```
## Load libraries
library(splines)
library(MASS)
library(xtable)
library(qvalue)

##Source functions
source("../functions.R")
```

Simulations are performed for a variety of alternative distributions:

```
alts <- c("alt_beta","alt_chisq_large_3_3","alt_chisq_large",
          "alt_chisq_small_3_3","alt_chisq_small",
          "alt_t_large","alt_t_small",
          "alt_z_large",
          "alt_z_small")
```

Make FDR-TPR table:

```
for(a in 1:9)
{
  alt <- alts[a]

  print(alt)

  ##For each simulation, get the FDR-TPR table: (BL = Boca-Leek method)
  scen5 <- NULL

  ##-------------------Set 9----------------##

  ##don't use Scott methods at all (at least for now) since main comparison is with Storey
  load(paste(alt,"/simResults_", 9, ".RData",sep=""))
  load(paste(alt,"/simResults_pi0x_thresh_", 9, "_full.RData",sep=""))

  FDR.ScottMat <- NULL
  FDR.ScottMat_emp <- NULL

  ##Get BH and Storey q-values for each simulation:
  qValuesSimsBH <- getQValuesSimsBH(pValuesSims)
  qValuesSimsStorey <- getQValuesSimsStorey(pValuesSims)

  print(mean(qValuesSimsStorey))

  ##Get estimated FDR for each simulation for the final estimates
  FDRreg <- getFDRregSims(pi0EstSim, qValuesSimsBH)
```

```
##get FDR-TPR table
scen9 <- estFDR.TPR(FDR.BL = FDRreg,
                    FDR.BH = qValuesSimsBH, FDR.Storey = qValuesSimsStorey,
                    FDR.Scott = FDR.ScottMat, FDR.Scott_emp = FDR.ScottMat_emp, nullHypSim

print("Degree = 5/4")
print(scen9)

save(list=c("scen9"),
     file=paste(alt,"FDR_TPR_sims_9.RData",sep="/"))

##-------------------Set 10----------------##

##don't use Scott methods at all (at least for now) since main comparison is with Storey
load(paste(alt,"/simResults_", 10, ".RData",sep=""))
load(paste(alt,"/simResults_pi0x_thresh_", 10, "_full.RData",sep=""))

FDR.ScottMat <- NULL
FDR.ScottMat_emp <- NULL

##Get BH and Storey q-values for each simulation:
qValuesSimsBH <- getQValuesSimsBH(pValuesSims)
qValuesSimsStorey <- getQValuesSimsStorey(pValuesSims)

print(mean(qValuesSimsStorey))

##Get estimated FDR for each simulation for the final estimates
FDRreg <- getFDRregSims(pi0EstSim, qValuesSimsBH)

##get FDR-TPR table
scen10 <- estFDR.TPR(FDR.BL = FDRreg,
                    FDR.BH = qValuesSimsBH, FDR.Storey = qValuesSimsStorey,
                    FDR.Scott = FDR.ScottMat, FDR.Scott_emp = FDR.ScottMat_emp, nullHypSim

print("Degree = 3/2")
print(scen10)

save(list=c("scen10"),
     file=paste(alt,"FDR_TPR_sims_10.RData",sep="/"))

##-------------------Set 11----------------##

##don't use Scott methods at all (at least for now) since main comparison is with Storey
load(paste(alt,"/simResults_", 11, ".RData",sep=""))
load(paste(alt,"/simResults_pi0x_thresh_", 11, "_full.RData",sep=""))
```

```
FDR.ScottMat <- NULL
FDR.ScottMat_emp <- NULL

##Get BH and Storey q-values for each simulation:
qValuesSimsBH <- getQValuesSimsBH(pValuesSims)
qValuesSimsStorey <- getQValuesSimsStorey(pValuesSims)

print(mean(qValuesSimsStorey))

##Get estimated FDR for each simulation for the final estimates
FDRreg <- getFDRregSims(piOEstSim, qValuesSimsBH)

##get FDR-TPR table
scen11 <- estFDR.TPR(FDR.BL = FDRreg,
                     FDR.BH = qValuesSimsBH, FDR.Storey = qValuesSimsStorey,
                     FDR.Scott = FDR.ScottMat, FDR.Scott_emp = FDR.ScottMat_emp, nullHypSi

print("Degree = 2")
print(scen11)

save(list=c("scen11"),
     file=paste(alt,"FDR_TPR_sims_11.RData",sep="/"))

##-------------------Set 12----------------##

##don't use Scott methods at all (at least for now) since main comparison is with Storey
load(paste(alt,"/simResults_", 12, ".RData",sep=""))
load(paste(alt,"/simResults_piOx_thresh_", 12, "_full.RData",sep=""))

FDR.ScottMat <- NULL
FDR.ScottMat_emp <- NULL

##Get BH and Storey q-values for each simulation:
qValuesSimsBH <- getQValuesSimsBH(pValuesSims)
qValuesSimsStorey <- getQValuesSimsStorey(pValuesSims)

print(mean(qValuesSimsStorey))

##Get estimated FDR for each simulation for the final estimates
FDRreg <- getFDRregSims(piOEstSim, qValuesSimsBH)

##get FDR-TPR table
scen12 <- estFDR.TPR(FDR.BL = FDRreg,
                     FDR.BH = qValuesSimsBH, FDR.Storey = qValuesSimsStorey,
                     FDR.Scott = FDR.ScottMat, FDR.Scott_emp = FDR.ScottMat_emp, nullHypSi
```

```
  print("Degree = 3")
  print(scen12)

  save(list=c("scen12"),
       file=paste(alt,"FDR_TPR_sims_12.RData",sep="/"))


  print("")
  print("")
}
```

```
## [1] "alt_beta"
## [1] 0.1514281
## [1] "Degree = 5/4"
##                  FDR         TPR Percent used
## BL        0.04884162 0.716304753          100
## Scott             NA          NA           NA
## Scott_emp         NA          NA           NA
## Storey    0.05399363 0.459392418          100
## BH        0.01882707 0.005525244          100
## [1] 0.1236569
## [1] "Degree = 3/2"
##                  FDR        TPR Percent used
## BL        0.04826643 0.77831431          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.05216259 0.64176900          100
## BH        0.01615193 0.00654693          100
## [1] 0.08865255
## [1] "Degree = 2"
##                  FDR         TPR Percent used
## BL        0.04401837 0.859617821          100
## Scott             NA          NA           NA
## Scott_emp         NA          NA           NA
## Storey    0.05167494 0.832832168          100
## BH        0.01236603 0.009362016          100
## [1] 0.05414994
## [1] "Degree = 3"
##                   FDR       TPR Percent used
## BL        0.036957921 0.9265954          100
## Scott              NA        NA           NA
## Scott_emp          NA        NA           NA
## Storey    0.052603509 0.9544215          100
## BH        0.008457081 0.0140840          100
## [1] ""
```

```
## [1] ""
## [1] "alt_chisq_large_3_3"
## [1] 0.1874864
## [1] "Degree = 5/4"
##                  FDR       TPR Percent used
## BL        0.04129034 0.6881453          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04629014 0.5850963          100
## BH        0.02182964 0.4818305          100
## [1] 0.1598187
## [1] "Degree = 3/2"
##                  FDR       TPR Percent used
## BL        0.03896865 0.7173932          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04495250 0.6084587          100
## BH        0.01998426 0.4882883          100
## [1] 0.1218336
## [1] "Degree = 2"
##                  FDR       TPR Percent used
## BL        0.03384265 0.7608474          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04411138 0.6462513          100
## BH        0.01622684 0.5036945          100
## [1] 0.08406996
## [1] "Degree = 3"
##                  FDR       TPR Percent used
## BL        0.02701703 0.8134404          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04032471 0.6952413          100
## BH        0.01201209 0.5174346          100
## [1] ""
## [1] ""
## [1] "alt_chisq_large"
## [1] 0.1598929
## [1] "Degree = 5/4"
##                  FDR       TPR Percent used
## BL        0.04537106 0.8284002          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04684400 0.7631161          100
## BH        0.02223582 0.6774138          100
```

```
## [1] 0.1347687
## [1] "Degree = 3/2"
##                  FDR       TPR Percent used
## BL        0.04202539 0.8465260          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04640506 0.7790655          100
## BH        0.01996901 0.6874343          100
## [1] 0.09710958
## [1] "Degree = 2"
##                  FDR       TPR Percent used
## BL        0.03917382 0.8759936          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04717336 0.8073221          100
## BH        0.01647811 0.6987620          100
## [1] 0.06407029
## [1] "Degree = 3"
##                  FDR       TPR Percent used
## BL        0.03094346 0.9029214          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04307106 0.8386824          100
## BH        0.01266572 0.7112029          100
## [1] ""
## [1] ""
## [1] "alt_chisq_small_3_3"
## [1] 0.5550805
## [1] "Degree = 5/4"
##                  FDR        TPR Percent used
## BL        0.02914114 0.02732592          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.03006795 0.02307761          100
## BH        0.02537607 0.01789784          100
## [1] 0.5347417
## [1] "Degree = 3/2"
##                  FDR        TPR Percent used
## BL        0.02143812 0.02960839          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.02334685 0.02483576          100
## BH        0.01683518 0.01817261          100
## [1] 0.4929895
## [1] "Degree = 2"
```

```
##                  FDR        TPR Percent used
## BL        0.01836705 0.03344979          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.02181542 0.02857928          100
## BH        0.01623033 0.02024421          100
## [1] 0.444089
## [1] "Degree = 3"
##                  FDR        TPR Percent used
## BL        0.01507075 0.03809769          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.01884888 0.03318552          100
## BH        0.01146850 0.02228729          100
## [1] ""
## [1] ""
## [1] "alt_chisq_small"
## [1] 0.4747686
## [1] "Degree = 5/4"
##                  FDR        TPR Percent used
## BL        0.02411719 0.10307473          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.02748009 0.09071214          100
## BH        0.02003841 0.07283582          100
## [1] 0.4503593
## [1] "Degree = 3/2"
##                  FDR        TPR Percent used
## BL        0.02052610 0.10654046          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.02400834 0.09518157          100
## BH        0.01693111 0.07558299          100
## [1] 0.4138542
## [1] "Degree = 2"
##                  FDR        TPR Percent used
## BL        0.01986013 0.11928813          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.02382198 0.10808939          100
## BH        0.01574713 0.08313369          100
## [1] 0.3708305
## [1] "Degree = 3"
##                  FDR        TPR Percent used
## BL        0.01601743 0.13235472          100
```

```
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.01900780 0.12063370          100
## BH        0.01321646 0.09010274          100
## [1] ""
## [1] ""
## [1] "alt_t_large"
## [1] 0.1808737
## [1] "Degree = 5/4"
##                  FDR       TPR Percent used
## BL        0.04122005 0.7250464          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04580017 0.6101603          100
## BH        0.02129198 0.4542850          100
## [1] 0.1518943
## [1] "Degree = 3/2"
##                  FDR       TPR Percent used
## BL        0.03859457 0.7570950          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04528159 0.6439935          100
## BH        0.01914510 0.4701897          100
## [1] 0.1144513
## [1] "Degree = 2"
##                  FDR       TPR Percent used
## BL        0.03444177 0.8007557          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04410167 0.6917268          100
## BH        0.01601078 0.4928940          100
## [1] 0.07744303
## [1] "Degree = 3"
##                  FDR       TPR Percent used
## BL        0.02780706 0.8488083          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04116828 0.7507425          100
## BH        0.01254335 0.5168736          100
## [1] ""
## [1] ""
## [1] "alt_t_small"
## [1] 0.5223421
## [1] "Degree = 5/4"
##                  FDR         TPR Percent used
```

```
## BL        0.02918142 0.017091206          100
## Scott             NA          NA           NA
## Scott_emp         NA          NA           NA
## Storey    0.03419720 0.011210780          100
## BH        0.03295208 0.006954554          100
## [1] 0.4970521
## [1] "Degree = 3/2"
##                  FDR         TPR Percent used
## BL        0.02729435 0.019513900          100
## Scott             NA          NA           NA
## Scott_emp         NA          NA           NA
## Storey    0.03554473 0.013342047          100
## BH        0.02331630 0.007541063          100
## [1] 0.4593495
## [1] "Degree = 2"
##                  FDR         TPR Percent used
## BL        0.02258528 0.024108043          100
## Scott             NA          NA           NA
## Scott_emp         NA          NA           NA
## Storey    0.02598107 0.016945699          100
## BH        0.01507197 0.008151423          100
## [1] 0.4177594
## [1] "Degree = 3"
##                  FDR         TPR Percent used
## BL        0.01607205 0.031111596          100
## Scott             NA          NA           NA
## Scott_emp         NA          NA           NA
## Storey    0.01951485 0.023361733          100
## BH        0.01388505 0.009932246          100
## [1] ""
## [1] ""
## [1] "alt_z_large"
## [1] 0.162161
## [1] "Degree = 5/4"
##                  FDR       TPR Percent used
## BL        0.04418528 0.8285937          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04713682 0.7623218          100
## BH        0.02251784 0.6800413          100
## [1] 0.1335182
## [1] "Degree = 3/2"
##                  FDR       TPR Percent used
## BL        0.04226618 0.8482693          100
## Scott             NA        NA           NA
```

```
## Scott_emp         NA        NA           NA
## Storey    0.04669502 0.7798288          100
## BH        0.02012696 0.6873357          100
## [1] 0.09844897
## [1] "Degree = 2"
##                  FDR       TPR Percent used
## BL        0.03756336 0.8761317          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04557777 0.8074607          100
## BH        0.01625153 0.6999171          100
## [1] 0.06313802
## [1] "Degree = 3"
##                  FDR       TPR Percent used
## BL        0.03078897 0.9051570          100
## Scott             NA        NA           NA
## Scott_emp         NA        NA           NA
## Storey    0.04355082 0.8422213          100
## BH        0.01233351 0.7121975          100
## [1] ""
## [1] ""
## [1] "alt_z_small"
## [1] 0.4802611
## [1] "Degree = 5/4"
##                  FDR        TPR Percent used
## BL        0.02596151 0.10120818          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.03088735 0.08925625          100
## BH        0.02256836 0.07244517          100
## [1] 0.4511397
## [1] "Degree = 3/2"
##                  FDR        TPR Percent used
## BL        0.02259561 0.10854834          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.02793050 0.09619238          100
## BH        0.02142490 0.07642863          100
## [1] 0.4100965
## [1] "Degree = 2"
##                  FDR        TPR Percent used
## BL        0.01935578 0.12092457          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.02241739 0.10721399          100
```

```
## BH        0.01575201 0.08243389          100
## [1] 0.364474
## [1] "Degree = 3"
##                  FDR        TPR Percent used
## BL        0.01481825 0.13342077          100
## Scott             NA         NA           NA
## Scott_emp         NA         NA           NA
## Storey    0.01837022 0.12109197          100
## BH        0.01313746 0.08925447          100
## [1] ""
## [1] ""
```

Session info:

```
devtools::session_info()

## Session info -------------------------------------------------

##  setting  value
##  version  R version 3.3.1 (2016-06-21)
##  system   x86_64, mingw32
##  ui       RTerm
##  language (EN)
##  collate  English_United States.1252
##  tz       America/New_York
##  date     2018-08-29

## Packages -----------------------------------------------------

##  package    * version date       source
##  colorspace   1.2-6   2015-03-11 CRAN (R 3.3.1)
##  devtools     1.12.0  2016-06-24 CRAN (R 3.3.3)
##  digest       0.6.12  2017-01-27 CRAN (R 3.3.3)
##  evaluate     0.10    2016-10-11 CRAN (R 3.3.1)
##  ggplot2      2.2.1   2016-12-30 CRAN (R 3.3.3)
##  gtable       0.2.0   2016-02-26 CRAN (R 3.3.1)
##  highr        0.6     2016-05-09 CRAN (R 3.3.1)
##  knitr      * 1.17    2017-08-10 CRAN (R 3.3.3)
##  lazyeval     0.2.0   2016-06-12 CRAN (R 3.3.1)
##  magrittr     1.5     2014-11-22 CRAN (R 3.3.1)
##  MASS       * 7.3-45  2016-04-21 CRAN (R 3.3.1)
##  memoise      1.0.0   2016-01-29 CRAN (R 3.3.1)
##  munsell      0.4.3   2016-02-13 CRAN (R 3.3.1)
##  plyr         1.8.4   2016-06-08 CRAN (R 3.3.1)
##  qvalue     * 2.4.2   2016-05-16 Bioconductor
##  Rcpp         0.12.13 2017-09-28 CRAN (R 3.3.3)
##  reshape2     1.4.1   2014-12-06 CRAN (R 3.3.1)
```

```
##  rlang        0.1.4   2017-11-05 CRAN (R 3.3.3)
##  scales       0.4.1   2016-11-09 CRAN (R 3.3.3)
##  stringi      1.1.1   2016-05-27 CRAN (R 3.3.0)
##  stringr      1.2.0   2017-02-18 CRAN (R 3.3.3)
##  tibble       1.3.3   2017-05-28 CRAN (R 3.3.3)
##  withr        1.0.2   2016-06-20 CRAN (R 3.3.1)
##  xtable     * 1.8-2   2016-02-05 CRAN (R 3.3.1)
```