Dimensionality reduction

Exercices

```
library(mixOmics)
```

1. Load the `nutrimouse` data from the `mixOmics` R package and investigate its structure. A data object provided by an R package can be loaded with `data`. Its structure can be obainted with `str`, `length`, `dim`, etc.

```
data("nutrimouse")
## display the structure of the nutrimouse object
str(nutrimouse)
```

```
## List of 4
##  $ gene    :'data.frame':    40 obs. of  120 variables:
##   ..$ X36b4   : num [1:40] -0.42 -0.44 -0.48 -0.45 -0.42 -0.43 -0.53 -0.49 -0.36 -0.5 ...
##   ..$ ACAT1   : num [1:40] -0.65 -0.68 -0.74 -0.69 -0.71 -0.69 -0.62 -0.69 -0.66 -0.62 ...
##   ..$ ACAT2   : num [1:40] -0.84 -0.91 -1.1 -0.65 -0.54 -0.8 -1 -0.91 -0.74 -0.79 ...
##   ..$ ACBP    : num [1:40] -0.34 -0.32 -0.46 -0.41 -0.38 -0.32 -0.44 -0.37 -0.39 -0.36 ...
##   ..$ ACC1    : num [1:40] -1.29 -1.23 -1.3 -1.26 -1.21 -1.13 -1.22 -1.29 -1.15 -1.21 ...
##   ..$ ACC2    : num [1:40] -1.13 -1.06 -1.09 -1.09 -0.89 -0.79 -1 -1.06 -1.08 -0.82 ...
##   ..$ ACOTH   : num [1:40] -0.93 -0.99 -1.06 -0.93 -1 -0.93 -0.94 -1.05 -0.88 -0.92 ...
##   ..$ ADISP   : num [1:40] -0.98 -0.97 -1.08 -1.02 -0.95 -0.97 -0.94 -1.02 -0.98 -0.99 ...
##   ..$ ADSS1   : num [1:40] -1.19 -1 -1.18 -1.07 -1.08 -1.07 -1.05 -1.16 -1.05 -1 ...
##   ..$ ALDH3   : num [1:40] -0.68 -0.62 -0.75 -0.71 -0.76 -0.75 -0.67 -0.75 -0.66 -0.69 ...
##   ..$ AM2R    : num [1:40] -0.59 -0.58 -0.66 -0.65 -0.59 -0.55 -0.66 -0.66 -0.53 -0.62 ...
##   ..$ AOX     : num [1:40] -0.16 -0.12 -0.16 -0.17 -0.31 -0.23 -0.09 -0.22 -0.06 -0.23 ...
##   ..$ BACT    : num [1:40] -0.22 -0.32 -0.32 -0.32 -0.31 -0.29 -0.25 -0.21 -0.15 -0.2 ...
##   ..$ BIEN    : num [1:40] -0.89 -0.88 -0.89 -0.77 -0.97 -0.84 -0.86 -0.9 -0.74 -0.76 ...
##   ..$ BSEP    : num [1:40] -0.69 -0.6 -0.7 -0.67 -0.68 -0.55 -0.67 -0.66 -0.6 -0.58 ...
##   ..$ Bcl.3   : num [1:40] -1.18 -1.07 -1.17 -1.12 -0.93 -1.08 -1.03 -1.01 -1.01 -1.1 ...
##   ..$ C16SR   : num [1:40] 1.66 1.65 1.57 1.61 1.66 1.7 1.58 1.62 1.72 1.55 ...
##   ..$ CACP    : num [1:40] -0.92 -0.87 -1.02 -0.89 -0.93 -0.97 -0.97 -0.96 -0.85 -0.95 ...
##   ..$ CAR1    : num [1:40] -0.97 -0.92 -0.98 -0.97 -1.06 -1.03 -0.91 -1.11 -0.85 -0.99 ...
##   ..$ CBS     : num [1:40] -0.26 -0.36 -0.4 -0.39 -0.35 -0.31 -0.32 -0.4 -0.26 -0.39 ...
##   ..$ CIDEA   : num [1:40] -1.21 -1.17 -1.29 -1.18 -1.15 -1.14 -1.16 -1.26 -1.12 -1.08 ...
##   ..$ COX1    : num [1:40] -1.11 -1.06 -1.17 -1.03 -0.99 -1.03 -1.15 -1.18 -0.94 -1.07 ...
##   ..$ COX2    : num [1:40] -1.18 -1.06 -1.14 -1.13 -1.1 -1.16 -1.06 -1.24 -1.23 -1.09 ...
##   ..$ CPT2    : num [1:40] -0.87 -0.87 -0.95 -0.88 -0.91 -0.92 -0.86 -0.93 -0.82 -0.88 ...
##   ..$ CYP24   : num [1:40] -1.37 -1.14 -1.3 -1.27 -1.2 -1.11 -1.12 -1.3 -1.14 -1.08 ...
##   ..$ CYP26   : num [1:40] -1.21 -1.12 -1.22 -1.18 -1.16 -1.1 -1.07 -1.23 -1.1 -1.1 ...
##   ..$ CYP27a1 : num [1:40] -0.71 -0.62 -0.78 -0.71 -0.69 -0.6 -0.69 -0.81 -0.62 -0.62 ...
##   ..$ CYP27b1 : num [1:40] -1.31 -1.14 -1.29 -1.27 -1.2 -1.15 -1.17 -1.28 -1.13 -1.15 ...
##   ..$ CYP2b10 : num [1:40] -1.23 -1.2 -1.32 -1.23 -1.22 -1.1 -1.07 -1.26 -1.19 -1.1 ...
##   ..$ CYP2b13 : num [1:40] -1.19 -1.06 -1.25 -1.13 -1.1 -1.07 -1.2 -1.37 -1.15 -1.11 ...
##   ..$ CYP2c29 : num [1:40] -0.06 -0.2 -0.3 -0.07 -0.29 -0.28 -0.1 -0.1 0.18 -0.33 ...
##   ..$ CYP3A11 : num [1:40] -0.09 -0.34 -0.45 -0.11 -0.51 -0.55 -0.18 -0.25 0.06 -0.4 ...
```

```
##     ..$ CYP4A10  : num [1:40] -0.81 -0.88 -0.71 -0.65 -1.16 -0.99 -0.62 -0.82 -0.48 -0.79 ...
##     ..$ CYP4A14  : num [1:40] -0.81 -0.84 -0.98 -0.41 -1.16 -1.09 -0.76 -0.87 -0.37 -0.95 ...
##     ..$ CYP7a    : num [1:40] -0.77 -0.71 -0.93 -0.8 -0.71 -0.74 -0.76 -0.88 -0.77 -0.77 ...
##     ..$ CYP8b1   : num [1:40] -0.77 -0.63 -0.53 -0.73 -0.51 -0.55 -0.57 -0.63 -0.6 -0.66 ...
##     ..$ FAS      : num [1:40] -0.41 -0.37 -0.3 -0.59 -0.06 0.18 -0.16 0.04 -0.53 0.08 ...
##     ..$ FAT      : num [1:40] -1.03 -0.98 -1.03 -1.06 -0.99 -0.99 -0.89 -1.08 -1.04 -0.91 ...
##     ..$ FDFT     : num [1:40] -0.98 -0.92 -1.04 -1 -0.99 -1 -1.02 -0.97 -1.03 -0.95 ...
##     ..$ FXR      : num [1:40] -0.93 -0.87 -1 -0.9 -0.89 -0.89 -0.86 -1.01 -0.81 -0.91 ...
##     ..$ G6PDH    : num [1:40] -1.22 -1.09 -1.28 -1.19 -1.16 -0.96 -1.15 -1.26 -1.13 -1.03 ...
##     ..$ G6Pase   : num [1:40] -0.46 -0.63 -1.06 -0.71 -0.58 -0.49 -0.51 -0.61 -0.38 -0.6 ...
##     ..$ GK       : num [1:40] -0.71 -0.67 -0.68 -0.75 -0.62 -0.59 -0.59 -0.66 -0.68 -0.47 ...
##     ..$ GS       : num [1:40] -1.24 -1.22 -1.36 -1.21 -1.22 -1.16 -1.15 -1.31 -1.16 -1.19 ...
##     ..$ GSTa     : num [1:40] 0 -0.05 -0.13 -0.09 -0.02 -0.11 -0.06 -0.04 0.03 -0.02 ...
##     ..$ GSTmu    : num [1:40] 0.02 -0.05 -0.19 0.03 -0.23 -0.05 -0.22 -0.07 0.23 -0.14 ...
##     ..$ GSTpi2   : num [1:40] 0.45 0.3 0.18 0.36 0.3 0.17 0.12 0.48 0.53 0.01 ...
##     ..$ HMGCoAred: num [1:40] -0.95 -0.86 -0.96 -1.02 -0.7 -0.76 -1 -0.88 -0.96 -0.7 ...
##     ..$ HPNCL    : num [1:40] -0.65 -0.69 -0.75 -0.61 -0.66 -0.56 -0.61 -0.71 -0.53 -0.6 ...
##     ..$ IL.2     : num [1:40] -0.94 -0.94 -1.16 -0.97 -0.93 -0.96 -0.96 -0.85 -0.84 -0.95 ...
##     ..$ L.FABP   : num [1:40] 0.24 0.27 0.17 0.16 0 0.23 0.18 0.18 0.2 0.2 ...
##     ..$ LCE      : num [1:40] 0.09 0.06 -0.05 0.01 -0.07 -0.1 -0.03 -0.08 0.12 -0.1 ...
##     ..$ LDLr     : num [1:40] -0.82 -0.68 -0.82 -0.94 -0.73 -0.74 -0.8 -0.83 -0.81 -0.72 ...
##     ..$ LPK      : num [1:40] -0.32 -0.39 -0.38 -0.38 -0.17 -0.14 -0.35 -0.13 -0.32 -0.24 ...
##     ..$ LPL      : num [1:40] -1.01 -0.97 -1.11 -0.99 -1.05 -0.99 -0.93 -1.07 -0.94 -0.95 ...
##     ..$ LXRa     : num [1:40] -0.82 -0.82 -0.91 -0.85 -0.83 -0.79 -0.77 -0.84 -0.75 -0.78 ...
##     ..$ LXRb     : num [1:40] -1 -0.95 -1.16 -1.01 -1.01 -0.99 -0.98 -1.04 -0.98 -0.99 ...
##     ..$ Lpin     : num [1:40] -0.87 -0.97 -0.95 -1 -0.57 -0.51 -0.81 -0.83 -0.83 -0.48 ...
##     ..$ Lpin1    : num [1:40] -0.85 -0.99 -0.94 -1.02 -0.53 -0.51 -0.81 -0.87 -0.82 -0.49 ...
##     ..$ Lpin2    : num [1:40] -0.85 -0.87 -0.9 -0.88 -0.72 -0.68 -0.8 -0.9 -0.68 -0.67 ...
##     ..$ Lpin3    : num [1:40] -1.23 -1.12 -1.25 -1.18 -1.12 -1.09 -1.04 -1.23 -1.13 -1.11 ...
##     ..$ M.CPT1   : num [1:40] -1.15 -1.06 -1.26 -1.1 -1.11 -1.14 -1.08 -1.19 -1.06 -1.09 ...
##     ..$ MCAD     : num [1:40] -0.6 -0.62 -0.7 -0.59 -0.69 -0.66 -0.53 -0.66 -0.45 -0.62 ...
##     ..$ MDR1     : num [1:40] -1.15 -1.1 -1.26 -1.13 -1.11 -1.09 -1.09 -1.19 -1.06 -1.1 ...
##     ..$ MDR2     : num [1:40] -0.77 -0.65 -0.86 -0.77 -0.7 -0.69 -0.81 -0.81 -0.69 -0.75 ...
##     ..$ MRP6     : num [1:40] -0.99 -0.85 -0.9 -0.95 -0.91 -0.84 -0.88 -1.02 -0.83 -0.86 ...
##     ..$ MS       : num [1:40] -1.11 -1.06 -1.2 -1.09 -1.09 -1.09 -0.99 -1.16 -1.06 -0.98 ...
##     ..$ MTHFR    : num [1:40] -0.96 -0.99 -1.1 -0.95 -0.93 -0.96 -0.88 -1.03 -1.01 -0.95 ...
##     ..$ NGFiB    : num [1:40] -1.21 -1.08 -1.24 -1.12 -1.11 -1.04 -1.02 -1.21 -1.11 -1.04 ...
##     ..$ NURR1    : num [1:40] -1.21 -1.1 -1.32 -1.11 -1.14 -1.18 -1.1 -1.26 -1.14 -1.09 ...
##     ..$ Ntcp     : num [1:40] -0.49 -0.45 -0.44 -0.54 -0.47 -0.46 -0.55 -0.5 -0.44 -0.43 ...
##     ..$ OCTN2    : num [1:40] -1.15 -1.15 -1.2 -1.17 -1.19 -1.11 -1.08 -1.21 -1.05 -1.08 ...
##     ..$ PAL      : num [1:40] -1.32 -1.25 -1.16 -1.25 -1.24 -1.02 -1.04 -1.27 -0.93 -0.92 ...
##     ..$ PDK4     : num [1:40] -1.16 -1.16 -1.27 -1.16 -1.13 -1.08 -1.14 -1.24 -1.19 -1.04 ...
##     ..$ PECI     : num [1:40] -0.68 -0.69 -0.92 -0.71 -0.83 -0.81 -0.79 -0.85 -0.58 -0.82 ...
##     ..$ PLTP     : num [1:40] -1.1 -0.99 -1.03 -1.08 -0.98 -0.89 -1.05 -1.07 -1.02 -0.85 ...
##     ..$ PMDCI    : num [1:40] -0.52 -0.52 -0.6 -0.52 -0.71 -0.69 -0.55 -0.57 -0.46 -0.69 ...
##     ..$ PON      : num [1:40] -0.52 -0.55 -0.65 -0.64 -0.57 -0.63 -0.56 -0.65 -0.6 -0.64 ...
##     ..$ PPARa    : num [1:40] -0.93 -0.86 -0.95 -0.97 -0.94 -0.95 -0.9 -1.12 -0.88 -0.95 ...
##     ..$ PPARd    : num [1:40] -1.51 -1.59 -1.71 -1.57 -1.53 -1.56 -1.49 -1.57 -1.58 -1.54 ...
##     ..$ PPARg    : num [1:40] -1.06 -1.02 -1.14 -1.05 -1.09 -1.01 -1 -1.13 -0.97 -1.07 ...
##     ..$ PXR      : num [1:40] -0.99 -0.96 -1.1 -0.99 -1 -1.03 -0.93 -1.07 -0.98 -0.96 ...
##     ..$ Pex11a   : num [1:40] -1 -1.02 -1.2 -1 -0.95 -1.07 -1.05 -1.02 -1 -1.01 ...
##     ..$ RARa     : num [1:40] -1.2 -1.06 -1.16 -1.17 -1.15 -1.13 -1.09 -1.24 -1.03 -1.09 ...
##     ..$ RARb2    : num [1:40] -1.19 -1.11 -1.23 -1.16 -1.14 -1.07 -1.09 -1.18 -1.12 -1.1 ...
##     ..$ RXRa     : num [1:40] -0.67 -0.59 -0.68 -0.72 -0.78 -0.62 -0.65 -0.76 -0.55 -0.67 ...
```

```
##   ..$ RXRb2   : num [1:40] -0.95 -0.95 -1.07 -0.95 -0.98 -0.94 -0.92 -1.03 -0.94 -0.95 ...
##   ..$ RXRg1   : num [1:40] -1.16 -1.1 -1.21 -1.1 -1.11 -1.03 -1.07 -1.19 -1.05 -1.04 ...
##   ..$ S14     : num [1:40] -0.93 -0.86 -0.84 -1.05 -0.65 -0.4 -0.73 -0.62 -0.99 -0.25 ...
##   ..$ SHP1    : num [1:40] -1.1 -0.97 -1.09 -1.03 -1.13 -0.98 -0.95 -1.21 -0.93 -0.97 ...
##   ..$ SIAT4c  : num [1:40] -1.07 -0.97 -1.04 -0.99 -0.94 -0.93 -0.89 -1.04 -0.93 -0.95 ...
##   ..$ SPI1.1  : num [1:40] 1.19 1.15 1.09 1.07 1.22 1.05 1.15 1.18 1.21 1.04 ...
##   ..$ SR.BI   : num [1:40] -0.84 -0.86 -0.95 -0.95 -1.06 -0.8 -0.83 -1 -0.83 -0.77 ...
##   ..$ THB     : num [1:40] -0.79 -0.85 -0.92 -0.79 -0.84 -0.86 -0.8 -0.86 -0.83 -0.85 ...
##   ..$ THIOL   : num [1:40] -0.18 -0.15 -0.24 -0.15 -0.35 -0.29 -0.22 -0.23 -0.17 -0.18 ...
##   ..$ TRa     : num [1:40] -1.48 -1.46 -1.58 -1.54 -1.46 -1.44 -1.32 -1.56 -1.46 -1.35 ...
##   ..$ TRb     : num [1:40] -1.07 -1 -1.16 -1.11 -1.01 -1 -0.97 -1.08 -1.02 -0.98 ...
##   ..$ Tpalpha : num [1:40] -0.69 -0.74 -0.81 -0.74 -0.82 -0.76 -0.72 -0.76 -0.65 -0.83 ...
##   ..$ Tpbeta  : num [1:40] -1.11 -1.09 -1.14 -1.04 -1.2 -1.05 -1 -1.16 -0.91 -1.07 ...
##   .. [list output truncated]
## $ lipid   :'data.frame':   40 obs. of  21 variables:
##   ..$ C14.0   : num [1:40] 0.34 0.38 0.36 0.22 0.37 1.7 0.35 0.34 0.22 1.38 ...
##   ..$ C16.0   : num [1:40] 26.4 24 23.7 25.5 24.8 ...
##   ..$ C18.0   : num [1:40] 10.22 9.93 8.96 8.14 9.63 ...
##   ..$ C16.1n.9: num [1:40] 0.35 0.55 0.55 0.49 0.46 0.66 0.36 0.29 0.44 0.9 ...
##   ..$ C16.1n.7: num [1:40] 3.1 2.54 2.65 2.82 2.85 7.26 3.6 3.27 2.36 7.01 ...
##   ..$ C18.1n.9: num [1:40] 17 20.1 22.9 21.9 21.4 ...
##   ..$ C18.1n.7: num [1:40] 2.41 3.92 3.96 2.52 2.96 8.99 2.15 1.99 1.81 8.85 ...
##   ..$ C20.1n.9: num [1:40] 0.26 0.23 0.26 0 0.3 0.36 0.25 0.31 0 0.21 ...
##   ..$ C20.3n.9: num [1:40] 0 0 0.19 0 0.27 2.89 0 0 0 2.03 ...
##   ..$ C18.2n.6: num [1:40] 8.93 14.98 16.06 13.89 14.55 ...
##   ..$ C18.3n.6: num [1:40] 0 0.3 0.27 0 0.27 2.66 0 0 0 0 ...
##   ..$ C20.2n.6: num [1:40] 0 0.3 0.33 0 0.23 0 0 0 0 0 ...
##   ..$ C20.3n.6: num [1:40] 0.78 1.64 1.51 1.1 1.58 0.81 0.68 0.72 1.07 0.59 ...
##   ..$ C20.4n.6: num [1:40] 3.07 15.34 13.27 3.92 11.85 ...
##   ..$ C22.4n.6: num [1:40] 0 0.58 0.54 0 0.32 0 0 0 0 0 ...
##   ..$ C22.5n.6: num [1:40] 0 2.1 1.77 0 0.44 0.56 0 0 0 0.39 ...
##   ..$ C18.3n.3: num [1:40] 5.97 0 0 0.49 0.42 0 8.4 6.01 0.55 0 ...
##   ..$ C20.3n.3: num [1:40] 0.37 0 0 0 0 0 0.42 0.39 0 0 ...
##   ..$ C20.5n.3: num [1:40] 8.62 0 0 2.99 0.3 0 7.37 7.96 3.13 0 ...
##   ..$ C22.5n.3: num [1:40] 1.75 0.48 0.22 1.04 0.35 2.13 2.05 2.33 1.65 0 ...
##   ..$ C22.6n.3: num [1:40] 10.39 2.61 2.51 14.99 6.69 ...
## $ diet    : Factor w/ 5 levels "coc","fish","lin",..: 3 5 5 2 4 1 3 3 2 1 ...
## $ genotype: Factor w/ 2 levels "wt","ppar": 1 1 1 1 1 1 1 1 1 1 ...
```

```r
## check dimensions
lapply(nutrimouse, dim) # apply function dim to each element in list nutrimouse
```

```
## $gene
## [1]  40 120
##
## $lipid
## [1] 40 21
##
## $diet
## NULL
##
## $genotype
## NULL
```

3

```r
lapply(nutrimouse, length) # apply function length to each element in list nutrimouse
```

```
## $gene
## [1] 120
##
## $lipid
## [1] 21
##
## $diet
## [1] 40
##
## $genotype
## [1] 40
```

```r
## get gene expression data structure
str(nutrimouse$gene)
```

2. Take the gene expression dataset in *samples* x *variables* matrix format. Investigate their distribution.

```
## 'data.frame':    40 obs. of  120 variables:
##  $ X36b4   : num  -0.42 -0.44 -0.48 -0.45 -0.42 -0.43 -0.53 -0.49 -0.36 -0.5 ...
##  $ ACAT1   : num  -0.65 -0.68 -0.74 -0.69 -0.71 -0.69 -0.62 -0.69 -0.66 -0.62 ...
##  $ ACAT2   : num  -0.84 -0.91 -1.1 -0.65 -0.54 -0.8 -1 -0.91 -0.74 -0.79 ...
##  $ ACBP    : num  -0.34 -0.32 -0.46 -0.41 -0.38 -0.32 -0.44 -0.37 -0.39 -0.36 ...
##  $ ACC1    : num  -1.29 -1.23 -1.3 -1.26 -1.21 -1.13 -1.22 -1.29 -1.15 -1.21 ...
##  $ ACC2    : num  -1.13 -1.06 -1.09 -1.09 -0.89 -0.79 -1 -1.06 -1.08 -0.82 ...
##  $ ACOTH   : num  -0.93 -0.99 -1.06 -0.93 -1 -0.93 -0.94 -1.05 -0.88 -0.92 ...
##  $ ADISP   : num  -0.98 -0.97 -1.08 -1.02 -0.95 -0.97 -0.94 -1.02 -0.98 -0.99 ...
##  $ ADSS1   : num  -1.19 -1 -1.18 -1.07 -1.08 -1.07 -1.05 -1.16 -1.05 -1 ...
##  $ ALDH3   : num  -0.68 -0.62 -0.75 -0.71 -0.76 -0.75 -0.67 -0.75 -0.66 -0.69 ...
##  $ AM2R    : num  -0.59 -0.58 -0.66 -0.65 -0.59 -0.55 -0.66 -0.66 -0.53 -0.62 ...
##  $ AOX     : num  -0.16 -0.12 -0.16 -0.17 -0.31 -0.23 -0.09 -0.22 -0.06 -0.23 ...
##  $ BACT    : num  -0.22 -0.32 -0.32 -0.32 -0.31 -0.29 -0.25 -0.21 -0.15 -0.2 ...
##  $ BIEN    : num  -0.89 -0.88 -0.89 -0.77 -0.97 -0.84 -0.86 -0.9 -0.74 -0.76 ...
##  $ BSEP    : num  -0.69 -0.6 -0.7 -0.67 -0.68 -0.55 -0.67 -0.66 -0.6 -0.58 ...
##  $ Bcl.3   : num  -1.18 -1.07 -1.17 -1.12 -0.93 -1.08 -1.03 -1.01 -1.01 -1.1 ...
##  $ C16SR   : num  1.66 1.65 1.57 1.61 1.66 1.7 1.58 1.62 1.72 1.55 ...
##  $ CACP    : num  -0.92 -0.87 -1.02 -0.89 -0.93 -0.97 -0.97 -0.96 -0.85 -0.95 ...
##  $ CAR1    : num  -0.97 -0.92 -0.98 -0.97 -1.06 -1.03 -0.91 -1.11 -0.85 -0.99 ...
##  $ CBS     : num  -0.26 -0.36 -0.4 -0.39 -0.35 -0.31 -0.32 -0.4 -0.26 -0.39 ...
##  $ CIDEA   : num  -1.21 -1.17 -1.29 -1.18 -1.15 -1.14 -1.16 -1.26 -1.12 -1.08 ...
##  $ COX1    : num  -1.11 -1.06 -1.17 -1.03 -0.99 -1.03 -1.15 -1.18 -0.94 -1.07 ...
##  $ COX2    : num  -1.18 -1.06 -1.14 -1.13 -1.1 -1.16 -1.06 -1.24 -1.23 -1.09 ...
##  $ CPT2    : num  -0.87 -0.87 -0.95 -0.88 -0.91 -0.92 -0.86 -0.93 -0.82 -0.88 ...
##  $ CYP24   : num  -1.37 -1.14 -1.3 -1.27 -1.2 -1.11 -1.12 -1.3 -1.14 -1.08 ...
##  $ CYP26   : num  -1.21 -1.12 -1.22 -1.18 -1.16 -1.1 -1.07 -1.23 -1.1 -1.1 ...
##  $ CYP27a1 : num  -0.71 -0.62 -0.78 -0.71 -0.69 -0.6 -0.69 -0.81 -0.62 -0.62 ...
##  $ CYP27b1 : num  -1.31 -1.14 -1.29 -1.27 -1.2 -1.15 -1.17 -1.28 -1.13 -1.15 ...
##  $ CYP2b10 : num  -1.23 -1.2 -1.32 -1.23 -1.22 -1.1 -1.07 -1.26 -1.19 -1.1 ...
##  $ CYP2b13 : num  -1.19 -1.06 -1.25 -1.13 -1.1 -1.07 -1.2 -1.37 -1.15 -1.11 ...
##  $ CYP2c29 : num  -0.06 -0.2 -0.3 -0.07 -0.29 -0.28 -0.1 -0.1 0.18 -0.33 ...
##  $ CYP3A11 : num  -0.09 -0.34 -0.45 -0.11 -0.51 -0.55 -0.18 -0.25 0.06 -0.4 ...
```

```
##  $ CYP4A10  : num  -0.81 -0.88 -0.71 -0.65 -1.16 -0.99 -0.62 -0.82 -0.48 -0.79 ...
##  $ CYP4A14  : num  -0.81 -0.84 -0.98 -0.41 -1.16 -1.09 -0.76 -0.87 -0.37 -0.95 ...
##  $ CYP7a    : num  -0.77 -0.71 -0.93 -0.8 -0.71 -0.74 -0.76 -0.88 -0.77 -0.77 ...
##  $ CYP8b1   : num  -0.77 -0.63 -0.53 -0.73 -0.51 -0.55 -0.57 -0.63 -0.6 -0.66 ...
##  $ FAS      : num  -0.41 -0.37 -0.3 -0.59 -0.06 0.18 -0.16 0.04 -0.53 0.08 ...
##  $ FAT      : num  -1.03 -0.98 -1.03 -1.06 -0.99 -0.99 -0.89 -1.08 -1.04 -0.91 ...
##  $ FDFT     : num  -0.98 -0.92 -1.04 -1 -0.99 -1 -1.02 -0.97 -1.03 -0.95 ...
##  $ FXR      : num  -0.93 -0.87 -1 -0.9 -0.89 -0.89 -0.86 -1.01 -0.81 -0.91 ...
##  $ G6PDH    : num  -1.22 -1.09 -1.28 -1.19 -1.16 -0.96 -1.15 -1.26 -1.13 -1.03 ...
##  $ G6Pase   : num  -0.46 -0.63 -1.06 -0.71 -0.58 -0.49 -0.51 -0.61 -0.38 -0.6 ...
##  $ GK       : num  -0.71 -0.67 -0.68 -0.75 -0.62 -0.59 -0.59 -0.66 -0.68 -0.47 ...
##  $ GS       : num  -1.24 -1.22 -1.36 -1.21 -1.22 -1.16 -1.15 -1.31 -1.16 -1.19 ...
##  $ GSTa     : num  0 -0.05 -0.13 -0.09 -0.02 -0.11 -0.06 -0.04 0.03 -0.02 ...
##  $ GSTmu    : num  0.02 -0.05 -0.19 0.03 -0.23 -0.05 -0.22 -0.07 0.23 -0.14 ...
##  $ GSTpi2   : num  0.45 0.3 0.18 0.36 0.3 0.17 0.12 0.48 0.53 0.01 ...
##  $ HMGCoAred: num  -0.95 -0.86 -0.96 -1.02 -0.7 -0.76 -1 -0.88 -0.96 -0.7 ...
##  $ HPNCL    : num  -0.65 -0.69 -0.75 -0.61 -0.66 -0.56 -0.61 -0.71 -0.53 -0.6 ...
##  $ IL.2     : num  -0.94 -0.94 -1.16 -0.97 -0.93 -0.96 -0.96 -0.85 -0.84 -0.95 ...
##  $ L.FABP   : num  0.24 0.27 0.17 0.16 0 0.23 0.18 0.18 0.2 0.2 ...
##  $ LCE      : num  0.09 0.06 -0.05 0.01 -0.07 -0.1 -0.03 -0.08 0.12 -0.1 ...
##  $ LDLr     : num  -0.82 -0.68 -0.82 -0.94 -0.73 -0.74 -0.8 -0.83 -0.81 -0.72 ...
##  $ LPK      : num  -0.32 -0.39 -0.38 -0.38 -0.17 -0.14 -0.35 -0.13 -0.32 -0.24 ...
##  $ LPL      : num  -1.01 -0.97 -1.11 -0.99 -1.05 -0.99 -0.93 -1.07 -0.94 -0.95 ...
##  $ LXRa     : num  -0.82 -0.82 -0.91 -0.85 -0.83 -0.79 -0.77 -0.84 -0.75 -0.78 ...
##  $ LXRb     : num  -1 -0.95 -1.16 -1.01 -1.01 -0.99 -0.98 -1.04 -0.98 -0.99 ...
##  $ Lpin     : num  -0.87 -0.97 -0.95 -1 -0.57 -0.51 -0.81 -0.83 -0.83 -0.48 ...
##  $ Lpin1    : num  -0.85 -0.99 -0.94 -1.02 -0.53 -0.51 -0.81 -0.87 -0.82 -0.49 ...
##  $ Lpin2    : num  -0.85 -0.87 -0.9 -0.88 -0.72 -0.68 -0.8 -0.9 -0.68 -0.67 ...
##  $ Lpin3    : num  -1.23 -1.12 -1.25 -1.18 -1.12 -1.09 -1.04 -1.23 -1.13 -1.11 ...
##  $ M.CPT1   : num  -1.15 -1.06 -1.26 -1.1 -1.11 -1.14 -1.08 -1.19 -1.06 -1.09 ...
##  $ MCAD     : num  -0.6 -0.62 -0.7 -0.59 -0.69 -0.66 -0.53 -0.66 -0.45 -0.62 ...
##  $ MDR1     : num  -1.15 -1.1 -1.26 -1.13 -1.11 -1.09 -1.09 -1.19 -1.06 -1.1 ...
##  $ MDR2     : num  -0.77 -0.65 -0.86 -0.77 -0.7 -0.69 -0.81 -0.81 -0.69 -0.75 ...
##  $ MRP6     : num  -0.99 -0.85 -0.9 -0.95 -0.91 -0.84 -0.88 -1.02 -0.83 -0.86 ...
##  $ MS       : num  -1.11 -1.06 -1.2 -1.09 -1.09 -1.09 -0.99 -1.16 -1.06 -0.98 ...
##  $ MTHFR    : num  -0.96 -0.99 -1.1 -0.95 -0.93 -0.96 -0.88 -1.03 -1.01 -0.95 ...
##  $ NGFiB    : num  -1.21 -1.08 -1.24 -1.12 -1.11 -1.04 -1.02 -1.21 -1.11 -1.04 ...
##  $ NURR1    : num  -1.21 -1.1 -1.32 -1.11 -1.14 -1.18 -1.1 -1.26 -1.14 -1.09 ...
##  $ Ntcp     : num  -0.49 -0.45 -0.44 -0.54 -0.47 -0.46 -0.55 -0.5 -0.44 -0.43 ...
##  $ OCTN2    : num  -1.15 -1.15 -1.2 -1.17 -1.19 -1.11 -1.08 -1.21 -1.05 -1.08 ...
##  $ PAL      : num  -1.32 -1.25 -1.16 -1.25 -1.24 -1.02 -1.04 -1.27 -0.93 -0.92 ...
##  $ PDK4     : num  -1.16 -1.16 -1.27 -1.16 -1.13 -1.08 -1.14 -1.24 -1.19 -1.04 ...
##  $ PECI     : num  -0.68 -0.69 -0.92 -0.71 -0.83 -0.81 -0.79 -0.85 -0.58 -0.82 ...
##  $ PLTP     : num  -1.1 -0.99 -1.03 -1.08 -0.98 -0.89 -1.05 -1.07 -1.02 -0.85 ...
##  $ PMDCI    : num  -0.52 -0.52 -0.6 -0.52 -0.71 -0.69 -0.55 -0.57 -0.46 -0.69 ...
##  $ PON      : num  -0.52 -0.55 -0.65 -0.64 -0.57 -0.63 -0.56 -0.65 -0.6 -0.64 ...
##  $ PPARa    : num  -0.93 -0.86 -0.95 -0.97 -0.94 -0.95 -0.9 -1.12 -0.88 -0.95 ...
##  $ PPARd    : num  -1.51 -1.59 -1.71 -1.57 -1.53 -1.56 -1.49 -1.57 -1.58 -1.54 ...
##  $ PPARg    : num  -1.06 -1.02 -1.14 -1.05 -1.09 -1.01 -1 -1.13 -0.97 -1.07 ...
##  $ PXR      : num  -0.99 -0.96 -1.1 -0.99 -1 -1.03 -0.93 -1.07 -0.98 -0.96 ...
##  $ Pex11a   : num  -1 -1.02 -1.2 -1 -0.95 -1.07 -1.05 -1.02 -1 -1.01 ...
##  $ RARa     : num  -1.2 -1.06 -1.16 -1.17 -1.15 -1.13 -1.09 -1.24 -1.03 -1.09 ...
##  $ RARb2    : num  -1.19 -1.11 -1.23 -1.16 -1.14 -1.07 -1.09 -1.18 -1.12 -1.1 ...
##  $ RXRa     : num  -0.67 -0.59 -0.68 -0.72 -0.78 -0.62 -0.65 -0.76 -0.55 -0.67 ...
```

```
##  $ RXRb2    : num  -0.95 -0.95 -1.07 -0.95 -0.98 -0.94 -0.92 -1.03 -0.94 -0.95 ...
##  $ RXRg1    : num  -1.16 -1.1 -1.21 -1.1 -1.11 -1.03 -1.07 -1.19 -1.05 -1.04 ...
##  $ S14      : num  -0.93 -0.86 -0.84 -1.05 -0.65 -0.4 -0.73 -0.62 -0.99 -0.25 ...
##  $ SHP1     : num  -1.1 -0.97 -1.09 -1.03 -1.13 -0.98 -0.95 -1.21 -0.93 -0.97 ...
##  $ SIAT4c   : num  -1.07 -0.97 -1.04 -0.99 -0.94 -0.93 -0.89 -1.04 -0.93 -0.95 ...
##  $ SPI1.1   : num  1.19 1.15 1.09 1.07 1.22 1.05 1.15 1.18 1.21 1.04 ...
##  $ SR.BI    : num  -0.84 -0.86 -0.95 -0.95 -1.06 -0.8 -0.83 -1 -0.83 -0.77 ...
##  $ THB      : num  -0.79 -0.85 -0.92 -0.79 -0.84 -0.86 -0.8 -0.86 -0.83 -0.85 ...
##  $ THIOL    : num  -0.18 -0.15 -0.24 -0.15 -0.35 -0.29 -0.22 -0.23 -0.17 -0.18 ...
##  $ TRa      : num  -1.48 -1.46 -1.58 -1.54 -1.46 -1.44 -1.32 -1.56 -1.46 -1.35 ...
##  $ TRb      : num  -1.07 -1 -1.16 -1.11 -1.01 -1 -0.97 -1.08 -1.02 -0.98 ...
##  $ Tpalpha  : num  -0.69 -0.74 -0.81 -0.74 -0.82 -0.76 -0.72 -0.76 -0.65 -0.83 ...
##  $ Tpbeta   : num  -1.11 -1.09 -1.14 -1.04 -1.2 -1.05 -1 -1.16 -0.91 -1.07 ...
##   [list output truncated]
```

```r
## check if there are missing values
any(is.na(nutrimouse$gene))
```

```
## [1] FALSE
```

```r
## investigate each variable
summary(nutrimouse$gene[, 1])
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -0.5800 -0.5025 -0.4600 -0.4552 -0.4200 -0.3000
```

```r
colors <- rainbow(20, alpha=1)
plot(density(scale(nutrimouse$gene[, 1], center=T, scale=F)),
     col=colors[1], xlim=c(-0.5,0.5), ylim=c(0,8))
sapply(2:20, function(i) {
    lines(density(scale(nutrimouse$gene[, i], center=T, scale=F)), col=colors[i])
})
```

```
## [[1]]
## NULL
##
## [[2]]
## NULL
##
## [[3]]
## NULL
##
## [[4]]
## NULL
##
## [[5]]
## NULL
##
## [[6]]
## NULL
##
## [[7]]
## NULL
##
## [[8]]
## NULL
```

```
##
## [[9]]
## NULL
##
## [[10]]
## NULL
##
## [[11]]
## NULL
##
## [[12]]
## NULL
##
## [[13]]
## NULL
##
## [[14]]
## NULL
##
## [[15]]
## NULL
##
## [[16]]
## NULL
##
## [[17]]
## NULL
##
## [[18]]
## NULL
##
## [[19]]
## NULL
```

```r
apply(nutrimouse$gene, 2, summary)
```

```
##              X36b4    ACAT1    ACAT2    ACBP     ACC1    ACC2    ACOTH    ADISP
## Min.      -0.58000 -0.75000 -1.10000 -0.66000 -1.4400 -1.2000 -1.06000 -1.08000
## 1st Qu.   -0.50250 -0.69000 -0.88000 -0.50250 -1.3000 -1.0900 -0.95000 -1.02000
## Median    -0.46000 -0.66000 -0.79500 -0.42500 -1.2600 -1.0450 -0.92000 -0.97000
## Mean      -0.45525 -0.65525 -0.76675 -0.43375 -1.2585 -1.0280 -0.91075 -0.97825
## 3rd Qu.   -0.42000 -0.62000 -0.64500 -0.35500 -1.2200 -0.9875 -0.88000 -0.94000
## Max.      -0.30000 -0.52000 -0.39000 -0.24000 -1.0700 -0.7900 -0.73000 -0.87000
##              ADSS1    ALDH3    AM2R     AOX     BACT     BIEN    BSEP     Bcl.3
## Min.      -1.19000 -0.9900 -0.780 -0.4800 -0.44000 -1.16000 -0.9000 -1.22000
## 1st Qu.   -1.14000 -0.9100 -0.670 -0.3175 -0.32250 -0.99000 -0.7600 -1.10250
## Median    -1.07500 -0.7850 -0.630 -0.2300 -0.30000 -0.92000 -0.7000 -1.06500
## Mean      -1.07575 -0.8100 -0.628 -0.2505 -0.28275 -0.92125 -0.6910 -1.05875
## 3rd Qu.   -1.03500 -0.7475 -0.590 -0.1675 -0.23500 -0.85500 -0.6275 -1.01000
## Max.      -0.91000 -0.6200 -0.460 -0.0400 -0.11000 -0.64000 -0.5100 -0.91000
##              C16SR    CACP    CAR1     CBS    CIDEA     COX1    COX2    CPT2    CYP24
## Min.       1.55000 -1.2600 -1.1900 -0.5600 -1.3300 -1.18000 -1.280 -1.2000 -1.3700
## 1st Qu.    1.59000 -1.0325 -0.9900 -0.4450 -1.2325 -1.09250 -1.180 -1.0100 -1.2600
## Median     1.61000 -0.9800 -0.9100 -0.4000 -1.1700 -1.05500 -1.130 -0.9450 -1.1800
## Mean       1.62675 -0.9845 -0.9135 -0.3995 -1.1840 -1.04975 -1.135 -0.9565 -1.1925
```

```
## 3rd Qu. 1.65250 -0.9375 -0.8475 -0.3375 -1.1400 -1.01000 -1.090 -0.8800 -1.1375
## Max.    1.78000 -0.8300 -0.6300 -0.2600 -1.0700 -0.88000 -1.040 -0.8200 -1.0500
##            CYP26 CYP27a1 CYP27b1 CYP2b10 CYP2b13 CYP2c29 CYP3A11 CYP4A10
## Min.     -1.3200 -0.88000  -1.350 -1.32000 -1.37000 -0.52000 -1.02000 -1.33000
## 1st Qu. -1.2225 -0.78500  -1.245 -1.23000 -1.19250 -0.28250 -0.71250 -1.15250
## Median  -1.1500 -0.73000  -1.180 -1.20000 -1.14000 -0.14000 -0.53000 -1.05000
## Mean    -1.1560 -0.72725  -1.200 -1.18475 -1.14575 -0.14725 -0.50825 -0.97975
## 3rd Qu. -1.1000 -0.67000  -1.150 -1.15000 -1.09750 -0.03000 -0.38500 -0.81750
## Max.    -0.9600 -0.59000  -0.990 -1.04000 -0.96000  0.18000  0.06000 -0.48000
##          CYP4A14   CYP7a  CYP8b1     FAS     FAT    FDFT     FXR   G6PDH
## Min.     -1.2900 -0.9300 -1.01000 -1.05000 -1.0900 -1.17000 -1.0600 -1.30000
## 1st Qu. -1.1500 -0.8000 -0.76000 -0.67000 -1.0400 -1.02000 -0.9525 -1.20250
## Median  -1.0800 -0.7700 -0.67000 -0.49000 -0.9950 -0.99000 -0.9000 -1.15000
## Mean    -0.9930 -0.7695 -0.68225 -0.45175 -0.9910 -0.98075 -0.9105 -1.15125
## 3rd Qu. -0.8925 -0.7400 -0.59000 -0.22500 -0.9475 -0.93750 -0.8775 -1.10750
## Max.    -0.1500 -0.6100 -0.50000  0.18000 -0.7500 -0.81000 -0.7600 -0.96000
##           G6Pase      GK      GS    GSTa   GSTmu  GSTpi2 HMGCoAred    HPNCL
## Min.     -1.06000 -0.9600 -1.3800 -0.4300 -0.440 0.00000  -1.0700 -0.97000
## 1st Qu. -0.82000 -0.8000 -1.3025 -0.1525 -0.200 0.12000  -0.9700 -0.75000
## Median  -0.69000 -0.7000 -1.2250 -0.0900 -0.140 0.21000  -0.9300 -0.69000
## Mean    -0.69825 -0.7145 -1.2325 -0.1030 -0.119 0.22975  -0.9135 -0.69375
## 3rd Qu. -0.53500 -0.6200 -1.1675 -0.0350 -0.050 0.33250  -0.8750 -0.60750
## Max.    -0.38000 -0.4600 -1.1200  0.0400  0.230 0.55000  -0.7000 -0.53000
##            IL.2  L.FABP     LCE    LDLr     LPK     LPL    LXRa    LXRb
## Min.     -1.1600 -0.4600 -0.26000 -0.9600 -0.570 -1.11000 -0.9100 -1.1600
## 1st Qu. -1.0025 -0.0750 -0.10000 -0.8525 -0.395 -1.03000 -0.8400 -1.0225
## Median  -0.9450  0.0600 -0.06000 -0.8200 -0.350 -0.99000 -0.8150 -0.9900
## Mean    -0.9505  0.0340 -0.05275 -0.8195 -0.344 -0.99075 -0.8115 -0.9960
## 3rd Qu. -0.8975  0.1825  0.00000 -0.7675 -0.295 -0.95000 -0.7775 -0.9675
## Max.    -0.8200  0.2800  0.12000 -0.6800 -0.130 -0.86000 -0.6500 -0.8400
##            Lpin   Lpin1   Lpin2   Lpin3   M.CPT1    MCAD    MDR1    MDR2
## Min.     -1.13000 -1.10000 -1.140 -1.2900 -1.29000 -0.7300 -1.30000 -0.92000
## 1st Qu. -0.85500 -0.87000 -0.910 -1.1975 -1.16500 -0.6600 -1.16250 -0.83000
## Median  -0.72500 -0.76000 -0.855 -1.1450 -1.12000 -0.6200 -1.12000 -0.78000
## Mean    -0.75325 -0.76475 -0.849 -1.1475 -1.12575 -0.6050 -1.13425 -0.77875
## 3rd Qu. -0.61500 -0.64000 -0.775 -1.0975 -1.09000 -0.5575 -1.09000 -0.71750
## Max.    -0.48000 -0.49000 -0.670 -0.9800 -0.96000 -0.4200 -0.99000 -0.65000
##            MRP6      MS   MTHFR    NGFiB   NURR1    Ntcp   OCTN2     PAL
## Min.     -1.09000 -1.20000 -1.1000 -1.29000 -1.32000 -0.6500 -1.28000 -1.3200
## 1st Qu. -1.00250 -1.11000 -1.0025 -1.20000 -1.21000 -0.4925 -1.19000 -1.2550
## Median  -0.95500 -1.06500 -0.9700 -1.12000 -1.14000 -0.4400 -1.15000 -1.2000
## Mean    -0.94775 -1.06075 -0.9720 -1.12925 -1.16125 -0.4370 -1.13925 -1.1445
## 3rd Qu. -0.87750 -1.00750 -0.9300 -1.07750 -1.10750 -0.3675 -1.08000 -1.0075
## Max.    -0.83000 -0.88000 -0.8800 -0.91000 -0.95000 -0.2500 -1.04000 -0.8900
##            PDK4    PECI    PLTP   PMDCI     PON   PPARa   PPARd   PPARg
## Min.     -1.28000 -1.11000 -1.15000 -1.07000 -0.7100 -1.1400 -1.7100 -1.190
## 1st Qu. -1.17250 -0.92250 -1.09250 -0.94250 -0.6325 -1.0225 -1.5900 -1.090
## Median  -1.13000 -0.84000 -1.05000 -0.76500 -0.5800 -0.9500 -1.5600 -1.055
## Mean    -1.13525 -0.84725 -1.03625 -0.76725 -0.5825 -0.9660 -1.5595 -1.052
## 3rd Qu. -1.08000 -0.79750 -0.99750 -0.60000 -0.5375 -0.9000 -1.5100 -1.010
## Max.    -1.01000 -0.58000 -0.85000 -0.44000 -0.4500 -0.8300 -1.4300 -0.900
##            PXR  Pex11a    RARa   RARb2    RXRa   RXRb2   RXRg1     S14
## Min.     -1.13000 -1.2000 -1.30000 -1.3000 -0.7800 -1.070 -1.2300 -1.05000
## 1st Qu. -1.03000 -1.0500 -1.18250 -1.1900 -0.6725 -1.000 -1.1425 -0.98000
```

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```
## Median  -0.99000 -1.0200 -1.13000 -1.1350 -0.6350 -0.960 -1.1000 -0.85500
## Mean    -0.99225 -1.0220 -1.13325 -1.1445 -0.6360 -0.964 -1.0955 -0.80675
## 3rd Qu. -0.94750 -0.9875 -1.07500 -1.0900 -0.5875 -0.935 -1.0500 -0.65750
## Max.    -0.84000 -0.9000 -0.97000 -0.9900 -0.4900 -0.780 -0.9000 -0.25000
##              SHP1    SIAT4c  SPI1.1   SR.BI     THB  THIOL     TRa      TRb
## Min.     -1.21000 -1.16000 0.96000 -1.060 -0.9200 -0.900 -1.670 -1.22000
## 1st Qu.  -1.07500 -0.99000 1.03750 -0.920 -0.8500 -0.590 -1.510 -1.11000
## Median   -0.99000 -0.96000 1.07500 -0.830 -0.8200 -0.345 -1.460 -1.06000
## Mean     -1.00675 -0.96225 1.09075 -0.843 -0.8170 -0.411 -1.457 -1.05425
## 3rd Qu.  -0.94750 -0.92750 1.15000 -0.800 -0.7875 -0.230 -1.395 -0.99750
## Max.     -0.78000 -0.84000 1.23000 -0.610 -0.6900 -0.030 -1.220 -0.92000
##            Tpalpha Tpbeta    UCP2      UCP3      VDR    VLDLr    Waf1     ap2
## Min.     -1.00000 -1.310 -1.0800 -1.27000 -1.30000 -1.19000 -1.3000 -1.3700
## 1st Qu.  -0.86000 -1.200 -1.0025 -1.15250 -1.18000 -1.09250 -1.1500 -1.2225
## Median   -0.83000 -1.140 -0.9800 -1.11000 -1.12000 -1.05500 -1.1300 -1.1900
## Mean     -0.81825 -1.130 -0.9660 -1.10775 -1.13175 -1.05325 -1.1235 -1.1880
## 3rd Qu.  -0.76000 -1.065 -0.9275 -1.05000 -1.08000 -1.01000 -1.0875 -1.1475
## Max.     -0.65000 -0.910 -0.7600 -0.92000 -0.94000 -0.91000 -0.9400 -1.0800
##            apoA.I    apoB    apoC3    apoE    c.fos cHMGCoAS   cMOAT   eif2g
## Min.     0.5400 -0.2700 -0.49000 0.86000 -1.22000 -1.24000 -1.0200 -1.230
## 1st Qu.  0.6575 -0.2000 -0.39000 0.98000 -1.15000 -1.10250 -0.8950 -1.100
## Median   0.7200 -0.1700 -0.34000 1.04000 -1.11000 -1.03000 -0.8700 -1.055
## Mean     0.7295 -0.1675 -0.34075 1.02825 -1.10525 -1.01375 -0.8485 -1.058
## 3rd Qu.  0.8100 -0.1450 -0.30000 1.07000 -1.06000 -0.91000 -0.7875 -1.020
## Max.     0.9200  0.0100 -0.18000 1.18000 -0.98000 -0.78000 -0.6900 -0.840
##            hABC1  i.BABP    i.BAT i.FABP    i.NOS   mABC1 mHMGCoAS
## Min.     -1.25000 -0.8900 -1.89000 -1.300 -1.4300 -0.9800  -0.5800
## 1st Qu.  -1.17250 -0.8325 -1.74250 -1.170 -1.2850 -0.9200  -0.3000
## Median   -1.13500 -0.8000 -1.69000 -1.140 -1.2400 -0.8700  -0.2100
## Mean     -1.13825 -0.7935 -1.69775 -1.122 -1.2460 -0.8765  -0.2210
## 3rd Qu.  -1.09750 -0.7475 -1.66000 -1.075 -1.2075 -0.8375  -0.1275
## Max.     -0.98000 -0.6700 -1.55000 -0.930 -1.0900 -0.8000   0.0600
```

density.default(x = scale(nutrimouse$gene[, 1], center = T, scale = F))

N = 40   Bandwidth = 0.0265
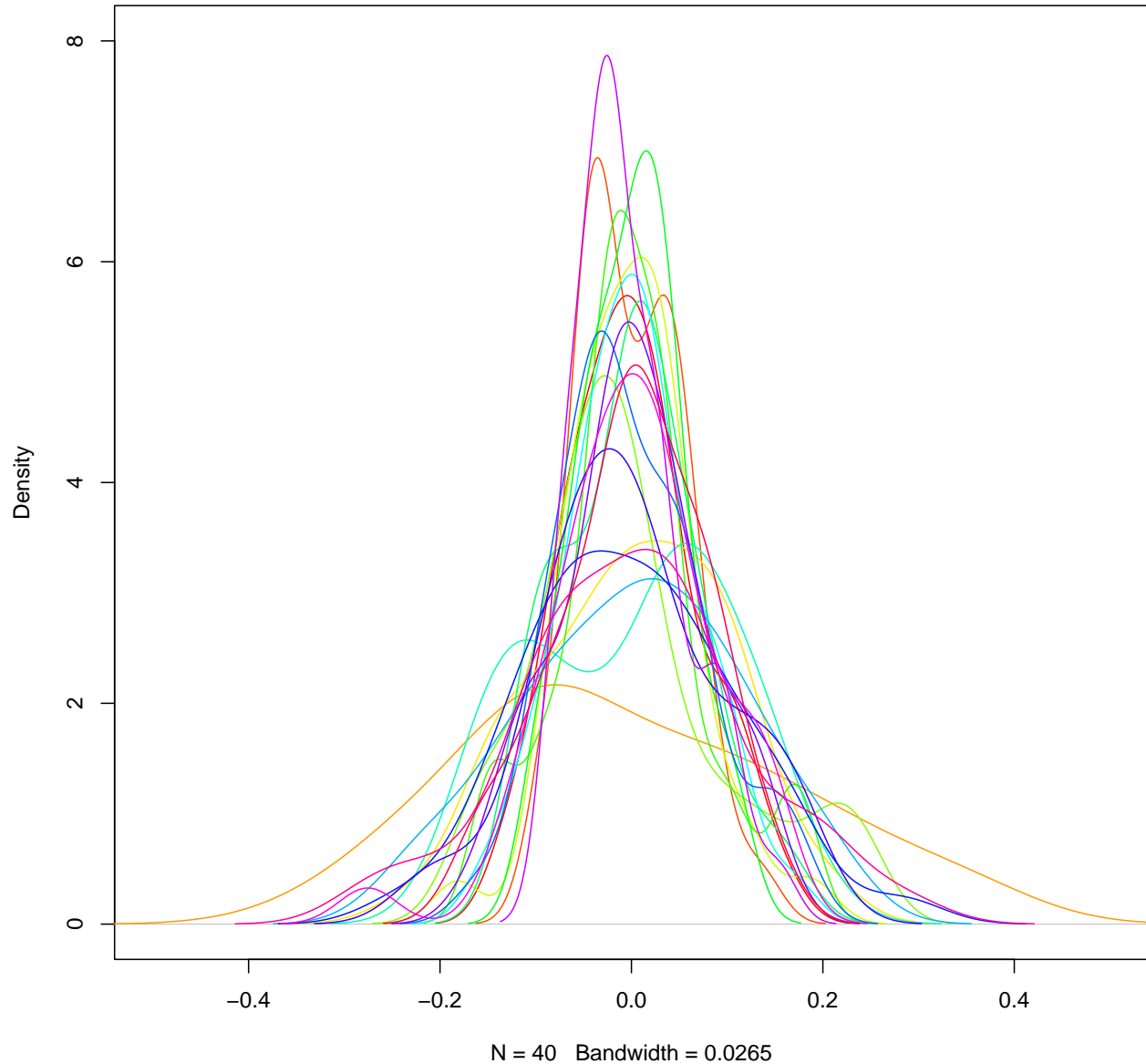
PLS

```
pls.res <- pls(X=nutrimouse$gene, Y=nutrimouse$lipid, ncomp=2, scale=TRUE, mode="canonical")
max(abs(scale(nutrimouse$gene, center=T, scale=T) - pls.res$X))
```

1. Perform PLS (`mixOmics::pls`) and investigate the output, sample distribution and variable relationship with plots.

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

```
max(abs(scale(nutrimouse$lipid, center=T, scale=T) - pls.res$Y))
```

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

The sample distribution plot can be performed with **variates**, sample coordinates in the new reference (rotated axes) for each of the two blocks.

```
str(pls.res$variates)
```

```
## List of 2
##  $ X: num [1:40, 1:2] 6.659 0.614 9.876 4.864 0.934 ...
##   ..- attr(*, "dimnames")=List of 2
##   .. ..$ : chr [1:40] "1" "2" "3" "4" ...
##   .. ..$ : chr [1:2] "comp1" "comp2"
##  $ Y: num [1:40, 1:2] 2.33 2.6 1.98 1.94 2.29 ...
##   ..- attr(*, "dimnames")=List of 2
##   .. ..$ : chr [1:40] "1" "2" "3" "4" ...
##   .. ..$ : chr [1:2] "comp1" "comp2"
```
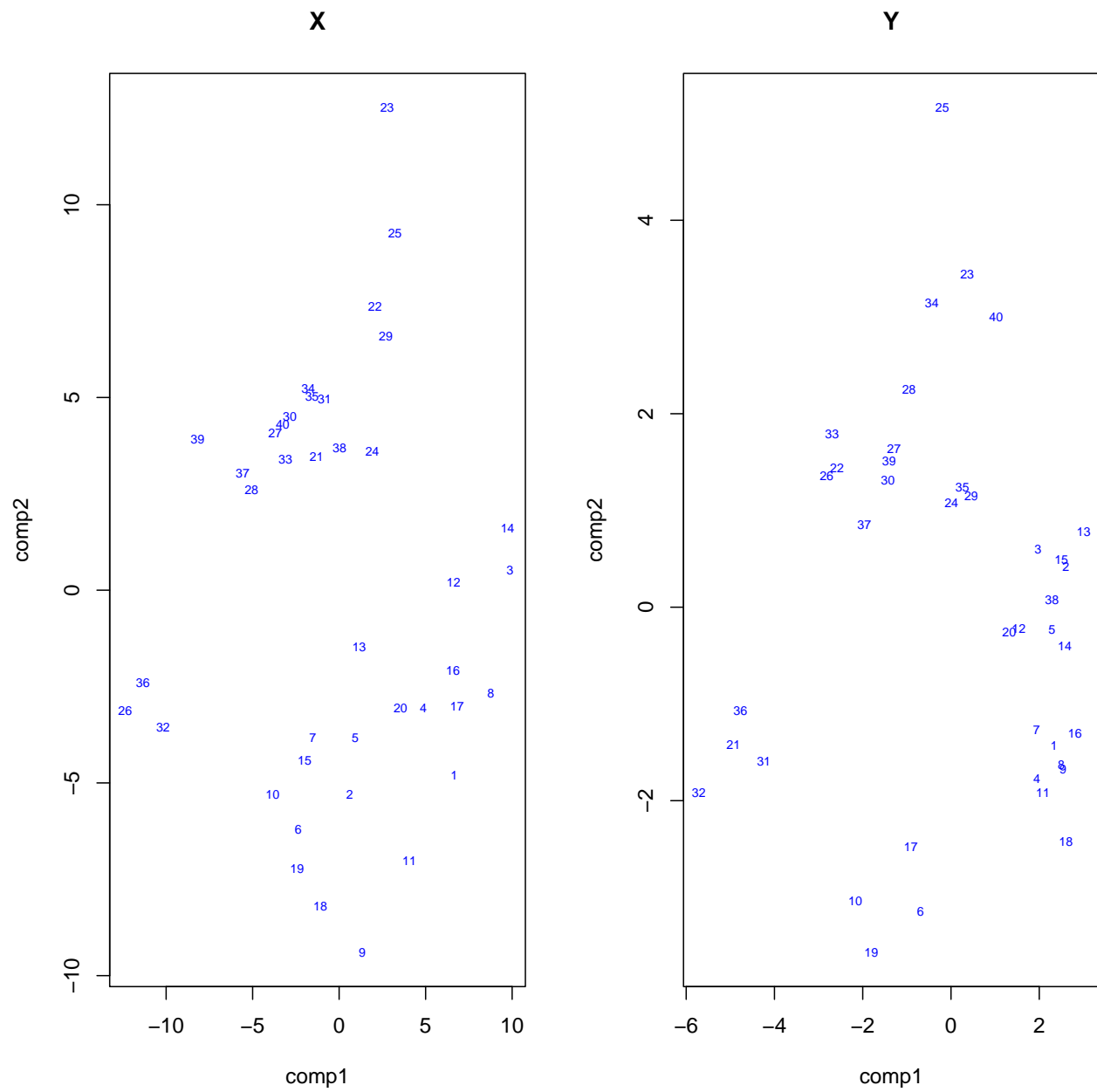
```
PCx <- "comp1"
PCy <- "comp2"
par(mfrow=c(1,2))
plot(pls.res$variates$X[, PCx], pls.res$variates$X[, PCy], xlab=PCx, ylab=PCy, main="X", type='n')
text(pls.res$variates$X[, PCx], pls.res$variates$X[, PCy], rownames(pls.res$variates$X), col='blue', ce
plot(pls.res$variates$Y[, PCx], pls.res$variates$Y[, PCy], xlab=PCx, ylab=PCy, main="Y", type='n')
text(pls.res$variates$Y[, PCx], pls.res$variates$Y[, PCy], rownames(pls.res$variates$Y), col='blue', ce
```
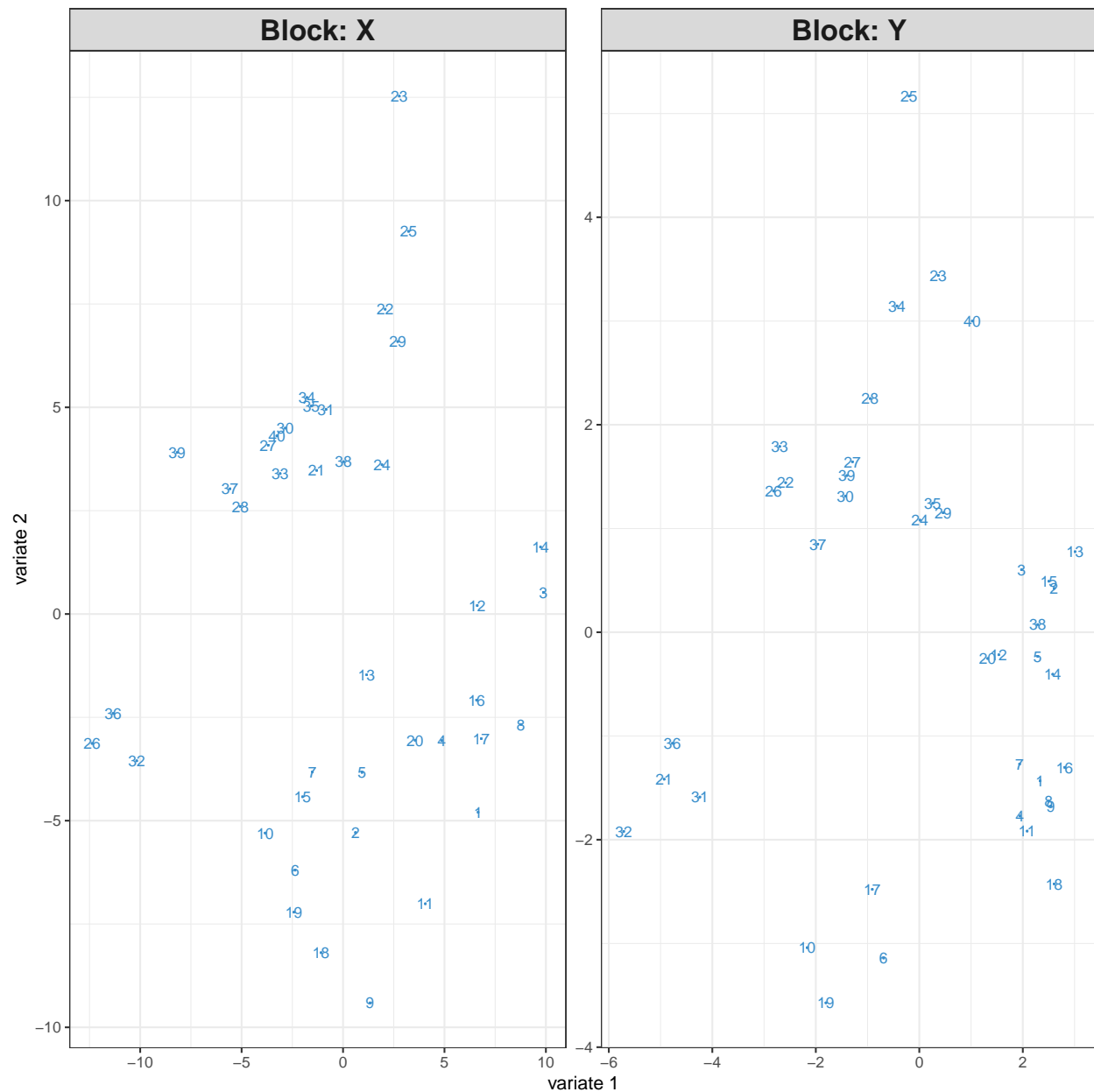
which is also produced with `plotIndiv`.

```
plotIndiv(pls.res)
```

Loading plot: plot of variables' contribution in each data block to each variate, after deflating more *important* variates.

```
par(mfrow=c(1,2), las=2, mar=c(4,8,1,1))
loadings.ind.X <- order(abs(pls.res$loadings$X[, "comp1"]), decreasing = T)
barplot(head(pls.res$loadings$X[loadings.ind.X, "comp1"], 10), main="X", horiz = T, cex.names=0.8)
loadings.ind.Y <- order(abs(pls.res$loadings$Y[, "comp1"]), decreasing = T)
barplot(head(pls.res$loadings$Y[loadings.ind.Y, "comp1"], 10), main="Y", horiz = T, cex.names=0.8)
```
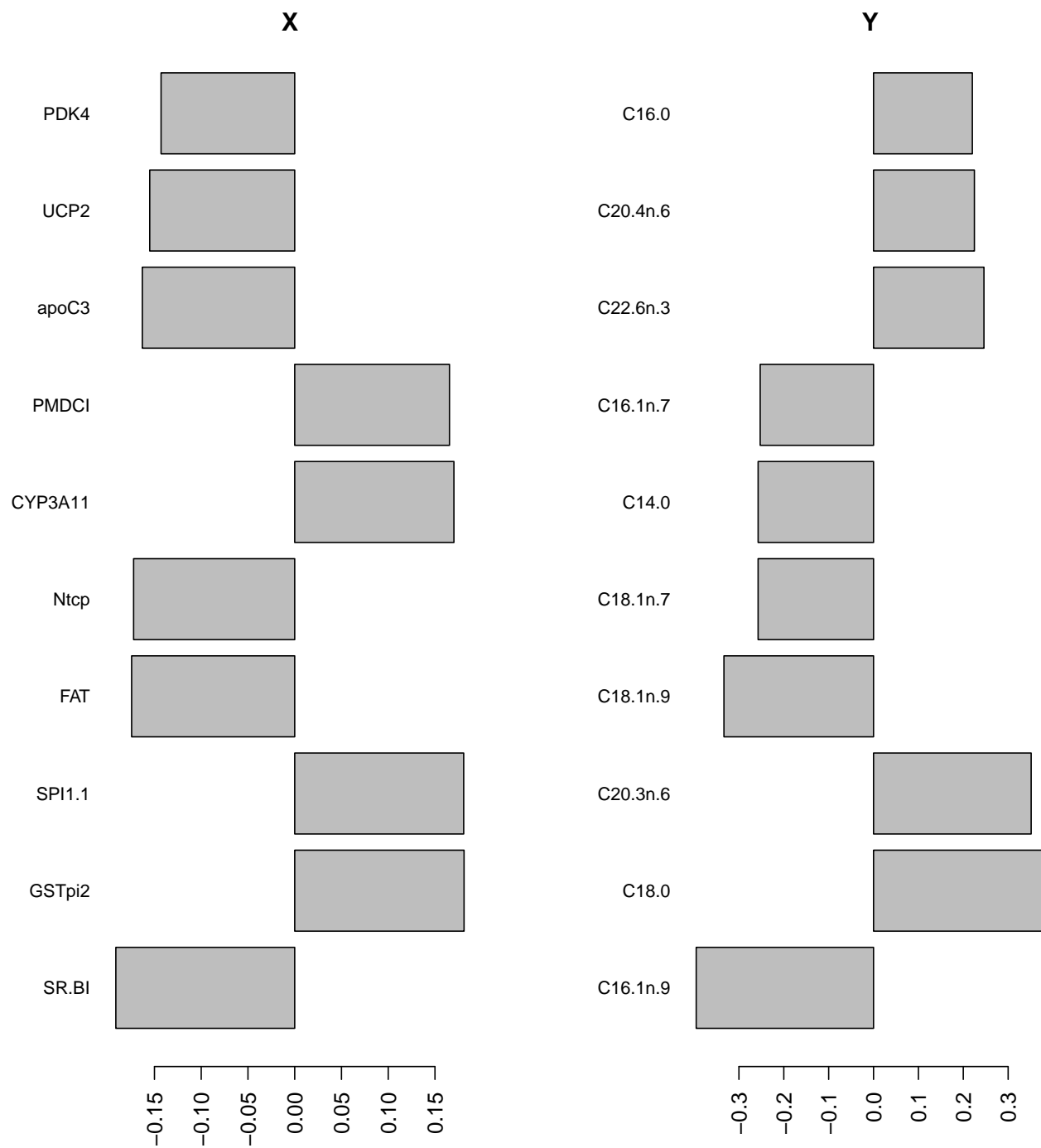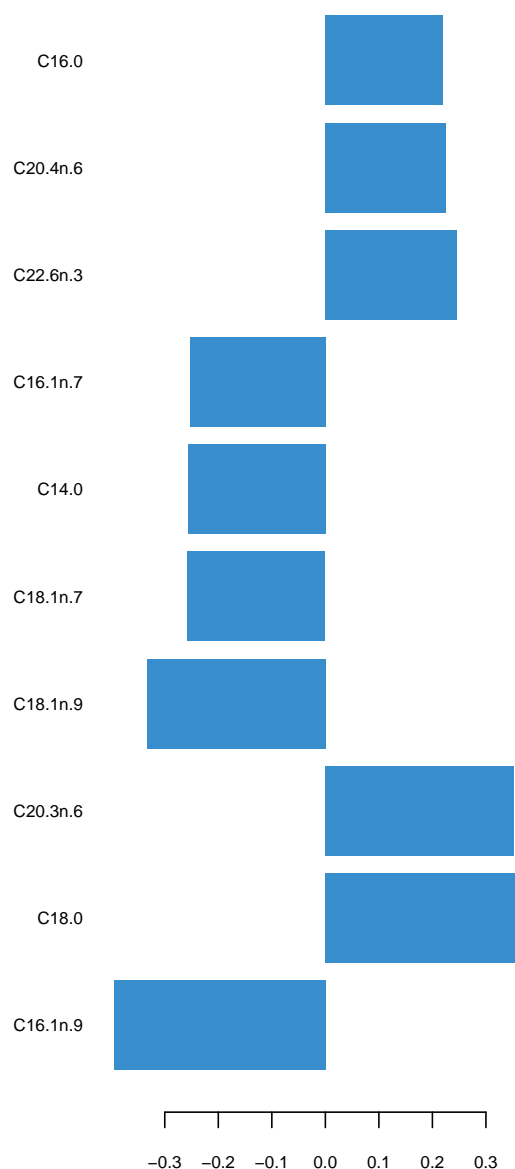
which is the same as with `plotLoadings`.

```
plotLoadings(pls.res, ndisplay = 10)
```
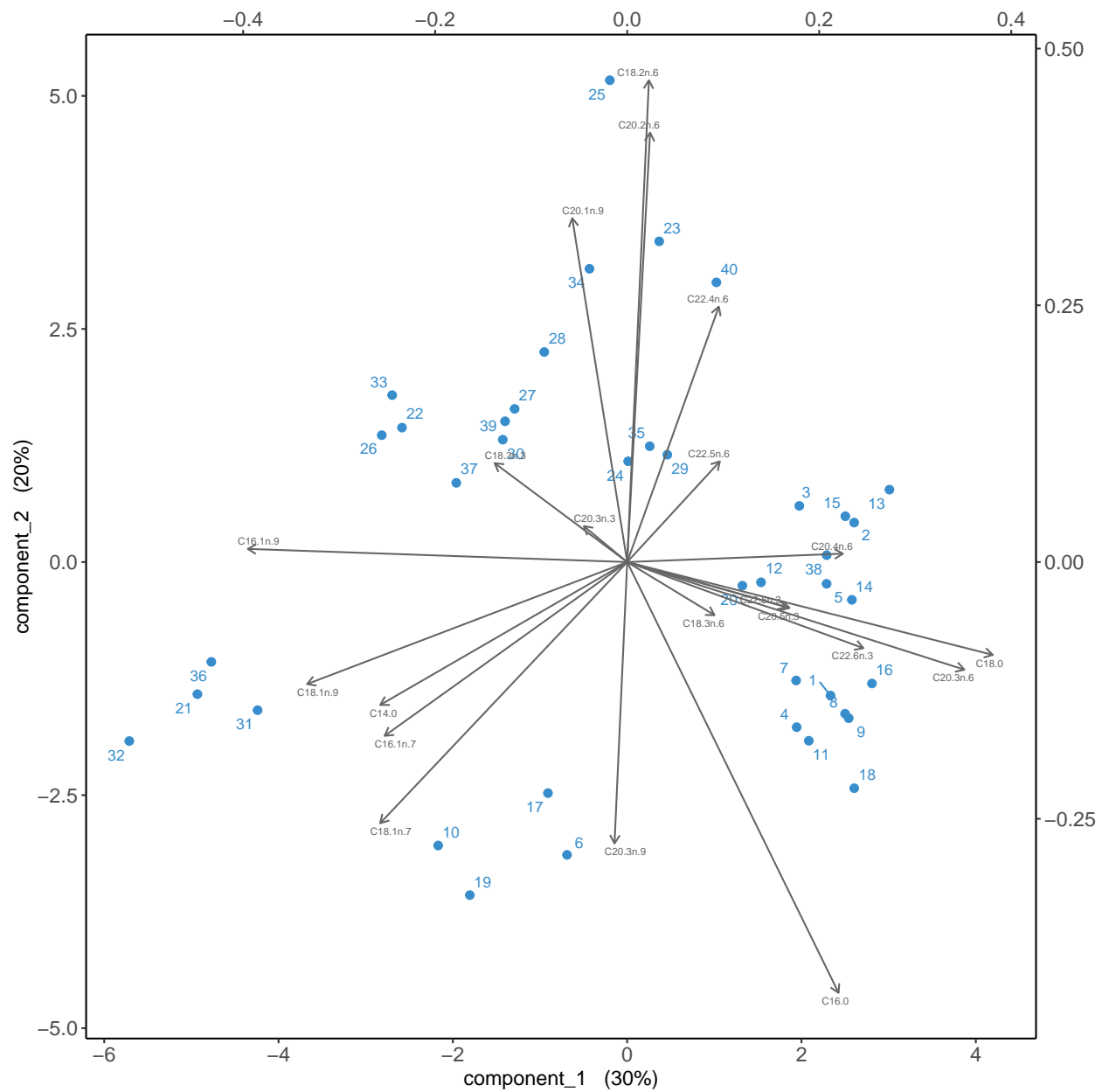
Loadings on comp 1
Block 'X'
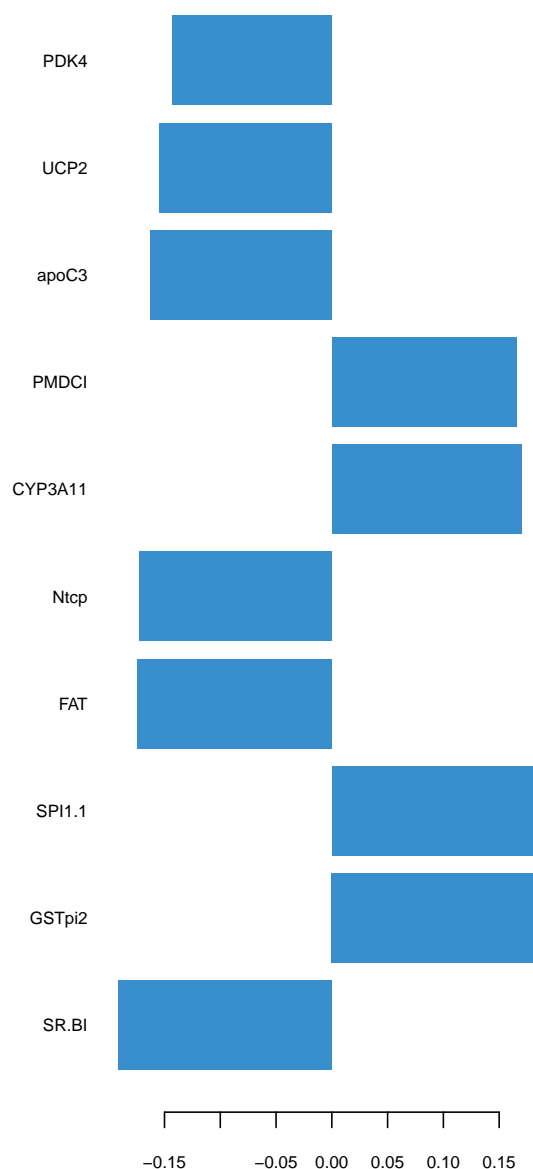
Loadings on comp 1
Block 'Y'

The plot of variable relationship could be obtained from **loadings.star**.

```
names(pls.res$loadings.star) <- c("X", "Y")
colnames(pls.res$loadings.star$X) <- colnames(pls.res$loadings.star$Y) <- c(PCx, PCy)
plot(1,1,type='n',
     xlim=range(c(pls.res$loadings.star$X[, PCx],pls.res$loadings.star$Y[, PCx])),
     ylim=range(c(pls.res$loadings.star$X[, PCy],pls.res$loadings.star$Y[, PCy])))
arrows(0, 0, pls.res$loadings.star$X[, PCx], pls.res$loadings.star$X[, PCy],
       length=0.1, angle=20, col=rgb(0,0,1,alpha=apply(pls.res$loadings.star$X[, c(PCx, PCy)], 1, norm,
text(pls.res$loadings.star$X[, PCx],
     pls.res$loadings.star$X[, PCy],
     rownames(pls.res$loadings.star$X), col='grey', cex=0.7)
arrows(0, 0, pls.res$loadings.star$Y[, PCx], pls.res$loadings.star$Y[, PCy],
```

```
        length=0.1, angle=20, col=rgb(1,0,0,alpha=apply(pls.res$loadings.star$Y[, c(PCx, PCy)], 1, norm,
text(pls.res$loadings.star$Y[, PCx],
     pls.res$loadings.star$Y[, PCy],
     rownames(pls.res$loadings.star$Y), col='grey', cex=0.7)
plotVar(pls.res)
```

Correlation Circle Plot

Both sample distribution and variable relationship plot could be done with `biplot` function.

```
biplot(pls.res, block="X", ind.names.size=3, var.names.size=2)
biplot(pls.res, block="Y", ind.names.size=3, var.names.size=2)
```

```
pls.reg.res <- pls(X=nutrimouse$gene, Y=nutrimouse$lipid, ncomp=2, scale=TRUE, mode="regression")
biplot(pls.res, block="X", ind.names.size=3, var.names.size=2)
biplot(pls.res, block="Y", ind.names.size=3, var.names.size=2)
```

2. Observe the difference between the two modes *regression* and *canonical* of PLS.

```
pls.regda.res <- pls(X=nutrimouse$gene, Y=c(0,1)[nutrimouse$genotype], ncomp=2, scale=TRUE, mode="regres
biplot(pls.regda.res, block="X", ind.names.size=3, var.names.size=2, group=nutrimouse$genotype, col.per
```

3. PLS between genes and genotype