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

License GPL

LazyLoad yes

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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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Version: 1.0
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LazyLoad: yes

Author(s)

Alessandro Barbiero, Riccardo Inchingolo
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References


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 \( \hat{R}^\prime = \Phi(\bar{x} - \bar{y})/\sqrt{s_x^2 + s_y^2} \)
- **CI**: the confidence interval \( \Phi[(\bar{x} - \bar{y})/\sqrt{s_x^2 + s_y^2}] \)
- **confidence_level**: the nominal confidence level \( 1 - \alpha \)

Author(s)

Alessandro Barbiero, Riccardo Inchingolo

References


See Also

SSR

Examples

```r
# 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
p <- 0.95
def <- 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)
```

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**SSR**

*Computation of reliability of stress-strength models*

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**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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