

# Package: StressStrength (via r-universe)

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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.

**License** GPL

**LazyLoad** yes

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**Repository** <https://alessandro-barbiero.r-universe.dev>

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StressStrength-package

*Computation and Sample Estimation of Reliability of Stress-Strength Models*

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### 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  
Type: Package  
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### Author(s)

Alessandro Barbiero, Riccardo Inchingolo

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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

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estSSR

*Sample estimation of reliability of stress-strength models*

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### 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")
```

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

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**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)

```

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SSR

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*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 $\mu_x$ 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**

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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