Package ‘StressStrength’

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Type Package

Title Computation and Estimation of Reliability of Stress-Strength Models

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Description Reliability of (normal) stress-strength models and for building two-sided or one-sided confidence intervals according to different approximate procedures.

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Contents

`StressStrength-package` *Computation and Sample Estimation of Reliability of Stress-Strength Models*

Description

Reliability of (normal) stress-strength models and for building two-side or one-side confidence intervals according to different approximate procedures.

Details

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Author(s)

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References

Kotz S, Lumelskii Y, Pensky M (2003) The stress-strength model and its generalizations: theory and applications. World Scientific, Singapore

Guo H, Krishnamoorthy K (2004) New approximate inferential methods for the reliability parameter in a stress-strength model: The normal case. Commun Stat Theory Methods 33:1715-1731

`estSSR` *Sample estimation of reliability of stress-strength models*

Description

The function provides sample estimates of reliability of stress-strength models, where stress and strength are modeled as independent r.v., whose distribution form is known except for the values of its parameters, assumed all unknown

Usage

```
estSSR(x, y, family="normal", twoside=TRUE, type="RG", alpha=0.05, B=2000)
```

Arguments

`x`	a random sample from r.v. X modeling strength
`y`	a random sample from r.v. Y modeling stress
`family`	the distribution of both X and Y
`twoside`	if TRUE, the function computes two-side confidence intervals; otherwise, one-side (a lower bound)
`type`	type of confidence interval (CI) to be built. For the normal family, "RG" stands for Reiser-Guttman, "AN" for large sample (asymptotically normal), "LOGIT" or "ARCSIN" for logit or arcsin variance stabilizing tranformations, "B" for percentile bootstrap, "GK" for Guo-Krishnamoorthy (one-sided only).
`alpha`	the complement to one of the nominal confidence level
`B`	number of bootstrap replicates (for type "B")

Details

For more details, please have a look at the references listed below

Value

A list comprising

`ML_est`	the sample value of the maximum likelihood estimator; for normal r.v. $\hat{R} = \Phi[(\bar{x}-\bar{y})/\sqrt{\hat{\sigma}_x^2+\hat{\sigma}_y^2}]$, where $\bar{x}$ and $\bar{y}$ are the sample means, and $\hat{\sigma}_x^2$, $\hat{\sigma}_y^2$ the biased maximum likelihood variance estimators
`Downton_est`	(for normal r.v.) the sample value of one of the approximated UMVU estimators proposed by Downton $\hat{R}' = \Phi[(\bar{x}-\bar{y})/\sqrt{s_x^2+s_y^2}]$
`CI`	the confidence interval
`confidence_level`	the nominal confidence level $1-\alpha$

Author(s)

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References

Barbiero A (2011) Confidence Intervals for Reliability of Stress-Strength Models in the Normal Case, Comm Stat Sim Comp 40(6):907-925

Downton F. (1973) The Estimation of Pr (Y < X) in the Normal Case, Technometrics , 15(3):551-558

Kotz S, Lumelskii Y, Pensky M (2003) The stress-strength model and its generalizations: theory and applications. World Scientific, Singapore

Guo H, Krishnamoorthy K (2004) New approximate inferential methods for the reliability parameter in a stress-strength model: The normal case. Commun Stat Theory Methods 33:1715-1731

Mukherjee SP, Maiti SS (1998) Stress-strength reliability in the Weibull case. Frontiers In Reliability 4:231-248. WorldScientific, Singapore

Reiser BJ, Guttman I (1986) Statistical inference for P(Y<X): The normal case. Technometrics 28:253-257

See Also

SSR

Examples

```
# distributional parameters of X and Y
parx<-c(1, 1)
pary<-c(0, 2)
# sample sizes
n<-10
m<-20
# true value of R
SSR(parx,pary)
# draw independent random samples from X and Y
x<-rnorm(n, parx[1], parx[2])
y<-rnorm(m, pary[1], pary[2])
# build two-sided confidence intervals
estSSR(x, y, type="RG")
estSSR(x, y, type="AN")
estSSR(x, y, type="LOGIT")
estSSR(x, y, type="ARCSIN")
estSSR(x, y, type="B")
estSSR(x, y, type="B",B=1000) # change number of bootstrap replicates
# and one-sided
estSSR(x, y, type="RG", twoside=FALSE)
estSSR(x, y, type="AN", twoside=FALSE)
estSSR(x, y, type="LOGIT", twoside=FALSE)
estSSR(x, y, type="ARCSIN", twoside=FALSE)
estSSR(x, y, type="B", twoside=FALSE)
estSSR(x, y, type="GK", twoside=FALSE)
# changing sample sizes
n<-20
m<-30
x<-rnorm(n, parx[1], parx[2])
y<-rnorm(m, pary[1], pary[2])
# build tow-sided confidence intervals
estSSR(x, y, type="RG")
estSSR(x, y, type="AN")
estSSR(x, y, type="LOGIT")
estSSR(x, y, type="ARCSIN")
estSSR(x, y, type="B")
```

gkf *Numerical solution for an equation involving noncentral T cdf*

Description

It provides the solution of the equation $F_t(q; df, x) = p$, where F_t is the cdf (calculated in q) of a non-central Student r.v. with df degrees of freedom and unkwon noncentrality parameter x. In R code, gkf provides the solution of `pt(q,df,x)=p`.

Usage

```
gkf(p, q, df, eps = 1e-05)
```

Arguments

p	a probability
q	a real value
df	degrees of freedom of noncentral T
eps	tolerance

Details

This function is used for building Guo-Krishnamoorthy confidence intervals for R

Value

the noncentrality parameter x satisfying the equation $F_t(q; df, x) = p$

Author(s)

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References

Guo H, Krishnamoorthy K (2004) New approximate inferential methods for the reliability parameter in a stress-strength model: The normal case. Commun Stat Theory Methods 33:1715-1731

See Also

estSSR

Examples

```
p<-0.95
q<-5
df<-12
ncp<-gkf(p, q, df)
ncp
# check if the result is correct
pt(q, df, ncp)
# OK
# changing the tolerance
ncp<-gkf(p, q, df, eps=1e-10)
ncp
pt(q, df, ncp)
```

SSR — *Computation of reliability of stress-strength models*

Description

For a stress-strength model, with independent r.v. X and Y representing the strength and the stress respectively, the function computes the reliability $R = P(X > Y)$

Usage

```
SSR(parx, pary, family = "normal")
```

Arguments

`parx`	parameters of X distribution (for the normal distribution, mean μ_x and standard deviation σ_x)
`pary`	parameters of Y distribution (for the normal distribution, mean μ_y and standard deviation σ_y)
`family`	family distribution for both X and Y (now, only "normal" available)

Details

The function computes $R = P(X > Y)$ where X and Y are independent r.v. following the `family` distribution with distributional parameters `parx` and `pary`.

Value

$R = P(X > Y)$. For normal distributions, $R = \Phi(d)$ with $d = (\mu_x - \mu_y)/\sqrt{\sigma_x^2 + \sigma_y^2}$.

Author(s)

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References

Kotz S, Lumelskii Y, Pensky M (2003) The stress-strength model and its generalizations: theory and applications. World Scientific, Singapore

See Also

estSSR

Examples

```
# let X be a normal r.v. with mean 1 and sd 1;
# and Y a normal r.v. with mean 0 and sd 2
# X and Y independent
parx<-c(1, 1)
pary<-c(0, 2)
# reliability of the stress-strength model (X=strength, Y=stress)
SSR(parx,pary)
# changing the parameters of Y
pary<-c(1.5, 2)
# reliability of the stress-strength model (X=strength, Y=stress)
SSR(parx,pary)
```

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