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

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

1 Normally-distributed test statistics

```
alts <- c("alt_z_large","alt_t_large")

alt <- alts[1]

print("I")

## [1] "I"

load(paste(alt,"simResults_1.RData",sep="/"))
load(paste(alt,"simResults_pi0x_thresh_1.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_emp_1.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_1.RData",sep="/"))

pi0StoreyMean <- mean(apply(pValuesSims, 1, function(p){qvalue(p)$pi0}))

mean(pi0MeansVars$pi0hatMeanFinal)

## [1] 0.906347

plotMeanPi0(pi0, pi0MeansVars, pi0hatScottMean, pi0StoreyMean, pi0StoreyMean, tme=tme, main=
legend("topright", inset=c(-0.45,0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Linear)",
                "Scott T (Linear)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

################################################################################
```

```r
print("II")
```

```
## [1] "II"
```

```r
load(paste(alt,"simResults_2.RData",sep="/"))
load(paste(alt,"simResults_pi0x_thresh_2.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_emp_2.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_2.RData",sep="/"))

pi0StoreyMean <- mean(apply(pValuesSims, 1, function(p){qvalue(p)$pi0}))

plotMeanPi0(pi0, pi0Lin.MeansVars, pi0hatLin.ScottMean, pi0StoreyMean, tme=tme, main="II")
legend("topright", inset=c(-0.45,0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Linear)",
                "Scott T (Linear)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

plotMeanPi0(pi0, pi0Spl.MeansVars, pi0hatSpl.ScottMean, pi0StoreyMean, tme=tme, main="II")
legend("topright", inset=c(-0.45, 0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Spline)",
                "Scott T (Spline)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

################################################################################

print("III")
```

```
## [1] "III"
```

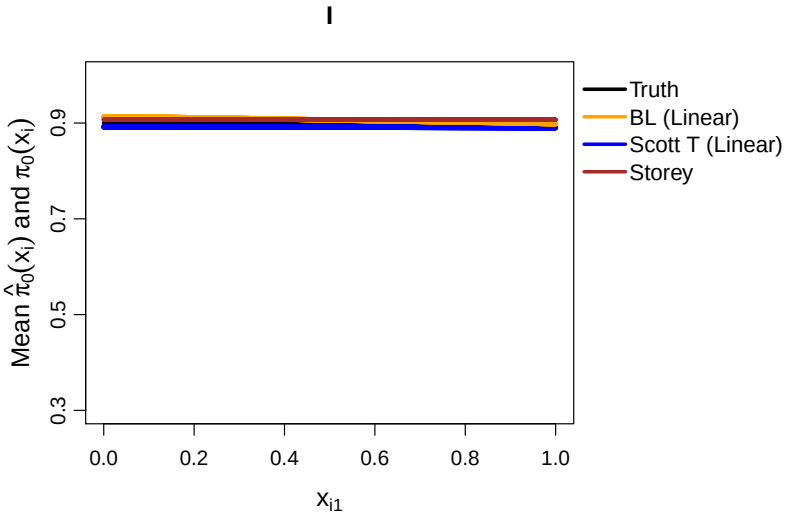
```r
load(paste(alt,"simResults_3.RData",sep="/"))
```

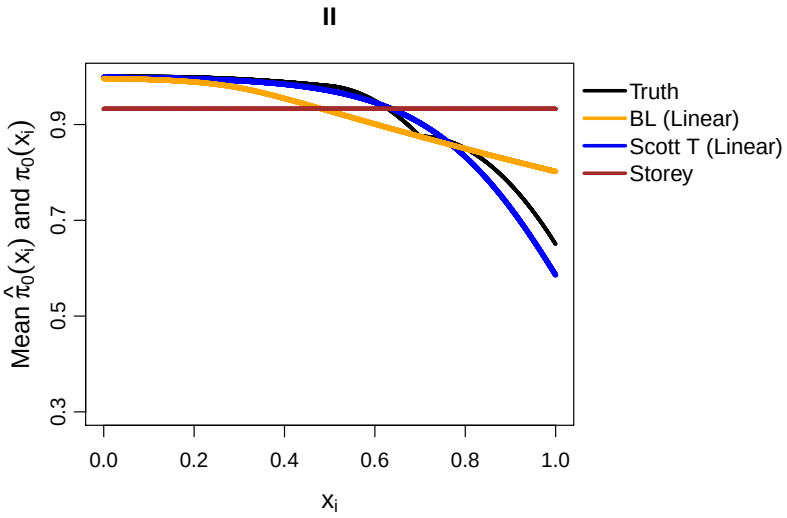
```r
load(paste(alt,"simResults_pi0x_thresh_3.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_emp_3.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_3.RData",sep="/"))

pi0StoreyMean <- mean(apply(pValuesSims, 1, function(p){qvalue(p)$pi0}))

plotMeanPi0(pi0, pi0Lin.MeansVars, pi0hatLin.ScottMean, pi0StoreyMean, tme=tme, main="III")
legend("topright", inset=c(-0.45,0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Linear)",
                "Scott T (Linear)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

plotMeanPi0(pi0, pi0Spl.MeansVars, pi0hatSpl.ScottMean, pi0StoreyMean, tme=tme, main="III")
legend("topright", inset=c(-0.45, 0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Spline)",
                "Scott T (Spline)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

################################################################################

print("IV")
```

```
## [1] "IV"
```

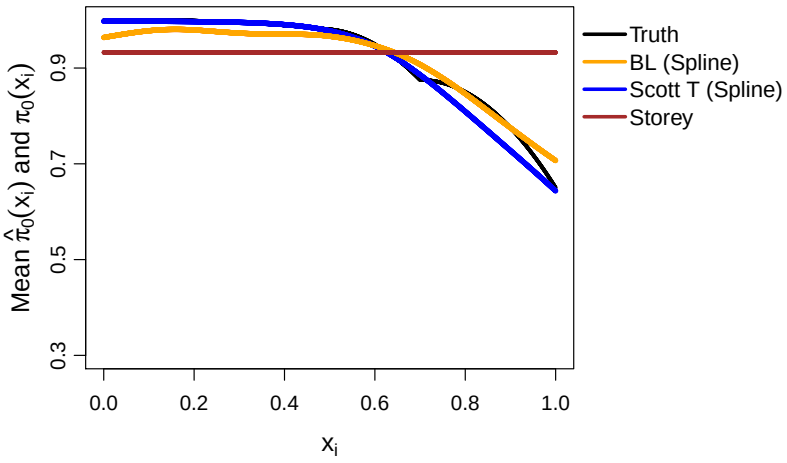
```r
load(paste(alt,"simResults_4.RData",sep="/"))
load(paste(alt,"simResults_pi0x_thresh_4.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_emp_4.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_4.RData",sep="/"))

pi0StoreyMean <- mean(apply(pValuesSims, 1, function(p){qvalue(p)$pi0}))
```

```
plotMeanPi0(pi0, pi0Lin.MeansVars, pi0hatLin.ScottMean, pi0StoreyMean, tme=tme, main="IV")
legend("topright", inset=c(-0.45,0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Linear)",
                "Scott T (Linear)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

plotMeanPi0(pi0, pi0Spl.MeansVars, pi0hatSpl.ScottMean, pi0StoreyMean, tme=tme, main="IV")
legend("topright", inset=c(-0.45, 0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Spline)",
                "Scott T (Spline)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)
```

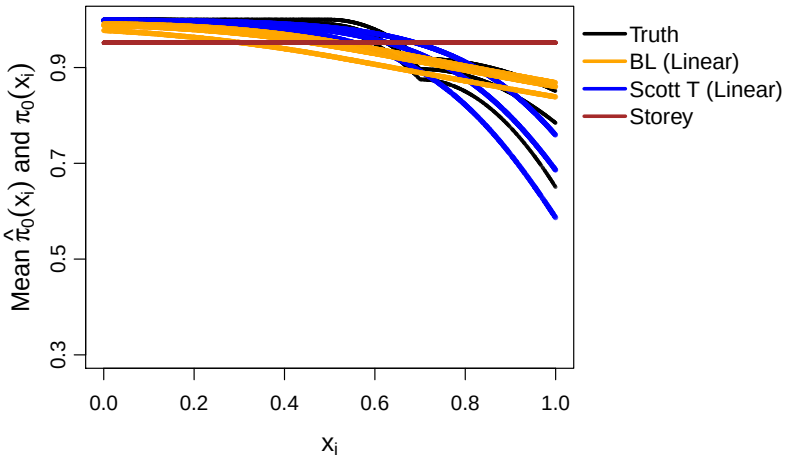

I
Truth
BL (Linear)
Scott T (Linear)
Storey
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_{i1}

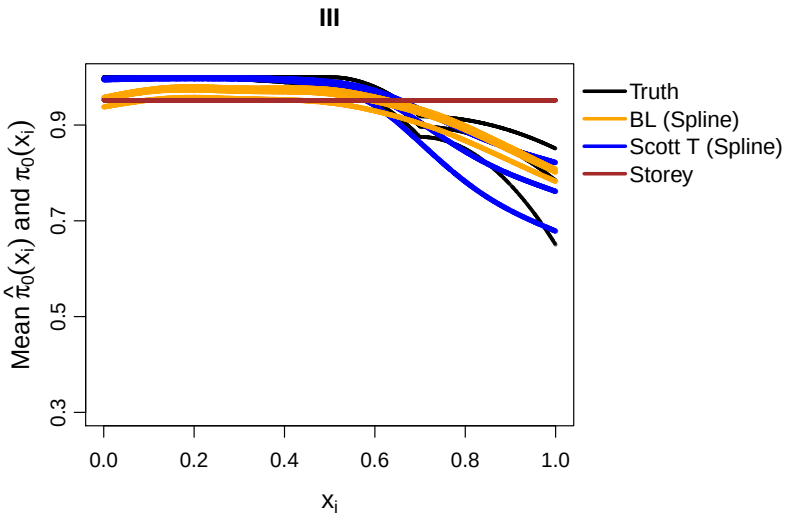

II
Truth
BL (Linear)
Scott T (Linear)
Storey
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_i

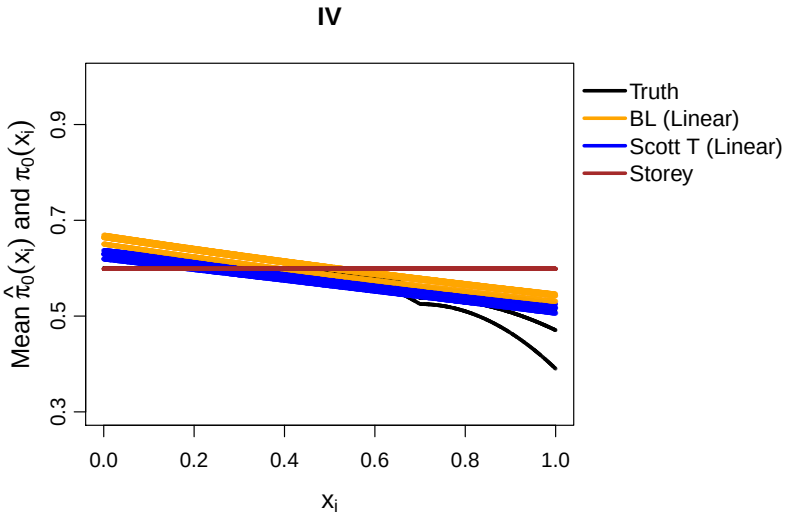
II

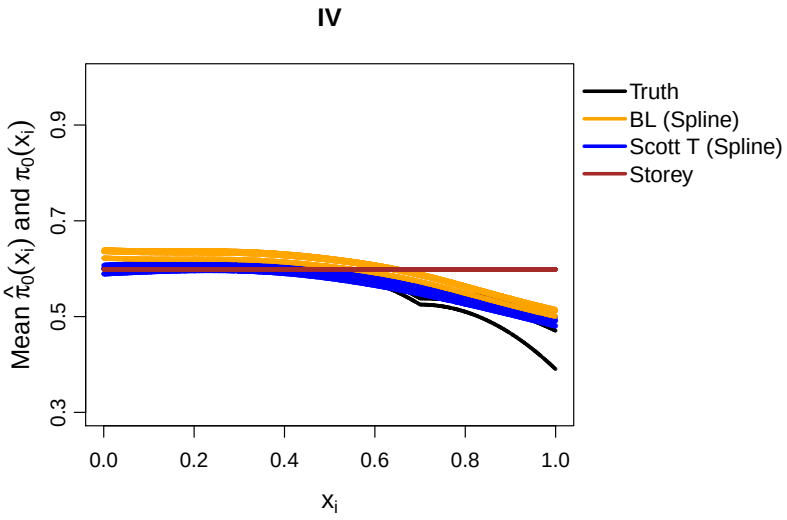

Truth
BL (Spline)
Scott T (Spline)
Storey
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_i

III


Truth
BL (Linear)
Scott T (Linear)
Storey
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_i


III
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_i
Truth
BL (Spline)
Scott T (Spline)
Storey


IV
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_i
Truth
BL (Linear)
Scott T (Linear)
Storey



2 T-distributed test statistics

```
alt <- alts[2]

print("I")

## [1] "I"

load(paste(alt,"simResults_1.RData",sep="/"))
load(paste(alt,"simResults_pi0x_thresh_1.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_emp_1.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_1.RData",sep="/"))

pi0StoreyMean <- mean(apply(pValuesSims, 1, function(p){qvalue(p)$pi0}))

mean(pi0MeansVars$pi0hatMeanFinal)

## [1] 0.9064674

plotMeanPi0(pi0, pi0MeansVars, pi0hatScottMean, pi0StoreyMean, tme=tme, main="I")
legend("topright", inset=c(-0.45,0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Linear)",
                "Scott T (Linear)",
                "Storey"),
       col=c("black",
```

```
              "orange",
              "blue",
              "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

################################################################################

print("II")
```

```
## [1] "II"
```

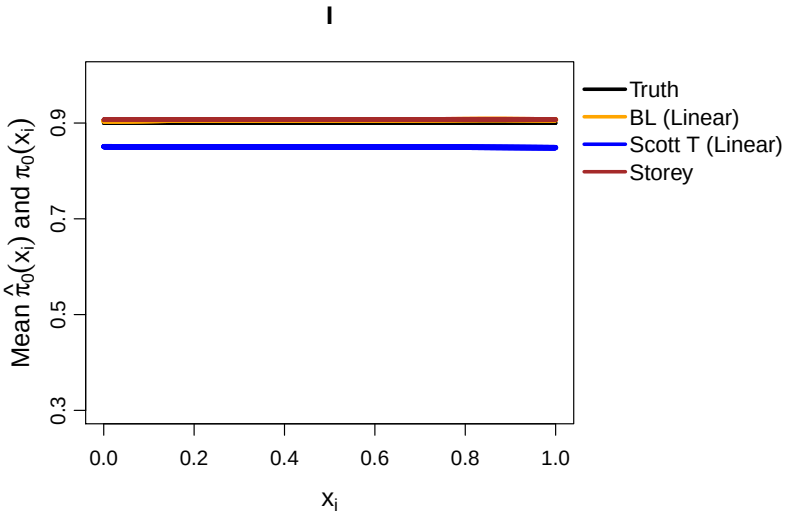
```
load(paste(alt,"simResults_2.RData",sep="/"))
load(paste(alt,"simResults_pi0x_thresh_2.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_emp_2.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_2.RData",sep="/"))

pi0StoreyMean <- mean(apply(pValuesSims, 1, function(p){qvalue(p)$pi0}))

plotMeanPi0(pi0, pi0Lin.MeansVars, pi0hatLin.ScottMean, pi0StoreyMean, tme=tme, main="II")
legend("topright", inset=c(-0.45,0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Linear)",
                "Scott T (Linear)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

plotMeanPi0(pi0, pi0Spl.MeansVars, pi0hatSpl.ScottMean, pi0StoreyMean, tme=tme, main="II")
legend("topright", inset=c(-0.45, 0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Spline)",
                "Scott T (Spline)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
```

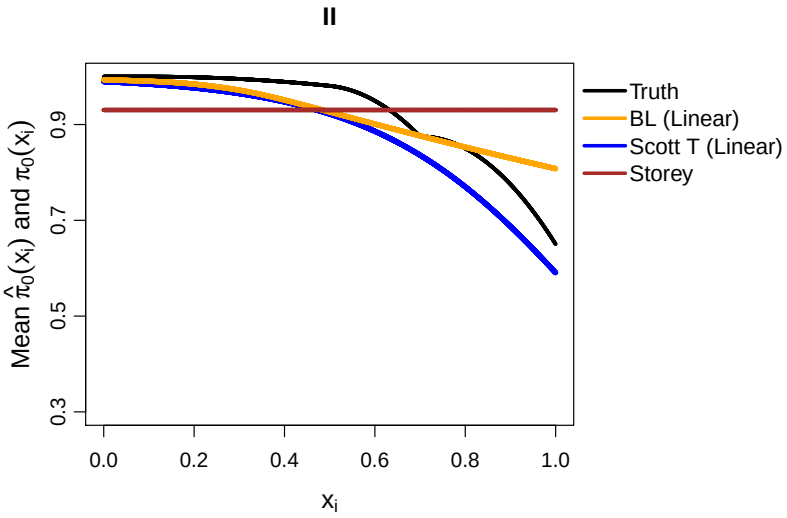
```
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

################################################################################

print("III")
```

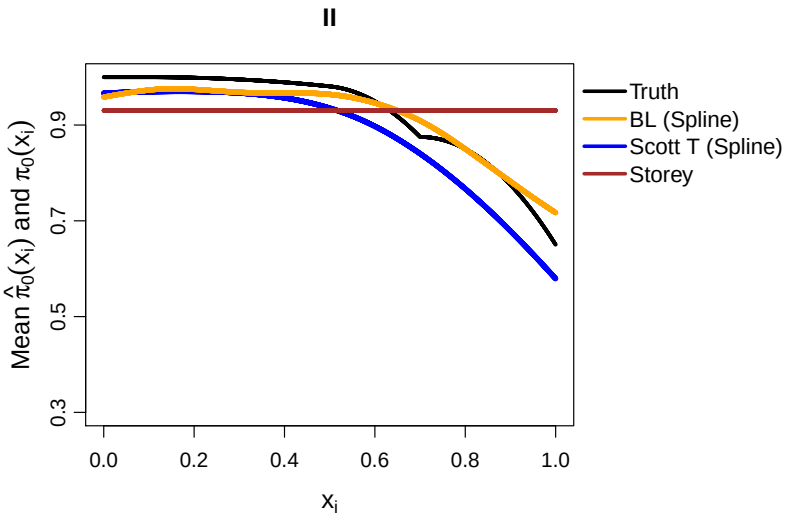
```
## [1] "III"
```

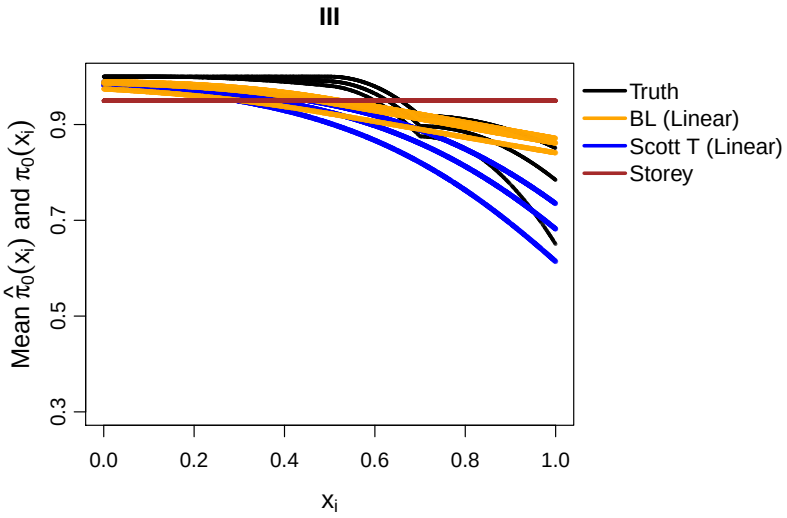
```
load(paste(alt,"simResults_3.RData",sep="/"))
load(paste(alt,"simResults_pi0x_thresh_3.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_emp_3.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_3.RData",sep="/"))

pi0StoreyMean <- mean(apply(pValuesSims, 1, function(p){qvalue(p)$pi0}))

plotMeanPi0(pi0, pi0Lin.MeansVars, pi0hatLin.ScottMean, pi0StoreyMean, tme=tme, main="III")
legend("topright", inset=c(-0.45,0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Linear)",
                "Scott T (Linear)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

plotMeanPi0(pi0, pi0Spl.MeansVars, pi0hatSpl.ScottMean, pi0StoreyMean, tme=tme, main="III")
legend("topright", inset=c(-0.45, 0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Spline)",
                "Scott T (Spline)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

################################################################################

print("IV")
```

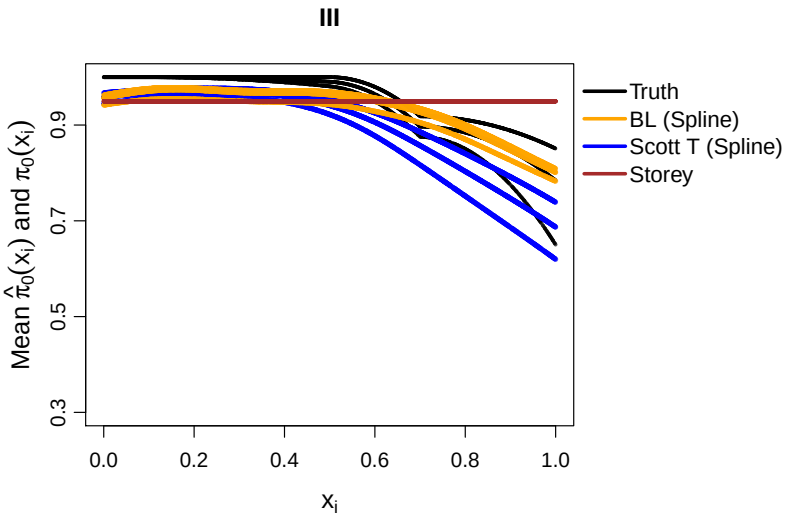
```
## [1] "IV"

load(paste(alt,"simResults_4.RData",sep="/"))
load(paste(alt,"simResults_pi0x_thresh_4.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_emp_4.RData",sep="/"))
load(paste(alt,"simResults_pi0x_Scott_4.RData",sep="/"))

pi0StoreyMean <- mean(apply(pValuesSims, 1, function(p){qvalue(p)$pi0}))

plotMeanPi0(pi0, pi0Lin.MeansVars, pi0hatLin.ScottMean, pi0StoreyMean, tme=tme, main="IV")
legend("topright", inset=c(-0.45,0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Linear)",
                "Scott T (Linear)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)

plotMeanPi0(pi0, pi0Spl.MeansVars, pi0hatSpl.ScottMean, pi0StoreyMean, tme=tme, main="IV")
legend("topright", inset=c(-0.45, 0),##x=-0.2, y=0.45,##"bottomright", ##x=-100, y=0.3,
       legend=c("Truth",
                "BL (Spline)",
                "Scott T (Spline)",
                "Storey"),
       col=c("black",
             "orange",
             "blue",
             "brown"),
       bty="n",
       lwd=c(3,3,3,3), lty=c(1,1,1,1),
       cex=1.2, x.intersp=0.2, y.intersp=1.0)
```

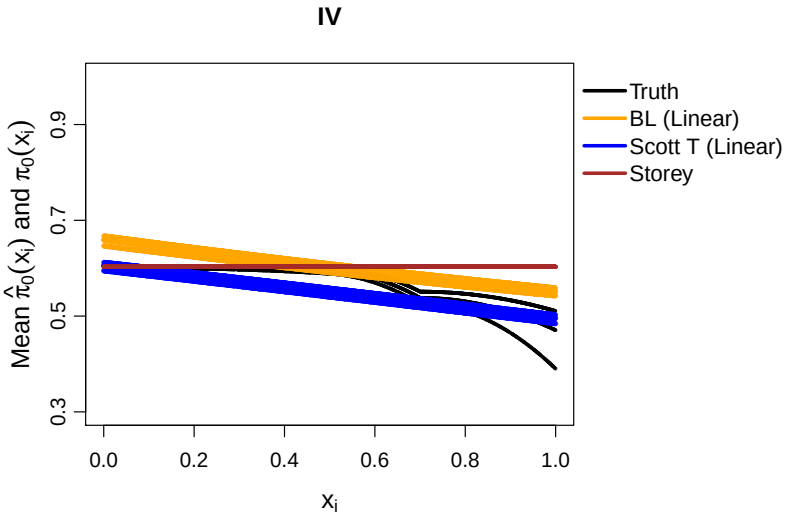

I
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_i
Truth
BL (Linear)
Scott T (Linear)
Storey

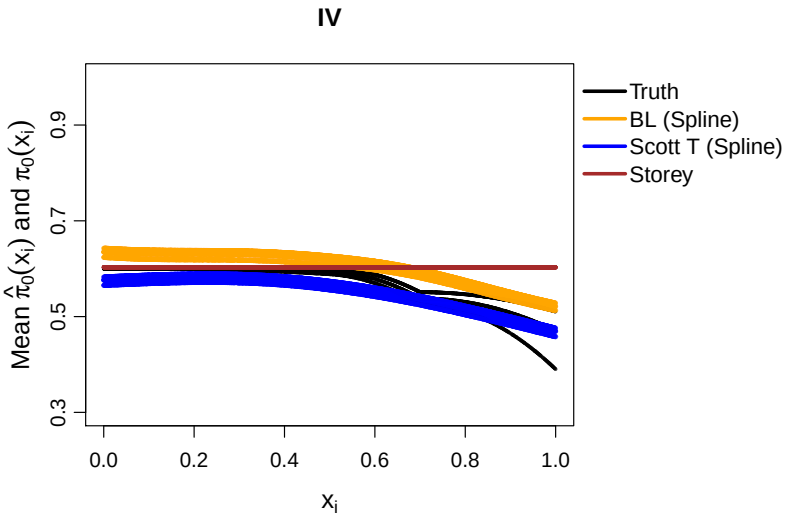

II
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_i
Truth
BL (Linear)
Scott T (Linear)
Storey


II
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_i
Truth
BL (Spline)
Scott T (Spline)
Storey


III
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_i
Truth
BL (Linear)
Scott T (Linear)
Storey


III
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_i
Truth
BL (Spline)
Scott T (Spline)
Storey


IV
Mean $\hat{\pi}_0(x_i)$ and $\pi_0(x_i)$
0.3
0.5
0.7
0.9
0.0
0.2
0.4
0.6
0.8
1.0
x_i
Truth
BL (Linear)
Scott T (Linear)
Storey



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     2018-10-04

## 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)
```