Messina E3: Messina vs ? on APGI

March 22, 2015

1 Preparation

```
library(plyr)
library(ggplot2)

## Loading required package:  methods

library(messina)

## Loading required package:  survival
## Loading required package:  splines

library(maxstat)
library(doMC)

## Loading required package:  foreach
## Loading required package:  iterators
## Loading required package:  parallel

paropts = list(.options.multicore = list(preschedule = FALSE))
```

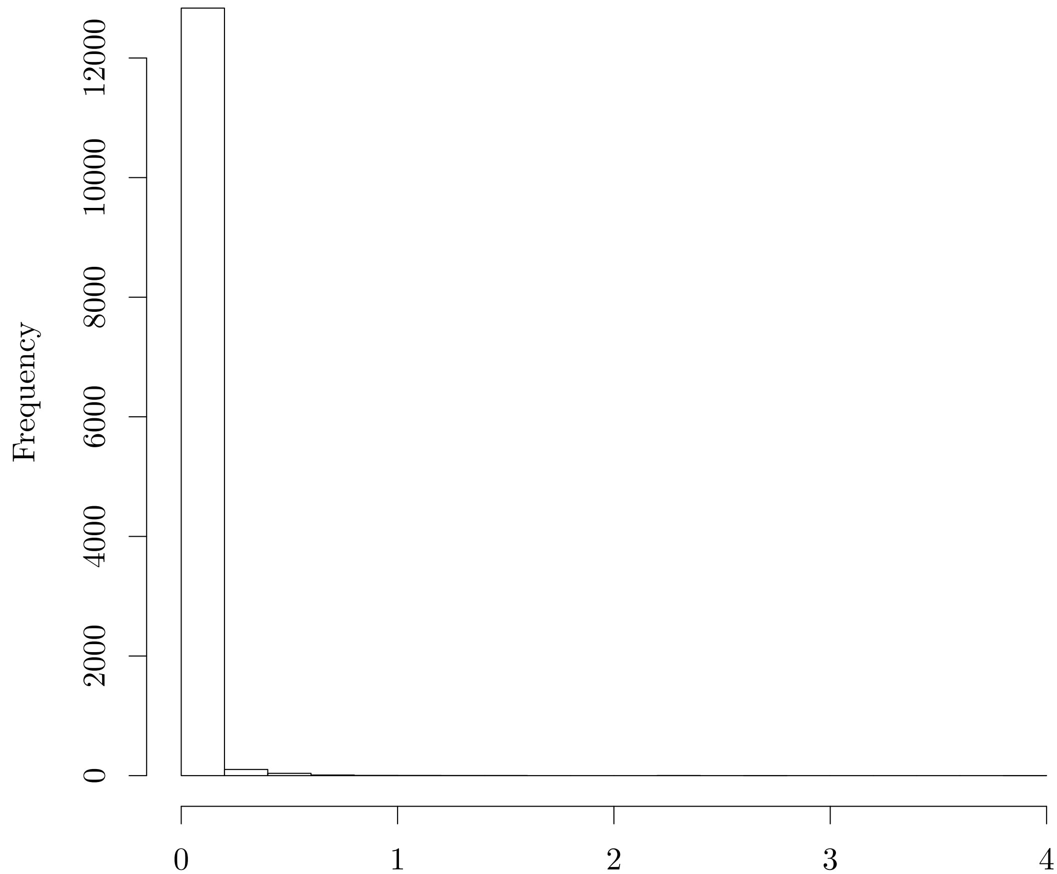
2 Data preparation

```
load("../biosurv/data/07_data_for_SIS.rda")
APGI.x = x.diag_dsd
APGI.y = y.diag_dsd
APGI.samps = samps.diag_dsd
APGI.feats = data.frame(symbol = rownames(APGI.x))

temp = NA
temp = ls()
rm(list = temp[!(temp %in% c("APGI.x", "APGI.y", "APGI.samps", "APGI.feats"))])

load("../biosurv/data/15_validation.rda")
rm(GSE28735.lingex, GSE21501.lingex)
GSE28735.x = GSE28735.gex
GSE21501.x = GSE21501.gex
GSE28735.feats = GSE28735.feat
GSE21501.feats = GSE21501.feat
rm(GSE28735.gex, GSE21501.gex, GSE28735.feat, GSE21501.feat)
```

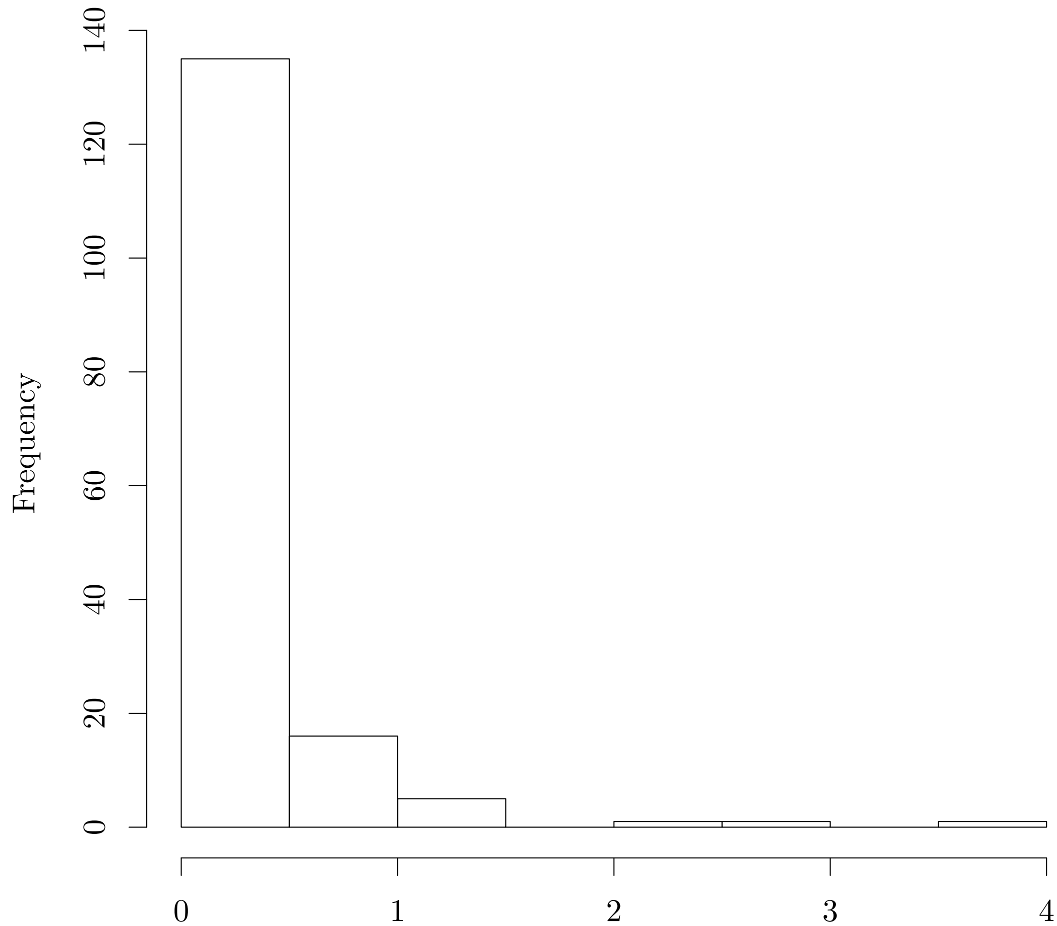
```r
load("../biosurv/data/validation/tcga-clin-gex.20141118.rda")
TCGA.x = data.merged$paad$gex$illuminahiseq_rnaseqv2
rownames(TCGA.x) = gsub("\\|.*", "", rownames(TCGA.x))
TCGA.x = TCGA.x[rownames(TCGA.x) != "?",]
TCGA.x = log2(TCGA.x + 1)
temp.time = as.numeric(as.character(data.merged$paad$clin$days_to_death))
temp.time[is.na(temp.time)] = as.numeric(as.character(data.merged$paad$clin$days_to_last_followup[is.na
TCGA.y = Surv(temp.time, data.merged$paad$clin$vital_status == "Dead")
TCGA.feats = data.frame(symbol = rownames(TCGA.x))
rm(data.merged)

keepMostVariableGeneMeasurement = function(gex, feats, ids)
{
        sds = apply(gex, 1, sd, na.rm = TRUE)
        perm = order(-sds)
        gex = gex[perm,,drop = FALSE]
        feats = feats[perm,,drop = FALSE]
        ids = ids[perm]
        drop = duplicated(ids) | is.null(ids)
        gex = gex[!drop,,drop = FALSE]
        feats = feats[!drop,,drop = FALSE]
        ids = ids[!drop]
        list(gex = gex, feats = feats, ids = ids)
}

# Now moved to the validation function
# regularizeX = function(x)
# {
#  require(robustbase)
#  location = apply(x, 1, median, na.rm = TRUE)
#  scale = apply(x, 1, scaleTau2, na.rm = TRUE)
#  (x - location) / scale
# }

temp = keepMostVariableGeneMeasurement(APGI.x, APGI.feats, APGI.feats$symbol)
APGI.x = temp$gex
APGI.feats = temp$feats
temp = keepMostVariableGeneMeasurement(GSE28735.x, GSE28735.feats, GSE28735.feats$Gene.symbol)
GSE28735.x = temp$gex
GSE28735.feats = temp$feats
temp = keepMostVariableGeneMeasurement(GSE21501.x, GSE21501.feats, GSE21501.feats$Gene.symbol)
GSE21501.x = temp$gex
GSE21501.feats = temp$feats

GSE28735.y = Surv(GSE28735.samp$time, GSE28735.samp$event)
GSE21501.y = Surv(GSE21501.samp$time, GSE21501.samp$event)

# APGI.xreg = regularizeX(APGI.x)
# GSE28735.xreg = regularizeX(GSE28735.x) # This one validated for survsigs
# GSE21501.xreg = regularizeX(GSE21501.x)
```

```r
# Temporary testing measure.  Probably will be used in real application, but somewhat defeats
# the whole purpose of Messina for testing, so should be removed when comparing vs other methods.
# temp.sel = apply(APGI.x, 1, sd) >= 1 & grepl("^D", rownames(APGI.x))
# APGI.x = APGI.x[temp.sel,,drop = FALSE]
# APGI.feats = APGI.feats[temp.sel,,drop = FALSE]

# messinaSurv(APGI.x, APGI.y, messinaSurvObj.CoxCoef(round(log(2), 3)), parallel = TRUE, silent = FALSE,
# messinaSurv(APGI.x, APGI.y, messinaSurvObj.Tau(0.6), parallel = TRUE, silent = FALSE, seed = 20150321)
# messinaSurv(APGI.x, APGI.y, messinaSurvObj.RelTau(0.7), parallel = TRUE, silent = FALSE, seed = 20150

registerDoMC(32)

library(plyr)
APGI.messina.cc2 = messinaSurv(APGI.x, APGI.y, messinaSurvObj.CoxCoef(round(log(2), 3)), parallel = TRUE

## Performance bootstrapping...
## Final training...

APGI.messina.cc3 = messinaSurv(APGI.x, APGI.y, messinaSurvObj.CoxCoef(round(log(3), 3)), parallel = TRUE

## Performance bootstrapping...
## Final training...

APGI.messina.tau6 = messinaSurv(APGI.x, APGI.y, messinaSurvObj.Tau(0.6), parallel = TRUE, silent = FALSE

## Performance bootstrapping...
## Final training...

APGI.messina.tau7 = messinaSurv(APGI.x, APGI.y, messinaSurvObj.Tau(0.7), parallel = TRUE, silent = FALSE

## Performance bootstrapping...
## Final training...

APGI.messina = APGI.messina.cc2
APGI.maxstat = alply(APGI.x, 1, function(x1) {
        data = data.frame(time = APGI.y[,1], event = APGI.y[,2], x = x1)
        test = try(maxstat.test(Surv(time, event) ~ x, data = data, smethod = "LogRank", pmethod = "HL")
        result = list(p.value = NA, threshold = NA)
        if (class(test) != "try-error")
        {
                result$p.value = test$p.value
                result$threshold = test$estimate
        }
        result
}, .parallel = TRUE)
```

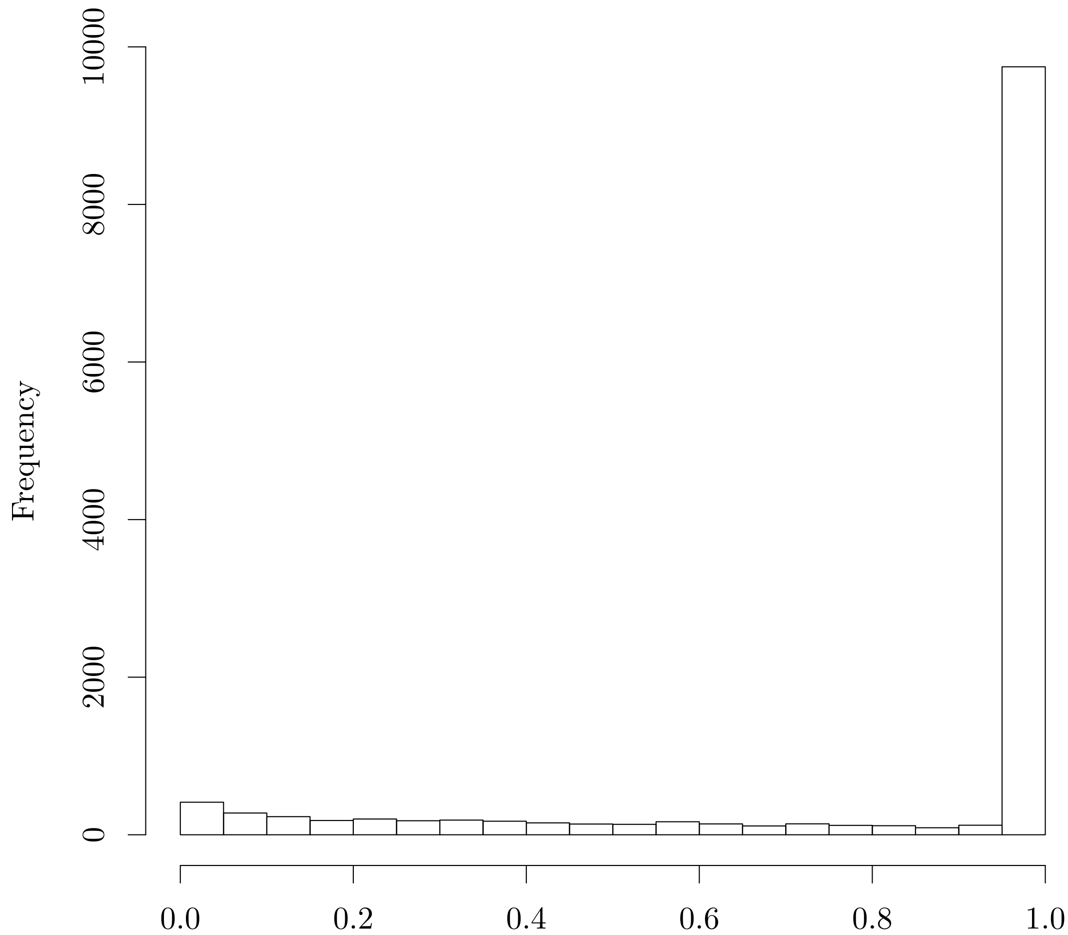
```r
print(dim(APGI.x))

## [1] 13000   110

hist(APGI.messina@fits@summary$margin, main = "", xlab = "")
```



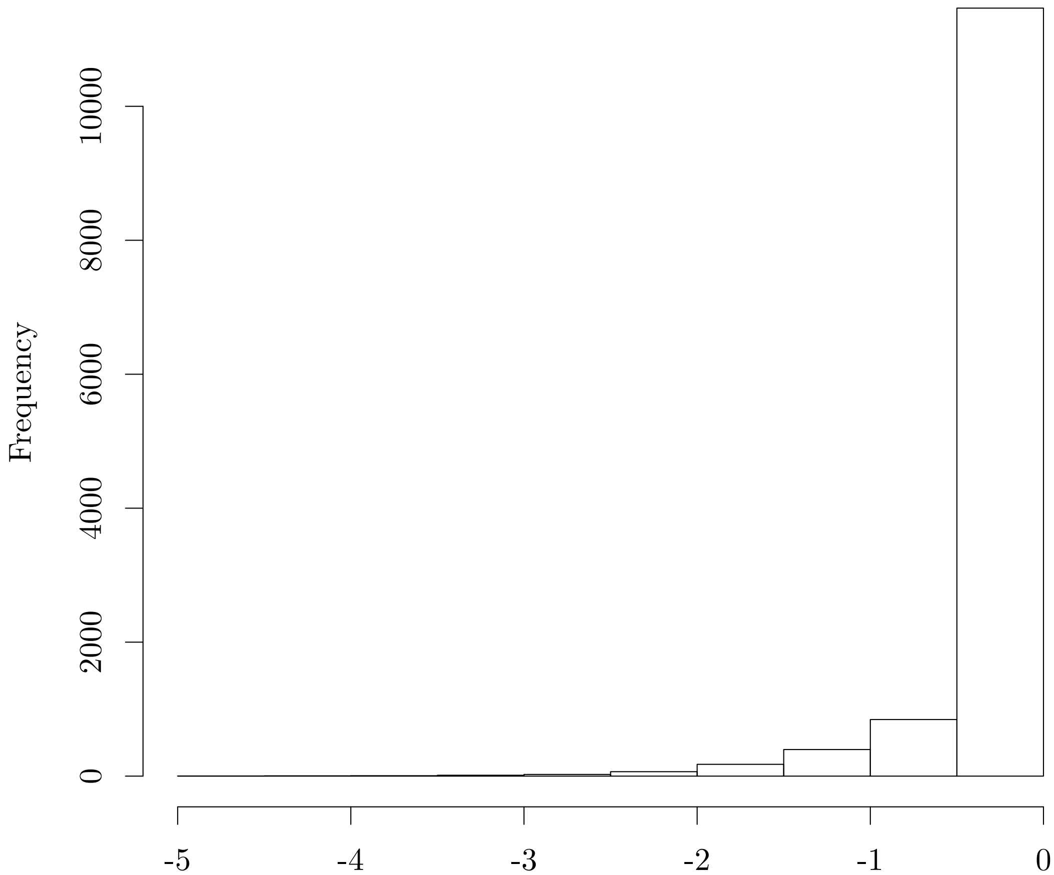

```
hist(APGI.messina@fits@summary$margin[APGI.messina@fits@summary$passed == TRUE], main = "", xlab = "")
```




```r
sum(APGI.messina@fits@summary$passed == TRUE)

## [1] 159

mean(APGI.messina@fits@summary$passed == TRUE)

## [1] 0.01223

sum(APGI.messina@fits@summary$margin >= 1)

## [1] 11

mean(APGI.messina@fits@summary$margin >= 1)

## [1] 0.0008462

sum(APGI.messina@fits@summary$margin >= 1 & APGI.messina@fits@summary$passed == TRUE)

## [1] 8

mean(APGI.messina@fits@summary$margin >= 1 & APGI.messina@fits@summary$passed == TRUE)

## [1] 0.0006154

hist(sapply(APGI.maxstat, function(x) x$p.value), main = "", xlab = "")
```




```
hist(log10(sapply(APGI.maxstat, function(x) x$p.value)), main = "", xlab = "")
```




```
sum(sapply(APGI.maxstat, function(x) x$p.value) < 0.05, na.rm = TRUE)

## [1] 413

sum(sapply(APGI.maxstat, function(x) x$p.value) < 0.05, na.rm = TRUE) / length(APGI.maxstat)

## [1] 0.03177
```

```
doValidation = function(train.features, train.x, train.threshold, train.merit, min_merit, test.features,
{
	require(robustbase)

	sel.merit = train.merit >= min_merit
	sel.val_avail = train.features %in% test.features
	sel = sel.merit & sel.val_avail
	print(fisher.test(table(sel.merit, sel.val_avail)))

	val.train.features = train.features[sel]
	val.train.x = train.x[sel,,drop=FALSE]
	val.train.threshold = train.threshold[sel]
	val.train.merit = train.merit[sel]
	val.perm = match(val.train.features, test.features)
	val.test.features = test.features[val.perm]
	val.test.x = test.x[val.perm,,drop=FALSE]

	stopifnot(val.test.features == val.train.features)
```

```
        # Translate the threshold on the training x to an approximate equivalent
        # on the test x, by normalization
        locscale.train = apply(val.train.x, 1, function(x) scaleTau2(x[!is.na(x)], mu.too = TRUE))
        loc.train = locscale.train[1,]
        scale.train = locscale.train[2,]

        locscale.test = apply(val.test.x, 1, function(x) scaleTau2(x[!is.na(x)], mu.too = TRUE))
        loc.test = locscale.test[1,]
        scale.test = locscale.test[2,]

        val.test.threshold = (val.train.threshold - loc.train) / scale.train * scale.test + loc.test

        val.chisq = mapply(function(row_index, threshold) {
                x = val.test.x[row_index,]
                xd = x > threshold
                if (all(xd) || all(!xd))        { return(NA) }
                fit = survdiff(test.y ~ xd)
                fit$chisq
        }, 1:length(val.test.threshold), val.test.threshold)

        result = data.frame(merit = val.train.merit, threshold.train = val.train.threshold, threshold.te
        rownames(result) = val.test.features
        result = result[order(-result$merit),]
        result
}

val.GSE28735.messina = doValidation(as.character(APGI.feats$symbol), APGI.x, APGI.messina@fits@summary$t

## Loading required package:  robustbase
##
## Attaching package:  'robustbase'
##
## The following object is masked from 'package:survival':
##
##     heart

##
##  Fisher's Exact Test for Count Data
##
## data:  table(sel.merit, sel.val_avail)
## p-value = 0.003805
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##   1.552 28.453
## sample estimates:
## odds ratio
##      6.109

val.GSE28735.maxstat = doValidation(as.character(APGI.feats$symbol), APGI.x, sapply(APGI.maxstat, functi

##
##  Fisher's Exact Test for Count Data
##
## data:  table(sel.merit, sel.val_avail)
```

```
## p-value < 2.2e-16
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##  2.431 3.653
## sample estimates:
## odds ratio
##      2.982

val.GSE21501.messina = doValidation(as.character(APGI.feats$symbol), APGI.x, APGI.messina@fits@summary$t

##
##  Fisher's Exact Test for Count Data
##
## data:  table(sel.merit, sel.val_avail)
## p-value = 1.561e-05
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##    3.835 176.208
## sample estimates:
## odds ratio
##      18.54

val.GSE21501.maxstat = doValidation(as.character(APGI.feats$symbol), APGI.x, sapply(APGI.maxstat, functi

##
##  Fisher's Exact Test for Count Data
##
## data:  table(sel.merit, sel.val_avail)
## p-value = 1.805e-10
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##  1.649 2.540
## sample estimates:
## odds ratio
##      2.051

val.TCGA.messina = doValidation(as.character(APGI.feats$symbol), APGI.x, APGI.messina@fits@summary$thres

##
##  Fisher's Exact Test for Count Data
##
## data:  table(sel.merit, sel.val_avail)
## p-value = 1
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##  0.2236    Inf
## sample estimates:
## odds ratio
##        Inf

val.TCGA.maxstat = doValidation(as.character(APGI.feats$symbol), APGI.x, sapply(APGI.maxstat, function(x

##
##  Fisher's Exact Test for Count Data
##
```

```
## data:  table(sel.merit, sel.val_avail)
## p-value = 0.08234
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##  0.961 2.318
## sample estimates:
## odds ratio
##       1.46
```

```
## Error in if (all(xd) || all(!xd)) {:  missing value where TRUE/FALSE needed
```

```
val.GSE28735.messina
```

```
##         merit threshold.train threshold.test    chisq
## KRT6A   3.999           9.503          4.754 1.638186
## ANGPTL4 2.716           8.900          3.754 0.670894
## DHRS9   1.468           8.965          4.404 0.007037
## FGG     1.365           8.585         13.796       NA
## PPY     1.098          11.931          4.068 2.536840
## LOX     1.051           7.686          6.841 0.494314
## IL20RB  1.043           6.971          4.060 0.435502
```

```
val.GSE21501.messina
```

```
##         merit threshold.train threshold.test  chisq
## KRT6A   3.999           9.503         3.3849 0.2333
## ANGPTL4 2.716           8.900         0.7529 0.1246
## KRT6C   2.333           7.458        40.3387     NA
## IGFBP1  1.474           7.070        -4.0458 2.3645
## DHRS9   1.468           8.965         1.9614 3.9596
## FGG     1.365           8.585         9.7976     NA
## PPY     1.098          11.931         3.8380 0.3419
## LOX     1.051           7.686        -0.5062 0.1867
## IL20RB  1.043           6.971         1.7140 0.6682
```

```
val.GSE28735.maxstat
```

```
##            merit threshold.train threshold.test     chisq
## ANGPTL4    4.835           8.356          3.527 1.217e+00
## KRT6A      4.450           8.915          4.503 2.180e+00
## LOX        4.225           7.502          6.609 5.419e-01
## PYGL       3.837           8.829          7.074 2.251e+00
## ST6GAL1    3.803           9.542          6.145 1.230e+00
## FAM189A2   3.630           6.455          4.052 3.197e-03
## KLHL5      3.511           8.978          6.464 2.728e+00
## ADM        3.394           8.820          4.730 1.088e+00
## E2F7       3.373           6.507          3.854 4.938e+00
## SMOX       3.165           7.190          4.852 2.650e-02
## KIF20A     3.123           7.250          3.584 2.396e+00
## CAPN6      3.073           6.516          4.094 7.537e-01
## IL20RB     2.994           6.505          3.492 6.901e-01
## P4HA1      2.882           9.080          7.426 3.618e-02
## FYN        2.854           8.079          6.086 5.064e-01
## AURKA      2.850           7.727          3.628 5.199e-01
## TCEA3      2.791           8.955          4.898 3.547e+00
```

```
## LOXL4      2.778          7.628          3.985 4.353e-03
## LDHA       2.744         11.922          9.716 6.056e-01
## CKAP2L     2.693          7.047          3.898 3.238e+00
## PPY        2.628         11.966          4.074 2.537e+00
## TREM1      2.588          6.546          5.146 3.641e-01
## PLOD1      2.541         10.492          5.802 6.070e-02
## CDC20      2.506          8.806          4.385 7.903e-01
## PFKP       2.483          9.183          5.636 7.701e-02
## ERRFI1     2.364         10.222          8.463 2.657e-02
## RGS5       2.303          8.665          6.941 1.157e-01
## TPX2       2.283          7.213          4.613 2.342e+00
## P4HA2      2.267          9.209          6.579 2.345e+00
## SLC15A1    2.242          6.716          5.053 4.828e-01
## DPY19L1    2.227          9.183          6.364 3.403e-02
## MME        2.227          6.441          4.645 1.425e-01
## ATF7IP2    2.212          7.139          5.793 4.623e-02
## PAEP       2.186          6.304          5.022 2.214e-01
## EPHX2      2.173          7.223          3.637 7.331e-01
## KYNU       2.169          7.161          5.370 9.540e-04
## FOXM1      2.166          6.884          4.573 5.998e+00
## NAMPT      2.159          7.988         10.049 3.699e-01
## PLOD2      2.155         10.451          7.593 3.300e+00
## UPP1       2.130          9.094          4.411 1.248e+00
## KCTD10     2.119          7.907          6.094 3.352e-04
## ZNF185     2.105          7.420          3.933 1.060e+00
## EDIL3      2.105          6.400          8.217 5.409e-03
## NEK2       2.103          8.167          4.426 5.032e-01
## LCP1       2.100          8.702          6.629 6.413e+00
## GAPDH      2.086         11.336          9.814 1.951e+00
## ARSD       2.085          9.970          6.440 2.866e+00
## KIF2C      2.080          6.839          3.953 3.629e+00
## ENO2       2.069          7.557          5.422 3.748e-02
## COL12A1    2.052          8.689          8.314 5.723e-02
## VSNL1      2.052          6.712          4.221 2.337e-03
## ENTHD1     2.044          6.345          3.130 1.851e-01
## CADPS2     2.043          7.892          5.795 3.026e+00
## ASPM       1.993          7.916          5.271 9.366e-02
## ASAP1      1.993          9.917          7.260 4.509e-02
## SPATA18    1.952          7.197          5.264 2.207e+00
## KRT18      1.943         12.487          7.917 6.325e-01
## POLQ       1.938          6.758          3.609 5.093e+00
## FAM3D      1.933          9.474          6.136 2.076e+00
## CD109      1.929          6.370          5.959 2.207e-01
## UBE2C      1.927          9.305          5.228 1.843e+00
## OCLN       1.922          7.722          7.186 5.277e-01
## WNK2       1.915          6.293          3.922 2.774e+00
## TGFBI      1.912         12.180          8.229 2.750e+00
## SPOCK1     1.903          8.915          5.387 7.009e+00
## CD300A     1.885          6.707          5.248 1.331e-01
## RAVER2     1.856          7.583          5.856 7.799e-01
## P2RY8      1.856          7.349          4.024 1.079e-02
## A4GNT      1.846          6.439          3.549 1.023e+00
## RIMKLB     1.825          7.221          6.093 7.238e-03
## ADAM23     1.824          6.394          4.155 7.598e-03
```

```
## FST         1.820            7.155          4.557 1.088e+00
## CA8         1.819            6.429          3.264 1.650e+00
## CEP55       1.819            7.985          4.831 1.431e+00
## IL1A        1.813            6.266          2.599 1.460e-01
## ANLN        1.811            7.020          4.871 3.439e+00
## DCBLD2      1.806           10.689          8.544 7.788e+00
## PLA2G10     1.795            9.726          4.000 4.374e+00
## KLHL13      1.791            6.430          3.543 6.677e-01
## STAG3L4     1.784            6.532          4.970 3.087e-01
## GOLM1       1.777            6.547          8.986        NA
## F3          1.770            9.228          7.930 4.135e-02
## NTS         1.760            6.317          2.643 1.702e+00
## TPI1        1.759           10.890          6.342 4.913e-01
## PTGES       1.757            7.540          4.722 7.838e-06
## IGKV1ORY-1 1.755           11.809          7.375 2.201e-03
## SNAI2       1.753            8.469          6.705 7.687e-02
## NFIA        1.727            7.914          5.845 1.255e+00
## COL7A1      1.726            8.066          4.932 2.645e+00
## FGD6        1.724            6.426          6.617 9.292e-01
## MCM4        1.721            7.948          5.209 1.214e+00
## TUBA1C      1.720           11.899          6.920 1.285e-02
## MELK        1.713            7.288          4.752 2.117e+00
## C5orf46     1.700            6.858          2.836        NA
## COL17A1     1.700           10.742          6.042 7.886e-01
## PDLIM7      1.691            8.030          6.383 6.057e-01
## PTTG1       1.674            9.067          4.939 1.004e+00
## DSG2        1.663           10.999          7.174 6.084e+00
## COL1A2      1.658           12.989         11.330 1.470e+00
## SYNE2       1.657            8.782          7.637 1.589e-01
## SERPINH1    1.646           10.187          6.735 2.134e+00
## PHLDA1      1.643            9.269          6.348 1.132e+00
## CTSE        1.642           11.677          9.666 1.154e+00
## ADH1A       1.635            8.432          4.306 3.482e+00
## WEE1        1.635            7.480          7.084 1.675e+00
## CHEK1       1.623            6.501          4.403 2.718e+00
## GSDMC       1.618            6.409          3.565 4.329e+00
## SLC2A1      1.615           10.218          7.422 3.749e-03
## SERPINB3    1.614            6.324          2.770 1.020e-02
## DHRS9       1.609            8.430          4.046 2.091e-01
## PPP1R3C     1.597            8.282          5.976 3.812e+00
## FLRT3       1.596            9.224          5.713 3.404e+00
## CCNB2       1.594            7.685          4.108 1.338e+00
## CORO1A      1.593            8.375          5.960 4.792e-03
## RHOF        1.591            6.800          4.881 5.617e-01
## GRAMD3      1.587            7.707          5.612 7.763e-03
## IL33        1.583            7.299          4.397 2.122e-03
## AQP1        1.577            7.146          5.848 7.817e-02
## VEGFA       1.573            7.090          6.212 1.095e-02
## ANGPTL2     1.563            9.897          5.866 1.308e+00
## SEMA4A      1.562            7.304          4.697 1.226e-01
## GCNT1       1.562            8.263          6.462 2.802e-01
## CCL19       1.560            9.155          6.111 2.032e-01
## CACHD1      1.555            6.709          5.075 4.289e-03
## NCAPG       1.544            7.323          5.149 4.495e-01
```

```
## FCGR2B     1.536          7.007          4.506 2.784e-02
## BOC        1.528          6.805          5.509 3.207e+00
## CNIH3      1.513          6.461          4.149 9.764e-01
## IL1R2      1.508          8.252          5.522 3.305e+00
## ITGA5      1.505          8.100          5.330 7.701e-02
## ITM2A      1.504          9.660          5.222 7.935e-01
## SLC9A9     1.502          7.348          6.777 2.790e-02
## TM4SF19    1.496          6.269          4.532 1.245e+00
## JAG1       1.488          9.130          8.263 4.872e+00
## FN1        1.486          6.406         11.169 2.450e-02
## NRP2       1.484          6.606          8.615        NA
## TNNI2      1.480          6.303          4.497 3.223e-01
## APOL1      1.469          6.456          7.103 6.062e-02
## KANK4      1.468          7.979          4.247 2.105e-01
## RFX2       1.463          6.427          5.086 5.510e-01
## DSC2       1.458          6.704          7.468 8.154e+00
## KRT17      1.449         10.862          6.923 1.492e+00
## ANKLE2     1.448          7.795          6.781 1.866e+00
## PRC1       1.445          8.324          5.413 2.803e+00
## PPP2R2C    1.443          6.859          3.662 4.825e+00
## KIF18A     1.440          6.472          3.550 1.717e+00
## NDRG2      1.438          8.691          6.250 2.768e+00
## LONRF2     1.437          6.411          4.445 4.865e-01
## SEMA3A     1.432          7.328          6.924 1.541e+00
## ARHGAP26   1.426          6.622          7.091 3.126e+00
## ZBED2      1.424          6.267          4.047 1.361e+00
## PCF11      1.422          6.970          5.972 5.690e+00
## IGJ        1.420          9.761         10.380 1.711e-02
## RGS16      1.419          6.813          5.669 4.387e+00
## HRASLS2    1.418          7.346          3.576 1.641e-01
## AHCYL2     1.417          8.620          7.190 4.483e+00
## TLE4       1.417          8.089          5.644 1.763e-02
## CDA        1.416          6.859          4.461 1.855e-01
## DNASE1     1.415          6.346          3.864 6.021e-01
## DKK1       1.413          9.728          5.287 1.032e+00
## CD38       1.405          7.104          6.298 7.484e-01
## MALL       1.405         10.388          6.245 3.778e-01
## GIMAP2     1.400          7.313          5.276 2.303e+00
## GPC3       1.399          7.457          6.106 8.675e-01
## SH3RF1     1.391          8.535          6.363 4.798e+00
## DUOXA2     1.384          7.261          4.065 3.746e+00
## FRMD6      1.379          9.411          7.018 1.674e+00
## KNTC1      1.365          7.209          5.133 2.333e+00
## TMSB10     1.364         13.721         10.239 9.794e-01
## KPNA2      1.356          6.543          6.121 6.968e-01
## CST6       1.354          8.451          4.027 1.272e+00
## CCNB1      1.353          7.364          5.563 3.176e-01
## CD79A      1.350          7.991          4.204 1.653e+00
## RAP1GAP    1.346          9.590          3.821 2.320e-01
## CENPF      1.346          7.209          5.142 5.130e-01
## SOD2       1.341          8.755          7.349        NA
## MIF        1.334         12.328          7.195 2.992e-01
## GBE1       1.331          7.564          6.499 1.296e+00
## MEOX1      1.331          6.748          4.334 3.263e-02
```

```
## KIF14      1.322           6.914          3.835 3.222e+00
## TRNP1      1.319          10.665          5.963 4.984e-03
## FGG        1.319           8.010         10.996        NA
## MUC16      1.312           6.930          3.937 1.296e-01
## DYNC2H1    1.312           7.510          6.309 4.117e+00
## MMP10      1.307           6.412          2.984 6.057e-01
## LETM2      1.306           6.642          4.413 6.681e-01

val.GSE21501.maxstat

##           merit threshold.train threshold.test     chisq
## ANGPTL4  4.835           8.356        0.19587 6.865e-01
## KRT6A    4.450           8.915        2.97484 2.615e-02
## LOX      4.225           7.502       -0.79221 1.058e+00
## KRT6C    4.215           6.392        5.59238        NA
## ST6GAL1  3.803           9.542        0.78319 5.739e-01
## FAM189A2 3.630           6.455        0.28808 7.248e-01
## ADM      3.394           8.820       -1.66023 7.681e+00
## E2F7     3.373           6.507       -2.26972 1.101e+01
## CAPN6    3.073           6.516        0.58777 1.934e+00
## IL20RB   2.994           6.505        0.27819 2.890e+00
## FGF13    2.837           6.400       -0.33980 2.197e+00
## TCEA3    2.791           8.955        0.67789 4.561e+00
## LOXL4    2.778           7.628        0.96728 4.499e-01
## TMEM26   2.688           6.692        0.77037 4.695e-02
## BIRC5    2.643           7.334       -1.61111 4.021e+00
## CD70     2.632           6.748       -0.60306 5.035e-01
## PPY      2.628          11.966        3.85564 7.804e-01
## TREM1    2.588           6.546        2.12235 4.167e+00
## IGFBP1   2.466           7.076       -4.02812 1.675e+00
## ERRFI1   2.364          10.222        0.59119 1.790e+01
## RGS5     2.303           8.665        4.26999 5.369e+00
## PHACTR3  2.275           6.884        1.98393 1.343e+00
## MME      2.227           6.441       -1.58576 2.189e-01
## PRDM16   2.206           6.605        3.97296 1.839e+00
## PAEP     2.186           6.304        0.77117 4.242e-01
## EPHX2    2.173           7.223        0.03016 4.564e-01
## KYNU     2.169           7.161       -1.99673 3.795e-01
## NAMPT    2.159           7.988        0.11528 1.970e+00
## PLOD2    2.155          10.451        0.06961 8.655e-02
## EDIL3    2.105           6.400        4.24471 1.304e+00
## NEK2     2.103           8.167       -1.80395 4.750e+00
## LCP1     2.100           8.702       -1.84614 2.896e+00
## COL12A1  2.052           8.689        1.83301 3.053e-01
## VSNL1    2.052           6.712       -1.64740 1.529e-01
## ENTHD1   2.044           6.345        1.75682 2.632e-01
## PCDH20   2.003           7.551        3.99419 1.354e+00
## ASPM     1.993           7.916       -0.07079 1.759e+00
## CATSPER1 1.956           6.371        0.89696 1.486e+00
## KRT18    1.943          12.487        0.25249 1.552e+00
## FAM3D    1.933           9.474        5.30834 6.346e+00
## CD109    1.929           6.370       -0.49431 4.737e-01
## UBE2C    1.927           9.305       -1.15748 2.006e+00
## OCLN     1.922           7.722        2.27334 3.056e+00
```

```
## TGFBI    1.912           12.180        1.17508 7.810e-02
## SPOCK1   1.903            8.915       -0.07385 3.241e-02
## P2RY2    1.899            6.885        2.53729 5.626e-01
## RAVER2   1.856            7.583        0.05711 4.701e-01
## P2RY8    1.856            7.349        0.52845 1.882e+00
## A4GNT    1.846            6.439        3.40057 8.431e-01
## APOA4    1.823            6.333       -1.04560 3.747e-01
## CEP55    1.819            7.985       -0.77283 1.442e-03
## IL1A     1.813            6.266       -0.13329 2.483e-02
## ANLN     1.811            7.020       -2.66571 1.547e-01
## DCBLD2   1.806           10.689        0.63766 4.607e+00
## PLA2G10  1.795            9.726        3.52033 1.519e-01
## GOLM1    1.777            6.547        4.36321 3.484e+00
## F3       1.770            9.228        3.33470 7.961e-01
## NTS      1.760            6.317       -5.02906 1.450e+00
## SNAI2    1.753            8.469        0.96462 2.333e+00
## COL7A1   1.726            8.066       -0.65725 1.243e+00
## FGD6     1.724            6.426        1.00560 2.874e-02
## NFIX     1.713            9.904        1.57937 1.036e+00
## C5orf46  1.700            6.858        1.16807 5.466e+00
## COL17A1  1.700           10.742        4.24593 2.682e-01
## VSTM2L   1.679            7.078        2.67464 2.975e-01
## COL1A2   1.658           12.989        3.96788 4.629e-03
## SERPINH1 1.646           10.187        0.16779 4.575e+00
## CTSE     1.642           11.677        7.26038 3.184e+00
## TNFRSF6B 1.638            7.634        3.32680 6.004e-01
## ADH1A    1.635            8.432        2.32552 1.282e+00
## CHEK1    1.623            6.501       -3.47669 7.154e-02
## SLC2A1   1.615           10.218       -0.52907 5.130e-01
## SERPINB3 1.614            6.324        0.71096 4.767e-01
## DHRS9    1.609            8.430        1.56562 2.307e+00
## PPP1R3C  1.597            8.282        0.52826 8.428e-05
## FLRT3    1.596            9.224        3.15856 2.789e+00
## CCNB2    1.594            7.685       -0.56249 1.099e+00
## CXCR5    1.589            6.681        7.98854        NA
## IL33     1.583            7.299        4.11799 2.212e-02
## AQP1     1.577            7.146        3.32621 1.330e-01
## TNFRSF17 1.573            7.032       12.81828        NA
## VEGFA    1.573            7.090       -0.39754 2.750e-01
## GCNT1    1.562            8.263        1.40450 6.109e-02
## CCL19    1.560            9.155        5.98546 9.945e-01
## ADRA1B   1.546            6.285        0.12758 3.060e+00
## CAV2     1.540            8.562        1.61441 2.749e+00
## FCGR2B   1.536            7.007        1.56740 9.048e-01
## MRAP2    1.532            7.684        0.29126 2.912e-01
## CCL3L3   1.524            6.799        1.79960 1.696e+00
## CNIH3    1.513            6.461        0.57543 1.041e+00
## IL1R2    1.508            8.252        3.85019 2.006e-01
## ITM2A    1.504            9.660       -0.78323 1.336e+00
## SLC9A9   1.502            7.348        3.46665 9.579e-02
## FN1      1.486            6.406        0.04531 3.830e-01
## SOX8     1.486            7.496        0.79012 5.370e-03
## NRP2     1.484            6.606        5.28797        NA
## TNNI2    1.480            6.303       -1.30119 7.253e+00
```

```
## HES1     1.479          8.112        1.10294 4.000e-01
## KCNH2    1.476          6.778        0.69336 2.375e+00
## APOL1    1.469          6.456        0.79884 2.381e-02
## KANK4    1.468          7.979        1.54307 1.052e-01
## KRT17    1.449         10.862        1.84873 3.034e+00
## PPP2R2C  1.443          6.859       -0.11054 1.115e-01
## KIF18A   1.440          6.472       -2.19452 1.770e-01
## LONRF2   1.437          6.411       -1.25358 1.612e+00
## SEMA3A   1.432          7.328        0.13548 6.067e-01
## ARHGAP26 1.426          6.622        1.86500 5.095e-01
## ZBED2    1.424          6.267        2.24266 7.387e-01
## SPOCD1   1.422          6.904        1.25823 5.807e+00
## IGJ      1.420          9.761        1.21379 3.078e-01
## RGS16    1.419          6.813        1.94034 2.366e-01
## HRASLS2  1.418          7.346        4.41621 2.843e-01
## AHCYL2   1.417          8.620        1.74374 4.884e+00
## DNASE1   1.415          6.346        0.03199 5.313e-02
## DKK1     1.413          9.728        0.52018 1.947e+00
## CD38     1.405          7.104        2.18938 7.635e-01
## MALL     1.405         10.388        3.83833 5.231e-01
## FGF18    1.397          6.280        1.94601 3.342e-03
## ZNF365   1.390          7.180        2.32667 3.166e-01
## FRMD6    1.379          9.411        1.01822 1.170e-02
## TK1      1.375          8.114       -1.37859 4.348e+00
## CST6     1.354          8.451        4.65564 2.530e-01
## CD79A    1.350          7.991        2.33695 7.925e-02
## RAP1GAP  1.346          9.590        0.53578 8.878e-03
## CENPF    1.346          7.209       -2.07887 2.536e+00
## SOD2     1.341          8.755       -0.40747 6.928e-01
## MEOX1    1.331          6.748        0.96369 5.732e-01
## KIF14    1.322          6.914       -1.85459 3.210e-01
## TRNP1    1.319         10.665        3.20514 9.527e-04
## FGG      1.319          8.010        6.42581        NA
## CBX1     1.317          6.644        0.09649 4.679e-01
## MUC16    1.312          6.930       -1.13833 1.513e-01
## DYNC2H1  1.312          7.510        0.47423 6.089e-03
## GATA6    1.310          6.470        3.72622 2.664e+00
## MMP10    1.307          6.412        1.44298 3.202e-02
```

```
val.TCGA.messina
```

```
##         merit threshold.train threshold.test  chisq
## KRT6A   3.999           9.503          3.656 1.4483
## ANGPTL4 2.716           8.900          3.336 0.2310
## KRT6C   2.333           7.458         16.773     NA
## CIDEC   2.269           8.021          3.192 2.0245
## IGFBP1  1.474           7.070          3.788     NA
## DHRS9   1.468           8.965          3.203 0.1557
## FGG     1.365           8.585         10.219     NA
## LYNX1   1.344           7.020          3.998     NA
## PPY     1.098          11.931          3.969 0.3139
## LOX     1.051           7.686          3.602 0.3011
## IL20RB  1.043           6.971          2.975 4.0928
```

```
val.TCGA.maxstat
```

```
## Error in eval(expr, envir, enclos):  object 'val.TCGA.maxstat' not found
```