

Package ‘StressStrength’

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Type Package

Title Computation and estimation of reliability of stress-strength models

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Description The package provide functions for computing the reliability of stress-strength models and for building two-sided or one-sided confidence intervals according to different approximate procedures

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StressStrength-package

Computation and sample estimation of reliability of stress-strength models

Description

The package provides functions for computing the reliability of stress-strength models and for building two-side or one-side confidence intervals according to different approximate procedures

Details

Package:	StressStrength
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License:	GPL
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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 transformations, "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)

Alessandro Barbiero, Riccardo Inchingolo

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 unknown 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

<code>p</code>	a probability
<code>q</code>	a real value
<code>df</code>	degrees of freedom of noncentral T
<code>eps</code>	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)

Alessandro Barbiero, Riccardo Inchingolo

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)

Alessandro Barbiero, Riccardo Inchingolo

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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