

# Replication

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## Exploratory data analysis

Do this once (set eval to TRUE only once)

```
# Install required libraries if not already installed
if (!requireNamespace("pheatmap", quietly = TRUE)) install.packages("pheatmap")
if (!requireNamespace("ggplot2", quietly = TRUE)) install.packages("ggplot2")
```

## Simulate data

```
n <- 100 ## number of subjects
g <- 5000 ## number of gene features
set.seed(123)
epxression <- matrix(rnorm(n*g), nrow=g, ncol=n) ## briefly simulate gene expression data
outcome <- matrix(rnorm(n), nrow=n, ncol=1) ## simulate a continuous outcome variable

# Add generic row and column names
rownames(epxression) <- paste0("Gene", seq_len(g)) # Generic gene names
colnames(epxression) <- paste0("Subject", seq_len(n)) # Generic subject names

rownames(outcome) <- paste0("Subject", seq_len(n)) # Generic subject names
colnames(outcome) <- paste0("Outcome", seq_len(1)) # Generic outcome names

# Verify the structure of the matrix
str(epxression)

## num [1:5000, 1:100] -0.5605 -0.2302 1.5587 0.0705 0.1293 ...
## - attr(*, "dimnames")=List of 2
##   ..$ : chr [1:5000] "Gene1" "Gene2" "Gene3" "Gene4" ...
##   ..$ : chr [1:100] "Subject1" "Subject2" "Subject3" "Subject4" ...
str(outcome)

## num [1:100, 1] 0.262 -1.521 0.237 0.66 -0.214 ...
## - attr(*, "dimnames")=List of 2
##   ..$ : chr [1:100] "Subject1" "Subject2" "Subject3" "Subject4" ...
##   ..$ : chr "Outcome1"
```

## Summary of the dataset

Get summary of gene expression data

```
summary(epxression)
```

```
##      Subject1        Subject2        Subject3        Subject4
## Min.   :-3.13739   Min.   :-3.845320   Min.   :-3.346902   Min.   :-3.48873
## 1st Qu.:-0.65514   1st Qu.:-0.683431   1st Qu.:-0.650219   1st Qu.:-0.71595
## Median :0.00757    Median :0.013040    Median :0.010631    Median :0.03959
## Mean   :-0.00057    Mean   :-0.004174    Mean   :0.008171    Mean   :-0.02638
## 3rd Qu.: 0.66098    3rd Qu.: 0.687930    3rd Qu.: 0.705198    3rd Qu.: 0.63257
## Max.   : 3.44599    Max.   : 3.847768    Max.   : 3.102420    Max.   : 3.75870
##      Subject5        Subject6        Subject7
## Min.   :-3.545884   Min.   :-3.497287   Min.   :-3.314692
## 1st Qu.:-0.695947   1st Qu.:-0.674103   1st Qu.:-0.658037
## Median :0.003935    Median :0.021310    Median :0.010991
## Mean   :-0.009621    Mean   :-0.004578    Mean   :0.005864
## 3rd Qu.: 0.683894    3rd Qu.: 0.684974    3rd Qu.: 0.688202
## Max.   : 4.322815    Max.   : 3.502046    Max.   : 3.982778
##      Subject8        Subject9        Subject10       Subject11
## Min.   :-4.129135   Min.   :-3.590108   Min.   :-3.42694   Min.   :-3.287792
## 1st Qu.:-0.694417   1st Qu.:-0.664623   1st Qu.:-0.66084   1st Qu.:-0.680371
## Median :0.003774    Median :0.020927    Median :0.02529   Median :0.001079
## Mean   :-0.016353   Mean   :0.004357    Mean   :0.02585   Mean   :0.005172
## 3rd Qu.: 0.649873    3rd Qu.: 0.672877   3rd Qu.: 0.69822   3rd Qu.: 0.659285
## Max.   : 3.498277   Max.   : 3.409307   Max.   : 3.59857   Max.   : 3.722831
##      Subject12       Subject13       Subject14       Subject15
## Min.   :-3.36355    Min.   :-3.724171   Min.   :-3.668168   Min.   :-3.968249
## 1st Qu.:-0.66348    1st Qu.:-0.668634   1st Qu.:-0.638366   1st Qu.:-0.646132
## Median :0.01423    Median :0.004118    Median :0.010060   Median :0.024655
## Mean   :0.01745    Mean   :-0.004395   Mean   :0.007885   Mean   :0.009198
## 3rd Qu.: 0.69363    3rd Qu.: 0.678741   3rd Qu.: 0.675352   3rd Qu.: 0.662653
## Max.   : 3.82693    Max.   : 3.868918   Max.   : 3.727903   Max.   : 3.856234
##      Subject16       Subject17       Subject18       Subject19
## Min.   :-3.347702   Min.   :-3.63427    Min.   :-3.882164   Min.   :-4.132090
## 1st Qu.:-0.666611   1st Qu.:-0.66505    1st Qu.:-0.665359   1st Qu.:-0.663004
## Median :0.000725    Median :0.01220    Median :0.000815   Median :0.006399
## Mean   :0.003074    Mean   :0.02532    Mean   :-0.003137   Mean   :-0.006054
## 3rd Qu.: 0.693787   3rd Qu.: 0.70741    3rd Qu.: 0.662273   3rd Qu.: 0.666806
## Max.   : 3.296935   Max.   : 3.72614    Max.   : 3.311354   Max.   : 3.804633
##      Subject20       Subject21       Subject22       Subject23
## Min.   :-3.51338    Min.   :-4.38210    Min.   :-3.58357   Min.   :-3.119954
## 1st Qu.:-0.68912    1st Qu.:-0.66145    1st Qu.:-0.63415   1st Qu.:-0.666589
## Median :0.02419    Median :0.01002    Median :0.01292   Median :0.010448
## Mean   :-0.01755    Mean   :0.01213    Mean   :0.02169   Mean   :0.002074
## 3rd Qu.: 0.64394    3rd Qu.: 0.67547    3rd Qu.: 0.69120   3rd Qu.: 0.689001
## Max.   : 3.63323    Max.   : 4.20609    Max.   : 4.11303   Max.   : 3.679167
##      Subject24       Subject25       Subject26       Subject27
## Min.   :-3.646808   Min.   :-3.464245   Min.   :-3.45079   Min.   :-4.171809
## 1st Qu.:-0.653631   1st Qu.:-0.650869   1st Qu.:-0.69240   1st Qu.:-0.662329
## Median :0.003413    Median :0.003689    Median :-0.01863   Median :-0.004859
## Mean   :-0.000549   Mean   :0.014771    Mean   :-0.01770   Mean   :0.005639
## 3rd Qu.: 0.679261    3rd Qu.: 0.674026   3rd Qu.: 0.67162   3rd Qu.: 0.669877
## Max.   : 3.739200   Max.   : 3.905947   Max.   : 3.53511   Max.   : 3.517973
##      Subject28       Subject29       Subject30       Subject31
## Min.   :-3.783642   Min.   :-3.810947   Min.   :-3.886389   Min.   :-3.47121
## 1st Qu.:-0.704395   1st Qu.:-0.672771   1st Qu.:-0.686908   1st Qu.:-0.66173
```

```

## Median : 0.000214   Median :-0.025756   Median :-0.015644   Median : 0.02016
## Mean   : 0.005027   Mean  :-0.007937   Mean  :-0.000671   Mean   : 0.01252
## 3rd Qu.: 0.711164   3rd Qu.: 0.664445   3rd Qu.: 0.673120   3rd Qu.: 0.70122
## Max.   : 4.016490   Max.  : 3.470600   Max.  : 3.492425   Max.   : 3.62431
## Subject32           Subject33           Subject34           Subject35
## Min.   :-3.50500    Min.  :-3.52675    Min.  :-3.364985   Min.   :-3.52917
## 1st Qu.:-0.65887    1st Qu.:-0.68326    1st Qu.:-0.673341   1st Qu.:-0.66278
## Median : 0.02218    Median :-0.01394    Median : 0.014348   Median : 0.04701
## Mean   : 0.02339    Mean   :-0.01985    Mean   :-0.000571   Mean   : 0.03059
## 3rd Qu.: 0.70101    3rd Qu.: 0.64233    3rd Qu.: 0.662316   3rd Qu.: 0.70278
## Max.   : 3.66731    Max.  : 3.86385    Max.  : 3.678648   Max.   : 3.59296
## Subject36           Subject37           Subject38           Subject39
## Min.   :-3.728327   Min.  :-4.2843     Min.  :-4.289319   Min.   :-3.717921
## 1st Qu.:-0.666374   1st Qu.:-0.6685     1st Qu.:-0.683130   1st Qu.:-0.631022
## Median : 0.013724   Median : 0.0141     Median : 0.004562   Median : 0.001302
## Mean   :-0.000316   Mean   : 0.0162     Mean   :-0.005718   Mean   : 0.014293
## 3rd Qu.: 0.637223   3rd Qu.: 0.6782     3rd Qu.: 0.668682   3rd Qu.: 0.688350
## Max.   : 3.870422   Max.  : 3.3123     Max.  : 4.124220   Max.   : 3.534363
## Subject40           Subject41           Subject42           Subject43
## Min.   :-4.235030   Min.  :-3.28571    Min.  :-3.736208   Min.   :-3.46173
## 1st Qu.:-0.682681   1st Qu.:-0.66226    1st Qu.:-0.694664   1st Qu.:-0.65329
## Median : 0.003884   Median : 0.01605    Median :-0.000848   Median : 0.01116
## Mean   :-0.000706   Mean   : 0.01007    Mean   : 0.003287   Mean   : 0.02344
## 3rd Qu.: 0.679456   3rd Qu.: 0.66791    3rd Qu.: 0.675002   3rd Qu.: 0.69683
## Max.   : 3.621941   Max.  : 3.97998    Max.  : 4.438207   Max.   : 3.83334
## Subject44           Subject45           Subject46           Subject47
## Min.   :-3.57071    Min.  :-3.512811   Min.  :-3.60410    Min.   :-3.683702
## 1st Qu.:-0.66481    1st Qu.:-0.669829   1st Qu.:-0.67768   1st Qu.:-0.641628
## Median : 0.01718    Median : 0.002360   Median :-0.02067   Median : 0.002099
## Mean   : 0.01760    Mean   :-0.004545   Mean   :-0.01955   Mean   : 0.002159
## 3rd Qu.: 0.67437    3rd Qu.: 0.670577   3rd Qu.: 0.66602   3rd Qu.: 0.671560
## Max.   : 3.53963    Max.  : 3.540067   Max.  : 3.47055   Max.   : 4.521510
## Subject48           Subject49           Subject50
## Min.   :-3.385984   Min.  :-3.864051   Min.  :-3.828184
## 1st Qu.:-0.682608   1st Qu.:-0.666140   1st Qu.:-0.681603
## Median : 0.009991   Median :-0.008381   Median :-0.003951
## Mean   : 0.007376   Mean   :-0.008613   Mean   :-0.008485
## 3rd Qu.: 0.695488   3rd Qu.: 0.662398   3rd Qu.: 0.663420
## Max.   : 3.683045   Max.  : 3.831116   Max.  : 3.909873
## Subject51           Subject52           Subject53           Subject54
## Min.   :-3.132911   Min.  :-3.37806    Min.  :-3.87594   Min.   :-3.400101
## 1st Qu.:-0.690660   1st Qu.:-0.71789    1st Qu.:-0.68363   1st Qu.:-0.665290
## Median : 0.007138   Median :-0.03716    Median :-0.01375   Median :-0.008804
## Mean   :-0.000060   Mean   :-0.03148    Mean   :-0.01023   Mean   :-0.001645
## 3rd Qu.: 0.678224   3rd Qu.: 0.63367    3rd Qu.: 0.67169   3rd Qu.: 0.678325
## Max.   : 4.124677   Max.  : 3.85911    Max.  : 3.14319   Max.   : 4.012678
## Subject55           Subject56           Subject57           Subject58
## Min.   :-3.161173   Min.  :-3.22691    Min.  :-3.886701   Min.   :-3.390823
## 1st Qu.:-0.672746   1st Qu.:-0.65916    1st Qu.:-0.673845   1st Qu.:-0.682571
## Median :-0.003995   Median : 0.03579    Median : 0.010880   Median : 0.004502
## Mean   :-0.014260   Mean   : 0.03072    Mean   : 0.002678   Mean   :-0.004148
## 3rd Qu.: 0.659599   3rd Qu.: 0.70115    3rd Qu.: 0.667013   3rd Qu.: 0.673469
## Max.   : 3.315813   Max.  : 3.21554    Max.  : 3.713466   Max.   : 3.474433
## Subject59           Subject60           Subject61           Subject62

```

```

## Min.   :-4.132421   Min.   :-3.524633   Min.   :-3.955943   Min.   :-3.60025
## 1st Qu.:-0.684022   1st Qu.:-0.678852   1st Qu.:-0.689750   1st Qu.:-0.68891
## Median : 0.004126   Median : 0.001338   Median :-0.006403   Median :-0.01031
## Mean   :-0.002937   Mean   :-0.003303   Mean   :-0.010667   Mean   :-0.01089
## 3rd Qu.: 0.658595   3rd Qu.: 0.667094   3rd Qu.: 0.666375   3rd Qu.: 0.67088
## Max.   : 4.335663   Max.   : 3.521668   Max.   : 3.322693   Max.   : 4.59988
## Subject63           Subject64           Subject65           Subject66
## Min.   :-3.582420   Min.   :-3.802029   Min.   :-3.620862   Min.   :-3.62076
## 1st Qu.:-0.661392   1st Qu.:-0.712918   1st Qu.:-0.660348   1st Qu.:-0.68972
## Median :-0.003873   Median :-0.003813   Median :-0.023392   Median :-0.02496
## Mean   : 0.005575   Mean   :-0.002615   Mean   :-0.004523   Mean   :-0.01197
## 3rd Qu.: 0.675311   3rd Qu.: 0.697134   3rd Qu.: 0.663280   3rd Qu.: 0.67499
## Max.   : 4.560770   Max.   : 3.425439   Max.   : 3.914826   Max.   : 3.76890
## Subject67           Subject68           Subject69           Subject70
## Min.   :-3.80704    Min.   :-3.421901   Min.   :-3.75397    Min.   :-3.440308
## 1st Qu.:-0.69107    1st Qu.:-0.665456   1st Qu.:-0.66399    1st Qu.:-0.668036
## Median :-0.02352    Median :-0.004383   Median : 0.02001    Median : 0.006168
## Mean   :-0.01020    Mean   : 0.008428   Mean   : 0.02271    Mean   : 0.013625
## 3rd Qu.: 0.67205    3rd Qu.: 0.674011   3rd Qu.: 0.69985    3rd Qu.: 0.650221
## Max.   : 3.41718    Max.   : 3.328418   Max.   : 3.61313    Max.   : 4.311408
## Subject71           Subject72           Subject73           Subject74
## Min.   :-4.351687   Min.   :-4.04539    Min.   :-3.72736    Min.   :-3.30575
## 1st Qu.:-0.684706   1st Qu.:-0.69233    1st Qu.:-0.65718    1st Qu.:-0.68257
## Median :-0.007832   Median :-0.02236    Median : 0.03337    Median :-0.02461
## Mean   : 0.004877   Mean   :-0.01088    Mean   : 0.01733    Mean   :-0.01171
## 3rd Qu.: 0.693027   3rd Qu.: 0.67966    3rd Qu.: 0.68532    3rd Qu.: 0.64830
## Max.   : 3.724642   Max.   : 4.19705    Max.   : 3.49062    Max.   : 3.22749
## Subject75           Subject76           Subject77           Subject78
## Min.   :-3.88035    Min.   :-3.756247   Min.   :-3.97580    Min.   :-3.39382
## 1st Qu.:-0.65339    1st Qu.:-0.663381   1st Qu.:-0.67811    1st Qu.:-0.69763
## Median : 0.04167    Median : 0.002080   Median :-0.02082    Median :-0.03009
## Mean   : 0.03591    Mean   : 0.003606   Mean   :-0.01445    Mean   :-0.02334
## 3rd Qu.: 0.71813    3rd Qu.: 0.667952   3rd Qu.: 0.65567    3rd Qu.: 0.65212
## Max.   : 3.32174    Max.   : 3.807814   Max.   : 4.75909    Max.   : 3.87518
## Subject79           Subject80           Subject81
## Min.   :-3.379216   Min.   :-3.435067   Min.   :-4.344709
## 1st Qu.:-0.699910   1st Qu.:-0.658255   1st Qu.:-0.697579
## Median : 0.015657   Median : 0.009161   Median :-0.002202
## Mean   :-0.004029   Mean   : 0.014581   Mean   : 0.000107
## 3rd Qu.: 0.679089   3rd Qu.: 0.700492   3rd Qu.: 0.685294
## Max.   : 3.743402   Max.   : 3.725226   Max.   : 4.105089
## Subject82           Subject83           Subject84           Subject85
## Min.   :-3.375939   Min.   :-3.36973   Min.   :-3.968929   Min.   :-3.813418
## 1st Qu.:-0.670887   1st Qu.:-0.70504   1st Qu.:-0.669562   1st Qu.:-0.675061
## Median :-0.002532   Median :-0.02662   Median :-0.017484   Median : 0.004612
## Mean   :-0.009904   Mean   :-0.02845   Mean   :-0.007497   Mean   : 0.002017
## 3rd Qu.: 0.656012   3rd Qu.: 0.65799   3rd Qu.: 0.672142   3rd Qu.: 0.655976
## Max.   : 3.556095   Max.   : 3.31213   Max.   : 3.704391   Max.   : 3.305563
## Subject86           Subject87           Subject88           Subject89
## Min.   :-3.677877   Min.   :-3.645745   Min.   :-3.37371   Min.   :-3.486584
## 1st Qu.:-0.611169   1st Qu.:-0.677209   1st Qu.:-0.67451   1st Qu.:-0.681422
## Median : 0.007506   Median :-0.002017   Median :-0.01821   Median :-0.008908
## Mean   : 0.020376   Mean   :-0.016888   Mean   :-0.01755   Mean   :-0.013466
## 3rd Qu.: 0.693861   3rd Qu.: 0.652611   3rd Qu.: 0.64814   3rd Qu.: 0.672181

```

```

##  Max.    : 3.583582   Max.    : 3.178540   Max.    : 4.06703   Max.    : 3.586106
##  Subject90          Subject91          Subject92          Subject93
##  Min.    :-3.58178   Min.    :-3.835446   Min.    :-3.545541   Min.    :-3.83223
##  1st Qu.:-0.68285   1st Qu.:-0.662353   1st Qu.:-0.680923   1st Qu.:-0.67882
##  Median  : 0.01079   Median  : 0.003976   Median :-0.017103   Median :-0.01348
##  Mean    : 0.01002   Mean    : 0.013293   Mean    :-0.004611   Mean    :-0.01189
##  3rd Qu.: 0.68464   3rd Qu.: 0.686722   3rd Qu.: 0.672114   3rd Qu.: 0.66976
##  Max.    : 3.63429   Max.    : 2.902224   Max.    : 3.952553   Max.    : 3.28121
##  Subject94          Subject95          Subject96          Subject97
##  Min.    :-3.26015   Min.    :-3.43247   Min.    :-3.92723   Min.    :-3.56583
##  1st Qu.:-0.71902   1st Qu.:-0.72845   1st Qu.:-0.68903   1st Qu.:-0.68742
##  Median :-0.03032   Median :-0.01894   Median :-0.02135   Median :-0.00291
##  Mean    :-0.02291   Mean    :-0.03315   Mean    :-0.01480   Mean    : 0.00071
##  3rd Qu.: 0.67097   3rd Qu.: 0.64323   3rd Qu.: 0.66726   3rd Qu.: 0.68546
##  Max.    : 3.66996   Max.    : 3.79243   Max.    : 3.54333   Max.    : 3.75506
##  Subject98          Subject99          Subject100
##  Min.    :-3.365212  Min.    :-3.55421   Min.    :-4.104114
##  1st Qu.:-0.677987  1st Qu.:-0.65532   1st Qu.:-0.670120
##  Median :-0.018113  Median : 0.02273   Median : 0.007368
##  Mean    :-0.002519  Mean    : 0.02700   Mean    :-0.007531
##  3rd Qu.: 0.658362  3rd Qu.: 0.70441   3rd Qu.: 0.654009
##  Max.    : 3.521878  Max.    : 3.43526   Max.    : 3.196152

```

Get summary of outcome data

```
summary(outcome)
```

```

##      Outcome1
##  Min.    :-1.92039
##  1st Qu.:-0.53049
##  Median :-0.10333
##  Mean    :-0.01797
##  3rd Qu.: 0.42913
##  Max.    : 2.17272

```

Check for missing values

```
sum(is.na(epxression))
```

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

```
sum(is.na(outcome))
```

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

## Distribution of the dataset

Get distribution of outcome data

```

library(ggplot2)

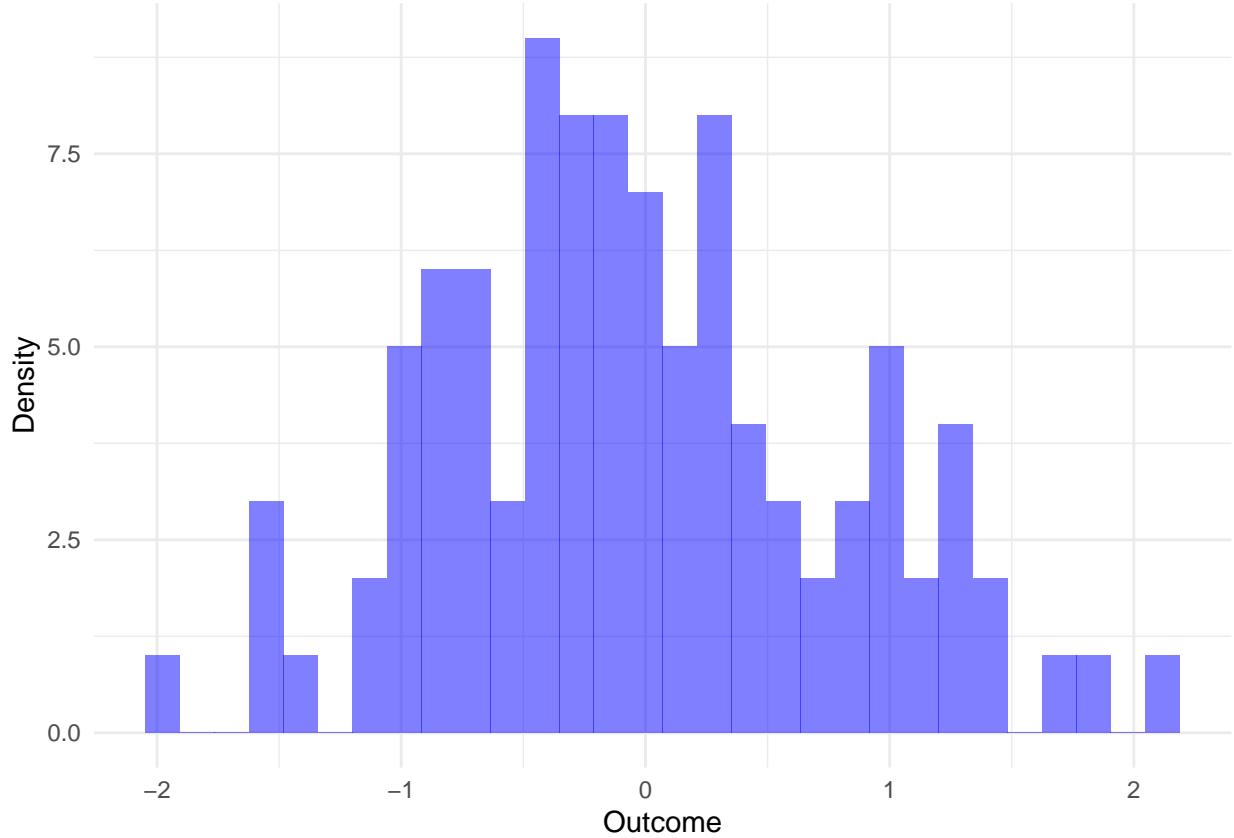
df <- as.data.frame(outcome)

p <- ggplot(df, aes(x = outcome)) +
  geom_histogram(alpha = 0.5, fill = "blue") +
  labs(x = "Outcome", y = "Density") +
  theme_minimal()

```

```
print(p)

## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

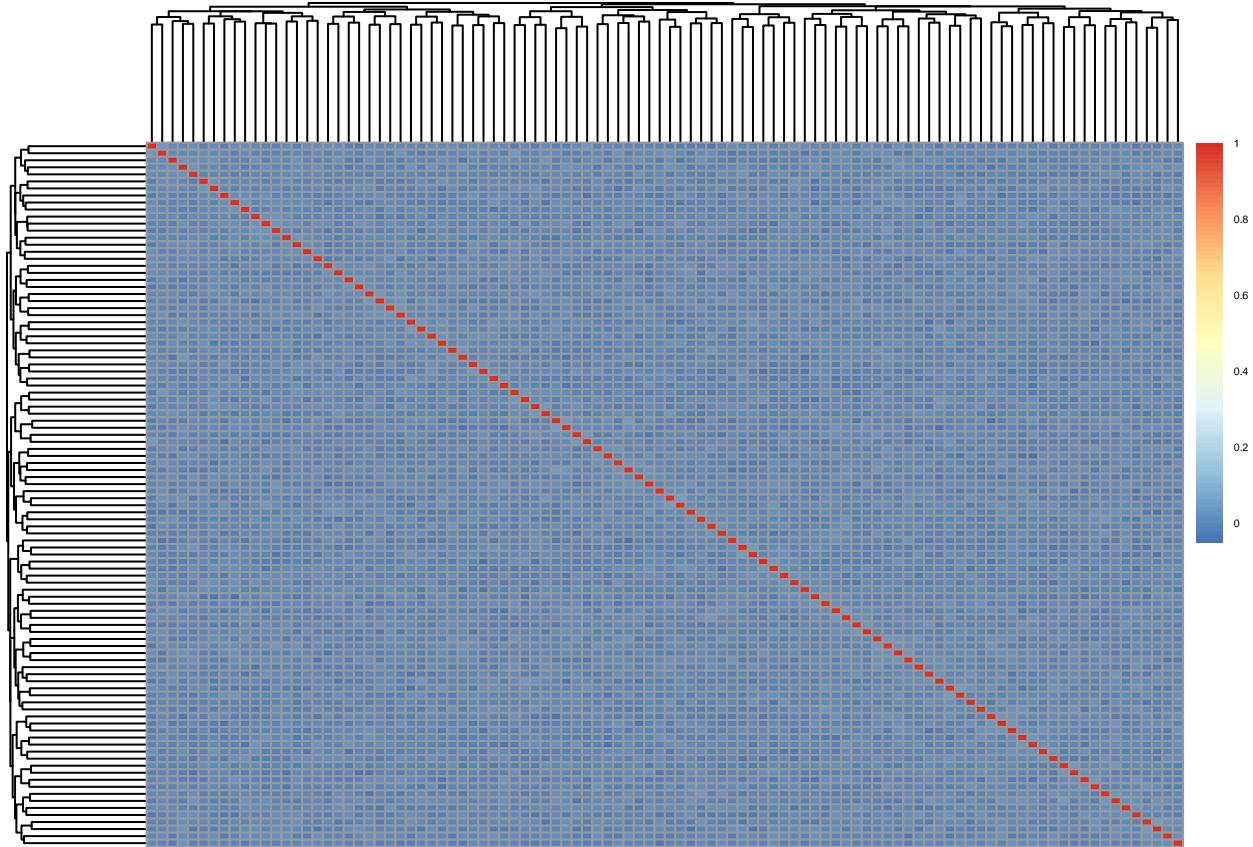


## Correlation analysis

```
library(pheatmap)

# Compute correlations
cor_matrix <- cor(epxression, use = "pairwise.complete.obs")

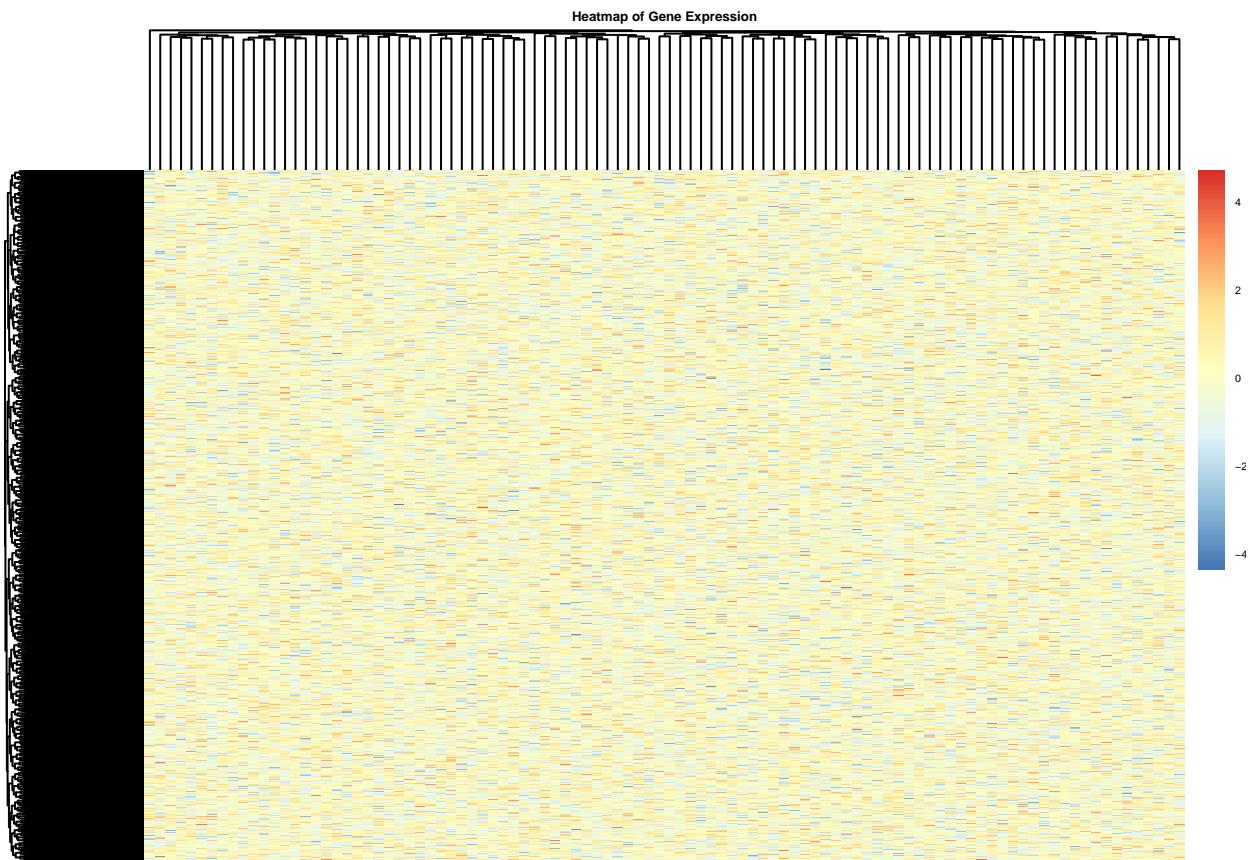
# Visualize correlations as a heatmap
pheatmap(cor_matrix,
         show_rownames = FALSE,
         show_colnames = FALSE,
         clustering_distance_rows = "correlation",
         clustering_distance_cols = "correlation",
         fontsize = 4)
```



## Heatmap of Gene Expression

```
# Scale the data (row-wise)
scaled_epxr <- t(scale(t(epxression)))

# Plot the heatmap
pheatmap(scaled_epxr,
          show_rownames = FALSE,
          show_colnames = FALSE,
          cluster_rows = TRUE,
          cluster_cols = TRUE,
          fontsize = 4,
          main = "Heatmap of Gene Expression")
```



## Replication

Do this once (set eval to TRUE only once)

```
install.packages("devtools")
library(devtools)

if (!require("BiocManager", quietly = TRUE))
  install.packages("BiocManager")
BiocManager::install("qvalue")

install_github("LingsongMeng/GuidedSparseKmeans")

library(GuidedSparseKmeans)

## Loading required package: cluster
## Loading required package: DescTools
## Loading required package: MASS
## Loading required package: survival
## Loading required package: jaccard
## Loading required package: mclust
## Package 'mclust' version 6.1.1
```

```

## Type 'citation("mclust")' for citing this R package in publications.
##
## Attaching package: 'mclust'
##
## The following object is masked from 'package:DescTools':
##
##     BrierScore

# Estimate tuning parameter K and lambda
Klam <- GuidedSparseKmeans.KLam(x=t(epxression), z=outcome, pre.K = NULL, s.one=10, model="linear", nst

## [1] "lam=0.25"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=0.5"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=0.75"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=1"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=1.25"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=1.5"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=1.75"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=2"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=2.25"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=2.5"
## [1] "s=10"
## [1] 1
## [1] 2

# Estimate tuning parameter s
s <- GuidedSparseKmeans.S(x=t(epxression), z=outcome, K=3, s=c(8:12), lam=1, model="linear", nstart = 20

## [1] "s=8"

```

```

## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
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## [1] 2
## [1] 3
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## [1] 2
## [1] "s=12"
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## [1] 2
## [1] "nperms=1"
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## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] 6
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## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] 6
## [1] "s=10"
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## [1] 2
## [1] 3
## [1] "s=11"
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## [1] 2
## [1] 3
## [1] "s=12"
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## [1] 2
## [1] 3
## [1] "nperms=2"
## [1] "s=8"
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## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1

```

```

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## [1] 2
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## [1] 4
## [1] 5
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## [1] 2
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## [1] 4
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## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1

```

```
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## [1] 3
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## [1] 2
## [1] 3
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## [1] 2
## [1] "nperms=7"
```

```

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## [1] 3
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## [1] 4
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```

```

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```

```

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```

```

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## [1] 2
## [1] "s=11"
## [1] 1

```

```

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## [1] 2

```

```

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```

```

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## [1] 2
## [1] 3

```

```

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## [1] 2

```

```

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```

```

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## [1] 3
## [1] 4
## [1] "s=10"

```

```

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## [1] "s=12"
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```

```

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## [1] 2
## [1] 3

```

```

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## [1] 3
## [1] 4
## [1] "s=10"
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## [1] 2
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## [1] 3
## [1] 4

```

```

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## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=43"

```

```

## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=44"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=45"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] 6
## [1] "s=9"
## [1] 1
## [1] 2

```

```

## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 2
## [1] "nperms=46"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "nperms=47"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=11"
## [1] 1
## [1] 2

```

```

## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=48"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=49"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=50"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4

```

```

## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] 4

# Obtain gene selection and clustering results
results <- GuidedSparseKmeans(x=t(epxression), outcome, K=3, s=10, lam=1, model="linear", nstart=20, maxit=100)

## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3

## Users can also obtain guidance first, then use the guidance in the next several steps.
# Obtain guidance
R2 <- getR2(t(epxression), outcome, model="linear")

# Estimate tuning parameter K and lambda
KLam <- GuidedSparseKmeans.KLam.R2out(x=t(epxression), R2.per=R2, pre.K = NULL, s.one=10, nstart = 20, maxit=100)

## [1] "lam=0.25"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=0.5"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=0.75"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=1"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=1.25"
## [1] "s=10"

```

```

## [1] 1
## [1] 2
## [1] "lam=1.5"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=1.75"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=2"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=2.25"
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "lam=2.5"
## [1] "s=10"
## [1] 1
## [1] 2
## Estimate tuning parameter s
s <- GuidedSparseKmeans.S.R2out(x=t(epxression), R2.per=R2, K=3, s=c(8:12), lam=1, nstart = 20, maxiter
                                ## [1] "s=8"
                                ## [1] 1
                                ## [1] 2
                                ## [1] 3
                                ## [1] "s=9"
                                ## [1] 1
                                ## [1] 2
                                ## [1] 3
                                ## [1] 4
                                ## [1] "s=10"
                                ## [1] 1
                                ## [1] 2
                                ## [1] 3
                                ## [1] "s=11"
                                ## [1] 1
                                ## [1] 2
                                ## [1] "s=12"
                                ## [1] 1
                                ## [1] 2
                                ## [1] "nperms=1"
                                ## [1] "s=8"
                                ## [1] 1
                                ## [1] 2
                                ## [1] 3
                                ## [1] "s=9"
                                ## [1] 1
                                ## [1] 2
                                ## [1] 3
                                ## [1] 4

```

```

## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=2"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=3"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"

```

```

## [1] 1
## [1] 2
## [1] "nperms=4"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=5"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "nperms=6"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5

```

```

## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=7"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "nperms=8"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3

```

```

## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=9"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=10"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] 6
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=11"

```

```

## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=12"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=13"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2

```

```

## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
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## [1] 2
## [1] 3
## [1] "nperms=14"
## [1] "s=8"
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## [1] 2
## [1] 3
## [1] "s=9"
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## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
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## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
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## [1] "nperms=15"
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## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
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## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] 6
## [1] 7
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3

```

```

## [1] 4
## [1] "s=11"
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## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
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## [1] 2
## [1] 3
## [1] "nperms=16"
## [1] "s=8"
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## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=17"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3

```

```

## [1] "s=12"
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## [1] 2
## [1] 3
## [1] "nperms=18"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
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## [1] 3
## [1] "nperms=19"
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## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
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## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=20"
## [1] "s=8"
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## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2

```

```

## [1] 3
## [1] "s=10"
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## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
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## [1] 2
## [1] 3
## [1] "nperms=21"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
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## [1] 2
## [1] "nperms=22"
## [1] "s=8"
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## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] 6
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4

```

```

## [1] 5
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "nperms=23"
## [1] "s=8"
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## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=24"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=25"

```

```

## [1] "s=8"
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## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=26"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=27"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2

```

```

## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=28"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=29"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "nperms=30"
## [1] "s=8"

```

```

## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=31"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "nperms=32"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3

```

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## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=33"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=34"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2

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## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=35"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=36"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] 6
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=37"
## [1] "s=8"
## [1] 1

```

```

## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=38"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=39"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2

```

```

## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=40"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=41"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1

```

```

## [1] 2
## [1] "nperms=42"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=43"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] 6
## [1] 7
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=44"
## [1] "s=8"
## [1] 1

```

```

## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=45"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=46"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] 6
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3

```

```

## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] "s=11"
## [1] 1
## [1] 2
## [1] "s=12"
## [1] 1
## [1] 2
## [1] "nperms=47"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=48"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4

```

```

## [1] 4
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=49"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] "s=12"
## [1] 1
## [1] 2
## [1] 3
## [1] "nperms=50"
## [1] "s=8"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=9"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=11"
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
## [1] "s=12"
## [1] 1
## [1] 2

```

```

## [1] 3
## [1] 4
## [1] 5

# Obtain gene selection and clustering results
results <- GuidedSparseKmeans.R2out(x=t(epxpression), R2.per=R2, K=3, s=10, lam=1, nstart=20, maxiter=15)

## [1] "s=10"
## [1] 1
## [1] 2
## [1] 3

```

## Heatmap of clustered gene expression data

```

# Assign cluster IDs to subjects
subj_clusters <- data.frame(
  Subject = colnames(scaled_epxr), # Subject names
  Cluster = results[[1]]$clusters # Corresponding cluster IDs
)

# Create a column annotation for clusters
annotation_col <- data.frame(
  Cluster = factor(results[[1]]$clusters) # Convert cluster IDs to factors
)

rownames(annotation_col) <- colnames(scaled_epxr) # Set rownames to subject names

# Order the matrix by clusters
sorted_indices <- order(annotation_col$Cluster)
epxr_sorted <- scaled_epxr[, sorted_indices]

# Update the annotation to match the sorted order
annotation_col <- annotation_col[sorted_indices, , drop = FALSE]

color_palette <- colorRampPalette(c("green", "red"))(100)
breaks <- seq(-4, 4, length.out = 101)

# Generate heatmap with annotation
pheatmap(epxr_sorted,
  cluster_cols = FALSE,
  cluster_rows = FALSE,
  show_rownames = FALSE,
  show_colnames = FALSE,
  color = color_palette,
  breaks = breaks,
  annotation_col = annotation_col)

```

