Uebung 11

Multivariate Statistik

SoSe 2019

Antje Jahn (FBMN, h_da)
Neudert, Baudisch, Kopfmann

Aufgabe 1 a)

```
clust <- read.csv("Ex11.csv")
library('VIM')
```

```
clust <- format(clust, scientific = FALSE)
nrow(clust)
#> [1] 999
```

```
clust[c(1:40)] <- lapply(clust[c(1:40)], as.numeric)
str(clust)
#> 'data.frame':    999 obs. of  40 variables:
#>  $ X.0.9619334 : num  -0.2925 0.2588 -1.1521 0.1958 0.0301 ...
#>  $ X0.4418028  : num  -1.139 -0.973 -2.213 0.593 -0.691 ...
#>  $ X.0.9750051 : num  0.196 0.588 -0.862 0.283 -0.403 ...
#>  $ X1.417504   : num  -1.281 -0.8 0.631 0.247 -0.73 ...
#>  $ X0.8188148  : num  -0.251 -1.82 0.952 1.979 -0.364 ...
#>  $ X0.3162937  : num  2.512 -2.059 -1.166 -0.871 1.125 ...
#>  $ X.0.02496682: num  -0.9222 -0.0648 -0.3916 -0.9897 -1.404 ...
#>  $ X.0.063966  : num  0.0595 1.5921 1.0636 -1.0323 -0.8061 ...
#>  $ X0.03149702 : num  -1.41 -0.173 -0.35 -1.11 -1.238 ...
#>  $ X.0.3503106 : num  -0.657 -0.121 -1.489 -0.385 0.578 ...
#>  $ X.0.7227299 : num  -0.116 -0.188 -0.243 1.651 -0.272 ...
#>  $ X.0.2819547 : num  0.826 -1.5 -0.433 -1.745 2.177 ...
#>  $ X1.337515   : num  0.3464 -1.2287 -0.0388 -0.3789 1.4364 ...
#>  $ X0.7019798  : num  -0.5695 0.856 -0.0579 -0.6798 -1.0258 ...
#>  $ X1.007616   : num  -0.132 1.25 -1.398 -2.132 0.298 ...
#>  $ X.0.4653828 : num  0.69 -0.898 -0.156 -0.23 -0.556 ...
#>  $ X0.6385951  : num  -0.909 0.87 -2.736 0.466 0.205 ...
#>  $ X0.2867807  : num  1.303 -0.225 0.776 -1.8 -1.192 ...
#>  $ X.0.2270782 : num  -1.673 0.45 0.614 0.626 0.235 ...
#>  $ X.0.2200452 : num  -0.5255 0.5514 2.0192 -0.0977 0.671 ...
#>  $ X.1.242573  : num  0.798 0.146 1.081 -0.3 0.131 ...
#>  $ X.0.1085056 : num  -0.69 0.13 -1.08 -0.53 1.07 ...
#>  $ X.1.864262  : num  0.9 1.304 -0.243 -2.024 1.231 ...
#>  $ X.0.5005122 : num  0.429 -1.662 0.513 -0.511 1.134 ...
#>  $ X.1.325008  : num  -0.676 -1.63 -0.513 0.046 0.556 ...
#>  $ X1.063411   : num  -0.5341 -0.0774 2.5517 1.268 -0.3588 ...
#>  $ X.0.2963712 : num  -1.733 1.306 -2.314 -0.744 1.08 ...
#>  $ X.0.1216457 : num  -1.603 0.793 -1.276 0.223 -0.206 ...
#>  $ X0.08516605 : num  -1.08362 1.55947 -1.22927 0.85846 -0.00616 ...
#>  $ X0.6241764  : num  0.0334 -0.6885 1.4344 0.2747 0.1643 ...
#>  $ X.0.5095915 : num  1.701 -0.615 -0.284 -0.693 1.157 ...
#>  $ X.0.2167255 : num  0.00729 0.01 0.19895 -0.84571 0.24177 ...
#>  $ X.0.05550597: num  0.0991 0.9458 -0.0918 -0.1775 0.0886 ...
```

```
#>  $ X.0.4844491 : num  0.564 -0.319 0.35 -0.166 0.183 ...
#>  $ X.0.5215811 : num  -0.257 -0.118 -0.299 1.483 0.943 ...
#>  $ X1.949135   : num  -0.582 0.621 1.514 -1.688 -0.21 ...
#>  $ X1.324335   : num  -0.1699 -0.0708 0.6712 -0.1414 0.5363 ...
#>  $ X0.4681471  : num  -0.5423 0.4017 0.0109 0.2008 -1.1852 ...
#>  $ X1.0611     : num  0.3129 -0.0162 -1.0437 -0.6759 -0.4227 ...
#>  $ X1.65597    : num  -1.284 -0.527 1.625 2.221 0.624 ...
```

Skalieren der Daten

```
scaled_data = t(as.matrix(scale(clust)))
```

```
#Let us apply kmeans for k=3 clusters
kmm = kmeans(scaled_data,5,nstart = 60,iter.max = 15) #we keep number of iter.max=15 to ensure the algo
kmm
#> K-means clustering with 5 clusters of sizes 6, 20, 4, 4, 6
#>
#> Cluster means:
#>             1           2          3           4           5           6
#> 1 -0.65293257 -0.03768118  0.3201111 -0.04555148 -0.32949186 -0.38874956
#> 2 -0.37161784 -0.13035899 -0.1191583 -0.27118251  0.09177602 -0.28814260
#> 3  0.08856917 -0.01887152 -0.7968997 -0.49724329  0.57702354 -0.04973452
#> 4 -0.78319049 -0.49090586 -1.0648990  0.51260323 -0.54926363  0.05930680
#> 5  0.52131197 -0.18331527 -0.1358904 -0.83481512  0.04058154 -0.18226590
#>            7           8          9          10          11           12
#> 1  0.2693997 -0.61242370  0.4129149 -0.12586306 -0.11344398 -0.009829228
#> 2 -0.1211400 -0.37586416 -0.3708198  1.62663688  1.72059797  1.664074561
#> 3  0.3126914  0.29568956  0.5338776  0.26831779 -0.70752839 -0.010429615
#> 4 -0.3948767 -0.13357774 -0.2372000  0.27359662  0.68705922  0.277998806
#> 5  0.3908269  0.02740118  0.7588462  0.03165377  0.01290324  0.446714976
#>           13         14          15         16         17         18
#> 1 -0.1792515 -0.4603594  0.39529678 -1.1720572 -0.3334882 -0.2269517
#> 2  1.5375534  1.3451297  1.39421046  1.2634387  1.4395779  1.3612312
#> 3  0.7647604 -0.1114630 -0.05920584  0.5384011  0.4240889  0.1055045
#> 4 -0.4819270 -0.2432016 -0.52716355  0.3573333  0.2218558  0.9887323
#> 5  0.8304547 -0.2553001 -0.28482853  0.3531113  0.1755410  0.1823990
#>           19          20           21          22          23          24
#> 1  0.5677292 -0.4456284  0.411038224 -0.58944506  0.80640302 -0.3782759
#> 2  1.4899759 -0.1229951 -0.271069658 -0.09074504 -0.09921251 -0.2118606
#> 3  0.7103414 -0.1542571 -0.003805002  0.49595437 -0.49355629 -0.2892790
#> 4 -0.6681783  1.1072158  0.227614221  0.94218789 -0.06738606 -0.4950885
#> 5 -0.4180680  0.2222333 -0.363746912 -0.22473144  1.02112655 -0.3742816
#>            25          26          27           28          29          30
#> 1 -0.07632688  0.2750312  0.38139605  0.089003126  0.08355035  0.1550209
#> 2 -0.06460533 -0.1320811 -0.36691247  0.025430789 -0.21630879 -0.3471511
#> 3 -0.66567915  0.3167454 -0.08532716  0.188448744 -0.64063374  0.2978999
#> 4 -0.52013622 -0.4439729 -0.45176058 -0.360283240 -0.57687231  0.5015907
#> 5  0.46540148  0.2379101  0.06653013 -0.006218144  0.24992445  0.0193832
#>            31          32           33          34          35          36
#> 1  0.43896819 -0.4709800  0.083331800 -0.89495651  0.5262321  0.7807821
#> 2 -0.26477050 -0.3687968 -0.105633410  0.07017628 -0.3253538 -0.2707660
#> 3  0.35846280  0.9947445  0.998880781 -0.58949291 -0.1399450 -0.2028861
#> 4  0.25472249 -0.7221197  0.004067165  0.87426310  0.3446951  0.3958152
#> 5 -0.04900111  0.5871501  0.038285929  0.20793615  0.6569464 -0.9284529
```

```
#>           37          38          39         40          41         42
#> 1  0.2445228  0.26612829 -0.48353931  0.4160063  0.05241789 -0.8641055
#> 2 -0.4575193  0.10645029 -0.14171386 -0.2189515 -0.55962325 -0.2133864
#> 3 -0.2417528 -0.32482099  0.42163902  0.1685215  0.36940873  0.5768088
#> 4  0.2704832  0.07022468 -0.06312819 -0.8372542  0.02474842 -0.7335332
#> 5  0.5313674  0.16014437  0.90443488 -0.1930511 -0.28692377 -0.2970924
#>           43          44         45          46          47         48
#> 1 -0.2284412 -0.410040330  0.2523642  0.02555843  0.12024182  0.1167303
#> 2 -0.2884094  0.271538367  0.1678662 -0.46828699 -0.03957990  0.3734940
#> 3 -0.3968998 -0.007011356 -1.0630995 -0.31146595  0.45057031 -0.7733195
#> 4  0.6094372  0.878730844 -0.3116950  0.27882881 -0.09055204  0.7938531
#> 5  0.4642647 -0.114793503  0.5208168 -0.33404405 -0.56532028 -0.3274485
#>           49          50         51          52          53         54
#> 1  0.2519002 -0.47625745 -0.1803616 -0.03397894  0.07006807 0.1521231
#> 2  0.1689789 -0.19732275 -0.1096104 -0.39064545  0.06101166 0.1015477
#> 3 -0.5052395  0.05335149 -0.8816434  0.23382834 -0.09307375 0.3510067
#> 4  0.6779938 -0.27268341  0.4434038  0.28183570 -0.58060013 0.7697884
#> 5 -0.4747610 -0.03860082 -0.8738160 -0.11553991 -1.15857969 0.4848286
#>           55          56          57         58          59          60
#> 1  0.2936580  0.83660972  0.96389754 -0.8151255  0.25198474 -0.43293809
#> 2 -0.2237806 -0.19949061 -0.28284603 -0.3253625 -0.02415848 -0.07723587
#> 3 -0.4365878 -1.00325012 -0.22282049  0.5770650 -0.65320219 -1.00676458
#> 4  0.7143900 -0.06877729  0.03029892  0.5050880  1.33557834 -0.73307169
#> 5  0.8711945  0.09202742 -0.24991871 -0.3213844 -0.25011593 -0.06793408
#>           61          62         63         64          65         66
#> 1 -0.2994688 -0.02661648  0.2933676 -0.8687416 0.308321333  0.5603507
#> 2 -0.1716111  0.05565590 -0.1743188 -0.2410408 0.003959843 -0.5425985
#> 3  0.2951959 -0.01588713 -0.5110950  0.6862824 0.501922499  0.1425356
#> 4 -0.7439120 -0.52931438 -1.0429400  0.5393907 0.007869601 -0.2978932
#> 5 -0.4378094 -0.20058601  0.3553418  0.4685499 0.300199623 -0.0723357
#>             67          68          69          70          71          72
#> 1  0.591758331  0.40415873 -0.24588737  0.40456349 -0.45941591 -0.07123055
#> 2  0.069128344 -0.05795774 -0.20241258 -0.17327019 -0.39225824 -0.27524147
#> 3  0.008976087 -1.32839945 -0.29399634  0.10112407  0.50824908  0.20272775
#> 4 -0.076671288  0.42463312  0.07883907 -0.09155771 -0.07671349 -0.31775849
#> 5 -1.209582198  0.16506374 -0.52397312 -0.23116589 -0.03524418 -0.75716969
#>           73          74          75         76          77         78
#> 1 -0.4478968  0.60794454  1.22737287  0.1493384 -0.52497349 -0.3738813
#> 2 -0.4379984 -0.18168741 -0.37088891 -0.4889365 -0.76899089 -0.1778989
#> 3 -0.3114641  0.16943600 -0.03061183  0.2402980 -0.43115134  0.1169313
#> 4  0.3626320 -0.02847437 -0.29489093  0.9037426  0.18491478 -0.8488177
#> 5  0.7542423  0.68223383  0.04309302  0.4575848 -0.02283312  0.3108973
#>           79         80          81          82         83          84
#> 1 -0.1338984 -0.4984065  0.51911339  0.408749981 -0.3139950  0.33587365
#> 2 -0.3008811 -0.1391844  0.08066834 -0.240625654 -0.2733893 -0.07868906
#> 3 -0.6224291  0.3248554  0.11224238  0.004672226  1.0036056 -0.27527680
#> 4 -0.1208858  0.7353870 -0.06788379 -0.834523728  0.3003228  1.47121663
#> 5 -1.0663669  0.2519644 -0.14365149  0.675278039  0.5017206 -0.77865210
#>           85          86         87          88          89         90
#> 1 -0.2965258  0.27807134  0.1388487 -0.21848379 -0.30532421 -0.2725529
#> 2 -0.2850831 -0.02402128 -0.3858371 -0.03740294 -0.08604632 -0.4574942
#> 3  0.3181019 -0.49205025  0.6634653  0.08270619 -0.20351583 -0.1439250
#> 4 -0.1639529 -0.85655827 -1.0991932  0.28350738  0.38691686 -0.1134014
```

```
#> 5 -0.1504066 -0.24173598  0.1500079  1.13711974 -0.26136841  0.4605060
#>           91         92         93         94          95          96
#> 1  0.4955692 -0.4213072 -0.4634990 0.08936219  0.37162897 -0.65775772
#> 2 -0.1111301 -0.2107736 -0.2856978 0.22069225 -0.38174396 -0.52005547
#> 3 -0.3581352  0.1719809 -0.3005216 0.37242527 -0.02043969  0.31218035
#> 4 -0.4460123 -0.3565933 -0.2100048 0.15435173 -0.19036045  0.22589694
#> 5 -0.3800253  0.1450556 -0.6683688 0.49951013  0.27979346  0.03597746
#>            97         98          99        100         101         102
#> 1  0.82976307  0.2571233 -0.51284064 -0.4281201  0.08908484 -0.05085597
#> 2 -0.38868732 -0.1842695 -0.04823037 -0.2101826 -0.60903738  0.06862975
#> 3  0.40529435  0.9261345 -0.76126211  0.1427432  0.01598073  0.07301713
#> 4  0.06090514  0.1679564  0.33668665  0.1987313 -0.31713962  0.11908894
#> 5 -0.01727092 -0.5095228  0.02943630 -0.3162786  0.26162368 -0.10512164
#>           103         104         105         106         107         108
#> 1  0.03268454 -0.11937055 -0.02676059 -0.24927610  0.15059039  0.3199368
#> 2 -0.41996995  0.03628597 -0.33782185 -0.09043603 -0.39731476 -0.3198139
#> 3  1.34547615  0.60211206  0.23267875 -0.05393762 -0.63221150 -0.9519872
#> 4 -0.34209980  0.57121002  0.56128863  0.32416558  0.46074442  0.1774898
#> 5  0.62912917  0.80418476  0.29707154  0.45139701 -0.05259747  0.6556487
#>           109         110         111         112         113         114
#> 1  0.33426883  0.2592015  0.22660049  0.1795284 -0.32101651 -0.7876200
#> 2 -0.18713798 -0.1828621 -0.41536508 -0.2857062 -0.15815029 -0.6940744
#> 3  0.26624720 -0.4818963 -0.47025473 -0.3792165  0.25472147 -0.5283800
#> 4  0.46605682 -0.0575877  0.07936352 -0.3900128 -0.44369862  0.5067358
#> 5  0.03174276  0.1344284  0.10181235 -0.2478251 -0.03864506 -0.9254685
#>           115         116         117         118         119         120
#> 1  0.2056763 -0.80179364 -0.4589792 -0.01287077 -0.65299428 -0.6626545
#> 2 -0.6548391 -0.28193948 -0.0248672 -0.16917252 -0.46087125 -0.1799984
#> 3  0.1483241  0.94228010  0.2461943  0.39872116  0.05468702 -1.2793512
#> 4 -0.4311119  0.04180792  0.1682408 -0.02377467 -0.65666646  0.6590055
#> 5  0.7368935  0.72280826 -0.7697384 -0.20577044 -0.38970124  0.1582693
#>           121         122         123         124         125         126
#> 1 -0.26278902  0.4050097  0.2779652 -0.06806864  0.2645823  0.4075911
#> 2 -0.28478555 -0.1280213 -0.6209063  0.14749476 -0.2707339 -0.3693148
#> 3  0.30292271 -0.1560288  0.2000287  0.32729822  0.4387156  0.1027881
#> 4 -0.99588094  0.6526278  0.1431587  0.34448214 -0.4285678 -0.1140092
#> 5  0.08803798  0.2554742 -0.5178308 -0.28643547 -0.5714683  0.1137160
#>           127         128         129         130         131         132
#> 1 -0.12176186 -0.12293418  0.06816794 -0.1557446 -0.1400442  0.04460554
#> 2 -0.01486872 -0.04566675 -0.37258822 -0.5944401  0.0184310 -0.12154245
#> 3 -0.19670479  0.75811423  0.77504594  0.9776132 -0.4619706  0.53296528
#> 4 -1.07589491 -0.46488600  1.14166708 -0.2481689  0.9262626 -0.17280460
#> 5 -0.03902597  0.14833305  0.17183569 -0.6140748 -0.0700036 -0.20698630
#>           133         134         135         136         137         138
#> 1  0.381552276  0.6330100  0.30126000 -0.2171590  0.1744577 -0.7805140
#> 2 -0.310826285 -0.5052728  0.09234226 -0.3554007 -0.2423965 -0.4599217
#> 3 -1.036601722  0.6264947 -0.51980031  1.2790199  0.3345854 -0.3965024
#> 4  1.641199591  0.6320004  0.10916596 -0.3845967 -0.7995270 -0.1899867
#> 5  0.009754401  0.4819932  0.89140450  0.4213859 -0.4123370 -0.3113772
#>           139         140         141         142         143         144
#> 1 -0.01086746 -0.25523403 -0.1765432 -0.8543973  0.3045971 -0.6387030
#> 2  0.03507214 -0.59107106  0.1049791 -0.1844108 -0.1877522 -0.1874742
#> 3  0.09309054 -0.45931965 -1.3686985  0.9031501  0.3620551 -0.4161519
```

```
#> 4  0.74610899 -0.09379896 -0.5642678 -0.4731945 -0.1859028 -0.6810929
#> 5  0.58590352  0.08246624  0.2591798 -0.1250495  0.9733864  0.3634333
#>          145         146        147         148         149        150
#> 1  0.1577444 -0.05890027 -0.1452037  0.03267094  0.65830566  0.5704079
#> 2  0.0273816 -0.20573727 -0.4051609 -0.52708075 -0.04983021 -0.1545578
#> 3  1.0048672 -0.15939108 -0.2091676  0.40316442 -0.10935245 -0.8132031
#> 4 -0.1638914  0.06551669  0.3956722  0.06161988 -0.03001500  0.2994339
#> 5 -0.2318873 -0.25426588 -1.0078834 -0.53900374 -0.20035935  0.3988125
#>          151         152         153         154         155         156
#> 1  0.2970520 -0.8772445  0.18926348 -0.66872364  0.04754606 -0.1419597
#> 2 -0.1998927 -0.0248404 -0.33435454 -0.10711989  0.18935530 -0.3908296
#> 3  0.9203701  0.8353240 -0.10866181 -0.08976758 -0.52698935  0.3716755
#> 4  0.1634228 -0.1315224 -0.52381821  0.07497978 -1.45190328  0.4451738
#> 5 -0.5194580 -1.2221056  0.06317895  0.15067122 -0.75943440 -0.7584065
#>            157         158         159         160         161         162
#> 1  0.051001559  0.4579355  0.57053811  0.1175550 -0.1962088  0.15791366
#> 2 -0.149268758 -0.4070264 -0.04287047 -0.1365019 -0.1981188 -0.36367445
#> 3 -0.705715128 -0.1213432 -0.05671325 -0.9358367  0.2909226 -0.02494178
#> 4 -0.003566287  0.4984736  0.68412281 -0.4389722  0.6604856 -0.65915138
#> 5 -0.284328316  0.2598854  0.06729398  0.1153083  0.7159439 -0.44049100
#>          163         164         165         166         167         168
#> 1  0.4640424  0.61339821  0.33631649  0.50906346 -0.02988715  0.6917919
#> 2 -0.2143637 -0.08253502 -0.01422696  0.01501698 -0.24345103 -0.3325655
#> 3  0.6974189  0.53376175  0.01289270 -0.67337411  0.03596347 -0.2083181
#> 4 -0.9449133  0.04471201 -0.01262969  0.50623115 -0.29404154 -0.3246160
#> 5 -0.2143666  0.29607272 -0.11226322  0.04743149 -0.51400189  0.2658628
#>           169         170         171         172         173         174
#> 1 -0.21593291  0.64754765  0.58229769 -0.04806168 -0.01385538 -0.42939340
#> 2 -0.09039814 -0.33426566 -0.69031693 -0.47621529 -0.31287627 -0.17482762
#> 3  1.00738750 -0.01851372  0.41373973 -0.30703778 -0.20341825 -0.08356962
#> 4  0.02904725  0.12550014 -0.18923539  0.02570236  0.01872816  0.28399307
#> 5 -0.77504362 -0.06472232  0.09536432 -0.38732010 -0.29522876 -0.10837164
#>           175         176         177         178         179         180
#> 1 -0.02835222  0.12368835  0.12692342 -0.10340293 -0.14313579  0.02207836
#> 2  0.03311640  0.01718515  0.06853988 -0.44442226 -0.06689367 -0.34657703
#> 3  1.02518727  0.09513698 -0.74704077 -0.68471190 -0.77551825  0.12849632
#> 4 -0.12412693  0.55564689  0.16528210  0.06335519 -0.42210989  0.33945918
#> 5 -0.27376516 -0.29174453  0.09411501  0.93851945  0.19843762  0.36399061
#>           181          182         183         184         185         186
#> 1  0.29262780 -0.314645559  0.13251735  0.59204370 -0.3674472  0.4439589
#> 2 -0.20360180 -0.055260829  0.04141384 -0.04641734 -0.3724033 -0.1648925
#> 3  0.21571441 -0.506614383  0.33005762 -0.21335144 -0.8495445 -0.5453443
#> 4 -0.05306831 -0.009699505 -0.05494839 -0.11863998 -0.6723188 -0.1308761
#> 5  0.25994555 -0.479878691  0.55024326 -0.01169700 -0.3764713 -0.1962039
#>           187         188         189          190         191         192
#> 1 -0.19458408 -0.3919685 -0.5392328  0.210025585 -0.15642377 -0.1121745
#> 2 -0.46623352 -0.1945033 -0.2765365 -0.437107682 -0.02824591 -0.0137198
#> 3  0.01005885  0.2603170  0.6625878  0.023276500 -1.24224639  0.6568225
#> 4  0.18205663 -1.4367227 -0.7931617 -0.009340915  0.50418100  0.2962404
#> 5 -0.15459726  0.4074572 -0.2700543  0.062493443 -0.05720502 -0.5768854
#>           193         194          195          196         197
#> 1 -0.42012725 -1.15310695  0.572721202  0.007686597  0.03384184
#> 2 -0.22959928  0.03871662 -0.008145671 -0.058586788 -0.22633581
```

```
#> 3  1.36755593  1.37581409 -0.298102574 -0.422326529 -0.73703229
#> 4 -0.13164775 -0.48136477 -0.186579852 -0.377846946 -0.29811528
#> 5  0.03493856 -0.43660797  0.104683459 -0.016863695 -0.58954363
#>           198        199         200          201        202         203
#> 1 -0.03961779 -0.4600117 -0.09576678 -0.098012810 -0.1945209  0.45427144
#> 2 -0.05257738 -0.2073000 -0.05471169 -0.298138118 -0.4792068 -0.11496417
#> 3  0.01157722 -0.7865783 -0.48331183 -0.595371875  0.2841724 -0.08655131
#> 4  0.17481905  0.4678694 -0.74620114  0.400773257  0.2804912  0.06989101
#> 5 -0.22659592  0.1144711 -0.02852588  0.001429395 -0.1838964  0.28945311
#>           204         205         206         207        208         209
#> 1  0.1191151  0.04870360  0.82670327  0.4946159 -0.2498191  0.79174749
#> 2 -0.1588761 -0.02950543 -0.29732272 -0.1016534 -0.1573904 -0.35680929
#> 3 -0.2002485 -0.59435678 -0.71773896  0.5945637 -0.3591834 -0.25090850
#> 4  1.1189000 -0.19947071  0.35767464 -0.7963723 -0.2264914 -0.45952646
#> 5 -0.4247872  0.20405086  0.09119122 -0.1336539  0.7015868 -0.00363324
#>           210         211         212         213         214         215
#> 1 -0.16636116 -0.09504943  0.09731115 -0.81835864  0.22841629  0.67470185
#> 2 -0.28051747 -0.08381073 -0.10372380  0.11129123 -0.09024021 -0.04638255
#> 3 -0.14316521 -0.68896910  0.05954856 -0.04942479  0.68244976 -0.17353753
#> 4  0.03204052  0.23877756 -0.77338759 -0.60879876 -0.17067634  0.02476100
#> 5 -0.18388737 -0.56022355  0.32635002 -0.08660871  0.39037864 -1.04303450
#>           216         217        218        219        220         221
#> 1  0.8054967  0.02464152  0.8158847  0.3803715  0.1182419 -0.07002739
#> 2 -0.2515823 -0.07630523 -0.2811819 -0.4373923 -0.1759834 -0.39606320
#> 3  0.1581896  0.87497295  0.7400291 -0.9960164 -0.7156804  0.30505963
#> 4  0.2221446  0.44570752  0.8641705 -0.5112934 -0.9541388  1.06227736
#> 5 -0.2215647 -0.47148349 -0.6190156  0.3161815 -0.1947727  0.06106580
#>           222        223         224         225        226        227
#> 1 -0.02374483  0.6492953 -0.34913675  0.03003728 -0.2191031  0.3885697
#> 2 -0.07066302 -0.6015252 -0.20323856 -0.22987130  0.2212300 -0.3419037
#> 3 -0.76860271 -0.4003603 -0.22659122  1.08562603 -0.2782425 -0.2397290
#> 4 -0.71897773  0.5455919  0.41704862 -0.12037647  0.3542746 -0.8212967
#> 5  0.45953492 -0.6131163  0.09676732 -0.16860680  0.2534536  0.3203354
#>           228         229        230         231        232          233
#> 1  0.06173504 -0.99654239  0.9812396  0.50755148 -0.4950941 -0.677181856
#> 2 -0.06864663 -0.09308773 -0.3247298 -0.04280057 -0.3929308 -0.324002544
#> 3 -0.57705045  0.49034857 -0.2653312 -1.05709535  0.7420107 -0.315045120
#> 4  0.26843993  1.14341767 -0.1324919  0.44256694  0.1858946  0.369593146
#> 5  0.11517102 -0.54427639  0.6866133 -0.35818162 -0.5073734 -0.004149914
#>           234        235         236         237         238         239
#> 1  0.17705121 -0.3706623 -0.32322869 -0.3882897  0.06898226 -0.06362893
#> 2 -0.12082307 -0.2634332 -0.11857208 -0.4379556 -0.14593985 -0.21615998
#> 3  0.06921086  0.6236115 -0.25179229  0.3562062 -0.30198756 -1.21257068
#> 4  0.61467929 -0.2482206 -0.16427799 -0.7446304  1.03780087  0.41616267
#> 5  0.53936179  0.3891229 -0.07269506 -0.4770216  0.64106217  0.02814720
#>           240        241        242          243         244         245
#> 1 -0.2036582  0.1108783 -0.5698648  0.307640986 -0.15816255  0.42990429
#> 2 -0.2013050 -0.3089057  0.1601684  0.039204756 -0.44501823 -0.16336883
#> 3 -0.3535575  0.1082523 -0.1014300 -0.009797501  0.13519220  0.21152877
#> 4 -0.5380722 -0.7436213 -0.4805238  0.027997142  0.27710936  0.07369758
#> 5  0.2337291 -0.3803719 -0.4444535  0.007129374 -0.07917051  0.29673414
#>           246         247        248         249          250         251
#> 1 -0.1571760 -0.11054146  0.3945439 -0.10207419 -0.005762165 -0.3920155
```

```
#> 2 -0.2708567  0.10481967 -0.1420319  0.03639378 -0.541031748 -0.3240877
#> 3 -0.2933394 -0.52686148  0.5514007  0.98256871 -0.071684350  0.6363105
#> 4 -0.7705080  0.08363008 -0.2224351  0.17973221  0.248710799 -1.0419485
#> 5 -0.3122277  0.48809258 -0.2105843  0.51630974  0.086991568 -0.5664398
#>           252        253        254         255         256         257
#> 1 -0.79349522  0.2667845  0.4130458  0.44320388 -0.11253834 -0.15464964
#> 2 -0.04088518 -0.1988928 -0.1105994 -0.24760256 -0.33944795  0.05478381
#> 3 -0.36582836  0.3265524  0.2328803 -0.05398845  0.95752932  0.12836319
#> 4  0.93602017 -0.2894260  0.1794442  0.04932595  0.03477383 -0.87984830
#> 5  0.24441960  0.5733056 -0.3528748 -0.25998261 -0.38844785 -0.41261352
#>           258         259          260         261         262         263
#> 1  0.19821541 -0.2575350  0.511767769 -0.1613375  0.8490005  0.4963020
#> 2 -0.07562479 -0.4515204 -0.115031076 -0.2506233 -0.4279321 -0.0402355
#> 3  0.05508310 -1.0486459  0.673314995  0.6759816  0.1584211 -0.2224855
#> 4  0.40434173  1.5239140 -0.002196145 -0.3608666  0.2339480  1.1881637
#> 5  0.68704161 -0.8636847 -0.537109874 -0.5548416  0.3045462  0.7434198
#>           264          265         266          267         268          269
#> 1 -0.52733508 -0.41030291 -0.56512817  0.41626359 -0.03622207  0.454498324
#> 2  0.04769223  0.06554644 -0.09646024 -0.34968273  0.06494382  0.002909401
#> 3 -0.05862514 -0.65918720 -0.67689574 -0.07990385  0.52418140  0.083492222
#> 4 -0.41690605  0.14355225 -0.38514991 -0.54587703 -0.16788794 -0.677954245
#> 5  0.05416319 -0.01814869  0.54806678 -0.65226542 -0.58154084  0.957038183
#>           270        271         272         273          274         275
#> 1 -0.2283377 -0.2542903  0.51702411  0.7884834  0.0444483820  0.09288147
#> 2 -0.2027082 -0.2507513 -0.23143191  0.3381160 -0.3367401840 -0.05484301
#> 3  0.2691276 -0.6076512  0.05286721  0.1040432 -0.0009331142  0.15110767
#> 4 -0.3253811  0.1191698  0.26049325 -0.6204638  0.2422610672 -0.38123253
#> 5 -0.9429862  0.1056658 -0.13248456 -0.1043087  0.1805338211  0.49600479
#>           276         277        278         279         280         281
#> 1 -0.55632059  0.11054018  0.1002715  0.10874364  0.1599731  0.1760556
#> 2 -0.15554869  0.04224552  0.0387671  0.04702720 -0.4101152 -0.2832606
#> 3  0.05641763 -0.47787549  0.6365669 -0.74699442  0.5173123  0.4172713
#> 4 -0.84288409 -0.34060213 -0.5145170 -0.39517984 -0.9749672 -0.7847612
#> 5 -0.21325753  0.23928910 -0.2070372 -0.07645852  0.3674222 -0.2250821
#>           282         283         284         285         286         287
#> 1 -0.50361648  0.1957443  0.23082132 -0.36572792  0.3781894  0.34587981
#> 2 -0.06664182  0.1157681 -0.15034506  0.04149202 -0.2472589 -0.36420949
#> 3  0.28414115  0.5088796 -0.08588344 -0.77022865  0.5850160 -0.01588048
#> 4 -0.01579165 -0.2225745 -0.13406296 -0.10324950 -0.2624028  0.59785071
#> 5 -0.25282832 -0.8769229 -0.11155346  0.41793594 -0.3938511 -0.56889572
#>           288         289         290         291         292         293
#> 1 -0.929298832 -0.05058438 -0.1321362 -0.06548937  0.07971995 -0.6095113
#> 2 -0.265870988 -0.01491961 -0.2421760 -0.14735920 -0.58905953 -0.2297312
#> 3  0.951011714 -0.83955245 -0.2425269 -0.02963904  0.46328495  0.6193254
#> 4  0.006875303  0.04214186 -1.0595060 -0.52682246  0.33252897 -0.2525349
#> 5 -0.619853379  0.84274040  0.6906785 -0.29209146  0.27337911  0.2659665
#>           294         295         296         297         298         299
#> 1 -0.2588170  0.14327089  0.1367911  0.1541647 -0.6451365 -0.2454932
#> 2 -0.2571485 -0.23782320 -0.3171164 -0.3028338 -0.1451964 -0.1840770
#> 3  0.7495209 -0.43799669 -0.6382841  0.2883908  0.2301080  0.5875673
#> 4 -0.3315445  0.15130182  0.4674131  0.1813776 -0.4701671 -0.3956435
#> 5 -0.1865789  0.07949498  0.2683446 -0.4361987  0.7867093  0.7933921
#>           300         301         302         303         304         305
```

```
#>  1  0.06589858  0.1580467  0.6315297 -0.05893037  0.32135394 -0.37649820
#>  2 -0.03907029 -0.1778240 -0.2214404 -0.03069261 -0.39330553 -0.12847727
#>  3  0.48134714  0.9303331  0.1882104 -0.69544073  0.58104539  1.91025547
#>  4  0.23185385 -0.3110922  0.7439579 -0.53397962 -0.05304700 -0.34154118
#>  5 -0.58056743  0.5871597 -0.1705773  0.09543652 -0.07715192 -0.06707516
#>           306         307         308         309         310         311
#>  1  0.3083191 -0.09730933  0.02979209  0.06358576  0.8254488 -0.1512513
#>  2 -0.2383749 -0.25225570 -0.12461752 -0.32541250 -0.1894473 -0.1687640
#>  3 -0.4669108 -0.16318052 -0.45638737  0.50075893 -0.1567762 -0.1940442
#>  4 -0.6394345 -0.85220806 -0.32272989  0.14425971 -0.7082144  0.3000587
#>  5  0.7129227  0.49778897 -0.26864604  0.54626360 -0.1068121  0.3525442
#>           312         313         314         315         316         317
#>  1  0.82039354 -0.18498430 -0.2207377 -0.5183145 -0.3286650  0.43188767
#>  2 -0.16534664 -0.04097014 -0.2481535 -0.2592501 -0.3146802 -0.18400773
#>  3  0.61588300 -1.09370979  0.1131162  0.1135318  0.7956170  0.06590423
#>  4 -0.24933172  0.13675384 -0.3639423  0.6374543  0.2223656 -0.34211941
#>  5 -0.03899257  0.18630660  0.4006508 -0.5868041  0.4713211 -0.29585804
#>           318         319         320          321          322
#>  1  0.83850501  0.62182673 0.095160530 -0.215327762  0.446211293
#>  2 -0.13791648  0.04775353 0.006345852  0.001958132  0.003370876
#>  3  0.37749307  0.29525040 0.160484219  0.102060255  0.524861910
#>  4 -0.82892703 -0.14062336 0.575562860  0.119711621 -0.709501690
#>  5 -0.01278158 -0.35673901 0.424946864  0.139123996  0.193549558
#>           323         324          325         326         327          328
#>  1 -0.28685487 -0.8683734 -0.076815683  0.20896275  0.43417719  0.53585343
#>  2 -0.14369827 -0.1064390 -0.001195293  0.04353154 -0.01745769 -0.19870906
#>  3 -0.29845285  0.4652770  0.450920988 -1.41288410 -0.37748821 -0.22127076
#>  4  0.04548457  0.4026670 -0.587450186  0.09924276 -0.04531448 -0.26472306
#>  5 -0.36171732  0.2422718 -0.967412014 -0.28071764  0.42658939  0.02646455
#>           329         330          331         332         333          334
#>  1 -0.2341534 -0.53118982  0.520622405 -0.6132434  0.19768501 -0.21080819
#>  2 -0.27051534  0.05846314 -0.493619047 -0.1503602 -0.07860417 -0.06975969
#>  3 -0.08812282 -0.51944909 -1.039002494  0.8155734 -0.07917443  0.95293279
#>  4  0.25104815 -0.41389479 -0.176966046 -0.2920346 -0.88586877  0.41449245
#>  5  0.09119682 -0.61855243 -0.005058847 -0.1257836 -0.31001308 -0.22061631
#>           335         336         337         338         339         340
#>  1 -0.15390064  0.07843821  0.12525820  0.1090802  0.77241619 -0.06050214
#>  2 -0.10062988 -0.40539145 -0.27236425 -0.1123775 -0.29111986 -0.27427107
#>  3 -0.59934990 -0.36072737 -0.43455623 -0.1352037 -0.02741347  0.24854054
#>  4 -0.09969756  1.42235326 -0.04107408  0.8077345 -0.59969866  0.25268863
#>  5  0.68811756  0.69457118 -0.20205908  0.5396668 -0.37552456  1.00356422
#>           341         342         343         344         345         346
#>  1 -0.2466827  0.35356303 0.147641896 -0.20056635 -0.4689421  0.20471211
#>  2  0.2414119 -0.01759022 0.095838964 -0.09698348 -0.1572625 -0.06172079
#>  3  0.5403636  0.36046156 0.018545881  0.54190793 -0.5263953 -0.64043006
#>  4  0.1476692 -1.03644678 0.160913647 -0.37176652 -0.4228240 -0.23409827
#>  5  0.1175750  0.89089975 0.004673002  0.18611971 -0.5273666  0.03498710
#>           347         348         349         350         351         352
#>  1 -0.69781539  0.04753899  0.12307473 -0.6692644  0.11915952  0.33061022
#>  2 -0.26239661 -0.09999711 -0.19624252 -0.3284257 -0.05405561 -0.31294779
#>  3  0.07753823  0.52070363  0.22506367 -0.3691400 -0.16634937  0.24843670
#>  4 -0.17103621  0.46529874  0.09994455  0.1855504 -0.54945308  0.03860849
#>  5  0.49769881  0.23555774 -0.04512022 -0.4024571  0.94057549  0.19265825
```

```
#>          353        354         355        356        357         358
#> 1 -0.3888338 -0.2813940  0.27468380  0.1284673 -0.1624097  0.19564086
#> 2 -0.4502637 -0.1579265 -0.29107030 -0.1670859 -0.1301331 -0.33794069
#> 3  0.2546045  0.1577496 -0.04719554 -0.2034554  0.3503378  0.19422055
#> 4  0.1298864 -0.2008702 -0.02056044  0.9951753 -0.5605762 -0.06962256
#> 5  0.3337949  0.1331620  0.18834583  0.1988448 -0.4952380 -0.03204378
#>          359        360        361         362         363        364
#> 1  0.50017574 -0.1820760 -0.5484316 -0.24081350 -0.49882223  0.1724026
#> 2 -0.30910520 -0.4590409 -0.2087517 -0.07006777 -0.13937048 -0.1542747
#> 3 -0.44964022 -0.2823780  0.2642874 -0.37683729 -0.06836475 -0.0462751
#> 4  0.35159259  0.1607749 -0.3246602 -0.05922967 -0.46460893 -0.1785681
#> 5  0.05835138 -0.7383609  0.1376705  0.58690072  1.20427122 -0.1328204
#>          365         366        367        368         369        370
#> 1 -0.1498326  0.55679679 -0.2364389 -0.3829215 -0.08598474 -0.7527183
#> 2 -0.2562049  0.01542249 -0.3863190 -0.3671246 -0.24027709 -0.4914935
#> 3  0.5169515  0.53671429  0.4963392  0.0443364 -0.54841335  0.6853309
#> 4  0.4602788 -0.65281112  0.3608253  0.1831794 -0.13160696  0.6927421
#> 5 -0.4129105  0.20626456  0.2086183  0.3248493 -0.24636896 -0.5581298
#>          371         372         373        374        375         376
#> 1 -0.1209429 -0.28891093  0.15950372  0.4554504 -0.1520976 -0.5188342
#> 2 -0.2708552 -0.67375535 -0.33842763 -0.5355013 -0.3158391 -0.5327149
#> 3 -0.7356287  0.19736287  0.06238895 -0.3826309  0.1558776  0.3829988
#> 4  0.1806447  0.57735518 -0.75429855 -0.4069402 -0.8763866  0.6704236
#> 5  0.6054707 -0.02506602  0.19409041  0.3461508  0.5663617 -0.4770541
#>          377         378         379        380        381         382
#> 1  0.1484546  0.12712899  0.12132627 -0.2520345  1.1414907  0.8261817
#> 2 -0.2215367 -0.36368870 -0.18138888 -0.2564696 -0.3060971 -0.4081535
#> 3 -1.0355968  0.41379778 -0.04281664 -0.2976979 -1.0793374 -0.7233423
#> 4 -0.1991216 -0.23943194 -0.15154648  0.4277175 -0.5072783  0.6025567
#> 5 -0.4549223  0.06485616  0.61916539 -0.3673046 -0.2575595 -0.5451579
#>          383         384        385         386        387         388
#> 1  0.06401572  0.63291082  0.4865032 -0.50210425  0.4498780  0.7655372
#> 2 -0.37485496 -0.27366350 -0.1785327 -0.58325064 -0.3321113 -0.2824488
#> 3 -0.46521759  0.50459162 -0.4333917 -0.02601396 -1.3814482  0.3440361
#> 4  0.59242461 -0.82032695  0.3141775 -0.67697985 -0.1278803  0.8919974
#> 5  0.21937988  0.03114518 -0.4103414  0.53812891  0.8232184  0.1508628
#>          389        390        391        392         393         394
#> 1  0.6204497  0.4655342 -0.2083090  0.3139321  0.04323464 -0.97216255
#> 2 -0.2438087 -0.3678750 -0.3123191 -0.2975324 -0.30668070  0.06409153
#> 3 -1.0064185  0.1253635  0.1840356  0.1360001  0.21953324  0.34049551
#> 4  0.2949708 -0.1804217 -0.3924494  0.9753885  0.21187423  1.20023173
#> 5  0.1969103  0.7727097  0.2369906  0.7113937  0.47589433 -0.26394512
#>          395         396         397        398          399        400
#> 1 -0.09470278  0.67763212 -0.27115930 -0.2228337 -0.329413653  0.2564827
#> 2 -0.57426390 -0.08934538  0.02065623 -0.2940273  0.06984184 -0.6542466
#> 3 -0.06343294  0.08951891  0.09088126 -0.4639714  0.805494759  0.4299139
#> 4 -0.24241972  0.26477857  0.54819208  0.1158466  0.428822792 -0.5596434
#> 5 -0.29552526  0.11597698 -0.15616689  0.2538140  0.008404814 -0.7710264
#>          401         402         403        404         405        406
#> 1 -0.05846292 -0.58746839  0.34165633  0.1233604 -0.31338212  0.4611290
#> 2 -0.36605872 -0.09253658 -0.19291976 -0.2861338 -0.15010200 -0.1686094
#> 3 -0.21964947 -0.02289572 -0.57322550 -0.1360332  0.34841494  0.6897352
#> 4  0.45262523  0.37316434  0.67681765 -0.2015184 -0.04247271 -0.6268045
```

```
#> 5  0.73586321 -0.39841494 -0.08130706  0.4110804  0.25872243 -0.4074596
#>           407         408        409         410          411         412
#> 1  0.44452192 -0.22751719  0.4914482 -0.30632350 -0.031887589 -0.53394068
#> 2  0.01137207 -0.18227131 -0.4122705 -0.08372707 -0.002538823 -0.03598376
#> 3  0.69137727 -0.17222267  0.6590490 -0.21602911  0.006492096 -0.41945403
#> 4  0.58015434  0.48245525 -0.3657118  0.10636764  0.058301912  0.68555670
#> 5 -0.19895932 -0.04282148  0.2974441 -0.07611438 -0.269045265  0.57943950
#>           413         414        415          416         417         418
#> 1 -0.29413855 -0.97705288 -0.7777529  0.004161935  0.37405994 -0.38359263
#> 2 -0.34680987 -0.44714677 -0.3755223 -0.262407834 -0.14132512 -0.09062592
#> 3 -0.12052633 -0.37049120 -0.1503765  0.088421071  0.24129264  0.02149397
#> 4  0.25945030  1.27439211 -1.0236223  0.379622439  0.53861227  0.17522030
#> 5 -0.06095789 -0.04102625 -0.1434496  0.555193373 -0.09604184  0.49949311
#>           419         420         421          422         423         424
#> 1  0.03524693  0.15161497 -0.09440421  0.430803372 -0.53643227 -0.27066567
#> 2 -0.17284778 -0.07375267 -0.33212074 -0.267680985 -0.02191643 -0.09298312
#> 3 -0.24167398 -0.48547933  0.25693878 -0.614844552 -0.87031962 -0.31510563
#> 4 -0.52949880  0.07827378  0.24159622 -0.005229472 -0.29982005 -0.28578761
#> 5 -0.30009795  0.08125442 -0.48205114  0.196783263  0.01989802  0.16698895
#>          425        426        427          428         429         430
#> 1  0.8026869  0.3164025 -0.1641314 -0.086460900  0.26262828 -0.3525628
#> 2 -0.4486130 -0.2467827 -0.1111693  0.088726185 -0.38322810 -0.1048749
#> 3 -0.2125312  0.4836965  1.1562290 -0.005983318 -0.00788391 -0.1165339
#> 4 -0.7087375  0.7297806 -0.2823974  0.155373169 -0.13018269 -0.1457920
#> 5 -0.8774190  0.6847616  0.4422757 -0.282304407  0.02853325 -0.3477355
#>           431        432           433         434         435         436
#> 1 -0.19874456 -0.2727443 -0.3506332525 -0.49005069 -0.24853741 -0.05644166
#> 2 -0.25935962 -0.4259408 -0.0002521077 -0.09250613 -0.11746306  0.01878174
#> 3  0.07475121 -0.5538708 -0.1322598746  0.33777992  0.19364382 -1.00005924
#> 4 -0.10526132  0.1909620  0.8565839189  0.52445277 -0.17676614  0.51675535
#> 5  0.04839775 -0.1886849 -0.0671208380 -0.15132139  0.06657756 -0.31447916
#>          437         438         439         440         441         442
#> 1  0.1835175 -0.30180669 -0.24911217 -0.05811262 -0.07713184  0.42640965
#> 2 -0.4360929 -0.34285640 -0.19377276  0.10009186  0.10490384 -0.02943465
#> 3  0.6386129  0.26067497  0.06410597  0.36753826  0.68695199 -0.68572523
#> 4 -0.7231504 -0.53369534 -0.05715560 -0.93596861 -0.30199466 -0.50382351
#> 5 -0.4049748 -0.09792776 -0.02549258 -0.03588785  0.61112844  0.31187710
#>          443         444          445        446         447         448
#> 1  0.7022157 -0.25906953  0.572962910 -0.4662536 -0.62820718 -0.01895617
#> 2 -0.3664160 -0.04114866 -0.001734693 -0.4392924  0.29863822 -0.34385216
#> 3 -0.2909948  1.30546253 -0.094923125 -0.5119083 -0.83815487 -0.38495514
#> 4  0.1495253  0.05660391 -0.422254154 -0.2646816 -0.21659811 -0.40413175
#> 5  0.3397178 -0.92561965  0.036848098  0.5040643  0.09991138  0.14886483
#>          449        450        451        452         453         454
#> 1  0.2578389  0.1945983  0.6321590  0.5797976 -0.27790523 -0.08297132
#> 2 -0.2473177 -0.3679577 -0.4643532 -0.3151017 -0.01194468 -0.59435062
#> 3  0.9099006  0.2871439 -0.3464939  0.5783902 -0.79162640 -0.59745094
#> 4 -0.1192693  0.5173956 -0.1529362  0.4177025  0.21341059 -0.11039574
#> 5 -0.9105052 -0.3597989 -0.6184625  0.5103723  0.33875557  0.46631715
#>           455          456         457         458         459         460
#> 1 -0.07111313 -0.834788998 -0.26963736  0.96477244 -0.03931857 0.23002682
#> 2 -0.36231867  0.115311899 -0.04620186 -0.21706486  0.21037835 0.04166292
#> 3 -0.10484507 -0.007321142 -0.11155687  0.79469567 -0.36890990 0.01763332
```

```
#> 4 -0.46175508 -0.602267991  0.20616634  0.78591902  0.15082357 0.01462283
#> 5  0.38008466  0.140877275  0.46045419  0.07123362 -0.14853114 0.16021951
#>           461          462         463        464        465         466
#> 1  0.08893506  0.118060365 -0.62328154 -0.2324360 -0.3174536 -0.58091079
#> 2 -0.83647883 -0.058368679 -0.38873229 -0.3228051  0.1010995 -0.13361619
#> 3  0.62813666 -0.278884143 -0.20728286 -0.1159230  0.3958841 -0.22159892
#> 4  0.17852302  1.408774749  0.07717735 -0.8440678 -0.4983956  0.04729106
#> 5 -0.41593464  0.003847981  0.70767345 -0.1845370  1.2676402  0.36831735
#>          467        468         469         470        471        472
#> 1 -1.0214872  0.4699514 -0.05173825 -0.23713905 -0.1364211  0.4456317
#> 2 -0.2909863 -0.2683078 -0.29742281 -0.13648942 -0.2245483 -0.1083608
#> 3 -0.3059604  1.4907296  0.21867661 -0.31945060  0.5114582  0.6322259
#> 4  0.5932978  0.1763340  0.46213125  0.01732972  0.3802164 -0.1952438
#> 5 -0.3317403  0.8148170  0.06418447 -0.29942490 -0.6379180 -0.1450814
#>           473         474         475        476        477        478
#> 1 -0.64321224  0.02728395  0.10078344 -0.7315166  0.2636861  0.5628129
#> 2 -0.31688715 -0.10136342 -0.05327698 -0.1950564 -0.2399486 -0.1893485
#> 3 -0.02393511  0.55813442  0.17036200  0.9586264 -0.1977060 -1.5429231
#> 4  0.76225968  0.37242666  0.10047930 -0.5717795  0.8439305  0.4964697
#> 5  0.74821374  0.24636068 -0.32576640 -0.3476198 -0.2206935  0.4571763
#>          479        480         481        482        483         484
#> 1  0.5235803 -0.4745194 -0.07792447  0.2255679  0.3183399 -0.243218856
#> 2 -0.3722569 -0.3026113  0.21690763 -0.1454142 -0.0906823 -0.279315574
#> 3  0.2459065  0.3290476  0.55262153 -0.4363157 -0.4387449 -0.005270621
#> 4  0.4508960  0.6321876 -0.32026513 -0.1867254  0.7950097  0.497964799
#> 5 -0.2324497  0.3974477 -0.46463525 -0.3104915 -0.2311004 -0.284613147
#>           485          486         487         488        489         490
#> 1 -0.27802886  0.001145152  0.95519202 -0.29699492 -0.7233408 -0.61795214
#> 2 -0.05678101 -0.158227698  0.03711207 -0.12372008 -0.2484519 -0.08492515
#> 3 -0.82142874  0.835475153 -0.35318004 -0.37621626 -1.2188814  0.59443371
#> 4 -0.42134970  0.431902174 -0.19284489 -0.08987509  0.1853687 -0.12354350
#> 5 -0.26540314 -0.343071879 -0.08460627 -0.17154000 -0.5162689  0.14005923
#>           491         492         493        494         495        496
#> 1  0.43874007 -0.49375846 -0.12951962  0.2571141 -0.40973956  0.0483506
#> 2 -0.38761921  0.12294725 -0.73677635 -0.1277114  0.05164898 -0.4289807
#> 3 -0.60717139 -0.08614331  0.06445508 -0.2261252  0.47523865 -0.6544011
#> 4 -0.06330394 -0.49845968 -0.44783426  0.2786129  0.49606524 -0.9147054
#> 5 -0.01131565  0.38662563 -0.66930797  0.3923289  0.68604044  0.8227037
#>          497        498          499        500         501         502
#> 1 -0.1883245 0.12628245 -0.1243521257 0.20563038 -0.26882762 -0.02763743
#> 2 -0.1578162 0.07362897 -0.0003274374 1.40456267  1.75189772  1.69711663
#> 3  0.5948407 0.16428550 -0.3792906706 0.08538298 -0.31743434  0.19027443
#> 4  1.3165209 0.51789914  0.0611995566 0.07111883 -0.28631666  0.42106490
#> 5 -0.2123876 0.12119105  0.1736605542 0.36635991 -0.08455343 -0.27216385
#>          503        504         505         506        507        508
#> 1 -0.2351657 -0.6020518 -0.02251395  0.03114512  0.1363008 -0.7039259
#> 2  1.2419118  1.6470960  1.54380721  1.28571572  1.8528533  1.8017876
#> 3 -0.4267987 -0.1926383 -0.33913455 -0.44090648  0.4812527  0.7754977
#> 4  0.8632818  1.1182051  0.91472906 -0.46086625 -0.2787639  0.1910734
#> 5 -0.6747142  0.1322356  0.31802594  0.04840475  0.8999062  0.1562820
#>          509         510        511        512         513        514
#> 1  0.4755866 -0.10633369  0.1049595  0.2895586 -0.16819591  0.3026810
#> 2  1.2003172  1.81109212  1.4792762  1.4622884  1.52935766  1.5248802
```

```
#> 3 -0.1509047  0.05358232 -0.1905656 -1.3298097 -0.24185087 -0.1871718
#> 4  0.4064875 -0.26476026  0.1121307 -0.6060397  0.04097193  0.7571746
#> 5 -0.2018832  0.48182669  0.3673395 -0.4782888  0.22393010  0.3783979
#>          515         516        517         518         519        520
#> 1 -0.6326884  0.17790367  0.1529473 0.000949494  0.11361548 0.09812261
#> 2  1.5559619  1.55896838  0.9514437 1.292185544  1.55367657 1.61736671
#> 3 -0.8179185  1.01707114  0.9075041 0.588472403  0.88142065 0.07829130
#> 4  0.6401386  0.01862849 -1.1016273 0.209676748 -0.31378323 0.09324847
#> 5  0.1432116 -0.56421531 -0.4775998 0.551810970  0.07454074 0.20100697
#>          521         522        523         524         525        526
#> 1 -0.1621031 -0.4124857  0.3829286  0.16393616 -0.10138938  0.7397632
#> 2  1.5975176  1.5324968  1.4368595  1.14485742  1.60852329  1.4969632
#> 3  0.5923674 -0.4113790 -0.3974979  0.02879990  0.77186286  0.1989546
#> 4 -0.5095456  0.1330409 -0.1350190  0.09448719  0.05082684  0.4668918
#> 5  0.0369825 -0.1566914 -0.6035754 -0.06789964  0.14263415 -0.9849619
#>          527         528        529         530         531        532
#> 1 -0.5249672 -0.5074125  0.04227187  0.1436162 -0.1115161  0.1102102
#> 2  1.1416396  1.5170490  1.47116568  1.3995933  1.1143836  1.4742794
#> 3 -0.4391366  0.2480318  0.27712556  0.1864313 -0.5480993 -0.5238488
#> 4 -0.4742186 -0.1686239 -0.48356212  0.1659317 -0.1234020 -0.3492770
#> 5 -0.1856317 -0.6540165  0.34711365 -0.1602043  0.1961470  0.3468394
#>           533         534         535         536         537         538
#> 1  0.86559317 -0.1575004 -0.01888199  0.9029136 -0.24127670  0.43468781
#> 2  1.74672549  1.5174088  1.46839683  1.5041989  1.65671952  1.45860367
#> 3  0.59149827 -0.1334661 -0.76511816 -0.1468837 -0.63263733 -0.02140968
#> 4 -0.09297852 -1.3191741 -0.19512176  0.6817900 -0.02217292 -0.79391060
#> 5  0.02205584  0.4638567 -0.29390553  0.5102829  0.08757419  0.49246010
#>          539         540        541         542         543        544
#> 1 -1.2850673  0.42112720  0.1573996  0.2950914 -0.1580974  0.2461036
#> 2  1.7832946  1.58668899  1.4969298  1.4424795  1.4690633  1.6410311
#> 3  0.4690894 -0.71372950  0.1653693  0.7815352  0.5732284  0.3096858
#> 4 -0.3562951  0.42350082  0.6979044 -0.2095406  0.1505243  0.2251811
#> 5  0.5886061  0.05077996 -0.4988030 -0.1344771  0.1495193 -0.3000748
#>          545         546         547         548         549         550
#> 1 -0.7384893 -0.1755618 -0.08937795 -0.1952706 0.009170035  0.31506241
#> 2  1.5515175  1.3050625  1.81634975  1.6864728 1.625985598  1.94061734
#> 3  0.5395583  0.1615067 -0.20169981 -0.2766119 0.176791836  0.45044295
#> 4  0.4624722 -0.3530398  0.68339808 -0.6386031 0.001634641  0.06244802
#> 5 -0.5242727 -0.3442774  0.21067310 -0.2159372 0.747443101 -0.01396852
#>          551         552         553         554         555         556
#> 1 -0.41368400 -0.01761842 -0.4153106 -0.5055195 -0.1916415  0.1106206
#> 2  1.22568109  1.31728614  1.6505580  1.5802521  1.5025665  1.2358365
#> 3  0.49312298 -0.02852972 -0.4870552 -0.6213101  0.5743329  0.2984626
#> 4  0.05435737  0.55150901  0.3099623  0.8303239  0.2033122  0.3196292
#> 5  0.26531694  0.12462296 -0.2785247  0.5656419  0.2426602 -0.2353362
#>          557         558          559         560         561         562
#> 1 0.01432198  0.32380039  0.1124631148 -0.32809326 -0.12092151 -0.21817319
#> 2 1.73024094  1.57494048  1.5913168344  1.75745771  1.52481737  1.40580754
#> 3 0.64687770 -0.34910396  0.0931666517  0.02057299 -1.08568126  0.06008485
#> 4 0.84938983  0.63833256 -0.0009207093  0.18022183 -0.04452153  0.49642564
#> 5 0.27054341  0.08715501  0.5637357044 -0.04678057 -0.54460236 -0.18654890
#>          563         564         565         566         567         568
#> 1  0.54965779 -0.47827593  0.8373319  0.45250635 -1.0600953 -0.2131507
```

```
#> 2  1.51072908  1.78406743  1.7867569  1.44540937  1.7113705  1.4419683
#> 3 -0.12323700 -0.11755455  0.1213718  0.01761069 -0.1392129  0.1767065
#> 4 -0.09497711  0.03097238 -0.0183718 -0.36001694  0.8083770 -0.2799513
#> 5 -0.82268262  0.14698253 -0.1242347 -0.22246799 -0.2320375  0.1771697
#>          569        570        571        572         573        574
#> 1  0.2006595 -0.9476748  0.4369781  0.5825721 -0.87012088  0.3426916
#> 2  1.5824690  1.5467432  1.6619796  1.2223396  1.34587223  1.4971112
#> 3 -0.4630460  0.3513185 -0.1892969 -0.8052954  0.06700105 -0.2283370
#> 4 -0.2625819  0.5448299  0.0507760 -0.1663153 -0.48409027 -0.1064669
#> 5 -0.2234180  0.1306242  0.3209654  0.3230902 -0.01706252 -0.2589465
#>          575         576        577        578         579         580
#> 1  0.2618689 -0.40178125 0.6350788  0.3283936  0.34020312  0.7330385
#> 2  1.5421300  1.20447941 1.7034082  1.4527622  1.30751286  1.3765522
#> 3 -0.3899005 -0.20488563 1.4604145  0.1435288 -0.59556496  0.1749258
#> 4  0.5932185  0.06093792 0.1044598 -0.5070787  1.19130638  0.6586431
#> 5 -0.0827593  0.04115268 0.6929459 -0.1354014  0.04173469 -0.1378840
#>           581         582         583         584         585         586
#> 1 -0.05965867  0.3908880  0.2309135 0.04211508 0.16115137  0.47603748
#> 2  1.70179035  1.4281791  1.7395391 1.37440276 1.73234008  1.63504939
#> 3 -0.79464425 -1.2823960  0.1174337 0.72159449 0.64529617 -0.28877397
#> 4 -1.05102198  0.2864017 -1.0808397 0.10513547 0.27056508  0.31053594
#> 5  0.49169990 -0.2392124 -0.5597592 0.42695234 0.05166746 -0.08704223
#>           587         588         589         590         591         592
#> 1 -0.03789617  0.13006104 -0.0801083  1.0023614 -0.68498954  0.5760526
#> 2  1.40340087  1.89909129  1.5767421  1.5044341  1.38572474  1.7467402
#> 3 -0.55594655  0.58605997 -0.2868340 -0.2760296  0.04270151 -1.0028636
#> 4  0.01821627 -0.14845139  0.1732367 -0.8125931 -0.32982992  0.2576952
#> 5  0.04619608  0.06025608 -0.1727694 -0.1603537 -0.09607106 -0.3927492
#>          593        594         595        596         597         598
#> 1 0.44132310 0.1194174  0.4531873 0.1638653  0.59321997 -0.21059849
#> 2 1.45882776 1.4845304  1.5233950 1.5777387  1.29963694  1.48445969
#> 3 0.67856175 0.1359853 -0.3454087 0.2220714 -0.03934745 -0.47885565
#> 4 0.09696444 0.3070784 -0.5318341 0.8787738 -0.83291629 -1.35241480
#> 5 0.61813768 0.1002287  0.2942750 0.1941199 -0.14322248  0.06371485
#>          599         600         601        602        603         604
#> 1 -0.5656951  0.15742241  0.06300663  0.1084210 0.28973389  0.3740172
#> 2  1.5823443 -0.24354123 -0.19986019 -0.1975115 0.01489423 -0.1580870
#> 3 -0.1650277 -0.05912083 -0.13206719  0.2256136 0.14193279 -0.8508302
#> 4 -0.7376680 -0.27420850  0.04900825  0.7914306 0.12635620 -0.0238759
#> 5 -0.9425688  0.04685634 -0.19957233 -0.1928028 0.08185413  0.5582874
#>          605        606         607         608        609         610
#> 1  0.1760117  1.1130777  0.28562411  0.15268160 -0.1732629  0.47892041
#> 2 -0.2513529 -0.2392276 -0.03185414 -0.11779342 -0.2796918 -0.55803218
#> 3 -0.1585968 -0.7704702  0.33071645  0.04301411  0.1300726 -0.08880430
#> 4  0.7657268  0.3058640  0.18609242  0.65799923 -0.1877893 -0.07365719
#> 5  0.2307637  0.8132690  0.36710420  0.42697062  0.3536543  0.46927534
#>           611         612         613         614         615         616
#> 1  0.13539246  0.3986611 -0.02346974 -0.2061695 -0.08922817 -0.49059664
#> 2 -0.10676764 -0.5715339 -0.07543696  0.3928630 -0.24550061 -0.05202011
#> 3 -0.02724951  0.1638489  0.40615554 -0.5493624 -0.78646692  0.23141103
#> 4 -0.49848413 -0.2099471 -0.53922053  0.5953518  0.19716902 -0.91917202
#> 5  0.13082606 -1.1284972  0.51060084 -1.0870190  0.05268219  0.76740112
#>          617         618         619         620          621         622
```

```
#>   [,1]       [,2]       [,3]       [,4]       [,5]       [,6]
#> 1  0.5752269  0.42981817 -0.25922601 -0.6245834  0.622114813 -0.3307448
#> 2 -0.1874114  0.04295360  0.19820379 -0.1502433 -0.549928144 -0.3304632
#> 3  0.4073398  0.44156713 -0.27605558  0.4020587 -0.005316599  0.1157115
#> 4  0.0297619 -0.10048283 -0.41463397 -1.0193304  0.109662607 -0.3233167
#> 5  0.1969061  0.07251558  0.08034389 -0.1245708  0.126971711 -0.2086159
#>          623         624         625        626        627         628
#> 1  0.11154435 -0.25838114 -0.12855285 -0.6776227 -0.6347673  0.20544123
#> 2 -0.23346947 -0.21511975 -0.35894894 -0.1760800  0.1220793 -0.00774676
#> 3  0.05150061  0.01218277 -0.57658035  0.2056634  0.6074756 -0.02366808
#> 4  0.87841288  0.72336140  0.23651352  0.2538604 -0.4494797 -0.58803042
#> 5  1.36739067 -0.87433932  0.01551737  0.1156511  0.6928576 -0.07965699
#>          629         630         631         632        633        634
#> 1  0.06179575 -0.01859085  0.65455953  1.11016857 -1.0078892  0.8033660
#> 2  0.07788059 -0.33295553 -0.21991411 -0.16095068  0.1365748 -0.2713199
#> 3 -0.07512568 -0.38567111 -1.16128594 -0.59755354  0.7310797 -0.9844840
#> 4 -0.03009723 -0.32441588  0.12786401  0.04749958  0.6751219  0.4743874
#> 5  0.08911003 -0.85037935 -0.06270182  0.27418286 -0.6661079  0.1608581
#>          635         636         637         638         639        640
#> 1 -0.02135316  0.07190710 -0.06205382  0.17443602  0.23456633 -0.4122220
#> 2 -0.11031296 -0.35805827  0.09684187 -0.24698414  0.14492497 -0.5332118
#> 3  0.41999020 -0.09098791  0.54962477  0.36106413  0.06191631  0.6078878
#> 4 -0.13130291  0.50155283 -0.56929412 -0.87236280 -0.27810451  0.1119182
#> 5  0.43862396  0.03498444 -0.39340246 -0.02655699 -0.33905637  0.2323365
#>          641        642        643         644        645          646
#> 1 -0.22983272  0.5253708  0.5732194  0.51949860 -0.1343351  0.004305671
#> 2 -0.15473137 -0.1544980 -0.1034184 -0.22041450 -0.2824935 -0.303797014
#> 3 -0.07977474 -0.4491968 -1.1688127 -0.08002250 -0.1351601  0.968298601
#> 4 -0.81623245  0.4787585 -0.8401758 -0.75818793 -0.7550176 -0.597383750
#> 5  0.32318678 -0.8180335  0.4635504 -0.02392737  0.4731449 -0.080849646
#>          647         648         649         650         651          652
#> 1 -0.26284941 -0.64905216  0.63622848  0.06521180  0.44423387 -0.082239097
#> 2 -0.09845102 -0.09671321 -0.10082128  0.16571790 -0.02686991 -0.006628834
#> 3 -0.71325369 -0.19693901 -0.03521839 -0.05436589 -0.29214210  0.162226537
#> 4 -0.02594651 -0.67796449  0.33167872 -0.64519573  0.40995790 -0.815416121
#> 5  0.74505737  0.55462177 -0.32177642  0.08556249 -0.14473171  0.079396892
#>          653        654          655         656        657         658
#> 1  0.08658630  0.3803976 -0.001111453  0.51104775 -0.2950923 -0.05458927
#> 2 -0.18802533 -0.1372751 -0.355722837  0.04991135 -0.5278061 -0.05520837
#> 3 -0.08439474 -0.3644118 -0.412044331  0.09246906 -0.1629141  0.44686772
#> 4  0.44307761 -0.6273584 -0.901448861  0.03306812 -0.4019955  0.92256054
#> 5 -0.60245667 -0.2364558 -0.130244079 -0.12575581 -0.6055081  0.16586381
#>          659        660         661         662        663         664
#> 1  0.8942686  0.5542121 -0.36853388 -0.15535432 -0.1371932 -0.32877702
#> 2 -0.4021425 -0.3750641  0.07549421  0.04004293  0.1354282 -0.12795306
#> 3 -0.4713316 -0.6561029  0.61990163 -1.04019476  0.3467328  0.03591614
#> 4  0.5161954 -0.7847251 -0.30146050  0.21637296  0.2284269 -0.77926696
#> 5 -0.1418927 -0.1147084 -0.11618652  0.82873853  0.2634256 -0.59762346
#>          665        666        667         668         669         670
#> 1 0.33622974 -0.1338507  0.5014833  0.36111802 -0.30172664 -0.23181982
#> 2 0.17153444 -0.4175671 -0.3142672 -0.45618066 -0.36665408 -0.21684955
#> 3 0.42100160  0.2867734 -0.7784346 -0.09889806  0.49350348 -0.07594976
#> 4 1.14052675  0.4846370 -0.1690758 -0.03862069  0.06819288  0.21542127
#> 5 0.04830504  0.1851324  0.4291430  0.22000322  0.47860513 -0.26035410
```

```
#>           671        672         673         674          675         676
#> 1  0.03354542 -0.4590974  0.33198050 -0.42848163  0.009364633  0.24216430
#> 2 -0.32375570 -0.4983792  0.02875551 -0.08116334 -0.031971620  0.07921775
#> 3  0.67929511 -0.4338478 -0.33151365 -0.41197514  0.769623165  0.05472683
#> 4  0.39134700  0.5738671  0.26070481 -0.82890985 -0.072077944  0.59370354
#> 5 -0.38003813 -0.2201886  0.10415155 -0.15669099 -0.152106165 -0.50670654
#>           677        678         679        680         681         682
#> 1  0.7984521 -0.3284940 -0.28062864  0.1306584  0.15466945  0.38268024
#> 2 -0.3490365 -0.3251701  0.27136489 -0.1633882 -0.06302492 -0.05329993
#> 3  0.3012890  0.7508444 -0.22416765 -0.4072659 -1.03222949 -0.07940279
#> 4  0.6765826  0.1825317  0.37296308 -0.7376649  0.26089873  0.42186943
#> 5 -0.3362317 -0.4766155  0.02891883  0.5596232  1.15832159 -0.61191569
#>           683        684         685         686        687         688
#> 1 -0.70953363 -0.4557026 -0.83915949  0.31631873  0.1585112 -0.26911123
#> 2  0.22701621 -0.3278823 -0.04318309  0.00311837 -0.2906127 -0.85498161
#> 3  0.19413499  0.7307339 -0.22611922 -0.79226821  0.2889934  0.18698111
#> 4 -0.03434275  0.1634847 -0.64493879 -0.74514297 -0.4353818 -0.34638730
#> 5  0.01208249 -0.2899810  0.04046239 -0.15078424 -0.6744526 -0.07572397
#>           689        690         691        692        693         694
#> 1 -0.50591432 -0.4462911 -0.97752780 -0.2575835 -0.3271771  0.05612661
#> 2 -0.27227048 -0.2281551 -0.39516080 -0.2053871 -0.1392215 -0.28540239
#> 3  0.42890073  0.4332662  0.01608457 -0.2130644  0.1635331 -0.25027053
#> 4 -0.34395673 -0.9761569  0.03993129 -0.2742084  0.5706896 -0.19469526
#> 5 -0.06326605  0.5724286  0.54455423  0.2837370 -0.1943162 -0.29783826
#>           695           696          697          698          699          700
#> 1  0.6733992  0.0002056087  0.267800419  0.05555859  0.04877295 -0.3223088
#> 2 -0.1730843  0.0294384640 -0.123884412 -0.31594219  0.03361934 -0.2108541
#> 3  0.5368062 -0.2537486916  0.552276515 -0.22604104  0.42105520  0.4906314
#> 4 -0.1197391  0.0067361028  0.005600253 -0.04509849 -0.25771697 -0.2835010
#> 5  0.2713987 -0.5399034998  0.065266281  0.51749277  0.32716817  0.1513930
#>           701         702         703         704         705         706
#> 1  0.4129871 -0.01314213 -0.10365174 -0.48168897  0.30486693 -0.3444593
#> 2 -0.4827319  0.18918093  0.03341905  0.01082181  0.12054284 -0.4532698
#> 3 -0.2273532 -0.16957589 -0.22138575  0.41349025 -0.09280737  0.1083587
#> 4 -0.2223465  0.04973261 -0.52996344  0.51948711 -0.41838555  0.1021773
#> 5  0.4963209  0.76032691 -0.38427786  0.23527791  0.49669584  0.5398775
#>           707         708          709         710         711         712
#> 1  0.08621766  0.60690794  0.228148402  0.1563638 -0.06203594 -0.3337289
#> 2 -0.28624003 -0.36732892 -0.430867547 -0.1570977  0.19640961 -0.1102558
#> 3  0.28694176  0.15930315  0.070903311  0.1215268 -0.35766699 -0.5784690
#> 4  0.85714697  0.91592657 -0.359961524 -0.5569998  0.59164232 -0.2497281
#> 5 -0.25690236 -0.03388069  0.009220486 -0.9959687  0.21231315  0.3383650
#>           713         714         715         716         717         718
#> 1  0.3541947 -0.84861521 -0.07570572 -0.18270293 -0.3494227  0.81568490
#> 2 -0.2315952 -0.06044923 -0.48733508 -0.04815252 -0.2554630 -0.16659214
#> 3 -0.7025240 -0.60054073  0.90051561  0.29434212 -0.8635087 -0.47232931
#> 4 -0.5125655 -0.11754422  0.23133304 -0.66637257  1.0155255  0.06261742
#> 5 -0.2060332 -0.76121057 -0.10272078  0.55364598 -0.2407623 -0.02424838
#>           719         720         721         722         723         724
#> 1  0.2067350 -0.2204792 -0.3645215  0.54339550 -0.02438388 -0.74684562
#> 2 -0.3116768 -0.2681751 -0.2746189 -0.06196019 -0.11677124  0.03848801
#> 3 -0.2968921  0.2611973 -0.3268921 -0.22133921  0.70215981  0.21855242
#> 4  0.7775052  0.3550789  0.1279315 -0.77689323 -1.04618006  0.44140501
```

```
#> 5  0.1814499  0.1955472 -0.2408207  0.66006982 -0.77866199  0.02250287
#>          725         726         727         728         729         730
#> 1  0.4080078 -0.1178629  0.59786457  0.2228159  0.5530162  0.35047523
#> 2 -0.3228195 -0.3745494  0.02705018 -0.2271431 -0.1287634 -0.02936578
#> 3  0.1802506  0.4065379 -0.73631670 -0.2761799  0.8451155 -0.05151783
#> 4 -0.5591195 -0.4542465 -0.19271824 -0.3017795  0.2674124  0.31365238
#> 5 -0.1962567 -0.4131270 -0.08447310  0.2149648 -0.4798752 -0.22072817
#>          731         732         733         734         735          736
#> 1  0.5947580  0.5720788 -0.17340199  0.2972158  0.81762118 -0.125557524
#> 2 -0.3978503 -0.3200450 -0.05286793 -0.3656345 -0.58610503 -0.044137990
#> 3  0.2947579  0.4840861 -0.21907950  0.4896492 -0.14766780 -0.477305607
#> 4  0.5694941 -0.6051393  0.48296560  0.1367838  0.03077847 -0.007713943
#> 5  0.1729577  0.2670610 -0.04901479  0.1762720 -0.50631489 -0.456460145
#>           737         738         739         740          741         742
#> 1 -0.06541808 -0.6739601 -0.39797641 -0.37182339 -0.006726624  0.28575981
#> 2 -0.18607571 -0.2375712 -0.12736731 -0.46191485  0.027784184 -0.04747412
#> 3 -0.96277624 -0.8617553  0.68924685  0.41320030  1.356709126 -0.41652852
#> 4  0.54398726  0.1904630  0.32249249  0.02905303  0.212637723  0.96025255
#> 5 -0.15343681 -0.6252137 -0.09732202  0.45804671 -0.623980715  0.32073269
#>           743         744         745          746         747         748
#> 1  0.12516315  0.21032997  0.3174486 -0.008784443 -0.31504920 -0.11162712
#> 2  0.04289637 -0.23270611 -0.2932020 -0.465098828 -0.16476901  0.04751925
#> 3  0.24108671  0.51036037 -0.2765438  0.002706145  0.96332355  0.46159625
#> 4 -0.79899490 -0.50471703  1.3767690  0.117057644  0.06932312 -0.11901909
#> 5 -0.16934209 -0.01666233  0.2651599  0.222833582 -0.26407980  0.23906497
#>          749         750         751         752         753         754
#> 1  0.2332486  0.5265214 -0.3724518  0.46877457 -0.1307506  0.09236585
#> 2 -0.2248141 -0.2036347  0.1960953 -0.54837525 -0.2473881 -0.05066223
#> 3 -0.6463786  0.5933169  0.1023518  0.03050769  0.3814090 -0.81279309
#> 4 -0.4684433  0.6562701 -0.3033275 -0.14854936 -0.1341095  0.29256362
#> 5 -0.6024641  0.6691749 -0.3395556 -0.73180588 -1.2037921  0.42479293
#>          755         756         757          758         759         760
#> 1 -0.4451516  0.4933583 -0.2006178  0.001203015  0.3541405 -0.2218614
#> 2 -0.4164422 -0.1542149 -0.3339746 -0.034104663 -0.1874015 -0.3866756
#> 3 -0.4420449  0.1599468 -0.1354026  0.342603218  0.3341643 -0.2892934
#> 4  0.5901337 -0.5655443 -0.1784834 -0.761625034 -0.9724554  0.5253020
#> 5 -0.2356788 -0.1281876  0.3914288  0.393100581 -0.2637055  0.1950744
#>           761          762         763         764          765
#> 1  0.513768508  0.234922291 -0.07653395  0.22845824  0.454991737
#> 2 -0.299778110  0.063595418 -0.56859454 -0.62147940  0.004776885
#> 3 -0.008540054  0.008596552 -0.95516990 -0.40702503  0.113382237
#> 4 -0.356317011 -0.436141660 -0.65882871 -0.22716375  0.476256201
#> 5  0.377553207 -0.298925537  0.02919577 -0.02601529 -0.044630232
#>           766         767         768         769         770          771
#> 1  0.45000240  0.2517663  0.09586127 -0.4857805 -0.2005510  0.74937155
#> 2 -0.09423559 -0.5770387  0.06172349 -0.5340129 -0.4064014 -0.03070465
#> 3  0.03056814  0.4754055 -0.20351638 -1.1551389  0.3235668 -0.54346243
#> 4 -0.72729075  0.3586778 -0.51605643  0.9327132 -0.4434924 -0.15380438
#> 5  0.13837141  0.1225086  0.14656546 -0.4429424  0.2268921 -0.36183517
#>           772         773         774         775         776          777
#> 1  0.4215993 -0.4351841  0.06184419 -0.7665268  0.3133624 -0.07344836
#> 2 -0.0575740 -0.1368262 -0.23456369 -0.3483941 -0.2322941 -0.32992470
#> 3  0.3774078 -0.7693286 -0.50140739  0.9144138  0.6384829  0.62102867
```

```
#> 4 -0.1385837 -0.1499774 -0.47236800 -0.4413517  0.8941945  0.42030247
#> 5 -0.4756680  0.2038822 -0.08976838  0.5713548 -0.3065192  0.07950457
#>           778         779        780         781        782         783
#> 1 -1.35785742  0.47049262 -0.3945658  0.02442468 -0.1002507  0.22270588
#> 2 -0.08923046 -0.06949418 -0.1893364  0.01323172 -0.1257239 -0.06621611
#> 3 -0.48171580 -0.61314909  0.2274666  0.10569767 -0.2445459 -0.25501468
#> 4  1.03669791  0.55172175  0.6497134 -0.27364456 -0.1824620  0.76456424
#> 5 -0.04577351 -0.20227185  0.1387296 -0.39962358  0.2880411  0.77457722
#>          784          785         786         787        788         789
#> 1  0.7042630  0.490234406 -0.15417123 -0.75762194  0.3074839  0.2071115
#> 2 -0.1663351  0.008883771 -0.37782960 -0.23304770 -0.2719596 -0.2865668
#> 3 -0.1227326  0.147460857  0.02023493 -0.54100895 -0.3797271  0.4623765
#> 4  0.4555658  1.286441873 -0.57616552 -0.30439396  0.3793404 -0.3283243
#> 5 -0.6720685 -0.047216221  0.38381815 -0.02771919 -0.1227310  0.4079164
#>          790         791         792         793        794         795
#> 1 -0.2733179 -0.05351293  0.02433102 -0.74083224 -0.1922083 -0.71994345
#> 2 -0.2869630 -0.30074163  0.34236438 -0.13315825 -0.2173737 -0.01100633
#> 3 -0.2254843  0.16318828  1.08927704  0.02897985 -0.5597298  0.57930740
#> 4  0.6420398 -0.69538227 -0.09802471 -0.13055521 -0.3152001 -0.79981358
#> 5 -0.1390884 -0.33186611  0.36589339  0.74787787 -0.6430866  0.47076524
#>           796         797         798         799         800         801
#> 1 -0.45365766  0.8907950  0.74855687  0.03371556  0.09921554 -0.45109647
#> 2  0.01906554 -0.2008655 -0.14746600 -0.21788625 -0.08788291 -0.02340793
#> 3 -0.64750285 -0.5271013 -0.64709692 -0.61529342  1.32356037 -0.65063803
#> 4  0.41791910  0.2002993  0.07564006  2.05008659  0.62022847 -0.19985602
#> 5 -0.22640330  0.1936495  0.51157046 -0.15223191 -0.52869575 -0.45364493
#>          802         803          804         805         806         807
#> 1  0.4111672 -0.8917421 -0.6103059660  0.5224491  0.05469729  0.3078831
#> 2 -0.3617920 -0.3369655 -0.0004163018 -0.3481966  0.08451213 -0.2743448
#> 3  0.3909614  0.3193829  0.1483275993  0.6780569  0.35365083  0.4347624
#> 4 -0.3424444  0.3228096 -0.7275175805  0.2291355  0.06758725  0.6451111
#> 5 -0.5253524 -0.6844106  0.2537610718  0.2955570 -0.15957943 -0.8676122
#>           808         809         810         811         812         813
#> 1 -0.266918432  0.1041376  0.16863914 -0.3014495  0.14049588  0.09396182
#> 2 -0.006235752 -0.3073398 -0.29517762 -0.1699731  0.11239790 -0.23711809
#> 3 -0.707885211 -0.2492797 -0.60933866 -0.6147726 -0.41055354  0.96344416
#> 4 -0.109004327 -0.2094466  0.46214163  0.3230224 -0.63341419  0.33082261
#> 5  0.861854547  0.3966186  0.01299542 -0.6693434  0.05341637  0.05008262
#>          814         815         816         817         818         819
#> 1  0.1096432 -0.4163902 -0.2505782 -0.5575096 -0.26414160 -0.01259576
#> 2 -0.1097228 -0.2030742 -0.3288650 -0.1852719 -0.23018677 -0.12359768
#> 3 -0.3937098  0.8577566  0.1004714 -0.3038119 -0.52523473  0.18675303
#> 4 -0.7229289  0.3611662 -0.1270804 -0.6661614  0.02586141  0.39192265
#> 5 -0.4513159  0.1022995 -0.0378420  0.6608405  0.41456670 -0.46357879
#>          820         821         822         823         824         825
#> 1  0.5200306  0.2151472 -0.3970393 -0.39985749 -0.23881608  0.07371192
#> 2 -0.1747192 -0.1351410 -0.2638480 -0.27225394  0.05116985  0.09096116
#> 3 -0.3965698  0.6296208  1.4707146  0.21915314  0.41952260 -0.42288624
#> 4  0.1240226  0.1622295  1.0908823  0.66855409  0.38972035  0.93271854
#> 5  0.6455757 -0.4147033  0.3692643 -0.06125604  0.19955879  0.16512674
#>           826         827         828         829         830         831
#> 1  0.04900425 -0.3524713  0.5842493  0.1834240 -0.04719248 -0.17000278
#> 2 -0.11598551 -0.3045434 -0.3390843 -0.1282123 -0.48552754 -0.12691506
```

```
#> 3 -0.42453788  0.7214207 -0.1413752 -0.2881987 -0.74557360  0.18088705
#> 4  0.07899116  0.1579410  0.4150498 -1.0704664  0.91448121  0.09486115
#> 5  0.06432228 -0.1295208 -0.2419796 -0.9588546  0.11115675  0.08547814
#>           832         833        834           835          836
#> 1 -0.65894500 -0.56466718 -0.3485018 -1.090704e+00 -0.172510944
#> 2 -0.33314617  0.01347359 -0.2420884 -9.235255e-05  0.005421612
#> 3  0.25874745  0.89140036  0.3135121  9.438072e-01  0.272753850
#> 4  0.11602729  0.84739293 -0.3700056  3.268897e-01 -0.138525345
#> 5 -0.06260554 -1.04233690 -0.2577588 -6.106464e-01 -0.734421432
#>           837          838        839         840         841        842
#> 1 -0.50344286  0.173963327 -0.6587737  0.34992582 -0.72256677  0.2571665
#> 2 -0.30751212 -0.002357671 -0.4499222 -0.42660485  0.02551043 -0.2422559
#> 3  0.73366917 -0.113884053  0.0899397  0.05986544 -0.97521206 -0.1754214
#> 4 -0.00981995  0.779034550  0.7190849  0.43096984  0.20966815  0.5004006
#> 5 -0.20344324  0.795918142 -0.5308016  0.12468248  0.45117356 -0.2951465
#>           843         844        845        846        847          848
#> 1  0.09346708  0.07160959  0.8499797 -0.5802570  0.3431943 -0.009278270
#> 2 -0.08862137 -0.36622634 -0.3334672  0.1180505 -0.4192297 -0.088806143
#> 3  0.91872219  0.87195693 -0.2411419 -0.3494477  0.2649281  0.004440631
#> 4  0.36153819 -0.26570646  0.1057673 -0.1006741 -0.4959904 -0.377359859
#> 5  0.15239122 -0.31092460 -0.5426163  0.5492576  0.6249646 -0.159078365
#>           849        850        851          852        853        854
#> 1  0.10604588 -0.1296886  0.3681700 -0.364173785 -0.5725783 -1.3354532
#> 2 -0.09474761 -0.3313803  0.1729763  0.418483271 -0.1776955 -0.2526549
#> 3  0.20405673 -0.1340099  0.0975335 -0.368706252 -0.1287611 -0.1637360
#> 4  0.87804096 -0.1878727 -0.8771883 -0.306840792 -0.6953335  0.7443467
#> 5 -0.27348343  0.1440613 -0.6663592  0.001153207 -0.5404332  0.2750331
#>           855        856         857         858         859         860
#> 1  0.4123326  0.0414796 -0.16906910 -0.01491473 -1.00378447 -0.04998139
#> 2 -0.0950220 -0.0685519  0.06861395 -0.17488470  0.02532586  0.09229224
#> 3 -0.8380207  0.4129488  0.44232311  0.40022098 -0.26150181  0.02062770
#> 4 -0.3688605  0.6582869  0.38580287  0.41718772 -0.47628109 -0.27980981
#> 5  0.1675265 -0.6450254  0.17713484 -0.33946009  0.12856302 -0.38430507
#>           861        862          863        864         865          866
#> 1 -0.4856728  0.1485241  0.458043263  0.7053622  0.03493369 -0.21438216
#> 2 -0.4948565 -0.3579505 -0.002755344 -0.1000324 -0.27694398  0.03525046
#> 3  0.3269846  0.1595729 -0.397572173 -0.1526729  0.14822439  0.45106430
#> 4  0.4005725  0.1125520  0.749127380  0.5008604 -1.12171793 -0.13910812
#> 5  0.6540672  0.1924047 -0.479337138 -0.5146872 -0.01151449  0.45587345
#>           867         868         869         870         871         872
#> 1 -0.047476941 -0.20031435  0.50114540  0.5740923 -0.22552564 -0.31580737
#> 2 -0.469551107 -0.50779892  0.18616906 -0.4660202 -0.31027427  0.01066211
#> 3 -0.002646645  0.49606077  0.57912843 -0.3279213 -0.06347086  0.10657610
#> 4  0.626126029  0.03690793  0.25154960 -0.4590444 -0.21133195 -0.08048723
#> 5 -0.743102929 -0.15468317 -0.03367495  0.9872219  0.45737120  0.23738689
#>           873         874         875         876         877         878
#> 1 -0.09598012 -0.09245056  0.17693881 -0.05806420  0.40166751 -0.06225583
#> 2  0.03897649 -0.07038718 -0.49981753 -0.05106914  0.00593532 -0.06793132
#> 3  0.08396222 -0.10027960 -0.69870864  0.26220646 -0.23118136 -0.11888422
#> 4 -0.14933172  0.56130413  0.43759367  0.38623448 -0.31086788  0.03958836
#> 5  0.71198474  0.56918732  0.09208503  0.44455486  0.19931151 -0.86847439
#>           879         880         881         882         883         884
#> 1 -0.03916108 -0.24340776  0.1275876 -0.03109459 -0.88908739 -0.43325934
```

```
#> 2 -0.50894940 -0.60056105 -0.3980324 -0.48852242 -0.36060196  0.08706226
#> 3 -0.11856465  0.60490242  0.2621687  0.93575355 -0.47248850 -0.30728164
#> 4  0.50869576  0.05321147  0.3743545  0.01603005 -0.35466407 -0.43002404
#> 5 -0.49344274 -0.14061453 -0.5064272 -0.85983119  0.06348581  0.68714568
#>          885         886        887        888         889        890
#> 1  0.1781144 -0.31804395 -0.1196628  0.0880550  0.42565603 -0.6723057
#> 2 -0.3820139 -0.24347529  0.2183143 -0.2796119 -0.09181601 -0.5060207
#> 3  0.8517023  0.08273771  1.0042434  0.0885867  0.09213116 -0.5962389
#> 4 -0.9457595 -0.93313609 -0.2558327 -0.5417179  0.08436273  0.4808880
#> 5 -0.4654928  0.77112306  0.1683189 -0.4127942  0.56369959 -0.5218526
#>          891         892          893         894        895          896
#> 1  0.06789178 -0.22696478  0.744027380  0.69106431 -0.2637612  0.381376263
#> 2 -0.01713622  0.02855613 -0.178064042 -0.47779182  0.1970491  0.001879772
#> 3  0.26853205  0.34978480 -0.327500406  0.03355600  0.3653258  0.410897495
#> 4 -0.12875828 -0.20817937 -0.153610314 -0.62350013 -0.1219857 -0.279500631
#> 5 -1.02496418  0.46801184  0.002665133 -0.03015913 -0.2283493 -0.719741068
#>          897        898        899        900        901          902
#> 1 -0.37619353 -0.2031186 -0.5478383  0.4726148 -0.3754247 -5.155391e-02
#> 2 -0.06209988 -0.2198317  0.0168379 -0.1872877 -0.2748914 -1.419353e-02
#> 3 -0.26048475  0.3369385 -0.2835646  0.2662173  0.1656694 -5.625799e-01
#> 4 -0.62100321  0.5662322 -0.2068409 -0.2812690 -0.6304459 -4.510271e-01
#> 5 -0.56264208 -0.3372480 -0.2022357 -0.3067012 -0.2457104 -3.110955e-05
#>          903        904         905        906         907        908
#> 1 -0.03851762  0.2861844  0.09994693  0.7561816  0.37038189 -0.1628279
#> 2 -0.24999178 -0.2918445 -0.23570156 -0.0447524 -0.22483243 -0.4847065
#> 3 -0.17629906  0.2601820 -0.33994147  0.6029871  0.06686615 -0.4600238
#> 4  0.18721121 -0.3038926  0.74872725  0.1813533  0.41095820 -0.3702743
#> 5  0.05673851  0.2596385 -0.70392270 -0.4696924  0.61339249  0.6594252
#>          909         910         911         912        913         914
#> 1  0.02509931  0.31769778 -0.03081071  0.60022939  1.1128917  0.25682801
#> 2 -0.06466259 -0.13073557 -0.42866933 -0.22163836  0.1270801 -0.17090345
#> 3  0.07674486 -0.05937173 -0.06063068  0.07313152 -0.6063177  0.40288928
#> 4 -0.75402286 -0.01253961  0.02543239 -0.14352242 -0.3332395 -0.07713992
#> 5  0.32541359 -0.10079006  0.29543538 -0.21987654  0.1250082  0.75270456
#>          915         916        917         918        919         920
#> 1 -1.1786016  0.30585281 -0.5341049 -0.21403790 -0.1704831  0.62774319
#> 2 -0.1115031 -0.08149816 -0.3359158 -0.07038508 -0.2384565 -0.32314244
#> 3 -0.4177336 -1.20729337  0.5518968 -0.56681981 -0.6768762  1.29260645
#> 4  0.8058535 -0.41644672 -0.5578503 -1.07481441 -0.8587315 -0.94533494
#> 5  0.7074596 -0.17590690  0.0802576  0.17475484 -0.5678667  0.04716792
#>          921         922        923        924         925        926
#> 1 -0.47163998 -0.30749123  0.4424826  0.1382158 -0.11443615 -0.3122141
#> 2 -0.07543868  0.02842824 -0.5056501 -0.1758806  0.01263115 -0.5382058
#> 3 -0.29705678 -0.07918715  0.1045943  0.2617422 -0.11245711 -0.3913766
#> 4  0.64586869 -0.05930989 -0.5204091  0.3077301  0.84866841  0.6002481
#> 5  0.31148717  0.43810758 -0.5749079 -0.8501942 -0.25692849 -0.6410251
#>          927         928          929         930         931         932
#> 1  0.15490285  0.3196536 -0.52916218  0.72762371 -1.09595979 -0.3678020
#> 2 -0.21450302 -0.1805928 -0.23057575 -0.25167038  0.02780574 -0.1872114
#> 3 -0.09129663 -0.2262789 -0.31969481 -0.04873302  0.75130060  0.2023166
#> 4 -0.24689772 -0.4340414  0.37161248 -0.24449067  0.04591207 -0.7886644
#> 5 -0.18739461 -0.3107782  0.04012788 -0.31680954  0.17300297 -0.0520401
#>          933         934         935         936         937         938
```

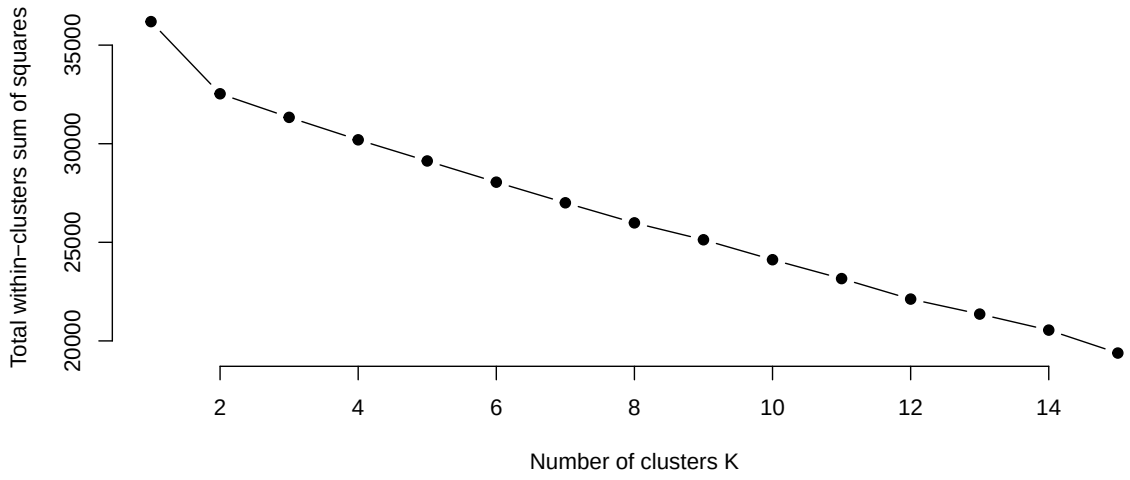
```
#>  1  0.63446713  0.4533957 -0.26814048 -0.08416369  0.3413637 -0.8615525
#>  2 -0.09000613 -0.4790011 -0.16989772 -0.03780131 -0.2483854  0.1290663
#>  3  0.47492060 -0.2740050 -0.48364044 -0.27242093 -0.2067417 -0.4443152
#>  4 -0.99205131  0.1237920 -0.07039423 -0.30220562 -1.1321238 -0.3420790
#>  5  0.09858250 -0.4694131  0.29075234  1.18233416 -0.9281559  0.1878335
#>           939        940         941         942         943         944
#>  1  0.4133870 -0.4620677 -0.35859771  0.01334758  0.29335988  0.63161547
#>  2 -0.1515867 -0.2227046 -0.18011008 -0.21777023  0.05833538 -0.01546944
#>  3 -0.2546335  0.3044130 -0.12947645 -0.12407927 -0.09461620 -0.75699534
#>  4 -0.1363565  0.2490209  0.37594614  0.53347223  0.04516103  0.34700871
#>  5  0.3756093 -0.3275589 -0.04169907 -0.10426751  0.02307948 -0.64726853
#>           945         946          947          948         949          950
#>  1 -0.3800867  0.09885320 -0.093622348  0.003854825 -0.1396118  0.03402672
#>  2 -0.2760283  0.05793133 -0.009277419 -0.059871166 -0.2027654 -0.10656315
#>  3  0.8431186  0.42213861  0.675260641  0.217742863 -1.1720931  0.24098797
#>  4 -1.1855156 -0.01559563  1.478496995  0.397452361 -0.1783053  0.38157813
#>  5 -0.2012601  0.25553942  0.481620591  0.202698232 -0.7341243  0.02659537
#>           951         952         953         954         955          956
#>  1 -0.03034646 -0.57397316  0.9215768 -0.69966930 -0.07058964  0.45280810
#>  2  0.01540740 -0.27738068 -0.5602273 -0.24046236 -0.05131833 -0.52980757
#>  3 -1.03508576  0.32554203  0.1416670 -0.08920384  0.04040035  0.07331129
#>  4  0.21280192  0.06521681 -0.1359811  1.40677852 -0.29236799  0.51700095
#>  5 -0.44509599 -0.37879135 -0.6064055 -0.07824753 -0.05969545 -0.09979373
#>           957         958         959         960         961         962
#>  1 -0.04384551 -0.01564051 -0.72376803 -0.09521153  1.0024562 -0.5036704
#>  2 -0.26531408 -0.17102953 -0.03697572 -0.27363341 -0.2436483 -0.4599659
#>  3  0.12233294 -0.02724637 -0.19582956 -0.20305918  0.3217269  0.2215923
#>  4  0.19456702 -0.43833959  0.63591851  0.49578812 -0.8490087  0.2947275
#>  5 -0.49050114  0.49180411 -0.16294076  0.16528762  0.1242479 -0.0992591
#>           963         964         965         966         967         968
#>  1  0.2349761 -0.11241934  0.03553782  0.09828602  0.2023683 -0.1645724
#>  2 -0.3605081 -0.23856302 -0.46812316  0.28061348 -0.2555891 -0.4698696
#>  3 -0.2686498 -0.42701786  0.02817307 -0.86618936 -0.6044532 -0.4677948
#>  4  1.1604714 -0.06825133 -0.25154210 -0.75390696 -0.5109193 -0.3862390
#>  5  0.0709320  0.09120613  0.22284600 -0.36700155  0.7102059  1.0059299
#>           969         970         971          972         973         974
#>  1  0.2561624 -0.14280886 -0.5185232  0.0791083410 -0.33126645 -0.5315725
#>  2 -0.1698527 -0.03827192 -0.2622173 -0.2149532018 -0.05656158 -0.1150551
#>  3  0.1105636  0.25064843  0.4946791  0.0004459663  0.82161055 -0.7150882
#>  4 -0.2678973  0.34715472 -0.3537663  0.4710499099  0.44753342  0.1980659
#>  5 -0.6969725 -0.11715858 -0.5977882  0.3234219632  0.16189157  0.4132262
#>           975         976         977         978          979          980
#>  1 -0.3527262  0.7951192  0.23564777  0.17931517 -0.283587948 -0.003777557
#>  2 -0.3462707 -0.2572410 -0.34777541  0.08644216 -0.267365188 -0.431048754
#>  3 -0.4296394 -0.3489732 -0.05367794  0.51948617 -0.004130759  0.967823724
#>  4 -0.4238638 -0.2031635  0.48070025 -0.15223062 -0.946462621 -1.368237194
#>  5  0.2868030  0.7390336 -0.48256893 -0.24314161  0.739674519 -0.775779960
#>           981         982         983          984          985          986
#>  1 -0.06653708 -0.14259783 -0.2503373 -0.937007985 -0.521694959  0.13818718
#>  2 -0.21156964  0.01731834 -0.3589901 -0.012474619 -0.003492390 -0.21470386
#>  3  0.37461871  0.30936225  0.1321706  0.546442403 -0.235517708 -0.57543986
#>  4  0.53148902 -0.91204050 -0.1061298  0.004624396 -0.439815478  0.08970725
#>  5  0.08876853  0.22209263 -0.8812674 -0.148350368 -0.006195863 -0.61635954
```

```
#>           987         988         989         990          991         992
#> 1  0.21774822 -0.79287679  0.45399780 -0.7645174  0.190300077  0.45946229
#> 2 -0.14167112 -0.05977998 -0.43172593 -0.1456071 -0.003537708 -0.26031019
#> 3  0.01039599 -0.13231940  0.35084496  0.4139772  0.280944935 -0.63890435
#> 4  0.32870972  0.44429793 -0.32141041 -0.1635785 -0.045666626 -0.05267257
#> 5 -0.86130092  0.27078203  0.06051313  0.3530737  0.384805662  0.13847014
#>           993         994        995         996        997         998
#> 1 -0.04070182  0.29539476 -0.2474200 -0.25967330 -0.3685144 -0.04007334
#> 2 -0.32712730 -0.03168406 -0.2362432 -0.33453575 -0.2623600 -0.30791152
#> 3  0.01770253 -0.78682235  0.1379680 -0.58513481 -0.2231518  0.67548014
#> 4  0.62398628  1.63328452  0.1305629  0.07934175  0.6496092 -0.32123826
#> 5  0.09225582  0.28371015  0.4251850 -0.34694729 -0.1582129  0.20518411
#>           999
#> 1  0.32975040
#> 2 -0.41400480
#> 3 -0.60957751
#> 4 -0.01658663
#> 5 -0.03068340
#>
#> Clustering vector:
#>  X.0.9619334   X0.4418028  X.0.9750051    X1.417504   X0.8188148
#>            3            4            1            1            4
#>   X0.3162937 X.0.02496682   X.0.063966  X0.03149702  X.0.3503106
#>            5            4            5            1            5
#>  X.0.7227299  X.0.2819547   X1.337515   X0.7019798    X1.007616
#>            3            3            5            5            3
#>  X.0.4653828   X0.6385951   X0.2867807  X.0.2270782  X.0.2200452
#>            1            4            5            1            1
#>   X.1.242573  X.0.1085056   X.1.864262  X.0.5005122   X.1.325008
#>            2            2            2            2            2
#>    X1.063411  X.0.2963712  X.0.1216457  X0.08516605   X0.6241764
#>            2            2            2            2            2
#>  X.0.5095915  X.0.2167255 X.0.05550597  X.0.4844491  X.0.5215811
#>            2            2            2            2            2
#>    X1.949135    X1.324335   X0.4681471      X1.0611     X1.65597
#>            2            2            2            2            2
#>
#> Within cluster sum of squares by cluster:
#> [1]  4896.690 13540.079  2934.875  2889.281  4857.595
#>  (between_SS / total_SS =  19.5 %)
#>
#> Available components:
#>
#> [1] "cluster"      "centers"      "totss"        "withinss"
#> [5] "tot.withinss" "betweenss"    "size"         "iter"
#> [9] "ifault"
```

Elbow-Method

```
#Elbow Method for finding the optimal number of clusters
set.seed(42)
# Compute and plot wss for k = 2 to k = 15.
k.max <- 15
data <- scaled_data
```

```
wss <- sapply(1:k.max,
              function(k){kmeans(data, k, nstart=60,iter.max = 15 )$tot.withinss})
wss
#>  [1] 36190.83 32531.95 31337.21 30197.84 29125.14 28050.54 27003.94
#>  [8] 25985.95 25128.65 24116.89 23159.64 22120.76 21359.88 20547.72
#> [15] 19384.38
plot(1:k.max, wss,
     type="b", pch = 19, frame = FALSE,
     xlab="Number of clusters K",
     ylab="Total within-clusters sum of squares")
```



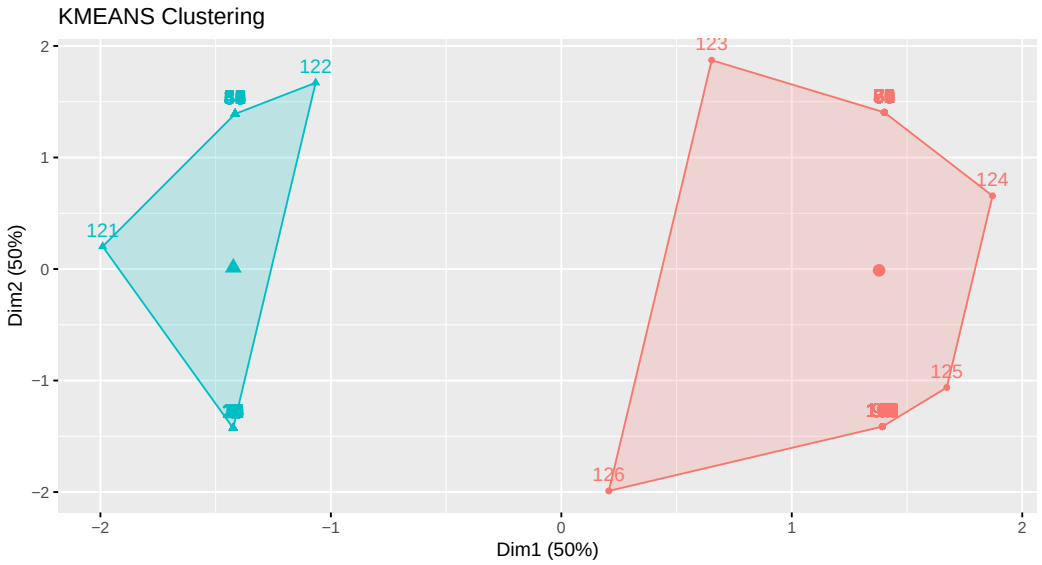
Elbow-Kriterium: Beim Elbow-Kriterium werden die Fehlerquadratsummen in ein Diagramm abgetragen. Zeigt sich im Kurvenverlauf ein Knick („Ellbogen“), so kann dieser Wert als Entscheidungskriterium für die Clusteranzahl verwendet werden.

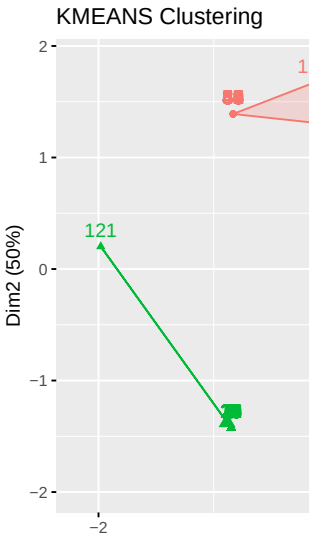
Optimale Anzahl der Cluster K=4.

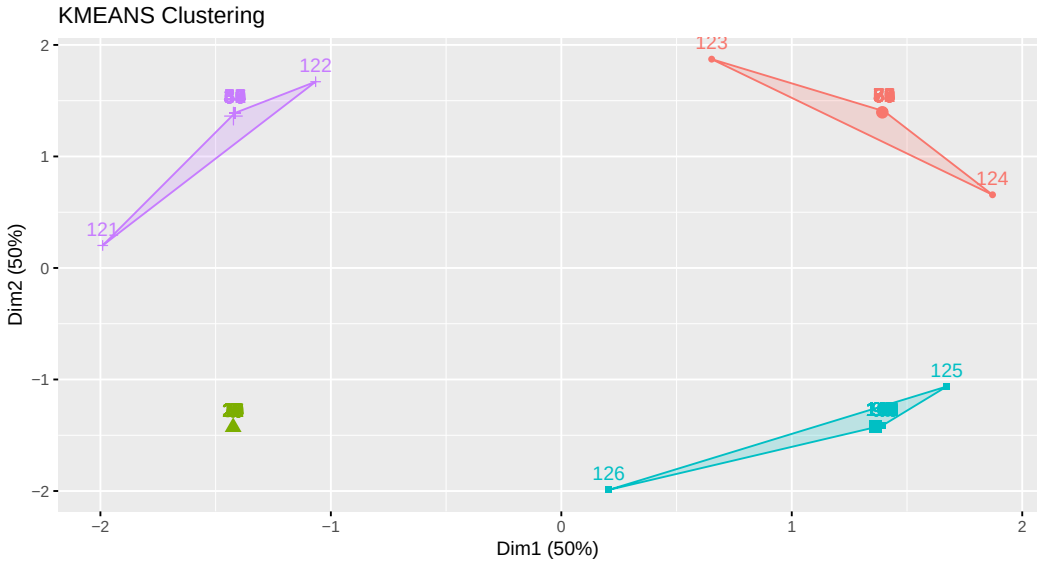
Aufgabe 2 a)

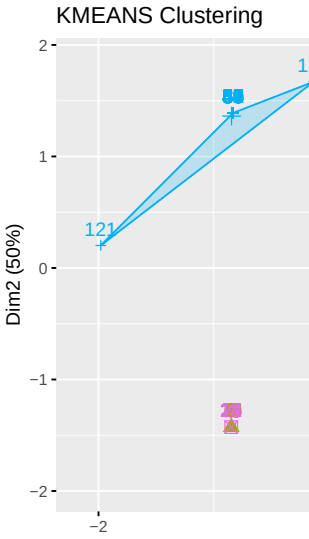
In diesem Aufgabenteil fuehren wir den Kmeans Algorithmus auf den clust Datensatz durch fuer die Werte k=$\{2, \ldots, 7\}$ und visualisieren anschliessend die Cluster.

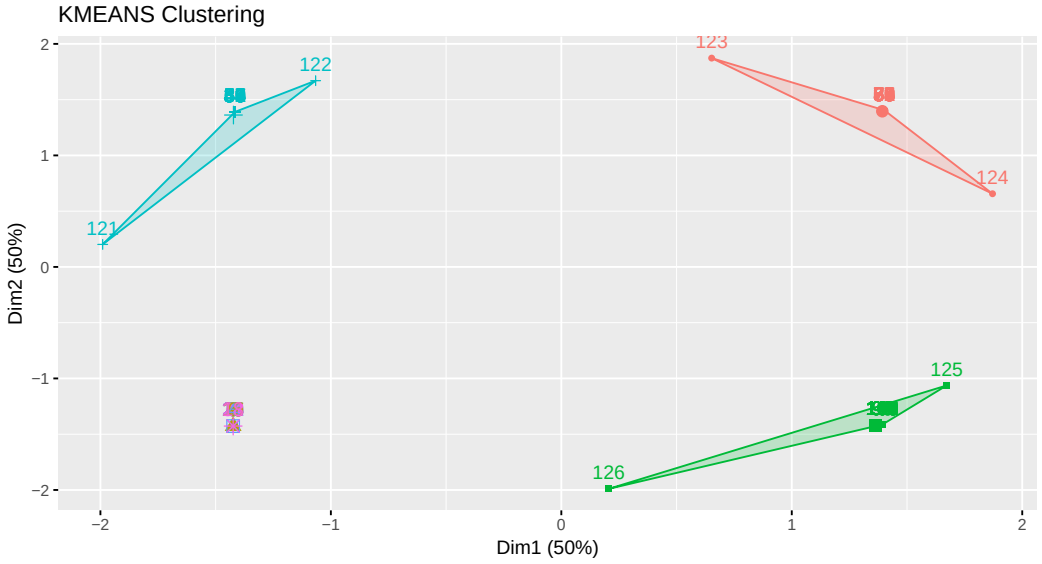
```
load("clust.RData")
packageTest("cluster")
packageTest("factoextra")
data <- clust
colnames(data) <- c("x1", "x2", "x3", "x4")
data <- scale(data)
for(i in 2:7) {
  par(mfrow=c(6,1))
  eclust(data, "kmeans", k=i)
}
```

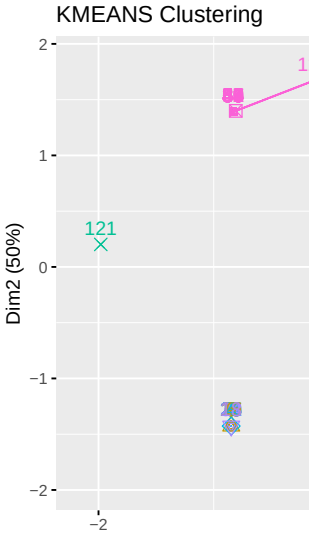

KMEANS Clustering
Dim2 (50%)
Dim1 (50%)
cluster
1
2
121
122
123
124
125
126


KMEANS Clustering
Dim2 (50%)
121


KMEANS Clustering
Dim2 (50%)
Dim1 (50%)
cluster
1
2
3
4
121
122
123
124
125
126


KMEANS Clustering
Dim2 (50%)
121

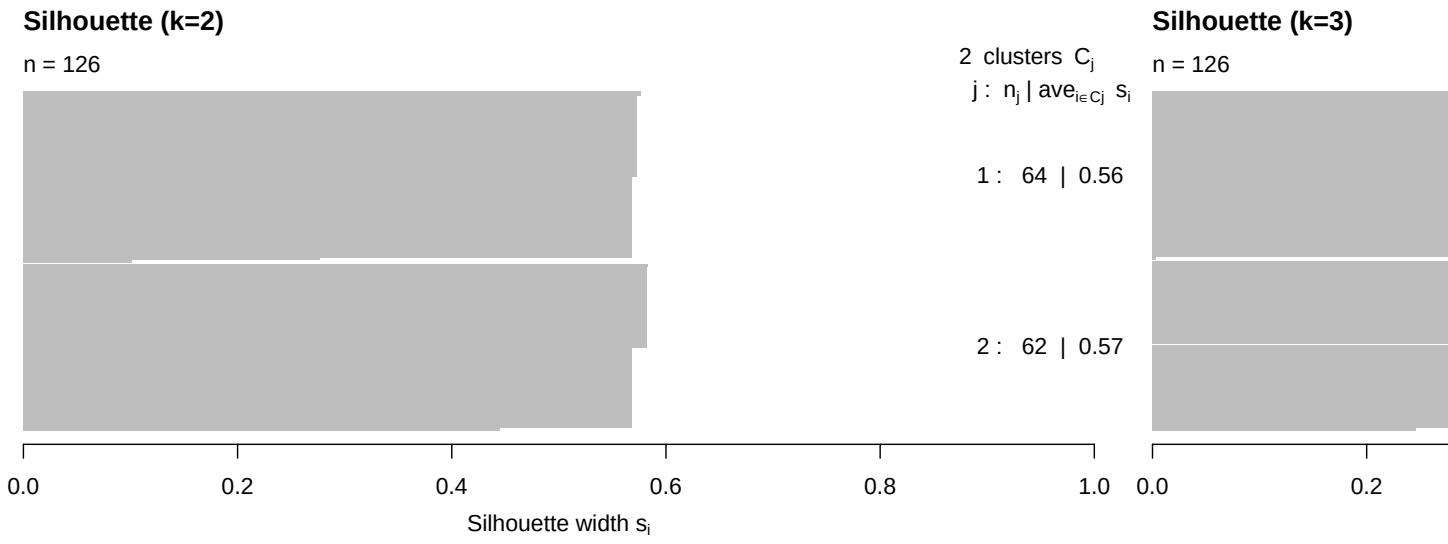

KMEANS Clustering
Dim2 (50%)
Dim1 (50%)
cluster
1
2
3
4
5
6
121
122
123
124
125
126


KMEANS Clustering
Dim2 (50%)
121

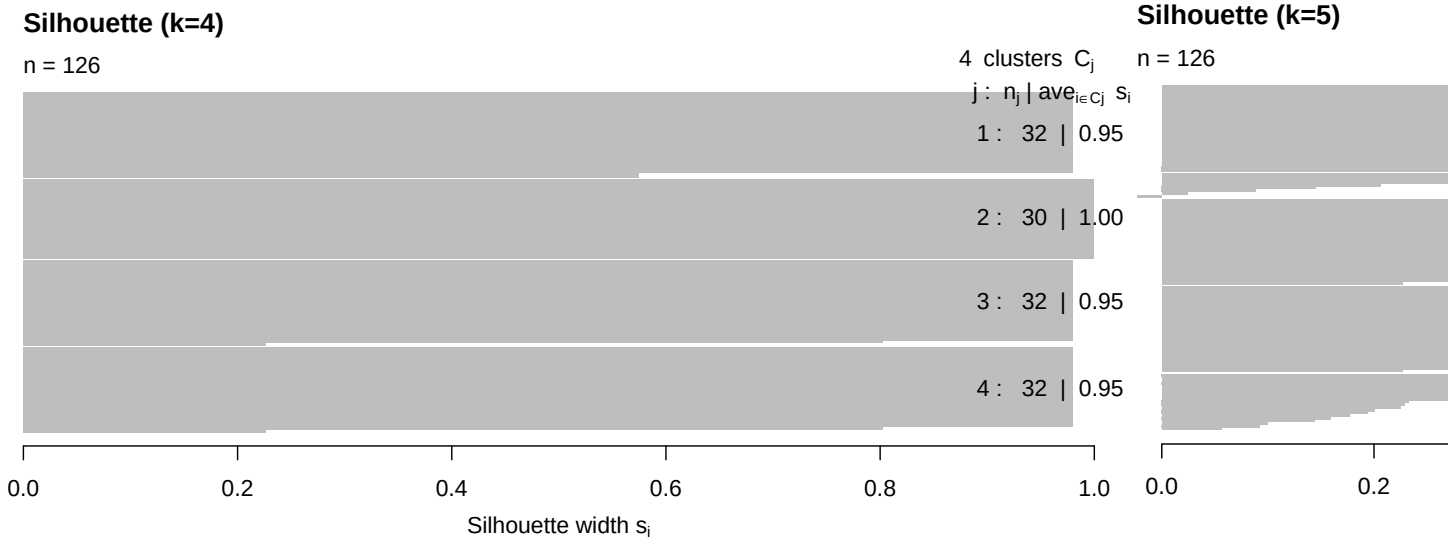
b)

Nun berechnen wir die Silhouetten sowie die Silhouetten-Koeffizienten fuer die Clusterungen aus a) und visualisieren anschliessend die Silhouetten inkl der Koeffizienten.

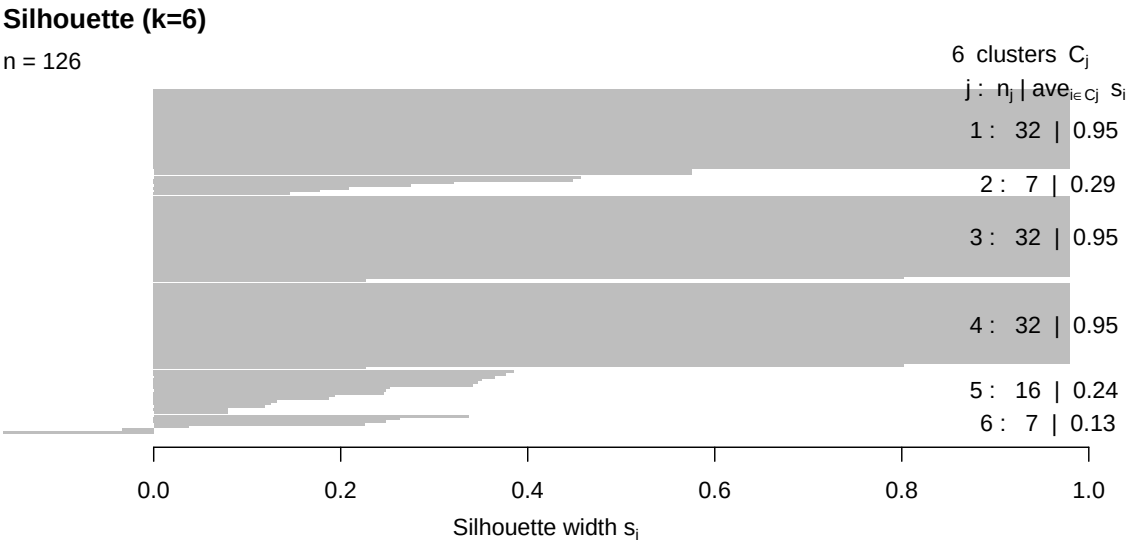
```
for(i in 2:7){
  km.res <- eclust(data, "kmeans", k=i, graph=FALSE)
  sil <- silhouette(km.res$cluster, dist(data))
  plot(sil, main=sprintf("Silhouette (k=%d)",i))
}
```



Average silhouette width : 0.



Average silhouette width : 0.7



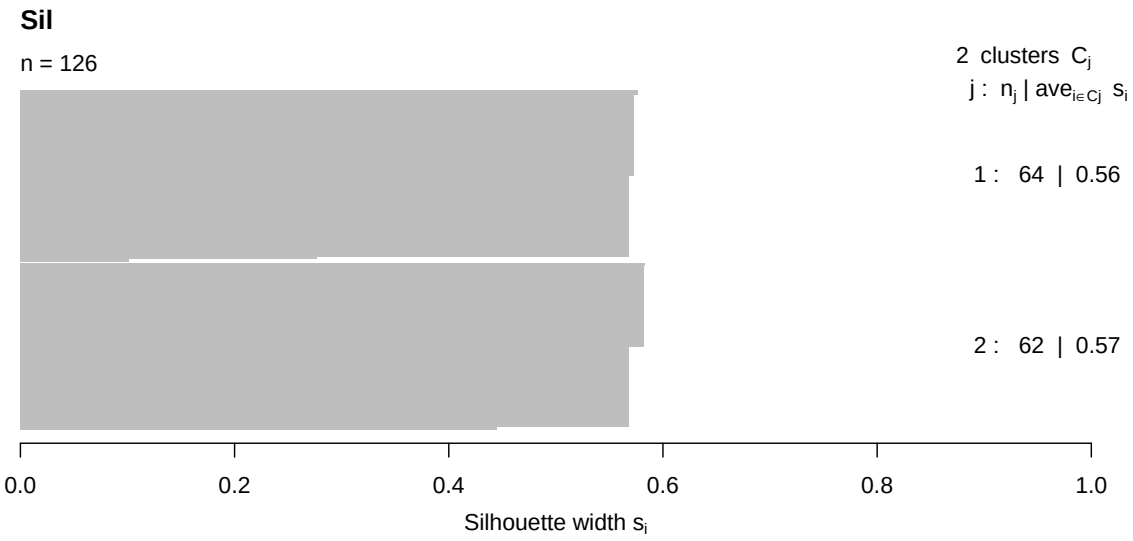
c)

Die Silhouette eines Datenpunktes entspricht einem Guetekriterium der Cluster. Sie gibt an, wie aehnlich bzw. unaehnlich ein Datenpunk zu seinen Nachbarpunkten im Mittel ist. Dabei werden die Vergleiche zwischen dem Datenpunkt und den Nachbarpunkten innerhalb des eigenen Clusters gemacht sowie zwischen dem Datenpunk und den Nachbarpunkten des nächsten Nachbar-Clusters.
Die Silhouette kann Werte aus dem Intervall [-1,1] annehmen.
1 bedeutet dabei, dass der Datenpunkt im Mittel relativ zentral innerhalb des eigenen Clusters liegt und somit weiter entfernt zu den Nachbarklustern ist. Diese Eigenschaft entspricht einem guten Clustering.
-1 bedeutet, dass der Datenpunkt im Mittel naeher zum Nachbar-Cluster liegt als zum eigenen Cluster.
0 wird einem Datenpunkt zugeordnet, wenn ein Cluster ausschliesslich diesen Datenpunkt enthaelt.
maximimieren wir den Wert der Silhouette, so erhalten wir den Silhouetten-Koeffizienten.
Vergleichen wir die Modelle mit unterschiedlichen Anzahl an Cluster, so waehlen wir das Modell mit k=4, da dieser die hoechste Silhouette besitzt sowie niedrigste Komplexitaet. Alle Cluster sind aehnlich gefuellt. Erhoehen wir die Anzahl der Cluster, so bleibt der Wert der Silhouette gleich, jedoch erhalten wir Silhouetten Werte gleich 0, diese entsprechen einem Cluster von einem Datenpunkt.

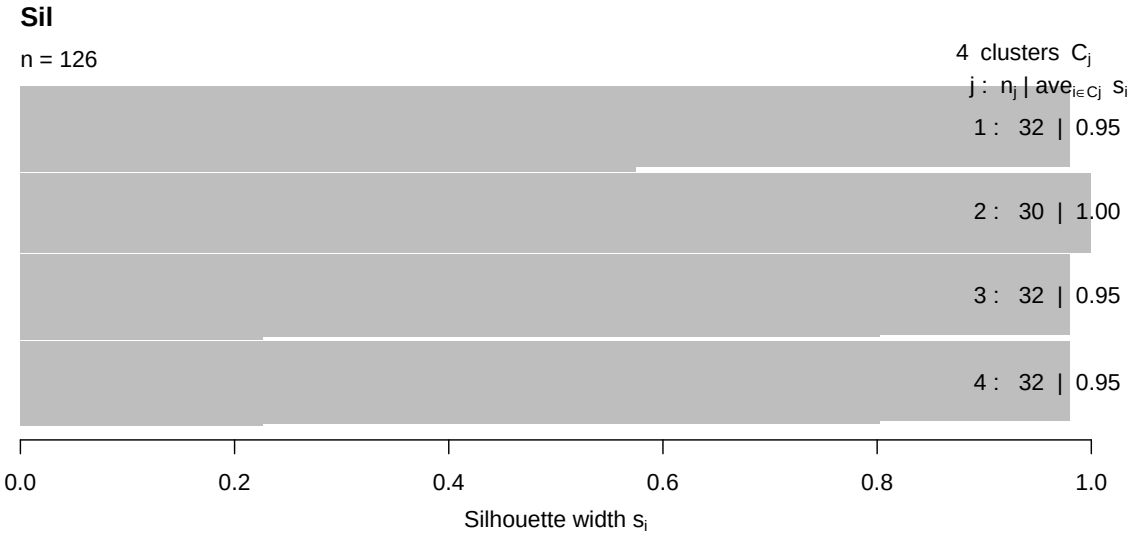
d)

Da das Ergebnis des K-Means-Verfahrens sehr stark von dem Initialzustand abhaengt, wiederholen wir im Folgenden den Algorithmus und setzen dabei fuer jeden Wert $k \in \{2, ..., 7\}$ zufaellig einen Startzustand. Diese Option wird mit dem parameter *nstart* erreicht, den wir z.B. auf 25 setzen, so dass der Algorithmus 25 Mal durchlaeuft mit jeweils zufaelligem Startzustand. Im default betraegt dieser Parameterwert 1.

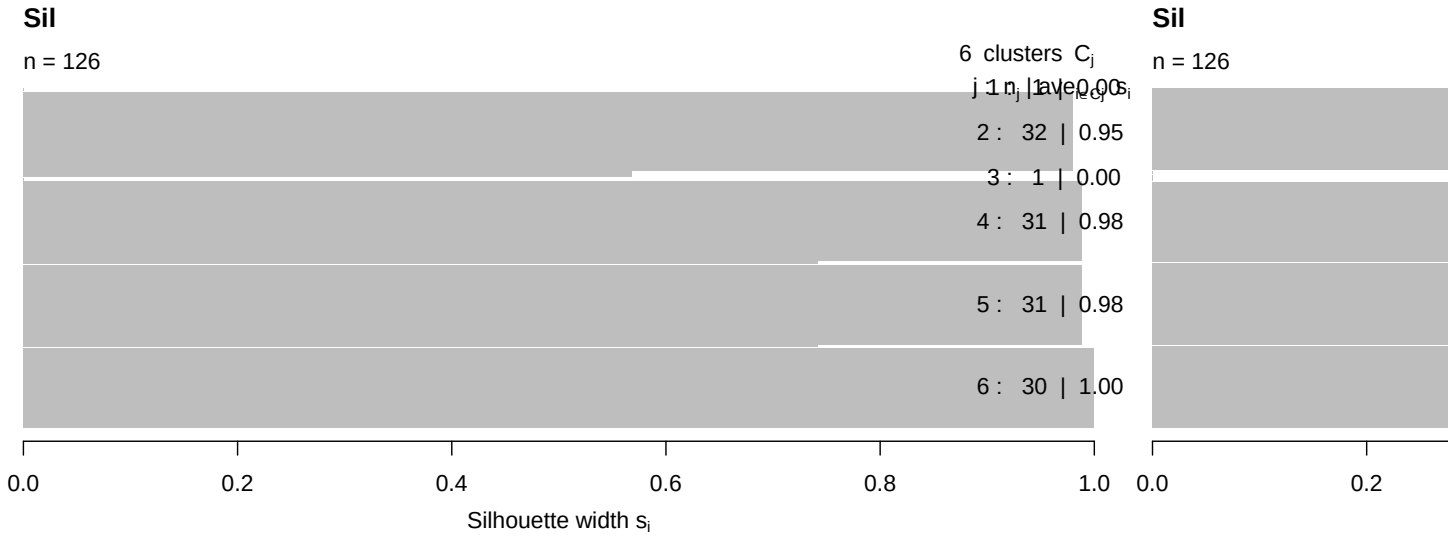
```
for(i in 2:7) {
  km.res <- eclust(data, "kmeans", k=i, graph=FALSE, nstart=25)
  sil <- silhouette(km.res$cluster, dist(data))
  plot(sil, main="Sil")
}
```



Average silhouette width : 0.57



Average silhouette width : 0.96



In unserem Fall erkennen keine signifikanten Unterschiede zu unserer Beobachtung auf Aufgabenteil b).