

```

## Load libraries
library(splines)
library(MASS)
library(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
## Loading required package: pkgmaker
## Loading required package: registry
##
## 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"))
}

```

## 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"))
}

```

### 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.MeanVars <- 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.MeanVars <- 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.MeanVars", "pi0Spl.MeanVars"))
}

```

## 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.MeanVars <- 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.MeanVars <- 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.MeanVars", "pi0Spl.MeanVars"))
}

```

Session info:

```

devtools::session_info()

## Session info -----
## setting value
## version R version 3.4.0 (2017-04-21)
## system x86_64, mingw32
## ui RTerm
## language (EN)
## collate English_United States.1252
## tz America/New_York
## date 2017-06-13

## Packages -----
## package * version date source
## assertthat 0.2.0 2017-04-11 CRAN (R 3.4.0)
## codetools 0.2-15 2016-10-05 CRAN (R 3.4.0)
## colorspace 1.3-2 2016-12-14 CRAN (R 3.4.0)
## DBI 0.6-1 2017-04-01 CRAN (R 3.4.0)
## devtools 1.12.0 2016-12-05 CRAN (R 3.4.0)
## digest 0.6.12 2017-01-27 CRAN (R 3.4.0)
## doParallel * 1.0.10 2015-10-14 CRAN (R 3.4.0)
## doRNG * 1.6.6 2017-04-10 CRAN (R 3.4.0)
## dplyr 0.5.0 2016-06-24 CRAN (R 3.4.0)
## evaluate 0.10 2016-10-11 CRAN (R 3.4.0)
## foreach * 1.4.3 2015-10-13 CRAN (R 3.4.0)
## ggplot2 2.2.1 2016-12-30 CRAN (R 3.4.0)
## gtable 0.2.0 2016-02-26 CRAN (R 3.4.0)
## highr 0.6 2016-05-09 CRAN (R 3.4.0)
## iterators * 1.0.8 2015-10-13 CRAN (R 3.4.0)
## knitr * 1.15.1 2016-11-22 CRAN (R 3.4.0)
## lazyeval 0.2.0 2016-06-12 CRAN (R 3.4.0)
## magrittr 1.5 2014-11-22 CRAN (R 3.4.0)

```

##	MASS	* 7.3-47	2017-02-26	CRAN	(R 3.4.0)
##	memoise	1.1.0	2017-04-21	CRAN	(R 3.4.0)
##	munsell	0.4.3	2016-02-13	CRAN	(R 3.4.0)
##	pkgmaker	* 0.22	2014-05-14	CRAN	(R 3.4.0)
##	plyr	1.8.4	2016-06-08	CRAN	(R 3.4.0)
##	R6	2.2.0	2016-10-05	CRAN	(R 3.4.0)
##	Rcpp	0.12.10	2017-03-19	CRAN	(R 3.4.0)
##	registry	* 0.3	2015-07-08	CRAN	(R 3.4.0)
##	reshape2	1.4.2	2016-10-22	CRAN	(R 3.4.0)
##	rngtools	* 1.2.4	2014-03-06	CRAN	(R 3.4.0)
##	scales	0.4.1	2016-11-09	CRAN	(R 3.4.0)
##	stringi	1.1.5	2017-04-07	CRAN	(R 3.4.0)
##	stringr	1.2.0	2017-02-18	CRAN	(R 3.4.0)
##	swfdr	* 1.0.0	2017-04-25	Bioconductor	
##	tibble	1.3.0	2017-04-01	CRAN	(R 3.4.0)
##	withr	1.0.2	2016-06-20	CRAN	(R 3.4.0)
##	xtable	1.8-2	2016-02-05	CRAN	(R 3.4.0)