Ordination

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```
cereal <-read.csv("http://reuningscherer.net/stat660/data/cereal.attitudes.csv")
```

```
library(vegan)
```

```
## Loading required package: permute
```

```
## Loading required package: lattice
```

```
## This is vegan 2.5-6
```

```
library(vegan3d)
library(mgcv)
```

```
## Loading required package: nlme
```

```
## This is mgcv 1.8-31. For overview type 'help("mgcv-package")'.
```

```
library(MASS)
library(rgl)
```

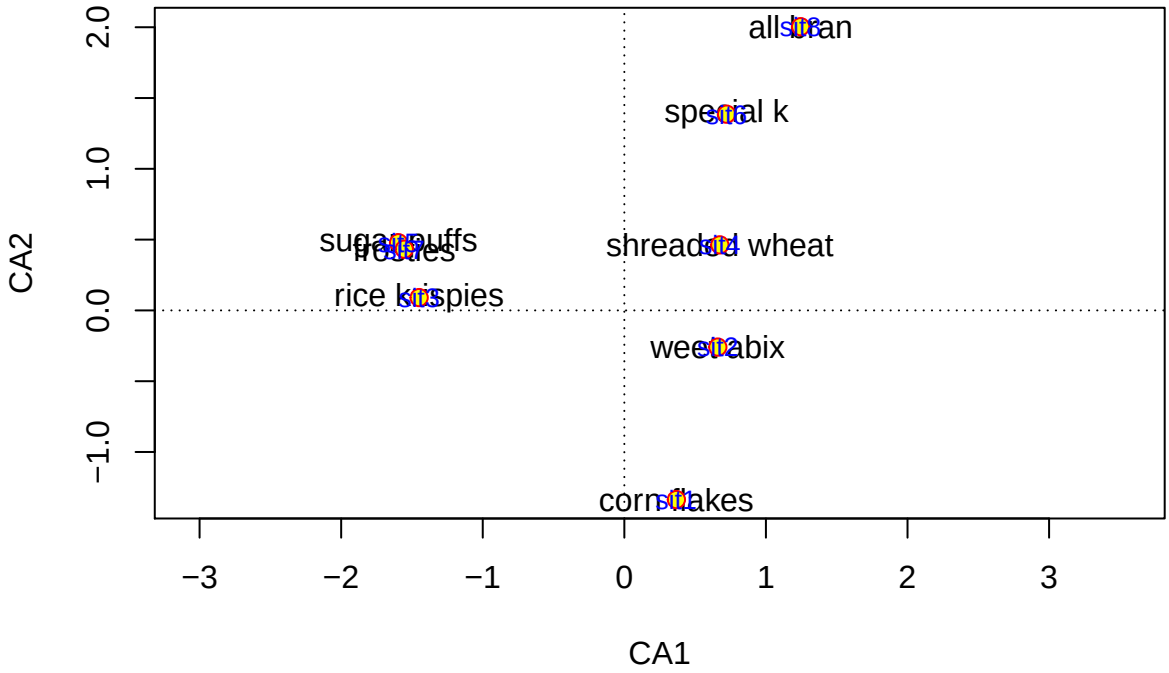
1) Fit correspondence analysis to your data

```
#Perform correspondence analysis
cerealcca <- cca(cereal[,2:12])
cerealcca
```

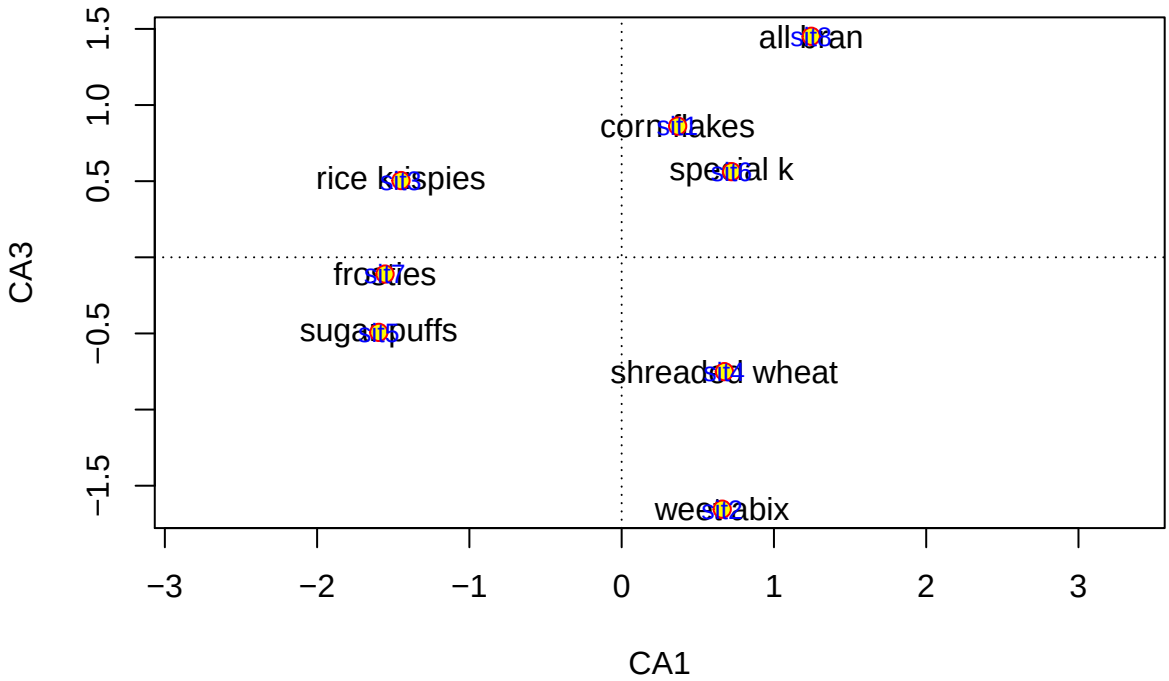
```
## Call: cca(X = cereal[, 2:12])
##
##               Inertia Rank
## Total          0.2697
## Unconstrained  0.2697    7
## Inertia is scaled Chi-square
##
## Eigenvalues for unconstrained axes:
##     CA1     CA2     CA3     CA4     CA5     CA6     CA7
## 0.17191 0.07409 0.01349 0.00919 0.00085 0.00016 0.00005
```

2)

```
#plot results
plot(cerealcca, type="n" ,xlim=c(-2,2.5))
text(cerealcca, dis="wa",labels=cereal[,1])
points(cerealcca, pch=21, col="red", bg="yellow", cex=1.2)
text(cerealcca, "sites", col="blue", cex=0.8)
```




```
plot(cerealcca, type="n" ,xlim=c(-2,2.5),choices = c(1,3))
text(cerealcca, dis="wa",labels=cereal[,1], choices = c(1,3))
points(cerealcca, pch=21, col="red", bg="yellow", cex=1.2, choices = c(1,3))
text(cerealcca, "sites", col="blue", cex=0.8, choices = c(1,3))
```



Looking at the inertia for each of the components, it appears that the first two dimensions contain most of the information of the data set - approximately 89%.

3) There seems to be some evidence of "data snaking" in higher dimensional space since the points on the plot. The distribution of the observations suggests there could possibly be data snaking. Looking at the 1st and 3rd component analysis, this pattern reemerges.

4) Cereals like all bran, special k, and Shreaded wheat seem to grouped together which could be because

they are healthier cereals. Cereals such as sugar puffs and rece crispies are grouped together which could be because they are sweeter, more kid-friendly cereals.

5)

```
cereal1 <- cereal[,2:12]

cereal.mds1 <- metaMDS(cereal1, distance="euclidean", k=1)
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.05701671
## Run 1 stress 0.05701671
## ... New best solution
## ... Procrustes: rmse 7.09724e-07  max resid 1.272995e-06
## ... Similar to previous best
## Run 2 stress 0.05701671
## ... New best solution
## ... Procrustes: rmse 4.584378e-07  max resid 8.513091e-07
## ... Similar to previous best
## Run 3 stress 0.4936134
## Run 4 stress 0.4599237
## Run 5 stress 0.488449
## Run 6 stress 0.4981386
## Run 7 stress 0.4014227
## Run 8 stress 0.05701671
## ... New best solution
## ... Procrustes: rmse 3.394719e-07  max resid 5.761547e-07
## ... Similar to previous best
## Run 9 stress 0.4981635
## Run 10 stress 0.4472136
## Run 11 stress 0.4144123
## Run 12 stress 0.4988333
## Run 13 stress 0.4991533
## Run 14 stress 0.4599468
## Run 15 stress 0.480213
## Run 16 stress 0.4677165
## Run 17 stress 0.2402196
## Run 18 stress 0.2371828
## Run 19 stress 0.4980483
## Run 20 stress 0.5
## *** Solution reached
```

```
cereal.mds2 <- metaMDS(cereal1, distance="euclidean", k=2)
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.0006858399
## Run 1 stress 0.0005435086
## ... New best solution
## ... Procrustes: rmse 0.03376177  max resid 0.0681304
## Run 2 stress 0.0001979065
## ... New best solution
## ... Procrustes: rmse 0.05193361  max resid 0.08972229
## Run 3 stress 0.0002420783
## ... Procrustes: rmse 0.01668221  max resid 0.02825989
```

```
## Run 4 stress 9.584511e-05
## ... New best solution
## ... Procrustes: rmse 0.0497622  max resid 0.1062925
## Run 5 stress 9.977128e-05
## ... Procrustes: rmse 0.02040533  max resid 0.03466957
## Run 6 stress 0.002387826
## Run 7 stress 0.0003063641
## ... Procrustes: rmse 0.09736172  max resid 0.1762502
## Run 8 stress 0.01585473
## Run 9 stress 0.01585502
## Run 10 stress 0.2854143
## Run 11 stress 0.2848613
## Run 12 stress 0.001095761
## Run 13 stress 9.960968e-05
## ... Procrustes: rmse 0.07331368  max resid 0.1373588
## Run 14 stress 0.0008322898
## Run 15 stress 0.001001183
## Run 16 stress 0.0158553
## Run 17 stress 0.001041205
## Run 18 stress 0.3074995
## Run 19 stress 9.635356e-05
## ... Procrustes: rmse 0.02298053  max resid 0.03947003
## Run 20 stress 0.01585467
## *** No convergence -- monoMDS stopping criteria:
##      9: no. of iterations >= maxit
##      4: stress < smin
##      7: stress ratio > sratmax
```

```
## Warning in metaMDS(cereal1, distance = "euclidean", k = 2): stress is (nearly)
## zero: you may have insufficient data
```

```
cereal.mds3 <- metaMDS(cereal1, distance="euclidean", k=3)
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 9.97713e-05
## Run 1 stress 9.667946e-05
## ... New best solution
## ... Procrustes: rmse 0.1345382  max resid 0.1995953
## Run 2 stress 0.0001475438
## ... Procrustes: rmse 0.1919881  max resid 0.375003
## Run 3 stress 0.00301659
## Run 4 stress 0.0001436197
## ... Procrustes: rmse 0.1994342  max resid 0.3745711
## Run 5 stress 9.577313e-05
## ... New best solution
## ... Procrustes: rmse 0.1266274  max resid 0.2528075
## Run 6 stress 9.977928e-05
## ... Procrustes: rmse 0.1276899  max resid 0.2577602
## Run 7 stress 0.0009487861
## Run 8 stress 9.996988e-05
## ... Procrustes: rmse 0.189653  max resid 0.3422654
## Run 9 stress 0.1823216
## Run 10 stress 9.784694e-05
## ... Procrustes: rmse 0.1134396  max resid 0.1913511
```

```
## Run 11 stress 0.001123287
## Run 12 stress 0.0002320336
## ... Procrustes: rmse 0.1173907  max resid 0.1816568
## Run 13 stress 0.001565394
## Run 14 stress 9.891685e-05
## ... Procrustes: rmse 0.1497661  max resid 0.2247068
## Run 15 stress 0.0007614261
## Run 16 stress 9.649991e-05
## ... Procrustes: rmse 0.1601815  max resid 0.3156881
## Run 17 stress 9.547735e-05
## ... New best solution
## ... Procrustes: rmse 0.1959405  max resid 0.371068
## Run 18 stress 0.0001530494
## ... Procrustes: rmse 0.1560469  max resid 0.2443883
## Run 19 stress 0.0001973507
## ... Procrustes: rmse 0.1717202  max resid 0.290463
## Run 20 stress 0.001436985
## *** No convergence -- monoMDS stopping criteria:
##     11: no. of iterations >= maxit
##      8: stress < smin
##      1: stress ratio > sratmax
```

```
## Warning in metaMDS(cereal1, distance = "euclidean", k = 3): stress is (nearly)
## zero: you may have insufficient data
```

6)

```
results <- matrix(NA,21,3)
#j is number of dimensions to try
for (j in 1:3){
  for (i in 1:20){
    temp <- cereal1[shuffle(nrow(cereal1)),1]
    for (k in 1:11) { temp <- cbind(temp,cereal1[shuffle(nrow(cereal1)),k]) }
    #store stress
    results[i,j] <- metaMDS(temp, k=j, distance="euclidean")$stress
  }
  results[21,j] <- metaMDS(cereal1[,1:11], k=j, distance="euclidean")$stress
}
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2553431
## Run 1 stress 0.4984588
## Run 2 stress 0.1915681
## ... New best solution
## ... Procrustes: rmse 0.3199766  max resid 0.4657809
## Run 3 stress 0.5
## Run 4 stress 0.4984588
## Run 5 stress 0.4705168
## Run 6 stress 0.3572108
## Run 7 stress 0.4424991
## Run 8 stress 0.2926008
## Run 9 stress 0.432498
## Run 10 stress 0.4976901
## Run 11 stress 0.2474582
## Run 12 stress 0.1915681
```

```
## ... Procrustes: rmse 2.764758e-07  max resid 4.543741e-07
## ... Similar to previous best
## Run 13 stress 0.4869873
## Run 14 stress 0.494072
## Run 15 stress 0.2805142
## Run 16 stress 0.3031023
## Run 17 stress 0.1915681
## ... New best solution
## ... Procrustes: rmse 2.450777e-07  max resid 5.173024e-07
## ... Similar to previous best
## Run 18 stress 0.5
## Run 19 stress 0.1915681
## ... New best solution
## ... Procrustes: rmse 1.412666e-07  max resid 2.891859e-07
## ... Similar to previous best
## Run 20 stress 0.2659682
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2510321
## Run 1 stress 0.4643151
## Run 2 stress 0.2536054
## Run 3 stress 0.317934
## Run 4 stress 0.4924515
## Run 5 stress 0.2536054
## Run 6 stress 0.3934356
## Run 7 stress 0.4588347
## Run 8 stress 0.4979696
## Run 9 stress 0.495631
## Run 10 stress 0.4976767
## Run 11 stress 0.4058786
## Run 12 stress 0.2566996
## Run 13 stress 0.4572469
## Run 14 stress 0.4437384
## Run 15 stress 0.3900426
## Run 16 stress 0.3942034
## Run 17 stress 0.3714077
## Run 18 stress 0.4924515
## Run 19 stress 0.4971236
## Run 20 stress 0.4957053
## *** No convergence -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2739995
## Run 1 stress 0.5
## Run 2 stress 0.3099539
## Run 3 stress 0.446677
## Run 4 stress 0.2575177
## ... New best solution
## ... Procrustes: rmse 0.1515475  max resid 0.3159687
## Run 5 stress 0.4277119
## Run 6 stress 0.4690832
```

```
## Run 7 stress 0.2766449
## Run 8 stress 0.3656663
## Run 9 stress 0.4811252
## Run 10 stress 0.3379218
## Run 11 stress 0.2627255
## Run 12 stress 0.3475401
## Run 13 stress 0.339447
## Run 14 stress 0.4589619
## Run 15 stress 0.3392379
## Run 16 stress 0.2739995
## Run 17 stress 0.4930511
## Run 18 stress 0.2786409
## Run 19 stress 0.4991384
## Run 20 stress 0.453116
## *** No convergence -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2302247
## Run 1 stress 0.3761241
## Run 2 stress 0.4187927
## Run 3 stress 0.498962
## Run 4 stress 0.2379829
## Run 5 stress 0.2324764
## Run 6 stress 0.4912237
## Run 7 stress 0.4811252
## Run 8 stress 0.4224119
## Run 9 stress 0.5
## Run 10 stress 0.441324
## Run 11 stress 0.4556667
## Run 12 stress 0.4655814
## Run 13 stress 0.4865153
## Run 14 stress 0.354116
## Run 15 stress 0.4725441
## Run 16 stress 0.4768817
## Run 17 stress 0.3137735
## Run 18 stress 0.3429068
## Run 19 stress 0.4739998
## Run 20 stress 0.4968948
## *** No convergence -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.3329217
## Run 1 stress 0.4801458
## Run 2 stress 0.4104709
## Run 3 stress 0.4409711
## Run 4 stress 0.3328461
## ... New best solution
## ... Procrustes: rmse 0.2526483  max resid 0.4909134
## Run 5 stress 0.3037115
## ... New best solution
```

```
## ... Procrustes: rmse 0.1598962  max resid 0.31737
## Run 6 stress 0.3952101
## Run 7 stress 0.3574979
## Run 8 stress 0.4142333
## Run 9 stress 0.4077672
## Run 10 stress 0.5
## Run 11 stress 0.4419152
## Run 12 stress 0.4792007
## Run 13 stress 0.4670995
## Run 14 stress 0.4855686
## Run 15 stress 0.4811252
## Run 16 stress 0.4890987
## Run 17 stress 0.3183592
## Run 18 stress 0.4818079
## Run 19 stress 0.4882089
## Run 20 stress 0.4728894
## *** No convergence -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2170437
## Run 1 stress 0.4744315
## Run 2 stress 0.2170437
## ... Procrustes: rmse 7.704419e-07  max resid 1.438887e-06
## ... Similar to previous best
## Run 3 stress 0.4488444
## Run 4 stress 0.3992661
## Run 5 stress 0.4460291
## Run 6 stress 0.4884685
## Run 7 stress 0.369583
## Run 8 stress 0.4797153
## Run 9 stress 0.4835343
## Run 10 stress 0.4782302
## Run 11 stress 0.4284655
## Run 12 stress 0.2366964
## Run 13 stress 0.3967755
## Run 14 stress 0.2484507
## Run 15 stress 0.4811252
## Run 16 stress 0.4349729
## Run 17 stress 0.2205307
## Run 18 stress 0.4813568
## Run 19 stress 0.4716287
## Run 20 stress 0.3884833
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2519988
## Run 1 stress 0.3916149
## Run 2 stress 0.2575386
## Run 3 stress 0.4568167
## Run 4 stress 0.5
## Run 5 stress 0.3200543
## Run 6 stress 0.3930918
```

```
## Run 7 stress 0.4993753
## Run 8 stress 0.4815707
## Run 9 stress 0.4646619
## Run 10 stress 0.489846
## Run 11 stress 0.4843733
## Run 12 stress 0.4692546
## Run 13 stress 0.4800611
## Run 14 stress 0.4868365
## Run 15 stress 0.2900142
## Run 16 stress 0.469634
## Run 17 stress 0.4879861
## Run 18 stress 0.4691794
## Run 19 stress 0.4870565
## Run 20 stress 0.3101563
## *** No convergence -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2096503
## Run 1 stress 0.48927
## Run 2 stress 0.4953912
## Run 3 stress 0.5
## Run 4 stress 0.4703432
## Run 5 stress 0.3358429
## Run 6 stress 0.3500769
## Run 7 stress 0.4971699
## Run 8 stress 0.2146167
## Run 9 stress 0.2801075
## Run 10 stress 0.4782088
## Run 11 stress 0.2132799
## Run 12 stress 0.493003
## Run 13 stress 0.4815855
## Run 14 stress 0.2452771
## Run 15 stress 0.4982652
## Run 16 stress 0.2109153
## Run 17 stress 0.2054462
## ... New best solution
## ... Procrustes: rmse 0.1024854  max resid 0.203874
## Run 18 stress 0.2109153
## Run 19 stress 0.3499383
## Run 20 stress 0.3569402
## *** No convergence -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.3466081
## Run 1 stress 0.4817307
## Run 2 stress 0.3919776
## Run 3 stress 0.3934156
## Run 4 stress 0.4250214
## Run 5 stress 0.3662567
## Run 6 stress 0.3286876
## ... New best solution
```

```
## ... Procrustes: rmse 0.3034122  max resid 0.6183757
## Run 7 stress 0.3859646
## Run 8 stress 0.4231751
## Run 9 stress 0.4300044
## Run 10 stress 0.4912156
## Run 11 stress 0.4659743
## Run 12 stress 0.4947562
## Run 13 stress 0.5
## Run 14 stress 0.4961342
## Run 15 stress 0.4124038
## Run 16 stress 0.3792153
## Run 17 stress 0.3521017
## Run 18 stress 0.3462762
## Run 19 stress 0.4320468
## Run 20 stress 0.3718745
## *** No convergence -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2635049
## Run 1 stress 0.3888168
## Run 2 stress 0.5
## Run 3 stress 0.4417737
## Run 4 stress 0.4702831
## Run 5 stress 0.48927
## Run 6 stress 0.2639429
## ... Procrustes: rmse 0.05841969  max resid 0.1227849
## Run 7 stress 0.4303258
## Run 8 stress 0.4582583
## Run 9 stress 0.2801821
## Run 10 stress 0.4699492
## Run 11 stress 0.3005847
## Run 12 stress 0.492996
## Run 13 stress 0.4676521
## Run 14 stress 0.4953912
## Run 15 stress 0.3793502
## Run 16 stress 0.469559
## Run 17 stress 0.4994268
## Run 18 stress 0.4714436
## Run 19 stress 0.2820817
## Run 20 stress 0.280002
## *** No convergence -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.3716279
## Run 1 stress 0.4217282
## Run 2 stress 0.4792132
## Run 3 stress 0.4599331
## Run 4 stress 0.4711539
## Run 5 stress 0.4378506
## Run 6 stress 0.2799825
```

```
## ... New best solution
## ... Procrustes: rmse 0.2454378  max resid 0.4692502
## Run 7 stress 0.4417024
## Run 8 stress 0.491715
## Run 9 stress 0.4902206
## Run 10 stress 0.476942
## Run 11 stress 0.462106
## Run 12 stress 0.2642553
## ... New best solution
## ... Procrustes: rmse 0.3358685  max resid 0.6742869
## Run 13 stress 0.321301
## Run 14 stress 0.4035072
## Run 15 stress 0.4882468
## Run 16 stress 0.3144442
## Run 17 stress 0.321301
## Run 18 stress 0.3657594
## Run 19 stress 0.4425348
## Run 20 stress 0.3144129
## *** No convergence -- monoMDS stopping criteria:
##      2: stress ratio > sratmax
##     18: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2731919
## Run 1 stress 0.2819506
## Run 2 stress 0.4391036
## Run 3 stress 0.4098059
## Run 4 stress 0.482352
## Run 5 stress 0.4246009
## Run 6 stress 0.3826277
## Run 7 stress 0.3628751
## Run 8 stress 0.4811252
## Run 9 stress 0.2539515
## ... New best solution
## ... Procrustes: rmse 0.1136501  max resid 0.2398666
## Run 10 stress 0.5
## Run 11 stress 0.3210807
## Run 12 stress 0.2500759
## ... New best solution
## ... Procrustes: rmse 0.07778183  max resid 0.1557904
## Run 13 stress 0.2813502
## Run 14 stress 0.4953912
## Run 15 stress 0.3496252
## Run 16 stress 0.5
## Run 17 stress 0.2697739
## Run 18 stress 0.2956195
## Run 19 stress 0.4288391
## Run 20 stress 0.321415
## *** No convergence -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.25413
```

```
## Run 1 stress 0.3185958
## Run 2 stress 0.25413
## ... New best solution
## ... Procrustes: rmse 3.666337e-07  max resid 6.43109e-07
## ... Similar to previous best
## Run 3 stress 0.4141972
## Run 4 stress 0.4177615
## Run 5 stress 0.3870215
## Run 6 stress 0.4968903
## Run 7 stress 0.4902777
## Run 8 stress 0.2173666
## ... New best solution
## ... Procrustes: rmse 0.3143219  max resid 0.6476739
## Run 9 stress 0.3702073
## Run 10 stress 0.5
## Run 11 stress 0.2173666
## ... Procrustes: rmse 2.631015e-07  max resid 4.867558e-07
## ... Similar to previous best
## Run 12 stress 0.4559001
## Run 13 stress 0.2173666
## ... New best solution
## ... Procrustes: rmse 2.26723e-07  max resid 3.642679e-07
## ... Similar to previous best
## Run 14 stress 0.3616106
## Run 15 stress 0.31487
## Run 16 stress 0.4561859
## Run 17 stress 0.4846757
## Run 18 stress 0.2173666
## ... Procrustes: rmse 2.981629e-07  max resid 4.955191e-07
## ... Similar to previous best
## Run 19 stress 0.47341
## Run 20 stress 0.4720015
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2726166
## Run 1 stress 0.286126
## Run 2 stress 0.4993265
## Run 3 stress 0.2618909
## ... New best solution
## ... Procrustes: rmse 0.04693111  max resid 0.09287451
## Run 4 stress 0.3301176
## Run 5 stress 0.3819421
## Run 6 stress 0.4657858
## Run 7 stress 0.3996453
## Run 8 stress 0.4336231
## Run 9 stress 0.4443613
## Run 10 stress 0.4964676
## Run 11 stress 0.4034433
## Run 12 stress 0.4930786
## Run 13 stress 0.4202646
## Run 14 stress 0.4314539
## Run 15 stress 0.4865851
## Run 16 stress 0.4529065
```

```
## Run 17 stress 0.286126
## Run 18 stress 0.3787252
## Run 19 stress 0.4695992
## Run 20 stress 0.2618909
## ... New best solution
## ... Procrustes: rmse 6.813922e-07  max resid 1.352563e-06
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2391174
## Run 1 stress 0.4911362
## Run 2 stress 0.4495021
## Run 3 stress 0.4418419
## Run 4 stress 0.4891786
## Run 5 stress 0.4417019
## Run 6 stress 0.4393011
## Run 7 stress 0.4541181
## Run 8 stress 0.2770519
## Run 9 stress 0.4267624
## Run 10 stress 0.4463692
## Run 11 stress 0.4602641
## Run 12 stress 0.4511294
## Run 13 stress 0.4862096
## Run 14 stress 0.4953912
## Run 15 stress 0.3775771
## Run 16 stress 0.2391174
## ... New best solution
## ... Procrustes: rmse 3.91705e-07  max resid 5.842944e-07
## ... Similar to previous best
## Run 17 stress 0.3987039
## Run 18 stress 0.4957053
## Run 19 stress 0.4835343
## Run 20 stress 0.4835343
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2971177
## Run 1 stress 0.4221837
## Run 2 stress 0.4936475
## Run 3 stress 0.3299772
## Run 4 stress 0.5
## Run 5 stress 0.4555619
## Run 6 stress 0.4514582
## Run 7 stress 0.4762768
## Run 8 stress 0.3629093
## Run 9 stress 0.4599331
## Run 10 stress 0.415159
## Run 11 stress 0.4300308
## Run 12 stress 0.4941035
## Run 13 stress 0.4811252
## Run 14 stress 0.4696789
## Run 15 stress 0.3149334
## Run 16 stress 0.5
```

```
## Run 17 stress 0.3292481
## Run 18 stress 0.2656367
## ... New best solution
## ... Procrustes: rmse 0.1145216  max resid 0.2254338
## Run 19 stress 0.2663968
## Run 20 stress 0.4813594
## *** No convergence -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.3420071
## Run 1 stress 0.2869472
## ... New best solution
## ... Procrustes: rmse 0.2807383  max resid 0.6013749
## Run 2 stress 0.4537778
## Run 3 stress 0.3221534
## Run 4 stress 0.4450821
## Run 5 stress 0.3882408
## Run 6 stress 0.2945152
## Run 7 stress 0.305811
## Run 8 stress 0.4874607
## Run 9 stress 0.2896488
## Run 10 stress 0.4756004
## Run 11 stress 0.4954539
## Run 12 stress 0.3828578
## Run 13 stress 0.2884026
## Run 14 stress 0.2820545
## ... New best solution
## ... Procrustes: rmse 0.05806328  max resid 0.1138196
## Run 15 stress 0.4596362
## Run 16 stress 0.4254522
## Run 17 stress 0.3590247
## Run 18 stress 0.3800309
## Run 19 stress 0.3252376
## Run 20 stress 0.3828578
## *** No convergence -- monoMDS stopping criteria:
##     20: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2566755
## Run 1 stress 0.3188107
## Run 2 stress 0.2574454
## Run 3 stress 0.2566755
## ... Procrustes: rmse 2.188747e-07  max resid 3.951003e-07
## ... Similar to previous best
## Run 4 stress 0.2566755
## ... Procrustes: rmse 1.697359e-07  max resid 2.954625e-07
## ... Similar to previous best
## Run 5 stress 0.5
## Run 6 stress 0.4954739
## Run 7 stress 0.4771252
## Run 8 stress 0.4123491
## Run 9 stress 0.5
```

```
## Run 10 stress 0.4867503
## Run 11 stress 0.2601754
## Run 12 stress 0.3699956
## Run 13 stress 0.3742071
## Run 14 stress 0.301427
## Run 15 stress 0.2836467
## Run 16 stress 0.3497702
## Run 17 stress 0.5
## Run 18 stress 0.4557357
## Run 19 stress 0.2628689
## Run 20 stress 0.3941967
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2136288
## Run 1 stress 0.4822599
## Run 2 stress 0.4076944
## Run 3 stress 0.2136288
## ... New best solution
## ... Procrustes: rmse 5.894676e-07  max resid 1.267865e-06
## ... Similar to previous best
## Run 4 stress 0.4735997
## Run 5 stress 0.2176481
## Run 6 stress 0.4734577
## Run 7 stress 0.4802165
## Run 8 stress 0.212894
## ... New best solution
## ... Procrustes: rmse 0.04097499  max resid 0.08934803
## Run 9 stress 0.4953912
## Run 10 stress 0.3076666
## Run 11 stress 0.2203482
## Run 12 stress 0.4811241
## Run 13 stress 0.4161031
## Run 14 stress 0.3270673
## Run 15 stress 0.4794686
## Run 16 stress 0.4889081
## Run 17 stress 0.4811252
## Run 18 stress 0.4685608
## Run 19 stress 0.464053
## Run 20 stress 0.4811252
## *** No convergence -- monoMDS stopping criteria:
##      1: stress ratio > sratmax
##     19: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.2799048
## Run 1 stress 0.44879
## Run 2 stress 0.4333822
## Run 3 stress 0.3957687
## Run 4 stress 0.3883985
## Run 5 stress 0.2918412
## Run 6 stress 0.5
## Run 7 stress 0.2563897
## ... New best solution
```

```
## ... Procrustes: rmse 0.07296161  max resid 0.1470601
## Run 8 stress 0.4718028
## Run 9 stress 0.342801
## Run 10 stress 0.4793868
## Run 11 stress 0.2836804
## Run 12 stress 0.2721156
## Run 13 stress 0.4651713
## Run 14 stress 0.3799928
## Run 15 stress 0.3721069
## Run 16 stress 0.4942973
## Run 17 stress 0.2847281
## Run 18 stress 0.5
## Run 19 stress 0.5
## Run 20 stress 0.394729
## *** No convergence -- monoMDS stopping criteria:
##      3: stress ratio > sratmax
##     17: scale factor of the gradient < sfgrmin
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.05701671
## Run 1 stress 0.4953912
## Run 2 stress 0.4640081
## Run 3 stress 0.4992191
## Run 4 stress 0.4780826
## Run 5 stress 0.4953816
## Run 6 stress 0.3747172
## Run 7 stress 0.4971699
## Run 8 stress 0.4802466
## Run 9 stress 0.05701671
## ... New best solution
## ... Procrustes: rmse 1.068334e-06  max resid 2.010912e-06
## ... Similar to previous best
## Run 10 stress 0.4014227
## Run 11 stress 0.482531
## Run 12 stress 0.4217477
## Run 13 stress 0.3715927
## Run 14 stress 0.4799288
## Run 15 stress 0.44277
## Run 16 stress 0.05701671
## ... New best solution
## ... Procrustes: rmse 9.727645e-07  max resid 1.640437e-06
## ... Similar to previous best
## Run 17 stress 0.05701671
## ... Procrustes: rmse 1.069437e-06  max resid 1.786475e-06
## ... Similar to previous best
## Run 18 stress 0.4811252
## Run 19 stress 0.4014227
## Run 20 stress 0.4869803
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.05271487
## Run 1 stress 0.05271494
## ... Procrustes: rmse 3.45544e-05  max resid 6.787345e-05
```

```
## ... Similar to previous best
## Run 2 stress 0.1332641
## Run 3 stress 0.1396195
## Run 4 stress 0.0527148
## ... New best solution
## ... Procrustes: rmse 7.491417e-05  max resid 0.0001479529
## ... Similar to previous best
## Run 5 stress 0.0527148
## ... Procrustes: rmse 1.55253e-06  max resid 2.371337e-06
## ... Similar to previous best
## Run 6 stress 0.1209158
## Run 7 stress 0.1396195
## Run 8 stress 0.05271479
## ... New best solution
## ... Procrustes: rmse 3.752325e-05  max resid 5.426306e-05
## ... Similar to previous best
## Run 9 stress 0.1209159
## Run 10 stress 0.05271486
## ... Procrustes: rmse 0.0003011742  max resid 0.0005957862
## ... Similar to previous best
## Run 11 stress 0.2187665
## Run 12 stress 0.05271475
## ... New best solution
## ... Procrustes: rmse 6.988357e-05  max resid 0.000138342
## ... Similar to previous best
## Run 13 stress 0.05271474
## ... New best solution
## ... Procrustes: rmse 4.965022e-05  max resid 9.839478e-05
## ... Similar to previous best
## Run 14 stress 0.1055274
## Run 15 stress 0.05271474
## ... New best solution
## ... Procrustes: rmse 1.267008e-05  max resid 2.120837e-05
## ... Similar to previous best
## Run 16 stress 0.05271474
## ... Procrustes: rmse 6.229331e-06  max resid 9.977081e-06
## ... Similar to previous best
## Run 17 stress 0.05271481
## ... Procrustes: rmse 3.872188e-05  max resid 7.28191e-05
## ... Similar to previous best
## Run 18 stress 0.05271484
## ... Procrustes: rmse 0.0001549692  max resid 0.0003065083
## ... Similar to previous best
## Run 19 stress 0.05271474
## ... New best solution
## ... Procrustes: rmse 9.532988e-06  max resid 1.889391e-05
## ... Similar to previous best
## Run 20 stress 0.05271474
## ... Procrustes: rmse 2.742326e-05  max resid 5.447536e-05
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.05087131
```

```
## Run 1 stress 0.05087142
## ... Procrustes: rmse 0.0001659853  max resid 0.0002592757
## ... Similar to previous best
## Run 2 stress 0.04992439
## ... New best solution
## ... Procrustes: rmse 0.1191195  max resid 0.2688907
## Run 3 stress 0.05087132
## Run 4 stress 0.05087143
## Run 5 stress 0.07821307
## Run 6 stress 0.07821323
## Run 7 stress 0.04992438
## ... New best solution
## ... Procrustes: rmse 0.000238696  max resid 0.000299552
## ... Similar to previous best
## Run 8 stress 0.05087153
## Run 9 stress 0.05087154
## Run 10 stress 0.0499246
## ... Procrustes: rmse 0.0002094414  max resid 0.0002978764
## ... Similar to previous best
## Run 11 stress 0.1569351
## Run 12 stress 0.04992444
## ... Procrustes: rmse 3.234923e-05  max resid 4.409432e-05
## ... Similar to previous best
## Run 13 stress 0.0508713
## Run 14 stress 0.05087148
## Run 15 stress 0.05087155
## Run 16 stress 0.05087141
## Run 17 stress 0.05087145
## Run 18 stress 0.05087173
## Run 19 stress 0.05087125
## Run 20 stress 0.05087148
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.06661023
## Run 1 stress 0.1000549
## Run 2 stress 0.1274977
## Run 3 stress 0.1000547
## Run 4 stress 0.06768982
## Run 5 stress 0.1548425
## Run 6 stress 0.1548424
## Run 7 stress 0.06769044
## Run 8 stress 0.11609
## Run 9 stress 0.1274988
## Run 10 stress 0.11609
## Run 11 stress 0.06661026
## ... Procrustes: rmse 9.825312e-05  max resid 0.0001989983
## ... Similar to previous best
## Run 12 stress 0.06661025
## ... Procrustes: rmse 7.91395e-05  max resid 0.0001484868
## ... Similar to previous best
## Run 13 stress 0.06661023
## ... Procrustes: rmse 7.141775e-06  max resid 1.235404e-05
## ... Similar to previous best
```

```
## Run 14 stress 0.173823
## Run 15 stress 0.1160901
## Run 16 stress 0.06661044
## ... Procrustes: rmse 0.0002469559  max resid 0.0005063978
## ... Similar to previous best
## Run 17 stress 0.06661028
## ... Procrustes: rmse 9.20465e-05  max resid 0.0001758758
## ... Similar to previous best
## Run 18 stress 0.11609
## Run 19 stress 0.06661037
## ... Procrustes: rmse 0.0002037572  max resid 0.0004218666
## ... Similar to previous best
## Run 20 stress 0.06661025
## ... Procrustes: rmse 3.344507e-05  max resid 5.412631e-05
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.047613
## Run 1 stress 0.2671135
## Run 2 stress 0.07826763
## Run 3 stress 0.06235078
## Run 4 stress 0.08431187
## Run 5 stress 0.06668008
## Run 6 stress 0.06668011
## Run 7 stress 0.08290535
## Run 8 stress 0.06668008
## Run 9 stress 0.04761298
## ... New best solution
## ... Procrustes: rmse 5.84657e-05  max resid 0.0001002312
## ... Similar to previous best
## Run 10 stress 0.07826766
## Run 11 stress 0.06938113
## Run 12 stress 0.04761293
## ... New best solution
## ... Procrustes: rmse 9.852384e-05  max resid 0.0001345271
## ... Similar to previous best
## Run 13 stress 0.0476131
## ... Procrustes: rmse 0.0001932882  max resid 0.0002505064
## ... Similar to previous best
## Run 14 stress 0.06668026
## Run 15 stress 0.06938221
## Run 16 stress 0.07067422
## Run 17 stress 0.06668008
## Run 18 stress 0.06235173
## Run 19 stress 0.04761299
## ... Procrustes: rmse 0.0001007292  max resid 0.0001348222
## ... Similar to previous best
## Run 20 stress 0.06235104
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.08077049
## Run 1 stress 0.2259251
```

```
## Run 2 stress 0.1190533
## Run 3 stress 0.08077049
## ... New best solution
## ... Procrustes: rmse 1.689675e-05  max resid 3.412693e-05
## ... Similar to previous best
## Run 4 stress 0.1174287
## Run 5 stress 0.1067111
## Run 6 stress 0.1190532
## Run 7 stress 0.2234477
## Run 8 stress 0.2714945
## Run 9 stress 0.08077049
## ... Procrustes: rmse 3.041512e-06  max resid 4.948862e-06
## ... Similar to previous best
## Run 10 stress 0.1067111
## Run 11 stress 0.08077052
## ... Procrustes: rmse 8.825599e-05  max resid 0.000187617
## ... Similar to previous best
## Run 12 stress 0.08077049
## ... New best solution
## ... Procrustes: rmse 3.674417e-06  max resid 6.742699e-06
## ... Similar to previous best
## Run 13 stress 0.119053
## Run 14 stress 0.1554143
## Run 15 stress 0.1190528
## Run 16 stress 0.2234477
## Run 17 stress 0.08077049
## ... New best solution
## ... Procrustes: rmse 1.673862e-06  max resid 3.81751e-06
## ... Similar to previous best
## Run 18 stress 0.08077049
## ... Procrustes: rmse 1.307894e-05  max resid 2.797369e-05
## ... Similar to previous best
## Run 19 stress 0.1554142
## Run 20 stress 0.1554142
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.04735383
## Run 1 stress 0.2848517
## Run 2 stress 0.04735383
## ... New best solution
## ... Procrustes: rmse 5.768309e-07  max resid 7.79055e-07
## ... Similar to previous best
## Run 3 stress 0.04735383
## ... New best solution
## ... Procrustes: rmse 4.487081e-07  max resid 6.966782e-07
## ... Similar to previous best
## Run 4 stress 0.04735383
## ... Procrustes: rmse 4.069814e-06  max resid 5.794678e-06
## ... Similar to previous best
## Run 5 stress 0.1516987
## Run 6 stress 0.1715198
## Run 7 stress 0.1455005
## Run 8 stress 0.04735383
```

```
## ... Procrustes: rmse 2.943993e-06  max resid 4.205933e-06
## ... Similar to previous best
## Run 9 stress 0.04735383
## ... Procrustes: rmse 1.885336e-06  max resid 2.632903e-06
## ... Similar to previous best
## Run 10 stress 0.04735383
## ... Procrustes: rmse 2.121748e-06  max resid 3.03539e-06
## ... Similar to previous best
## Run 11 stress 0.1747118
## Run 12 stress 0.04735383
## ... New best solution
## ... Procrustes: rmse 1.010385e-06  max resid 1.401198e-06
## ... Similar to previous best
## Run 13 stress 0.1516987
## Run 14 stress 0.04735383
## ... Procrustes: rmse 1.60842e-06  max resid 2.307202e-06
## ... Similar to previous best
## Run 15 stress 0.04735383
## ... Procrustes: rmse 6.633528e-07  max resid 9.363057e-07
## ... Similar to previous best
## Run 16 stress 0.04735383
## ... Procrustes: rmse 4.114239e-06  max resid 5.884984e-06
## ... Similar to previous best
## Run 17 stress 0.04735383
## ... New best solution
## ... Procrustes: rmse 2.575574e-07  max resid 4.094577e-07
## ... Similar to previous best
## Run 18 stress 0.1603497
## Run 19 stress 0.1603497
## Run 20 stress 0.1455005
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.08388941
## Run 1 stress 0.209175
## Run 2 stress 0.1102387
## Run 3 stress 0.08388982
## ... Procrustes: rmse 0.0002107487  max resid 0.0003908283
## ... Similar to previous best
## Run 4 stress 0.08388952
## ... Procrustes: rmse 7.119808e-05  max resid 9.955432e-05
## ... Similar to previous best
## Run 5 stress 0.1614605
## Run 6 stress 0.2237651
## Run 7 stress 0.1614605
## Run 8 stress 0.1102389
## Run 9 stress 0.1102389
## Run 10 stress 0.1102403
## Run 11 stress 0.1102386
## Run 12 stress 0.1102267
## Run 13 stress 0.2150313
## Run 14 stress 0.1554044
## Run 15 stress 0.08388906
## ... New best solution
```

```
## ... Procrustes: rmse 0.0005730575  max resid 0.001059812
## ... Similar to previous best
## Run 16 stress 0.08388995
## ... Procrustes: rmse 0.0008313249  max resid 0.001544022
## ... Similar to previous best
## Run 17 stress 0.08388908
## ... Procrustes: rmse 0.0002784351  max resid 0.0005185481
## ... Similar to previous best
## Run 18 stress 0.1614605
## Run 19 stress 0.2459808
## Run 20 stress 0.1742039
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.03456253
## Run 1 stress 0.03456221
## ... New best solution
## ... Procrustes: rmse 7.293463e-05  max resid 0.0001099003
## ... Similar to previous best
## Run 2 stress 0.1209084
## Run 3 stress 0.03456108
## ... New best solution
## ... Procrustes: rmse 0.0003468438  max resid 0.000527687
## ... Similar to previous best
## Run 4 stress 0.03456095
## ... New best solution
## ... Procrustes: rmse 0.002783735  max resid 0.004245
## ... Similar to previous best
## Run 5 stress 0.0747162
## Run 6 stress 0.1391207
## Run 7 stress 0.1268764
## Run 8 stress 0.07471549
## Run 9 stress 0.07471565
## Run 10 stress 0.03455996
## ... New best solution
## ... Procrustes: rmse 0.002335685  max resid 0.003551395
## ... Similar to previous best
## Run 11 stress 0.03455981
## ... New best solution
## ... Procrustes: rmse 7.422491e-05  max resid 0.0001105522
## ... Similar to previous best
## Run 12 stress 0.1209083
## Run 13 stress 0.03456107
## ... Procrustes: rmse 0.0005114897  max resid 0.000766761
## ... Similar to previous best
## Run 14 stress 0.03456189
## ... Procrustes: rmse 0.0007742088  max resid 0.001178443
## ... Similar to previous best
## Run 15 stress 0.1391207
## Run 16 stress 0.07471608
## Run 17 stress 0.1209114
## Run 18 stress 0.07471722
## Run 19 stress 0.03455937
## ... New best solution
```

```
## ... Procrustes: rmse 0.0002823017  max resid 0.0004284047
## ... Similar to previous best
## Run 20 stress 0.1268764
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.1269464
## Run 1 stress 0.1236365
## ... New best solution
## ... Procrustes: rmse 0.1513568  max resid 0.3204509
## Run 2 stress 0.1563068
## Run 3 stress 0.1767507
## Run 4 stress 0.1382342
## Run 5 stress 0.1236365
## ... New best solution
## ... Procrustes: rmse 1.363403e-05  max resid 2.908458e-05
## ... Similar to previous best
## Run 6 stress 0.1336599
## Run 7 stress 0.1597304
## Run 8 stress 0.1336601
## Run 9 stress 0.1269463
## Run 10 stress 0.1269467
## Run 11 stress 0.1730384
## Run 12 stress 0.1725833
## Run 13 stress 0.1269463
## Run 14 stress 0.1336599
## Run 15 stress 0.1336601
## Run 16 stress 0.1580046
## Run 17 stress 0.1336599
## Run 18 stress 0.2139579
## Run 19 stress 0.1269465
## Run 20 stress 0.1597316
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.07811119
## Run 1 stress 0.07811119
## ... New best solution
## ... Procrustes: rmse 1.349638e-05  max resid 1.886215e-05
## ... Similar to previous best
## Run 2 stress 0.07811119
## ... Procrustes: rmse 3.625012e-06  max resid 6.590549e-06
## ... Similar to previous best
## Run 3 stress 0.1290663
## Run 4 stress 0.2363209
## Run 5 stress 0.07811119
## ... Procrustes: rmse 3.96207e-05  max resid 7.307885e-05
## ... Similar to previous best
## Run 6 stress 0.07811119
## ... New best solution
## ... Procrustes: rmse 1.829978e-06  max resid 3.180272e-06
## ... Similar to previous best
## Run 7 stress 0.07811119
## ... Procrustes: rmse 4.313944e-06  max resid 7.970202e-06
```

```
## ... Similar to previous best
## Run 8 stress 0.07811119
## ... Procrustes: rmse 2.607367e-05  max resid 4.760831e-05
## ... Similar to previous best
## Run 9 stress 0.07811119
## ... Procrustes: rmse 4.185449e-06  max resid 7.774237e-06
## ... Similar to previous best
## Run 10 stress 0.07811119
## ... Procrustes: rmse 6.729038e-06  max resid 1.084808e-05
## ... Similar to previous best
## Run 11 stress 0.07811119
## ... Procrustes: rmse 1.66615e-06  max resid 2.970705e-06
## ... Similar to previous best
## Run 12 stress 0.1084937
## Run 13 stress 0.07811129
## ... Procrustes: rmse 5.810316e-05  max resid 8.666989e-05
## ... Similar to previous best
## Run 14 stress 0.07811119
## ... Procrustes: rmse 1.5071e-06  max resid 2.70478e-06
## ... Similar to previous best
## Run 15 stress 0.1084935
## Run 16 stress 0.07811119
## ... Procrustes: rmse 4.015497e-06  max resid 7.017942e-06
## ... Similar to previous best
## Run 17 stress 0.07811119
## ... Procrustes: rmse 2.32687e-05  max resid 4.25127e-05
## ... Similar to previous best
## Run 18 stress 0.07811119
## ... New best solution
## ... Procrustes: rmse 1.980594e-06  max resid 3.706352e-06
## ... Similar to previous best
## Run 19 stress 0.07811119
## ... Procrustes: rmse 3.705676e-05  max resid 6.807451e-05
## ... Similar to previous best
## Run 20 stress 0.07811119
## ... Procrustes: rmse 3.330848e-05  max resid 6.172156e-05
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.1084052
## Run 1 stress 0.07713253
## ... New best solution
## ... Procrustes: rmse 0.1481377  max resid 0.2754361
## Run 2 stress 0.1443908
## Run 3 stress 0.1134891
## Run 4 stress 0.08156213
## Run 5 stress 0.1443885
## Run 6 stress 0.1057963
## Run 7 stress 0.1316562
## Run 8 stress 0.1443738
## Run 9 stress 0.1057956
## Run 10 stress 0.1084065
## Run 11 stress 0.08156227
```

```
## Run 12 stress 0.08156213
## Run 13 stress 0.07713251
## ... New best solution
## ... Procrustes: rmse 2.707848e-05  max resid 5.295858e-05
## ... Similar to previous best
## Run 14 stress 0.1568447
## Run 15 stress 0.08156213
## Run 16 stress 0.1557418
## Run 17 stress 0.148128
## Run 18 stress 0.1084066
## Run 19 stress 0.07713247
## ... New best solution
## ... Procrustes: rmse 0.0001285895  max resid 0.0002508436
## ... Similar to previous best
## Run 20 stress 0.08156213
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.06961363
## Run 1 stress 0.1372936
## Run 2 stress 0.1001323
## Run 3 stress 0.1332849
## Run 4 stress 0.1001323
## Run 5 stress 0.06961363
## ... Procrustes: rmse 2.848325e-06  max resid 4.887518e-06
## ... Similar to previous best
## Run 6 stress 0.1372936
## Run 7 stress 0.1372936
## Run 8 stress 0.1372936
## Run 9 stress 0.1372936
## Run 10 stress 0.06961363
## ... Procrustes: rmse 6.013777e-07  max resid 1.102746e-06
## ... Similar to previous best
## Run 11 stress 0.1066137
## Run 12 stress 0.2304645
## Run 13 stress 0.1372936
## Run 14 stress 0.06961363
## ... Procrustes: rmse 1.27765e-06  max resid 1.891836e-06
## ... Similar to previous best
## Run 15 stress 0.06961363
## ... Procrustes: rmse 2.244147e-06  max resid 3.953177e-06
## ... Similar to previous best
## Run 16 stress 0.06961363
## ... Procrustes: rmse 1.94473e-06  max resid 3.071061e-06
## ... Similar to previous best
## Run 17 stress 0.2332323
## Run 18 stress 0.1001324
## Run 19 stress 0.1001323
## Run 20 stress 0.1372936
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.1190432
## Run 1 stress 0.1129107
```

```
## ... New best solution
## ... Procrustes: rmse 0.2361977  max resid 0.4882824
## Run 2 stress 0.1504946
## Run 3 stress 0.1657746
## Run 4 stress 0.1129107
## ... Procrustes: rmse 1.9009e-05  max resid 2.906952e-05
## ... Similar to previous best
## Run 5 stress 0.1504937
## Run 6 stress 0.1916888
## Run 7 stress 0.1190432
## Run 8 stress 0.1129107
## ... Procrustes: rmse 1.921814e-05  max resid 3.073576e-05
## ... Similar to previous best
## Run 9 stress 0.1129107
## ... New best solution
## ... Procrustes: rmse 1.527127e-05  max resid 2.273806e-05
## ... Similar to previous best
## Run 10 stress 0.1190432
## Run 11 stress 0.1190432
## Run 12 stress 0.2059961
## Run 13 stress 0.1975335
## Run 14 stress 0.1271271
## Run 15 stress 0.1129107
## ... Procrustes: rmse 8.469508e-05  max resid 0.0001205496
## ... Similar to previous best
## Run 16 stress 0.1190432
## Run 17 stress 0.1190432
## Run 18 stress 0.1129107
## ... Procrustes: rmse 6.087243e-05  max resid 8.934197e-05
## ... Similar to previous best
## Run 19 stress 0.1129107
## ... New best solution
## ... Procrustes: rmse 7.456274e-06  max resid 1.164863e-05
## ... Similar to previous best
## Run 20 stress 0.1129107
## ... Procrustes: rmse 0.0001488349  max resid 0.0002214033
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 9.729716e-05
## Run 1 stress 0.0004615177
## ... Procrustes: rmse 0.00249777  max resid 0.004833244
## ... Similar to previous best
## Run 2 stress 0.0002142042
## ... Procrustes: rmse 0.1030629  max resid 0.2094219
## Run 3 stress 0.0002329473
## ... Procrustes: rmse 0.1031345  max resid 0.2095722
## Run 4 stress 0.0005130748
## ... Procrustes: rmse 0.002784194  max resid 0.005393174
## ... Similar to previous best
## Run 5 stress 0.0001908217
## ... Procrustes: rmse 0.001159945  max resid 0.002218216
## ... Similar to previous best
```

```
## Run 6 stress 9.330499e-05
## ... New best solution
## ... Procrustes: rmse 9.152243e-06  max resid 1.71681e-05
## ... Similar to previous best
## Run 7 stress 9.678377e-05
## ... Procrustes: rmse 1.53668e-05  max resid 2.651767e-05
## ... Similar to previous best
## Run 8 stress 0.0003084344
## ... Procrustes: rmse 0.001733228  max resid 0.003342039
## ... Similar to previous best
## Run 9 stress 0.2300857
## Run 10 stress 0.0004659876
## ... Procrustes: rmse 0.00253786  max resid 0.004914218
## ... Similar to previous best
## Run 11 stress 0.0001129784
## ... Procrustes: rmse 0.1025523  max resid 0.2083323
## Run 12 stress 0.001313893
## Run 13 stress 9.817173e-05
## ... Procrustes: rmse 0.1025638  max resid 0.2083667
## Run 14 stress 0.0003073242
## ... Procrustes: rmse 0.103382  max resid 0.2100876
## Run 15 stress 0.002206557
## Run 16 stress 9.76281e-05
## ... Procrustes: rmse 1.332624e-05  max resid 2.479376e-05
## ... Similar to previous best
## Run 17 stress 0.002126018
## Run 18 stress 9.229597e-05
## ... New best solution
## ... Procrustes: rmse 5.208278e-06  max resid 8.154101e-06
## ... Similar to previous best
## Run 19 stress 0.1034755
## Run 20 stress 0.0001202311
## ... Procrustes: rmse 0.0007992386  max resid 0.001513974
## ... Similar to previous best
## *** Solution reached
```

```
## Warning in metaMDS(temp, k = j, distance = "euclidean"): stress is (nearly)
## zero: you may have insufficient data
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.1158004
## Run 1 stress 0.1158012
## ... Procrustes: rmse 0.0003562438  max resid 0.0005705372
## ... Similar to previous best
## Run 2 stress 0.1157999
## ... New best solution
## ... Procrustes: rmse 0.0005800049  max resid 0.0008445314
## ... Similar to previous best
## Run 3 stress 0.1670956
## Run 4 stress 0.1509201
## Run 5 stress 0.1899399
## Run 6 stress 0.2101326
## Run 7 stress 0.1626656
## Run 8 stress 0.1286898
```

```
## Run 9 stress 0.164709
## Run 10 stress 0.1158002
## ... Procrustes: rmse 0.0003936703  max resid 0.0006018739
## ... Similar to previous best
## Run 11 stress 0.1687044
## Run 12 stress 0.1670956
## Run 13 stress 0.1679501
## Run 14 stress 0.1158
## ... Procrustes: rmse 0.0005992224  max resid 0.0009056606
## ... Similar to previous best
## Run 15 stress 0.1687044
## Run 16 stress 0.1681143
## Run 17 stress 0.1509201
## Run 18 stress 0.162666
## Run 19 stress 0.115801
## ... Procrustes: rmse 0.0008263222  max resid 0.001269818
## ... Similar to previous best
## Run 20 stress 0.1286898
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.05954882
## Run 1 stress 0.2819219
## Run 2 stress 0.05954882
## ... New best solution
## ... Procrustes: rmse 2.416004e-05  max resid 4.532039e-05
## ... Similar to previous best
## Run 3 stress 0.1485411
## Run 4 stress 0.05954882
## ... Procrustes: rmse 8.036761e-06  max resid 1.386593e-05
## ... Similar to previous best
## Run 5 stress 0.2474614
## Run 6 stress 0.2842805
## Run 7 stress 0.05954883
## ... Procrustes: rmse 5.592956e-05  max resid 0.0001048734
## ... Similar to previous best
## Run 8 stress 0.05954882
## ... Procrustes: rmse 4.266111e-05  max resid 7.997445e-05
## ... Similar to previous best
## Run 9 stress 0.05954882
## ... New best solution
## ... Procrustes: rmse 7.746986e-06  max resid 1.457695e-05
## ... Similar to previous best
## Run 10 stress 0.1355918
## Run 11 stress 0.05954883
## ... Procrustes: rmse 5.519777e-05  max resid 0.0001036766
## ... Similar to previous best
## Run 12 stress 0.1696998
## Run 13 stress 0.2878907
## Run 14 stress 0.1355918
## Run 15 stress 0.05954882
## ... Procrustes: rmse 3.216302e-05  max resid 5.988948e-05
## ... Similar to previous best
## Run 16 stress 0.1696998
```

```
## Run 17 stress 0.05954882
## ... Procrustes: rmse 2.057223e-05  max resid 3.800026e-05
## ... Similar to previous best
## Run 18 stress 0.05954882
## ... Procrustes: rmse 6.078815e-06  max resid 1.088026e-05
## ... Similar to previous best
## Run 19 stress 0.1696998
## Run 20 stress 0.05954882
## ... Procrustes: rmse 9.5863e-06  max resid 1.720488e-05
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.037214
## Run 1 stress 0.09050191
## Run 2 stress 0.09050087
## Run 3 stress 0.09050077
## Run 4 stress 0.03721398
## ... New best solution
## ... Procrustes: rmse 8.625385e-05  max resid 0.0001324308
## ... Similar to previous best
## Run 5 stress 0.03721402
## ... Procrustes: rmse 6.30692e-05  max resid 8.920523e-05
## ... Similar to previous best
## Run 6 stress 0.07765363
## Run 7 stress 0.1718361
## Run 8 stress 0.03721397
## ... New best solution
## ... Procrustes: rmse 3.82988e-05  max resid 6.107854e-05
## ... Similar to previous best
## Run 9 stress 0.0776536
## Run 10 stress 0.2067232
## Run 11 stress 0.1166541
## Run 12 stress 0.07765361
## Run 13 stress 0.03721398
## ... Procrustes: rmse 3.990223e-05  max resid 6.209928e-05
## ... Similar to previous best
## Run 14 stress 0.1718361
## Run 15 stress 0.1718361
## Run 16 stress 0.1718362
## Run 17 stress 0.09050109
## Run 18 stress 0.1166538
## Run 19 stress 0.233892
## Run 20 stress 0.2353136
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.09092996
## Run 1 stress 0.2036348
## Run 2 stress 0.09092996
## ... New best solution
## ... Procrustes: rmse 1.909109e-06  max resid 2.98679e-06
## ... Similar to previous best
## Run 3 stress 0.09092996
```

```
## ... Procrustes: rmse 1.820002e-06  max resid 3.033828e-06
## ... Similar to previous best
## Run 4 stress 0.1208841
## Run 5 stress 0.1456889
## Run 6 stress 0.1377776
## Run 7 stress 0.1208841
## Run 8 stress 0.09092996
## ... Procrustes: rmse 1.037717e-05  max resid 1.87474e-05
## ... Similar to previous best
## Run 9 stress 0.09092996
## ... Procrustes: rmse 1.510604e-06  max resid 2.95332e-06
## ... Similar to previous best
## Run 10 stress 0.1442524
## Run 11 stress 0.1377776
## Run 12 stress 0.09092996
## ... Procrustes: rmse 3.665841e-06  max resid 5.880692e-06
## ... Similar to previous best
## Run 13 stress 0.09092996
## ... Procrustes: rmse 2.289798e-05  max resid 4.543513e-05
## ... Similar to previous best
## Run 14 stress 0.1377776
## Run 15 stress 0.2293739
## Run 16 stress 0.09092996
## ... Procrustes: rmse 6.193125e-06  max resid 1.092721e-05
## ... Similar to previous best
## Run 17 stress 0.09092996
## ... Procrustes: rmse 4.698003e-07  max resid 6.23191e-07
## ... Similar to previous best
## Run 18 stress 0.1208841
## Run 19 stress 0.1208841
## Run 20 stress 0.09092996
## ... Procrustes: rmse 4.895652e-06  max resid 8.777413e-06
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.06860425
## Run 1 stress 0.2852172
## Run 2 stress 0.1242621
## Run 3 stress 0.07531797
## Run 4 stress 0.06860633
## ... Procrustes: rmse 0.0007869619  max resid 0.001397014
## ... Similar to previous best
## Run 5 stress 0.0715229
## Run 6 stress 0.07152312
## Run 7 stress 0.06860463
## ... Procrustes: rmse 0.000917236  max resid 0.001648452
## ... Similar to previous best
## Run 8 stress 0.07152289
## Run 9 stress 0.06860527
## ... Procrustes: rmse 0.0006073892  max resid 0.001095948
## ... Similar to previous best
## Run 10 stress 0.07152344
## Run 11 stress 0.1343808
```

```
## Run 12 stress 0.2001578
## Run 13 stress 0.07531784
## Run 14 stress 0.07152348
## Run 15 stress 0.07531789
## Run 16 stress 0.07531784
## Run 17 stress 0.1343809
## Run 18 stress 0.124262
## Run 19 stress 0.07152337
## Run 20 stress 0.07531784
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.08658245
## Run 1 stress 0.1232646
## Run 2 stress 0.1575737
## Run 3 stress 0.1159469
## Run 4 stress 0.1159473
## Run 5 stress 0.1232644
## Run 6 stress 0.1159443
## Run 7 stress 0.08658245
## ... Procrustes: rmse 5.530976e-06  max resid 8.199193e-06
## ... Similar to previous best
## Run 8 stress 0.1232645
## Run 9 stress 0.08658245
## ... New best solution
## ... Procrustes: rmse 1.649803e-06  max resid 2.660202e-06
## ... Similar to previous best
## Run 10 stress 0.08868506
## Run 11 stress 0.1575738
## Run 12 stress 0.2568282
## Run 13 stress 0.1146362
## Run 14 stress 0.08868507
## Run 15 stress 0.1575737
## Run 16 stress 0.114636
## Run 17 stress 0.1232646
## Run 18 stress 0.1706776
## Run 19 stress 0.1232644
## Run 20 stress 0.08658245
## ... Procrustes: rmse 8.12062e-07  max resid 1.027564e-06
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.0006858399
## Run 1 stress 0.001160526
## ... Procrustes: rmse 0.006401455  max resid 0.01096853
## Run 2 stress 0.0001846847
## ... New best solution
## ... Procrustes: rmse 0.03172377  max resid 0.0655017
## Run 3 stress 0.3083098
## Run 4 stress 9.981715e-05
## ... New best solution
## ... Procrustes: rmse 0.0984274  max resid 0.1878375
## Run 5 stress 9.896946e-05
```

```
## ... New best solution
## ... Procrustes: rmse 0.03001289  max resid 0.05076462
## Run 6 stress 9.907013e-05
## ... Procrustes: rmse 0.006214504  max resid 0.01138198
## Run 7 stress 0.01585456
## Run 8 stress 0.001134092
## Run 9 stress 0.001283323
## Run 10 stress 9.893311e-05
## ... New best solution
## ... Procrustes: rmse 0.05277764  max resid 0.1096973
## Run 11 stress 0.01617962
## Run 12 stress 0.001205942
## Run 13 stress 0.01585447
## Run 14 stress 0.0007875653
## Run 15 stress 0.0006578647
## Run 16 stress 0.01585444
## Run 17 stress 0.0006928195
## Run 18 stress 0.001656419
## Run 19 stress 0.001123805
## Run 20 stress 0.001061974
## *** No convergence -- monoMDS stopping criteria:
##     11: no. of iterations >= maxit
##      4: stress < smin
##      5: stress ratio > sratmax
```

```
## Warning in metaMDS(cereal1[, 1:11], k = j, distance = "euclidean"): stress is
## (nearly) zero: you may have insufficient data
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 9.764983e-05
## Run 1 stress 9.652293e-05
## ... New best solution
## ... Procrustes: rmse 0.05152957  max resid 0.06978434
## Run 2 stress 0.0623368
## Run 3 stress 9.818943e-05
## ... Procrustes: rmse 0.04550126  max resid 0.06114898
## Run 4 stress 9.516954e-05
## ... New best solution
## ... Procrustes: rmse 0.01788749  max resid 0.03003837
## Run 5 stress 9.782092e-05
## ... Procrustes: rmse 0.02199341  max resid 0.02832559
## Run 6 stress 9.277258e-05
## ... New best solution
## ... Procrustes: rmse 0.03832582  max resid 0.0558952
## Run 7 stress 9.868476e-05
## ... Procrustes: rmse 0.04601663  max resid 0.07462773
## Run 8 stress 9.138838e-05
## ... New best solution
## ... Procrustes: rmse 0.01686728  max resid 0.02619572
## Run 9 stress 9.518213e-05
## ... Procrustes: rmse 0.01447473  max resid 0.02565369
## Run 10 stress 0.06233769
## Run 11 stress 9.553839e-05
## ... Procrustes: rmse 0.02014251  max resid 0.03570134
```

```
## Run 12 stress 0.0001237812
## ... Procrustes: rmse 0.04052406  max resid 0.05841777
## Run 13 stress 0.06233676
## Run 14 stress 9.920726e-05
## ... Procrustes: rmse 0.04597159  max resid 0.06508412
## Run 15 stress 9.5581e-05
## ... Procrustes: rmse 0.05194084  max resid 0.0825696
## Run 16 stress 0.0001121579
## ... Procrustes: rmse 0.07202045  max resid 0.1051122
## Run 17 stress 9.639069e-05
## ... Procrustes: rmse 0.02333778  max resid 0.03059396
## Run 18 stress 9.057177e-05
## ... New best solution
## ... Procrustes: rmse 0.05934531  max resid 0.1000212
## Run 19 stress 9.364508e-05
## ... Procrustes: rmse 0.01582749  max resid 0.03388567
## Run 20 stress 9.789449e-05
## ... Procrustes: rmse 0.05608562  max resid 0.0843277
## *** No convergence -- monoMDS stopping criteria:
##      2: no. of iterations >= maxit
##     15: stress < smin
##      3: stress ratio > sratmax
```

```
## Warning in metaMDS(temp, k = j, distance = "euclidean"): stress is (nearly)
## zero: you may have insufficient data
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.02179599
## Run 1 stress 0.02179635
## ... Procrustes: rmse 0.0001285956  max resid 0.0002569499
## ... Similar to previous best
## Run 2 stress 0.02179728
## ... Procrustes: rmse 0.003233286  max resid 0.006487245
## ... Similar to previous best
## Run 3 stress 0.02789823
## Run 4 stress 0.02179709
## ... Procrustes: rmse 0.0003613823  max resid 0.0007233809
## ... Similar to previous best
## Run 5 stress 0.01688349
## ... New best solution
## ... Procrustes: rmse 0.1788856  max resid 0.3333045
## Run 6 stress 0.02179602
## Run 7 stress 0.02179738
## Run 8 stress 0.02194153
## Run 9 stress 0.02179679
## Run 10 stress 0.02179684
## Run 11 stress 0.0256694
## Run 12 stress 0.02612616
## Run 13 stress 0.01688359
## ... Procrustes: rmse 9.900051e-05  max resid 0.0001789483
## ... Similar to previous best
## Run 14 stress 0.01688348
## ... New best solution
## ... Procrustes: rmse 6.705609e-05  max resid 0.0001171458
```

```
## ... Similar to previous best
## Run 15 stress 0.01688355
## ... Procrustes: rmse 0.0001371881  max resid 0.0002596441
## ... Similar to previous best
## Run 16 stress 0.02612577
## Run 17 stress 0.02705136
## Run 18 stress 0.01688366
## ... Procrustes: rmse 0.000170698  max resid 0.0003500722
## ... Similar to previous best
## Run 19 stress 0.01688346
## ... New best solution
## ... Procrustes: rmse 5.303483e-05  max resid 9.493069e-05
## ... Similar to previous best
## Run 20 stress 0.02183557
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.0419621
## Run 1 stress 0.04117179
## ... New best solution
## ... Procrustes: rmse 0.0399973  max resid 0.06262194
## Run 2 stress 0.03866926
## ... New best solution
## ... Procrustes: rmse 0.1059842  max resid 0.238535
## Run 3 stress 0.03866956
## ... Procrustes: rmse 0.0004287867  max resid 0.0007347308
## ... Similar to previous best
## Run 4 stress 0.01694295
## ... New best solution
## ... Procrustes: rmse 0.1943847  max resid 0.3074711
## Run 5 stress 0.01694341
## ... Procrustes: rmse 0.002092766  max resid 0.003023257
## ... Similar to previous best
## Run 6 stress 0.01694223
## ... New best solution
## ... Procrustes: rmse 0.001732786  max resid 0.002502565
## ... Similar to previous best
## Run 7 stress 0.01694249
## ... Procrustes: rmse 4.575063e-05  max resid 7.407919e-05
## ... Similar to previous best
## Run 8 stress 0.01694394
## ... Procrustes: rmse 0.0004856852  max resid 0.0006971547
## ... Similar to previous best
## Run 9 stress 0.01694329
## ... Procrustes: rmse 0.0003208709  max resid 0.0004585723
## ... Similar to previous best
## Run 10 stress 0.03866994
## Run 11 stress 0.01694134
## ... New best solution
## ... Procrustes: rmse 0.0009657919  max resid 0.001393038
## ... Similar to previous best
## Run 12 stress 0.03866994
## Run 13 stress 0.01694269
## ... Procrustes: rmse 0.00111688  max resid 0.001614549
```

```
## ... Similar to previous best
## Run 14 stress 0.01694278
## ... Procrustes: rmse 0.0007147238  max resid 0.001034145
## ... Similar to previous best
## Run 15 stress 0.01694217
## ... Procrustes: rmse 0.00050555  max resid 0.0007311961
## ... Similar to previous best
## Run 16 stress 0.01694265
## ... Procrustes: rmse 0.001107534  max resid 0.001594353
## ... Similar to previous best
## Run 17 stress 0.0411714
## Run 18 stress 0.016943
## ... Procrustes: rmse 0.0007627537  max resid 0.001099507
## ... Similar to previous best
## Run 19 stress 0.04399203
## Run 20 stress 0.1395617
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.000787782
## Run 1 stress 0.001020426
## ... Procrustes: rmse 0.03997554  max resid 0.05775772
## Run 2 stress 0.001094697
## ... Procrustes: rmse 0.06553718  max resid 0.1041078
## Run 3 stress 0.000733537
## ... New best solution
## ... Procrustes: rmse 0.03484186  max resid 0.05212392
## Run 4 stress 0.1132841
## Run 5 stress 0.0006461371
## ... New best solution
## ... Procrustes: rmse 0.03437309  max resid 0.05459462
## Run 6 stress 0.001159309
## Run 7 stress 0.001064722
## ... Procrustes: rmse 0.02300523  max resid 0.03491305
## Run 8 stress 0.0008865283
## ... Procrustes: rmse 0.02055425  max resid 0.03465173
## Run 9 stress 0.0008692562
## ... Procrustes: rmse 0.0075893  max resid 0.009786686
## Run 10 stress 0.00241898
## Run 11 stress 0.002478745
## Run 12 stress 0.00166767
## Run 13 stress 0.0009672779
## ... Procrustes: rmse 0.03473856  max resid 0.06720491
## Run 14 stress 9.938015e-05
## ... New best solution
## ... Procrustes: rmse 0.0532396  max resid 0.09774249
## Run 15 stress 0.002365184
## Run 16 stress 0.002409667
## Run 17 stress 0.002463508
## Run 18 stress 0.001219632
## Run 19 stress 0.000764239
## Run 20 stress 9.943803e-05
## ... Procrustes: rmse 0.02357891  max resid 0.03635834
## *** No convergence -- monoMDS stopping criteria:
```

```
##     17: no. of iterations >= maxit
##      2: stress < smin
##      1: stress ratio > sratmax
```

```
## Warning in metaMDS(temp, k = j, distance = "euclidean"): stress is (nearly)
## zero: you may have insufficient data
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.0003457191
## Run 1 stress 0.001225671
## Run 2 stress 0.0643972
## Run 3 stress 0.000610667
## ... Procrustes: rmse 0.06174425  max resid 0.1022207
## Run 4 stress 8.935048e-05
## ... New best solution
## ... Procrustes: rmse 0.04828904  max resid 0.07636435
## Run 5 stress 0.0001461292
## ... Procrustes: rmse 0.05543416  max resid 0.08135599
## Run 6 stress 0.001046812
## Run 7 stress 0.001742874
## Run 8 stress 0.0008946283
## Run 9 stress 0.0002948035
## ... Procrustes: rmse 0.05303237  max resid 0.07545005
## Run 10 stress 0.0009725508
## Run 11 stress 0.0008607795
## Run 12 stress 0.0006218231
## Run 13 stress 9.760364e-05
## ... Procrustes: rmse 0.0380844  max resid 0.05765847
## Run 14 stress 9.565914e-05
## ... Procrustes: rmse 0.02647316  max resid 0.03400343
## Run 15 stress 0.001149373
## Run 16 stress 0.03118819
## Run 17 stress 0.03118791
## Run 18 stress 0.001761098
## Run 19 stress 0.05743803
## Run 20 stress 0.0003283549
## ... Procrustes: rmse 0.06150223  max resid 0.09204289
## *** No convergence -- monoMDS stopping criteria:
##     13: no. of iterations >= maxit
##      3: stress < smin
##      4: stress ratio > sratmax
```

```
## Warning in metaMDS(temp, k = j, distance = "euclidean"): stress is (nearly)
## zero: you may have insufficient data
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.03439781
## Run 1 stress 0.04027075
## Run 2 stress 0.04027201
## Run 3 stress 0.03439794
## ... Procrustes: rmse 0.001260702  max resid 0.00144963
## ... Similar to previous best
## Run 4 stress 0.03439817
## ... Procrustes: rmse 0.0004568546  max resid 0.0007697602
```

```
## ... Similar to previous best
## Run 5 stress 0.03440046
## ... Procrustes: rmse 0.00210575  max resid 0.002572251
## ... Similar to previous best
## Run 6 stress 0.04027072
## Run 7 stress 0.04027061
## Run 8 stress 0.04027051
## Run 9 stress 0.0400239
## Run 10 stress 0.04027117
## Run 11 stress 0.04928347
## Run 12 stress 0.04027034
## Run 13 stress 0.04928213
## Run 14 stress 0.04027086
## Run 15 stress 0.04968585
## Run 16 stress 0.03439762
## ... New best solution
## ... Procrustes: rmse 0.0009225503  max resid 0.001047216
## ... Similar to previous best
## Run 17 stress 0.04027189
## Run 18 stress 0.03439767
## ... Procrustes: rmse 0.0007794495  max resid 0.001285224
## ... Similar to previous best
## Run 19 stress 0.03439766
## ... Procrustes: rmse 0.0009236441  max resid 0.001211487
## ... Similar to previous best
## Run 20 stress 0.0343978
## ... Procrustes: rmse 0.0002629524  max resid 0.0003543961
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.07532367
## Run 1 stress 0.0749337
## ... New best solution
## ... Procrustes: rmse 0.1853879  max resid 0.3069819
## Run 2 stress 0.07687583
## Run 3 stress 0.06952582
## ... New best solution
## ... Procrustes: rmse 0.2003524  max resid 0.4527392
## Run 4 stress 0.07561693
## Run 5 stress 0.06952583
## ... Procrustes: rmse 0.0003493281  max resid 0.0006150015
## ... Similar to previous best
## Run 6 stress 0.06952604
## ... Procrustes: rmse 0.000449499  max resid 0.0008253617
## ... Similar to previous best
## Run 7 stress 0.0753347
## Run 8 stress 0.07493647
## Run 9 stress 0.07493579
## Run 10 stress 0.07561713
## Run 11 stress 0.1823077
## Run 12 stress 0.07533414
## Run 13 stress 0.07533464
## Run 14 stress 0.06952621
```

```
## ... Procrustes: rmse 0.0002674029  max resid 0.0005081795
## ... Similar to previous best
## Run 15 stress 0.07561689
## Run 16 stress 0.0695259
## ... Procrustes: rmse 0.0004471976  max resid 0.0008197505
## ... Similar to previous best
## Run 17 stress 0.07561693
## Run 18 stress 0.07494459
## Run 19 stress 0.07533443
## Run 20 stress 0.07493977
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 9.927494e-05
## Run 1 stress 9.896807e-05
## ... New best solution
## ... Procrustes: rmse 0.08326791  max resid 0.1523696
## Run 2 stress 9.783826e-05
## ... New best solution
## ... Procrustes: rmse 0.1236368  max resid 0.249052
## Run 3 stress 9.807471e-05
## ... Procrustes: rmse 0.1327258  max resid 0.2252215
## Run 4 stress 9.649786e-05
## ... New best solution
## ... Procrustes: rmse 0.1065968  max resid 0.1603505
## Run 5 stress 0.0006617245
## Run 6 stress 9.459277e-05
## ... New best solution
## ... Procrustes: rmse 0.0941666  max resid 0.2124728
## Run 7 stress 0.0005985102
## Run 8 stress 8.746519e-05
## ... New best solution
## ... Procrustes: rmse 0.08004159  max resid 0.1528087
## Run 9 stress 9.585708e-05
## ... Procrustes: rmse 0.1029292  max resid 0.1687558
## Run 10 stress 0.000799012
## Run 11 stress 0.000805176
## Run 12 stress 0.001118364
## Run 13 stress 0.001404663
## Run 14 stress 9.868626e-05
## ... Procrustes: rmse 0.1141216  max resid 0.2275347
## Run 15 stress 0.0001998305
## ... Procrustes: rmse 0.1160752  max resid 0.1950194
## Run 16 stress 9.887974e-05
## ... Procrustes: rmse 0.1223677  max resid 0.2509945
## Run 17 stress 8.358132e-05
## ... New best solution
## ... Procrustes: rmse 0.116668  max resid 0.2180251
## Run 18 stress 9.376505e-05
## ... Procrustes: rmse 0.08280888  max resid 0.132149
## Run 19 stress 0.0002515645
## ... Procrustes: rmse 0.1115466  max resid 0.1963705
## Run 20 stress 9.585776e-05
## ... Procrustes: rmse 0.1123934  max resid 0.2187403
```

```
## *** No convergence -- monoMDS stopping criteria:
##      8: no. of iterations >= maxit
##     12: stress < smin
## Warning in metaMDS(temp, k = j, distance = "euclidean"): stress is (nearly)
## zero: you may have insufficient data
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.00194324
## Run 1 stress 0.002044241
## ... Procrustes: rmse 0.001986122  max resid 0.002415843
## ... Similar to previous best
## Run 2 stress 0.002234833
## ... Procrustes: rmse 0.00572634  max resid 0.007502558
## Run 3 stress 0.002070797
## ... Procrustes: rmse 0.0005044389  max resid 0.0009373946
## ... Similar to previous best
## Run 4 stress 0.002088839
## ... Procrustes: rmse 0.002826303  max resid 0.003558849
## ... Similar to previous best
## Run 5 stress 0.001943814
## ... Procrustes: rmse 0.0001075768  max resid 0.0001695396
## ... Similar to previous best
## Run 6 stress 0.07354541
## Run 7 stress 0.001943243
## ... Procrustes: rmse 5.818979e-05  max resid 8.975131e-05
## ... Similar to previous best
## Run 8 stress 0.002159328
## ... Procrustes: rmse 0.004256668  max resid 0.005507573
## ... Similar to previous best
## Run 9 stress 0.001943251
## ... Procrustes: rmse 3.215804e-06  max resid 4.17488e-06
## ... Similar to previous best
## Run 10 stress 0.002066322
## ... Procrustes: rmse 0.002399135  max resid 0.002987927
## ... Similar to previous best
## Run 11 stress 0.002156156
## ... Procrustes: rmse 0.004039104  max resid 0.005194146
## ... Similar to previous best
## Run 12 stress 0.001943259
## ... Procrustes: rmse 6.205482e-05  max resid 9.84514e-05
## ... Similar to previous best
## Run 13 stress 0.00194327
## ... Procrustes: rmse 7.900662e-05  max resid 0.0001236798
## ... Similar to previous best
## Run 14 stress 0.113731
## Run 15 stress 0.1581706
## Run 16 stress 0.1129775
## Run 17 stress 0.002134663
## ... Procrustes: rmse 0.003724444  max resid 0.004764196
## ... Similar to previous best
## Run 18 stress 0.00194327
## ... Procrustes: rmse 7.29747e-05  max resid 0.0001131873
## ... Similar to previous best
```

```
## Run 19 stress 0.1129751
## Run 20 stress 0.001944095
## ... Procrustes: rmse 0.000203186  max resid 0.0003238314
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.03869446
## Run 1 stress 0.02531008
## ... New best solution
## ... Procrustes: rmse 0.1909998  max resid 0.3385739
## Run 2 stress 0.1141288
## Run 3 stress 0.04756174
## Run 4 stress 0.03869563
## Run 5 stress 0.1703684
## Run 6 stress 0.03869432
## Run 7 stress 0.03869535
## Run 8 stress 0.03869471
## Run 9 stress 0.02531022
## ... Procrustes: rmse 9.510543e-05  max resid 0.0001772479
## ... Similar to previous best
## Run 10 stress 0.03869476
## Run 11 stress 0.03869486
## Run 12 stress 0.02531036
## ... Procrustes: rmse 0.0001546644  max resid 0.0002889012
## ... Similar to previous best
## Run 13 stress 0.03869642
## Run 14 stress 0.03869452
## Run 15 stress 0.03869413
## Run 16 stress 0.03869468
## Run 17 stress 0.02531013
## ... Procrustes: rmse 4.73659e-05  max resid 7.968536e-05
## ... Similar to previous best
## Run 18 stress 0.02531008
## ... Procrustes: rmse 2.643489e-05  max resid 4.131816e-05
## ... Similar to previous best
## Run 19 stress 0.03869685
## Run 20 stress 0.0386966
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.003392188
## Run 1 stress 0.0149146
## Run 2 stress 0.002550035
## ... New best solution
## ... Procrustes: rmse 0.01702987  max resid 0.02819237
## Run 3 stress 0.09796807
## Run 4 stress 0.1003173
## Run 5 stress 0.08164287
## Run 6 stress 0.01491476
## Run 7 stress 0.01491471
## Run 8 stress 0.01491484
## Run 9 stress 0.01491458
## Run 10 stress 0.005482409
```

```
## Run 11 stress 0.002011988
## ... New best solution
## ... Procrustes: rmse 0.01042531  max resid 0.01418478
## Run 12 stress 0.200423
## Run 13 stress 0.01491481
## Run 14 stress 0.04375289
## Run 15 stress 0.01491495
## Run 16 stress 0.01491462
## Run 17 stress 0.08164292
## Run 18 stress 0.01491494
## Run 19 stress 0.01491501
## Run 20 stress 0.003163439
## *** No convergence -- monoMDS stopping criteria:
##      4: no. of iterations >= maxit
##     16: stress ratio > sratmax
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.01061153
## Run 1 stress 0.01056725
## ... New best solution
## ... Procrustes: rmse 0.01337096  max resid 0.03288739
## Run 2 stress 0.01054271
## ... New best solution
## ... Procrustes: rmse 0.01599119  max resid 0.03157091
## Run 3 stress 0.01058628
## ... Procrustes: rmse 0.01052308  max resid 0.0192557
## Run 4 stress 0.01051653
## ... New best solution
## ... Procrustes: rmse 0.009312519  max resid 0.02285475
## Run 5 stress 0.01064512
## ... Procrustes: rmse 0.02516663  max resid 0.05475642
## Run 6 stress 0.01052806
## ... Procrustes: rmse 0.00507583  max resid 0.01153914
## Run 7 stress 0.01404216
## Run 8 stress 0.01054057
## ... Procrustes: rmse 0.009396074  max resid 0.02340855
## Run 9 stress 0.01873293
## Run 10 stress 0.0106857
## ... Procrustes: rmse 0.02842678  max resid 0.06010627
## Run 11 stress 0.01061688
## ... Procrustes: rmse 0.01388868  max resid 0.02840363
## Run 12 stress 0.01052471
## ... Procrustes: rmse 0.004077603  max resid 0.008604989
## ... Similar to previous best
## Run 13 stress 0.0106868
## ... Procrustes: rmse 0.02681613  max resid 0.04499907
## Run 14 stress 0.01065472
## ... Procrustes: rmse 0.02636922  max resid 0.0578266
## Run 15 stress 0.1426823
## Run 16 stress 0.01873334
## Run 17 stress 0.01061919
## ... Procrustes: rmse 0.01837615  max resid 0.03196477
## Run 18 stress 0.01052134
## ... Procrustes: rmse 0.002890165  max resid 0.005582055
```

```
## ... Similar to previous best
## Run 19 stress 0.01054667
## ... Procrustes: rmse 0.009580502  max resid 0.0228878
## Run 20 stress 0.01061371
## ... Procrustes: rmse 0.01758102  max resid 0.03278427
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.004305777
## Run 1 stress 0.01399599
## Run 2 stress 0.01394151
## Run 3 stress 0.004305863
## ... Procrustes: rmse 0.0001777406  max resid 0.0002351308
## ... Similar to previous best
## Run 4 stress 0.01403296
## Run 5 stress 0.01400341
## Run 6 stress 0.005721471
## Run 7 stress 0.005821974
## Run 8 stress 0.005994787
## Run 9 stress 0.006300846
## Run 10 stress 0.004342399
## ... Procrustes: rmse 0.001552199  max resid 0.003141667
## ... Similar to previous best
## Run 11 stress 0.005111457
## Run 12 stress 0.2004248
## Run 13 stress 0.006381587
## Run 14 stress 0.0051168
## Run 15 stress 0.01396857
## Run 16 stress 0.01396681
## Run 17 stress 0.004971286
## Run 18 stress 0.004305689
## ... New best solution
## ... Procrustes: rmse 7.071782e-05  max resid 9.94393e-05
## ... Similar to previous best
## Run 19 stress 0.01398131
## Run 20 stress 0.004305799
## ... Procrustes: rmse 2.004054e-05  max resid 3.266336e-05
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.02469719
## Run 1 stress 0.01437009
## ... New best solution
## ... Procrustes: rmse 0.2092661  max resid 0.4328418
## Run 2 stress 0.0001590113
## ... New best solution
## ... Procrustes: rmse 0.1955815  max resid 0.3605764
## Run 3 stress 0.02469747
## Run 4 stress 0.0001770268
## ... Procrustes: rmse 0.0001038028  max resid 0.0001528284
## ... Similar to previous best
## Run 5 stress 0.02469359
## Run 6 stress 0.02469652
```

```
## Run 7 stress 0.0246945
## Run 8 stress 0.1182563
## Run 9 stress 0.002757632
## Run 10 stress 0.01444136
## Run 11 stress 0.0001241573
## ... New best solution
## ... Procrustes: rmse 0.000263908  max resid 0.000379982
## ... Similar to previous best
## Run 12 stress 0.000413832
## ... Procrustes: rmse 0.001797226  max resid 0.003112363
## ... Similar to previous best
## Run 13 stress 0.01410533
## Run 14 stress 0.02469965
## Run 15 stress 0.0001110688
## ... New best solution
## ... Procrustes: rmse 0.0001512493  max resid 0.0002327247
## ... Similar to previous best
## Run 16 stress 0.0002952105
## ... Procrustes: rmse 0.00124791  max resid 0.00179275
## ... Similar to previous best
## Run 17 stress 9.986722e-05
## ... New best solution
## ... Procrustes: rmse 0.00134582  max resid 0.001824728
## ... Similar to previous best
## Run 18 stress 0.01421903
## Run 19 stress 0.0002200563
## ... Procrustes: rmse 0.002078791  max resid 0.00256072
## ... Similar to previous best
## Run 20 stress 0.0142142
## *** Solution reached
## Warning in metaMDS(temp, k = j, distance = "euclidean"): stress is (nearly)
## zero: you may have insufficient data
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.0003370901
## Run 1 stress 0.0009815628
## Run 2 stress 0.000552
## ... Procrustes: rmse 0.006619917  max resid 0.01244157
## Run 3 stress 0.0006306626
## ... Procrustes: rmse 0.01635586  max resid 0.02696416
## Run 4 stress 0.0001865916
## ... New best solution
## ... Procrustes: rmse 0.009619515  max resid 0.0129262
## Run 5 stress 0.0004904718
## ... Procrustes: rmse 0.04248773  max resid 0.07814103
## Run 6 stress 9.94987e-05
## ... New best solution
## ... Procrustes: rmse 0.0155915  max resid 0.02717611
## Run 7 stress 0.000760653
## Run 8 stress 9.78086e-05
## ... New best solution
## ... Procrustes: rmse 0.003131162  max resid 0.005005013
## ... Similar to previous best
```

```
## Run 9 stress 0.000711387
## Run 10 stress 0.00102583
## Run 11 stress 0.0006639343
## Run 12 stress 0.0009318231
## Run 13 stress 0.0004831711
## ... Procrustes: rmse 0.02329513  max resid 0.0422963
## Run 14 stress 0.0001284062
## ... Procrustes: rmse 0.0100702  max resid 0.01468915
## Run 15 stress 0.2004283
## Run 16 stress 0.001237285
## Run 17 stress 0.0009509935
## Run 18 stress 0.0004697023
## ... Procrustes: rmse 0.02375556  max resid 0.04305885
## Run 19 stress 0.0004974596
## ... Procrustes: rmse 0.02369102  max resid 0.04168844
## Run 20 stress 0.0007342193
## *** Solution reached
```

```
## Warning in metaMDS(temp, k = j, distance = "euclidean"): stress is (nearly)
## zero: you may have insufficient data
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.01246845
## Run 1 stress 0.0124689
## ... Procrustes: rmse 0.0005132874  max resid 0.0007531198
## ... Similar to previous best
## Run 2 stress 0.03155236
## Run 3 stress 0.03155021
## Run 4 stress 0.01246827
## ... New best solution
## ... Procrustes: rmse 0.0001736271  max resid 0.0002594935
## ... Similar to previous best
## Run 5 stress 0.04484283
## Run 6 stress 0.03801422
## Run 7 stress 0.04484262
## Run 8 stress 0.03801772
## Run 9 stress 0.04484288
## Run 10 stress 0.03154991
## Run 11 stress 0.01246856
## ... Procrustes: rmse 0.0002339761  max resid 0.0003372923
## ... Similar to previous best
## Run 12 stress 0.04484259
## Run 13 stress 0.01246866
## ... Procrustes: rmse 0.0002672696  max resid 0.0003872151
## ... Similar to previous best
## Run 14 stress 0.01246835
## ... Procrustes: rmse 0.00012861  max resid 0.000184303
## ... Similar to previous best
## Run 15 stress 0.04484259
## Run 16 stress 0.01246827
## ... Procrustes: rmse 3.151503e-05  max resid 4.632616e-05
## ... Similar to previous best
## Run 17 stress 0.03155051
## Run 18 stress 0.03944025
```

```
## Run 19 stress 0.01246874
## ... Procrustes: rmse 0.0002265193  max resid 0.0003240167
## ... Similar to previous best
## Run 20 stress 0.01246849
## ... Procrustes: rmse 0.0001876921  max resid 0.0002726794
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.01841791
## Run 1 stress 0.02667671
## Run 2 stress 0.01841707
## ... New best solution
## ... Procrustes: rmse 0.0002844977  max resid 0.0005264613
## ... Similar to previous best
## Run 3 stress 0.0760079
## Run 4 stress 0.06382518
## Run 5 stress 0.02824733
## Run 6 stress 0.0266765
## Run 7 stress 0.01841794
## ... Procrustes: rmse 0.0002212256  max resid 0.0003777167
## ... Similar to previous best
## Run 8 stress 0.02816479
## Run 9 stress 0.01841655
## ... New best solution
## ... Procrustes: rmse 0.0002695956  max resid 0.0004912359
## ... Similar to previous best
## Run 10 stress 0.01841747
## ... Procrustes: rmse 0.0003375574  max resid 0.0005888751
## ... Similar to previous best
## Run 11 stress 0.02053556
## Run 12 stress 0.02053587
## Run 13 stress 0.02053561
## Run 14 stress 0.02667695
## Run 15 stress 0.02053556
## Run 16 stress 0.0184189
## ... Procrustes: rmse 0.0007009723  max resid 0.001249624
## ... Similar to previous best
## Run 17 stress 0.02053548
## Run 18 stress 0.01841765
## ... Procrustes: rmse 0.0004519597  max resid 0.0008310454
## ... Similar to previous best
## Run 19 stress 0.06382591
## Run 20 stress 0.01841642
## ... New best solution
## ... Procrustes: rmse 0.0001643858  max resid 0.000282804
## ... Similar to previous best
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.01038405
## Run 1 stress 0.05832454
## Run 2 stress 0.01058191
## ... Procrustes: rmse 0.05348105  max resid 0.07270164
```

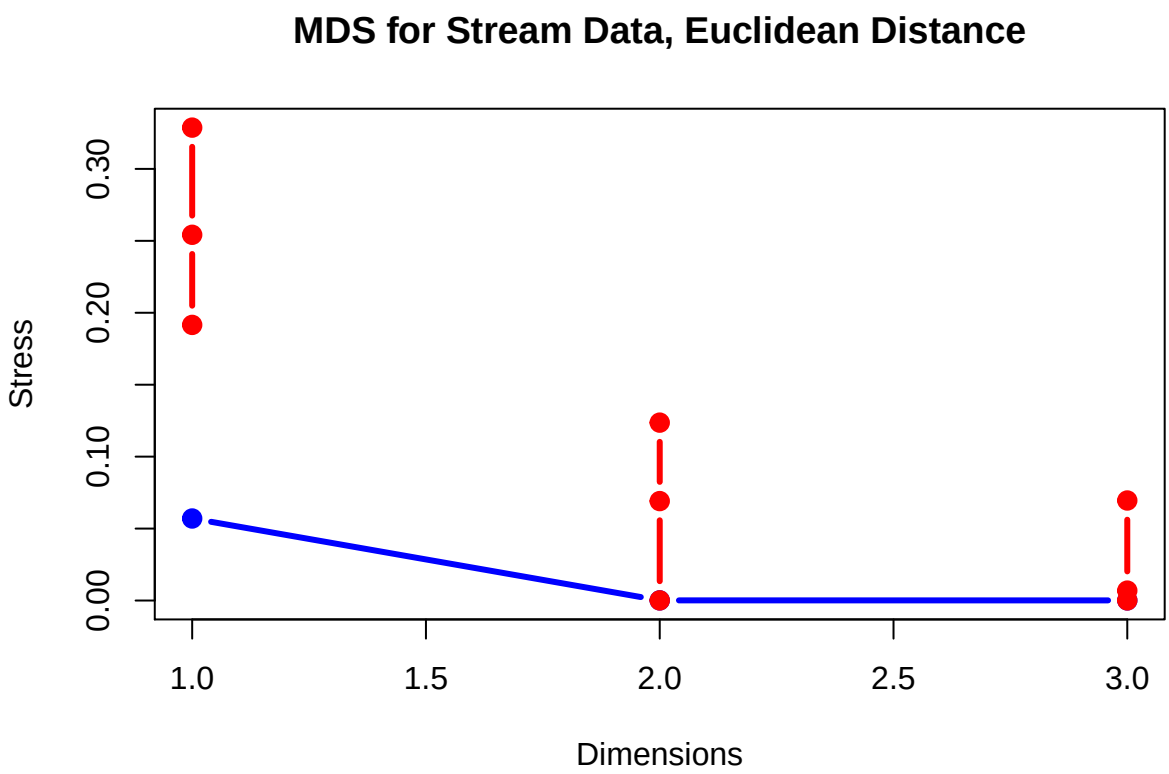
```
## Run 3 stress 0.009463187
## ... New best solution
## ... Procrustes: rmse 0.04818916  max resid 0.06602238
## Run 4 stress 0.01037467
## Run 5 stress 0.01757711
## Run 6 stress 0.01757716
## Run 7 stress 0.01757726
## Run 8 stress 0.01757702
## Run 9 stress 0.01066086
## Run 10 stress 0.009463027
## ... New best solution
## ... Procrustes: rmse 6.151863e-05  max resid 0.0001038867
## ... Similar to previous best
## Run 11 stress 0.01041565
## Run 12 stress 0.01082608
## Run 13 stress 0.01757702
## Run 14 stress 0.01757702
## Run 15 stress 0.01035066
## Run 16 stress 0.009462947
## ... New best solution
## ... Procrustes: rmse 6.090624e-05  max resid 0.0001279397
## ... Similar to previous best
## Run 17 stress 0.02430228
## Run 18 stress 0.01757708
## Run 19 stress 0.02430078
## Run 20 stress 0.01757711
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.03533694
## Run 1 stress 0.03533712
## ... Procrustes: rmse 0.0003068852  max resid 0.0006252913
## ... Similar to previous best
## Run 2 stress 0.03533765
## ... Procrustes: rmse 0.0004178275  max resid 0.000826204
## ... Similar to previous best
## Run 3 stress 0.0367322
## Run 4 stress 0.02305168
## ... New best solution
## ... Procrustes: rmse 0.2182478  max resid 0.3899712
## Run 5 stress 0.02305274
## ... Procrustes: rmse 0.0001806533  max resid 0.0003482411
## ... Similar to previous best
## Run 6 stress 0.02305011
## ... New best solution
## ... Procrustes: rmse 0.0004774695  max resid 0.000945298
## ... Similar to previous best
## Run 7 stress 0.04378089
## Run 8 stress 0.02304914
## ... New best solution
## ... Procrustes: rmse 0.0004803121  max resid 0.0009488874
## ... Similar to previous best
## Run 9 stress 0.03533704
## Run 10 stress 0.07911516
```

```
## Run 11 stress 0.02218963
## ... New best solution
## ... Procrustes: rmse 0.1519188  max resid 0.1853397
## Run 12 stress 0.02223057
## ... Procrustes: rmse 0.00933512  max resid 0.01797963
## Run 13 stress 0.02304981
## Run 14 stress 0.07911712
## Run 15 stress 0.03674198
## Run 16 stress 0.02305217
## Run 17 stress 0.0221902
## ... Procrustes: rmse 0.0001512644  max resid 0.0002435038
## ... Similar to previous best
## Run 18 stress 0.03168425
## Run 19 stress 0.02305168
## Run 20 stress 0.03533733
## *** Solution reached
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.001095839
## Run 1 stress 0.0005034788
## ... New best solution
## ... Procrustes: rmse 0.004000498  max resid 0.005561339
## ... Similar to previous best
## Run 2 stress 0.01505337
## Run 3 stress 0.0005098686
## ... Procrustes: rmse 4.465168e-05  max resid 6.203016e-05
## ... Similar to previous best
## Run 4 stress 0.0005693089
## ... Procrustes: rmse 0.0004630591  max resid 0.0006500567
## ... Similar to previous best
## Run 5 stress 0.01881383
## Run 6 stress 0.0003864015
## ... New best solution
## ... Procrustes: rmse 0.0008009974  max resid 0.001105665
## ... Similar to previous best
## Run 7 stress 0.01607569
## Run 8 stress 0.01834301
## Run 9 stress 9.695617e-05
## ... New best solution
## ... Procrustes: rmse 0.002581313  max resid 0.003570278
## ... Similar to previous best
## Run 10 stress 0.0292749
## Run 11 stress 0.01858503
## Run 12 stress 9.489711e-05
## ... New best solution
## ... Procrustes: rmse 0.2208148  max resid 0.4309303
## Run 13 stress 0.0003535073
## ... Procrustes: rmse 0.2202398  max resid 0.418203
## Run 14 stress 0.0006397028
## Run 15 stress 0.01501912
## Run 16 stress 0.0007545772
## Run 17 stress 0.0006897344
## Run 18 stress 0.01779676
## Run 19 stress 0.02927728
```

```
## Run 20 stress 0.01503037
## *** No convergence -- monoMDS stopping criteria:
##     15: no. of iterations >= maxit
##      2: stress < smin
##      3: stress ratio > sratmax

## Warning in metaMDS(temp, k = j, distance = "euclidean"): stress is (nearly)
## zero: you may have insufficient data

## Square root transformation
## Wisconsin double standardization
## Run 0 stress 9.97713e-05
## Run 1 stress 0.0006678446
## Run 2 stress 9.674004e-05
## ... New best solution
## ... Procrustes: rmse 0.09387331  max resid 0.1370215
## Run 3 stress 0.001436603
## Run 4 stress 9.008694e-05
## ... New best solution
## ... Procrustes: rmse 0.1871145  max resid 0.35979
## Run 5 stress 9.173985e-05
## ... Procrustes: rmse 0.1656545  max resid 0.3304241
## Run 6 stress 9.644068e-05
## ... Procrustes: rmse 0.1654004  max resid 0.3258878
## Run 7 stress 0.000250349
## ... Procrustes: rmse 0.02312036  max resid 0.041361
## Run 8 stress 9.236928e-05
## ... Procrustes: rmse 0.188701  max resid 0.3852133
## Run 9 stress 9.598021e-05
## ... Procrustes: rmse 0.1250754  max resid 0.2141138
## Run 10 stress 0.0004670451
## ... Procrustes: rmse 0.2084103  max resid 0.3939243
## Run 11 stress 0.000605222
## Run 12 stress 9.787044e-05
## ... Procrustes: rmse 0.09812593  max resid 0.1948014
## Run 13 stress 9.919853e-05
## ... Procrustes: rmse 0.2002875  max resid 0.3642363
## Run 14 stress 9.613153e-05
## ... Procrustes: rmse 0.101808  max resid 0.2063439
## Run 15 stress 0.0007444203
## Run 16 stress 0.0002040574
## ... Procrustes: rmse 0.1113071  max resid 0.2148832
## Run 17 stress 9.929387e-05
## ... Procrustes: rmse 0.2061303  max resid 0.3461741
## Run 18 stress 9.826145e-05
## ... Procrustes: rmse 0.2211078  max resid 0.4035802
## Run 19 stress 9.686007e-05
## ... Procrustes: rmse 0.2101246  max resid 0.357011
## Run 20 stress 9.824826e-05
## ... Procrustes: rmse 0.17549  max resid 0.2932528
## *** No convergence -- monoMDS stopping criteria:
##      7: no. of iterations >= maxit
##     13: stress < smin

## Warning in metaMDS(cereal1[, 1:11], k = j, distance = "euclidean"): stress is
```

```
## (nearly) zero: you may have insufficient data
```

```
#plot stress results

plot(c(1:3),results[21,],type="b", col="blue", lwd=3,
     ylim=c(0, max(results)), xlab="Dimensions", ylab="Stress", pch=19,
     main="MDS for Stream Data, Euclidean Distance")
mins <- apply(results[1:20,],2,min)
maxs <- apply(results[1:20,],2,max)
meds <- apply(results[1:20,],2,median)

for (i in 1:5){
  points(rep(i,3),c(mins[i], meds[i], maxs[i]),type="b", col="red", lwd=3, pch=19)
}
legend(3.5,(.9*max(results)),c("MDS Solution", "20 Permutations"), lwd=3, col=c("blue","red"))
```



A plot of results suggests that 2 dimensions is a good solution (after that, results are not different than random results)

7)

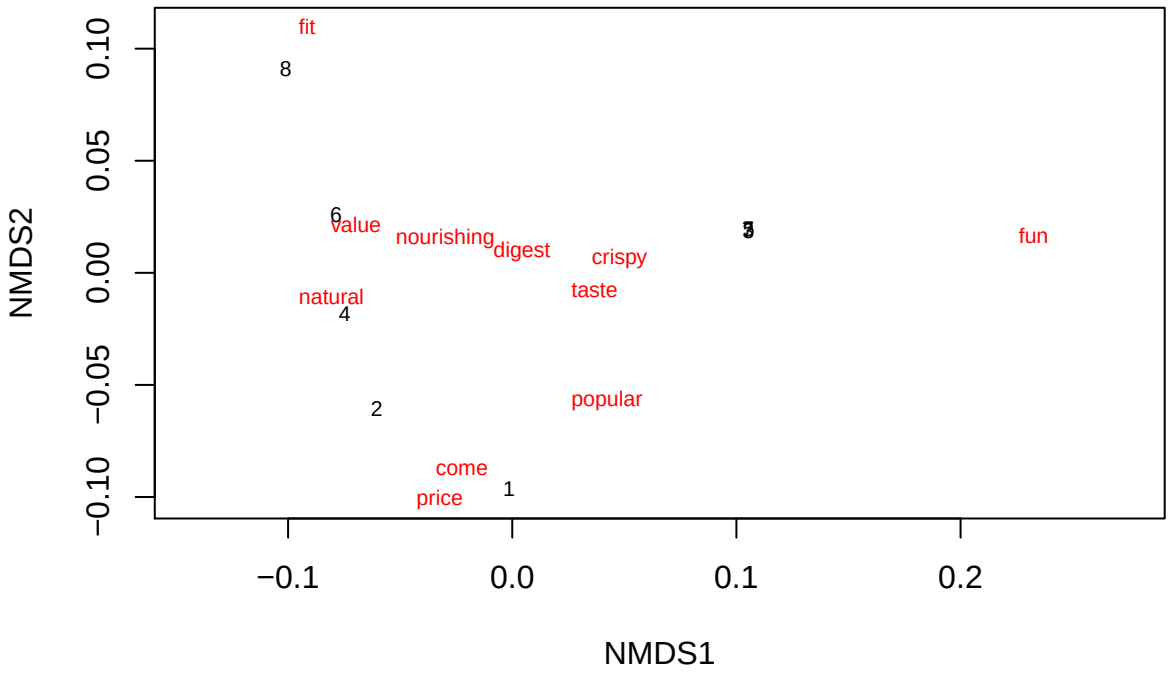
```
#two dimensional solution
cereal.mds2 <- metaMDS(cereal[,2:12], k=2, distance="euclidean")
```

```
## Square root transformation
## Wisconsin double standardization
## Run 0 stress 0.0006858399
## Run 1 stress 0.0009145307
## ... Procrustes: rmse 0.03591398  max resid 0.07082214
## Run 2 stress 0.0005238797
## ... New best solution
## ... Procrustes: rmse 0.03364157  max resid 0.06797733
```

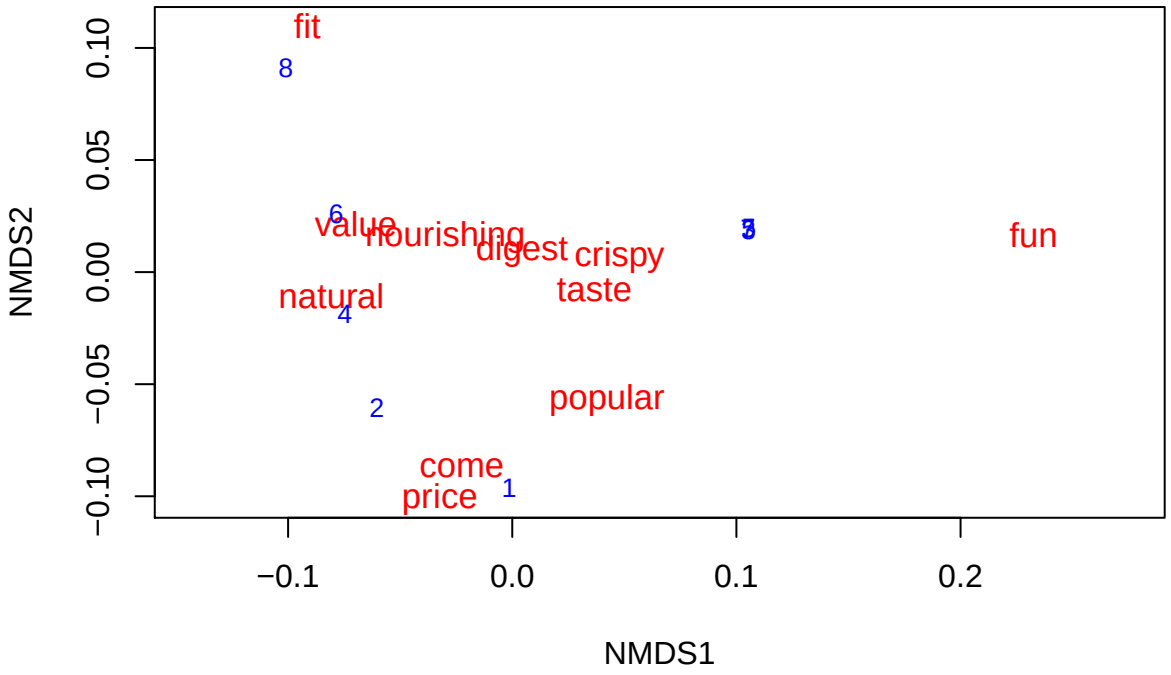
```
## Run 3 stress 0.0005533798
## ... Procrustes: rmse 0.005954264  max resid 0.008638485
## Run 4 stress 0.2852246
## Run 5 stress 9.936468e-05
## ... New best solution
## ... Procrustes: rmse 0.03025625  max resid 0.05147079
## Run 6 stress 0.0007486932
## Run 7 stress 0.0004279732
## ... Procrustes: rmse 0.02959591  max resid 0.05019771
## Run 8 stress 0.0005869341
## ... Procrustes: rmse 0.03064873  max resid 0.05152727
## Run 9 stress 0.0003423047
## ... Procrustes: rmse 0.02528061  max resid 0.05066713
## Run 10 stress 0.0001927285
## ... Procrustes: rmse 0.04506925  max resid 0.09329082
## Run 11 stress 0.0003331527
## ... Procrustes: rmse 0.02837789  max resid 0.04787313
## Run 12 stress 0.0001345343
## ... Procrustes: rmse 0.01323068  max resid 0.02403306
## Run 13 stress 0.0005068132
## ... Procrustes: rmse 0.03015041  max resid 0.05089603
## Run 14 stress 0.0002793028
## ... Procrustes: rmse 0.01662629  max resid 0.03007808
## Run 15 stress 0.001264052
## Run 16 stress 0.0005234795
## ... Procrustes: rmse 0.02774975  max resid 0.04573544
## Run 17 stress 0.0005447334
## ... Procrustes: rmse 0.03038647  max resid 0.05119491
## Run 18 stress 0.00100344
## Run 19 stress 0.01585464
## Run 20 stress 9.890311e-05
## ... New best solution
## ... Procrustes: rmse 0.06351113  max resid 0.1310237
## *** No convergence -- monoMDS stopping criteria:
##     16: no. of iterations >= maxit
##      2: stress < smin
##      2: stress ratio > sratmax
```

```
## Warning in metaMDS(cereal[, 2:12], k = 2, distance = "euclidean"): stress is
## (nearly) zero: you may have insufficient data
```

```r
#quick plot
plot(cereal.mds2,type="t")
```




```
#more refined plot
fig<-ordiplot(cereal.mds2,type="none",cex=1.1)
text(fig,"species",col="red",cex=1.1)
text(fig,"sites",col="blue",cex=0.8)
```



8) There are no other variables to overlay in this dataset. Therefore, we are unable to overlay other variables to interpret our ordination axes