

```

## Load libraries
library(splines)
library(MASS)
library(swfdr)

## Error in library(swfdr): there is no package called 'swfdr'

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

##don't need doRNG here, but easier to keep it in

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

```

Function to pull out means and variances across simulations:

```

pullMeansVars <- function(pi0EstSim)
{
  ##pull out estimates at lambda=0.8, lambda=0.9, and final estimate
  pi0hat0.8 <- sapply(pi0EstSim, function(x){x[[1]]})
  pi0hat0.9 <- sapply(pi0EstSim, function(x){x[[2]]})
  pi0hatFinal <- sapply(pi0EstSim, function(x){x[[3]]})

  ##get means across simulations
  pi0hatMean0.8 <- rowMeans(pi0hat0.8)
  pi0hatMean0.9 <- rowMeans(pi0hat0.9)
  pi0hatMeanFinal <- rowMeans(pi0hatFinal)
}

```

```

##also get variances across simulations
pi0hatVar0.8 <- apply(pi0hat0.8,1,var)
pi0hatVar0.9 <- apply(pi0hat0.9,1,var)
pi0hatVarFinal <- apply(pi0hatFinal,1,var)

return(list(pi0hatMean0.8=pi0hatMean0.8,
            pi0hatMean0.9=pi0hatMean0.9,
            pi0hatMeanFinal=pi0hatMeanFinal,
            pi0hatVar0.8=pi0hatVar0.8,
            pi0hatVar0.9=pi0hatVar0.9,
            pi0hatVarFinal=pi0hatVarFinal))
}

```

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")

```

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="/"))

  pi0EstSim <- estimate_pi0x_sims(pValuesSims, tme)

  ##pull out means and variances of estimates at lambda=0.8, lambda=0.9, and final estimate
  pi0MeansVars <- pullMeansVars(pi0EstSim)

  ##save full results
  save(file=paste(alt,"simResults_pi0x_thresh_1_full.RData",sep="/"),
        list=c("pi0EstSim"))

  ##save summary results
  save(file=paste(alt,"simResults_pi0x_thresh_1.RData",sep="/"),
        list=c("tme", "pi0", "pi0MeansVars"))
}

## Warning in readChar(con, 5L, useBytes = TRUE): cannot open compressed
file 'alt_chisq_small_3_3/simResults.1.RData', probable reason 'No such

```

```
file or directory'  
## Error in readChar(con, 5L, useBytes = TRUE): cannot open the connection
```

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

Perform estimation and save estimates:

```
for(alt in alts)  
{  
  load(paste(alt,"simResults_2.RData",sep="/"))  
  splineMat <- ns(tme,df=3)  
  
  ##-----linear fit-----##  
  pi0EstSim.lin <- estimate_pi0x_sims(pValuesSims, tme)  
  
  ##pull out means and variances of estimates at lambda=0.8, lambda=0.9, and final estimate  
  pi0Lin.MeansVars <- pullMeansVars(pi0EstSim.lin)  
  
  ##-----spline fit-----#  
  pi0EstSim.spl <- estimate_pi0x_sims(pValuesSims, splineMat)  
  
  ##pull out means and variances of estimates at lambda=0.8, lambda=0.9, and final estimate  
  pi0Spl.MeansVars <- pullMeansVars(pi0EstSim.spl)  
  
  ##save full results  
  save(file=paste(alt,"simResults_pi0x_thresh_2_full.RData",sep="/"),  
        list=c("pi0EstSim.lin","pi0EstSim.spl"))  
  
  ##save summary results  
  save(file=paste(alt,"simResults_pi0x_thresh_2.RData",sep="/"),  
        list=c("tme", "pi0", "pi0Lin.MeansVars", "pi0Spl.MeansVars"))  
}  
  
## Warning in readChar(con, 5L, useBytes = TRUE): cannot open compressed  
file 'alt_chisq_small_3.3/simResults.2.RData', probable reason 'No such  
file or directory'  
## Error in readChar(con, 5L, useBytes = TRUE): cannot open the connection
```

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

Perform estimation and save estimates:

```
for(alt in alts)
{
  load(paste(alt,"simResults_3.RData",sep="/"))

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

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

  ##-----linear fit-----##
  pi0EstSim.lin <- estimate_pi0x_sims(pValuesSims, linearMat)

  ##pull out means and variances of estimates at lambda=0.8, lambda=0.9, and final estimate
  pi0Lin.MeansVars <- pullMeansVars(pi0EstSim.lin)

  ##-----spline fit-----#
  pi0EstSim.spl <- estimate_pi0x_sims(pValuesSims, splineMat)

  ##pull out means and variances of estimates at lambda=0.8, lambda=0.9, and final estimate
  pi0Spl.MeansVars <- pullMeansVars(pi0EstSim.spl)

  ##save full results
  save(file=paste(alt,"simResults_pi0x_thresh_3_full.RData",sep="/"),
       list=c("pi0EstSim.lin","pi0EstSim.spl"))

  ##save summary results
  save(file=paste(alt,"simResults_pi0x_thresh_3.RData",sep="/"),
       list=c("tme1", "tme2", "pi0", "pi0Lin.MeansVars", "pi0Spl.MeansVars"))
}

## Warning in readChar(con, 5L, useBytes = TRUE): cannot open compressed
file 'alt_chisq_small_3.3/simResults_3.RData', probable reason 'No such
file or directory'
## Error in readChar(con, 5L, useBytes = TRUE): cannot open the connection
```

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

Perform estimation and save estimates:

```
for(alt in alts)
{
  load(paste(alt,"simResults_4.RData",sep="/"))

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

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

  ##-----linear fit-----##
  pi0EstSim.lin <- estimate_pi0x_sims(pValuesSims, linearMat)

  ##pull out means and variances of estimates at lambda=0.8, lambda=0.9, and final estimate
  pi0Lin.MeansVars <- pullMeansVars(pi0EstSim.lin)

  ##-----spline fit-----#
  pi0EstSim.spl <- estimate_pi0x_sims(pValuesSims, splineMat)

  ##pull out means and variances of estimates at lambda=0.8, lambda=0.9, and final estimate
  pi0Spl.MeansVars <- pullMeansVars(pi0EstSim.spl)

  ##save full results
  save(file=paste(alt,"simResults_pi0x_thresh_4_full.RData",sep="/"),
       list=c("pi0EstSim.lin", "pi0EstSim.spl"))

  ##save summary results
  save(file=paste(alt,"simResults_pi0x_thresh_4.RData",sep="/"),
       list=c("tme1", "tme2", "pi0", "pi0Lin.MeansVars", "pi0Spl.MeansVars"))
}

## Warning in readChar(con, 5L, useBytes = TRUE): cannot open compressed
file 'alt_chisq_small_3.3/simResults_4.RData', probable reason 'No such
file or directory'
## Error in readChar(con, 5L, useBytes = TRUE): cannot open the connection
```

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 2018-09-17

## Packages -----
## package * version date source
## codetools 0.2-14 2015-07-15 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)
## doParallel * 1.0.10 2015-10-14 CRAN (R 3.3.1)
## doRNG * 1.6 2014-03-07 CRAN (R 3.3.1)
## evaluate 0.10 2016-10-11 CRAN (R 3.3.1)
## foreach * 1.4.3 2015-10-13 CRAN (R 3.3.1)
## highr 0.6 2016-05-09 CRAN (R 3.3.1)
## iterators * 1.0.8 2015-10-13 CRAN (R 3.3.0)
## knitr * 1.17 2017-08-10 CRAN (R 3.3.3)
## 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)
## pkgmaker * 0.22 2014-05-14 CRAN (R 3.3.2)
## registry * 0.3 2015-07-08 CRAN (R 3.3.2)
## rngtools * 1.2.4 2014-03-06 CRAN (R 3.3.2)
## stringi 1.1.1 2016-05-27 CRAN (R 3.3.0)
## stringr 1.2.0 2017-02-18 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)
```