

Package ‘epsiwal’

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Title Exact Post Selection Inference with Applications to the Lasso

BugReports <https://github.com/shabbychef/epsiwal/issues>

Description Implements the conditional estimation procedure of Lee, Sun, Sun and Taylor (2016) <[doi:10.1214/15-AOS1371](https://doi.org/10.1214/15-AOS1371)>. This procedure allows hypothesis testing on the mean of a normal random vector subject to linear constraints.

Depends R (>= 3.0.2)

Suggests testthat

URL <https://github.com/shabbychef/epsiwal>

Collate 'ci_connorm.r' 'epsiwal.r' 'pconnorm.r' 'ptruncnorm.r' 'utils.r'

RoxygenNote 6.1.1

NeedsCompilation no

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ci_connorm	<i>ci_connorm</i> .
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Description

Confidence intervals on normal mean, subject to linear constraints.

Usage

```
ci_connorm(y, A, b, eta, Sigma = NULL, p = c(level/2, 1 - (level/2)),
           level = 0.05, Sigma_eta = Sigma %% eta)
```

Arguments

<i>y</i>	an n vector, assumed multivariate normal with mean μ and covariance Σ .
<i>A</i>	an $k \times n$ matrix of constraints.
<i>b</i>	a k vector of inequality limits.
<i>eta</i>	an n vector of the test contrast, η .
<i>Sigma</i>	an $n \times n$ matrix of the population covariance, Σ . Not needed if <i>Sigma_eta</i> is given.
<i>p</i>	a vector of probabilities for which we return equivalent $\eta^\top \mu$.
<i>level</i>	if <i>p</i> is not given, we set it by default to $c(\text{level}/2, 1 - \text{level}/2)$.
<i>Sigma_eta</i>	an n vector of $\Sigma \eta$.

Details

Inverts the constrained normal inference procedure described by Lee *et al.*

Let y be multivariate normal with unknown mean μ and known covariance Σ . Conditional on $Ay \leq b$ for conformable matrix A and vector b , and given contrast vector η and level p , we compute $\eta^\top \mu$ such that the cumulative distribution of $\eta^\top y$ equals p .

Value

The values of $\eta^\top \mu$ which have the corresponding CDF.

Note

An error will be thrown if we do not observe $Ay \leq b$.

Author(s)

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References

Lee, J. D., Sun, D. L., Sun, Y. and Taylor, J. E. "Exact post-selection inference, with application to the Lasso." *Ann. Statist.* 44, no. 3 (2016): 907-927. doi:10.1214/15-AOS1371. <https://arxiv.org/abs/1311.6238>

See Also

the CDF function, `pconnorm`.

Examples

```
set.seed(1234)
n <- 10
y <- rnorm(n)
A <- matrix(rnorm(n*(n-3)), ncol=n)
b <- A%%y + runif(nrow(A))
Sigma <- diag(runif(n))
mu <- rnorm(n)
eta <- rnorm(n)

pval <- pconnorm(y=y, A=A, b=b, eta=eta, mu=mu, Sigma=Sigma)
cival <- ci_connorm(y=y, A=A, b=b, eta=eta, Sigma=Sigma, p=pval)
stopifnot(abs(cival - sum(eta*mu)) < 1e-4)
```

epsival

Exact Post Selection Inference with Applications to the Lasso.

Description

Exact Post Selection Inference with Applications to the Lasso.

Details

This simple package supports the simple procedure outlined in Lee *et al.* where one observes a normal random variable, then performs inference conditional on some linear inequalities.

Suppose y is multivariate normal with mean μ and covariance Σ . Conditional on $Ay \leq b$, one can perform inference on $\eta^\top \mu$ by transforming y to a truncated normal. Similarly one can invert this procedure and find confidence intervals on $\eta^\top \mu$.

Legal Mumbo Jumbo

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Note

This package is maintained as a hobby.

Author(s)

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References

Lee, J. D., Sun, D. L., Sun, Y. and Taylor, J. E. "Exact post-selection inference, with application to the Lasso." Ann. Statist. 44, no. 3 (2016): 907-927. doi:10.1214/15-AOS1371. <https://arxiv.org/abs/1311.6238>

Pav, S. E. "Conditional inference on the asset with maximum Sharpe ratio." Arxiv e-print (2019). <http://arxiv.org/abs/1906.00573>

epsiwal-NEWS

News for package 'epsiwal':

Description

News for package 'epsiwal'

epsiwal Initial Version 0.1.0 (2019-06-28)

- first CRAN release.

pconnorm

pconnorm .

Description

CDF of the conditional normal variate.

Usage

```
pconnorm(y, A, b, eta, mu = NULL, Sigma = NULL, Sigma_eta = Sigma
%% eta, eta_mu = as.numeric(t(eta) %% mu), lower.tail = TRUE,
log.p = FALSE)
```

Arguments

y	an n vector, assumed multivariate normal with mean μ and covariance Σ .
A	an $k \times n$ matrix of constraints.
b	a k vector of inequality limits.
eta	an n vector of the test contrast, η .
mu	an n vector of the population mean, μ . Not needed if eta_mu is given.
Sigma	an $n \times n$ matrix of the population covariance, Σ . Not needed if Sigma_eta is given.

Sigma_eta	an n vector of $\Sigma\eta$.
eta_mu	the scalar $\eta^\top\mu$.
lower.tail	logical; if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
log.p	logical; if TRUE, probabilities p are given as $\log(p)$.

Details

Computes the CDF of the truncated normal conditional on linear constraints, as described in section 5 of Lee *et al.*

Let y be multivariate normal with mean μ and covariance Σ . Conditional on $Ay \leq b$ for conformable matrix A and vector b we compute the CDF of a truncated normal maximally aligned with η . Inference depends on the population parameters only via $\eta^\top\mu$ and $\Sigma\eta$, and only these need to be given.

The test statistic is aligned with y , meaning that an output p-value near one casts doubt on the null hypothesis that $\eta^\top\mu$ is less than the posited value.

Value

The CDF.

Note

An error will be thrown if we do not observe $Ay \leq b$.

Author(s)

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References

Lee, J. D., Sun, D. L., Sun, Y. and Taylor, J. E. "Exact post-selection inference, with application to the Lasso." *Ann. Statist.* 44, no. 3 (2016): 907-927. doi:10.1214/15-AOS1371. <https://arxiv.org/abs/1311.6238>

See Also

the confidence interval function, `ci_connorm`.

ptruncnorm

ptruncnorm .

Description

Cumulative distribution of the truncated normal function.

Usage

```
ptruncnorm(q, mean = 0, sd = 1, a = -Inf, b = Inf,  
           lower.tail = TRUE, log.p = FALSE)
```

Arguments

q	vector of quantiles.
mean	vector of means.
sd	vector of standard deviations.
a	vector of the left truncation value(s).
b	vector of the right truncation value(s).
lower.tail	logical; if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
log.p	logical; if TRUE, probabilities p are given as $\log(p)$.

Value

The distribution function of the truncated normal.

Invalid arguments will result in return value NaN with a warning.

Note

Input are recycled as possible.

Author(s)

Steven E. Pav <shabbychef@gmail.com>

References

Hattaway, James T. "Parameter estimation and hypothesis testing for the truncated normal distribution with applications to introductory statistics grades." BYU Masters Thesis (2010). <https://scholarsarchive.byu.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=3052&context=etd>

Examples

```
y <- ptruncnorm(seq(-5,5,length.out=101), a=-1, b=2)
```

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