```
## 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")
```

Define nulltype for Scott method:

```
nulltype <- "theoretical"
```

Simulations are performed for a variety of alternative distributions:

```
altsGrid <- as.matrix(expand.grid(dist=c("z","t"),nrBlocks=c(10,20),corr=c(0.2,0.5,0.9)))
alts <- apply(altsGrid, 1, function(x){paste("alt",x[1],"large",x[2],x[3],sep="_")})
alts

##  [1] "alt_z_large_10_0.2" "alt_t_large_10_0.2"
##  [3] "alt_z_large_20_0.2" "alt_t_large_20_0.2"
##  [5] "alt_z_large_10_0.5" "alt_t_large_10_0.5"
##  [7] "alt_z_large_20_0.5" "alt_t_large_20_0.5"
##  [9] "alt_z_large_10_0.9" "alt_t_large_10_0.9"
## [11] "alt_z_large_20_0.9" "alt_t_large_20_0.9"
```

1 Probability of being a false positive is flat

Perform estimation and save estimates:

```
for(alt in alts)
{
  load(paste(alt,"simResults_1.RData",sep="/"))
  ntest <- ncol(zValuesSims)

  pi0hatScottMat <- estimate_Scott_sims(zValuesSims, tme, nulltype)

  pi0hatScottMean <- colMeans(pi0hatScottMat[,1:ntest])
  pi0hatScottVar <- apply(pi0hatScottMat[,1:ntest],2,var)

  pi0hat.ScottMat <- pi0hatScottMat[,1:ntest]
  FDR.ScottMat <- pi0hatScottMat[,(ntest+1):(2*ntest)]

  ##save full results
  save(file=paste(alt,"simResults_pi0x_Scott_1_full.RData",sep="/"),
       list=c("pi0hat.ScottMat", "FDR.ScottMat"))

  ##save summary results
  save(file=paste(alt,"simResults_pi0x_Scott_1.RData",sep="/"),
       list=c("tme", "pi0",
              "pi0hatScottMean","pi0hatScottVar"))
}
```

2 Probability of being a false positive is smooth in one variable

Perform estimation and save estimates:

```r
for(alt in alts)
{
  load(paste(alt,"simResults_2.RData",sep="/"))
  ntest <- ncol(zValuesSims)

  splineMat <- ns(tme,df=3)

  ##--------linear fit-------##
  pi0hatScottMatFitLin <- estimate_Scott_sims(zValuesSims, tme, nulltype)

  pi0hatLin.ScottMean <- colMeans(pi0hatScottMatFitLin[,1:ntest])
  pi0hatLin.ScottVar <- apply(pi0hatScottMatFitLin[,1:ntest],2,var)

  pi0hat.Lin.ScottMat <- pi0hatScottMatFitLin[,1:ntest]
  FDR.Lin.ScottMat <- pi0hatScottMatFitLin[,(ntest+1):(2*ntest)]

  ##---------spline fit---------#
  pi0hatScottMatFitSpl <- estimate_Scott_sims(zValuesSims, splineMat, nulltype)

  pi0hatSpl.ScottMean <- colMeans(pi0hatScottMatFitSpl[,1:ntest])
  pi0hatSpl.ScottVar <- apply(pi0hatScottMatFitSpl[,1:ntest],2,var)

  pi0hat.Spl.ScottMat <- pi0hatScottMatFitSpl[,1:ntest]
  FDR.Spl.ScottMat <- pi0hatScottMatFitSpl[,(ntest+1):(2*ntest)]

  ##save full results
  save(file=paste(alt,"simResults_pi0x_Scott_2_full.RData",sep="/"),
       list=c("pi0hat.Lin.ScottMat", "FDR.Lin.ScottMat",
              "pi0hat.Spl.ScottMat", "FDR.Spl.ScottMat"))

  ##save summary results
  save(file=paste(alt,"simResults_pi0x_Scott_2.RData",sep="/"),
       list=c("tme", "pi0",
              "pi0hatLin.ScottMean", "pi0hatLin.ScottVar",
              "pi0hatSpl.ScottMean", "pi0hatSpl.ScottVar"))
}
```

3 Probability of being a false positive is smooth in one variable within levels of second variable

Perform estimation and save estimates:

```r
for(alt in alts)
{
  load(paste(alt,"simResults_3.RData",sep="/"))
  ntest <- ncol(zValuesSims)

  m <- model.matrix(~as.character(tme2))[,-1]

  linearMat <- cbind(tme1, m)
  splineMat <- cbind(ns(tme1,df=3), m)

  ##--------linear fit-------##
  pi0hatScottMatFitLin <- estimate_Scott_sims(zValuesSims, linearMat, nulltype)

  pi0hatLin.ScottMean <- colMeans(pi0hatScottMatFitLin[,1:ntest])
  pi0hatLin.ScottVar <- apply(pi0hatScottMatFitLin[,1:ntest],2,var)

  pi0hat.Lin.ScottMat <- pi0hatScottMatFitLin[,1:ntest]
  FDR.Lin.ScottMat <- pi0hatScottMatFitLin[,(ntest+1):(2*ntest)]

  ##---------spline fit---------#
  pi0hatScottMatFitSpl <- estimate_Scott_sims(zValuesSims, splineMat, nulltype)

  pi0hatSpl.ScottMean <- colMeans(pi0hatScottMatFitSpl[,1:ntest])
  pi0hatSpl.ScottVar <- apply(pi0hatScottMatFitSpl[,1:ntest],2,var)

  pi0hat.Spl.ScottMat <- pi0hatScottMatFitSpl[,1:ntest]
  FDR.Spl.ScottMat <- pi0hatScottMatFitSpl[,(ntest+1):(2*ntest)]

  ##save full results
  save(file=paste(alt,"simResults_pi0x_Scott_3_full.RData",sep="/"),
       list=c("pi0hat.Lin.ScottMat", "FDR.Lin.ScottMat",
              "pi0hat.Spl.ScottMat", "FDR.Spl.ScottMat"))

  ##save summary results
  save(file=paste(alt,"simResults_pi0x_Scott_3.RData",sep="/"),
       list=c("tme1", "tme2", "pi0",
              "pi0hatLin.ScottMean", "pi0hatLin.ScottVar",
              "pi0hatSpl.ScottMean", "pi0hatSpl.ScottVar"))
}
```

4 Probability of being a false positive is smooth in one variable within levels of second variable - lower priors

Perform estimation and save estimates:

```r
for(alt in alts)
{
  load(paste(alt,"simResults_4.RData",sep="/"))
  ntest <- ncol(zValuesSims)

  m <- model.matrix(~as.character(tme2))[,-1]

  linearMat <- cbind(tme1, m)
  splineMat <- cbind(ns(tme1,df=3), m)

  ##--------linear fit-------##
  pi0hatScottMatFitLin <- estimate_Scott_sims(zValuesSims, linearMat, nulltype)

  pi0hatLin.ScottMean <- colMeans(pi0hatScottMatFitLin[,1:ntest])
  pi0hatLin.ScottVar <- apply(pi0hatScottMatFitLin[,1:ntest],2,var)

  pi0hat.Lin.ScottMat <- pi0hatScottMatFitLin[,1:ntest]
  FDR.Lin.ScottMat <- pi0hatScottMatFitLin[,(ntest+1):(2*ntest)]

  ##---------spline fit---------#
  pi0hatScottMatFitSpl <- estimate_Scott_sims(zValuesSims, splineMat, nulltype)

  pi0hatSpl.ScottMean <- colMeans(pi0hatScottMatFitSpl[,1:ntest])
  pi0hatSpl.ScottVar <- apply(pi0hatScottMatFitSpl[,1:ntest],2,var)

  pi0hat.Spl.ScottMat <- pi0hatScottMatFitSpl[,1:ntest]
  FDR.Spl.ScottMat <- pi0hatScottMatFitSpl[,(ntest+1):(2*ntest)]

  ##save full results
  save(file=paste(alt,"simResults_pi0x_Scott_4_full.RData",sep="/"),
       list=c("pi0hat.Lin.ScottMat", "FDR.Lin.ScottMat",
              "pi0hat.Spl.ScottMat", "FDR.Spl.ScottMat"))

  ##save summary results
  save(file=paste(alt,"simResults_pi0x_Scott_4.RData",sep="/"),
       list=c("tme1", "tme2", "pi0",
              "pi0hatLin.ScottMean", "pi0hatLin.ScottVar",
              "pi0hatSpl.ScottMean", "pi0hatSpl.ScottVar"))
}
```

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      2017-06-01

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

##   package     * version date
##   assertthat    0.1     2013-12-06
##   BayesLogit  * 0.6     2016-10-20
##   codetools     0.2-14  2015-07-15
##   colorspace    1.2-6   2015-03-11
##   curl        * 0.9.7   2016-04-10
##   DBI           0.4-1   2016-05-08
##   devtools      1.12.0  2016-06-24
##   digest        0.6.9   2016-01-08
##   doParallel  * 1.0.10  2015-10-14
##   doRNG       * 1.6     2014-03-07
##   dplyr         0.4.3   2015-09-01
##   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
##   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       * 1.15.1  2016-11-22
##   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
##   pkgmaker   * 0.22    2014-05-14
##   plyr         1.8.4   2016-06-08
##   R6           2.1.2   2016-01-26
##   Rcpp         0.12.10 2017-03-19
##   registry   * 0.3     2015-07-08
##   rngtools   * 1.2.4   2014-03-06
##   scales       0.4.1   2016-11-09
##   stringi      1.1.1   2016-05-27
##   stringr      1.0.0   2015-04-30
##   tibble       1.2     2016-08-26
##   tidyr        0.5.1   2016-06-14
##   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 3.3.1)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.3)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
##   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 3.3.1)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.0)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
##   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 3.3.2)
##   CRAN (R 3.3.2)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.3)
##   CRAN (R 3.3.2)
##   CRAN (R 3.3.2)
##   CRAN (R 3.3.3)
##   CRAN (R 3.3.0)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.2)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
##   CRAN (R 3.3.1)
```