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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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

Package: StressStrength
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Author(s)

Alessandro Barbiero, Riccardo Inchingolo

Maintainer: Alessandro Barbiero <alessandro.barbiero@unimi.it>

References


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. \( \hat{R} = \Phi\left(\frac{\bar{x} - \bar{y}}{\sqrt{\hat{\sigma}_x^2 + \hat{\sigma}_y^2}}\right) \) 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 \( \hat{R}' = \Phi\left(\frac{\bar{x} - \bar{y}}{\sqrt{s_x^2 + s_y^2}}\right) \)

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


and applications. World Scientific, Singapore

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 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")
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

- \( p \) 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)

Alessandro Barbiero, Riccardo Inchingolo

References


See Also

estSSR
**Examples**

```r
cpy<-0.95
cq<-5
cdf<-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**

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

**Arguments**

- **parx**: parameters of $X$ distribution (for the normal distribution, mean $\mu_x$ and standard deviation $\sigma_x$)
- **pary**: parameters of $Y$ distribution (for the normal distribution, mean $\mu_y$ and standard deviation $\sigma_y$)
- **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


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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