```
## Load libraries
library(splines)
library(MASS)
library(FDRreg)

## Loading required package:  fda
## Warning:  package 'fda' was built under R version 3.3.3
## Loading required package:  Matrix
##
## Attaching package:  'fda'
## The following object is masked from 'package:graphics':
##
##    matplot
## Loading required package:  BayesLogit
## Warning:  package 'BayesLogit' was built under R version 3.3.2
## Loading required package:  mvtnorm
## Warning:  package 'mvtnorm' was built under R version 3.3.2

library(curl)

library(doParallel) ##to make cluster (on Windows)

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

library(foreach) ##to use foreach function that does the parallel processing
library(doRNG) ##for reproducible seeds when doing parallel processing

## Loading required package:  rngtools
## Warning:  package 'rngtools' was built under R version 3.3.2
## Loading required package:  pkgmaker
## Warning:  package 'pkgmaker' was built under R version 3.3.2
## Loading required package:  registry
## Warning:  package 'registry' was built under R version 3.3.2
##
## Attaching package:  'pkgmaker'
## The following object is masked from 'package:base':
##
##    isNamespaceLoaded

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

options(warn=1)
```

Define nulltype for Scott method:

```
nulltype <- "empirical"
```

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")
alts <- alts[c(6,8)]
```

# 1 Probability of being a false positive is 0.9

Perform estimation and save estimates:

```
for(alt in alts)
{
  print(alt)

  load(paste(alt,"simResults_1.RData",sep="/"))
  ntest <- ncol(zValuesSims)

  splineMat <- ns(tme,df=3)

  pi0hatScottMat_empFitSpl <- estimate_Scott_sims(zValuesSims, splineMat, nulltype)

  pi0hatSpl.ScottMean_emp <- colMeans(pi0hatScottMat_empFitSpl[,1:ntest])
  pi0hatSpl.ScottVar_emp <- apply(pi0hatScottMat_empFitSpl[,1:ntest],2,var)

  pi0hat.Spl.ScottMat_emp <- pi0hatScottMat_empFitSpl[,1:ntest]
  FDR.Spl.ScottMat_emp <- pi0hatScottMat_empFitSpl[,(ntest+1):(2*ntest)]

  ##save full results
  save(file=paste(alt,"simResults_pi0x_Scott_emp_1_splines_full.RData",sep="/"),
       list=c("pi0hat.Spl.ScottMat_emp", "FDR.Spl.ScottMat_emp"))

  ##save summary results
  save(file=paste(alt,"simResults_pi0x_Scott_emp_1_splines.RData",sep="/"),
       list=c("tme", "pi0",
              "pi0hatSpl.ScottMean_emp", "pi0hatSpl.ScottVar_emp"))
}

## [1] "alt_t_large"
## [1] "alt_z_large"
```

## 2 Probability of being a false positive is linear

Perform estimation and save estimates:

```
for(alt in alts)
{
  print(alt)

  load(paste(alt,"simResults_5.RData",sep="/"))
  ntest <- ncol(zValuesSims)

  splineMat <- ns(tme,df=3)

  pi0hatScottMat_empFitSpl <- estimate_Scott_sims(zValuesSims, splineMat, nulltype)

  pi0hatSpl.ScottMean_emp <- colMeans(pi0hatScottMat_empFitSpl[,1:ntest])
  pi0hatSpl.ScottVar_emp <- apply(pi0hatScottMat_empFitSpl[,1:ntest],2,var)

  pi0hat.Spl.ScottMat_emp <- pi0hatScottMat_empFitSpl[,1:ntest]
  FDR.Spl.ScottMat_emp <- pi0hatScottMat_empFitSpl[,(ntest+1):(2*ntest)]

  ##save full results
  save(file=paste(alt,"simResults_pi0x_Scott_emp_5_splines_full.RData",sep="/"),
       list=c("pi0hat.Spl.ScottMat_emp", "FDR.Spl.ScottMat_emp"))

  ##save summary results
  save(file=paste(alt,"simResults_pi0x_Scott_emp_5_splines.RData",sep="/"),
       list=c("tme", "pi0",
              "pi0hatSpl.ScottMean_emp", "pi0hatSpl.ScottVar_emp"))
}
```

```
## [1] "alt_t_large"
## [1] "alt_z_large"
```

## 3 Probability of being a false positive is 1

Nothing from alternative distribution, since this is for the global null:

```
folder <- "global_null"
```

Perform estimation and save estimates:

```
set.seed(880184)

print(folder)
```

```
## [1] "global_null"

load(paste(folder,"simResults_0.RData",sep="/"))
ntest <- ncol(zValuesSims)

splineMat <- ns(tme,df=3)

pi0hatScottMat_empFitSpl <- estimate_Scott_sims(zValuesSims, splineMat, nulltype)

pi0hatSpl.ScottMean_emp <- colMeans(pi0hatScottMat_empFitSpl[,1:ntest])
pi0hatSpl.ScottVar_emp <- apply(pi0hatScottMat_empFitSpl[,1:ntest],2,var)

pi0hat.Spl.ScottMat_emp <- pi0hatScottMat_empFitSpl[,1:ntest]
FDR.Spl.ScottMat_emp <- pi0hatScottMat_empFitSpl[,(ntest+1):(2*ntest)]

##save full results
save(file=paste(folder,"simResults_pi0x_Scott_emp_0_splines_full.RData",sep="/"),
     list=c("pi0hat.Spl.ScottMat_emp", "FDR.Spl.ScottMat_emp"))

##save summary results
save(file=paste(folder,"simResults_pi0x_Scott_emp_0_splines.RData",sep="/"),
     list=c("tme", "pi0",
            "pi0hatSpl.ScottMean_emp", "pi0hatSpl.ScottVar_emp"))
```

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     2018-09-18

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

##  package    * version date
##  assertthat   0.1     2013-12-06
##  BayesLogit * 0.6     2016-10-20
##  bindr        0.1     2016-11-13
##  bindrcpp     0.2     2017-06-17
##  codetools    0.2-14  2015-07-15
```

```
##  colorspace   1.2-6   2015-03-11
##  curl       * 0.9.7   2016-04-10
##  devtools     1.12.0  2016-06-24
##  digest       0.6.12  2017-01-27
##  doParallel * 1.0.10  2015-10-14
##  doRNG      * 1.6     2014-03-07
##  dplyr        0.7.4   2017-09-28
##  evaluate     0.10    2016-10-11
##  fda        * 2.4.4   2014-12-16
##  FDRreg     * 0.2-1   2017-05-03
##  foreach    * 1.4.3   2015-10-13
##  ggdendro     0.1-20  2016-04-27
##  ggplot2      2.2.1   2016-12-30
##  glue         1.1.1   2017-06-21
##  gridExtra    2.2.1   2016-02-29
##  gtable       0.2.0   2016-02-26
##  highr        0.6     2016-05-09
##  iterators  * 1.0.8   2015-10-13
##  knitr      * 1.17    2017-08-10
##  lattice      0.20-33 2015-07-14
##  lazyeval     0.2.0   2016-06-12
##  magrittr     1.5     2014-11-22
##  MASS       * 7.3-45  2016-04-21
##  Matrix     * 1.2-6   2016-05-02
##  memoise      1.0.0   2016-01-29
##  mosaic       0.14.4  2016-07-29
##  mosaicData   0.14.0  2016-06-17
##  munsell      0.4.3   2016-02-13
##  mvtnorm    * 1.0-6   2017-03-02
##  pkgconfig    2.0.1   2017-03-21
##  pkgmaker   * 0.22    2014-05-14
##  plyr         1.8.4   2016-06-08
##  purrr        0.2.4   2017-10-18
##  R6           2.1.2   2016-01-26
##  Rcpp         0.12.13 2017-09-28
##  registry   * 0.3     2015-07-08
##  rlang        0.1.4   2017-11-05
##  rngtools   * 1.2.4   2014-03-06
##  scales       0.4.1   2016-11-09
##  stringi      1.1.1   2016-05-27
##  stringr      1.2.0   2017-02-18
##  tibble       1.3.3   2017-05-28
##  tidyr        0.7.2   2017-10-16
##  withr        1.0.2   2016-06-20
##  xtable       1.8-2   2016-02-05
```

```
##  source
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.2)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.3)
##  Github (jgscott/FDRreg@8025d1a)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.0)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.1)
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##  CRAN (R 3.3.3)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.2)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.2)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.2)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.2)
##  CRAN (R 3.3.3)
```

```
##  CRAN (R 3.3.0)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.3)
##  CRAN (R 3.3.1)
##  CRAN (R 3.3.1)
```