
## Run 18 stress 0.09157821
## ... Procrustes: rmse 0.02073152  max resid 0.05957014
## Run 19 stress 0.09309239
## Run 20 stress 0.09118249
## ... New best solution
## ... Procrustes: rmse 0.003141341  max resid 0.01599141
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     18: no. of iterations >= maxit
##      2: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09314353
## Run 2 stress 0.09139514
## ... New best solution
## ... Procrustes: rmse 0.05980716  max resid 0.2098639
## Run 3 stress 0.09153442
## ... Procrustes: rmse 0.07277694  max resid 0.2517963
## Run 4 stress 0.0923334
## Run 5 stress 0.0913669
## ... New best solution
## ... Procrustes: rmse 0.01240013  max resid 0.04178435
## Run 6 stress 0.09234432
## Run 7 stress 0.09135907
## ... New best solution
## ... Procrustes: rmse 0.00924566  max resid 0.04450625
## Run 8 stress 0.09195937
```

```
## Run 9 stress 0.09153756
## ... Procrustes: rmse 0.07343039  max resid 0.2795523
## Run 10 stress 0.09124265
## ... New best solution
## ... Procrustes: rmse 0.01818205  max resid 0.06470448
## Run 11 stress 0.09135851
## ... Procrustes: rmse 0.01745809  max resid 0.05572849
## Run 12 stress 0.09237431
## Run 13 stress 0.09156024
## ... Procrustes: rmse 0.07337754  max resid 0.2553298
## Run 14 stress 0.09156061
## ... Procrustes: rmse 0.07340445  max resid 0.2533256
## Run 15 stress 0.09310746
## Run 16 stress 0.09255697
## Run 17 stress 0.09121128
## ... New best solution
## ... Procrustes: rmse 0.01932165  max resid 0.09837631
## Run 18 stress 0.09235556
## Run 19 stress 0.0928614
## Run 20 stress 0.09258982
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09309216
## Run 2 stress 0.09279025
## Run 3 stress 0.09286752
## Run 4 stress 0.09119191
## ... New best solution
## ... Procrustes: rmse 0.05452607  max resid 0.1580805
## Run 5 stress 0.09228781
## Run 6 stress 0.09240604
## Run 7 stress 0.09160337
## ... Procrustes: rmse 0.04454634  max resid 0.2524093
## Run 8 stress 0.09337393
## Run 9 stress 0.09144767
## ... Procrustes: rmse 0.03802512  max resid 0.2042974
## Run 10 stress 0.0951744
## Run 11 stress 0.09237835
## Run 12 stress 0.09156099
## ... Procrustes: rmse 0.07129143  max resid 0.2075152
## Run 13 stress 0.09134113
## ... Procrustes: rmse 0.0259116  max resid 0.1105147
## Run 14 stress 0.09251369
## Run 15 stress 0.09480772
## Run 16 stress 0.09142985
## ... Procrustes: rmse 0.03625172  max resid 0.1931496
## Run 17 stress 0.09136174
## ... Procrustes: rmse 0.04105456  max resid 0.2072993
## Run 18 stress 0.09155956
## ... Procrustes: rmse 0.07089803  max resid 0.2035852
## Run 19 stress 0.09153824
## ... Procrustes: rmse 0.07156737  max resid 0.2098004
## Run 20 stress 0.09153545
```

```
## ... Procrustes: rmse 0.07111954  max resid 0.2095539
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09232271
## ... Procrustes: rmse 0.04021774  max resid 0.1473084
## Run 2 stress 0.09143883
## ... New best solution
## ... Procrustes: rmse 0.06250417  max resid 0.2190852
## Run 3 stress 0.09145754
## ... Procrustes: rmse 0.007016846  max resid 0.02027107
## Run 4 stress 0.09236499
## Run 5 stress 0.09209248
## Run 6 stress 0.0915365
## ... Procrustes: rmse 0.06959336  max resid 0.2469465
## Run 7 stress 0.09153763
## ... Procrustes: rmse 0.0695046  max resid 0.2471511
## Run 8 stress 0.09309037
## Run 9 stress 0.09309457
## Run 10 stress 0.0930907
## Run 11 stress 0.0913716
## ... New best solution
## ... Procrustes: rmse 0.01385259  max resid 0.04175065
## Run 12 stress 0.09155958
## ... Procrustes: rmse 0.07239114  max resid 0.244448
## Run 13 stress 0.0940582
## Run 14 stress 0.09133837
## ... New best solution
## ... Procrustes: rmse 0.03281915  max resid 0.1797261
## Run 15 stress 0.09234782
## Run 16 stress 0.09141367
## ... Procrustes: rmse 0.02810429  max resid 0.1385073
## Run 17 stress 0.0925609
## Run 18 stress 0.09131397
## ... New best solution
## ... Procrustes: rmse 0.02276946  max resid 0.09180202
## Run 19 stress 0.09136835
## ... Procrustes: rmse 0.04788307  max resid 0.2529815
## Run 20 stress 0.09309322
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     12: no. of iterations >= maxit
##      8: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09546875
## Run 2 stress 0.0914051
## ... New best solution
## ... Procrustes: rmse 0.06088835  max resid 0.2141997
## Run 3 stress 0.09252868
## Run 4 stress 0.09153447
## ... Procrustes: rmse 0.07171132  max resid 0.2502244
## Run 5 stress 0.09232911
## Run 6 stress 0.09398827
## Run 7 stress 0.09154352
```

```
## ... Procrustes: rmse 0.07196096  max resid 0.2499148
## Run 8 stress 0.09226488
## Run 9 stress 0.09147764
## ... Procrustes: rmse 0.02628732  max resid 0.1204867
## Run 10 stress 0.09235792
## Run 11 stress 0.09153419
## ... Procrustes: rmse 0.07182887  max resid 0.2504136
## Run 12 stress 0.09326451
## Run 13 stress 0.09155872
## ... Procrustes: rmse 0.07087877  max resid 0.2499119
## Run 14 stress 0.09263468
## Run 15 stress 0.09125819
## ... New best solution
## ... Procrustes: rmse 0.03695834  max resid 0.1965673
## Run 16 stress 0.09147706
## ... Procrustes: rmse 0.05433987  max resid 0.3032366
## Run 17 stress 0.0920739
## Run 18 stress 0.09153486
## ... Procrustes: rmse 0.06988166  max resid 0.1910752
## Run 19 stress 0.09187001
## Run 20 stress 0.09225938
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09140801
## ... New best solution
## ... Procrustes: rmse 0.05161648  max resid 0.1629693
## Run 2 stress 0.09309397
## Run 3 stress 0.09207821
## Run 4 stress 0.09230297
## Run 5 stress 0.09136827
## ... New best solution
## ... Procrustes: rmse 0.04714581  max resid 0.2459329
## Run 6 stress 0.09162957
## ... Procrustes: rmse 0.07502114  max resid 0.2988155
## Run 7 stress 0.09314948
## Run 8 stress 0.09117871
## ... New best solution
## ... Procrustes: rmse 0.03708566  max resid 0.182366
## Run 9 stress 0.09208083
## Run 10 stress 0.09157889
## ... Procrustes: rmse 0.07114153  max resid 0.2171468
## Run 11 stress 0.0927703
## Run 12 stress 0.09153364
## ... Procrustes: rmse 0.07178691  max resid 0.2211435
## Run 13 stress 0.09153827
## ... Procrustes: rmse 0.07223407  max resid 0.2215594
## Run 14 stress 0.09232298
## Run 15 stress 0.0922493
## Run 16 stress 0.09139558
## ... Procrustes: rmse 0.02738483  max resid 0.1457335
## Run 17 stress 0.09153786
## ... Procrustes: rmse 0.07231835  max resid 0.2242345
```

```
## Run 18 stress 0.09242807
## Run 19 stress 0.09405354
## Run 20 stress 0.09240361
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     18: no. of iterations >= maxit
##      2: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09236695
## ... Procrustes: rmse 0.05678158  max resid 0.2281654
## Run 2 stress 0.09431201
## Run 3 stress 0.09207473
## ... New best solution
## ... Procrustes: rmse 0.005381434  max resid 0.02430722
## Run 4 stress 0.09153476
## ... New best solution
## ... Procrustes: rmse 0.04191846  max resid 0.1167419
## Run 5 stress 0.09153664
## ... Procrustes: rmse 0.001982205  max resid 0.008261569
## ... Similar to previous best
## Run 6 stress 0.09236895
## Run 7 stress 0.09232266
## Run 8 stress 0.09132436
## ... New best solution
## ... Procrustes: rmse 0.0707295  max resid 0.2440394
## Run 9 stress 0.09159833
## ... Procrustes: rmse 0.06943141  max resid 0.2311372
## Run 10 stress 0.09140085
## ... Procrustes: rmse 0.03439078  max resid 0.1903367
## Run 11 stress 0.09207507
## Run 12 stress 0.0915338
## ... Procrustes: rmse 0.07033769  max resid 0.2408527
## Run 13 stress 0.09119253
## ... New best solution
## ... Procrustes: rmse 0.01888663  max resid 0.06823323
## Run 14 stress 0.09292725
## Run 15 stress 0.09211179
## Run 16 stress 0.09153665
## ... Procrustes: rmse 0.07157634  max resid 0.2123485
## Run 17 stress 0.09119044
## ... New best solution
## ... Procrustes: rmse 0.0005573007  max resid 0.001636999
## ... Similar to previous best
## Run 18 stress 0.0912812
## ... Procrustes: rmse 0.007494939  max resid 0.03847849
## Run 19 stress 0.09144235
## ... Procrustes: rmse 0.03674276  max resid 0.1978001
## Run 20 stress 0.09236406
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09139856
## ... New best solution
## ... Procrustes: rmse 0.04917299  max resid 0.1620398
## Run 2 stress 0.09240999
## Run 3 stress 0.09340453
```

```
## Run 4 stress 0.09237613
## Run 5 stress 0.09135994
## ... New best solution
## ... Procrustes: rmse 0.03460855  max resid 0.1878523
## Run 6 stress 0.09118304
## ... New best solution
## ... Procrustes: rmse 0.03459475  max resid 0.164843
## Run 7 stress 0.0915192
## ... Procrustes: rmse 0.03779218  max resid 0.2110674
## Run 8 stress 0.09136067
## ... Procrustes: rmse 0.03924963  max resid 0.1954373
## Run 9 stress 0.09142978
## ... Procrustes: rmse 0.04793084  max resid 0.2581201
## Run 10 stress 0.09144981
## ... Procrustes: rmse 0.03711011  max resid 0.1967211
## Run 11 stress 0.09147988
## ... Procrustes: rmse 0.05007977  max resid 0.2737385
## Run 12 stress 0.09271056
## Run 13 stress 0.09309206
## Run 14 stress 0.0923448
## Run 15 stress 0.09141468
## ... Procrustes: rmse 0.04702164  max resid 0.2518003
## Run 16 stress 0.09240938
## Run 17 stress 0.09154957
## ... Procrustes: rmse 0.07216239  max resid 0.2149682
## Run 18 stress 0.09220878
## Run 19 stress 0.09153775
## ... Procrustes: rmse 0.07192332  max resid 0.2149302
## Run 20 stress 0.09118974
## ... Procrustes: rmse 0.001491102  max resid 0.007574038
## ... Similar to previous best
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09206706
## ... New best solution
## ... Procrustes: rmse 0.03220885  max resid 0.09121853
## Run 2 stress 0.09155636
## ... New best solution
## ... Procrustes: rmse 0.01450799  max resid 0.06126108
## Run 3 stress 0.0914069
## ... New best solution
## ... Procrustes: rmse 0.06858897  max resid 0.2076386
## Run 4 stress 0.09153718
## ... Procrustes: rmse 0.06815821  max resid 0.2022594
## Run 5 stress 0.09126375
## ... New best solution
## ... Procrustes: rmse 0.01265596  max resid 0.04395541
## Run 6 stress 0.09133223
## ... Procrustes: rmse 0.01672079  max resid 0.0543876
## Run 7 stress 0.09243987
## Run 8 stress 0.0923815
## Run 9 stress 0.09154413
## ... Procrustes: rmse 0.07072372  max resid 0.1978979
## Run 10 stress 0.09140823
```

```
## ... Procrustes: rmse 0.05015951  max resid 0.2730832
## Run 11 stress 0.09120071
## ... New best solution
## ... Procrustes: rmse 0.002400246  max resid 0.0121242
## Run 12 stress 0.09139757
## ... Procrustes: rmse 0.03297365  max resid 0.1762631
## Run 13 stress 0.09145803
## ... Procrustes: rmse 0.05122559  max resid 0.2815538
## Run 14 stress 0.09286129
## Run 15 stress 0.09157012
## ... Procrustes: rmse 0.07111419  max resid 0.2012631
## Run 16 stress 0.09154236
## ... Procrustes: rmse 0.07118606  max resid 0.2042187
## Run 17 stress 0.09139815
## ... Procrustes: rmse 0.04612659  max resid 0.2452147
## Run 18 stress 0.09286197
## Run 19 stress 0.09153505
## ... Procrustes: rmse 0.07102916  max resid 0.2039714
## Run 20 stress 0.09125292
## ... Procrustes: rmse 0.01986101  max resid 0.1017663
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.0915354
## ... New best solution
## ... Procrustes: rmse 0.03908679  max resid 0.09437615
## Run 2 stress 0.0915459
## ... Procrustes: rmse 0.003675727  max resid 0.01402646
## Run 3 stress 0.0913638
## ... New best solution
## ... Procrustes: rmse 0.07026426  max resid 0.2527511
## Run 4 stress 0.09153446
## ... Procrustes: rmse 0.0701823  max resid 0.2508124
## Run 5 stress 0.09335281
## Run 6 stress 0.09417554
## Run 7 stress 0.09146555
## ... Procrustes: rmse 0.03242909  max resid 0.180795
## Run 8 stress 0.09153704
## ... Procrustes: rmse 0.07004404  max resid 0.2519298
## Run 9 stress 0.09153494
## ... Procrustes: rmse 0.07015354  max resid 0.2511935
## Run 10 stress 0.09485927
## Run 11 stress 0.09206352
## Run 12 stress 0.09126704
## ... New best solution
## ... Procrustes: rmse 0.03070091  max resid 0.1388105
## Run 13 stress 0.09118678
## ... New best solution
## ... Procrustes: rmse 0.01552375  max resid 0.08094129
## Run 14 stress 0.09118031
## ... New best solution
## ... Procrustes: rmse 0.002721975  max resid 0.01446288
## Run 15 stress 0.09118745
```

```
## ... Procrustes: rmse 0.002668763  max resid 0.01415809
## Run 16 stress 0.09153443
## ... Procrustes: rmse 0.07205461  max resid 0.2295963
## Run 17 stress 0.09136515
## ... Procrustes: rmse 0.01271092  max resid 0.04423978
## Run 18 stress 0.0915562
## ... Procrustes: rmse 0.07155133  max resid 0.2204865
## Run 19 stress 0.09153852
## ... Procrustes: rmse 0.07251525  max resid 0.2295496
## Run 20 stress 0.09228444
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09672807
## Run 2 stress 0.09309364
## Run 3 stress 0.09207691
## ... New best solution
## ... Procrustes: rmse 0.004918626  max resid 0.0229821
## Run 4 stress 0.09195994
## ... New best solution
## ... Procrustes: rmse 0.03384548  max resid 0.09946778
## Run 5 stress 0.092793
## Run 6 stress 0.09123372
## ... New best solution
## ... Procrustes: rmse 0.0670271  max resid 0.1780682
## Run 7 stress 0.091533
## ... Procrustes: rmse 0.05397553  max resid 0.3005474
## Run 8 stress 0.0915324
## ... Procrustes: rmse 0.01787915  max resid 0.05189202
## Run 9 stress 0.09215065
## Run 10 stress 0.09143863
## ... Procrustes: rmse 0.03981211  max resid 0.21632
## Run 11 stress 0.09462331
## Run 12 stress 0.09120304
## ... New best solution
## ... Procrustes: rmse 0.002975664  max resid 0.01505288
## Run 13 stress 0.09211818
## Run 14 stress 0.09156075
## ... Procrustes: rmse 0.07062426  max resid 0.1981045
## Run 15 stress 0.0914287
## ... Procrustes: rmse 0.04987053  max resid 0.2708137
## Run 16 stress 0.0922718
## Run 17 stress 0.09232686
## Run 18 stress 0.09139513
## ... Procrustes: rmse 0.01321528  max resid 0.04505986
## Run 19 stress 0.09136364
## ... Procrustes: rmse 0.04242413  max resid 0.2156319
## Run 20 stress 0.09286359
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     18: no. of iterations >= maxit
##      2: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09140457
```

```
## ... New best solution
## ... Procrustes: rmse 0.0599569  max resid 0.2133465
## Run 2 stress 0.09207355
## Run 3 stress 0.09142692
## ... Procrustes: rmse 0.003498299  max resid 0.01170598
## Run 4 stress 0.09154093
## ... Procrustes: rmse 0.07148304  max resid 0.2501672
## Run 5 stress 0.09118526
## ... New best solution
## ... Procrustes: rmse 0.03179181  max resid 0.1654944
## Run 6 stress 0.09120356
## ... Procrustes: rmse 0.003009996  max resid 0.0144928
## Run 7 stress 0.0930913
## Run 8 stress 0.0920761
## Run 9 stress 0.09309114
## Run 10 stress 0.09210634
## Run 11 stress 0.09118882
## ... Procrustes: rmse 0.0008440015  max resid 0.004301311
## ... Similar to previous best
## Run 12 stress 0.09148745
## ... Procrustes: rmse 0.01878225  max resid 0.0535127
## Run 13 stress 0.09207984
## Run 14 stress 0.09119335
## ... Procrustes: rmse 0.009737975  max resid 0.04895412
## Run 15 stress 0.09201579
## Run 16 stress 0.09153479
## ... Procrustes: rmse 0.07134486  max resid 0.2115701
## Run 17 stress 0.09166256
## ... Procrustes: rmse 0.03945467  max resid 0.2135258
## Run 18 stress 0.09153618
## ... Procrustes: rmse 0.07185819  max resid 0.2156703
## Run 19 stress 0.0914419
## ... Procrustes: rmse 0.03529018  max resid 0.1898519
## Run 20 stress 0.09228476
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09150034
## ... New best solution
## ... Procrustes: rmse 0.06457207  max resid 0.2292981
## Run 2 stress 0.0916281
## ... Procrustes: rmse 0.06886213  max resid 0.2428401
## Run 3 stress 0.09153756
## ... Procrustes: rmse 0.06785654  max resid 0.2442166
## Run 4 stress 0.09209831
## Run 5 stress 0.09234434
## Run 6 stress 0.09284714
## Run 7 stress 0.09125353
## ... New best solution
## ... Procrustes: rmse 0.04209964  max resid 0.2285249
## Run 8 stress 0.09139388
## ... Procrustes: rmse 0.03581641  max resid 0.1922296
## Run 9 stress 0.09140559
## ... Procrustes: rmse 0.01263141  max resid 0.0440923
## Run 10 stress 0.09136013
```

```
## ... Procrustes: rmse 0.04388502  max resid 0.2256631
## Run 11 stress 0.09244295
## Run 12 stress 0.09232661
## Run 13 stress 0.09153483
## ... Procrustes: rmse 0.06967586  max resid 0.1892913
## Run 14 stress 0.09139456
## ... Procrustes: rmse 0.04995083  max resid 0.2708431
## Run 15 stress 0.09147809
## ... Procrustes: rmse 0.04500942  max resid 0.246429
## Run 16 stress 0.09153718
## ... Procrustes: rmse 0.07003304  max resid 0.1924319
## Run 17 stress 0.09247906
## Run 18 stress 0.0915848
## ... Procrustes: rmse 0.07008689  max resid 0.1901142
## Run 19 stress 0.09144023
## ... Procrustes: rmse 0.008281614  max resid 0.03695304
## Run 20 stress 0.09117815
## ... New best solution
## ... Procrustes: rmse 0.01035524  max resid 0.05359178
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09217365
## ... Procrustes: rmse 0.03170186  max resid 0.09340254
## Run 2 stress 0.09149963
## ... New best solution
## ... Procrustes: rmse 0.04528167  max resid 0.1625544
## Run 3 stress 0.09306215
## Run 4 stress 0.09242619
## Run 5 stress 0.09140892
## ... New best solution
## ... Procrustes: rmse 0.03962048  max resid 0.1995145
## Run 6 stress 0.09118488
## ... New best solution
## ... Procrustes: rmse 0.0320449  max resid 0.1707277
## Run 7 stress 0.09288095
## Run 8 stress 0.09289051
## Run 9 stress 0.09277597
## Run 10 stress 0.0913601
## ... Procrustes: rmse 0.03817621  max resid 0.1884531
## Run 11 stress 0.09390161
## Run 12 stress 0.09239588
## Run 13 stress 0.09153608
## ... Procrustes: rmse 0.07159376  max resid 0.2114935
## Run 14 stress 0.09207462
## Run 15 stress 0.09142936
## ... Procrustes: rmse 0.03456847  max resid 0.1829366
## Run 16 stress 0.09153466
## ... Procrustes: rmse 0.07154732  max resid 0.2117211
## Run 17 stress 0.09233597
## Run 18 stress 0.09153292
## ... Procrustes: rmse 0.02032678  max resid 0.05640315
## Run 19 stress 0.09541343
```

```
## Run 20 stress 0.09237556
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.0912967
## ... New best solution
## ... Procrustes: rmse 0.05471305  max resid 0.1639748
## Run 2 stress 0.09279994
## Run 3 stress 0.091564
## ... Procrustes: rmse 0.06984426  max resid 0.1787722
## Run 4 stress 0.09253396
## Run 5 stress 0.09317535
## Run 6 stress 0.09126194
## ... New best solution
## ... Procrustes: rmse 0.02652089  max resid 0.1316294
## Run 7 stress 0.09133941
## ... Procrustes: rmse 0.01794915  max resid 0.0745533
## Run 8 stress 0.09228745
## Run 9 stress 0.09154238
## ... Procrustes: rmse 0.07372396  max resid 0.2594015
## Run 10 stress 0.09309285
## Run 11 stress 0.09309177
## Run 12 stress 0.09153762
## ... Procrustes: rmse 0.07439951  max resid 0.2644948
## Run 13 stress 0.0915594
## ... Procrustes: rmse 0.07361735  max resid 0.2597921
## Run 14 stress 0.09237109
## Run 15 stress 0.09193078
## Run 16 stress 0.09309264
## Run 17 stress 0.09135882
## ... Procrustes: rmse 0.01691232  max resid 0.04456373
## Run 18 stress 0.09155743
## ... Procrustes: rmse 0.03017952  max resid 0.1328558
## Run 19 stress 0.09153627
## ... Procrustes: rmse 0.07373772  max resid 0.2620148
## Run 20 stress 0.09119227
## ... New best solution
## ... Procrustes: rmse 0.01959835  max resid 0.1001763
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09153521
## ... New best solution
## ... Procrustes: rmse 0.03806292  max resid 0.09014157
## Run 2 stress 0.09349206
## Run 3 stress 0.09119744
## ... New best solution
## ... Procrustes: rmse 0.07096457  max resid 0.2042844
## Run 4 stress 0.09360883
## Run 5 stress 0.09117982
## ... New best solution
## ... Procrustes: rmse 0.004556336  max resid 0.02253776
```

```
## Run 6 stress 0.09309483
## Run 7 stress 0.09142999
## ... Procrustes: rmse 0.04638865  max resid 0.2476955
## Run 8 stress 0.09118533
## ... Procrustes: rmse 0.002431313  max resid 0.01214482
## Run 9 stress 0.09209144
## Run 10 stress 0.0949091
## Run 11 stress 0.09238855
## Run 12 stress 0.09133616
## ... Procrustes: rmse 0.01507394  max resid 0.04356622
## Run 13 stress 0.09135108
## ... Procrustes: rmse 0.02638198  max resid 0.1126892
## Run 14 stress 0.09207426
## Run 15 stress 0.09210559
## Run 16 stress 0.09153599
## ... Procrustes: rmse 0.07231438  max resid 0.223619
## Run 17 stress 0.09137083
## ... Procrustes: rmse 0.04022751  max resid 0.2034188
## Run 18 stress 0.09153663
## ... Procrustes: rmse 0.07237104  max resid 0.2227813
## Run 19 stress 0.09276882
## Run 20 stress 0.09136058
## ... Procrustes: rmse 0.03531952  max resid 0.1710303
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09134836
## ... New best solution
## ... Procrustes: rmse 0.04898069  max resid 0.158515
## Run 2 stress 0.0912011
## ... New best solution
## ... Procrustes: rmse 0.01509766  max resid 0.04601812
## Run 3 stress 0.09119926
## ... New best solution
## ... Procrustes: rmse 0.01337262  max resid 0.06832543
## Run 4 stress 0.09154202
## ... Procrustes: rmse 0.07134562  max resid 0.2053605
## Run 5 stress 0.0914859
## ... Procrustes: rmse 0.05206555  max resid 0.2881395
## Run 6 stress 0.09155075
## ... Procrustes: rmse 0.07057429  max resid 0.2013375
## Run 7 stress 0.09121838
## ... Procrustes: rmse 0.002100709  max resid 0.01052535
## Run 8 stress 0.09155962
## ... Procrustes: rmse 0.07065695  max resid 0.2001015
## Run 9 stress 0.09235523
## Run 10 stress 0.09153599
## ... Procrustes: rmse 0.07122859  max resid 0.208358
## Run 11 stress 0.09236714
## Run 12 stress 0.09227714
## Run 13 stress 0.09121696
## ... Procrustes: rmse 0.0149745  max resid 0.07561228
## Run 14 stress 0.09206289
```

```
## Run 15 stress 0.09154879
## ... Procrustes: rmse 0.07137849  max resid 0.2040325
## Run 16 stress 0.09132809
## ... Procrustes: rmse 0.02141776  max resid 0.08045274
## Run 17 stress 0.09131166
## ... Procrustes: rmse 0.008035528  max resid 0.04057036
## Run 18 stress 0.09559732
## Run 19 stress 0.09153542
## ... Procrustes: rmse 0.07107932  max resid 0.2040631
## Run 20 stress 0.09309083
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09237935
## ... Procrustes: rmse 0.04546589  max resid 0.1699174
## Run 2 stress 0.09409971
## Run 3 stress 0.09155954
## ... New best solution
## ... Procrustes: rmse 0.03720839  max resid 0.09030862
## Run 4 stress 0.09154135
## ... New best solution
## ... Procrustes: rmse 0.005892014  max resid 0.02334204
## Run 5 stress 0.0923978
## Run 6 stress 0.09142391
## ... New best solution
## ... Procrustes: rmse 0.07048771  max resid 0.2492249
## Run 7 stress 0.09156171
## ... Procrustes: rmse 0.06955472  max resid 0.2475163
## Run 8 stress 0.09316065
## Run 9 stress 0.09140299
## ... New best solution
## ... Procrustes: rmse 0.01836716  max resid 0.07157965
## Run 10 stress 0.09207742
## Run 11 stress 0.09330762
## Run 12 stress 0.09153661
## ... Procrustes: rmse 0.07297642  max resid 0.2410384
## Run 13 stress 0.09239845
## Run 14 stress 0.09160588
## ... Procrustes: rmse 0.0501736  max resid 0.2832466
## Run 15 stress 0.09304006
## Run 16 stress 0.09153525
## ... Procrustes: rmse 0.07279422  max resid 0.2408408
## Run 17 stress 0.09155104
## ... Procrustes: rmse 0.0709405  max resid 0.2404608
## Run 18 stress 0.09403695
## Run 19 stress 0.09166602
## ... Procrustes: rmse 0.05067018  max resid 0.2826205
## Run 20 stress 0.09137049
## ... New best solution
## ... Procrustes: rmse 0.04457082  max resid 0.252469
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
```

```
## Run 0 stress 0.09216961
## Run 1 stress 0.09118337
## ... New best solution
## ... Procrustes: rmse 0.05468879  max resid 0.1591736
## Run 2 stress 0.09309184
## Run 3 stress 0.09125293
## ... Procrustes: rmse 0.007079703  max resid 0.03600273
## Run 4 stress 0.0915639
## ... Procrustes: rmse 0.07225633  max resid 0.2161129
## Run 5 stress 0.09136229
## ... Procrustes: rmse 0.04008624  max resid 0.2010905
## Run 6 stress 0.0923082
## Run 7 stress 0.09207673
## Run 8 stress 0.09207332
## Run 9 stress 0.09285963
## Run 10 stress 0.09208302
## Run 11 stress 0.09156366
## ... Procrustes: rmse 0.07121825  max resid 0.2092143
## Run 12 stress 0.09120101
## ... Procrustes: rmse 0.01049809  max resid 0.05218185
## Run 13 stress 0.09156152
## ... Procrustes: rmse 0.07179978  max resid 0.2149707
## Run 14 stress 0.09156052
## ... Procrustes: rmse 0.07128034  max resid 0.2096083
## Run 15 stress 0.09138598
## ... Procrustes: rmse 0.04391653  max resid 0.2284799
## Run 16 stress 0.09159841
## ... Procrustes: rmse 0.02292907  max resid 0.06414823
## Run 17 stress 0.09159112
## ... Procrustes: rmse 0.07091526  max resid 0.2061242
## Run 18 stress 0.09234696
## Run 19 stress 0.09153544
## ... Procrustes: rmse 0.07171671  max resid 0.2176605
## Run 20 stress 0.09228101
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09147988
## ... New best solution
## ... Procrustes: rmse 0.06379081  max resid 0.2477507
## Run 2 stress 0.09154524
## ... Procrustes: rmse 0.07334523  max resid 0.2350335
## Run 3 stress 0.09207599
## Run 4 stress 0.0923641
## Run 5 stress 0.09286993
## Run 6 stress 0.091364
## ... New best solution
## ... Procrustes: rmse 0.01424016  max resid 0.07689172
## Run 7 stress 0.09250513
## Run 8 stress 0.09153578
## ... Procrustes: rmse 0.07422588  max resid 0.2476559
## Run 9 stress 0.09153501
## ... Procrustes: rmse 0.07423482  max resid 0.2475896
```

```
## Run 10 stress 0.09240868
## Run 11 stress 0.09232179
## Run 12 stress 0.09118772
## ... New best solution
## ... Procrustes: rmse 0.03421109  max resid 0.1675366
## Run 13 stress 0.09309146
## Run 14 stress 0.09121097
## ... Procrustes: rmse 0.0122628  max resid 0.06097485
## Run 15 stress 0.09288139
## Run 16 stress 0.09286385
## Run 17 stress 0.09164719
## ... Procrustes: rmse 0.02721571  max resid 0.09334883
## Run 18 stress 0.09120567
## ... Procrustes: rmse 0.01155168  max resid 0.05894416
## Run 19 stress 0.09235983
## Run 20 stress 0.09155445
## ... Procrustes: rmse 0.07309013  max resid 0.2437789
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     12: no. of iterations >= maxit
##      8: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09309971
## Run 2 stress 0.09213782
## ... New best solution
## ... Procrustes: rmse 0.02799884  max resid 0.08547066
## Run 3 stress 0.09153805
## ... New best solution
## ... Procrustes: rmse 0.01904894  max resid 0.06154607
## Run 4 stress 0.09164909
## ... Procrustes: rmse 0.007182224  max resid 0.01625404
## Run 5 stress 0.09424529
## Run 6 stress 0.09145072
## ... New best solution
## ... Procrustes: rmse 0.06951866  max resid 0.2461317
## Run 7 stress 0.09163529
## ... Procrustes: rmse 0.07063525  max resid 0.2451252
## Run 8 stress 0.09156907
## ... Procrustes: rmse 0.07170065  max resid 0.2471923
## Run 9 stress 0.09138955
## ... New best solution
## ... Procrustes: rmse 0.01459088  max resid 0.04193338
## Run 10 stress 0.09138683
## ... New best solution
## ... Procrustes: rmse 0.0005357527  max resid 0.002940195
## ... Similar to previous best
## Run 11 stress 0.091182
## ... New best solution
## ... Procrustes: rmse 0.04390901  max resid 0.2290907
## Run 12 stress 0.09343017
## Run 13 stress 0.09303788
## Run 14 stress 0.09246925
## Run 15 stress 0.09235032
## Run 16 stress 0.09132576
## ... Procrustes: rmse 0.01638523  max resid 0.04420503
```

```
## Run 17 stress 0.09240301
## Run 18 stress 0.09267401
## Run 19 stress 0.09424049
## Run 20 stress 0.09153579
## ... Procrustes: rmse 0.07183886  max resid 0.2151979
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09227267
## ... Procrustes: rmse 0.00710901  max resid 0.03426094
## Run 2 stress 0.09309208
## Run 3 stress 0.09118499
## ... New best solution
## ... Procrustes: rmse 0.05469096  max resid 0.1589866
## Run 4 stress 0.09336675
## Run 5 stress 0.09208064
## Run 6 stress 0.09121095
## ... Procrustes: rmse 0.003954448  max resid 0.01919466
## Run 7 stress 0.09390281
## Run 8 stress 0.09236914
## Run 9 stress 0.09279099
## Run 10 stress 0.09155286
## ... Procrustes: rmse 0.0712528  max resid 0.2084625
## Run 11 stress 0.09153754
## ... Procrustes: rmse 0.0718396  max resid 0.2131044
## Run 12 stress 0.09155276
## ... Procrustes: rmse 0.02127467  max resid 0.05872064
## Run 13 stress 0.09207578
## Run 14 stress 0.09136643
## ... Procrustes: rmse 0.0130816  max resid 0.04455489
## Run 15 stress 0.09159155
## ... Procrustes: rmse 0.02257528  max resid 0.0648442
## Run 16 stress 0.0928634
## Run 17 stress 0.09158612
## ... Procrustes: rmse 0.05104377  max resid 0.2807195
## Run 18 stress 0.09153478
## ... Procrustes: rmse 0.07138725  max resid 0.2103567
## Run 19 stress 0.09122774
## ... Procrustes: rmse 0.01467644  max resid 0.07349956
## Run 20 stress 0.09118325
## ... New best solution
## ... Procrustes: rmse 0.0004814852  max resid 0.00248973
## ... Similar to previous best
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09155301
## ... New best solution
## ... Procrustes: rmse 0.06560453  max resid 0.2672658
## Run 2 stress 0.09229899
## Run 3 stress 0.09344471
## Run 4 stress 0.09153434
## ... New best solution
## ... Procrustes: rmse 0.07234956  max resid 0.2296601
```

```
## Run 5 stress 0.09141205
## ... New best solution
## ... Procrustes: rmse 0.07351582  max resid 0.2408473
## Run 6 stress 0.09118338
## ... New best solution
## ... Procrustes: rmse 0.04193977  max resid 0.219016
## Run 7 stress 0.09140274
## ... Procrustes: rmse 0.04108584  max resid 0.2130364
## Run 8 stress 0.09154698
## ... Procrustes: rmse 0.07328584  max resid 0.2364129
## Run 9 stress 0.09263342
## Run 10 stress 0.09138371
## ... Procrustes: rmse 0.01557721  max resid 0.0495822
## Run 11 stress 0.09234913
## Run 12 stress 0.09216959
## Run 13 stress 0.09255689
## Run 14 stress 0.09290983
## Run 15 stress 0.09211618
## Run 16 stress 0.09121362
## ... Procrustes: rmse 0.006222705  max resid 0.02957567
## Run 17 stress 0.09156396
## ... Procrustes: rmse 0.07212727  max resid 0.2265509
## Run 18 stress 0.09153559
## ... Procrustes: rmse 0.07263183  max resid 0.2302511
## Run 19 stress 0.0913699
## ... Procrustes: rmse 0.03639089  max resid 0.1794077
## Run 20 stress 0.09153502
## ... Procrustes: rmse 0.07235428  max resid 0.2300058
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09153527
## ... New best solution
## ... Procrustes: rmse 0.03813739  max resid 0.09044764
## Run 2 stress 0.09242269
## Run 3 stress 0.09238397
## Run 4 stress 0.09136812
## ... New best solution
## ... Procrustes: rmse 0.06796001  max resid 0.206615
## Run 5 stress 0.09153495
## ... Procrustes: rmse 0.06821707  max resid 0.2105875
## Run 6 stress 0.0933118
## Run 7 stress 0.09227214
## Run 8 stress 0.09137444
## ... Procrustes: rmse 0.0007322196  max resid 0.001911441
## ... Similar to previous best
## Run 9 stress 0.09154214
## ... Procrustes: rmse 0.06844902  max resid 0.2083976
## Run 10 stress 0.09151332
## ... Procrustes: rmse 0.04924592  max resid 0.2890384
## Run 11 stress 0.09242927
## Run 12 stress 0.0911788
## ... New best solution
```

```
## ... Procrustes: rmse 0.01450483  max resid 0.04597562
## Run 13 stress 0.09119265
## ... Procrustes: rmse 0.004130541  max resid 0.01893627
## Run 14 stress 0.09121475
## ... Procrustes: rmse 0.008403987  max resid 0.04264901
## Run 15 stress 0.09153394
## ... Procrustes: rmse 0.07209724  max resid 0.2226351
## Run 16 stress 0.09173784
## Run 17 stress 0.09236546
## Run 18 stress 0.09119391
## ... Procrustes: rmse 0.004264802  max resid 0.02222751
## Run 19 stress 0.09140339
## ... Procrustes: rmse 0.0264626  max resid 0.1380274
## Run 20 stress 0.09210596
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09124813
## ... New best solution
## ... Procrustes: rmse 0.05391348  max resid 0.1610519
## Run 2 stress 0.0918372
## Run 3 stress 0.09136343
## ... Procrustes: rmse 0.04525545  max resid 0.2355012
## Run 4 stress 0.09132442
## ... Procrustes: rmse 0.02239938  max resid 0.09287317
## Run 5 stress 0.09232563
## Run 6 stress 0.09126682
## ... Procrustes: rmse 0.001497435  max resid 0.005958849
## ... Similar to previous best
## Run 7 stress 0.09153656
## ... Procrustes: rmse 0.07021841  max resid 0.1949809
## Run 8 stress 0.09253653
## Run 9 stress 0.09270658
## Run 10 stress 0.09153483
## ... Procrustes: rmse 0.04281045  max resid 0.2366357
## Run 11 stress 0.09149465
## ... Procrustes: rmse 0.05490987  max resid 0.3087201
## Run 12 stress 0.09234476
## Run 13 stress 0.09148725
## ... Procrustes: rmse 0.04418794  max resid 0.2206504
## Run 14 stress 0.0914166
## ... Procrustes: rmse 0.05157081  max resid 0.2829615
## Run 15 stress 0.09422455
## Run 16 stress 0.09312383
## Run 17 stress 0.09228883
## Run 18 stress 0.09153841
## ... Procrustes: rmse 0.07018304  max resid 0.1927843
## Run 19 stress 0.09153464
## ... Procrustes: rmse 0.06990173  max resid 0.193934
## Run 20 stress 0.09139941
## ... Procrustes: rmse 0.01761772  max resid 0.04761643
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
```

```
## Run 1 stress 0.09147173
## ... New best solution
## ... Procrustes: rmse 0.04757048  max resid 0.1631946
## Run 2 stress 0.09309213
## Run 3 stress 0.09247983
## Run 4 stress 0.09142167
## ... New best solution
## ... Procrustes: rmse 0.005953713  max resid 0.03014131
## Run 5 stress 0.09153738
## ... Procrustes: rmse 0.06797561  max resid 0.2029631
## Run 6 stress 0.09239796
## Run 7 stress 0.09140178
## ... New best solution
## ... Procrustes: rmse 0.03452051  max resid 0.1787392
## Run 8 stress 0.09207249
## Run 9 stress 0.09210014
## Run 10 stress 0.09425898
## Run 11 stress 0.09154743
## ... Procrustes: rmse 0.07085764  max resid 0.2499404
## Run 12 stress 0.09140491
## ... Procrustes: rmse 0.02147972  max resid 0.09067759
## Run 13 stress 0.0915615
## ... Procrustes: rmse 0.07079347  max resid 0.2494034
## Run 14 stress 0.09118281
## ... New best solution
## ... Procrustes: rmse 0.02756921  max resid 0.1455839
## Run 15 stress 0.09207423
## Run 16 stress 0.09207699
## Run 17 stress 0.09207604
## Run 18 stress 0.0914577
## ... Procrustes: rmse 0.03446965  max resid 0.183909
## Run 19 stress 0.09327372
## Run 20 stress 0.09209494
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09155849
## ... New best solution
## ... Procrustes: rmse 0.03737232  max resid 0.09019137
## Run 2 stress 0.09118003
## ... New best solution
## ... Procrustes: rmse 0.0721254  max resid 0.2235243
## Run 3 stress 0.09231423
## Run 4 stress 0.09236065
## Run 5 stress 0.09215255
## Run 6 stress 0.09178978
## Run 7 stress 0.09144587
## ... Procrustes: rmse 0.03242575  max resid 0.1723174
## Run 8 stress 0.09158694
## ... Procrustes: rmse 0.07310242  max resid 0.2400838
## Run 9 stress 0.09143485
## ... Procrustes: rmse 0.03075959  max resid 0.1631709
## Run 10 stress 0.09153763
```

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## ... Procrustes: rmse 0.07284112  max resid 0.2302597
## Run 11 stress 0.09118054
## ... Procrustes: rmse 0.003449699  max resid 0.0182102
## Run 12 stress 0.09136934
## ... Procrustes: rmse 0.01446242  max resid 0.04595578
## Run 13 stress 0.09153433
## ... Procrustes: rmse 0.07252106  max resid 0.2260861
## Run 14 stress 0.09310026
## Run 15 stress 0.09160117
## ... Procrustes: rmse 0.04087271  max resid 0.2250486
## Run 16 stress 0.09236776
## Run 17 stress 0.09412657
## Run 18 stress 0.09208278
## Run 19 stress 0.09280455
## Run 20 stress 0.09249565
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09158158
## ... New best solution
## ... Procrustes: rmse 0.03924166  max resid 0.0950253
## Run 2 stress 0.09156636
## ... New best solution
## ... Procrustes: rmse 0.06966586  max resid 0.2260089
## Run 3 stress 0.09211347
## Run 4 stress 0.09213389
## Run 5 stress 0.09139634
## ... New best solution
## ... Procrustes: rmse 0.01321162  max resid 0.06852073
## Run 6 stress 0.09153475
## ... Procrustes: rmse 0.07292948  max resid 0.2419356
## Run 7 stress 0.09137731
## ... New best solution
## ... Procrustes: rmse 0.02168286  max resid 0.1156004
## Run 8 stress 0.09286022
## Run 9 stress 0.09121533
## ... New best solution
## ... Procrustes: rmse 0.03332488  max resid 0.1539409
## Run 10 stress 0.09154368
## ... Procrustes: rmse 0.07045558  max resid 0.1998072
## Run 11 stress 0.09117962
## ... New best solution
## ... Procrustes: rmse 0.008544344  max resid 0.04283382
## Run 12 stress 0.09286121
## Run 13 stress 0.09239114
## Run 14 stress 0.09145106
## ... Procrustes: rmse 0.03127282  max resid 0.1668535
## Run 15 stress 0.09132537
## ... Procrustes: rmse 0.01536522  max resid 0.04291766
## Run 16 stress 0.09248831
## Run 17 stress 0.09119418
## ... Procrustes: rmse 0.005267379  max resid 0.02774455
## Run 18 stress 0.0911978
```

```
## ... Procrustes: rmse 0.006936625  max resid 0.03343234
## Run 19 stress 0.09134061
## ... Procrustes: rmse 0.01989464  max resid 0.07968802
## Run 20 stress 0.09153557
## ... Procrustes: rmse 0.07216938  max resid 0.2285995
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09230845
## ... Procrustes: rmse 0.01077334  max resid 0.05122307
## Run 2 stress 0.091534
## ... New best solution
## ... Procrustes: rmse 0.0388115  max resid 0.09255428
## Run 3 stress 0.0915834
## ... Procrustes: rmse 0.006361648  max resid 0.02176015
## Run 4 stress 0.09155946
## ... Procrustes: rmse 0.005652646  max resid 0.0220788
## Run 5 stress 0.09136089
## ... New best solution
## ... Procrustes: rmse 0.07475894  max resid 0.2487656
## Run 6 stress 0.09339239
## Run 7 stress 0.09145557
## ... Procrustes: rmse 0.01516951  max resid 0.08268663
## Run 8 stress 0.09234679
## Run 9 stress 0.09118275
## ... New best solution
## ... Procrustes: rmse 0.03860111  max resid 0.1909175
## Run 10 stress 0.09119615
## ... Procrustes: rmse 0.002717389  max resid 0.01359748
## Run 11 stress 0.09234883
## Run 12 stress 0.09166019
## ... Procrustes: rmse 0.07192419  max resid 0.2148797
## Run 13 stress 0.09316653
## Run 14 stress 0.09153589
## ... Procrustes: rmse 0.07191029  max resid 0.2162828
## Run 15 stress 0.0930912
## Run 16 stress 0.09233127
## Run 17 stress 0.09278051
## Run 18 stress 0.09398824
## Run 19 stress 0.09124683
## ... Procrustes: rmse 0.007228943  max resid 0.03269466
## Run 20 stress 0.09154889
## ... Procrustes: rmse 0.07216331  max resid 0.2145924
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     14: no. of iterations >= maxit
##      6: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.091364
## ... New best solution
## ... Procrustes: rmse 0.05861967  max resid 0.2171433
## Run 2 stress 0.09126406
## ... New best solution
## ... Procrustes: rmse 0.04406472  max resid 0.227564
```

```
## Run 3 stress 0.09132552
## ... Procrustes: rmse 0.02055981  max resid 0.08899248
## Run 4 stress 0.09120715
## ... New best solution
## ... Procrustes: rmse 0.0183108  max resid 0.09725342
## Run 5 stress 0.09118442
## ... New best solution
## ... Procrustes: rmse 0.01099626  max resid 0.05844048
## Run 6 stress 0.09155941
## ... Procrustes: rmse 0.07117195  max resid 0.2084241
## Run 7 stress 0.0930902
## Run 8 stress 0.09475839
## Run 9 stress 0.09138771
## ... Procrustes: rmse 0.04450276  max resid 0.2330712
## Run 10 stress 0.09232657
## Run 11 stress 0.09238401
## Run 12 stress 0.09355295
## Run 13 stress 0.09157098
## ... Procrustes: rmse 0.07236882  max resid 0.2137253
## Run 14 stress 0.09118746
## ... Procrustes: rmse 0.0007415425  max resid 0.003436903
## ... Similar to previous best
## Run 15 stress 0.09121271
## ... Procrustes: rmse 0.004203998  max resid 0.02101769
## Run 16 stress 0.09239948
## Run 17 stress 0.09309148
## Run 18 stress 0.0913281
## ... Procrustes: rmse 0.01880626  max resid 0.0695736
## Run 19 stress 0.09153445
## ... Procrustes: rmse 0.07148661  max resid 0.2152678
## Run 20 stress 0.09239186
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09153398
## ... New best solution
## ... Procrustes: rmse 0.03841878  max resid 0.09015083
## Run 2 stress 0.09554305
## Run 3 stress 0.09118496
## ... New best solution
## ... Procrustes: rmse 0.07135224  max resid 0.2132796
## Run 4 stress 0.09293394
## Run 5 stress 0.09142725
## ... Procrustes: rmse 0.0344616  max resid 0.1846071
## Run 6 stress 0.09232907
## Run 7 stress 0.09158926
## ... Procrustes: rmse 0.02241241  max resid 0.06193845
## Run 8 stress 0.09233998
## Run 9 stress 0.09118207
## ... New best solution
## ... Procrustes: rmse 0.000831801  max resid 0.004253851
## ... Similar to previous best
## Run 10 stress 0.09136965
## ... Procrustes: rmse 0.01461229  max resid 0.04528543
## Run 11 stress 0.09118087
```

```
## ... New best solution
## ... Procrustes: rmse 0.00113467  max resid 0.005427376
## ... Similar to previous best
## Run 12 stress 0.09228119
## Run 13 stress 0.09531563
## Run 14 stress 0.09207474
## Run 15 stress 0.09334402
## Run 16 stress 0.09239839
## Run 17 stress 0.09139766
## ... Procrustes: rmse 0.02911832  max resid 0.1539386
## Run 18 stress 0.09207253
## Run 19 stress 0.09286125
## Run 20 stress 0.09277402
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09135996
## ... New best solution
## ... Procrustes: rmse 0.05684598  max resid 0.2091622
## Run 2 stress 0.09144758
## ... Procrustes: rmse 0.03607086  max resid 0.1962392
## Run 3 stress 0.09137183
## ... Procrustes: rmse 0.008216208  max resid 0.04392487
## Run 4 stress 0.09412877
## Run 5 stress 0.09517777
## Run 6 stress 0.09231763
## Run 7 stress 0.09225732
## Run 8 stress 0.09309085
## Run 9 stress 0.09280144
## Run 10 stress 0.09138794
## ... Procrustes: rmse 0.034642  max resid 0.1884099
## Run 11 stress 0.09141977
## ... Procrustes: rmse 0.0365601  max resid 0.1998198
## Run 12 stress 0.09230946
## Run 13 stress 0.09117897
## ... New best solution
## ... Procrustes: rmse 0.03194658  max resid 0.1503886
## Run 14 stress 0.09259177
## Run 15 stress 0.09280194
## Run 16 stress 0.09155121
## ... Procrustes: rmse 0.07158709  max resid 0.2223854
## Run 17 stress 0.09118152
## ... Procrustes: rmse 0.003660818  max resid 0.01904638
## Run 18 stress 0.09119191
## ... Procrustes: rmse 0.004679894  max resid 0.02358925
## Run 19 stress 0.09154004
## ... Procrustes: rmse 0.07264666  max resid 0.2283598
## Run 20 stress 0.09279589
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     17: no. of iterations >= maxit
##      3: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09133234
## ... New best solution
## ... Procrustes: rmse 0.05009947  max resid 0.1592169
```

```
## Run 2 stress 0.09248452
## Run 3 stress 0.09234691
## Run 4 stress 0.09209358
## Run 5 stress 0.09234636
## Run 6 stress 0.09118395
## ... New best solution
## ... Procrustes: rmse 0.0213299  max resid 0.07879654
## Run 7 stress 0.09175644
## Run 8 stress 0.09148324
## ... Procrustes: rmse 0.01527489  max resid 0.06095644
## Run 9 stress 0.09209749
## Run 10 stress 0.09153436
## ... Procrustes: rmse 0.07147029  max resid 0.2133859
## Run 11 stress 0.09132383
## ... Procrustes: rmse 0.02235084  max resid 0.1144535
## Run 12 stress 0.09142772
## ... Procrustes: rmse 0.04786597  max resid 0.2579707
## Run 13 stress 0.09119699
## ... Procrustes: rmse 0.01008365  max resid 0.05051376
## Run 14 stress 0.09144377
## ... Procrustes: rmse 0.01621583  max resid 0.0472708
## Run 15 stress 0.0920924
## Run 16 stress 0.09235093
## Run 17 stress 0.09394237
## Run 18 stress 0.09166362
## ... Procrustes: rmse 0.02474959  max resid 0.0773933
## Run 19 stress 0.09153418
## ... Procrustes: rmse 0.07153643  max resid 0.2128225
## Run 20 stress 0.09175469
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09266812
## ... Procrustes: rmse 0.06744929  max resid 0.2040916
## Run 2 stress 0.09141495
## ... New best solution
## ... Procrustes: rmse 0.06209  max resid 0.2211072
## Run 3 stress 0.09309291
## Run 4 stress 0.09234564
## Run 5 stress 0.09153554
## ... Procrustes: rmse 0.07266802  max resid 0.2413517
## Run 6 stress 0.09118172
## ... New best solution
## ... Procrustes: rmse 0.04256239  max resid 0.222113
## Run 7 stress 0.09234589
## Run 8 stress 0.09248201
## Run 9 stress 0.09136441
## ... Procrustes: rmse 0.03652367  max resid 0.1788668
## Run 10 stress 0.0913702
## ... Procrustes: rmse 0.03753634  max resid 0.1861034
## Run 11 stress 0.09119919
## ... Procrustes: rmse 0.008524472  max resid 0.04414345
## Run 12 stress 0.0913586
```

```
## ... Procrustes: rmse 0.03387489  max resid 0.1619914
## Run 13 stress 0.09158514
## ... Procrustes: rmse 0.07188025  max resid 0.2232286
## Run 14 stress 0.09118044
## ... New best solution
## ... Procrustes: rmse 0.004495918  max resid 0.02403247
## Run 15 stress 0.09158048
## ... Procrustes: rmse 0.07220029  max resid 0.2130909
## Run 16 stress 0.09136035
## ... Procrustes: rmse 0.03065771  max resid 0.142956
## Run 17 stress 0.09118382
## ... Procrustes: rmse 0.001567889  max resid 0.005856629
## ... Similar to previous best
## Run 18 stress 0.09229809
## Run 19 stress 0.09153647
## ... Procrustes: rmse 0.0719489  max resid 0.2210169
## Run 20 stress 0.0917909
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09309252
## Run 2 stress 0.09209457
## ... New best solution
## ... Procrustes: rmse 0.003306357  max resid 0.01603128
## Run 3 stress 0.09153737
## ... New best solution
## ... Procrustes: rmse 0.04088853  max resid 0.1099464
## Run 4 stress 0.09255092
## Run 5 stress 0.09242735
## Run 6 stress 0.09153606
## ... New best solution
## ... Procrustes: rmse 0.0003730459  max resid 0.001745312
## ... Similar to previous best
## Run 7 stress 0.09208061
## Run 8 stress 0.09153614
## ... Procrustes: rmse 0.003112828  max resid 0.009999885
## ... Similar to previous best
## Run 9 stress 0.09140091
## ... New best solution
## ... Procrustes: rmse 0.0730328  max resid 0.2422284
## Run 10 stress 0.09154138
## ... Procrustes: rmse 0.07219537  max resid 0.2419376
## Run 11 stress 0.09139256
## ... New best solution
## ... Procrustes: rmse 0.001446677  max resid 0.007860543
## ... Similar to previous best
## Run 12 stress 0.09118246
## ... New best solution
## ... Procrustes: rmse 0.04456242  max resid 0.2338277
## Run 13 stress 0.09276798
## Run 14 stress 0.09322615
## Run 15 stress 0.09226762
## Run 16 stress 0.09427217
## Run 17 stress 0.09156814
## ... Procrustes: rmse 0.0716523  max resid 0.2110585
```

```
## Run 18 stress 0.09286244
## Run 19 stress 0.09153553
## ... Procrustes: rmse 0.07200417  max resid 0.219579
## Run 20 stress 0.09236158
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      4: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09157983
## ... New best solution
## ... Procrustes: rmse 0.03645706  max resid 0.08913465
## Run 2 stress 0.0929369
## Run 3 stress 0.09136072
## ... New best solution
## ... Procrustes: rmse 0.07378848  max resid 0.2843615
## Run 4 stress 0.09201967
## Run 5 stress 0.09153633
## ... Procrustes: rmse 0.07475918  max resid 0.2490846
## Run 6 stress 0.09232824
## Run 7 stress 0.09156098
## ... Procrustes: rmse 0.074147  max resid 0.2479982
## Run 8 stress 0.0930916
## Run 9 stress 0.0922673
## Run 10 stress 0.09153944
## ... Procrustes: rmse 0.07436402  max resid 0.2485632
## Run 11 stress 0.09154329
## ... Procrustes: rmse 0.07495854  max resid 0.2924405
## Run 12 stress 0.09290522
## Run 13 stress 0.09233182
## Run 14 stress 0.09432695
## Run 15 stress 0.0913361
## ... New best solution
## ... Procrustes: rmse 0.0321317  max resid 0.1765819
## Run 16 stress 0.09135056
## ... Procrustes: rmse 0.01861557  max resid 0.100295
## Run 17 stress 0.09235816
## Run 18 stress 0.09154465
## ... Procrustes: rmse 0.06980517  max resid 0.2239834
## Run 19 stress 0.09164268
## ... Procrustes: rmse 0.01766915  max resid 0.07028483
## Run 20 stress 0.0923451
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09132494
## ... New best solution
## ... Procrustes: rmse 0.05080006  max resid 0.1567821
## Run 2 stress 0.09208023
## Run 3 stress 0.09148494
## ... Procrustes: rmse 0.02153022  max resid 0.1152298
## Run 4 stress 0.09154704
## ... Procrustes: rmse 0.07098198  max resid 0.2497183
## Run 5 stress 0.0915728
```

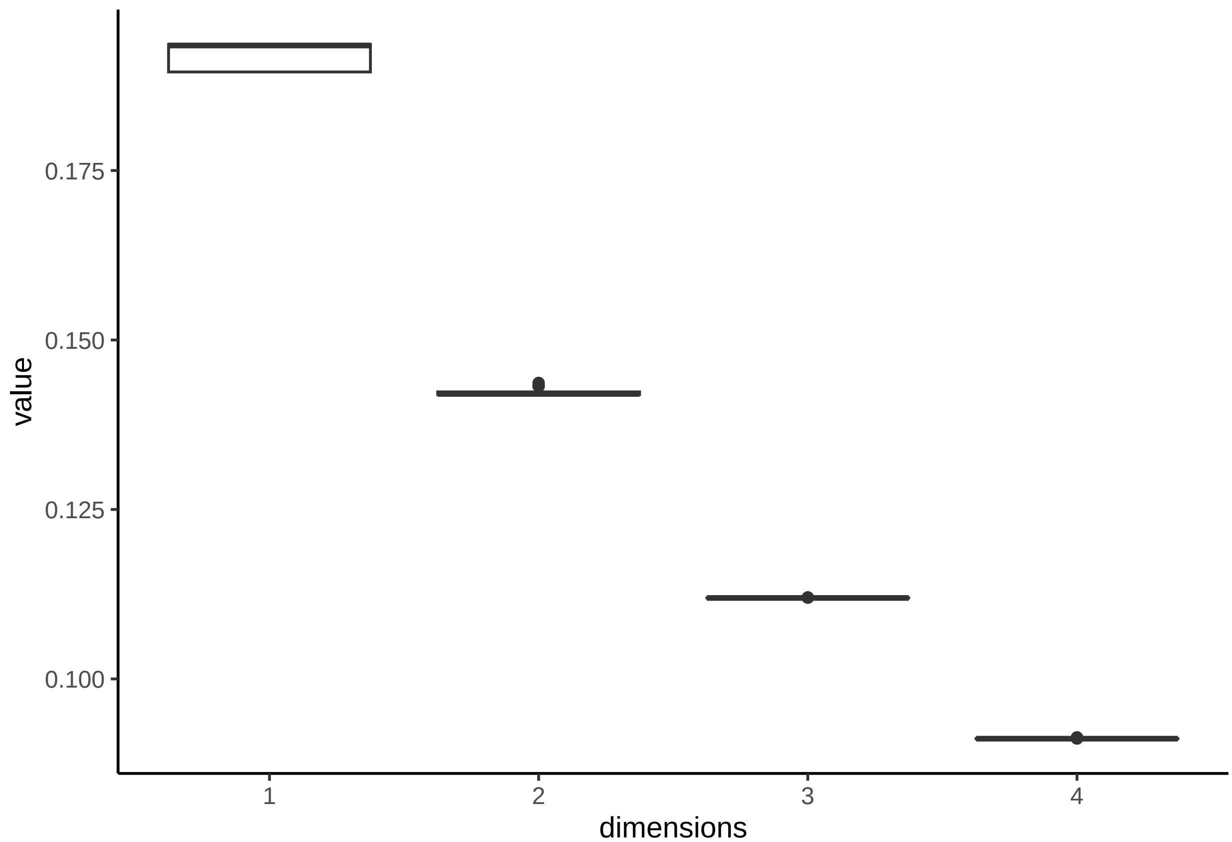
```
## ... Procrustes: rmse 0.07188961  max resid 0.247549
## Run 6 stress 0.09153822
## ... Procrustes: rmse 0.0710978  max resid 0.2460709
## Run 7 stress 0.09121085
## ... New best solution
## ... Procrustes: rmse 0.02045325  max resid 0.08228936
## Run 8 stress 0.09138167
## ... Procrustes: rmse 0.0126872  max resid 0.0440109
## Run 9 stress 0.0911826
## ... New best solution
## ... Procrustes: rmse 0.004787885  max resid 0.02434175
## Run 10 stress 0.0915353
## ... Procrustes: rmse 0.07195278  max resid 0.2183182
## Run 11 stress 0.09155989
## ... Procrustes: rmse 0.07141556  max resid 0.2097741
## Run 12 stress 0.0913872
## ... Procrustes: rmse 0.01597728  max resid 0.04842993
## Run 13 stress 0.09153455
## ... Procrustes: rmse 0.07187541  max resid 0.217397
## Run 14 stress 0.09284992
## Run 15 stress 0.09341494
## Run 16 stress 0.09144015
## ... Procrustes: rmse 0.03500198  max resid 0.1875597
## Run 17 stress 0.09142255
## ... Procrustes: rmse 0.01438401  max resid 0.04658179
## Run 18 stress 0.09146472
## ... Procrustes: rmse 0.04909128  max resid 0.2663312
## Run 19 stress 0.09153481
## ... Procrustes: rmse 0.07193849  max resid 0.2179455
## Run 20 stress 0.0915376
## ... Procrustes: rmse 0.07215392  max resid 0.2179043
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09246008
## ... Procrustes: rmse 0.06145951  max resid 0.2461671
## Run 2 stress 0.09154936
## ... New best solution
## ... Procrustes: rmse 0.03749572  max resid 0.09038117
## Run 3 stress 0.09286043
## Run 4 stress 0.09153423
## ... New best solution
## ... Procrustes: rmse 0.002777808  max resid 0.009233246
## ... Similar to previous best
## Run 5 stress 0.09153692
## ... Procrustes: rmse 0.003388154  max resid 0.01513201
## Run 6 stress 0.09138359
## ... New best solution
## ... Procrustes: rmse 0.07362145  max resid 0.2435301
## Run 7 stress 0.09138276
## ... New best solution
## ... Procrustes: rmse 0.0001647092  max resid 0.0009173648
## ... Similar to previous best
```

```
## Run 8 stress 0.09309924
## Run 9 stress 0.09234087
## Run 10 stress 0.09236462
## Run 11 stress 0.0921754
## Run 12 stress 0.09251762
## Run 13 stress 0.09371557
## Run 14 stress 0.09209698
## Run 15 stress 0.09118144
## ... New best solution
## ... Procrustes: rmse 0.03909639  max resid 0.1988242
## Run 16 stress 0.09153573
## ... Procrustes: rmse 0.07226733  max resid 0.2279561
## Run 17 stress 0.09285976
## Run 18 stress 0.09135983
## ... Procrustes: rmse 0.03331401  max resid 0.1593887
## Run 19 stress 0.09156106
## ... Procrustes: rmse 0.0726444  max resid 0.2301618
## Run 20 stress 0.0913711
## ... Procrustes: rmse 0.0366406  max resid 0.1824135
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      5: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09153445
## ... New best solution
## ... Procrustes: rmse 0.0388503  max resid 0.09305044
## Run 2 stress 0.09249418
## Run 3 stress 0.09559957
## Run 4 stress 0.09118569
## ... New best solution
## ... Procrustes: rmse 0.07162102  max resid 0.2157312
## Run 5 stress 0.09155959
## ... Procrustes: rmse 0.07112353  max resid 0.2074396
## Run 6 stress 0.09227081
## Run 7 stress 0.09153496
## ... Procrustes: rmse 0.07156252  max resid 0.2154254
## Run 8 stress 0.09139809
## ... Procrustes: rmse 0.0174288  max resid 0.05184307
## Run 9 stress 0.09148647
## ... Procrustes: rmse 0.01816771  max resid 0.04954498
## Run 10 stress 0.09139621
## ... Procrustes: rmse 0.04580484  max resid 0.2423288
## Run 11 stress 0.09248444
## Run 12 stress 0.09237815
## Run 13 stress 0.09156174
## ... Procrustes: rmse 0.07102788  max resid 0.2077912
## Run 14 stress 0.09159967
## ... Procrustes: rmse 0.07231503  max resid 0.215801
## Run 15 stress 0.09138395
## ... Procrustes: rmse 0.04350464  max resid 0.2255397
## Run 16 stress 0.09133389
## ... Procrustes: rmse 0.01411204  max resid 0.04201252
## Run 17 stress 0.0931153
## Run 18 stress 0.09118974
```

```
## ... Procrustes: rmse 0.0008330889  max resid 0.003824017
## ... Similar to previous best
## Run 19 stress 0.09141108
## ... Procrustes: rmse 0.04721292  max resid 0.2527316
## Run 20 stress 0.09309056
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.09235872
## ... Procrustes: rmse 0.05195768  max resid 0.2223674
## Run 2 stress 0.09238653
## ... Procrustes: rmse 0.05856752  max resid 0.2291006
## Run 3 stress 0.09207351
## ... New best solution
## ... Procrustes: rmse 0.005861205  max resid 0.02576101
## Run 4 stress 0.09209308
## ... Procrustes: rmse 0.03151956  max resid 0.0980458
## Run 5 stress 0.091185
## ... New best solution
## ... Procrustes: rmse 0.05363305  max resid 0.159866
## Run 6 stress 0.09118544
## ... Procrustes: rmse 0.000338734  max resid 0.001496417
## ... Similar to previous best
## Run 7 stress 0.09506673
## Run 8 stress 0.09118456
## ... New best solution
## ... Procrustes: rmse 0.000157366  max resid 0.0007112665
## ... Similar to previous best
## Run 9 stress 0.09141216
## ... Procrustes: rmse 0.04682602  max resid 0.2489077
## Run 10 stress 0.09232665
## Run 11 stress 0.09284878
## Run 12 stress 0.09309585
## Run 13 stress 0.09130335
## ... Procrustes: rmse 0.0102649  max resid 0.05227666
## Run 14 stress 0.09307939
## Run 15 stress 0.09138919
## ... Procrustes: rmse 0.02898684  max resid 0.1559107
## Run 16 stress 0.09225278
## Run 17 stress 0.09334836
## Run 18 stress 0.0915349
## ... Procrustes: rmse 0.07150182  max resid 0.2130203
## Run 19 stress 0.09234746
## Run 20 stress 0.09255325
## *** Best solution repeated 1 times
## Run 0 stress 0.09216961
## Run 1 stress 0.0915636
## ... New best solution
## ... Procrustes: rmse 0.03786227  max resid 0.09077737
## Run 2 stress 0.09136052
## ... New best solution
## ... Procrustes: rmse 0.0687693  max resid 0.2100693
## Run 3 stress 0.09426501
## Run 4 stress 0.09207216
## Run 5 stress 0.09283767
```

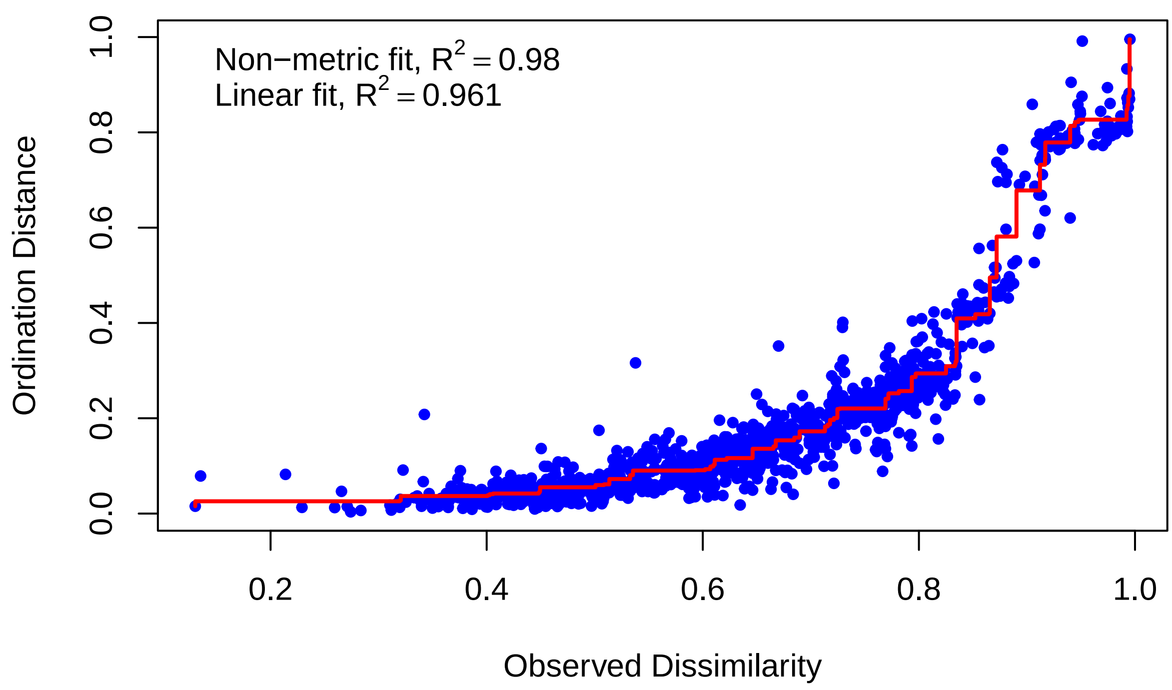
```
## Run 6 stress 0.09309053
## Run 7 stress 0.09143235
## ... Procrustes: rmse 0.008422294  max resid 0.0199154
## Run 8 stress 0.09309532
## Run 9 stress 0.09156821
## ... Procrustes: rmse 0.06816999  max resid 0.2039264
## Run 10 stress 0.09207294
## Run 11 stress 0.09153435
## ... Procrustes: rmse 0.06856415  max resid 0.2093899
## Run 12 stress 0.09146269
## ... Procrustes: rmse 0.03585513  max resid 0.1802051
## Run 13 stress 0.09153809
## ... Procrustes: rmse 0.0688631  max resid 0.2109173
## Run 14 stress 0.09207784
## Run 15 stress 0.09153495
## ... Procrustes: rmse 0.06838323  max resid 0.209635
## Run 16 stress 0.09177194
## ... Procrustes: rmse 0.01940968  max resid 0.07670853
## Run 17 stress 0.09245027
## Run 18 stress 0.09139697
## ... Procrustes: rmse 0.03170372  max resid 0.1632036
## Run 19 stress 0.09118358
## ... New best solution
## ... Procrustes: rmse 0.01280418  max resid 0.04415545
## Run 20 stress 0.09311551
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     12: no. of iterations >= maxit
##      8: stress ratio > sratmax
## Run 0 stress 0.09216961
## Run 1 stress 0.09136015
## ... New best solution
## ... Procrustes: rmse 0.05838982  max resid 0.2145518
## Run 2 stress 0.09238764
## Run 3 stress 0.09151622
## ... Procrustes: rmse 0.01140503  max resid 0.03756977
## Run 4 stress 0.09153455
## ... Procrustes: rmse 0.07478541  max resid 0.2932334
## Run 5 stress 0.09286007
## Run 6 stress 0.09232456
## Run 7 stress 0.09136051
## ... Procrustes: rmse 0.008188284  max resid 0.04296839
## Run 8 stress 0.09144034
## ... Procrustes: rmse 0.01309614  max resid 0.04143024
## Run 9 stress 0.09153699
## ... Procrustes: rmse 0.07388669  max resid 0.2479932
## Run 10 stress 0.09146133
## ... Procrustes: rmse 0.0111342  max resid 0.03757625
## Run 11 stress 0.09156907
## ... Procrustes: rmse 0.07207834  max resid 0.2466551
## Run 12 stress 0.09153738
## ... Procrustes: rmse 0.07471219  max resid 0.2924462
## Run 13 stress 0.09259774
## Run 14 stress 0.0912274
## ... New best solution
```

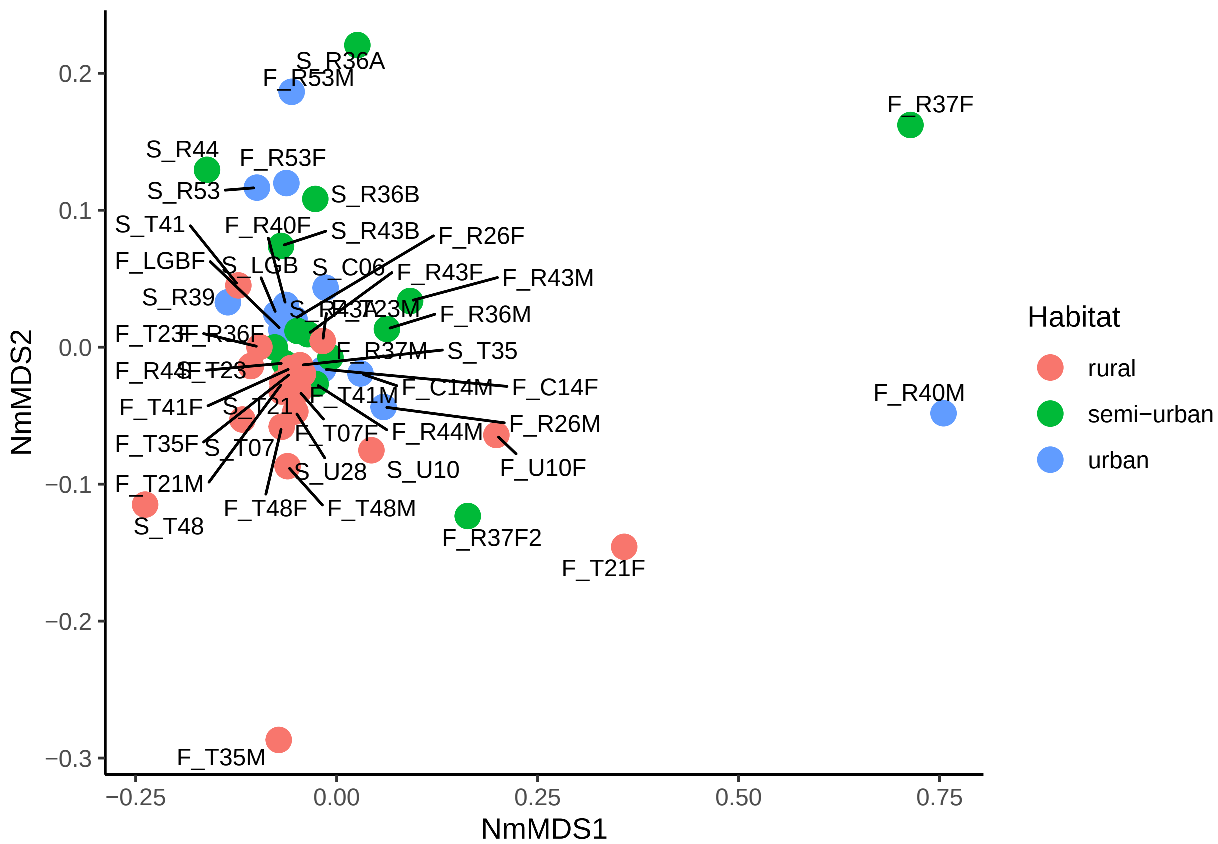
```
## ... Procrustes: rmse 0.04241141  max resid 0.217022
## Run 15 stress 0.09207628
## Run 16 stress 0.09141341
## ... Procrustes: rmse 0.0492705  max resid 0.2708075
## Run 17 stress 0.09139193
## ... Procrustes: rmse 0.01286238  max resid 0.04415484
## Run 18 stress 0.09154329
## ... Procrustes: rmse 0.07065849  max resid 0.200364
## Run 19 stress 0.09143477
## ... Procrustes: rmse 0.03918135  max resid 0.2120507
## Run 20 stress 0.09232137
## *** Best solution was not repeated -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      7: stress ratio > sratmax
```

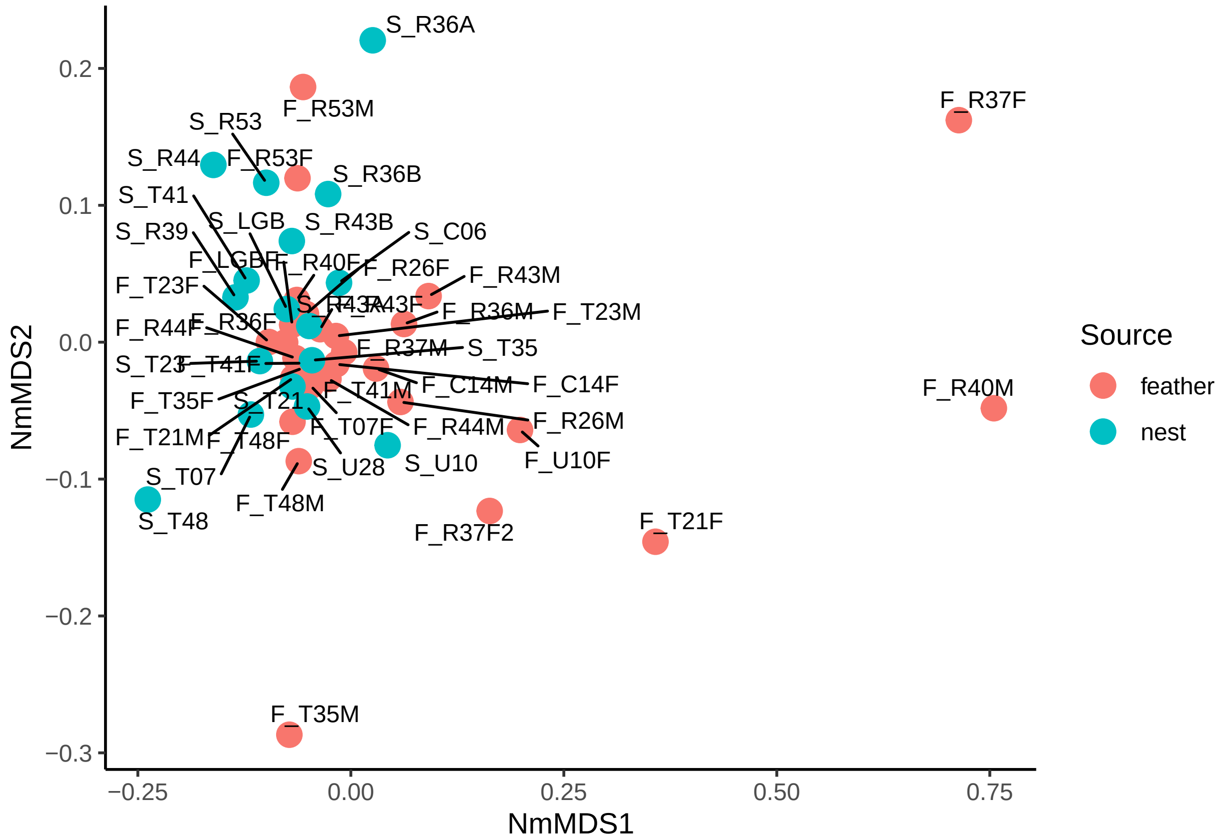



```
## Run 0 stress 0.144726
## Run 1 stress 0.1445095
## ... New best solution
## ... Procrustes: rmse 0.009193746  max resid 0.03837663
## Run 2 stress 0.1510107
## Run 3 stress 0.1495821
## Run 4 stress 0.1525813
## Run 5 stress 0.1422544
## ... New best solution
## ... Procrustes: rmse 0.05631306  max resid 0.2511122
## Run 6 stress 0.1500818
```

```
## Run 7 stress 0.1528695
## Run 8 stress 0.1498838
## Run 9 stress 0.1426996
## ... Procrustes: rmse 0.02550536  max resid 0.08581559
## Run 10 stress 0.1432273
## Run 11 stress 0.1436977
## Run 12 stress 0.1493972
## Run 13 stress 0.1504702
## Run 14 stress 0.1422032
## ... New best solution
## ... Procrustes: rmse 0.01652968  max resid 0.08524706
## Run 15 stress 0.1490077
## Run 16 stress 0.1497851
## Run 17 stress 0.143171
## Run 18 stress 0.1557573
## Run 19 stress 0.1446137
## Run 20 stress 0.1456896
## *** Best solution was not repeated -- monoMDS stopping criteria:
##      1: no. of iterations >= maxit
##     19: stress ratio > sratmax
```




NmMDS2
NmMDS1
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.25
0.00
0.25
0.50
0.75
Habitat
rural
semi−urban
urban
S_R36A
F_R53M
F_R37F
S_R44
F_R53F
S_R53
S_R36B
S_T41
F_R40F
S_R43B
F_R26F
F_LGBF
S_LGB
S_C06
F_R43F
F_R43M
S_R39
F_R36M
F_R37M
S_T35
F_C14M
F_C14F
F_R40M
F_T41F
S_T21
F_T41M
F_R26M
F_T35F
S_T07
F_T07F
F_R44M
F_T21M
S_U28
S_U10
F_U10F
S_T48
F_T48F
F_T48M
F_R37F2
F_T21F
F_T35M



The Shepard plot suggests that both the linear and non-metric fits are excellent fits, and indicates that the lower-dimensional representation of the data is capturing almost all of the dissimilarity structure in the original high-dimensional data. The higher R-squared value in the Non-Metric Fit suggests that the NMDS solution is a slightly better model, strictly considering R-squared.

From these scatter plots, the composition of the microbial communities appear to be related more to source, rather than habitat.

6. Statistical Inference - Estimation (if applicable)

Point Estimation

- Compute a single value that estimates the parameter of interest.

Interval Estimation

- Compute a confidence interval that contains the parameter with a specific level of confidence.

7. Model Validation

Assumptions Checking

- Check whether the assumptions of the chosen model are met.

Goodness-of-fit

- Evaluate how well the model fits the data.

Residual Analysis

- Analyze residuals to understand the variance unexplained by the model.

Cross-Validation

- Use techniques like k-fold cross-validation to ensure model stability and to prevent overfitting.

8. Interpretation

Prediction

- How will predictions be generated, validated, and used?

Results Interpretation

- Interpret the results in the context of the problem.

Limitations

- Discuss any limitations or assumptions in the analysis.

9. Communcation

Report Writing

- Write a clear and concise report or paper that details the analysis.

Visualization Tools

- Depending on the audience, create interactive dashboards or other visualization tools to make results accessible and understandable.

Presentation

- Present the findings to stakeholders or peers.

10. Ethical Considerations

- Always ensure that the data and methods used adhere to ethical standards, especially if the data contains personal information. Consider privacy, consent, potential biases in the data, and the implications of your analysis and predictions.

References

1. www.tru.ca, Thompson Rivers University. "BIOL 4001: Biostatistics." *Thompson Rivers University*, http://www.tru.ca/distance/courses/biol4001.html. Accessed 20 Aug. 2023.

2. *Introduction to R*. https://www.zoology.ubc.ca/~bio501/R/workshops/workshops-intro.html. Accessed 20 Aug. 2023.

3. *Resources for The Analysis of Biological Data*. https://whitlockschluter3e.zoology.ubc.ca/index.html. Accessed 20 Aug. 2023.