Package 'asus'

August 24, 2023

Type Package

Title Adaptive SURE Thresholding Using Side Information

Version 1.5.0

Description Provides the ASUS procedure for estimating a high dimensional sparse parameter in the presence of auxiliary data that encode side information on sparsity. It is a robust data combination procedure in the sense that even when pooling non-informative auxiliary data ASUS would be at least as efficient as competing soft thresholding based methods that do not use auxiliary data.
For more information, please see the paper Adaptive Sparse Estimation with Side Information by Banerjee, Mukherjee and Sun (JASA 2020).

License GPL (>= 2)

Encoding UTF-8

URL https://github.com/trambakbanerjee/asus#asus

Imports wavethresh, stats, utils

RoxygenNote 7.2.3

Suggests knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation no

Author Trambak Banerjee [aut, cre],
Gourab Mukherjee [aut],
Wenguang Sun [aut]

Maintainer Trambak Banerjee <trambak@ku.edu>

Repository CRAN

Date/Publication 2023-08-24 16:20:14 UTC

R topics documented:

`asus` *Adaptive SURE thresholding with side information (asus)*

Description

ASUS procedure for shrinkage estimation of a high dimensional sparse parameter.

Usage

```
asus(d, v.d, s, k = 2, m = 50)
```

Arguments

`d`	an n vector of primary observations
`v.d`	an n vector of variances for each component of d
`s`	an n vector of side information
`k`	number of groups. Default is k=2
`m`	partitions the support of $\|s\|$ into m equidistant points. Default is $m = 50$

Details

Estimates a sparse high dimensional vector using the ASUS procedure described in Banerjee et al. (2017). If k = 1 then ASUS is the SureShrink estimator. The current implementation of ASUS estimates the grouping thresholds based on the magnitude of $|s|$. See the reference for more details.

Value

1. est - an n vector holding the estimates
2. mse - estimate of risk
3. tau - k-1 vector of grouping parameters if k>=2
4. t - k vector of thresholding parameters
5. size - k vector of group sizes

References

Banerjee. T, Mukherjee. G and Sun. W. Adaptive Sparse Estimation with Side Information. Journal of the American Statistical Association 115, no. 532 (2020): 2053-2067.

See Also

`sureshrink`,`ejs`,`sureshrink.mse`

Examples

```
library(asus)
set.seed(42)
d<-rnorm(10,2,1)
v.d<- rep(1,10)
set.seed(42)
s<-rnorm(10,3,0.1)
asus.out<-asus(d,v.d,s)
```

`asus.cuts` *Risk of asus with pre-defined grouping thresholds*

Description

Estimates the risk of asus when there are k(>2) groups with pre-defined grouping thresholds

Usage

```
asus.cuts(d, v.d, s, cutpoints)
```

Arguments

`d`	an n vector of primary observations
`v.d`	an n vector of variances for each component of d
`s`	an n vector of side information
`cutpoints`	k-1 pre-defined grouping thresholds for k groups. k must be bigger than 2.

Details

Estimates the risk of asus when there are k(>2) groups with k pre-defined grouping thresholds. This function is called when `asus` executes.

Value

mse - estimate of risk

References

Banerjee. T, Mukherjee. G and Sun. W. Adaptive Sparse Estimation with Side Information. Journal of the American Statistical Association 115, no. 532 (2020): 2053-2067.

See Also

`asus`,`sureshrink`,`ejs`,`sureshrink.mse`

Examples

```
library(asus)
set.seed(42)
d<-rnorm(10)
v.d<- rep(1,10)
set.seed(42)
s<-rnorm(10)
out<-asus.cuts(d,v.d,s,c(0.1,0.5,1))
```

---

ejs *Extended James-Stein (ejs) estimator*

Description

Extended James-Stein estimator of a high dimensional sparse parameter.

Usage

```
ejs(d, v.d)
```

Arguments

d	an n vector of observations
v.d	an n vector of variances for each component of d

Details

Extended James-Stein estimator of mean from Brown (2008) and equation (7.3) in Xie et al. (2012)

Value

est - an n vector holding the estimates

References

1. Brown, L.D. (2008). In-Season Prediction of Batting Averages: A Field Test of Empirical Bayes and Bayes Methodologies. The Annals of Applied Statistics, 2, 113-152
2. Xie, X. C., Kou, S. C., and Brown, L. D. (2012). SURE Estimates for a Heteroscedastic Hierarchical Model. Journal of the American Statistical Association, 107, 1465-1479.

See Also

sureshrink,asus

Examples

```
library(asus)
set.seed(42)
d<-rnorm(10,2,1)
v.d<- rep(1,10)
theta.hat<-ejs(d,v.d)
```

---

softTh *Soft Thresholding estimator*

Description

Soft thresholds the input signal y with the threshold value thld

Usage

```
softTh(y, thld)
```

Arguments

y	1D signal to be thresholded
thld	numeric threshold value

Value

a numeric vector of thresholded values of the same length as y.

References

Donoho, David L. "De-noising by soft-thresholding." IEEE transactions on information theory 41, no. 3 (1995): 613-627.

Examples

```
library(asus)
set.seed(42)
y<-rnorm(10,2,1)
thld<- 3
x<-softTh(y,thld)
```

`sureshrink` *SureShrink estimator*

Description

SureShrink estimator of a high dimensional sparse parameter from Donoho and Johnstone (1995)

Usage

```
sureshrink(d, v.d)
```

Arguments

`d`	an n vector of observations
`v.d`	an n vector of variances for each component of d

Details

Estimates a threshold t by minimizing the SURE function and then soft thresholds d using t.

Value

1. est - an n vector holding the estimates
2. t - estimated threshold

References

David L Donoho and Iain M Johnstone. Adapting to unknown smoothness via wavelet shrinkage. Journal of the american statistical association, 90(432):1200-1224, 1995

See Also

`sureshrink.mse`

Examples

```
library(asus)
set.seed(42)
d<-rnorm(10,2,1)
v.d<- rep(1,10)
theta.hat<-sureshrink(d,v.d)
```

`sureshrink.mse` *SURE estimate of risk*

Description

Stein's Unbiased Risk Estimate for the sureshrink estimator

Usage

```
sureshrink.mse(d, v.d, type = 1, t = 0)
```

Arguments

`d`	an n vector of observations
`v.d`	an n vector of variances for each component of d
`type`	set type=1 if you want the thresholding parameter t to be estimated. Otherwise set type = 0 in which case you must provide t. Default is type = 1
`t`	soft thresholding parameter. If type = 1, then t is estimated whereas if type = 0 then you must provide t. Default is t = 0 (and type = 1)

Details

Estimates the risk of the surehsrink estimator of Donoho and Johnstone (1995).

Value

1. sure.est - SURE estimate of risk
2. t - estimated threshold (meaningless if type = 0)

References

1. Charles M Stein. Estimation of the mean of a multivariate normal distribution. The annals of Statistics, pages 1135-1151, 1981
2. David L Donoho and Iain M Johnstone. Adapting to unknown smoothness via wavelet shrinkage. Journal of the american statistical association, 90(432):1200-1224, 1995

See Also

`sureshrink`,`asus`

Examples

```
library(asus)
set.seed(42)
d<-rnorm(10,2,1)
v.d<- rep(1,10)
mse<-sureshrink.mse(d,v.d)
```

Index