Package ‘OptSig’

April 18, 2020

Type Package

Title Optimal Level of Significance for Regression and Other Statistical Tests

Version 2.1

Imports pwr

Date 2020-04-18

Author Jae H. Kim <J.Kim@latrobe.edu.au>

Maintainer Jae H. Kim <J.Kim@latrobe.edu.au>

Description Calculates the optimal level of significance based on a decision-theoretic approach. The optimal level is chosen so that the expected loss from hypothesis testing is minimized. A range of statistical tests are covered, including the test for the population mean, population proportion, and a linear restriction in a multiple regression model.
The details are covered in Kim, Jae H. and Choi, In, 2020, Choosing the Level of Significance: A Decision-Theoretic Approach, Abacus.
See also Kim, Jae H., 2020, Decision-
theoretic hypothesis testing: A primer with R package OptSig, The American Statistician.

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NeedsCompilation no

Repository CRAN

Date/Publication 2020-04-18 07:40:18 UTC

R topics documented:

`OptSig-package` *Optimal Level of Significance for Regression and Other Statistical Tests*

Description

Calculates the optimal level of significance based on a decision-theoretic approach. The optimal level is chosen so that the expected loss from hypothesis testing is minimized. A range of statistical tests are covered, including the test for the population mean, population proportion, and a linear restriction in a multiple regression model. The details are covered in Kim, Jae H. and Choi, In, 2020, Choosing the Level of Significance: A Decision-Theoretic Approach, Abacus. See also Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician.

Details

The DESCRIPTION file:

Package:	OptSig
Type:	Package
Title:	Optimal Level of Significance for Regression and Other Statistical Tests
Version:	2.1
Imports:	pwr
Date:	2020-04-18
Author:	Jae H. Kim <J.Kim@latrobe.edu.au>
Maintainer:	Jae H. Kim <J.Kim@latrobe.edu.au>
Description:	Calculates the optimal level of significance based on a decision-theoretic approach. The optimal level is chosen
License:	GPL-2

Index of help topics:

```
Opt.sig.norm.test       Optimal significance level calculation for the
                        mean of a normal distribution (known variance)
Opt.sig.t.test          Optimal significance level calculation for
                        t-tests of means (one sample, two samples and
```

	paired samples)
OptSig-package	Optimal Level of Significance for Regression and Other Statistical Tests
OptSig.2p	Optimal significance level calculation for the test for two proportions (same sample sizes)
OptSig.2p2n	Optimal significance level calculation for the test for two proportions (different sample sizes)
OptSig.Boot	Optimal Significance Level for the F-test using the bootstrap
OptSig.BootWeight	Weighted Optimal Significance Level for the F-test based on the bootstrap
OptSig.Chisq	Optimal Significance Level for a Chi-square test
OptSig.F	Optimal Significance Level for an F-test
OptSig.Weight	Weighted Optimal Significance Level for the F-test based on the assumption of normality in the error term
OptSig.anova	Optimal significance level calculation for balanced one-way analysis of variance tests
OptSig.p	Optimal significance level calculation for proportion tests (one sample)
OptSig.r	Optimal significance level calculation for correlation test
OptSig.t2n	Optimal significance level calculation for two samples (different sizes) t-tests of means
Power.Chisq	Function to calculate the power of a Chi-square test
Power.F	Function to calculate the power of an F-test
R.OLS	Restricted OLS estimation and F-test
data1	Data for the U.S. production function estimation

The package accompanies the paper: Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach. Abacus. Wiley.

It oprovides functions for the optimal level of significance for the test for linear restiction in a regeression model.

Other basic statistical tests, including those for population mean and proportion, are also covered using the functions from the pwr package.

Author(s)

Jae H. Kim <J.Kim@latrobe.edu.au>

Maintainer: Jae H. Kim <J.Kim@latrobe.edu.au>

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach: Abacus: a Journal of Accounting, Finance and Business Studies. Wiley. <https://doi.org/10.1111/abac.12172>

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale,NJ: Lawrence Erlbaum.

Stephane Champely (2017). pwr: Basic Functions for Power Analysis. R package version 1.2-1. https://CRAN.R-project.org/package=pwr

See Also

Leamer, E. 1978, Specification Searches: Ad Hoc Inference with Nonexperimental Data, Wiley, New York.

Kim, JH and Ji, P. 2015, Significance Testing in Empirical Finance: A Critical Review and Assessment, Journal of Empirical Finance 34, 1-14. <DOI:http://dx.doi.org/10.1016/j.jempfin.2015.08.006>

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
data(data1)
y=data1$lnoutput; x=cbind(data1$lncapital,data1$lnlabor)
# Restriction matrices to test for constant returns to scale
Rmat=matrix(c(0,1,1),nrow=1); rvec=matrix(0.94,nrow=1)
# Model Estimation and F-test
M=R.OLS(y,x,Rmat,rvec)

# Degrees of Freedom and estimate of non-centrality parameter
K=ncol(x)+1; T=length(y)
df1=nrow(Rmat);df2=T-K; NCP=M$ncp

# Optimal level of Significance: Under Normality
OptSig.F(df1,df2,ncp=NCP,p=0.5,k=1, Figure=TRUE)
```

`data1` *Data for the U.S. production function estimation*

Description

US production, captal, labour in natrual logs for the year 2005

Usage

```
data("data1")
```

Format

A data frame with 51 observations on the following 3 variables.

`lnoutput` natrual log of output

`lnlabor` natrual log of labor

`lncapital` natrual log of capital

Details

The data contains 51 observations for 50 US states and Washington DC

Source

Gujarati, D. 2015, Econometrics by Example, Second edition, Palgrave.

References

See Section 2.2 of Gujarari (2015)

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach, Abacus: a Journal of Accounting, Finance and Business Studies. Wiley. <https://doi.org/10.1111/abac.12172>

Examples

```
data(data1)
```

`Opt.sig.norm.test` *Optimal significance level calculation for the mean of a normal distribution (known variance)*

Description

Computes the optimal significance level for the mean of a normal distribution (known variance)

Usage

```
Opt.sig.norm.test(ncp=NULL,d=NULL,n=NULL,p=0.5,k=1,alternative="two.sided",Figure=TRUE)
```

Arguments

`ncp`	Non-centrality parameter
`d`	Effect size, Cohen's d
`n`	Sample size
`p`	prior probability for H0, default is p = 0.5
`k`	relative loss from Type I and II errors, k = L2/L1, default is k = 1
`alternative`	a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less"
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

Refer to Kim and Choi (2020) for the details of k and p

Either ncp or d value should be given.

In a general term, if X ~ N(mu,sigma^2); let H0:mu = mu0; and H1:mu = mu1;

ncp = sqrt(n)(mu1-mu0)/sigma

d = (mu1-mu0)/sigma: Cohen's d

Value

`alpha.opt`	Optimal level of significance
`beta.opt`	Type II error probability at the optimal level

Note

Also refer to the manual for the pwr package

The black curve in the figure is the line of enlightened judgement: see Kim and Choi (2019). The red dot inticates the optimal significance level that minimizes the expected loss: (alpha.opt,beta.opt). The blue horizontal line indicates the case of alpha = 0.05 as a reference point.

Author(s)

Jae H. Kim (using a function from the pwr package)

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach: Abacus: a Journal of Accounting, Finance and Business Studies. Wiley. <https://doi.org/10.1111/abac.12172>

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale,NJ: Lawrence Erlbaum.

Stephane Champely (2017). pwr: Basic Functions for Power Analysis. R package version 1.2-1. https://CRAN.R-project.org/package=pwr

See Also

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
Opt.sig.norm.test(d=0.2,n=60,alternative="two.sided")
```

`Opt.sig.t.test` *Optimal significance level calculation for t-tests of means (one sample, two samples and paired samples)*

Description

Computes the optimal significance level for the test for t-tests of means

Usage

```
Opt.sig.t.test(ncp=NULL,d=NULL,n=NULL,p=0.5,k=1,
              type="one.sample",alternative="two.sided",Figure=TRUE)
```

Arguments

`ncp`	Non-centrality parameter
`d`	Effect size
`n`	Sample size
`p`	prior probability for H0, default is p = 0.5
`k`	relative loss from Type I and II errors, k = L2/L1, default is k = 1
`type`	Type of t test : one- two- or paired-sample
`alternative`	a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less"
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

Refer to Kim and Choi (2020) for the details of k and p

Either ncp or d value should be given, with the value of n.

In a general term, if X ~ N(mu,sigma^2); let H0:mu = mu0; and H1:mu = mu1;

ncp = sqrt(n)(mu1-mu0)/sigma

d = (mu1-mu0)/sigma: Cohen's d

Value

`alpha.opt`	Optimal level of significance
`beta.opt`	Type II error probability at the optimal level

Note

Also refer to the manual for the pwr package

The black curve in the figure is the line of enlightened judgement: see Kim and Choi (2020). The red dot inticates the optimal significance level that minimizes the expected loss: (alpha.opt,beta.opt). The blue horizontal line indicates the case of alpha = 0.05 as a reference point.

Author(s)

Jae H. Kim (using a function from the pwr package)

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach: Abacus: a Journal of Accounting, Finance and Business Studies. Wiley. <https://doi.org/10.1111/abac.12172>

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale,NJ: Lawrence Erlbaum.

Stephane Champely (2017). pwr: Basic Functions for Power Analysis. R package version 1.2-1. https://CRAN.R-project.org/package=pwr

See Also

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
Opt.sig.t.test(d=0.2,n=60,type="one.sample",alternative="two.sided")
```

OptSig.2p — *Optimal significance level calculation for the test for two proportions (same sample sizes)*

Description

Computes the optimal significance level for the test for two proportions

Usage

```
OptSig.2p(ncp=NULL,h=NULL,n=NULL,p=0.5,k=1,alternative="two.sided",Figure=TRUE)
```

Arguments

`ncp`	Non-centrality parameter
`h`	Effect size, Cohen's h
`n`	Number of observations (per sample)
`p`	prior probability for H0, default is p = 0.5
`k`	relative loss from Type I and II errors, k = L2/L1, default is k = 1
`alternative`	a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less"
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

Refer to Kim and Choi (2020) for the details of k and p

Either ncp or h value should be specified.

For h, refer to Cohen (1988) or Champely (2017)

In a general term, if X ~ N(mu,sigma^2); let H0:mu = mu0; and H1:mu = mu1;

ncp = sqrt(n)(mu1-mu0)/sigma

Value

`alpha.opt`	Optimal level of significance
`beta.opt`	Type II error probability at the optimal level

Note

Also refer to the manual for the pwr package,

The black curve in the figure is the line of enlightened judgement: see Kim and Choi (2020). The red dot inticates the optimal significance level that minimizes the expected loss: (alpha.opt,beta.opt). The blue horizontal line indicates the case of alpha = 0.05 as a reference point.

Author(s)

Jae H. Kim (using a function from the pwr package)

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach: Abacus: a Journal of Accounting, Finance and Business Studies. Wiley. <https://doi.org/10.1111/abac.12172>

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale,NJ: Lawrence Erlbaum.

Stephane Champely (2017). pwr: Basic Functions for Power Analysis. R package version 1.2-1. https://CRAN.R-project.org/package=pwr

See Also

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
OptSig.2p(h=0.2,n=60,alternative="two.sided")
```

OptSig.2p2n — *Optimal significance level calculation for the test for two proportions (different sample sizes)*

Description

Computes the optimal significance level for the test for two proportions

Usage

```
OptSig.2p2n(ncp=NULL,h=NULL,n1=NULL,n2=NULL,p=0.5,k=1,alternative="two.sided",Figure=TRUE)
```

Arguments

`ncp`	Non-centrality parameter
`h`	Effect size, Cohen's h
`n1`	Number of observations (1st sample)
`n2`	Number of observations (2nd sample)
`p`	prior probability for H0, default is p = 0.5
`k`	relative loss from Type I and II errors, k = L2/L1, default is k = 1
`alternative`	a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less"
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

Refer to Kim and Choi (2020) for the details of k and p

Either ncp or h value should be specified.

For h, refer to Cohen (1988) or Chapmely (2017)

Assume X ~ N(mu,sigma^2); and let H0:mu = mu0; and H1:mu = mu1;

ncp = sqrt(n)(mu1-mu0)/sigma

Value

`alpha.opt`	Optimal level of significance
`beta.opt`	Type II error probability at the optimal level

Note

Also refer to the manual for the pwr package

The black curve in the figure is the line of enlightened judgement: see Kim and Choi (2020). The red dot inticates the optimal significance level that minimizes the expected loss: (alpha.opt,beta.opt). The blue horizontal line indicates the case of alpha = 0.05 as a reference point.

Author(s)

Jae H. Kim (using a function from the pwr package)

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach: Abacus: a Journal of Accounting, Finance and Business Studies. Wiley. <https://doi.org/10.1111/abac.12172>

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Stephane Champely (2017). pwr: Basic Functions for Power Analysis. R package version 1.2-1. https://CRAN.R-project.org/package=pwr

See Also

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
OptSig.2p2n(h=0.30,n1=80,n2=245,alternative="greater")
```

OptSig.anova — *Optimal significance level calculation for balanced one-way analysis of variance tests*

Description

Computes the optimal significance level for the test for balanced one-way analysis of variance tests

Usage

```
OptSig.anova(K = NULL, n = NULL, f = NULL, p = 0.5, k = 1, Figure = TRUE)
```

Arguments

`K`	Number of groups
`n`	Number of observations (per group)
`f`	Effect size
`p`	prior probability for H0, default is p = 0.5
`k`	relative loss from Type I and II errors, k = L2/L1, default is k = 1
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

Refer to Kim and Choi (2020) for the details of k and p

For the value of f, refer to Cohen (1988) or Champely (2017)

Value

`alpha.opt`	Optimal level of significance
`beta.opt`	Type II error probability at the optimal level

Note

Also refer to the manual for the pwr package

The black curve in the figure is the line of enlightened judgement: see Kim and Choi (2020). The red dot inticates the optimal significance level that minimizes the expected loss: (alpha.opt,beta.opt). The blue horizontal line indicates the case of alpha = 0.05 as a reference point.

Author(s)

Jae H. Kim (using a function from the pwr package)

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach: Abacus: a Journal of Accounting, Finance and Business Studies. Wiley. <https://doi.org/10.1111/abac.12172>

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale,NJ: Lawrence Erlbaum.

Stephane Champely (2017). pwr: Basic Functions for Power Analysis. R package version 1.2-1. https://CRAN.R-project.org/package=pwr

See Also

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
OptSig.anova(f=0.28,K=4,n=20)
```

OptSig.Boot *Optimal Significance Level for the F-test using the bootstrap*

Description

The function calculates the optimal level of significance for the F-test

The bootstrap can be conducted using either iid resampling or wild bootstrap.

Usage

```
OptSig.Boot(y,x,Rmat,rvec,p=0.5,k=1,nboot=3000,wild=FALSE,Figure=TRUE)
```

Arguments

y	a matrix of dependent variable, T by 1
x	a matrix of K independent variable, T by K
Rmat	a matrix for J restrictions, J by (K+1)
rvec	a vector for restrictions, J by 1
p	prior probability for H0, default is p = 0.5
k	relative loss from Type I and II errors, k = L2/L1, default is k = 1
nboot	the number of bootstrap iterations, the default is 3000
wild	if TRUE, wild bootsrap is conducted; if FALSE (default), bootstrap is based on iid residual resampling
Figure	show graph if TRUE (default). No graph otherwise

Details

See Kim and Choi (2020)

Value

`alpha.opt`	Optimal level of significance
`crit.opt`	Critical value at the optimal level
`beta.opt`	Type II error probability at the optimal level

Note

Applicable to a linear regression model

The black curve in the figure plots the denity under H0; The blue curve in the figure plots the denity under H1.

Author(s)

Jae H. Kim

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach, Abacus, Wiley. <https://doi.org/10.1111/abac.12172>

See Also

Leamer, E. 1978, Specification Searches: Ad Hoc Inference with Nonexperimental Data, Wiley, New York.

Kim, JH and Ji, P. 2015, Significance Testing in Empirical Finance: A Critical Review and Assessment, Journal of Empirical Finance 34, 1-14. <DOI:http://dx.doi.org/10.1016/j.jempfin.2015.08.006>

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
data(data1)
# Define Y and X
y=data1$lnoutput; x=cbind(data1$lncapital,data1$lnlabor)

# Restriction matrices to test for constant returns to scale
Rmat=matrix(c(0,1,1),nrow=1); rvec=matrix(0.94,nrow=1)

OptSig.Boot(y,x,Rmat,rvec,p=0.5,k=1,nboot=1000,Figure=TRUE)
```

OptSig.BootWeight *Weighted Optimal Significance Level for the F-test based on the bootstrap*

Description

The function calculates the weighted optimal level of significance for the F-test

The weights are obtained from the bootstrap distribution of the non-centrality parameter estimates

Usage

```
OptSig.BootWeight(y,x,Rmat,rvec,p=0.5,k=1,nboot=3000,wild=FALSE,Figure=TRUE)
```

Arguments

`y`	a matrix of dependent variable, T by 1
`x`	a matrix of K independent variable, T by K
`Rmat`	a matrix for J restrictions, J by (K+1)
`rvec`	a vector for restrictions, J by 1
`p`	prior probability for H0, default is p = 0.5
`k`	relative loss from Type I and II errors, k = L2/L1, default is k = 1
`nboot`	the number of bootstrap iterations, the default is 3000
`wild`	if TRUE, wild bootsrap is conducted (default); if FALSE, bootstrap is based on iid resampling
`Figure`	show graph if TRUE . No graph if FALSE (default)

Details

The bootstrap can be conducted using either iid resampling or wild bootstrap.

Value

`alpha.opt`	Optimal level of significance
`crit.opt`	Critical value at the optimal level

Note

Applicable to a linear regression model

Author(s)

Jae H. Kim

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach. Abacus, Wiley. <https://doi.org/10.1111/abac.12172>

See Also

Leamer, E. 1978, Specification Searches: Ad Hoc Inference with Nonexperimental Data, Wiley, New York.

Kim, JH and Ji, P. 2015, Significance Testing in Empirical Finance: A Critical Review and Assessment, Journal of Empirical Finance 34, 1-14. <DOI:http://dx.doi.org/10.1016/j.jempfin.2015.08.006>

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
data(data1)
# Define Y and X
y=data1$lnoutput; x=cbind(data1$lncapital,data1$lnlabor)
# Restriction matrices to test for constant returns to scale
Rmat=matrix(c(0,1,1),nrow=1); rvec=matrix(0.94,nrow=1)

OptSig.Boot(y,x,Rmat,rvec,p=0.5,k=1,nboot=1000,Figure=TRUE)
```

OptSig.Chisq *Optimal Significance Level for a Chi-square test*

Description

The function calculates the optimal level of significance for a Ch-square test

Usage

```
OptSig.Chisq(w=NULL, N=NULL, ncp=NULL, df, p = 0.5, k = 1, Figure = TRUE)
```

Arguments

`w`	Effect size, Cohen's w
`N`	Total number of observations
`ncp`	a value of the non-centality paramter
`df`	the degrees of freedom
`p`	prior probability for H0, default is p = 0.5
`k`	relative loss from Type I and II errors, k = L2/L1, default is k = 1
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

See Kim and Choi (2020)

Value

`alpha.opt`	Optimal level of significance
`crit.opt`	Critical value at the optimal level
`beta.opt`	Type II error probability at the optimal level

Note

Applicable to any Chi-square test Either ncp or w (with N) should be given.

The black curve in the figure is the line of enlightened judgement: see Kim and Choi (2020). The red dot inticates the optimal significance level that minimizes the expected loss: (alpha.opt,beta.opt). The blue horizontal line indicates the case of alpha = 0.05 as a reference point.

Author(s)

Jae. H Kim

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach: Abacus: a Journal of Accounting, Finance and Business Studies. Wiley. <https://doi.org/10.1111/abac.12172>

See Also

Leamer, E. 1978, Specification Searches: Ad Hoc Inference with Nonexperimental Data, Wiley, New York.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale,NJ: Lawrence Erlbaum.

Kim, JH and Ji, P. 2015, Significance Testing in Empirical Finance: A Critical Review and Assessment, Journal of Empirical Finance 34, 1-14. <DOI:http://dx.doi.org/10.1016/j.jempfin.2015.08.006>

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
# Optimal level of Significance for the Breusch-Pagan test: Chi-square version
data(data1)                 # call the data: Table 2.1 of Gujarati (2015)

# Extract Y and X
y=data1$lnoutput; x=cbind(data1$lncapital,data1$lnlabor)

# Restriction matrices for the slope coefficents sum to 1
Rmat=matrix(c(0,1,1),nrow=1); rvec=matrix(1,nrow=1)

# Model Estimation
```

```
M=R.OLS(y,x,Rmat,rvec); print(M$coef)

# Breusch-Pagan test for heteroskedasticity
e = M$resid[,1]                  # residuals from unrestricted model estimation

# Restriction matrices for the slope coefficients being 0
Rmat=matrix(c(0,0,1,0,0,1),nrow=2); rvec=matrix(0,nrow=2)

# Model Estimation for the auxilliary regression
M1=R.OLS(e^2,x,Rmat,rvec);

# Degrees of Freedom and estimate of non-centrality parameter
df1=nrow(Rmat); NCP=M1$ncp

# LM stat and p-value
LM=nrow(data1)*M1$Rsq[1,1]
pval=pchisq(LM,df=df1,lower.tail = FALSE)

OptSig.Chisq(df=df1,ncp=NCP,p=0.5,k=1, Figure=TRUE)
```

`OptSig.F` *Optimal Significance Level for an F-test*

Description

The function calculates the optimal level of significance for an F-test

Usage

```
OptSig.F(df1, df2, ncp, p = 0.5, k = 1, Figure = TRUE)
```

Arguments

`df1`	the first degrees of freedom for the F-distribution
`df2`	the second degrees of freedom for the F-distribution
`ncp`	a value of of the non-centality paramter
`p`	prior probability for H0, default is p = 0.5
`k`	relative loss from Type I and II errors, k = L2/L1, default is k = 1
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

See Kim and Choi (2020)

Value

`alpha.opt`	Optimal level of significance
`crit.opt`	Critical value at the optimal level
`beta.opt`	Type II error probability at the optimal level

Note

Applicable to any F-test, following F-distribution

The black curve in the figure is the line of enlightened judgement: see Kim and Choi (2020). The red dot inticates the optimal significance level that minimizes the expected loss: (alpha.opt,beta.opt). The blue horizontal line indicates the case of alpha = 0.05 as a reference point.

Author(s)

Jae. H Kim

References

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Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
data(data1)
# Define Y and X
y=data1$lnoutput; x=cbind(data1$lncapital,data1$lnlabor)
# Restriction matrices to test for constant returns to scale
Rmat=matrix(c(0,1,1),nrow=1); rvec=matrix(0.94,nrow=1)
# Model Estimation and F-test
M=R.OLS(y,x,Rmat,rvec)

# Degrees of Freedom and estimate of non-centrality parameter
K=ncol(x)+1; T=length(y)
df1=nrow(Rmat);df2=T-K; NCP=M$ncp

# Optimal level of Significance: Under Normality
OptSig.F(df1,df2,ncp=NCP,p=0.5,k=1, Figure=TRUE)
```

OptSig.p — *Optimal significance level calculation for proportion tests (one sample)*

Description

Computes the optimal significance level for proportion tests (one sample)

Usage

```
OptSig.p(ncp=NULL,h=NULL,n=NULL,p=0.5,k=1,alternative="two.sided",Figure=TRUE)
```

Arguments

`ncp`	Non-centraity parameter
`h`	Effect size, Cohen's h
`n`	Number of observations (per sample)
`p`	prior probability for H0, default is p = 0.5
`k`	relative loss from Type I and II errors, k = L2/L1, default is k = 1
`alternative`	a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less"
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

Refer to Kim and Choi (2020) for the details of k and p

Either ncp or h value should be given

For h, refer to Cohen (1988) or Chapmely (2017)

In a general term, if X ~ N(mu,sigma^2); let H0:mu = mu0; and H1:mu = mu1;

ncp = sqrt(n)(mu1-mu0)/sigma

Value

`alpha.opt`	Optimal level of significance
`beta.opt`	Type II error probability at the optimal level

Note

Also refer to the manual for the pwr package

The black curve in the figure is the line of enlightened judgement: see Kim and Choi (2020). The red dot inticates the optimal significance level that minimizes the expected loss: (alpha.opt,beta.opt). The blue horizontal line indicates the case of alpha = 0.05 as a reference point.

Author(s)

Jae H. Kim (using a function from the pwr package)

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach: Abacus: a Journal of Accounting, Finance and Business Studies. Wiley. <https://doi.org/10.1111/abac.12172>

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Stephane Champely (2017). pwr: Basic Functions for Power Analysis. R package version 1.2-1. https://CRAN.R-project.org/package=pwr

See Also

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
OptSig.p(h=0.2,n=60,alternative="two.sided")
```

OptSig.r — *Optimal significance level calculation for correlation test*

Description

Computes the optimal significance level for the correlation test

Usage

```
OptSig.r(r=NULL,n=NULL,p=0.5,k=1,alternative="two.sided",Figure=TRUE)
```

Arguments

`r`	Linear correlation coefficient
`n`	sample size
`p`	prior probability for H0, default is p = 0.5
`k`	relative loss from Type I and II error, k = L2/L1, default is k = 1
`alternative`	a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less"
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

Refer to Kim and Choi (2020) for the details of k and p

In a general term, if X ~ N(mu,sigma^2); let H0:mu = mu0; and H1:mu = mu1;

ncp = sqrt(n)(mu1-mu0)/sigma

Value

`alpha.opt`	Optimal level of significance
`beta.opt`	Type II error probability at the optimal level

Note

Also refer to the manual for the pwr package

The black curve in the figure is the line of enlightened judgement: see Kim and Choi (2020). The red dot inticates the optimal significance level that minimizes the expected loss: (alpha.opt,beta.opt). The blue horizontal line indicates the case of alpha = 0.05 as a reference point.

Author(s)

Jae H. Kim (using a function from the pwr package)

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach: Abacus: a Journal of Accounting, Finance and Business Studies. Wiley. <https://doi.org/10.1111/abac.12172>

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Stephane Champely (2017). pwr: Basic Functions for Power Analysis. R package version 1.2-1. https://CRAN.R-project.org/package=pwr

See Also

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
OptSig.r(r=0.2,n=60,alternative="two.sided")
```

OptSig.t2n *Optimal significance level calculation for two samples (different sizes) t-tests of means*

Description

Computes the optimal significance level for two samples (different sizes) t-tests of means

Usage

```
OptSig.t2n(ncp=NULL,d=NULL,n1=NULL,n2=NULL,p=0.5,k=1,alternative="two.sided",Figure=TRUE)
```

Arguments

ncp	Non-centrality parameter
d	Effect size
n1	umber of observations in the first sample
n2	umber of observations in the second sample
p	prior probability for H0, default is p = 0.5
k	relative loss from Type I and II errors, k = L2/L1, default is k = 1
alternative	a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less"
Figure	show graph if TRUE (default); No graph if FALSE

Details

Refer to Kim and Choi (2020) for the details of k and p

Either ncp or d value should be specified.

In a general term, if X ~ N(mu,sigma^2); let H0:mu = mu0; and H1:mu = mu1;

ncp = sqrt(n)(mu1-mu0)/sigma

d = (mu1-mu0)/sigma: Cohen's d

Value

alpha.opt	Optimal level of significance
beta.opt	Type II error probability at the optimal level

Note

Also refer to the manual for the pwr package

The black curve in the figure is the line of enlightened judgement: see Kim and Choi (2020). The red dot inticates the optimal significance level that minimizes the expected loss: (alpha.opt,beta.opt). The blue horizontal line indicates the case of alpha = 0.05 as a reference point.

Author(s)

Jae H. Kim (using a function from the pwr package)

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach: Abacus: a Journal of Accounting, Finance and Business Studies. Wiley. <https://doi.org/10.1111/abac.12172>

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale,NJ: Lawrence Erlbaum.

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See Also

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
OptSig.t2n(d=0.6,n1=90,n2=60,alternative="greater")
```

OptSig.Weight — *Weighted Optimal Significance Level for the F-test based on the assumption of normality in the error term*

Description

The function calculates the weighted optimal level of significance for the F-test

The weights are obtained from a folded-normal distribution with mean m and staradrd deviation delta

Usage

```
OptSig.Weight(df1, df2, m, delta = 2, p = 0.5, k = 1, Figure = TRUE)
```

Arguments

`df1`	the first degrees of freedom for the F-distribution
`df2`	the second degrees of freedom for the F-distribution
`m`	a value of of the non-centality paramter, the mean of the folded-normal distribution
`delta`	standard deviation of the folded-normal distribution
`p`	prior probability for H0, default is p = 0.5
`k`	relative loss from Type I and II errors, k = L2/L1, default is k = 1
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

See Kim and Choi (2020)

Value

`alpha.opt`	Optimal level of significance
`crit.opt`	Critical value at the optimal level

Note

The figure shows the folded-normal distribution

Author(s)

Jae H. Kim

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach, Abacus, Wiley. <https://doi.org/10.1111/abac.12172>

See Also

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Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
data(data1)
# Define Y and X
y=data1$lnoutput; x=cbind(data1$lncapital,data1$lnlabor)
# Restriction matrices to test for constant returns to scale
Rmat=matrix(c(0,1,1),nrow=1); rvec=matrix(0.94,nrow=1)
# Model Estimation and F-test
M=R.OLS(y,x,Rmat,rvec)

# Degrees of Freedom and estimate of non-centrality parameter
K=ncol(x)+1; T=length(y)
df1=nrow(Rmat);df2=T-K; NCP=M$ncp

OptSig.Weight(df1,df2,m=NCP,delta=3,p=0.5,k=1,Figure=TRUE)
```

`Power.Chisq` *Function to calculate the power of a Chi-square test*

Description

This function calculates the power of a Chi-square test, given the value of non-centrality parameter

Usage

```
Power.Chisq(df, ncp, alpha, Figure = TRUE)
```

Arguments

`df`	degree of freedom
`ncp`	a value of of the non-centality paramter
`alpha`	the level of significance
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

See Kim and Choi (2020)

Value

`Power`	Power of the test
`Crit.val`	Critical value at alpha level of signifcance

Note

See Application Section and Appendix of Kim and Choi (2017)

Author(s)

Jae H. Kim

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach, Abacus, Wiley. <https://doi.org/10.1111/abac.12172>

See Also

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Examples

```
Power.Chisq(df=5,ncp=5,alpha=0.05,Figure=TRUE)
```

`Power.F` *Function to calculate the power of an F-test*

Description

This function calculates the power of an F-test, given the value of non-centrality parameter

Usage

```
Power.F(df1, df2, ncp, alpha, Figure = TRUE)
```

Arguments

`df1`	the first degrees of freedom for the F-distribution
`df2`	the second degrees of freedom for the F-distribution
`ncp`	a value of of the non-centality paramter
`alpha`	the level of significance
`Figure`	show graph if TRUE (default); No graph if FALSE

Details

See Kim and Choi (2020)

Value

`Power`	Power of the test
`Crit.val`	Critical value at alpha level of signifcance

Note

See Application Section and Appendix of Kim and Choi (2020)

Author(s)

Jae H. Kim

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach, Abacus, Wiley. <https://doi.org/10.1111/abac.12172>

See Also

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Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
data(data1)
# Define Y and X
y=data1$lnoutput; x=cbind(data1$lncapital,data1$lnlabor)
# Restriction matrices to test for constant returns to scale
Rmat=matrix(c(0,1,1),nrow=1); rvec=matrix(0.94,nrow=1)
# Model Estimation and F-test
M=R.OLS(y,x,Rmat,rvec)
# Degrees of Freedom and estimate of non-centrality parameter
K=ncol(x)+1; T=length(y)
df1=nrow(Rmat);df2=T-K; NCP=M$ncp

Power.F(df1,df2,ncp=NCP,alpha=0.20747,Figure=TRUE)
```

R.OLS *Restricted OLS estimation and F-test*

Description

Function to calcuate the Restricted (under H0) OLS Estimators and F-test statistic

Usage

```
R.OLS(y, x, Rmat, rvec)
```

Arguments

y	a matrix of dependent variable, T by 1
x	a matrix of K independent variable, T by K
Rmat	a matrix for J restrictions, J by (K+1)
rvec	a vector for restrictions, J by 1

Details

Rmat and rvec are the matrices for the linear restrictions, which a user should supply.

Refer to an econometrics textbook for details.

Value

`coef`	matrix of estimated coefficients, (K+1) by 2, under H1 and H0
`RSq`	R-square values under H1 and H0, 2 by 1
`resid`	residual vector under H1 and H0, T by 2
`F.stat`	F-statistic and p-value
`ncp`	non-centrality parameter, estimated by replaicing unknowns using OLS estimates

Note

The function automatically adds an intercept, so the user need not include a vector of ones in x matrix.

Author(s)

Jae H. Kim

References

Kim and Choi, 2020, Choosing the Level of Significance: A Decision-theoretic Approach, Abacus, Wiley. <https://doi.org/10.1111/abac.12172>

See Also

Leamer, E. 1978, Specification Searches: Ad Hoc Inference with Nonexperimental Data, Wiley, New York.

Kim, JH and Ji, P. 2015, Significance Testing in Empirical Finance: A Critical Review and Assessment, Journal of Empirical Finance 34, 1-14. <DOI:http://dx.doi.org/10.1016/j.jempfin.2015.08.006>

Kim, Jae H., 2020, Decision-theoretic hypothesis testing: A primer with R package OptSig, The American Statistician. <https://doi.org/10.1080/00031305.2020.1750484.>

Examples

```
data(data1)
# Define Y and X
y=data1$lnoutput; x=cbind(data1$lncapital,data1$lnlabor)
# Restriction matrices to test for constant returns to scale
Rmat=matrix(c(0,1,1),nrow=1); rvec=matrix(1,nrow=1)
# Model Estimation and F-test
M=R.OLS(y,x,Rmat,rvec)
```

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