Package ‘ciuupi2’

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Type Package

Title Kabaila and Giri (2009) Confidence Interval

Version 1.0.1

Description Computes a confidence interval for a specified linear combination of the regression parameters in a linear regression model with iid normal errors with unknown variance when there is uncertain prior information that a distinct specified linear combination of the regression parameters takes a specified number. This confidence interval, found by numerical nonlinear constrained optimization, has the required minimum coverage and utilizes this uncertain prior information through desirable expected length properties. This confidence interval is proposed by Kabaila, P. and Giri, K. (2009) <doi:10.1016/j.jspi.2009.03.018>.

License GPL-2

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Author Nishika Ranathunga [aut],
Paul Kabaila [aut, cre]

Maintainer Paul Kabaila <P.Kabaila@latrobe.edu.au>

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R topics documented:

`bsciuupi2` *Compute the vector (b(d/6),...,b(5d/6),s(0),...,s(5d/6)) that specifies the Kabaila & Giri (2009) CIUUPI*

Description

Compute the vector (b(d/6),...,b(5d/6),s(0),...,s(5d/6)) that specifies the Kabaila and Giri (2009) confidence interval that utilizes uncertain prior information (CIUUPI) and has minimum coverage 1 - `alpha`.

Usage

```
bsciuupi2(alpha, m, rho, obj = 1, natural = 1)
```

Arguments

`alpha`	The minimum coverage probability is 1 - `alpha`
`m`	Degrees of freedom `n -p`
`rho`	A known correlation
`obj`	Equal to 1 (default) for the first definition of the scaled expected length or 2 for the second definition of the scaled expected length
`natural`	Equal to 1 (default) if the functions b and s are found by natural cubic spline interpolation or 0 if these functions are found by clamped cubic spline interpolation in the interval [-d, d]

Details

Suppose that

$$y = X\beta + \epsilon$$

where y is a random n-vector of responses, X is a known n by p matrix with linearly independent columns, β is an unknown parameter p-vector and ϵ is the random error with components that are independent and identically normally distributed with zero mean and unknown variance. The parameter of interest is θ = `a'` β. The uncertain prior information is that τ = `c'` β takes the value `t`, where `a` and `c` are specified linearly independent vectors nonzero p-vectors and `t` is a specified number. `rho` is the known correlation between the least squares estimators of θ and τ. It is determined by the n by p design matrix X and the p-vectors a and c using `find_rho`.

The confidence interval for θ, with minimum coverage probability `1 -alpha`, that utilizes the uncertain prior information that $\tau =$ `t` belongs to a class of confidence intervals indexed by the functions b and s. The function b is an odd continuous function and the function s is an even continuous function. In addition, b(x)=0 and s(x) is equal to the $1-\alpha/2$ quantile of the t distribution with `m` degrees of freedom for all |x| greater than or equal to d, where d is a sufficiently large positive number (chosen by the function `bsciuupi2`). The values of these functions in the interval $[-d, d]$ are specified by the vectors $(b(d/6), b(2d/6), \ldots, b(5d/6))$ and $(s(0), s(d/6), \ldots, s(5d/6))$ as follows. By assumption, $b(0) = 0$ and $b(-i) = -b(i)$ and $s(-i) = s(i)$ for $i = d/6, ..., d$. The values of $b(x)$ and $s(x)$ for any x in the interval $[-d, d]$ are found using cube spline interpolation for the given values of $b(i)$ and $s(i)$ for $i = -d, -5d/6, ..., 0, d/6, ..., 5d/6, d$. The choices of d for $m = 1, 2$ and > 2 are $d = 20, 10$ and 6, respectively.

The vector $(b(d/6), b(2d/6), \ldots, b(5d/6), s(0), s(d/6), \ldots, s(5d/6))$ is found by numerical nonlinear constrained optimization so that the confidence interval has minimum coverage probability `1 -alpha` and utilizes the uncertain prior information that $\tau =$ t through its desirable expected length properties. The optimization is performed using the `slsqp` function in the `nloptr` package.

The first definition of the scaled expected length of the Kabaila and Giri(2009) CIUUPI is the expected length of this confidence interval divided by the expected length of the usual confidence interval with coverage probability `1 -alpha`. The second definition of the scaled expected length of the Kabaila and Giri(2009) CIUUPI is the expected value of the ratio of the length of this confidence interval divided by the length of the usual confidence interval, with coverage probability `1 -alpha`, computed from the same data.

In the examples, we continue with the same 2 x 2 factorial example described in the documentation for `find_rho`.

Value

The vector $(b(d/6), b(2d/6), \ldots, b(5d/6), s(0), s(d/6), \ldots, s(5d/6))$ that specifies the Kabaila & Giri (2009) CIUUPI, with minimum coverage 1 - `alpha`.

References

Kabaila, P. and Giri, R. (2009). Confidence intervals in regression utilizing prior information. Journal of Statistical Planning and Inference, 139, 3419-3429.

See Also

`find_rho`

Examples

```
# Compute the vector (b(d/6),...,b(5d/6),s(0),...,s(5d/6)) that specifies the
# Kabaila & Giri (2009) CIUUPI, with minimum coverage 1 - alpha,
# for the first definition of the scaled expected length (default)
# for given alpha, m and rho (takes about 30 mins to run):

bsvec <- bsciuupi2(alpha = 0.05, m = 8, rho = -0.7071068)


# The result bsvec is (to 7 decimal places) the following:
# c(-0.0287487, -0.2151595, -0.3430403, -0.3125889, -0.0852146,
#    1.9795390,  2.0665414,  2.3984471,  2.6460159,  2.6170066,  2.3925494)
```

`bsspline2` *Evaluate the functions b and s at x*

Description

Evaluate the functions b and s, as specified by the vector (b(d/6),b(2d/6),...,b(5d/6),s(0),s(d/6),...,s(5d/6)) computed using `bsciuupi2`, `alpha`, `m` and `natural` at `x`.

Usage

```
bsspline2(x, bsvec, alpha, m, natural = 1)
```

Arguments

`x`	A value or vector of values at which the functions b and s are to be evaluated
`bsvec`	The vector $(b(d/6), b(2d/6), \ldots, b(5d/6), s(0), s(d/6), \ldots, s(5d/6))$ computed using `bsciuupi2`
`alpha`	The minimum coverage probability is 1 - `alpha`
`m`	Degrees of freedom `n -p`
`natural`	Equal to 1 (default) if the b and s functions are evaluated by natural cubic spline interpolation or 0 if evaluated by clamped cubic spline interpolation. This parameter must take the same value as that used in `bsciuupi2`

Details

The function b is an odd continuous function and the function s is an even continuous function. In addition, b(x)=0 and s(x) is equal to the $1 - \alpha/2$ quantile of the t distribution with `m` degrees of freedom for all |x| greater than or equal to d, where d is a sufficiently large positive number (chosen by the function `bsciuupi2`). The values of these functions in the interval $[-d, d]$ are specified by the vector $(b(d/6), b(2d/6), \ldots, b(5d/6), s(0), s(d/6), \ldots, s(5d/6))$ as follows. By assumption, $b(0) = 0$ and $b(-i) = -b(i)$ and $s(-i) = s(i)$ for $i = d/6, ..., d$. The values of $b(x)$ and $s(x)$ for any x in the interval $[-d, d]$ are found using cubic spline interpolation for the given values of $b(i)$ and $s(i)$ for $i = -d, -5d/6, ..., 0, d/6, ..., 5d/6, d$. The choices of d for $m = 1, 2$ and > 2 are $d = 20, 10$ and 6 respectively.

The vector $(b(d/6), b(2d/6), \ldots, b(5d/6), s(0), s(d/6), \ldots, s(5d/6))$ that specifies the Kabaila and Giri(2009) confidence interval that utilizes uncertain prior information (CIUUPI), with minimum coverage probability `1 -alpha`, is obtained using `bsciuupi2`.

In the examples, we continue with the same 2 x 2 factorial example described in the documentation for `find_rho`.

Value

A data frame containing `x` and the corresponding values of the functions b and s.

References

Kabaila, P. and Giri, R. (2009). Confidence intervals in regression utilizing prior information. Journal of Statistical Planning and Inference, 139, 3419-3429.

See Also

find_rho, bsciuupi2

Examples

```
alpha <- 0.05
m <- 8

# Find the vector (b(d/6),...,b(5d/6),s(0),...,s(5d/6)) that specifies the
# Kabaila & Giri (2009) CIUUPI for the first definition of the
# scaled expected length (default) (takes about 30 mins to run):

bsvec <- bsciuupi2(alpha, m, rho = -0.7071068)


# The result bsvec is (to 7 decimal places) the following:
bsvec <- c(-0.0287487, -0.2151595, -0.3430403, -0.3125889, -0.0852146,
            1.9795390,  2.0665414,  2.3984471,  2.6460159,  2.6170066,  2.3925494)

# Graph the functions b and s
x <- seq(0, 8, by = 0.1)
splineval <- bsspline2(x, bsvec, alpha, m)

plot(x, splineval[, 2], type = "l", main = "b function",
ylab = " ", las = 1, lwd = 2, xaxs = "i", col = "blue")
plot(x, splineval[, 3], type = "l", main = "s function",
ylab = " ", las = 1, lwd = 2, xaxs = "i",  col = "blue")
```

---

cistandard2 *Compute the usual confidence interval*

Description

Compute the usual 1 - alpha confidence interval

Usage

```
cistandard2(X, a, y, alpha)
```

Arguments

`X`	A known n by p matrix
`a`	A p-vector used to specify the parameter of interest
`y`	The n-vector of observed responses
`alpha`	1 - `alpha` is the coverage probability of the confidence interval

Details

Suppose that

$$Y = X\beta + \epsilon$$

is a random n-vector of responses, X is a known n by p matrix with linearly independent columns, β is an unknown parameter p-vector and ϵ is the random error with components that are independent and identically normally distributed with zero mean and unknown variance. The parameter of interest is $\theta =$ `a`' β, where `a` is a specified p-vector. Then `cistandard2` computes the usual 1 - `alpha` confidence interval for θ, for given n-vector of observed responses `y`.

In the examples, we continue with the same 2 x 2 factorial example described in the documentation for `find_rho`, for the vector of observed responses y = (-1.3, 0.8, 2.6, 5.8, 0.3, 1.3, 4.3, 5.0, -0.4, 1.0, 5.2, 6.2).

The design matrix X and the vector `a` (denoted in R by a.vec) are entered into R using the commands in the following example.

Value

The usual 1 - `alpha` confidence interval.

References

Kabaila, P. and Giri, K. (2009) Confidence intervals in regression utilizing prior information. Journal of Statistical Planning and Inference, 139, 3419 - 3429.

See Also

`find_rho`

Examples

```
col1 <- rep(1,4)
col2 <- c(-1, 1, -1, 1)
col3 <- c(-1, -1, 1, 1)
col4 <- c(1, -1, -1, 1)
X.single.rep <- cbind(col1, col2, col3, col4)
X <- rbind(X.single.rep, X.single.rep, X.single.rep)
a.vec <- c(0, 2, 0, -2)
y <- c(-1.3, 0.8, 2.6, 5.8, 0.3, 1.3, 4.3, 5.0, -0.4, 1.0, 5.2, 6.2)

# Calculate the usual 95% confidence interval
res <- cistandard2(X, a=a.vec, y, alpha = 0.05)
res
```

```
# The usual 1 - alpha confidence interval for theta is (-0.08185, 3.08185)
```

`ciuupi2` *Compute the Kabaila & Giri (2009) CIUUPI*

Description

Compute the Kabaila and Giri (2009) confidence interval that utilizes uncertain prior information (CIUUPI), with minimum coverage 1 - `alpha`, for a given vector `y` of observed responses.

Usage

```
ciuupi2(alpha, X, a, c, bsvec, t, y, natural = 1)
```

Arguments

`alpha`	1 - `alpha` is the minimum coverage probability of the confidence interval
`X`	The n by p design matrix
`a`	A vector used to specify the parameter of interest
`c`	A vector used to specify the parameter about which we have uncertain prior information
`bsvec`	The vector (b(d/6),b(2d/6),...,b(5d/6),s(0),s(d/6),...,s(5d/6)) computed using `bsciuupi2`
`t`	A number used to specify the uncertain prior information, which has the form $\tau = \mathrm{t}$
`y`	The n-vector of observed responses
`natural`	Equal to 1 (default) if the b and s functions are evaluated by natural cubic spline interpolation or 0 if evaluated by clamped cubic spline interpolation. This parameter must take the same value as that used in `bsciuupi2`

Details

Suppose that

$$y = X\beta + \epsilon$$

where y is a random n-vector of responses, X is a known n by p matrix with linearly independent columns, β is an unknown parameter p-vector and ϵ is a random n-vector with components that are independent and identically normally distributed with zero mean and unknown variance. The parameter of interest is $\theta =$ `a`' β. The uncertain prior information is that $\tau =$ `c`' β takes the value `t`, where `a` and `c` are specified linearly independent vectors nonzero p-vectors and `t` is a specified number. Given the vector `bsvec`, computed using `bsciuupi2`, the design matrix `X`, the vectors `a` and `c` and the number `t`, `ciuupi2` computes the confidence interval for θ that utilizes the uncertain prior information that τ = `t` for given n-vector of observed responses `y`.

In the examples, we continue with the same 2 x 2 factorial example described in the documentation for `find_rho`, for the vector of observed responses y = (-1.3, 0.8, 2.6, 5.8, 0.3, 1.3, 4.3, 5.0, -0.4, 1.0, 5.2, 6.2).

Value

The Kabaila & Giri (2009) confidence interval, with minimum coverage 1 - alpha, that utilizes the uncertain prior information.

References

Kabaila, P. and Giri, K. (2009) Confidence intervals in regression utilizing prior information. Journal of Statistical Planning and Inference, 139, 3419 - 3429.

See Also

find_rho, bsciuupi2

Examples

```
# Specify the design matrix X and vectors a and c
# (denoted in R by a.vec and c.vec, respectively)
col1 <- rep(1,4)
col2 <- c(-1, 1, -1, 1)
col3 <- c(-1, -1, 1, 1)
col4 <- c(1, -1, -1, 1)
X.single.rep <- cbind(col1, col2, col3, col4)
X <- rbind(X.single.rep, X.single.rep, X.single.rep)
a.vec <- c(0, 2, 0, -2)
c.vec <- c(0, 0, 0, 1)


# Compute the vector (b(d/6),...,b(5d/6),s(0),...,s(5d/6)) that specifies the
# Kabaila & Giri (2009) CIUUPI, with minimum coverage 1 - alpha, for the
# first definition of the scaled expected length (default)
# for given alpha, m and rho (takes about 30 mins to run):

bsvec <- bsciuupi2(alpha = 0.05, m = 8, rho = -0.7071068)


# The result bsvec is (to 7 decimal places) the following:
bsvec <- c(-0.0287487, -0.2151595, -0.3430403, -0.3125889, -0.0852146,
            1.9795390,  2.0665414,  2.3984471,  2.6460159,  2.6170066,  2.3925494)


# Specify t and y
t <- 0
y <- c(-1.3, 0.8, 2.6, 5.8, 0.3, 1.3, 4.3, 5.0, -0.4, 1.0, 5.2, 6.2)

# Find the Kabaila and Giri (2009) CIUUPI, with minimum coverage 1 - alpha,
# for the first definition of the scaled expected length
res <- ciuupi2(alpha=0.05, X, a=a.vec, c=c.vec, bsvec, t, y, natural = 1)
res

# The Kabaila and Giri (2009) CIUUPI, with minimum coverage 1 - alpha,
# is (0.14040, 2.85704).
# The usual 1 - alpha confidence interval for theta is (-0.08185, 3.08185).
```

`cpciuupi2` *Compute the coverage probability of the Kabaila & Giri (2009) CIU-UPI*

Description

Evaluate the coverage probability of the Kabaila & Giri (2009) confidence interval that utilizes uncertain prior information (CIUUPI), with minimum coverage 1 - `alpha`, at `gam`.

Usage

```
cpciuupi2(gam, bsvec, alpha, m, rho, natural = 1)
```

Arguments

`gam`	A value of gamma or vector of gamma values at which the coverage probability function is evaluated
`bsvec`	The vector (b(d/6),b(2d/6),...,b(5d/6),s(0),s(d/6),...,s(5d/6)) computed using `bsciuupi2`
`alpha`	The minimum coverage probability is 1 - `alpha`
`m`	Degrees of freedom `n -p`
`rho`	A known correlation
`natural`	Equal to 1 (default) if the b and s functions are obtained by natural cubic spline interpolation or 0 if obtained by clamped cubic spline interpolation. This parameter must take the same value as that used in `bsciuupi2`

Details

Suppose that

$$y = X\beta + \epsilon$$

where y is a random n-vector of responses, X is a known n by p matrix with linearly independent columns, β is an unknown parameter p-vector and ϵ is a random n-vector with components that are independent and identically normally distributed with zero mean and unknown variance. The parameter of interest is $\theta =$ `a`' β. The uncertain prior information is that $\tau =$ `c`' β takes the value `t`, where `a` and `c` are specified linearly independent vectors and `t` is a specified number. `rho` is the known correlation between the least squares estimators of θ and τ. It is determined by the n by p design matrix X and the p-vectors a and c using `find_rho`.

In the examples, we continue with the same 2 x 2 factorial example described in the documentation for `find_rho`.

Value

The value(s) of the coverage probability of the Kabaila & Giri (2009) CIUUPI at `gam`.

References

Kabaila, P. and Giri, K. (2009) Confidence intervals in regression utilizing prior information. Journal of Statistical Planning and Inference, 139, 3419 - 3429.

See Also

find_rho, bsciuupi2

Examples

```
alpha <- 0.05
m <- 8

# Find the vector (b(d/6),...,b(5d/6),s(0),...,s(5d/6)) that specifies the
# Kabaila & Giri (2009) CIUUPI for the first definition of the
# scaled expected length (default) (takes about 30 mins to run):

bsvec <- bsciuupi2(alpha, m, rho = -0.7071068)


# The result bsvec is (to 7 decimal places) the following:
bsvec <- c(-0.0287487, -0.2151595, -0.3430403, -0.3125889, -0.0852146,
            1.9795390,  2.0665414,  2.3984471,  2.6460159,  2.6170066,  2.3925494)


# Graph the coverage probability function
gam <- seq(0, 10, by = 0.1)
cp <- cpciuupi2(gam, bsvec, alpha, m, rho = -0.7071068)
plot(gam, cp, type = "l", lwd = 2, ylab = "", las = 1, xaxs = "i",
main = "Coverage Probability", col = "blue",
xlab = expression(paste("|", gamma, "|")), ylim = c(0.9490, 0.9510))
abline(h = 1-alpha, lty = 2)
```

---

find_rho *Find rho*

Description

Find the correlation rho for given n by p design matrix X and given p-vectors a and c

Usage

```
find_rho(X, a, c)
```

Arguments

X	The n by p design matrix
a	A vector used to specify the parameter of interest
c	A vector used to specify the parameter about which we have uncertain prior information

Details

Suppose that

$$y = X\beta + \epsilon$$

where y is a random n-vector of responses, X is a known n by p matrix with linearly independent columns, β is an unknown parameter p-vector and ϵ is a random n-vector with components that are independent and identically normally distributed with zero mean and unknown variance. The parameter of interest is $\theta =$ a' β. The uncertain prior information is that $\tau =$ c' β takes the value t, where a and c are specified linearly independent nonzero p-vectors and t is a specified number. rho is the known correlation between the least squares estimators of θ and τ. It is determined by the n by p design matrix X and the p-vectors a and c.

Value

The value of the correlation rho.

X, a and c for a particular example

Consider the same 2 x 2 factorial example as that described in Section 4 of Kabaila and Giri (2009), except that the number of replicates is 3 instead of 20. In this case, X is a 12 x 4 matrix, β is an unknown parameter 4-vector and ϵ is a random 12-vector with components that are independent and identically normally distributed with zero mean and unknown variance. In other words, the length of the response vector y is n = 12 and the length of the parameter vector β is p = 4, so that $m = n - p$ = 8. The parameter of interest is $\theta =$ a' β, where the column vector a = (0, 2, 0, -2). Also, the parameter $\tau =$ c' β, where the column vector c = (0, 0, 0, 1). The uncertain prior information is that $\tau =$ t, where t = 0.

The design matrix X and the vectors a and c (denoted in R by a.vec and c.vec, respectively) are entered into R using the commands in the following example.

References

Kabaila, P. and Giri, R. (2009). Confidence intervals in regression utilizing prior information. Journal of Statistical Planning and Inference, 139, 3419-3429.

Examples

```
col1 <- rep(1,4)
col2 <- c(-1, 1, -1, 1)
col3 <- c(-1, -1, 1, 1)
col4 <- c(1, -1, -1, 1)
X.single.rep <- cbind(col1, col2, col3, col4)
X <- rbind(X.single.rep, X.single.rep, X.single.rep)
```

```
a.vec <- c(0, 2, 0, -2)
c.vec <- c(0, 0, 0, 1)

# Find the value of rho
rho <- find_rho(X, a=a.vec, c=c.vec)
rho

# The value of rho is -0.7071068
```

---

sel1ciuupi2 *Compute the first definition of the scaled expected length of the Kabaila & Giri (2009) CIUUPI*

Description

Evaluate the first definition of the scaled expected length of the Kabaila & Giri (2009) confidence interval that utilizes uncertain prior information (CIUUPI), with minimum coverage 1 - `alpha`, at `gam`.

Usage

```
sel1ciuupi2(gam, bsvec, alpha, m, rho, natural = 1)
```

Arguments

`gam`	A value of gamma or vector of gamma values at which the first definition of the scaled expected length function is evaluated
`bsvec`	The vector (b(d/6),b(2d/6),...,b(5d/6),s(0),s(d/6),...,s(5d/6)) computed using `bsciuupi2`
`alpha`	The minimum coverage probability is 1 - `alpha`
`m`	Degrees of freedom `n -p`
`rho`	A known correlation
`natural`	Equal to 1 (default) if the b and s functions are obtained by natural cubic spline interpolation or 0 if obtained by clamped cubic spline interpolation. This parameter must take the same value as that used in `bsciuupi2`

Details

Suppose that

$$y = X\beta + \epsilon$$

where y is a random n-vector of responses, X is a known n by p matrix with linearly independent columns, β is an unknown parameter p-vector and ϵ is a random n-vector with components that are independent and identically normally distributed with zero mean and unknown variance. The parameter of interest is $\theta =$ `a`' β. The uncertain prior information is that $\tau =$ `c`' β takes the value `t`, where `a` and `c` are specified linearly independent vectors and `t` is a specified number. `rho` is the known correlation between the least squares estimators of θ and τ. It is determined by the n by p design matrix X and the p-vectors a and c using `find_rho`.

The Kabaila & Giri (2009) CIUUPI is specified by the vector (b(d/6),...,b(5d/6),s(0),...,s(5d/6)), `alpha`, `m` and `natural`

The first definition of the scaled expected length of the Kabaila and Giri(2009) CIUUPI is the expected length of this confidence interval divided by the expected length of the usual confidence interval with coverage probability `1 -alpha`.

In the examples, we continue with the same 2 x 2 factorial example described in the documentation for `find_rho`.

Value

The value(s) of the first definition of the scaled expected length of the Kabaila & Giri (2009) CIUUPI at `gam`.

References

Kabaila, P. and Giri, K. (2009) Confidence intervals in regression utilizing prior information. Journal of Statistical Planning and Inference, 139, 3419 - 3429.

See Also

`find_rho`, `bsciuupi2`

Examples

```
alpha <- 0.05
m <- 8

# Find the vector (b(d/6),...,b(5d/6),s(0),...,s(5d/6)) that specifies the
# Kabaila & Giri (2009) CIUUPI for the first definition of the
# scaled expected length (default) (takes about 30 mins to run):

bsvec <- bsciuupi2(alpha, m, rho = -0.7071068)


# The result bsvec is (to 7 decimal places) the following:
bsvec <- c(-0.0287487, -0.2151595, -0.3430403, -0.3125889, -0.0852146,
            1.9795390,  2.0665414,  2.3984471,  2.6460159,  2.6170066,  2.3925494)


# Graph the squared scaled expected length function
gam <- seq(0, 10, by = 0.1)
sel <- sel1ciuupi2(gam, bsvec, alpha, m, rho = -0.7071068)
plot(gam, sel^2, type = "l", lwd = 2, ylab = "", las = 1, xaxs = "i",
main = "Squared Scaled Expected Length", col = "blue",
xlab = expression(paste("|", gamma, "|")))
abline(h = 1, lty = 2)
```

sel2ciuupi2 — *Compute the second definition of the scaled expected length of the Kabaila & Giri (2009) CIUUPI*

Description

Evaluate the second definition of the scaled expected length of the Kabaila & Giri (2009) confidence interval that utilizes uncertain prior information (CIUUPI), with minimum coverage 1 - `alpha`, at `gam`.

Usage

```
sel2ciuupi2(gam, bsvec, alpha, m, rho, natural = 1)
```

Arguments

`gam`	A value of gamma or vector of gamma values at which the second definition of the scaled expected length function is evaluated
`bsvec`	The vector (b(d/6),b(2d/6),...,b(5d/6),s(0),s(d/6),...,s(5d/6)) computed using `bsciuupi2`
`alpha`	The minimum coverage probability is 1 - `alpha`
`m`	Degrees of freedom `n -p`
`rho`	A known correlation
`natural`	Equal to 1 (default) if the b and s functions are obtained by natural cubic spline interpolation or 0 if obtained by clamped cubic spline interpolation. This parameter must take the same value as that used in `bsciuupi2`

Details

Suppose that

$$y = X\beta + \epsilon$$

where y is a random n-vector of responses, X is a known n by p matrix with linearly independent columns, β is an unknown parameter p-vector and ϵ is a random n-vector with components that are independent and identically normally distributed with zero mean and unknown variance. The parameter of interest is $\theta =$ `a`' β. The uncertain prior information is that $\tau =$ `c`' β takes the value `t`, where `a` and `c` are specified linearly independent vectors and `t` is a specified number. `rho` is the known correlation between the least squares estimators of θ and τ. It is determined by the n by p design matrix X and the p-vectors a and c using `find_rho`.

The Kabaila & Giri (2009) CIUUPI is specified by the vector (b(d/6),...,b(5d/6),s(0),...,s(5d/6)), `alpha`, `m` and `natural`

The second definition of the scaled expected length of the Kabaila and Giri(2009) CIUUPI is the expected value of the ratio of the length of this confidence interval divided by the length of the usual confidence interval, with coverage probability `1 -alpha`, computed from the same data.

In the examples, we continue with the same 2 x 2 factorial example described in the documentation for `find_rho`.

Value

The value(s) of the second definition of the scaled expected length of the Kabaila & Giri (2009) CIUUPI at gam.

References

Kabaila, P. and Giri, K. (2009) Confidence intervals in regression utilizing prior information. Journal of Statistical Planning and Inference, 139, 3419 - 3429.

See Also

find_rho, bsciuupi2

Examples

```
alpha <- 0.05
m <- 8

# Find the vector (b(d/6),...,b(5d/6),s(0),...,s(5d/6)) that specifies the
# Kabaila & Giri (2009) CIUUPI for the second definition of the
# scaled expected length (takes about 30 mins to run):

bsvec <- bsciuupi2(alpha, m, rho = -0.7071068, obj = 2)


# The result bsvec is (to 7 decimal places) the following:
bsvec <- c(-0.0344224, -0.2195927, -0.3451243, -0.3235045, -0.1060439,
            1.9753281,  2.0688684,  2.3803642,  2.6434660,  2.6288564,  2.4129931)


# Graph the squared scaled expected length function
gam <- seq(0, 10, by = 0.1)
sel <- sel2ciuupi2(gam, bsvec, alpha, m, rho = -0.7071068)
plot(gam, sel^2, type = "l", lwd = 2, ylab = "", las = 1, xaxs = "i",
main = "Squared Scaled Expected Length", col = "blue",
xlab = expression(paste("|", gamma, "|")))
abline(h = 1, lty = 2)
```

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