Package ‘VaRES’

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Type Package

Title Computes value at risk and expected shortfall for over 100 parametric distributions

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Description Computes Value at risk and expected shortfall, two most popular measures of financial risk, for over one hundred parametric distributions, including all commonly known distributions. Also computed are the corresponding probability density function and cumulative distribution function.

License GPL (>= 2)

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VaresMpackage

Computes value at risk and expected shortfall for over 100 parametric distributions

Description

Computes Value at risk and expected shortfall, two most popular measures of financial risk, for over one hundred parametric distributions, including all commonly known distributions. Also computed are the corresponding probability density function and cumulative distribution function.

Details

Package: VaRES
Type: Package
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Author(s)

Saralees Nadarajah, Stephen Chan and Emmanuel Afuecheta
Maintainer: Saralees Nadarajah <Saralees.Nadarajah@manchester.ac.uk>

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

aep

Asymmetric exponential power distribution
Description

Computes the pdf, cdf, value at risk and expected shortfall for the asymmetric exponential power distribution due to Zhu and Zinde-Walsh (2009) given by

\[ f(x) = \begin{cases} 
\frac{\alpha}{\alpha^*} K(q_1) \exp \left[ -\frac{1}{q_1} \frac{|x|^{q_1}}{2\alpha^*} \right], & \text{if } x \leq 0, \\
\frac{1 - \alpha}{1 - \alpha^*} K(q_2) \exp \left[ -\frac{1}{q_2} \frac{|x|^{q_2}}{1 - 2\alpha^*} \right], & \text{if } x > 0 
\end{cases} \]

\[ F(x) = \begin{cases} 
\alpha Q \left( \frac{1}{q_1} \frac{|x|}{\alpha^*} \right)^{q_1}, & \text{if } x \leq 0, \\
1 - (1 - \alpha)Q \left( \frac{1}{q_2} \frac{|x|^{q_2}}{2 - 2\alpha^*} \right)^{q_2}, & \text{if } x > 0 
\end{cases} \]

\[ \text{VaR}_p(X) = \begin{cases} 
-2\alpha^* \left[ q_1 Q^{-1} \left( \frac{p}{\alpha^*, q_1} \right) \right]^{\frac{1}{q_1}}, & \text{if } p \leq \alpha, \\
2 (1 - \alpha^*) \left[ q_2 Q^{-1} \left( \frac{1 - p}{1 - \alpha^*, q_2} \right) \right]^{\frac{1}{q_2}}, & \text{if } p > \alpha 
\end{cases} \]

\[ \text{ES}_p(X) = \begin{cases} 
-2\alpha^* \left[ q_1 Q^{-1} \left( \frac{v}{\alpha^*, q_1} \right) \right]^{\frac{1}{q_1}} dv, & \text{if } p \leq \alpha, \\
-2\alpha^* \left[ q_1 Q^{-1} \left( \frac{v}{\alpha^*, q_1} \right) \right]^{\frac{1}{q_1}} dv + 2 \frac{(1 - \alpha^*)}{p} \int_0^\alpha \left[ q_2 Q^{-1} \left( \frac{1 - v}{1 - \alpha^*, q_2} \right) \right]^{\frac{1}{q_2}} dv, & \text{if } p > \alpha 
\end{cases} \]

for \(-\infty < x < \infty\), \(0 < p < 1\), \(0 < \alpha < 1\), the scale parameter, \(q_1 > 0\), the first shape parameter, and \(q_2 > 0\), the second shape parameter, where \(\alpha^* = \alpha K(q_1) / \{\alpha K(q_1) + (1 - \alpha)K(q_2)\}\), \(K(q) = \frac{1}{2q^{q/2}\Gamma(q/2)}\), \(Q_1(a,x) = \int_x^\infty t^{a-1} \exp(-t) dt / \Gamma(a)\) denotes the regularized complementary incomplete gamma function, \(\Gamma(a) = \int_0^\infty t^{a-1} \exp(-t) dt\) denotes the gamma function, and \(Q^{-1}(a,x)\) denotes the inverse of \(Q(a,x)\).

Usage

- `daep(x, q1=1, q2=1, alpha=0.5, log=FALSE)`
- `paep(x, q1=1, q2=1, alpha=0.5, log.p=FALSE, lower.tail=TRUE)`
- `varaep(p, q1=1, q2=1, alpha=0.5, log.p=FALSE, lower.tail=TRUE)`
- `esaep(p, q1=1, q2=1, alpha=0.5)`

Arguments

- `x` scaler or vector of values at which the pdf or cdf needs to be computed
- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `alpha` the value of the scale parameter, must be in the unit interval, the default is 0.5
q1 the value of the first shape parameter, must be positive, the default is 1
q2 the value of the second shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value
An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10,min=0,max=1)
daep(x)
paep(x)
varaep(x)
esaep(x)

---

arcsine Arcsine distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the arcsine distribution given by

\[
f(x) = \frac{1}{\pi \sqrt{(x-a)(b-x)}},
\]
\[
F(x) = \frac{2}{\pi} \arcsin \left( \sqrt{\frac{x-a}{b-a}} \right),
\]
\[
\text{VaR}_p(X) = a + (b - a) \sin^2 \left( \frac{\pi p}{2} \right),
\]
\[
\text{ES}_p(X) = a + \frac{b - a}{p} \int_0^p \sin^2 \left( \frac{\pi v}{2} \right) dv
\]

for \( a \leq x \leq b, 0 < p < 1, -\infty < a < \infty, \) the first location parameter, and \( -\infty < a < b < \infty, \) the second location parameter.
arcsine

Usage

darcsine(x, a=0, b=1, log=FALSE)
parcsine(x, a=0, b=1, log.p=FALSE, lower.tail=TRUE)
vararcsine(p, a=0, b=1, log.p=FALSE, lower.tail=TRUE)
esarcsine(p, a=0, b=1)

Arguments

x      scaler or vector of values at which the pdf or cdf needs to be computed
p      scaler or vector of values at which the value at risk or expected shortfall needs
to be computed
a      the value of the first location parameter, can take any real value, the default is
        zero
b      the value of the second location parameter, can take any real value but must be
        greater than a, the default is 1
log    if TRUE then log(pdf) are returned
log.p  if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the
same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall,
submitted

Examples

x=runif(10,min=0,max=1)
darcsine(x)
parcsine(x)
vararcsine(x)
esarcsine(x)
Generalized asymmetric Student’s t distribution

 Computes the pdf, cdf, value at risk and expected shortfall for the generalized asymmetric Student’s t distribution due to Zhu and Galbraith (2010) given by

\[
\begin{align*}
    f(x) &= \begin{cases} 
        \frac{\alpha}{\alpha^*} K(\nu_1) \left[ 1 + \frac{1}{\nu_1} \left( \frac{x}{2\alpha^*} \right)^2 \right]^{-\frac{\nu_1+1}{2}}, & \text{if } x \leq 0, \\
        \frac{1 - \alpha}{1 - \alpha^*} K(\nu_2) \left[ 1 + \frac{1}{\nu_2} \left( \frac{x}{2(1 - \alpha^*)} \right)^2 \right]^{-\frac{\nu_2+1}{2}}, & \text{if } x > 0
    \end{cases}
\end{align*}
\]

\[
F(x) = 2\alpha F_{\nu_1} \left( \frac{\min(x, 0)}{2\alpha^*} \right) - 1 + \alpha + 2(1 - \alpha) F_{\nu_2} \left( \frac{\max(x, 0)}{2 - 2\alpha} \right),
\]

\[
\text{VaR}_p(X) = 2\alpha^* F_{\nu_1}^{-1} \left( \frac{\min(p, \alpha)}{2\alpha} \right) + 2(1 - \alpha^*) F_{\nu_2}^{-1} \left( \frac{\max(p, \alpha) + 1 - 2\alpha}{2 - 2\alpha} \right),
\]

\[
\text{ES}_p(X) = \frac{2\alpha^*}{p} \int_0^p F_{\nu_1}^{-1} \left( \frac{\min(v, \alpha)}{2\alpha} \right) dv + \frac{2(1 - \alpha^*)}{p} \int_0^p F_{\nu_2}^{-1} \left( \frac{\max(v, \alpha) + 1 - 2\alpha}{2 - 2\alpha} \right) dv
\]

for \(-\infty < x < \infty, 0 < p < 1, 0 < \alpha < 1, \) the scale parameter, \( \nu_1 > 0, \) the first degree of freedom parameter, and \( \nu_2 > 0, \) the second degree of freedom parameter, where \( \alpha^* = \alpha K(\nu_1) / \{ \alpha K(\nu_1) + (1 - \alpha) K(\nu_2) \}, \) \( K(\nu) = \Gamma((\nu + 1)/2) / [\sqrt{\pi \nu} \Gamma(\nu/2)], \) \( F_{\nu}(\cdot) \) denotes the cdf of a Student’s t random variable with \( \nu \) degrees of freedom, and \( F_{\nu}^{-1}(\cdot) \) denotes the inverse of \( F_{\nu}(\cdot). \)

Usage

\[
\begin{align*}
    \text{dast}(x, \text{nu}1=1, \text{nu}2=1, \text{alpha}=0.5, \text{log}=\text{FALSE}) \\
    \text{past}(x, \text{nu}1=1, \text{nu}2=1, \text{alpha}=0.5, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
    \text{varast}(p, \text{nu}1=1, \text{nu}2=1, \text{alpha}=0.5, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
    \text{esast}(p, \text{nu}1=1, \text{nu}2=1, \text{alpha}=0.5)
\end{align*}
\]

Arguments

\[
\begin{align*}
    x & \quad \text{scaler or vector of values at which the pdf or cdf needs to be computed} \\
    p & \quad \text{scaler or vector of values at which the value at risk or expected shortfall needs to be computed} \\
    \text{alpha} & \quad \text{the value of the scale parameter, must be in the unit interval, the default is 0.5} \\
    \text{nu}1 & \quad \text{the value of the first degree of freedom parameter, must be positive, the default is 1} \\
    \text{nu}2 & \quad \text{the value of the second degree of freedom parameter, must be positive, the default is 1} \\
    \text{log} & \quad \text{if TRUE then log(pdf) are returned} \\
    \text{log.p} & \quad \text{if TRUE then log(cdf) are returned and quantiles are computed for exp(p)} \\
    \text{lower.tail} & \quad \text{if FALSE then 1-cdf are returned and quantiles are computed for 1-p}
\end{align*}
\]
asylaplace

Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\[
x = \text{runif}(10, \text{min}=0, \text{max}=1)
dast(x)
past(x)
varast(x)
esast(x)
\]
Description

Computes the pdf, cdf, value at risk and expected shortfall for the asymmetric Laplace distribution
due to Kotz et al. (2001) given by

\[
  f(x) = \begin{cases} 
    \frac{\kappa \sqrt{2}}{\tau (1 + \kappa^2)} \exp \left( -\frac{\kappa \sqrt{2}}{\tau} |x - \theta| \right), & \text{if } x \geq \theta, \\
    \frac{\kappa \sqrt{2}}{\tau (1 + \kappa^2)} \exp \left( -\frac{\sqrt{2}}{\kappa \tau} |x - \theta| \right), & \text{if } x < \theta,
  \end{cases}
\]

\[
  F(x) = \begin{cases} 
    1 - \frac{1}{1 + \kappa^2} \exp \left( \frac{\sqrt{2}(x - \theta)}{\kappa \tau} \right), & \text{if } x \geq \theta, \\
    \frac{\kappa^2}{1 + \kappa^2} \exp \left( \frac{\sqrt{2}(x - \theta)}{\kappa \tau} \right), & \text{if } x < \theta,
  \end{cases}
\]

\[
  \text{VaR}_p(X) = \begin{cases} 
    \theta - \frac{\tau}{\sqrt{2} \kappa} \log \left( \frac{1}{1-p} \right) \left( 1 + \kappa^2 \right), & \text{if } p \geq \frac{\kappa^2}{1 + \kappa^2}, \\
    \theta + \frac{\kappa \tau}{\sqrt{2}} \log \left( \frac{1}{1-p} \right) \left( 1 + \kappa^2 \right), & \text{if } p < \frac{\kappa^2}{1 + \kappa^2},
  \end{cases}
\]

\[
  \text{ES}_p(X) = \begin{cases} 
    \frac{\theta + \kappa \tau}{\sqrt{2} \kappa} \log \left( \frac{1}{1-p} \right) \left( 1 + \kappa^2 \right) + \frac{2 \kappa (1 + \kappa^2)}{\tau (1 - \kappa^4)} \log \left( 1 + \kappa^2 \right), & \text{if } p \geq \frac{\kappa^2}{1 + \kappa^2}, \\
    \frac{\theta + \kappa \tau}{\sqrt{2} \kappa} \log \left( \frac{1}{1-p} \right) \left( 1 + \kappa^2 \right) + \frac{\sqrt{2} \kappa (1 + \kappa^2)}{\tau (1 - \kappa^4)} \log \left( 1 + \kappa^2 \right), & \text{if } p < \frac{\kappa^2}{1 + \kappa^2},
  \end{cases}
\]

for \(-\infty < x < \infty\), \(0 < p < 1\), \(-\infty < \theta < \infty\), the location parameter, \(\kappa > 0\), the first scale parameter, and \(\tau > 0\), the second scale parameter.

Usage

dasylaplace(x, tau=1, kappa=1, theta=0, log=FALSE)
pasylaplace(x, tau=1, kappa=1, theta=0, log.p=FALSE, lower.tail=TRUE)
varasylaplace(p, tau=1, kappa=1, theta=0, log.p=FALSE, lower.tail=TRUE)
esasylaplace(p, tau=1, kappa=1, theta=0)

Arguments

\(x\) scaler or vector of values at which the pdf or cdf needs to be computed

\(p\) scaler or vector of values at which the value at risk or expected shortfall needs to be computed

\(\theta\) the value of the location parameter, can take any real value, the default is zero

\(\kappa\) the value of the first scale parameter, must be positive, the default is 1
asypower

- **tau**: the value of the second scale parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

**Author(s)**

Saralees Nadarajah

**References**

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

**Examples**

```r
x = runif(10, min = 0, max = 1)
dasylaplace(x)
pasylaplace(x)
varasylaplace(x)
esasylaplace(x)
```

---

**asypower**  
*Asymmetric power distribution*
Description

Computes the pdf, cdf, value at risk and expected shortfall for the asymmetric power distribution due to Komunjer (2007) given by

\[
\begin{align*}
    f(x) &= \begin{cases} 
      \frac{\delta^{1/\lambda}}{\Gamma(1+1/\lambda)} \exp\left[-\frac{\delta}{\lambda^a} |x|^\lambda\right], & \text{if } x \leq 0, \\
      \frac{\delta^{1/\lambda}}{\Gamma(1+1/\lambda)} \exp\left[-\frac{\delta}{(1-a)^{\lambda}} |x|^\lambda\right], & \text{if } x > 0
    \end{cases} \\
    F(x) &= \begin{cases} 
      a - a\mathcal{I}\left(\frac{\delta}{\lambda^a} \sqrt[\lambda]{|x|^\lambda}, 1/\lambda\right), & \text{if } x \leq 0, \\
      a - (1-a)\mathcal{I}\left(\frac{\delta}{(1-a)^\lambda} \sqrt[\lambda]{|x|^\lambda}, 1/\lambda\right), & \text{if } x > 0
    \end{cases}
\end{align*}
\]

\[
\begin{align*}
    \text{VaR}_p(X) &= \begin{cases} 
      -\frac{1}{p} \left[\frac{a^\lambda}{\delta^{\lambda}}\right]^{1/\lambda} \int_0^p \mathcal{I}^{-1}\left(1 - \frac{1}{1-a}, 1/\lambda\right) \frac{1}{\Gamma(\gamma)} \int_0^x t^{\gamma-1} \exp(-t) \, dt, & \text{if } p \leq a, \\
      -\frac{1}{p} \left[\frac{(1-a)^\lambda}{\delta^{\lambda}}\right]^{1/\lambda} \int_0^p \mathcal{I}^{-1}\left(1 - \frac{1}{1-a}, 1/\lambda\right) \frac{1}{\Gamma(\gamma)} \int_0^x t^{\gamma-1} \exp(-t) \, dt, & \text{if } p > a
    \end{cases}
\end{align*}
\]

\[
\begin{align*}
    \text{ES}_p(X) &= \begin{cases} 
      -\frac{1}{p} \left[\frac{a^\lambda}{\delta^{\lambda}}\right]^{1/\lambda} \int_0^p \mathcal{I}^{-1}\left(1 - \frac{1}{1-a}, 1/\lambda\right) \frac{1}{\Gamma(\gamma)} \int_0^x t^{\gamma-1} \exp(-t) \, dt, & \text{if } p \leq a, \\
      -\frac{1}{p} \left[\frac{(1-a)^\lambda}{\delta^{\lambda}}\right]^{1/\lambda} \int_a^p \mathcal{I}^{-1}\left(1 - \frac{1}{1-a}, 1/\lambda\right) \frac{1}{\Gamma(\gamma)} \int_0^x t^{\gamma-1} \exp(-t) \, dt, & \text{if } p > a
    \end{cases}
\end{align*}
\]

for \(-\infty < x < \infty, 0 < p < 1, 0 < a < 1, \) the first scale parameter, \(\delta > 0,\) the second scale parameter, and \(\lambda > 0,\) the shape parameter, where \(\mathcal{I}(x, \gamma) = \frac{1}{\Gamma(\gamma)} \int_0^x t^{\gamma-1} \exp(-t) \, dt.\)

Usage

dasypower(x, a=0.5, lambda=1, delta=1, log=FALSE)
pasypower(x, a=0.5, lambda=1, delta=1, log.p=FALSE, lower.tail=TRUE)
varasypower(p, a=0.5, lambda=1, delta=1, log.p=FALSE, lower.tail=TRUE)
esasypower(p, a=0.5, lambda=1, delta=1)

Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **a**: the value of the first scale parameter, must be in the unit interval, the default is 0.5
- **delta**: the value of the second scale parameter, must be positive, the default is 1
- **lambda**: the value of the shape parameter, must be positive, the default is 1
beard

log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value
An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=unif(10,min=0,max=1)
dasypower(x)
pasypower(x)
varasypower(x)
esasypower(x)

beard Beard distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the Beard distribution due to Beard (1959) given by

\[ f(x) = \frac{a \exp(bx) [1 + a\rho]^{\rho^{-1/b}}}{[1 + a\rho \exp(bx)]^{1+\rho^{-1/b}}}, \]
\[ F(x) = 1 - \frac{[1 + a\rho \exp(bx)]^{\rho^{-1/b}}}{[1 + a\rho]^{\rho^{-1/b}}}, \]
\[ \text{VaR}_p(X) = \frac{1}{b} \log \left[ \frac{1 + a\rho}{a\rho (1 - p)^{\rho^{-1/b}}} - \frac{1}{a\rho} \right], \]
\[ \text{ES}_p(X) = \frac{1}{p} \int_0^p \log \left[ \frac{1}{a\rho} + \frac{1 + a\rho}{a\rho (1 - v)^{\rho^{-1/b}}} \right] dv \]

for \( x > 0, 0 < p < 1, a > 0, \) the first scale parameter, \( b > 0, \) the second scale parameter, and \( \rho > 0, \) the shape parameter.
Usage

dbeard(x, a=1, b=1, rho=1, log=FALSE)
pbeard(x, a=1, b=1, rho=1, log.p=FALSE, lower.tail=TRUE)
varbeard(p, a=1, b=1, rho=1, log.p=FALSE, lower.tail=TRUE)
esbeard(p, a=1, b=1, rho=1)

Arguments

x scaler or vector of values at which the pdf or cdf needs to be computed
p scaler or vector of values at which the value at risk or expected shortfall needs to be computed
a the value of the first scale parameter, must be positive, the default is 1
b the value of the second scale parameter, must be positive, the default is 1
rho the value of the shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10,min=0,max=1)
dbeard(x)
pbeard(x)
varbeard(x)
esbeard(x)
Description

Computes the pdf, cdf, value at risk and expected shortfall for the beta Burr distribution due to Paranaíba et al. (2011) given by

\[
f(x) = \frac{ba^{bd}}{B(c,d)a^{bd+1}} \left[ 1 + \left( \frac{x}{a} \right)^{-b} \right]^{-c-d},
\]

\[
F(x) = \frac{I_{1+\left( \frac{x}{a} \right)^{-b}}} {I_{1+\left( c, d \right)}}
\]

\[
\text{VaR}_p(X) = a \left[ \frac{I_p^{-1}(c,d)}{I_{1+\left( c, d \right)}} \right]^{1/b} \left[ 1 - I_p^{-1}(c,d) \right]^{-1/b},
\]

\[
\text{ES}_p(X) = \frac{a}{p} \int_0^p \left[ \frac{I_u^{-1}(c,d)}{I_{1+\left( c, d \right)}} \right]^{1/b} \left[ 1 - I_u^{-1}(c,d) \right]^{-1/b} \, dv
\]

for \( x > 0, \ 0 < p < 1, \ a > 0, \) the scale parameter, \( b > 0, \) the first shape parameter, \( c > 0, \) the second shape parameter, and \( d > 0, \) the third shape parameter, where \( I_x(a,b) = \int_0^x t^{a-1}(1-t)^{b-1} \, dt \) denotes the incomplete beta function ratio, \( B(a,b) = \int_0^1 t^{a-1}(1-t)^{b-1} \, dt \) denotes the beta function, and \( I_x^{-1}(a,b) \) denotes the inverse function of \( I_x(a,b) \).

Usage

dbetaburr(x, a=1, b=1, c=1, d=1, log=FALSE)
pbetaburr(x, a=1, b=1, c=1, d=1, log.p=FALSE, lower.tail=TRUE)
varbetaburr(p, a=1, b=1, c=1, d=1, log.p=FALSE, lower.tail=TRUE)
esbetaburr(p, a=1, b=1, c=1, d=1)

Arguments

- \( x \) scaler or vector of values at which the pdf or cdf needs to be computed
- \( p \) scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \( a \) the value of the scale parameter, must be positive, the default is 1
- \( b \) the value of the first shape parameter, must be positive, the default is 1
- \( c \) the value of the second shape parameter, must be positive, the default is 1
- \( d \) the value of the third shape parameter, must be positive, the default is 1
- \( \log \) if TRUE then log(pdf) are returned
- \( \log.p \) if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- \( \text{lower.tail} \) if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).
Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10, min=0, max=1)
dbetaburr(x)
pbetaburr(x)
varbetaburr(x)
esbetaburr(x)

betaburr7  Beta Burr XII distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the beta Burr XII distribution given by
\[
\begin{align*}
    f(x) &= \frac{ke^{c-1}}{B(a,b)} \left[1 - (1 + x^c)^{-k}\right]^{a-1} (1 + x^c)^{-bk-1}, \\
    F(x) &= I_{1-(1+x^c)^{-k}}(a,b), \\
    \text{VaR}_p(X) &= \left\{\left[1 - I^{-1}_p(a,b)\right]^{-1/k} - 1\right\}^{1/c}, \\
    \text{ES}_p(X) &= \frac{1}{p} \int_0^p \left\{\left[1 - I^{-1}_p(a,b)\right]^{-1/k} - 1\right\}^{1/c} dv
\end{align*}
\]
for \( x > 0, 0 < p < 1, a > 0, \) the first shape parameter, \( b > 0, \) the second shape parameter, \( c > 0, \) the third shape parameter, and \( k > 0, \) the fourth shape parameter.

Usage
dbetaburr7(x, a=1, b=1, c=1, k=1, log=false)
pbetaburr7(x, a=1, b=1, c=1, k=1, log.p=false, lower.tail=TRUE)
varbetaburr7(p, a=1, b=1, c=1, k=1, log.p=false, lower.tail=TRUE)
esbetaburr7(p, a=1, b=1, c=1, k=1)

Arguments
x  scaler or vector of values at which the pdf or cdf needs to be computed
p  scaler or vector of values at which the value at risk or expected shortfall needs to be computed
a  the value of the first shape parameter, must be positive, the default is 1
betadist

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b the value of the second shape parameter, must be positive, the default is 1
c the value of the third shape parameter, must be positive, the default is 1
k the value of the fourth shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10,min=0,max=1)
dbetaburr7(x)
pbetaburr7(x)
varbetaburr7(x)
esbetaburr7(x)

---------------------

betadist Beta distribution

---------------------

Description

Computes the pdf, cdf, value at risk and expected shortfall for the beta distribution given by

\[ f(x) = \frac{x^{a-1}(1 - x)^{b-1}}{B(a, b)} , \]
\[ F(x) = I_x(a, b) , \]
\[ \text{VaR}_p(X) = I_p^{-1}(a, b) , \]
\[ \text{ES}_p(X) = \frac{1}{p} \int_0^p I_v^{-1}(a, b)dv \]

for \( 0 < x < 1 , 0 < p < 1 , a > 0 \), the first parameter, and \( b > 0 \), the second shape parameter.
Usage

```r
dbetadist(x, a=1, b=1, log=FALSE)
pbetadist(x, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
varbetadist(p, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
esbetadist(p, a=1, b=1)
```  

Arguments

- `x`: scaler or vector of values at which the pdf or cdf needs to be computed
- `p`: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `a`: the value of the first scale parameter, must be positive, the default is 1
- `b`: the value of the second scale parameter, must be positive, the default is 1
- `log`: if TRUE then log(pdf) are returned
- `log.p`: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail`: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x=runif(10, min=0, max=1)
dbetadist(x)
pbetadist(x)
varbetadist(x)
esbetadist(x)
```
Description

Computes the pdf, cdf, value at risk and expected shortfall for the beta exponential distribution due to Nadarajah and Kotz (2006) given by

\[ f(x) = \frac{\lambda \exp(-b \lambda x)}{B(a,b)} [1 - \exp(-\lambda x)]^{a-1}, \]
\[ F(x) = I_{1-exp(-\lambda x)}(a,b), \]
\[ \text{VaR}_p(X) = -\frac{1}{\lambda} \log \left[ 1 - I_p^{-1}(a,b) \right], \]
\[ \text{ES}_p(X) = -\frac{1}{p \lambda} \int_0^p \log \left[ 1 - I_v^{-1}(a,b) \right] dv \]

for \( x > 0, 0 < p < 1, a > 0, b > 0, \) the first shape parameter, \( b > 0, \) the second shape parameter, and \( \lambda > 0, \) the scale parameter, where \( I_x(a,b) = \int_0^x t^{a-1}(1-t)^{b-1} dt / B(a,b) \) denotes the incomplete beta function ratio, \( B(a,b) = \int_0^1 t^{a-1}(1-t)^{b-1} dt \) denotes the beta function, and \( I_x^{-1}(a,b) \) denotes the inverse function of \( I_x(a,b). \)

Usage

\[
\begin{align*}
\text{dbetaexp}(x, \text{lambda}=1, a=1, b=1, \text{log}=\text{FALSE}) \\
\text{pbetaexp}(x, \text{lambda}=1, a=1, b=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
\text{varbetaexp}(p, \text{lambda}=1, a=1, b=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
\text{esbetaexp}(p, \text{lambda}=1, a=1, b=1)
\end{align*}
\]

Arguments

\[
\begin{align*}
x & \text{ scaler or vector of values at which the pdf or cdf needs to be computed} \\
p & \text{ scaler or vector of values at which the value at risk or expected shortfall needs to be computed} \\
\text{lambda} & \text{ the value of the scale parameter, must be positive, the default is 1} \\
a & \text{ the value of the first shape parameter, must be positive, the default is 1} \\
b & \text{ the value of the second shape parameter, must be positive, the default is 1} \\
\text{log} & \text{ if TRUE then log(pdf) are returned} \\
\text{log.p} & \text{ if TRUE then log(cdf) are returned and quantiles are computed for exp(p)} \\
\text{lower.tail} & \text{ if FALSE then 1-cdf are returned and quantiles are computed for 1-p}
\end{align*}
\]

Value

An object of the same length as \( x, \) giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p, \) giving the values at risk or expected shortfall computed at \( p.\)
Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x <- runif(10, min = 0, max = 1)
dbetaexp(x)
pbetaexp(x)
varbetaexp(x)
esbetaexp(x)
```

---

**betafrechet**

*Beta Frechet distribution*

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the beta Frechet distribution due to Barreto-Souza et al. (2011) given by

\[
f(x) = \frac{\alpha \sigma^\alpha}{x^{\alpha+1}B(a,b)} \exp\left\{-a \left(\frac{\sigma}{x}\right)^\alpha\right\} \left[1 - \exp\left\{-\left(\frac{\sigma}{x}\right)^\alpha\right\}\right]^{b-1},
\]

\[
F(x) = \int_0^x \exp\left\{-\left(\frac{\sigma}{v}\right)^\alpha\right\} dv,
\]

\[
{\text{VaR}}_p(X) = \sigma \left[-\log I_p^{-1}(a,b)\right]^{-1/\alpha},
\]

\[
{\text{ES}}_p(X) = \frac{\sigma}{p} \int_0^p \left[-\log I_v^{-1}(a,b)\right]^{-1/\alpha} dv
\]

for \( x > 0, 0 < p < 1, a > 0, \) the first shape parameter, \( \sigma > 0, \) the scale parameter, \( b > 0, \) the second shape parameter, and \( \alpha > 0, \) the third shape parameter.

**Usage**

```r
dbetafrechet(x, a=1, b=1, alpha=1, sigma=1, log=FALSE)
pbetafrechet(x, a=1, b=1, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
varbetafrechet(p, a=1, b=1, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
esbetafrechet(p, a=1, b=1, alpha=1, sigma=1)
```

**Arguments**

- `x` scaler or vector of values at which the pdf or cdf needs to be computed
- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `sigma` the value of the scale parameter, must be positive, the default is 1
betagompertz

\[ f(x) = \frac{b\eta \exp(bx)}{B(c,d)} \exp(d\eta \exp(bx)) \{ 1 - \exp(\eta - \eta \exp(bx)) \}^{c-1}, \]

\[ F(x) = I_1^{-\exp(\eta - \eta \exp(bx))}(c,d), \]

\[ \text{VaR}_p(X) = \frac{1}{b} \log \left\{ 1 - \frac{1}{\eta} \log \left[ 1 - I_p^{-1}(c,d) \right] \right\}, \]

\[ \text{ES}_p(X) = \frac{1}{pb} \int_0^p \log \left\{ 1 - \frac{1}{\eta} \log \left[ 1 - I_v^{-1}(c,d) \right] \right\} dv \]

for \( x > 0, 0 < p < 1, b > 0 \), the first scale parameter, \( \eta > 0 \), the second scale parameter, \( c > 0 \), the first shape parameter, and \( d > 0 \), the second shape parameter.
Usage

dbetagompertz(x, b=1, c=1, d=1, eta=1, log=FALSE)
pbetagompertz(x, b=1, c=1, d=1, eta=1, log.p=FALSE, lower.tail=TRUE)
varbetagompertz(p, b=1, c=1, d=1, eta=1, log.p=FALSE, lower.tail=TRUE)
esbetagompertz(p, b=1, c=1, d=1, eta=1)

Arguments

  x  scaler or vector of values at which the pdf or cdf needs to be computed
  p  scaler or vector of values at which the value at risk or expected shortfall needs
to be computed
  b  the value of the first scale parameter, must be positive, the default is 1
  eta the value of the second scale parameter, must be positive, the default is 1
  c  the value of the first shape parameter, must be positive, the default is 1
  d  the value of the second shape parameter, must be positive, the default is 1
  log if TRUE then log(pdf) are returned
  log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
  lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

  An object of the same length as x, giving the pdf or cdf values computed at x or an object of the
  same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

  Saralees Nadarajah

References

  S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall,
submitted

Examples

  x=runif(10, min=0, max=1)
dbetagompertz(x)
pbetagompertz(x)
varbetagompertz(x)
esbetagompertz(x)
**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the beta Gumbel distribution due to Nadarajah and Kotz (2004) given by

$$f(x) = \frac{1}{\sigma B(a, b)} \exp \left( \frac{\mu - x}{\sigma} \right) \exp \left[ -a \exp \left( \frac{\mu - x}{\sigma} \right) \right] \left\{ 1 - \exp \left( -\exp \left( \frac{\mu - x}{\sigma} \right) \right) \right\}^{b-1},$$

$$F(x) = I_{\exp \left( -\exp \left( \frac{\mu - x}{\sigma} \right) \right)}(a, b),$$

$$\text{VaR}_p(X) = \mu - \sigma \log \left[ -\log I_{p^{-1}}(a, b) \right],$$

$$\text{ES}_p(X) = \mu - \frac{\sigma}{p} \int_0^p \log \left[ -\log I_{v^{-1}}(a, b) \right] dv$$

for $-\infty < x < \infty$, $0 < p < 1$, $-\infty < \mu < \infty$, the location parameter, $\sigma > 0$, the scale parameter, $a > 0$, the first shape parameter, and $b > 0$, the second shape parameter.

**Usage**

```r
dabetagumbel(x, a=1, b=1, mu=0, sigma=1, log=FALSE)
pbetagumbel(x, a=1, b=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
varbetagumbel(p, a=1, b=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
esbetagumbel(p, a=1, b=1, mu=0, sigma=1)
```

**Arguments**

- `x` scaler or vector of values at which the pdf or cdf needs to be computed
- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `mu` the value of the location parameter, can take any real value, the default is zero
- `sigma` the value of the scale parameter, must be positive, the default is 1
- `a` the value of the first shape parameter, must be positive, the default is 1
- `b` the value of the second shape parameter, must be positive, the default is 1
- `log` if TRUE then log(pdf) are returned
- `log.p` if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

**Author(s)**

Saralees Nadarajah
References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x = runif(10, min=0, max=1)
dbetagumbel(x)
pbetagumbel(x)
varbetagumbel(x)
esbetagumbel(x)
```

**betagumbel2**  
*Beta Gumbel 2 distribution*

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the beta Gumbel II distribution given by

\[
 f(x) = \frac{abx^{-a-1}}{B(c,d)} \exp \left( -bdx^{-a} \right) \left[ 1 - \exp \left( -bdx^{-a} \right) \right]^{c-1},
\]

\[
 F(x) = I_{1-\exp(-bx^{-a})}(c,d),
\]

\[
 \text{VaR}_p(X) = b^{1/a} \left\{ -\log \left[ 1 - I_{p}^{-1}(c,d) \right] \right\}^{-1/a},
\]

\[
 \text{ES}_p(X) = b^{1/a} \int_0^p \left\{ -\log \left[ 1 - I_{v}^{-1}(c,d) \right] \right\}^{-1/a} dv
\]

for \( x > 0 \), \( 0 < p < 1 \), \( a > 0 \), the first shape parameter, \( b > 0 \), the scale parameter, \( c > 0 \), the second shape parameter, and \( d > 0 \), the third shape parameter.

**Usage**

```r
dbetagumbel2(x, a=1, b=1, c=1, d=1, log=FALSE)
pbetagumbel2(x, a=1, b=1, c=1, d=1, log.p=FALSE, lower.tail=TRUE)
varbetagumbel2(p, a=1, b=1, c=1, d=1, log.p=FALSE, lower.tail=TRUE)
esbetagumbel2(p, a=1, b=1, c=1, d=1)
```

**Arguments**

- `x` : scaler or vector of values at which the pdf or cdf needs to be computed
- `p` : scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `b` : the value of the scale parameter, must be positive, the default is 1
- `a` : the value of the first shape parameter, must be positive, the default is 1
- `c` : the value of the second shape parameter, must be positive, the default is 1
- `d` : the value of the third shape parameter, must be positive, the default is 1
- `log` : if TRUE then log(pdf) are returned
- `log.p` : if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` : if FALSE then 1-cdf are returned and quantiles are computed for 1-p
betalognorm

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dbetagumbel2(x)
pbetagumbel2(x)
varbetagumbel2(x)
#esbetagumbel2(x)

betalognorm

Beta lognormal distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the beta lognormal distribution due to Castellares et al. (2013) given by

\[ f(x) = \frac{1}{\sigma x B(a, b)} \phi \left( \frac{\log x - \mu}{\sigma} \right) \Phi_{a-1} \left( \frac{\log x - \mu}{\sigma} \right) \Phi_{b-1} \left( \frac{\mu - \log x}{\sigma} \right), \]
\[ F(x) = I_{\Phi \left( \frac{\log x - \mu}{\sigma} \right)} (a, b), \]
\[ \text{VaR}_p(X) = \exp \left[ \mu + \sigma \Phi^{-1} \left( I_{p}^{-1}(a, b) \right) \right], \]
\[ \text{ES}_p(X) = \frac{\exp(\mu)}{p} \int_0^p \exp \left[ \sigma \Phi^{-1} \left( I_{v}^{-1}(a, b) \right) \right] \, dv \]

for \( x > 0, 0 < p < 1, -\infty < \mu < \infty, \) the location parameter, \( \sigma > 0, \) the scale parameter, \( a > 0, \) the first shape parameter, and \( b > 0, \) the second shape parameter, where \( \phi(\cdot) \) denotes the pdf of a standard normal random variable, and \( \Phi(\cdot) \) denotes the cdf of a standard normal random variable.

Usage

dbetalognorm(x, a=1, b=1, mu=0, sigma=1, log=FALSE)
pbetalognorm(x, a=1, b=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
varbetalognorm(p, a=1, b=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
esbetalognorm(p, a=1, b=1, mu=0, sigma=1)
**betalomax**

**Arguments**

- `x` scaler or vector of values at which the pdf or cdf needs to be computed
- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `mu` the value of the location parameter, can take any real value, the default is zero
- `sigma` the value of the scale parameter, must be positive, the default is 1
- `a` the value of the first shape parameter, must be positive, the default is 1
- `b` the value of the second shape parameter, must be positive, the default is 1
- `log` if TRUE then log(pdf) are returned
- `log.p` if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

**Author(s)**

Saralees Nadarajah

**References**

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

**Examples**

```r
x=runif(10,min=0,max=1)
dbetalognorm(x)
pbetalognorm(x)
varbetalognorm(x)
esbetalognorm(x)
```

---

betalomax **Beta Lomax distribution**
Description

Computes the pdf, cdf, value at risk and expected shortfall for the beta Lomax distribution due to Lemonte and Cordeiro (2013) given by

\[
f(x) = \frac{\alpha}{\lambda} \left( 1 + \frac{x}{\lambda} \right)^{1-\beta a - 1} \left[ 1 - \left( 1 + \frac{x}{\lambda} \right)^{-\alpha} \right]^{a - 1},
\]
\[
F(x) = I_{1+\left(1+\frac{x}{\lambda}\right)^{-\alpha}}(a, b),
\]
\[
\text{VaR}_p(X) = \lambda \left[ 1 - I_p^{-1}(a, b) \right]^{-1/\alpha} - \lambda,
\]
\[
\text{ES}_p(X) = \frac{\lambda}{p} \int_p^0 \left[ 1 - I_v^{-1}(a, b) \right]^{-1/\alpha} dv - \lambda
\]

for \(x > 0\), \(0 < p < 1\), \(a > 0\), the first shape parameter, \(b > 0\), the second shape parameter, \(\alpha > 0\), the third shape parameter, and \(\lambda > 0\), the scale parameter.

Usage

\[
dbeta1omax(x, a=1, b=1, alpha=1, lambda=-1, log=FALSE)\\
pbeta1omax(x, a=1, b=1, alpha=1, lambda=-1, log.p=FALSE, lower.tail=TRUE)\\
varbetalomax(p, a=1, b=1, alpha=1, lambda=-1, log.p=FALSE, lower.tail=TRUE)\\
esbetalomax(p, a=1, b=1, alpha=1, lambda=1)
\]

Arguments

- \(x\) scaler or vector of values at which the pdf or cdf needs to be computed
- \(p\) scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \(lambda\) the value of the scale parameter, must be positive, the default is 1
- \(a\) the value of the first scale parameter, must be positive, the default is 1
- \(b\) the value of the second scale parameter, must be positive, the default is 1
- \(alpha\) the value of the third scale parameter, must be positive, the default is 1
- \(log\) if TRUE then log(pdf) are returned
- \(log.p\) if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- \(lower.tail\) if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted
Examples

```r
x = runif(10, min=0, max=1)
dbetalomax(x)
pbetalomax(x)
varbetalomax(x)
esbetalomax(x)
```

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the beta normal distribution due to Eugene et al. (2002) given by

\[
  f(x) = \frac{1}{\sigma B(a, b)} \phi \left( \frac{x - \mu}{\sigma} \right) \Phi^{a-1} \left( \frac{x - \mu}{\sigma} \right) \Phi^{b-1} \left( \frac{\mu - x}{\sigma} \right),
\]

\[
  F(x) = I_{\phi \left( \frac{\mu - x}{\sigma} \right)} (a, b),
\]

\[
  \text{VaR}_p(X) = \mu + \sigma \Phi^{-1} \left( P^{-1}(a, b) \right),
\]

\[
  \text{ES}_p(X) = \mu + \frac{\sigma}{p} \int_0^p \Phi^{-1} \left( P^{-1}(a, b) \right) dv
\]

for \(-\infty < x < \infty, 0 < p < 1, -\infty < \mu < \infty,\) the location parameter, \(\sigma > 0,\) the scale parameter, \(a > 0,\) the first shape parameter, and \(b > 0,\) the second shape parameter.

**Usage**

```r
dbetanorm(x, mu=0, sigma=1, a=1, b=1, log=FALSE)
pbetanorm(x, mu=0, sigma=1, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
varbetanorm(p, mu=0, sigma=1, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
esbetanorm(p, mu=0, sigma=1, a=1, b=1)
```

**Arguments**

- `x` scaler or vector of values at which the pdf or cdf needs to be computed
- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `mu` the value of the location parameter, can take any real value, the default is zero
- `sigma` the value of the scale parameter, must be positive, the default is 1
- `a` the value of the first shape parameter, must be positive, the default is 1
- `b` the value of the second shape parameter, must be positive, the default is 1
- `log` if TRUE then log(pdf) are returned
- `log.p` if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` if FALSE then 1-cdf are returned and quantiles are computed for 1-p
**Value**

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

**Author(s)**

Saralees Nadarajah

**References**

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

**Examples**

```r
x=runif(10, min=0, max=1)
dbetapareto(x)
pbetapareto(x)
varbetapareto(x)
esbetapareto(x)
```

---

**betapareto**

**Beta Pareto distribution**

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the beta Pareto distribution due to Akinsete et al. (2008) given by

\[
 f(x) = \frac{aK^{ad}x^{ad-1}}{B(c, d)} \left[ 1 - \left( \frac{K}{x} \right)^a \right]^{c-1},
\]

\[
 F(x) = I_{1-(\frac{K}{x})^a}(c, d),
\]

\[
 \text{VaR}_p(X) = K \left[ 1 - I_p^{-1}(c, d) \right]^{-1/a},
\]

\[
 \text{ES}_p(X) = \frac{K}{p} \int_0^p \left[ 1 - I_v^{-1}(c, d) \right]^{-1/a} dv
\]

for \( x \geq K, 0 < p < 1, K > 0 \), the scale parameter, \( a > 0 \), the first shape parameter, \( c > 0 \), the second shape parameter, and \( d > 0 \), the third shape parameter.

**Usage**

```r
dbetapareto(x, K=1, a=1, c=1, d=1, log=FALSE)
pbetapareto(x, K=1, a=1, c=1, d=1, log.p=FALSE, lower.tail=TRUE)
varbetapareto(p, K=1, a=1, c=1, d=1, log.p=FALSE, lower.tail=TRUE)
esbetapareto(p, K=1, a=1, c=1, d=1)
```
Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **k**: the value of the scale parameter, must be positive, the default is 1
- **a**: the value of the first shape parameter, must be positive, the default is 1
- **c**: the value of the second shape parameter, must be positive, the default is 1
- **d**: the value of the third shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x=runif(10, min=0, max=1)
dbetapareto(x)
pbetapareto(x)
varbetapareto(x)
esbetapareto(x)
```
Description

Computes the pdf, cdf, value at risk and expected shortfall for the beta Weibull distribution due to Cordeiro et al. (2012b) given by

\[ f(x) = \frac{\alpha x^{\alpha-1}}{\sigma^\alpha B(a,b)} \exp\left\{ -b \left( \frac{x}{\sigma} \right)^\alpha \right\} \left[ 1 - \exp\left\{ -\left( \frac{x}{\sigma} \right)^\alpha \right\} \right]^{a-1}, \]
\[ F(x) = I_{1-\exp\left\{ -\left( \frac{x}{\sigma} \right)^\alpha \right\}}(a,b), \]
\[ \text{VaR}_p(X) = \sigma \left\{ -\log \left[ 1 - \frac{1}{I_{1-p}^{-1}(a,b)} \right] \right\}^{1/a}, \]
\[ \text{ES}_p(X) = \sigma \int_0^p \left\{ -\log \left[ 1 - \frac{1}{I_v^{-1}(a,b)} \right] \right\}^{1/a} dv \]

for \( x > 0, \ 0 < p < 1, \ a > 0, \) the first shape parameter, \( b > 0, \) the second shape parameter, \( \alpha > 0, \) the third shape parameter, and \( \sigma > 0, \) the scale parameter.

Usage

dbetaeibull(x, a=1, b=1, alpha=1, sigma=1, log=FALSE)
pbetaeibull(x, a=1, b=1, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
varbetaeibull(p, a=1, b=1, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
esbetaeibull(p, a=1, b=1, alpha=1, sigma=1)

Arguments

- \( x \) scaler or vector of values at which the pdf or cdf needs to be computed
- \( p \) scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \( \sigma \) the value of the scale parameter, must be positive, the default is 1
- \( a \) the value of the first shape parameter, must be positive, the default is 1
- \( b \) the value of the second shape parameter, must be positive, the default is 1
- \( \alpha \) the value of the third shape parameter, must be positive, the default is 1
- \( \log \) if TRUE then log(pdf) are returned
- \( \log.p \) if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- \( \text{lower.tail} \) if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \( x, \) giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p, \) giving the values at risk or expected shortfall computed at \( p. \)

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted
Examples

\begin{verbatim}
x = runif(10, min=0, max=1)
dbetaweibull(x)
pbetaweibull(x)
varbetaweibull(x)
esbetaweibull(x)
\end{verbatim}

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Birnbaum-Saunders distribution due to Birnbaum and Saunders (1969a, 1969b) given by

\begin{align*}
f(x) &= \frac{x^{1/2} + x^{-1/2}}{2\gamma x^2} \Phi \left( \frac{x^{1/2} - x^{-1/2}}{\gamma} \right), \\
F(x) &= \Phi \left( \frac{x^{1/2} - x^{-1/2}}{\gamma} \right), \\
\text{VaR}_p(X) &= \frac{1}{4} \left\{ \gamma \Phi^{-1}(p) + \sqrt{4 + \gamma^2 [\Phi^{-1}(p)]^2} \right\}^2, \\
\text{ES}_p(X) &= \frac{1}{4p} \int_0^p \left\{ \gamma \Phi^{-1}(v) + \sqrt{4 + \gamma^2 [\Phi^{-1}(v)]^2} \right\}^2 dv
\end{align*}

for \( x > 0, 0 < p < 1, \) and \( \gamma > 0, \) the scale parameter.

Usage

\begin{verbatim}
dBS(x, gamma=1, log=FALSE)
pBS(x, gamma=1, log.p=FALSE, lower.tail=TRUE)
varBS(p, gamma=1, log.p=FALSE, lower.tail=TRUE)
esBS(p, gamma=1)
\end{verbatim}

Arguments

- \textbf{x} : scaler or vector of values at which the pdf or cdf needs to be computed
- \textbf{p} : scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \textbf{gamma} : the value of the scale parameter, must be positive, the default is 1
- \textbf{log} : if TRUE then log(pdf) are returned
- \textbf{log.p} : if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- \textbf{lower.tail} : if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \textbf{x}, giving the pdf or cdf values computed at \textbf{x} or an object of the same length as \textbf{p}, giving the values at risk or expected shortfall computed at \textbf{p}. 

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10, min=0, max=1)
dBS(x)
pBS(x)
varBS(x)
esBS(x)

burr

Burr distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the Burr distribution due to Burr (1942) given by

\[ f(x) = \frac{b a b}{x^{b+1}} \left[ 1 + \left( \frac{x}{a} \right)^{-b} \right]^{-2}, \]

\[ F(x) = \frac{1 + \left( \frac{x}{a} \right)^{-b}}{1}, \]

\[ \text{VaR}_p(X) = a p^{1/b} (1 - p)^{-1/b}, \]

\[ \text{ES}_p(X) = \frac{a}{p} B_p (1/b + 1, 1 - 1/b) \]

for \( x > 0, 0 < p < 1, a > 0, \) the scale parameter, and \( b > 0, \) the shape parameter, where \( B_x(a, b) = \int_0^x t^{a-1} (1 - t)^{-b-1} dt \) denotes the incomplete beta function.

Usage
dburr(x, a=1, b=1, log=FALSE)
pburr(x, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
varburr(p, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
esburr(p, a=1, b=1)

Arguments

x scaler or vector of values at which the pdf or cdf needs to be computed
p scaler or vector of values at which the value at risk or expected shortfall needs to be computed
a the value of the scale parameter, must be positive, the default is 1
b the value of the shape parameter, must be positive, the default is 1
log    if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value
An object of the same length as x, giving the pdf or cdf values computed at x or an object of the
same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10, min=0, max=1)
dburr(x)
pburr(x)
varburr(x)
esburr(x)

burr7  

Burr XII distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the Burr XII distribution due to Burr
(1942) given by
\[
f(x) = \frac{kcx^{c-1}}{(1+x^c)^{k+1}},
\]
\[
F(x) = 1 - (1+x^c)^{-k},
\]
\[
\text{VaR}_p(X) = \left[(1-p)^{-1/k} - 1\right]^{1/c},
\]
\[
\text{ES}_p(X) = \frac{1}{p} \int_0^p \left[(1-v)^{-1/k} - 1\right]^{1/c} \, dv
\]
for \(x > 0\), \(0 < p < 1\), \(c > 0\), the first shape parameter, and \(k > 0\), the second shape parameter.

Usage
dburr7(x, k=1, c=1, log=FALSE)
pburr7(x, k=1, c=1, log.p=FALSE, lower.tail=TRUE)
varburr7(p, k=1, c=1, log.p=FALSE, lower.tail=TRUE)
esburr7(p, k=1, c=1)
Cauchy

Arguments

x  scaler or vector of values at which the pdf or cdf needs to be computed
p  scaler or vector of values at which the value at risk or expected shortfall needs to be computed
k  the value of the first shape parameter, must be positive, the default is 1
c  the value of the second shape parameter, must be positive, the default is 1
log  if TRUE then log(pdf) are returned
log.p  if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail  if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10,min=0,max=1)
dburr7(x)
pburr7(x)
varburr7(x)
esburr7(x)

Cauchy  Cauchy distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Cauchy distribution given by

\[
f(x) = \frac{1}{\pi} \frac{\sigma}{(x - \mu)^2 + \sigma^2},
\]

\[
F(x) = \frac{1}{2} + \frac{1}{\pi} \arctan \left( \frac{x - \mu}{\sigma} \right),
\]

\[
\text{VaR}_p(X) = \mu + \sigma \tan \left( \pi \left( p - \frac{1}{2} \right) \right),
\]

\[
\text{ES}_p(X) = \mu + \frac{\sigma}{p} \int_0^p \tan \left( \pi \left( v - \frac{1}{2} \right) \right) dv
\]
for $-\infty < x < \infty$, $0 < p < 1$, $-\infty < \mu < \infty$, the location parameter, and $\sigma > 0$, the scale parameter.

**Usage**

\[
d\text{Cauchy}(x, \mu=0, \sigma=1, \log=\text{FALSE})
\]

\[
p\text{Cauchy}(x, \mu=0, \sigma=1, \log.p=\text{FALSE}, \text{lower.tail=TRUE})
\]

\[
\text{varCauchy}(p, \mu=0, \sigma=1, \log.p=\text{FALSE}, \text{lower.tail=TRUE})
\]

\[
\text{esCauchy}(p, \mu=0, \sigma=1)
\]

**Arguments**

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **mu**: the value of the location parameter, can take any real value, the default is zero
- **sigma**: the value of the scale parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

**Author(s)**

Saralees Nadarajah

**References**

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

**Examples**

\[
x=\text{runif}(10, \text{min}=0, \text{max}=1)
\]

\[
d\text{Cauchy}(x)
\]

\[
p\text{Cauchy}(x)
\]

\[
\text{varCauchy}(x)
\]

\[
\text{esCauchy}(x)
\]
Description

 Computes the pdf, cdf, value at risk and expected shortfall for the Chen distribution due to Chen (2000) given by

\[
    f(x) = \lambda bx^{b-1} \exp\left(\frac{x^b}{b}\right) \exp\left[\lambda - \lambda \exp\left(\frac{x^b}{b}\right)\right],
\]

\[
    F(x) = 1 - \exp\left[\lambda - \lambda \exp\left(\frac{x^b}{b}\right)\right],
\]

\[
    \text{VaR}_p(X) = \frac{\log\left(1 - \frac{\log(1-p)}{\lambda}\right)}{1/b},
\]

\[
    \text{ES}_p(X) = \frac{1}{p} \int_0^p \left\{\log\left[1 - \frac{\log(1-v)}{\lambda}\right]\right\}^{1/b} dv
\]

for \(x > 0, 0 < p < 1, b > 0\), the shape parameter, and \(\lambda > 0\), the scale parameter.

Usage

\[
    \text{dchen}(x, b=1, \lambda=1, \text{log}=\text{FALSE})
\]
\[
    \text{pchen}(x, b=1, \lambda=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE})
\]
\[
    \text{varchen}(p, b=1, \lambda=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE})
\]
\[
    \text{eschen}(p, b=1, \lambda=1)
\]

Arguments

- \(x\)  scaler or vector of values at which the pdf or cdf needs to be computed
- \(p\)  scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \(\lambda\)  the value of the scale parameter, must be positive, the default is 1
- \(b\)  the value of the shape parameter, must be positive, the default is 1
- \(\text{log}\)  if TRUE then \(\log(\text{pdf})\) are returned
- \(\text{log.p}\)  if TRUE then \(\log(\text{cdf})\) are returned and quantiles are computed for \(\exp(p)\)
- \(\text{lower.tail}\)  if FALSE then \(1-\text{cdf}\) are returned and quantiles are computed for \(1-p\)

Value

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted
Examples

```r
x = runif(10, min = 0, max = 1)
dchen(x)
pchen(x)
varchen(x)
eschen(x)
```

---

**clg** *(Compound Laplace gamma distribution)*

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the compound Laplace gamma distribution given by

\[
f(x) = \frac{ab}{2} \left\{1 + b|x-\theta|\right\}^{-(a+1)},
F(x) = \begin{cases}
1 - \frac{1}{2} \left\{1 + b|x-\theta|\right\}^{-a}, & \text{if } x \leq \theta, \\
1 - \frac{1}{2} \left\{1 + b|x-\theta|\right\}^{-a}, & \text{if } x > \theta,
\end{cases}
\]

\[
\text{VaR}_p(X) = \begin{cases}
\theta - \frac{1}{b} - \frac{(2p)^{-1/a}}{b}, & \text{if } p \leq 1/2, \\
\theta - \frac{1}{b} + \frac{(2(1-p))^{-1/a}}{b}, & \text{if } p > 1/2,
\end{cases}
\]

\[
\text{ES}_p(X) = \begin{cases}
\theta - \frac{1}{b} - \frac{2(1-p)^{1-1/a}}{2pb(1-1/a)}, & \text{if } p \leq 1/2, \\
\theta - \frac{1}{b} - \frac{2(1-p)^{1-1/a}}{2pb(1-1/a)}, & \text{if } p > 1/2
\end{cases}
\]

for \(-\infty < x < \infty, 0 < p < 1, -\infty < \theta < \infty, \) the location parameter, \(b > 0, \) the scale parameter, and \(a > 0, \) the shape parameter.

**Usage**

```r
dclg(x, a=1, b=1, theta=0, log=FALSE)
pclg(x, a=1, b=1, theta=0, log=p=FALSE, lower.tail=TRUE)
varclg(p, a=1, b=1, theta=0, log=p=FALSE, lower.tail=TRUE)
esclg(p, a=1, b=1, theta=0)
```

**Arguments**

- **x** scaler or vector of values at which the pdf or cdf needs to be computed
- **p** scaler or vector of values at which the value at risk or expected shortfall needs to be computed
**compbeta**

Description

Computes the pdf, cdf, value at risk and expected shortfall for the complementary beta distribution due to Jones (2002) given by

\[
\begin{align*}
f(x) &= B(a, b) \left\{ I^{-1}_x(a, b) \right\}^{1-a} \left\{ 1 - I^{-1}_x(a, b) \right\}^{1-b}, \\
F(x) &= I^{-1}_x(a, b), \\
\text{VaR}_p(X) &= I_p(a, b), \\
\text{ES}_p(X) &= \frac{1}{p} \int_0^p I_v(a, b)dv
\end{align*}
\]

for \(0 < x < 1, 0 < p < 1, a > 0\), the first shape parameter, and \(b > 0\), the second shape parameter.

theta: the value of the location parameter, can take any real value, the default is zero

b: the value of the scale parameter, must be positive, the default is 1

a: the value of the shape parameter, must be positive, the default is 1

log: if TRUE then log(pdf) are returned

log.p: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)

lower.tail: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x=runif(10, min=0, max=1)
dclg(x)
pclg(x)
varclg(x)
esclg(x)
```
compbeta

Usage

dcompbeta(x, a=1, b=1, log=FALSE)
pcompbeta(x, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
varcompbeta(p, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
escompbeta(p, a=1, b=1)

Arguments

x scaler or vector of values at which the pdf or cdf needs to be computed
p scaler or vector of values at which the value at risk or expected shortfall needs
to be computed
a the value of the first shape parameter, must be positive, the default is 1
b the value of the second shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the
same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall,
submitted

Examples

x=runif(10, min=0, max=1)
dcompbeta(x)
pcompbeta(x)
varcompbeta(x)
escompbeta(x)
Dagum distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Dagum distribution due to Dagum (1975, 1977, 1980) given by

\[
f(x) = \frac{a c b^a x^{ac-1}}{[x^a + b]^c+1},
\]

\[
F(x) = \left[1 + \left(\frac{b}{x}\right)^a\right]^{-c},
\]

\[
\text{VaR}_p(X) = b \left(1 - p^{-1/c}\right)^{-1/a},
\]

\[
\text{ES}_p(X) = \frac{b}{p} \int_0^p \left(1 - v^{-1/c}\right)^{-1/a} dv
\]

for \(x > 0, 0 < p < 1, a > 0\), the first shape parameter, \(b > 0\), the scale parameter, and \(c > 0\), the second shape parameter.

Usage

ddagum(x, a=1, b=1, c=1, log=FALSE)

pdagum(x, a=1, b=1, c=1, log.p=FALSE, lower.tail=TRUE)

vardagum(p, a=1, b=1, c=1, log.p=FALSE, lower.tail=TRUE)

esdagum(p, a=1, b=1, c=1)

Arguments

\(x\) scalar or vector of values at which the pdf or cdf needs to be computed

\(p\) scalar or vector of values at which the value at risk or expected shortfall needs to be computed

\(b\) the value of the scale parameter, must be positive, the default is 1

\(a\) the value of the first shape parameter, must be positive, the default is 1

\(c\) the value of the second shape parameter, must be positive, the default is 1

\(\text{log}\) if TRUE then log(pdf) are returned

\(\text{log.p}\) if TRUE then log(cdf) are returned and quantiles are computed for exp(p)

\(\text{lower.tail}\) if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).
Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
ddagum(x)
pdagum(x)
vardagum(x)
esdagum(x)

dweibull

Double Weibull distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the double Weibull distribution due to Balakrishnan and Kocherlakota (1985) given by

\[
f(x) = \frac{c}{2\sigma} \left( \frac{x - \mu}{\sigma} \right)^{c-1} \exp\left\{ - \left( \frac{x - \mu}{\sigma} \right)^c \right\},
\]\n
\[
F(x) = \begin{cases} 
\frac{1}{2} \exp\left\{-\left(\frac{\mu - x}{\sigma}\right)^c\right\}, & \text{if } x \leq \mu, \\
1 - \frac{1}{2} \exp\left\{-\left(\frac{x - \mu}{\sigma}\right)^c\right\}, & \text{if } x > \mu,
\end{cases}
\]

\[
\text{VaR}_p(X) = \begin{cases} 
\mu - \sigma \left[ -\log(2p) \right]^{1/c}, & \text{if } p \leq 1/2, \\
\mu + \sigma \left[ -\log(2(1-p)) \right]^{1/c}, & \text{if } p > 1/2,
\end{cases}
\]

\[
\text{ES}_p(X) = \begin{cases} 
\mu - \frac{\sigma}{p} \int_0^p \left[ -\log(2 - \log v) \right]^{1/c} dv, & \text{if } p \leq 1/2, \\
\mu - \frac{\sigma}{p} \int_0^{1/2} \left[ -\log 2 - \log v \right]^{1/c} dv + \frac{\sigma}{p} \int_0^{p} \left[ -\log(1 - v) \right]^{1/c} dv, & \text{if } p > 1/2\]
\]

for \(-\infty < x < \infty, 0 < p < 1, -\infty < \mu < \infty, \) the location parameter, \(\sigma > 0,\) the scale parameter, and \(c > 0,\) the shape parameter.
Usage

\begin{align*}
\text{ddweibull}(x, c=1, \mu=0, \sigma=1, \log=FALSE) \\
\text{pdweibull}(x, c=1, \mu=0, \sigma=1, \log.p=FALSE, \text{lower.tail}=TRUE) \\
\text{vardweibull}(p, c=1, \mu=0, \sigma=1, \log.p=FALSE, \text{lower.tail}=TRUE) \\
\text{esdweibull}(p, c=1, \mu=0, \sigma=1)
\end{align*}

Arguments

- \text{x}: scaler or vector of values at which the pdf or cdf needs to be computed
- \text{p}: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \text{mu}: the value of the location parameter, can take any real value, the default is zero
- \text{sigma}: the value of the scale parameter, must be positive, the default is 1
- \text{c}: the value of the shape parameter, must be positive, the default is 1
- \text{log}: if TRUE then log(pdf) are returned
- \text{log.p}: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- \text{lower.tail}: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \text{x}, giving the pdf or cdf values computed at \text{x} or an object of the same length as \text{p}, giving the values at risk or expected shortfall computed at \text{p}.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\begin{align*}
x=\text{runif}(10, \text{min}=0, \text{max}=1) \\
\text{ddweibull}(x) \\
\text{pdweibull}(x) \\
\text{vardweibull}(x) \\
\text{esdweibull}(x)
\end{align*}
Description

Computes the pdf, cdf, value at risk and expected shortfall for the exponentiated exponential distribution due to Gupta and Kundu (1999, 2001) given by

\[
\begin{align*}
    f(x) &= a\lambda \exp(-\lambda x)|1 - \exp(-\lambda x)|^{a-1}, \\
    F(x) &= [1 - \exp(-\lambda x)^a, \\
    \text{VaR}_p(X) &= -\frac{1}{\lambda} \log \left(1 - p^{1/a}\right), \\
    \text{ES}_p(X) &= -\frac{1}{p\lambda} \int_0^p \log \left(1 - v^{1/a}\right) dv
\end{align*}
\]

for \(x > 0, 0 < p < 1, a > 0\), the shape parameter and \(\lambda > 0\), the scale parameter.

Usage

dexpexp(x, lambda=1, a=1, log=FALSE)
pexpexp(x, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)
varexpexp(p, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)
esexpexp(p, lambda=1, a=1)

Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **lambda**: the value of the scale parameter, must be positive, the default is 1
- **a**: the value of the shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted
expext

Examples

```r
x = runif(10, min = 0, max = 1)
dexpexp(x)
pexpexp(x)
varexpexp(x)
esexpexp(x)
```

expext

Exponential extension distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the exponential extension distribution due to Nadarajah and Haghighi (2011) given by

\[
\begin{align*}
f(x) &= a\lambda(1 + \lambda x)^{a-1} \exp\left[1 - (1 + \lambda x)^a\right], \\
F(x) &= 1 - \exp\left[1 - (1 + \lambda x)^a\right], \\
\text{VaR}_p(X) &= \left[1 - \log(1 - p)\right]^{1/a} - 1, \\
\text{ES}_p(X) &= -\frac{1}{\lambda} + \frac{1}{\lambda p} \int_0^p \left[1 - \log(1 - v)\right]^{1/a} dv
\end{align*}
\]

for \( x > 0, 0 < p < 1, a > 0 \), the shape parameter and \( \lambda > 0 \), the scale parameter.

Usage

```r
dexpexp(x, lambda=1, a=1, log=FALSE)
pexpexp(x, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)
varexpexp(p, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)
esexpexp(p, lambda=1, a=1)
```

Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **lambda**: the value of the scale parameter, must be positive, the default is 1
- **a**: the value of the shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.
expgeo

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
```r
x = runif(10, min=0, max=1)
dexpgeo(x)
pexpgeo(x)
varexpgeo(x)
esexpgeo(x)
```

---

expgeo

**Exponential geometric distribution**

Description
Computes the pdf, cdf, value at risk and expected shortfall for the exponential geometric distribution due to Adamidis and Loukas (1998) given by

\[
f(x) = \frac{\lambda \theta \exp(-\lambda x)}{[1 - (1 - \theta) \exp(-\lambda x)]^2},
\]

\[
F(x) = \frac{\theta \exp(-\lambda x)}{1 - (1 - \theta) \exp(-\lambda x)},
\]

\[
\text{VaR}_p(X) = -\frac{1}{\lambda} \log \frac{\theta + (1 - \theta)p}{\theta + (1 - \theta)p},
\]

\[
\text{ES}_p(X) = -\frac{\log p}{\lambda} \frac{\theta \log \theta}{\theta + (1 - \theta)p} + \frac{\theta + (1 - \theta)p}{\theta + (1 - \theta)p} \log [\theta + (1 - \theta)p]
\]

for \( x > 0, 0 < p < 1, 0 < \theta < 1, \) the first scale parameter, and \( \lambda > 0, \) the second scale parameter.

Usage
```r
dexpgeo(x, theta=0.5, lambda=1, log=FALSE)
pexpgeo(x, theta=0.5, lambda=1, log.p=FALSE, lower.tail=TRUE)
varexpgeo(p, theta=0.5, lambda=1, log.p=FALSE, lower.tail=TRUE)
esexpgeo(p, theta=0.5, lambda=1)
```

Arguments
- **x**
  - scaler or vector of values at which the pdf or cdf needs to be computed
- **p**
  - scaler or vector of values at which the value at risk or expected shortfall needs to be computed
explog

theta
the value of the first scale parameter, must be in the unit interval, the default is 0.5

lambda
the value of the second scale parameter, must be positive, the default is 1

log
if TRUE then log(pdf) are returned

log.p
if TRUE then log(cdf) are returned and quantiles are computed for exp(p)

lower.tail
if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value
An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10,min=0,max=1)
dexpgeo(x)
pexpgeo(x)
varexpgeo(x)
esexpgeo(x)

Description
Computes the pdf, cdf, value at risk and expected shortfall for the exponential logarithmic distribution due to Tahmasbi and Rezaei (2008) given by

\[ f(x) = \frac{b(1-a) \exp(-bx)}{\log a [1 - (1 - a) \exp(-bx)]}, \]

\[ F(x) = 1 - \frac{\log a}{\log [1 - (1 - a) \exp(-bx)]}, \]

\[ \text{VaR}_p(X) = -\frac{1}{b} \log \left[ \frac{1 - a^{1-p}}{1 - a} \right], \]

\[ \text{ES}_p(X) = -\frac{1}{bp} \int_0^p \log \left[ \frac{1 - a^{1-v}}{1 - a} \right] dv \]

for \( x > 0, 0 < p < 1, 0 < a < 1 \), the first scale parameter, and \( b > 0 \), the second scale parameter.
Usage

dexplog(x, a=0.5, b=1, log=FALSE)
pexplog(x, a=0.5, b=1, log.p=FALSE, lower.tail=TRUE)
varexplog(p, a=0.5, b=1, log.p=FALSE, lower.tail=TRUE)
esexplog(p, a=0.5, b=1)

Arguments

x scaler or vector of values at which the pdf or cdf needs to be computed
p scaler or vector of values at which the value at risk or expected shortfall needs to be computed
a the value of the first scale parameter, must be in the unit interval, the default is 0.5
b the value of the second scale parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10,min=0,max=1)
dexplog(x)
pexplog(x)
varexplog(x)
esexplog(x)
explogis

Exponentiated logistic distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the exponentiated logistic distribution given by

\[ f(x) = \left(\frac{a}{b}\right) \exp\left(-\frac{x}{b}\right) \left[1 + \exp\left(-\frac{x}{b}\right)\right]^{-a-1}, \]
\[ F(x) = \left[1 + \exp\left(-\frac{x}{b}\right)\right]^{-a}, \]
\[ \text{VaR}_p(X) = -\frac{b}{p} \log\left[p^{-1/a} - 1\right], \]
\[ \text{ES}_p(X) = -\frac{b}{p} \int_0^p \log\left[v^{-1/a} - 1\right] dv \]

for \(-\infty < x < \infty, 0 < p < 1, a > 0,\) the shape parameter, and \(b > 0,\) the scale parameter.

Usage

\[
\begin{align*}
dexplogis(x, a=1, b=1, log=FALSE) \\
pexplogis(x, a=1, b=1, log.p=FALSE, lower.tail=TRUE) \\
varexplogis(p, a=1, b=1, log.p=FALSE, lower.tail=TRUE) \\
esexplogis(p, a=1, b=1)
\end{align*}
\]

Arguments

- \(x\) scaler or vector of values at which the pdf or cdf needs to be computed
- \(p\) scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \(b\) the value of the scale parameter, must be positive, the default is 1
- \(a\) the value of the shape parameter, must be positive, the default is 1
- \(log\) if TRUE then log(pdf) are returned
- \(log.p\) if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- \(lower.tail\) if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted
Examples

```r
x = runif(10, min = 0, max = 1)
dexplogis(x)
pexplogis(x)
varexplogis(x)
esexplogis(x)
```

---

**Exponential distribution**

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the exponential distribution given by

\[
\begin{align*}
    f(x) &= \lambda \exp(-\lambda x), \\
    F(x) &= 1 - \exp(-\lambda x), \\
    \text{VaR}_p(X) &= -\frac{1}{\lambda} \log(1 - p), \\
    \text{ES}_p(X) &= -\frac{1}{p\lambda} \{\log(1 - p)p - p - \log(1 - p)\}
\end{align*}
\]

for \(x > 0\), \(0 < p < 1\), and \(\lambda > 0\), the scale parameter.

**Usage**

```r
dexplogis(x, lambda = 1, log = FALSE)
pexplogis(x, lambda = 1, log.p = FALSE, lower.tail = TRUE)
varexplogis(p, lambda = 1, log.p = FALSE, lower.tail = TRUE)
esexplogis(p, lambda = 1)
```

**Arguments**

- `x`.scaler or vector of values at which the pdf or cdf needs to be computed
- `p`.scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `lambda` the value of the scale parameter, must be positive, the default is 1
- `log`if TRUE then log(pdf) are returned
- `log.p`if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail`if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

**Author(s)**

Saralees Nadarajah
Exponential Poisson distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the exponential Poisson distribution due to Kus (2007) given by

\[
\begin{align*}
  f(x) &= \frac{b\lambda \exp[-bx - \lambda + \lambda \exp(-bx)]}{1 - \exp(-\lambda)}, \\
  F(x) &= \frac{1 - \exp[-\lambda + \lambda \exp(-bx)]}{1 - \exp(-\lambda)}, \\
  \text{VaR}_p(X) &= -\frac{1}{b} \log \left\{ \frac{1}{\lambda} \log \left[ 1 - p + p \exp(-\lambda) \right] + 1 \right\}, \\
  \text{ES}_p(X) &= -\frac{1}{bp} \int_0^p \log \left\{ \frac{1}{\lambda} \log \left[ 1 - v + v \exp(-\lambda) \right] + 1 \right\} dv
\end{align*}
\]

for \( x > 0, 0 < p < 1, b > 0 \), the first scale parameter, and \( \lambda > 0 \), the second scale parameter.

Usage

\[
\begin{align*}
  &\text{dexppois}(x, b=1, \lambda=1, \log=\text{FALSE}) \\
  &\text{pexppois}(x, b=1, \lambda=1, \log.p=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
  &\text{varexppois}(p, b=1, \lambda=1, \log.p=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
  &\text{esexppois}(p, b=1, \lambda=1)
\end{align*}
\]

Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **b**: the value of the first scale parameter, must be positive, the default is 1
- **lambda**: the value of the second scale parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p
Value
An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
\[
\begin{align*}
x &= \text{runif}(10, \text{min}=0, \text{max}=1) \\
dx &= \text{dexp}(x) \\
p &= \text{pexp}(x) \\
v &= \text{varexp}(x) \\
es &= \text{esexp}(x)
\end{align*}
\]

---

exppower

Exponential power distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the exponential power distribution due to Subbotin (1923) given by

\[
f(x) = \begin{cases} 
\frac{1}{2^{1/a} \sigma^{1/a} \Gamma(1 + 1/a)} \exp \left\{ -\frac{|x - \mu|^{a}}{a \sigma^{a}} \right\}, & \text{if } x \leq \mu, \\
\frac{1}{2} Q \left( \frac{1}{a} \frac{(\mu - x)^{a}}{\sigma^{a}} \right), & \text{if } x > \mu,
\end{cases}
\]

\[
F(x) = \begin{cases} 
1 - \frac{1}{2} Q \left( \frac{1}{a} \frac{(x - \mu)^{a}}{\sigma^{a}} \right), & \text{if } x > \mu,
\end{cases}
\]

\[
\text{VaR}_p(X) = \begin{cases} 
\mu - a^{1/a} \sigma \left[ Q^{-1} \left( \frac{1}{a}, 2p \right) \right]^{1/a}, & \text{if } p \leq 1/2, \\
\mu + a^{1/a} \sigma \left[ Q^{-1} \left( \frac{1}{a}, 2(1-p) \right) \right]^{1/a}, & \text{if } p > 1/2,
\end{cases}
\]

\[
\text{ES}_p(X) = \begin{cases} 
\mu - a^{1/a} \sigma \int_0^p \left[ Q^{-1} \left( \frac{1}{a}, 2v \right) \right]^{1/a} dv, & \text{if } p \leq 1/2, \\
\mu - a^{1/a} \sigma \int_0^1 \left[ Q^{-1} \left( \frac{1}{a}, 2v \right) \right]^{1/a} dv \\
+ a^{1/a} \sigma \int_{1/2}^{p} \left[ Q^{-1} \left( \frac{1}{a}, 2(1-v) \right) \right]^{1/a} dv, & \text{if } p > 1/2
\end{cases}
\]
for $-\infty < x < \infty$, $0 < p < 1$, $-\infty < \mu < \infty$, the location parameter, $\sigma > 0$, the scale parameter, and $a > 0$, the shape parameter.

Usage

dexppower(x, mu=0, sigma=1, a=1, log=FALSE)
pexppower(x, mu=0, sigma=1, a=1, log.p=FALSE, lower.tail=TRUE)
varexppower(p, mu=0, sigma=1, a=1, log.p=FALSE, lower.tail=TRUE)
esexppower(p, mu=0, sigma=1, a=1)

Arguments

x scaler or vector of values at which the pdf or cdf needs to be computed
p scaler or vector of values at which the value at risk or expected shortfall needs to be computed
mu the value of the location parameter, can take any real value, the default is zero
sigma the value of the scale parameter, must be positive, the default is 1
a the value of the shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dexppower(x)
pexppower(x)
varexppower(x)
esexppower(x)
Description

Computes the pdf, cdf, value at risk and expected shortfall for the exponentiated Weibull distribution due to Mudholkar and Srivastava (1993) and Mudholkar et al. (1995) given by

\[
\begin{align*}
  f(x) &= a\alpha\sigma^{-\alpha}x^{\alpha-1}\exp\left[-\left(x/\sigma\right)^\alpha\right]\left\{1 - \exp\left[-\left(x/\sigma\right)^\alpha\right]\right\}^{a-1}, \\
  F(x) &= \left\{1 - \exp\left[-\left(x/\sigma\right)^\alpha\right]\right\}^a, \\
  \text{VaR}_p(X) &= \sigma\left[-\log \left(1 - p^{1/\alpha}\right)\right]^{1/\alpha}, \\
  \text{ES}_p(X) &= \sigma/p \int_0^p \left[-\log \left(1 - v^{1/\alpha}\right)\right]^{1/\alpha} dv
\end{align*}
\]

for \(x > 0\), \(0 < p < 1\), \(a > 0\), the first shape parameter, \(\alpha > 0\), the second shape parameter, and \(\sigma > 0\), the scale parameter.

Usage

dexpweibull(x, a=1, alpha=1, sigma=1, log=FALSE)
pexpweibull(x, a=1, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
varexpweibull(p, a=1, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
esexpweibull(p, a=1, alpha=1, sigma=1)

Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **sigma**: the value of the scale parameter, must be positive, the default is 1
- **a**: the value of the first shape parameter, must be positive, the default is 1
- **alpha**: the value of the second shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

Author(s)

Saralees Nadarajah
References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10, min=0, max=1)
dexpweibull(x)
pexpweibull(x)
varexpweibull(x)
esexpweibull(x)

F
F distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the F distribution given by

\[
f(x) = \frac{1}{B\left(\frac{d_1}{2}, \frac{d_2}{2}\right)} \left(\frac{d_1}{d_2}\right)^{\frac{d_1}{2}} \left(\frac{x}{d_2}\right)^{\frac{d_1}{2} - 1} \left(1 + \frac{d_1}{d_2} x\right)^{-\frac{d_1 + d_2}{2}}, \]

\[
F(x) = I_{\frac{d_1}{d_2}}\left(\frac{d_1}{2}, \frac{d_2}{2}\right),
\]

\[
\text{VaR}_p(X) = \frac{d_2}{d_1} \frac{I_p^{-1}\left(\frac{d_1}{2}, \frac{d_2}{2}\right)}{1 - I_p^{-1}\left(\frac{d_1}{2}, \frac{d_2}{2}\right)},
\]

\[
\text{ES}_p(X) = \frac{d_2}{d_1} p \int_0^p I_v^{-1}\left(\frac{d_1}{2}, \frac{d_2}{2}\right) dv
\]

for \( x \geq K, 0 < p < 1, d_1 > 0, \) the first degree of freedom parameter, and \( d_2 > 0, \) the second degree of freedom parameter.

Usage
\[
dF(x, d1=1, d2=1, log=FALSE)
pF(x, d1=1, d2=1, log.p=FALSE, lower.tail=TRUE)
varF(p, d1=1, d2=1, log.p=FALSE, lower.tail=TRUE)
esF(p, d1=1, d2=1)
\]

Arguments
\begin{itemize}
\item \textbf{x} \hspace{1cm} scaler or vector of values at which the pdf or cdf needs to be computed
\item \textbf{p} \hspace{1cm} scaler or vector of values at which the value at risk or expected shortfall needs to be computed
\item \textbf{d1} \hspace{1cm} the value of the first degree of freedom parameter, must be positive, the default is 1
\end{itemize}
d2 the value of the second degree of freedom parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value
An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10, min=0, max=1)
dFr(x)
pFr(x)
varFr(x)
esFr(x)

Description
Computes the pdf, cdf, value at risk and expected shortfall for the Freimer distribution due to Freimer et al. (1988) given by

$$\text{VaR}_p(X) = \frac{1}{a} \left[ \frac{p^b - 1}{b} - \frac{(1 - p)^c - 1}{c} \right],$$

$$\text{ES}_p(X) = \frac{1}{a} \left( \frac{1}{c} - \frac{1}{b} \right) + \frac{p^b}{ab(b+1)} + \frac{(1 - p)^c+1 - 1}{pac(c+1)}$$

for $0 < p < 1$, $a > 0$, the scale parameter, $b > 0$, the first shape parameter, and $c > 0$, the second shape parameter.

Usage
varFR(p, a=1, b=1, c=1, log.p=FALSE, lower.tail=TRUE)
esFR(p, a=1, b=1, c=1)
frechet

Arguments

- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `a` the value of the scale parameter, must be positive, the default is 1
- `b` the value of the first shape parameter, must be positive, the default is 1
- `c` the value of the second shape parameter, must be positive, the default is 1
- `log` if TRUE then log(pdf) are returned
- `log.p` if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x=runif(10, min=0, max=1)
varfr(x)
esfr(x)
```

---

frechet Frechet distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Fréchet distribution due to Fréchet (1927) given by

\[
f(x) = \frac{\alpha \sigma^\alpha}{x^{\alpha+1}} \exp \left\{ - \left( \frac{\sigma}{x} \right)^\alpha \right\},
\]

\[
F(x) = \exp \left\{ - \left( \frac{\sigma}{x} \right)^\alpha \right\},
\]

\[
\text{VaR}_p(X) = \sigma \left[ -\log p \right]^{-1/\alpha},
\]

\[
\text{ES}_p(X) = \frac{\sigma}{p} \Gamma (1 - 1/\alpha, -\log p)
\]

for \( x > 0, \ 0 < p < 1, \ \alpha > 0, \) the shape parameter, and \( \sigma > 0, \) the scale parameter, where \( \Gamma(a, x) = \int_x^\infty t^{a-1} \exp(-t) \, dt \) denotes the complementary incomplete gamma function.
Usage

dfrechet(x, alpha=1, sigma=1, log=FALSE)
pfrechet(x, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
varfrechet(p, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
esfrechet(p, alpha=1, sigma=1)

Arguments

x scalar or vector of values at which the pdf or cdf needs to be computed
p scalar or vector of values at which the value at risk or expected shortfall needs to be computed
sigma the value of the scale parameter, must be positive, the default is 1
alpha the value of the shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10,min=0,max=1)
dfrechet(x)
pfrechet(x)
varfrechet(x)
esfrechet(x)
Description

Computes the pdf, cdf, value at risk and expected shortfall for the gamma distribution given by

\[ f(x) = \frac{b^a x^{a-1} \exp(-bx)}{\Gamma(a)}, \]
\[ F(x) = \frac{\gamma(a, bx)}{\Gamma(a)}, \]
\[ \text{VaR}_p(X) = \frac{1}{b} Q^{-1}(a, 1 - p), \]
\[ \text{ES}_p(X) = \frac{1}{bp} \int_0^p Q^{-1}(a, 1 - v) dv \]

for \( x > 0, 0 < p < 1, b > 0 \), the scale parameter, and \( a > 0 \), the shape parameter, where \( \gamma(a, x) = \int_0^x t^{a-1} \exp(-t) dt \) denotes the incomplete gamma function, \( Q(a, x) = \int_x^{\infty} t^{a-1} \exp(-t) dt / \Gamma(a) \) denotes the regularized complementary incomplete gamma function, \( \Gamma(a) = \int_0^{\infty} t^{a-1} \exp(-t) dt \) denotes the gamma function, and \( Q^{-1}(a, x) \) denotes the inverse of \( Q(a, x) \).

Usage

- \( \text{dGamma}(x, a=1, b=1, \log=\text{FALSE}) \)
- \( \text{pgamma}(x, a=1, b=1, \log.p=\text{FALSE}, \lower.tail=\text{TRUE}) \)
- \( \text{varGamma}(p, a=1, b=1, \log.p=\text{FALSE}, \lower.tail=\text{TRUE}) \)
- \( \text{esGamma}(p, a=1, b=1) \)

Arguments

- \( x \) scaler or vector of values at which the pdf or cdf needs to be computed
- \( p \) scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \( b \) the value of the scale parameter, must be positive, the default is 1
- \( a \) the value of the shape parameter, must be positive, the default is 1
- \( \log \) if TRUE then log(pdf) are returned
- \( \log.p \) if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- \( \lower.tail \) if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah
References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dGamma(x)
pGamma(x)
varGamma(x)
esGamma(x)

dgenbeta(x, a=1, b=1, c=0, d=1, log=FALSE)
pgenbeta(x, a=1, b=1, c=0, d=1, log.p=FALSE, lower.tail=TRUE)
vargenbeta(p, a=1, b=1, c=0, d=1, log.p=FALSE, lower.tail=TRUE)
esgenbeta(p, a=1, b=1, c=0, d=1)

Arguments

x scaler or vector of values at which the pdf or cdf needs to be computed
p scaler or vector of values at which the value at risk or expected shortfall needs to be computed
c the value of the first location parameter, can take any real value, the default is zero
d the value of the second location parameter, can take any real value but must be greater than c, the default is 1
a the value of the first shape parameter, must be positive, the default is 1

Description

Computes the pdf, cdf, value at risk and expected shortfall for the generalized beta distribution given by

\[ f(x) = \frac{(x - c)^{a-1}(d - x)^{b-1}}{B(a, b)(d - c)^{a+b-1}}, \]
\[ F(x) = I_{x-c}^a(a, b), \]
\[ \text{VaR}_p(X) = c + (d - c)I_p^{-1}(a, b), \]
\[ \text{ES}_p(X) = c + \frac{d - c}{p} \int_0^p I_v^{-1}(a, b)dv \]

for \( c \leq x \leq d, 0 < p < 1, a > 0, \) the first shape parameter, \( b > 0, \) the second shape parameter, \( -\infty < c < \infty, \) the first location parameter, and \( -\infty < c < d < \infty, \) the second location parameter.
the value of the second shape parameter, must be positive, the default is 1

if TRUE then log(pdf) are returned

if TRUE then log(cdf) are returned and quantiles are computed for exp(p)

if FALSE then 1-cdf are returned and quantiles are computed for 1-p

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Saralees Nadarajah

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

x=runif(10,min=0,max=1)
dgenbeta(x)
pgenbeta(x)
vargenbeta(x)
esgenbeta(x)

Computes the pdf, cdf, value at risk and expected shortfall for the generalized beta II distribution given by

\[ f(x) = \frac{e^{axc - 1} (1 - x^c)^{b-1}}{B(a, b)}, \]
\[ F(x) = I_{x^c}(a, b), \]
\[ \text{VaR}_p(X) = \left[ I_{p}^{-1}(a, b) \right]^{1/c}, \]
\[ \text{ES}_p(X) = \frac{1}{p} \int_{0}^{p} \left[ I_{v}^{-1}(a, b) \right]^{1/c} dv \]

for 0 < x < 1, 0 < p < 1, a > 0, the first shape parameter, b > 0, the second shape parameter, and c > 0, the third shape parameter.
Usage

dgenbeta2(x, a=1L, b=1L, c=1L, log=FALSE)
pagenbeta2(x, a=1L, b=1L, c=1L, log.p=FALSE, lower.tail=TRUE)
vargenbeta2(p, a=1L, b=1L, c=1L, log.p=FALSE, lower.tail=TRUE)
esgenbeta2(p, a=1L, b=1L, c=1L)

Arguments

x     scaler or vector of values at which the pdf or cdf needs to be computed
p     scaler or vector of values at which the value at risk or expected shortfall needs to be computed
a     the value of the first shape parameter, must be positive, the default is 1
b     the value of the second shape parameter, must be positive, the default is 1
c     the value of the third shape parameter, must be positive, the default is 1
log   if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dgenbeta2(x)
pagenbeta2(x)
vargenbeta2(x)
esgenbeta2(x)
Description

Computes the pdf, cdf, value at risk and expected shortfall for the generalized inverse beta distribution given by

\[ f(x) = ax^{ac-1} \frac{1}{B(c,d)} (1 + x^a)^{c+d}, \]
\[ F(x) = I_x^{ac} (c, d), \]
\[ \text{VaR}_p(X) = \left[ \frac{I_p^{-1}(c, d)}{1 - I_p^{-1}(c, d)} \right]^{1/a}, \]
\[ \text{ES}_p(X) = \frac{1}{p} \int_0^p \frac{I_{v}^{-1}(c, d)}{1 - I_{v}^{-1}(c, d)} dv \]

for \( x > 0, 0 < p < 1, a > 0, \) the first shape parameter, \( c > 0, \) the second shape parameter, and \( d > 0, \) the third shape parameter.

Usage

\begin{align*}
\text{dgeninvbeta}(x, a=1, c=1, d=1, \log=FALSE) \\
\text{pgeninvbeta}(x, a=1, c=1, d=1, \log.p=FALSE, \text{lower.tail}=TRUE) \\
\text{vargeninvbeta}(p, a=1, c=1, d=1, \log.p=FALSE, \text{lower.tail}=TRUE) \\
\text{esgeninvbeta}(p, a=1, c=1, d=1)
\end{align*}

Arguments

- \( x \) scaler or vector of values at which the pdf or cdf needs to be computed
- \( p \) scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \( a \) the value of the first shape parameter, must be positive, the default is 1
- \( c \) the value of the second shape parameter, must be positive, the default is 1
- \( d \) the value of the second shape parameter, must be positive, the default is 1
- \( \log \) if TRUE then log(pdf) are returned
- \( \log.p \) if TRUE then log(cdf) are returned and quantiles are computed for \( \exp(p) \)
- \( \text{lower.tail} \) if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah
References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dgeninvbeta(x)
pgeninvbeta(x)
vargeninvbeta(x)
esgeninvbeta(x)

---

Generalized logistic distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the generalized logistic distribution given by

\[
f(x) = \frac{a \exp \left( -\frac{x-\mu}{\sigma} \right)}{\sigma \{1 + \exp \left( -\frac{x-\mu}{\sigma} \right)\}^{1+a},}
\]

\[
F(x) = \frac{1}{\sigma \{1 + \exp \left( -\frac{x-\mu}{\sigma} \right)\}^a},
\]

\[
\text{VaR}_p(X) = \mu - \sigma \log \left( \frac{1}{p^{1/a} - 1} \right),
\]

\[
\text{ES}_p(X) = \mu - \frac{1}{p} \int_0^p \log \left( u^{-1/a} - 1 \right) \, du
\]

for \(-\infty < x < \infty\), \(0 < p < 1\), \(-\infty < \mu < \infty\), the location parameter, \(\sigma > 0\), the scale parameter, and \(a > 0\), the shape parameter.

Usage

dgenlogis(x, a=1, mu=0, sigma=1, log=FALSE)
plogis(x, a=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
vargenlogis(p, a=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
esgenlogis(p, a=1, mu=0, sigma=1)

Arguments

\(x\) scaler or vector of values at which the pdf or cdf needs to be computed

\(p\) scaler or vector of values at which the value at risk or expected shortfall needs to be computed

\(\mu\) the value of the location parameter, can take any real value, the default is zero

\(\sigma\) the value of the scale parameter, must be positive, the default is 1

\(a\) the value of the shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for \( \exp(p) \)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-\( p \)

**Value**

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

**Author(s)**

Saralees Nadarajah

**References**

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

**Examples**

\[
x = \text{runif}(10, \text{min}=0, \text{max}=1)
\]

dgenlogis(x)
pgenlogis(x)
vargenlogis(x)
esgenlogis(x)

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the generalized logistic III distribution given by

\[
f(x) = \frac{1}{\sigma B(\alpha, \alpha)} \exp\left(\alpha \frac{x - \mu}{\sigma}\right) \left\{1 + \exp\left(\frac{x - \mu}{\sigma}\right)\right\}^{-2\alpha},
\]

\[
F(x) = I_{\frac{1}{1 + \exp\left(-\frac{x - \mu}{\sigma}\right)}}(\alpha, \alpha),
\]

\[
\text{VaR}_p(X) = \mu - \sigma \log \frac{1 - I_p^{-1}(\alpha, \alpha)}{I_p^{-1}(\alpha, \alpha)},
\]

\[
\text{ES}_p(X) = \mu - \frac{\sigma}{p} \int_0^p \log \frac{1 - I_v^{-1}(\alpha, \alpha)}{I_v^{-1}(\alpha, \alpha)} dv
\]

for \(-\infty < x < \infty, 0 < p < 1, -\infty < \mu < \infty\), the location parameter, \( \sigma > 0 \), the scale parameter, and \( \alpha > 0 \), the shape parameter.
Usage

dgenlogis3(x, alpha=1, mu=0, sigma=1, log=FALSE)
pgenlogis3(x, alpha=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
vargenlogis3(p, alpha=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
esgenlogis3(p, alpha=1, mu=0, sigma=1)

Arguments

x       scaler or vector of values at which the pdf or cdf needs to be computed
p       scaler or vector of values at which the value at risk or expected shortfall needs to be computed
mu      the value of the location parameter, can take any real value, the default is zero
sigma   the value of the scale parameter, must be positive, the default is 1
alpha   the value of the shape parameter, must be positive, the default is 1
log     if TRUE then log(pdf) are returned
log.p   if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dgenlogis3(x)
pgenlogis3(x)
vargenlogis3(x)
esgenlogis3(x)
**Generalized logistic IV distribution**

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the generalized logistic IV distribution given by

\[
\begin{align*}
f(x) &= \frac{1}{\sigma B(\alpha, a)} \exp \left( -\alpha \frac{x - \mu}{\sigma} \right) \left\{ 1 + \exp \left( -\frac{x - \mu}{\sigma} \right) \right\}^{\frac{-\alpha - a}{\alpha}}, \\
F(x) &= \frac{1}{1 + \exp \left( -\frac{x - \mu}{\sigma} \right)} \left( \alpha, a \right), \\
\text{VaR}_p(X) &= \mu - \sigma \log \left( 1 - \frac{1 - I^{-1}_p(\alpha, a)}{I^{-1}_p(\alpha, a)} \right), \\
\text{ES}_p(X) &= \mu - \frac{\sigma}{p} \int_0^p \log \left( \frac{1 - I^{-1}_v(\alpha, a)}{I^{-1}_v(\alpha, a)} \right) dv
\end{align*}
\]

for \(-\infty < x < \infty\), \(0 < p < 1\), \(-\infty < \mu < \infty\), the location parameter, \(\sigma > 0\), the scale parameter, \(\alpha > 0\), the first shape parameter, and \(a > 0\), the second shape parameter.

**Usage**

\[
\begin{align*}
d\text{genlogis4}(x, a=1, alpha=1, mu=0, sigma=1, log=FALSE) \\
p\text{genlogis4}(x, a=1, alpha=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE) \\
v\text{arrgenlogis4}(p, a=1, alpha=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE) \\
es\text{genlogis4}(p, a=1, alpha=1, mu=0, sigma=1)
\end{align*}
\]

**Arguments**

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **mu**: the value of the location parameter, can take any real value, the default is zero
- **sigma**: the value of the scale parameter, must be positive, the default is 1
- **alpha**: the value of the first shape parameter, must be positive, the default is 1
- **a**: the value of the second shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.
Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=rnorm(10,mean=0,sd=1)
dgenpareto(x)
pnormpareto(x)
vargenpareto(x)
esgenpareto(x)

dgenpareto(pg)
pnormpareto(pg)
vargenpareto(pg)
esgenpareto(pg)

Description
Computes the pdf, cdf, value at risk and expected shortfall for the generalized Pareto distribution due to Pickands (1975) given by

\[
 f(x) = \frac{1}{k} \left( 1 - \frac{c x}{k} \right)^{1/c - 1}, \\
 F(x) = 1 - \left( 1 - \frac{c x}{k} \right)^{1/c}, \\
 \text{VaR}_p(X) = \frac{k}{c} \left[ 1 - (1 - p)^{1/c} \right], \\
 \text{ES}_p(X) = \frac{k}{c} + \frac{k (1 - p)^{c+1}}{p c (c + 1)} - \frac{k}{pc(c+1)}
\]

for \( x < k/c \) if \( c > 0 \), \( x > k/c \) if \( c < 0 \), and \( x > 0 \) if \( c = 0 \), \( 0 < p < 1 \), \( k > 0 \), the scale parameter and \(-\infty < c < \infty \), the shape parameter.

Usage
\[
dgenpareto(x, k=1, c=1, log=FALSE) \\
pnormpareto(x, k=1, c=1, log.p=FALSE, lower.tail=TRUE) \\
vargenpareto(p, k=1, c=1, log.p=FALSE, lower.tail=TRUE) \\
esgenpareto(p, k=1, c=1)
\]

Arguments
\[
x \quad \text{scaler or vector of values at which the pdf or cdf needs to be computed} \\
p \quad \text{scaler or vector of values at which the value at risk or expected shortfall needs to be computed}
\]
**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the generalized power Weibull distribution due to Nikulin and Haghighi (2006) given by

\[
f(x) = a \theta x^{a-1} \left[1 + x^a \right]^\theta -1 \exp \left\{1 - \left[1 + x^a \right]^\theta \right\},
\]

\[
F(x) = 1 - \exp \left\{1 - \left[1 + x^a \right]^\theta \right\},
\]

\[
\text{VaR}_p(X) = \left\{1 - \log(1 - p)\right\}^{1/a} - 1 \right\}^{1/a},
\]

\[
\text{ES}_p(X) = \frac{1}{p} \int_0^p \left\{1 - \log(1 - v)\right\}^{1/a} - 1 \right\}^{1/a} dv
\]

for \(x > 0, 0 < p < 1, \alpha > 0\), the first shape parameter, and \(\theta > 0\), the second shape parameter.
Usage

dgenpowerweibull(x, a=1, theta=1, log=FALSE)
pgepowerweibull(x, a=1, theta=1, log.p=FALSE, lower.tail=TRUE)
vargenpowerweibull(p, a=1, theta=1, log.p=FALSE, lower.tail=TRUE)
esgenpowerweibull(p, a=1, theta=1)

Arguments

x scalar or vector of values at which the pdf or cdf needs to be computed
p scalar or vector of values at which the value at risk or expected shortfall needs to be computed
a the value of the first shape parameter, must be positive, the default is 1
theta the value of the second shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dgenpowerweibull(x)
pgepowerweibull(x)
vargenpowerweibull(x)
esgenpowerweibull(x)
Generalized uniform distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the generalized uniform distribution given by

\[
 f(x) = hkc(x - a)^{c-1}[1 - k(x - a)^c]^{h-1},
\]
\[
 F(x) = 1 - [1 - k(x - a)^c]^h,
\]
\[
 \text{VaR}_p(X) = a + k^{-1/c} \left[ 1 - (1 - p)^{1/h} \right]^{1/c},
\]
\[
 \text{ES}_p(X) = a + k^{-1/c} \int_p^1 \left[ 1 - (1 - v)^{1/h} \right]^{1/c} dv
\]

for \( a \leq x \leq a + k^{-1/c} \), \( 0 < p < 1 \), \( -\infty < a < \infty \), the location parameter, \( c > 0 \), the first shape parameter, \( k > 0 \), the scale parameter, and \( h > 0 \), the second shape parameter.

Usage

\[
d\text{genunif}(x, a=0, c=1, h=1, k=1, \text{log} = \text{FALSE})
\]
\[
p\text{genunif}(x, a=0, c=1, h=1, k=1, \text{log} = \text{FALSE}, \text{lower.tail} = \text{TRUE})
\]
\[
v\text{argunif}(p, a=0, c=1, h=1, k=1, \text{log} = \text{FALSE}, \text{lower.tail} = \text{TRUE})
\]
\[
es\text{genunif}(p, a=0, c=1, h=1, k=1)
\]

Arguments

\( x \) scaler or vector of values at which the pdf or cdf needs to be computed

\( p \) scaler or vector of values at which the value at risk or expected shortfall needs to be computed

\( a \) the value of the location parameter, can take any real value, the default is zero

\( k \) the value of the scale parameter, must be positive, the default is 1

\( c \) the value of the first scale parameter, must be positive, the default is 1

\( h \) the value of the second scale parameter, must be positive, the default is 1

\( \text{log} \) if TRUE then log(pdf) are returned

\( \text{log} \) if TRUE then log(cdf) are returned and quantiles are computed for exp(p)

\( \text{lower.tail} \) if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah
References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dgenunif(x)
pgenunif(x)
vargenunif(x)
esgenunif(x)

---

**gev**  
*Generalized extreme value distribution*

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the generalized extreme value distribution due to Fisher and Tippett (1928) given by

\[
 f(x) = \frac{1}{\sigma} \left[ 1 + \xi \left( \frac{x - \mu}{\sigma} \right) \right]^{-1/\xi - 1} \exp \left\{ - \left[ 1 + \xi \left( \frac{x - \mu}{\sigma} \right) \right]^{-1/\xi} \right\}, \\
 F(x) = \exp \left\{ - \left[ 1 + \xi \left( \frac{x - \mu}{\sigma} \right) \right]^{-1/\xi} \right\}, \\
 \text{VaR}_p(X) = \mu - \frac{\sigma}{\xi} + \frac{\sigma}{\xi} (-\log p)^{-\xi}, \\
 \text{ES}_p(X) = \mu - \frac{\sigma}{\xi} + \frac{\sigma}{\xi} \int_0^p (-\log v)^{-\xi} dv
\]

for \( x \geq \mu - \sigma/\xi \) if \( \xi > 0 \), \( x \leq \mu - \sigma/\xi \) if \( \xi < 0 \), \( -\infty < x < \infty \) if \( \xi = 0 \), \( 0 < p < 1 \), \( -\infty < \mu < \infty \), the location parameter, \( \sigma > 0 \), the scale parameter, and \( -\infty < \xi < \infty \), the shape parameter.

**Usage**

\[
\text{dgev}(x, \mu=0, \sigma=1, \xi=1, \log=\text{FALSE}) \\
\text{pgev}(x, \mu=0, \sigma=1, \xi=1, \text{log.p=FALSE, lower.tail=TRUE}) \\
\text{vargev}(p, \mu=0, \sigma=1, \xi=1, \text{log.p=FALSE, lower.tail=TRUE}) \\
\text{esgev}(p, \mu=0, \sigma=1, \xi=1)
\]

**Arguments**

- **x**  
  scaler or vector of values at which the pdf or cdf needs to be computed

- **p**  
  scaler or vector of values at which the value at risk or expected shortfall needs to be computed

- **mu**  
  the value of the location parameter, can take any real value, the default is zero
gompertz

sigma  the value of the scale parameter, must be positive, the default is 1
xi     the value of the shape parameter, must be positive, the default is 1
log    if TRUE then log(pdf) are returned
log.p  if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail  if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(100,min=0,max=1)
dgevHx)
pgevHx)
vargevHx)
esgevHx)

-------

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Gompertz distribution due to Gompertz (1825) given by

\[
\begin{align*}
    f(x) &= b\eta \exp(bx) \exp[\eta - \eta \exp(bx)], \\
    F(x) &= 1 - \exp[\eta - \eta \exp(bx)], \\
    \text{VaR}_p(X) &= \frac{1}{b} \log \left[ \frac{1}{p} \log(1 - p) \right], \\
    \text{ES}_p(X) &= \frac{1}{pb} \int_0^p \log \left[ \frac{1}{\eta} \log(1 - v) \right] dv
\end{align*}
\]

for \(x > 0, 0 < p < 1, b > 0\), the first scale parameter and \(\eta > 0\), the second scale parameter.
Usage

dgompertz(x, b=1, eta=1, log=FALSE)
pgompertz(x, b=1, eta=1, log.p=FALSE, lower.tail=TRUE)
vargompertz(p, b=1, eta=1, log.p=FALSE, lower.tail=TRUE)
esgompertz(p, b=1, eta=1)

Arguments

x                            scaler or vector of values at which the pdf or cdf needs to be computed
p                            scaler or vector of values at which the value at risk or expected shortfall needs
to be computed
b                            the value of the first scale parameter, must be positive, the default is 1
eta                          the value of the second scale parameter, must be positive, the default is 1
log                          if TRUE then log(pdf) are returned
log.p                        if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail                   if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the
same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall,
submitted

Examples

x=runif(10, min=0, max=1)
dgompertz(x)
pgompertz(x)
vargompertz(x)
esgompertz(x)
Description

Computes the pdf, cdf, value at risk and expected shortfall for the Gumbel distribution given by due to Gumbel (1954) given by

\[ f(x) = \frac{1}{\sigma} \exp\left(\frac{\mu - x}{\sigma}\right) \exp\left[-\exp\left(\frac{\mu - x}{\sigma}\right)\right], \]
\[ F(x) = \exp\left[-\exp\left(\frac{\mu - x}{\sigma}\right)\right], \]
\[ \text{VaR}_p(X) = \mu - \sigma \log(-\log p), \]
\[ \text{ES}_p(X) = \mu - \frac{\sigma}{p} \int_0^p \log(-\log v)dv \]

for \(-\infty < x < \infty\), \(0 < p < 1\), \(-\infty < \mu < \infty\), the location parameter, and \(\sigma > 0\), the scale parameter.

Usage

\begin{verbatim}
dgumbel(x, mu=0, sigma=1, log=FALSE)
pgumbel(x, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
vargumbel(p, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
esgumbel(p, mu=0, sigma=1)
\end{verbatim}

Arguments

\begin{itemize}
  \item \textbf{x} \hspace{1cm} scaler or vector of values at which the pdf or cdf needs to be computed
  \item \textbf{p} \hspace{1cm} scaler or vector of values at which the value at risk or expected shortfall needs to be computed
  \item \textbf{mu} \hspace{1cm} the value of the location parameter, can take any real value, the default is zero
  \item \textbf{sigma} \hspace{1cm} the value of the scale parameter, must be positive, the default is 1
  \item \textbf{log} \hspace{1cm} if TRUE then log(pdf) are returned
  \item \textbf{log.p} \hspace{1cm} if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
  \item \textbf{lower.tail} \hspace{1cm} if FALSE then 1-cdf are returned and quantiles are computed for 1-p
\end{itemize}

Value

An object of the same length as \textbf{x}, giving the pdf or cdf values computed at \textbf{x} or an object of the same length as \textbf{p}, giving the values at risk or expected shortfall computed at \textbf{p}.

Author(s)

Saralees Nadarajah
References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x = runif(10, min=0, max=1)
dgumbel(x)
pgumbel(x)
vargumbel(x)
esgumbel(x)
```

---

**gumbel2**

**Gumbel II distribution**

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the Gumbel II distribution

\[
\begin{align*}
f(x) &= abx^{-a-1} \exp \left( -bx^{-a} \right), \\
F(x) &= 1 - \exp \left( -bx^{-a} \right), \\
\text{VaR}_p(X) &= b^{1/a} \left[ - \log(1 - p) \right]^{-1/a}, \\
\text{ES}_p(X) &= \frac{b^{1/a}}{p} \int_0^p \left[ - \log(1 - v) \right]^{-1/a} \, dv
\end{align*}
\]

for \( x > 0, 0 < p < 1, a > 0 \), the shape parameter, and \( b > 0 \), the scale parameter.

**Usage**

```r
dgumbel2(x, a=1, b=1, log=FALSE)
pgumbel2(x, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
vargumbel2(p, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
esgumbel2(p, a=1, b=1)
```

**Arguments**

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **a**: the value of the scale parameter, must be positive, the default is 1
- **b**: the value of the shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for \( \exp(p) \)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for \( 1-p \)
Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x = runif(10, min = 0, max = 1)
dhalfcauchy(x, sigma = 1, log = FALSE)
pgumbelRH(x, sigma = 1, log = TRUE, lower = TRUE)
varhalfcauchy(x, sigma = 1)
eshalfcauchy(x, sigma = 1)
```

Half Cauchy distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the half Cauchy distribution given by

\[
 f(x) = \frac{2}{\pi} \frac{\sigma}{x^2 + \sigma^2}, \\
 F(x) = \frac{2}{\pi} \arctan \left( \frac{x}{\sigma} \right), \\
 \text{VaR}_p(X) = \sigma \tan \left( \frac{\pi p}{2} \right), \\
 \text{ES}_p(X) = \frac{\sigma}{p} \int_0^p \tan \left( \frac{\pi v}{2} \right) dv 
\]

for \( x > 0, 0 < p < 1, \) and \( \sigma > 0, \) the scale parameter.

Usage

```r
dhalfcauchy(x, sigma = 1, log = FALSE)
phalfcauchy(x, sigma = 1, log = FALSE, lower = TRUE)
varhalfcauchy(p, sigma = 1, log = FALSE, lower = TRUE)
eshalfcauchy(p, sigma = 1)
```
Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **sigma**: the value of the scale parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x=runif(10, min=0, max=1)
dhalfcauchy(x)
phalfcauchy(x)
varhalfcauchy(x)
eshalfcauchy(x)
```

---

**halflogis**

**Half logistic distribution**

Description

Computes the pdf, cdf, value at risk and expected shortfall for the half logistic distribution given by

\[
\begin{align*}
    f(x) &= \frac{2\lambda \exp(-\lambda x)}{[1 + \exp(-\lambda x)]^2}, \\
    F(x) &= \frac{1 - \exp(-\lambda x)}{1 + \exp(-\lambda x)}, \\
    \text{VaR}_p(X) &= -\frac{1}{\lambda} \log \frac{1 - p}{1 + p}, \\
    \text{ES}_p(X) &= -\frac{1}{\lambda} \log \frac{1 - p}{1 + p} + \frac{1}{\lambda p} \log (1 - p^2)
\end{align*}
\]

for \(x > 0\), \(0 < p < 1\), and \(\lambda > 0\), the scale parameter.
Usage

dhalflogis(x, lambda=1, log=FALSE)
phalflogis(x, lambda=1, log.p=FALSE, lower.tail=TRUE)
varhalflogis(p, lambda=1, log.p=FALSE, lower.tail=TRUE)
eshalflogis(p, lambda=1)

Arguments

x         scaler or vector of values at which the pdf or cdf needs to be computed
p         scaler or vector of values at which the value at risk or expected shortfall needs
to be computed
lambda    the value of the scale parameter, must be positive, the default is 1
log       if TRUE then log(pdf) are returned
log.p     if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the
same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall,
submitted

Examples

x=runif(10, min=0, max=1)
dhalflogis(x)
phalflogis(x)
varhalflogis(x)
eshalflogis(x)
Half normal distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for Half normal distribution given by

\[ f(x) = \frac{2}{\sigma} \phi \left( \frac{x}{\sigma} \right), \]
\[ F(x) = 2\Phi \left( \frac{x}{\sigma} \right) - 1, \]
\[ \text{VaR}_p(X) = \sigma \Phi^{-1} \left( \frac{1 + p}{2} \right), \]
\[ \text{ES}_p(X) = \frac{\sigma}{p} \int_0^p \Phi^{-1} \left( \frac{1 + v}{2} \right) \, dv \]

for \( x > 0, 0 < p < 1, \text{ and } \sigma > 0 \), the scale parameter.

Usage

```r
dhalfnorm(x, sigma=1, log=FALSE)
phalfnorm(x, sigma=1, log.p=FALSE, lower.tail=TRUE)
varhalfnorm(p, sigma=1, log.p=FALSE, lower.tail=TRUE)
eshalfnorm(p, sigma=1)
```

Arguments

- `x` scaler or vector of values at which the pdf or cdf needs to be computed
- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `sigma` the value of the scale parameter, must be positive, the default is 1
- `log` if TRUE then log(pdf) are returned
- `log.p` if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted
Examples

```r
x = runif(10, min=0, max=1)
dhalfnorm(x)
phalfnorm(x)
varhalfnorm(x)
eshalfnorm(x)
```

**halfT**

*Half Student’s t distribution*

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the half Student’s t distribution given by

\[
f(x) = \frac{2\Gamma\left(\frac{n+1}{2}\right)}{\sqrt{n\pi}\Gamma\left(\frac{n}{2}\right)} \left(1 + \frac{x^2}{n}\right)^{-\frac{n+1}{2}},
\]

\[
F(x) = I_x^{\frac{1}{2} - \frac{n}{2}},
\]

\[
\text{VaR}_p(X) = \sqrt{n} I_p^{-1}\left(\frac{1}{2}, \frac{1}{2}, \frac{n}{2}\right),
\]

\[
\text{ES}_p(X) = \frac{\sqrt{n}}{p} \int_0^p \sqrt{\frac{I_v^{-1}\left(\frac{1}{2}, \frac{1}{2}, \frac{n}{2}\right)}{1 - I_v^{-1}\left(\frac{1}{2}, \frac{1}{2}, \frac{n}{2}\right)}} dv
\]

for \(-\infty < x < \infty\), \(0 < p < 1\), and \(n > 0\), the degree of freedom parameter.

**Usage**

```r
dhalfT(x, n=1, log=FALSE)
phalfT(x, n=1, log.p=FALSE, lower.tail=TRUE)
varhalfT(p, n=1, log.p=FALSE, lower.tail=TRUE)
eshalfT(p, n=1)
```

**Arguments**

- `x` scaler or vector of values at which the pdf or cdf needs to be computed
- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `n` the value of the degree of freedom parameter, must be positive, the default is 1
- `log` if TRUE then log(pdf) are returned
- `log.p` if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`. 
Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
```r
x=runif(10, min=0, max=1)
dhalf(x)
phalf(x)
varhalf(x)
eshalf(x)
```

HBlaplace

Holla-Bhattacharya Laplace distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the Holla-Bhattacharya Laplace distribution due to Holla and Bhattacharya (1968) given by

\[
f(x) = \begin{cases} 
  a \phi \exp \{ \phi (x - \theta) \}, & \text{if } x \leq \theta, \\
  (1 - a) \phi \exp \{ \phi (\theta - x) \}, & \text{if } x > \theta, \\
  a \exp \{ \phi x - \theta \phi \}, & \text{if } x \leq \theta,
\end{cases}
\]

\[
F(x) = \begin{cases} 
  a \exp (\phi x - \theta \phi), & \text{if } x \leq \theta, \\
  1 - (1 - a) \exp (\theta \phi - \phi x), & \text{if } x > \theta,
\end{cases}
\]

\[
\text{VaR}_p(X) = \begin{cases} 
  \theta + \frac{1}{\phi} \log \left( \frac{p}{a} \right), & \text{if } p \leq a, \\
  \theta - \frac{1}{\phi} \log \left( \frac{1 - p}{1 - a} \right), & \text{if } p > a,
\end{cases}
\]

\[
\text{ES}_p(X) = \begin{cases} 
  \frac{1}{p} \left[ \theta (1 + p - a) + \frac{p - 2a - (1 - a) \log a}{\phi} + \frac{1 - p}{\phi} \log \frac{1 - p}{1 - a} \right], & \text{if } p > a,
\end{cases}
\]

for \(-\infty < x < \infty\), \(0 < p < 1\), \(-\infty < \theta < \infty\), the location parameter, \(0 < a < 1\), the first scale parameter, and \(\phi > 0\), the second scale parameter.

Usage
```r
dHBlaplace(x, a=0.5, theta=0, phi=1, log=FALSE)
pHBlaplace(x, a=0.5, theta=0, phi=1, log.p=FALSE, lower.tail=TRUE)
varHBlaplace(p, a=0.5, theta=0, phi=1, log.p=FALSE, lower.tail=TRUE)
esHBlaplace(p, a=0.5, theta=0, phi=1)
```
Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **theta**: the value of the location parameter, can take any real value, the default is zero
- **a**: the value of the first scale parameter, must be in the unit interval, the default is 0.5
- **phi**: the value of the second scale parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10,min=0,max=1)
dHLaplace(x)
phHLaplace(x)
varHLaplace(x)
esHLaplace(x)

HL

Hankin-Lee distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Hankin-Lee distribution due to Hankin and Lee (2006) given by

\[ \text{VaR}_p(X) = \frac{c p^a}{(1 - p)^b} \]

\[ \text{ES}_p(X) = \frac{c}{p} B_p(a + 1, 1 - b) \]

for \( 0 < p < 1, c > 0 \), the scale parameter, \( a > 0 \), the first shape parameter, and \( b > 0 \), the second shape parameter.
Usage

\[
\text{varHL}(p, a=1, b=1, c=1, \log.p=\text{FALSE}, \text{lower.tail}=\text{TRUE})
\]
\[
\text{esHL}(p, a=1, b=1, c=1)
\]

Arguments

- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **c**: the value of the scale parameter, must be positive, the default is 1
- **a**: the value of the first shape parameter, must be positive, the default is 1
- **b**: the value of the second shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for \(\exp(p)\)
- **lower.tail**: if FALSE then \(1-cdf\) are returned and quantiles are computed for \(1-p\)

Value

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\[
x=\text{runif}(10, \text{min}=0, \text{max}=1)
\]
\[
\text{varHL}(x)
\]
\[
\text{esHL}(x)
\]
Hlogis

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Hosking logistic distribution due to Hosking (1989, 1990) given by

\[
\begin{align*}
    f(x) &= \frac{(1 - kx)^{1/k - 1}}{[1 + (1 - kx)^{1/k}]^2}, \\
    F(x) &= \frac{1}{1 + (1 - kx)^{1/k}}, \\
    \text{VaR}_p(X) &= \frac{1}{k} \left[ 1 - \left( \frac{1 - p}{p} \right)^k \right], \\
    \text{ES}_p(X) &= \frac{1}{k - 1} - \frac{1}{kp} B_p(1 - k, 1 + k)
\end{align*}
\]

for \(x < 1/k\) if \(k > 0\), \(x > 1/k\) if \(k < 0\), \(-\infty < x < \infty\) if \(k = 0\), and \(-\infty < k < \infty\), the shape parameter.

Usage

\[
\begin{align*}
    \text{dHlogis}(x, k=1, \log=FALSE) \\
    \text{pHlogis}(x, k=1, \log.p=FALSE, lower.tail=TRUE) \\
    \text{varHlogis}(p, k=1, \log.p=FALSE, lower.tail=TRUE) \\
    \text{esHlogis}(p, k=1)
\end{align*}
\]

Arguments

- \(x\): scaler or vector of values at which the pdf or cdf needs to be computed
- \(p\): scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \(k\): the value of the shape parameter, must be positive, the default is 1
- \(\log\): if TRUE then log(pdf) are returned
- \(\log.p\): if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- \(\text{lower.tail}\): if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted
Examples

```r
x = runif(10, min = 0, max = 1)
dhlogis(x)
pHlogis(x)
varHlogis(x)
esHlogis(x)
```

**invbeta**

*Inverse beta distribution*

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the inverse beta distribution given by

\[
f(x) = \frac{x^{a-1}}{B(a, b)(1 + x)^{a+b}},
\]

\[
F(x) = I_{\frac{1}{1+x}}(a, b),
\]

\[
\text{VaR}_p(X) = \frac{I_p^{-1}(a, b)}{1 - I_p^{-1}(a, b)},
\]

\[
\text{ES}_p(X) = \frac{1}{p} \int_0^p \frac{I_v^{-1}(a, b)}{1 - I_v^{-1}(a, b)} dv
\]

for \(x > 0\), \(0 < p < 1\), \(a > 0\), the first shape parameter, and \(b > 0\), the second shape parameter.

**Usage**

```r
dinvbeta(x, a = 1, b = 1, log = FALSE)
pinvbeta(x, a = 1, b = 1, log.p = FALSE, lower.tail = TRUE)
varinvbeta(p, a = 1, b = 1, log.p = FALSE, lower.tail = TRUE)
esinvbeta(p, a = 1, b = 1)
```

**Arguments**

- `x` scaler or vector of values at which the pdf or cdf needs to be computed
- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `a` the value of the first shape parameter, must be positive, the default is 1
- `b` the value of the second shape parameter, must be positive, the default is 1
- `log` if TRUE then log(pdf) are returned
- `log.p` if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`. 
invexpexp

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=rnorm(10, mean=0, sd=1)
dinvexpexp(x, lambda=1, a=1, log=FALSE)
pinvexpexp(x, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)
varinvexpexp(p, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)
esinvexpexp(p, lambda=1, a=1)

Description
Computes the pdf, cdf, value at risk and expected shortfall for the inverse exponentiated exponential distribution due to Ghitany et al. (2013) given by

\[ f(x) = a \lambda x^{-2} \exp\left(\frac{-\lambda}{x}\right) \left[1 - \exp\left(\frac{-\lambda}{x}\right)\right]^{a-1}, \]

\[ F(x) = 1 - \left[1 - \exp\left(\frac{-\lambda}{x}\right)\right]^a, \]

\[ \text{VaR}_p(X) = \lambda \left\{- \log \left[1 - (1 - p)^{1/a}\right]\right\}^{-1}, \]

\[ \text{ES}_p(X) = \frac{\lambda}{p} \int_0^p \left\{- \log \left[1 - (1 - v)^{1/a}\right]\right\}^{-1} dv \]

for \( x > 0, 0 < p < 1, a > 0, \) the shape parameter and \( \lambda > 0, \) the scale parameter.

Usage

dinvexpexp(x, lambda=1, a=1, log=FALSE)
pinvexpexp(x, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)
varinvexpexp(p, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)
esinvexpexp(p, lambda=1, a=1)

Arguments
\( x \quad \) scaler or vector of values at which the pdf or cdf needs to be computed
\( p \quad \) scaler or vector of values at which the value at risk or expected shortfall needs to be computed
\( \lambda \quad \) the value of the scale parameter, must be positive, the default is 1
invgamma

invgamma

Inverse gamma distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the inverse gamma distribution given by

\[ f(x) = \frac{b^a \exp(-b/x)}{x^{a+1} \Gamma(a)}, \]
\[ F(x) = Q(a, b/x), \]
\[ \text{VaR}_p(X) = b \left[ Q^{-1}(a, p) \right]^{-1}, \]
\[ \text{ES}_p(X) = \frac{b}{p} \int_0^p \left[ Q^{-1}(a, v) \right]^{-1} dv \]

for \( x > 0, 0 < p < 1, a > 0 \), the shape parameter, and \( b > 0 \), the scale parameter.

Usage

\[
\text{dinvgamma}(x, a=1, b=1, \log=FALSE) \\
\text{pinvgamma}(x, a=1, b=1, \log.p=FALSE, \text{lower.tail}=TRUE) \\
\text{varinvgamma}(p, a=1, b=1, \log.p=FALSE, \text{lower.tail}=TRUE) \\
\text{esinvgamma}(p, a=1, b=1)
\]
Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **b**: the value of the scale parameter, must be positive, the default is 1
- **a**: the value of the shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x = runif(10, min = 0, max = 1)
dinvgamma(x)
pinvgamma(x)
varinvgamma(x)
esinvgamma(x)
```

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Kumaraswamy distribution due to Kumaraswamy (1980) given by

\[ f(x) = abx^{a-1}(1-x^a)^{b-1}, \]
\[ F(x) = 1 - (1 - x^a)^b, \]
\[ \text{VaR}_p(X) = \left[ 1 - (1 - p)^{1/b} \right]^{1/a}, \]
\[ \text{ES}_p(X) = \frac{1}{p} \int_0^p \left[ 1 - (1 - v)^{1/b} \right]^{1/a} dv \]

for \( 0 < x < 1, \ 0 < p < 1, \ a > 0, \) the first shape parameter, and \( b > 0, \) the second shape parameter.
Usage

dkum(x, a=1, b=1, log=FALSE)
pkum(x, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
varkum(p, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
eskum(p, a=1, b=1)

Arguments

x scaler or vector of values at which the pdf or cdf needs to be computed
p scaler or vector of values at which the value at risk or expected shortfall needs
to be computed
a the value of the first shape parameter, must be positive, the default is 1
b the value of the second shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the
same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall,
submitted

Examples

x=runif(10, min=0, max=1)
dkum(x)
pkum(x)
varkum(x)
eskum(x)
Description

Computes the pdf, cdf, value at risk and expected shortfall for the Kumaraswamy Burr XII distribution due to Parana\'iba et al. (2013) given by

\[
f(x) = \frac{abkxc^{-1}}{(1 + xc)^{k+1}} \left[ 1 - (1 + xc)^{-k} \right]^{-a-1} \left\{ 1 - \left[ 1 - (1 + xc)^{-k} \right]^{a} \right\}^{b-1},
\]

\[
F(x) = 1 - \left\{ 1 - \left[ 1 - (1 + xc)^{-k} \right]^{a} \right\}^{b},
\]

\[
\text{VaR}_p(X) = \left[ \left\{ 1 - \left[ 1 - (1 - p)^{1/b} \right]^{1/a} \right\}^{-1/k} - 1 \right]^{1/c},
\]

\[
\text{ES}_p(X) = \frac{1}{p} \int_{0}^{p} \left[ \left\{ 1 - \left[ 1 - (1 - v)^{1/b} \right]^{1/a} \right\}^{-1/k} - 1 \right]^{1/c} dv
\]

for \( x > 0, 0 < p < 1, a > 0, \) the first shape parameter, \( b > 0, \) the second shape parameter, \( c > 0, \) the third shape parameter, and \( k > 0, \) the fourth shape parameter.

Usage

- `dkumburr7(x, a=1, b=1, k=1, c=1, log=FALSE)`
- `pkumburr7(x, a=1, b=1, k=1, c=1, log.p=FALSE, lower.tail=TRUE)`
- `varkumburr7(p, a=1, b=1, k=1, c=1, log.p=FALSE, lower.tail=TRUE)`
- `eskumburr7(p, a=1, b=1, k=1, c=1)`

Arguments

- `x` scaler or vector of values at which the pdf or cdf needs to be computed
- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `a` the value of the first shape parameter, must be positive, the default is 1
- `b` the value of the second shape parameter, must be positive, the default is 1
- `c` the value of the third shape parameter, must be positive, the default is 1
- `k` the value of the fourth shape parameter, must be positive, the default is 1
- `log` if TRUE then log(pdf) are returned
- `log.p` if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`. 
**Author(s)**
Saralees Nadarajah

**References**
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

**Examples**
x=runif(10, min=0, max=1)
dkumburr7(x)
pkumburr7(x)
varkumburr7(x)
eskumburr7(x)

---

**kumexp**  
**Kumaraswamy exponential distribution**

**Description**
Computes the pdf, cdf, value at risk and expected shortfall for the Kumaraswamy exponential distribution due to Cordeiro and de Castro (2011) given by

\[
    f(x) = ab\lambda \exp(-\lambda x) \left(1 - \exp(-\lambda x)\right)^{a-1} \left(1 - \left[1 - \exp(-\lambda x)\right]^a\right)^{b-1},
\]

\[
    F(x) = 1 - \left(1 - \left[1 - \exp(-\lambda x)\right]^a\right)^b,
\]

\[
    \text{VaR}_p(X) = -\frac{1}{\lambda} \log \left\{ 1 - \left[1 - (1-p)^{1/b}\right]^{1/a} \right\},
\]

\[
    \text{ES}_p(X) = -\frac{1}{p\lambda} \int_0^p \log \left\{ 1 - \left[1 - v^{1/6}\right]^{1/a} \right\} dv
\]

for \(x > 0, 0 < p < 1, a > 0, \) the first shape parameter, \(b > 0, \) the second shape parameter, and \(\lambda > 0,\) the scale parameter.

**Usage**

\[
dkumexp(x, \text{lambda}=1, a=1, b=1, \text{log}=\text{FALSE})
pkumexp(x, \text{lambda}=1, a=1, b=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE})
varkumexp(p, \text{lambda}=1, a=1, b=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE})
eskumexp(p, \text{lambda}=1, a=1, b=1)
\]

**Arguments**

- \(x\)  
scaler or vector of values at which the pdf or cdf needs to be computed

- \(p\)  
scaler or vector of values at which the value at risk or expected shortfall needs to be computed

- \(\text{lambda}\)  
the value of the scale parameter, must be positive, the default is 1
kumgamma

a the value of the first shape parameter, must be positive, the default is 1
b the value of the second shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value
An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10,min=0,max=1)
dkumexp(x)
pkumexp(x)
varkumexp(x)
everkumexp(x)

kumgamma Kumaraswamy gamma distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the Kumaraswamy gamma distribution due to de Pascoa et al. (2011) given by

\[
f(x) = cd b^a x^{a-1} \exp(-bx) \frac{\gamma^{c-1}(a, bx)}{\Gamma^c(a)} \left[ 1 - \frac{\gamma^c(a, bx)}{\Gamma^c(a)} \right]^{d-1},
\]

\[
F(x) = 1 - \left[ 1 - \frac{\gamma^c(a, bx)}{\Gamma^c(a)} \right]^{d},
\]

\[
\text{VaR}_p(X) = \frac{1}{b} Q^{-1} \left( a, 1 - \left[ 1 - (1-p)^{1/a} \right]^{1/c} \right),
\]

\[
\text{ES}_p(X) = \frac{1}{bp} \int_0^p Q^{-1} \left( a, 1 - \left[ 1 - (1-v)^{1/d} \right]^{1/c} \right) dv
\]

for \( x > 0, \ 0 < p < 1, \ a > 0, \) the first shape parameter, \( b > 0, \) the scale parameter, \( c > 0, \) the second shape parameter, and \( d > 0, \) the third shape parameter.
Usage

\texttt{dkumgamma(x, a=1, b=1, c=1, d=1, log=FALSE)}
\texttt{pkumgamma(x, a=1, b=1, c=1, d=1, log.p=FALSE, lower.tail=TRUE)}
\texttt{varkumgamma(p, a=1, b=1, c=1, d=1, log.p=FALSE, lower.tail=TRUE)}
\texttt{eskumgamma(p, a=1, b=1, c=1, d=1)}

Arguments

\textit{x} 
scaler or vector of values at which the pdf or cdf needs to be computed

\textit{p} 
scaler or vector of values at which the value at risk or expected shortfall needs to be computed

\textit{b} 
the value of the scale parameter, must be positive, the default is 1

\textit{a} 
the value of the first shape parameter, must be positive, the default is 1

\textit{c} 
the value of the second shape parameter, must be positive, the default is 1

\textit{d} 
the value of the third shape parameter, must be positive, the default is 1

\textit{log} 
if TRUE then log(pdf) are returned

\textit{log.p} 
if TRUE then log(cdf) are returned and quantiles are computed for \text{exp(p)}

\textit{lower.tail} 
if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \textit{x}, giving the pdf or cdf values computed at \textit{x} or an object of the same length as \textit{p}, giving the values at risk or expected shortfall computed at \textit{p}.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\texttt{x=runif(10, min=0, max=1)}
\texttt{dkumgamma(x)}
\texttt{pkumgamma(x)}
\texttt{varkumgamma(x)}
\texttt{eskumgamma(x)}
### Description

Computes the pdf, cdf, value at risk and expected shortfall for the Kumaraswamy Gumbel distribution due to Cordeiro et al. (2012a) given by

\[ f(x) = \frac{ab}{\sigma} \exp \left( \frac{\mu - x}{\sigma} \right) \exp \left[ -a \exp \left( \frac{\mu - x}{\sigma} \right) \right] \left\{ 1 - \exp \left[ -a \exp \left( \frac{\mu - x}{\sigma} \right) \right] \right\}^{b-1}, \]

\[ F(x) = 1 - \left\{ 1 - \exp \left[ -a \exp \left( \frac{\mu - x}{\sigma} \right) \right] \right\}^b, \]

\[ \text{VaR}_p(X) = \mu - \sigma \log \left\{ - \log \left[ 1 - (1-p)^{1/b} \right]^{1/a} \right\}, \]

\[ \text{ES}_p(X) = \mu - \sigma \int_0^p \log \left\{ - \log \left[ 1 - (1-v)^{1/b} \right]^{1/a} \right\} dv \]

for \(-\infty < x < \infty\), \(0 < p < 1\), \(-\infty < \mu < \infty\), the location parameter, \(\sigma > 0\), the scale parameter, \(a > 0\), the first shape parameter, and \(b > 0\), the second shape parameter.

### Usage

- `dkumgumbel(x, a=1, b=1, mu=0, sigma=1, log=FALSE)`
- `pkumgumbel(x, a=1, b=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)`
- `varkumgumbel(p, a=1, b=1, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)`
- `eskumgumbel(p, a=1, b=1, mu=0, sigma=1)`

### Arguments

- `x` : scaler or vector of values at which the pdf or cdf needs to be computed
- `p` : scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `mu` : the value of the location parameter, can take any real value, the default is zero
- `sigma` : the value of the scale parameter, must be positive, the default is 1
- `a` : the value of the first shape parameter, must be positive, the default is 1
- `b` : the value of the second shape parameter, must be positive, the default is 1
- `log` : if TRUE then log(pdf) are returned
- `log.p` : if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` : if FALSE then 1-cdf are returned and quantiles are computed for 1-p

### Value

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`. 
**Author(s)**

Saralees Nadarajah

**References**

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

**Examples**

```r
x = runif(10, min = 0, max = 1)
dkumgumbel(x)
pkumgumbel(x)
varkumgumbel(x)
eskumgumbel(x)
```

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the Kumaraswamy half normal distribution due to Cordeiro et al. (2012c) given by

\[
f(x) = \frac{2ab}{\sigma} \phi \left( \frac{x}{\sigma} \right) \left[ 2\Phi \left( \frac{x}{\sigma} \right) - 1 \right]^{a-1} \left\{ 1 - \left[ 2\Phi \left( \frac{x}{\sigma} \right) - 1 \right]^a \right\}^{b-1},
\]

\[
F(x) = 1 - \left\{ 1 - \left[ 2\Phi \left( \frac{x}{\sigma} \right) - 1 \right]^a \right\}^{b},
\]

\[
\text{VaR}_p(X) = \sigma \Phi^{-1} \left( \frac{1}{2} + \frac{1}{2} \left[ 1 - (1 - p)^{1/b} \right]^{1/a} \right),
\]

\[
\text{ES}_p(X) = \frac{\sigma}{p} \int_0^p \Phi^{-1} \left( \frac{1}{2} + \frac{1}{2} \left[ 1 - (1 - v)^{1/b} \right]^{1/a} \right) dv
\]

for \( x > 0, 0 < p < 1, \sigma > 0, \) the scale parameter, \( a > 0, \) the first shape parameter, and \( b > 0, \) the second shape parameter.

**Usage**

```r
dkumhalfnorm(x, sigma=1, a=1, b=1, log=FALSE)
pkumhalfnorm(x, sigma=1, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
varkumhalfnorm(p, sigma=1, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
eskumhalfnorm(p, sigma=1, a=1, b=1)
```
**Arguments**

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **sigma**: the value of the scale parameter, must be positive, the default is 1
- **a**: the value of the first shape parameter, must be positive, the default is 1
- **b**: the value of the second shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

**Author(s)**

Saralees Nadarajah

**References**

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

**Examples**

```r
x = runif(10, min=0, max=1)
dkumhalfnorm(x)
pkumhalfnorm(x)
varkumhalfnorm(x)
eskumhalfnorm(x)
```

---

**kumloglogis**

*Kumaraswamy log-logistic distribution*
Description

Computes the pdf, cdf, value at risk and expected shortfall for the Kumaraswamy log-logistic distribution due to de Santana et al. (2012) given by

\[
f(x) = \frac{ab\alpha^\beta x^{a\beta-1}}{(\alpha^\beta + x^\beta)^{a+1}} \left[ 1 - \frac{x^{a\beta}}{\alpha^\beta + x^\beta} \right]^{b-1},
\]

\[
F(x) = \left[ 1 - \frac{x^{a\beta}}{(\alpha^\beta + x^\beta)^a} \right]^b,
\]

\[
\text{VaR}_p(X) = \alpha \left\{ \left[ 1 - (1 - p)^{1/b} \right]^{1/a} - 1 \right\}^{-1/\beta},
\]

\[
\text{ES}_p(X) = \frac{\alpha}{p} \int_0^p \left\{ \left[ 1 - (1 - v)^{1/b} \right]^{1/a} - 1 \right\}^{-1/\beta} dv
\]

for \(x > 0\), \(0 < p < 1\), \(\alpha > 0\), the scale parameter, \(\beta > 0\), the first shape parameter, \(a > 0\), the second shape parameter, and \(b > 0\), the third shape parameter.

Usage

\begin{verbatim}
dkumloglogis(x, a=1, b=1, alpha=1, beta=1, log=FALSE)
pkumloglogis(x, a=1, b=1, alpha=1, beta=1, log.p=FALSE, lower.tail=TRUE)
varkumloglogis(p, a=1, b=1, alpha=1, beta=1, log.p=FALSE, lower.tail=TRUE)
eskumloglogis(p, a=1, b=1, alpha=1, beta=1)
\end{verbatim}

Arguments

- \(x\) scaler or vector of values at which the pdf or cdf needs to be computed
- \(p\) scalar or vector of values at which the value at risk or expected shortfall needs to be computed
- \(\alpha\) the value of the scale parameter, must be positive, the default is 1
- \(\beta\) the value of the first shape parameter, must be positive, the default is 1
- \(a\) the value of the second shape parameter, must be positive, the default is 1
- \(b\) the value of the third shape parameter, must be positive, the default is 1
- \(\log\) if TRUE then log(pdf) are returned
- \(\log.p\) if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- \(\text{lower.tail}\) if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

Author(s)

Saralees Nadarajah
kumnnormal

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10, min=0, max=1)
dkumloglogis(x)
pkumloglogis(x)
varkumloglogis(x)
eskumloglogis(x)

kumnnormal  Kumareswamy normal distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for Kumareswamy normal distribution due to Cordeiro and de Castro (2011) given by

\begin{align*}
f(x) &= \frac{ab}{\sigma^a} \phi \left( \frac{x - \mu}{\sigma} \right) \Phi^{a-1} \left( \frac{x - \mu}{\sigma} \right) \left[ 1 - \Phi \left( \frac{x - \mu}{\sigma} \right) \right]^{b-1}, \\
F(x) &= 1 - \left[ 1 - \Phi \left( \frac{x - \mu}{\sigma} \right) \right]^{b}, \\
\text{VaR}_p(X) &= \mu + \sigma \Phi^{-1} \left( \left[ 1 - (1 - p)^{1/b} \right]^{1/a} \right), \\
\text{ES}_p(X) &= \mu + \frac{\sigma}{p} \int_0^p \Phi^{-1} \left( \left[ 1 - (1 - v)^{1/b} \right]^{1/a} \right) dv
\end{align*}

for $-\infty < x < \infty$, $0 < p < 1$, $-\infty < \mu < \infty$, the location parameter, $\sigma > 0$, the scale parameter, $a > 0$, the first shape parameter, and $b > 0$, the second shape parameter.

Usage

dkumnormal(x, mu=0, sigma=1, a=1, b=1, log=FALSE)
pkumnormal(x, mu=0, sigma=1, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
varkumnormal(p, mu=0, sigma=1, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
eskunormal(p, mu=0, sigma=1, a=1, b=1)

Arguments

x  scaler or vector of values at which the pdf or cdf needs to be computed
p  scaler or vector of values at which the value at risk or expected shortfall needs to be computed
mu  the value of the location parameter, can take any real value, the default is zero
sigma  the value of the scale parameter, must be positive, the default is 1
kumpareto

a  the value of the first shape parameter, must be positive, the default is 1
b  the value of the second shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value
An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runifH10,min=0,max=1)
dkumnormal(x)
pkumnormal(x)
varkumnormal(x)
eskumnormal(x)

kumpareto  Kumaraswamy Pareto distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the Kumaraswamy Pareto distribution due to Pereira et al. (2013) given by

\[ f(x) = abcK^{c}x^{-c-1} \left[ 1 - \left( \frac{K}{x} \right)^{c} \right]^{a-1} \left\{ 1 - \left[ 1 - \left( \frac{K}{x} \right)^{c} \right]^{a} \right\}^{b-1}, \]

\[ F(x) = 1 - \left\{ 1 - \left[ 1 - \left( \frac{K}{x} \right)^{c} \right]^{a} \right\}^{b}, \]

\[ \text{VaR}_p(X) = K \left\{ 1 - \left[ 1 - (1 - p)^{1/b} \right]^{1/a} \right\}^{-1/c}, \]

\[ \text{ES}_p(X) = \frac{K}{p} \int_{0}^{p} \left\{ 1 - \left[ 1 - (1 - v)^{1/b} \right]^{1/a} \right\}^{-1/c} dv \]

for \( x \geq K, 0 < p < 1, K > 0, \) the scale parameter, \( c > 0, \) the first shape parameter, \( a > 0, \) the second shape parameter, and \( b > 0, \) the third shape parameter.
Usage

\[
dkumpareto(x, K=1, a=1, b=1, c=1, log=FALSE) \\
pkumpareto(x, K=1, a=1, b=1, c=1, log.p=FALSE, lower.tail=TRUE) \\
varkumpareto(p, K=1, a=1, b=1, c=1, log.p=FALSE, lower.tail=TRUE) \\
eskumpareto(p, K=1, a=1, b=1, c=1)
\]

Arguments

- \(x\) : scaler or vector of values at which the pdf or cdf needs to be computed
- \(p\) : scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \(K\) : the value of the scale parameter, must be positive, the default is 1
- \(a\) : the value of the first shape parameter, must be positive, the default is 1
- \(b\) : the value of the second shape parameter, must be positive, the default is 1
- \(c\) : the value of the third shape parameter, must be positive, the default is 1
- \(log\) : if TRUE then log(pdf) are returned
- \(log.p\) : if TRUE then log(cdf) are returned and quantiles are computed for \(\exp(p)\)
- \(lower.tail\) : if FALSE then 1-cdf are returned and quantiles are computed for \(1-p\)

Value

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\[
x=runif(10, min=0, max=1) \\
dkumpareto(x) \\
pkumpareto(x) \\
varkumpareto(x) \\
eskumpareto(x)
\]
Description

Computes the pdf, cdf, value at risk and expected shortfall for the Kumaraswamy Weibull distribution due to Cordeiro et al. (2010) given by

\[
f(x) = \frac{ab\alpha x^{\alpha-1}}{\sigma^\alpha} \exp \left[-\left(\frac{x}{\sigma}\right)^\alpha\right] \left\{1 - \exp \left[-\left(\frac{x}{\sigma}\right)^\alpha\right]\right\}^{a-1} \left[1 - \left\{1 - \exp \left[-\left(\frac{x}{\sigma}\right)^\alpha\right]\right\}^a\right]^{b-1},
\]

\[
F(x) = 1 - \left[1 - \left\{1 - \exp \left[-\left(\frac{x}{\sigma}\right)^\alpha\right]\right\}^a\right]^b,
\]

\[
\text{VaR}_p(X) = \sigma \left[ - \log \left\{1 - \left[1 - (1-p)^{1/b}\right]^{1/a}\right\} \right]^{1/\alpha},
\]

\[
\text{ES}_p(X) = \sigma \frac{1}{p} \int_0^p \left[ - \log \left\{1 - \left[1 - (1-v)^{1/b}\right]^{1/a}\right\} \right]^{1/\alpha} dv
\]

for \(x > 0, 0 < p < 1, a > 0, \) the first shape parameter, \(b > 0, \) the second shape parameter, \(\alpha > 0, \) the third shape parameter, and \(\sigma > 0, \) the scale parameter.

Usage

dkumweibull(x, a=1, b=1, alpha=1, sigma=1, log=FALSE)
pkumweibull(x, a=1, b=1, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
varkumweibull(p, a=1, b=1, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
eskumweibull(p, a=1, b=1, alpha=1, sigma=1)

Arguments

\(x\) scaler or vector of values at which the pdf or cdf needs to be computed

\(p\) scaler or vector of values at which the value at risk or expected shortfall needs to be computed

\(\text{sigma}\) the value of the scale parameter, must be positive, the default is 1

\(a\) the value of the first shape parameter, must be positive, the default is 1

\(b\) the value of the second shape parameter, must be positive, the default is 1

\(\text{alpha}\) the value of the third shape parameter, must be positive, the default is 1

\(\text{log}\) if TRUE then log(pdf) are returned

\(\text{log.p}\) if TRUE then log(cdf) are returned and quantiles are computed for exp(p)

\(\text{lower.tail}\) if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \(x,\) giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p,\) giving the values at risk or expected shortfall computed at \(p.\)
Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10, min=0, max=1)
dkmweibull(x)
plmweibull(x)
varkmweibull(x)
eskmweibull(x)

Description
Computes the pdf, cdf, value at risk and expected shortfall for the Laplace distribution due to Laplace (1774) given by

\[
f(x) = \frac{1}{2\sigma} \exp \left( -\frac{|x - \mu|}{\sigma} \right),
\]

\[
F(x) = \begin{cases} 
\frac{1}{2} \exp \left( \frac{x - \mu}{\sigma} \right), & \text{if } x < \mu, \\
1 - \frac{1}{2} \exp \left( -\frac{x - \mu}{\sigma} \right), & \text{if } x \geq \mu,
\end{cases}
\]

\[
\text{VaR}_p(X) = \begin{cases} 
\mu + \sigma \log(2p), & \text{if } p < 1/2, \\
\mu - \sigma \log[2(1-p)], & \text{if } p \geq 1/2,
\end{cases}
\]

\[
\text{ES}_p(X) = \begin{cases} 
\mu + \sigma - \frac{\sigma}{p} + \sigma \frac{1-p}{p} \log(1-p) + \sigma \frac{1-p}{p} \log 2, & \text{if } p \geq 1/2
\end{cases}
\]

for $-\infty < x < \infty$, $0 < p < 1$, $-\infty < \mu < \infty$, the location parameter, and $\sigma > 0$, the scale parameter.

Usage

dlape(x, mu=0, sigma=1, log=FALSE)
plape(x, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
varepe(p, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
eslapae(p, mu=0, sigma=1)
Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **mu**: the value of the location parameter, can take any real value, the default is zero
- **sigma**: the value of the scale parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x=runif(10,min=0,max=1)
dlaplace(x)
plaplace(x)
varlaplace(x)
eslaplace(x)
```

1fr  

*Linear failure rate distribution*

Description

Computes the pdf, cdf, value at risk and expected shortfall for the linear failure rate distribution due to Bain (1974) given by

\[
\begin{align*}
    f(x) &= (a + bx) \exp \left( -ax - bx^2 / 2 \right), \\
    F(x) &= 1 - \exp \left( -ax - bx^2 / 2 \right), \\
    \text{VaR}_p(X) &= -a + \sqrt{a^2 - 2b \log(1 - p)}, \\
    \text{ES}_p(X) &= -a + \frac{b}{b p} \int_0^p \sqrt{a^2 - 2b \log(1 - v)} dv
\end{align*}
\]

for \( x > 0, 0 < p < 1, a > 0 \), the first scale parameter, and \( b > 0 \), the second scale parameter.
Usage

dlfr(x, a=1, b=1, log=FALSE)
plfr(x, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
varlfr(p, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
eslfr(p, a=1, b=1)

Arguments

x  scaler or vector of values at which the pdf or cdf needs to be computed
p  scaler or vector of values at which the value at risk or expected shortfall needs to be computed
a  the value of the first scale parameter, must be positive, the default is 1
b  the value of the second scale parameter, must be positive, the default is 1
log  if TRUE then log(pdf) are returned
log.p  if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail  if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10,min=0,max=1)
dlfr(x)
plfr(x)
varlfr(x)
eslfr(x)
**Libby-Novick beta distribution**

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the Libby-Novick beta distribution due to Libby and Novick (1982) given by

\[
\begin{align*}
  f(x) &= \frac{\lambda a x^{a-1}(1-x)^{b-1}}{B(a, b)[1 - (1 - \lambda)x]^{a+b}}, \\
  F(x) &= I_{\frac{x}{\lambda + (1 - \lambda)x}}(a, b), \\
  \text{VaR}_p(X) &= \frac{\lambda - (\lambda - 1)I^{-1}_p(a, b)}{\lambda - (\lambda - 1)I^{-1}_p(a, b)}, \\
  \text{ES}_p(X) &= \frac{1}{p} \int_0^p \frac{I^{-1}_p(a, b)}{I - (\lambda - 1)I^{-1}_p(a, b)} \, dv
\end{align*}
\]

for \(0 < x < 1, \, 0 < p < 1, \, \lambda > 0,\) the scale parameter, \(a > 0,\) the first shape parameter, and \(b > 0,\) the second shape parameter.

**Usage**

- `dlnbeta(x, lambda=1, a=1, b=1, log=FALSE)`
- `plnbeta(x, lambda=1, a=1, b=1, logp=FALSE, lower.tail=TRUE)`
- `varlnbeta(p, lambda=1, a=1, b=1, logp=FALSE, lower.tail=TRUE)`
- `eslnbeta(p, lambda=1, a=1, b=1)`

**Arguments**

- `x`: scaler or vector of values at which the pdf or cdf needs to be computed
- `p`: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `lambda`: the value of the scale parameter, must be positive, the default is 1
- `a`: the value of the first shape parameter, must be positive, the default is 1
- `b`: the value of the second shape parameter, must be positive, the default is 1
- `log`: if TRUE then log(pdf) are returned
- `logp`: if TRUE then log(cdf) are returned and quantiles are computed for \(\exp(p)\)
- `lower.tail`: if FALSE then 1-cdf are returned and quantiles are computed for \(1-p\)

**Value**

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

**Author(s)**

Saralees Nadarajah
logbeta

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10, min=0, max=1)
dlNbeta(x)
pNbeta(x)
varLNbeta(x)
esLNbeta(x)

logbeta

Log beta distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the log beta distribution given by

\[
f(x) = \frac{\left(\log d - \log c\right)^{1-a-b}}{xB(a, b)} (\log x - \log c)^{a-1} (\log d - \log x)^{b-1},
\]

\[
F(x) = \frac{\log x - \log c}{\log d - \log c} I^{-1}_{\log d - \log c} (a, b),
\]

\[
\text{VaR}_p(X) = c \left( \frac{d}{c} \right)^{I^{-1}_{\log d - \log c} (a, b)},
\]

\[
\text{ES}_p(X) = \frac{c}{p} \int_0^p \left( \frac{d}{c} \right)^{I^{-1}_{\log d - \log c} (a, b)} dv
\]

for \(0 < c \leq x \leq d, 0 < p < 1, a > 0,\) the first shape parameter, \(b > 0,\) the second shape parameter, \(c > 0,\) the first location parameter, and \(d > 0,\) the second location parameter.

Usage
dlogbeta(x, a=1, b=1, c=1, d=2, log=FALSE)
plogbeta(x, a=1, b=1, c=1, d=2, log.p=FALSE, lower.tail=TRUE)
varlogbeta(p, a=1, b=1, c=1, d=2, log.p=FALSE, lower.tail=TRUE)
eslogbeta(p, a=1, b=1, c=1, d=2)

Arguments
- \(x\) scaler or vector of values at which the pdf or cdf needs to be computed
- \(p\) scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \(c\) the value of the first location parameter, must be positive, the default is 1
- \(d\) the value of the second location parameter, must be positive and greater than \(c,\) the default is 2
- \(a\) the value of the first scale parameter, must be positive, the default is 1
the value of the second scale parameter, must be positive, the default is 1
if TRUE then log(pdf) are returned
if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value
An object of the same length as x, giving the pdf or cdf values computed at x or an object of the
same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10,min=0,max=1)
dlogbeta(x)
plogbeta(x)
varlogbeta(x)
eslogbeta(x)
Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **mu**: the value of the location parameter, can take any real value, the default is zero
- **sigma**: the value of the scale parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x = runif(10, min=0, max=1)
dlogcauchy(x)
plogcauchy(x)
varlogcauchy(x)
#eslogcauchy(x)
```

Description

Computes the pdf, cdf, value at risk and expected shortfall for the log gamma distribution due to Consul and Jain (1971) given by

$$ f(x) = \frac{a^r x^{a-1} (- \log x)^{r-1}}{\Gamma(r)}, $$

$$ F(x) = Q(r, -a \log x), $$

$$ \text{VaR}_p(X) = \exp \left[ - \frac{1}{a} Q^{-1}(r, p) \right], $$

$$ \text{ES}_p(X) = \frac{1}{p} \int_0^p \exp \left[ - \frac{1}{a} Q^{-1}(r, v) \right] dv $$

for $x > 0$, $0 < p < 1$, $a > 0$, the first shape parameter, and $r > 0$, the second shape parameter.
Usage

dloggamma(x, a=1, r=1, log=FALSE)
ploggamma(x, a=1, r=1, log.p=FALSE, lower.tail=TRUE)
varloggamma(p, a=1, r=1, log.p=FALSE, lower.tail=TRUE)
esloggamma(p, a=1, r=1)

Arguments

  x  scaler or vector of values at which the pdf or cdf needs to be computed
  p  scaler or vector of values at which the value at risk or expected shortfall needs
to be computed
  a  the value of the first scale parameter, must be positive, the default is 1
  r  the value of the second scale parameter, must be positive, the default is 1
  log if TRUE then log(pdf) are returned
  log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
  lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

  An object of the same length as x, giving the pdf or cdf values computed at x or an object of the
  same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

  Saralees Nadarajah

References

  S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall,
  submitted

Examples

  x=runif(100, min=0, max=1)
dloggamma(x)
ploggamma(x)
varloggamma(x)
esloggamma(x)
## Logistic exponential distribution

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the logistic exponential distribution due to Lan and Leemis (2008) given by

\[
f(x) = \frac{a \lambda \exp(\lambda x) \left[\exp(\lambda x) - 1\right]^{a-1}}{\left\{1 + \left[\exp(\lambda x) - 1\right]^{a}\right\}^2},
\]

\[
F(x) = \frac{1 + \left[\exp(\lambda x) - 1\right]^{a}}{\left[\exp(\lambda x) - 1\right]^{a}},
\]

\[
\text{VaR}_p(X) = \frac{1}{\lambda} \log \left(1 + \left(\frac{p}{1-p}\right)^{1/a}\right),
\]

\[
\text{ES}_p(X) = \frac{1}{p\lambda} \int_0^p \log \left[1 + \left(\frac{\nu}{1-\nu}\right)^{1/a}\right] d\nu
\]

for \( x > 0, 0 < p < 1, a > 0, \) the shape parameter and \( \lambda > 0, \) the scale parameter.

**Usage**

- `dlogisexp(x, lambda=1, a=1, log=FALSE)`
- `plogisexp(x, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)`
- `varlogisexp(p, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)`
- `eslogisexp(p, lambda=1, a=1)`

**Arguments**

- `x` scaler or vector of values at which the pdf or cdf needs to be computed
- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `lambda` the value of the scale parameter, must be positive, the default is 1
- `a` the value of the shape parameter, must be positive, the default is 1
- `log` if TRUE then log(pdf) are returned
- `log.p` if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

**Author(s)**

Saralees Nadarajah
References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x = runif(10, min = 0, max = 1)
dlogisrayleigh(x)
plogisrayleigh(x)
varlogisrayleigh(x)
eslogisrayleigh(x)

Description
Computes the pdf, cdf, value at risk and expected shortfall for the logistic Rayleigh distribution due to Lan and Leemis (2008) given by

\[
f(x) = a\lambda x \exp \left( \lambda x^2 / 2 \right) \left[ \exp \left( \lambda x^2 / 2 \right) - 1 \right]^a \left\{ 1 + \left[ \exp \left( \lambda x^2 / 2 \right) - 1 \right]^a \right\}^{-2},
\]
\[
F(x) = \frac{\left[ \exp \left( \lambda x^2 / 2 \right) - 1 \right]^a}{1 + \left[ \exp \left( \lambda x^2 / 2 \right) - 1 \right]^a},
\]
\[
\text{VaR}_p(X) = \sqrt{2 \lambda} \log \left[ 1 + \left( \frac{p}{1 - p} \right)^{1/a} \right]^1/2,
\]
\[
\text{ES}_p(X) = \frac{\sqrt{2 \lambda}}{p} \left\{ \log \left[ 1 + \left( \frac{v}{1 - v} \right)^{1/a} \right] \right\}^{1/2} dv
\]

for $x > 0$, $0 < p < 1$, $a > 0$, the shape parameter, and $\lambda > 0$, the scale parameter.

Usage

dlogisrayleigh(x, a = 1, lambda = 1, log = FALSE)
plogisrayleigh(x, a = 1, lambda = 1, log.p = FALSE, lower.tail = TRUE)
varlogisrayleigh(p, a = 1, lambda = 1, log.p = FALSE, lower.tail = TRUE)
eslogisrayleigh(p, a = 1, lambda = 1)

Arguments
x scaler or vector of values at which the pdf or cdf needs to be computed
p scaler or vector of values at which the value at risk or expected shortfall needs to be computed
lambda the value of the scale parameter, must be positive, the default is 1
a the value of the shape parameter, must be positive, the default is 1
logistic

log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dlogisrayleigh(x)
plogisrayleigh(x)
varlogisrayleigh(x)
eslogisrayleigh(x)

logistic

Logistic distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the logistic distribution given by

\[ f(x) = \frac{1}{\sigma} \exp\left(-\frac{x - \mu}{\sigma}\right) \left[1 + \exp\left(-\frac{x - \mu}{\sigma}\right)\right]^{-2}, \]
\[ F(x) = \frac{1}{1 + \exp\left(-\frac{x - \mu}{\sigma}\right)}, \]
\[ \text{VaR}_p(X) = \mu + \sigma \log[p(1-p)], \]
\[ \text{ES}_p(X) = \mu - 2\sigma + \sigma \log p - \sigma \frac{1-p}{p} \log(1-p) \]

for \(-\infty < x < \infty, 0 < p < 1, -\infty < \mu < \infty,\) the location parameter, and \(\sigma > 0,\) the scale parameter.

Usage

dlogistic(x, mu=0, sigma=1, log=FALSE)
plogistic(x, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
varlogistic(p, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
eslogistic(p, mu=0, sigma=1)
Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **mu**: the value of the location parameter, can take any real value, the default is zero
- **sigma**: the value of the scale parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x = runif(10, min = 0, max = 1)
dlogistic(x)
plogistic(x)
varlogistic(x)
eslogistic(x)
```

---

`loglaplace`  
*Log Laplace distribution*
Description

Computes the pdf, cdf, value at risk and expected shortfall for the log Laplace distribution given by

\[
    f(x) = \begin{cases} 
        \frac{ab^b}{\delta^b(a+b)}, & \text{if } x \leq \delta, \\
        \frac{abδ}{x^{a+1}(a+b)}, & \text{if } x > \delta, \\
        \frac{aδ}{\delta^b(a+b)}, & \text{if } x \leq \delta,
    \end{cases}
\]

\[
    F(x) = \begin{cases} 
        \frac{ax}{\delta^b(a+b)}, & \text{if } x \leq \delta, \\
        1 - \frac{bδ}{x^a(a+b)}, & \text{if } x > \delta,
    \end{cases}
\]

\[
    \text{VaR}_p(X) = \begin{cases} 
        \delta \left[ \frac{a+b}{p-a} \right]^{1/b}, & \text{if } p \leq \frac{a}{a+b}, \\
        \delta \left[ (1-p) \frac{a+b}{a} \right]^{-1/a}, & \text{if } p > \frac{a}{a+b}, \\
        \delta b \left[ \frac{a+b}{p-a} \right]^{1/b}, & \text{if } p \leq \frac{a}{a+b},
    \end{cases}
\]

\[
    \text{ES}_p(X) = \begin{cases} 
        \frac{aδ}{p(1+1/b)(a+b)} + \frac{a^{1/a}b^{1-1/a}δ}{p(a+b)(1-1/a)}, & \text{if } p \leq \frac{a}{a+b}, \\
        \frac{δ}{p(1-1/a)} \left[ \frac{a}{(a+b)(1-p)} \right]^{1/a}, & \text{if } p > \frac{a}{a+b},
    \end{cases}
\]

for \(-\infty < x < \infty, 0 < p < 1, \delta > 0\), the scale parameter, \(a > 0\), the first shape parameter, and \(b > 0\), the second shape parameter.

Usage

\[
    \text{dloglaplace}(x, a=1, b=1, \text{delta}=0, \text{log}=\text{FALSE}) \\
    \text{ploglaplace}(x, a=1, b=1, \text{delta}=0, \text{log}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
    \text{varloglaplace}(p, a=1, b=1, \text{delta}=0, \text{log}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
    \text{esloglaplace}(p, a=1, b=1, \text{delta}=0)
\]

Arguments

- \(x\) scaler or vector of values at which the pdf or cdf needs to be computed
- \(p\) scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \(\text{delta}\) the value of the scale parameter, must be positive, the default is 1
- \(a\) the value of the first shape parameter, must be positive, the default is 1
- \(b\) the value of the second shape parameter, must be positive, the default is 1
- \(\text{log}\) if TRUE then log(pdf) are returned
- \(\text{log.p}\) if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- \(\text{lower.tail}\) if FALSE then 1-cdf are returned and quantiles are computed for 1-p
Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\[
x = \text{runif}(10, \text{min}=0, \text{max}=1)\\
d\loglaplace(x)\\
p\loglaplace(x)\\
\text{varloglaplace}(x)\\
\text{esloglaplace}(x)
\]

---

**Loglog distribution**

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the Loglog distribution due to Pham (2002) given by

\[
f(x) = a \log(\lambda)x^{a-1}\lambda^{-a} \exp \left[ 1 - \lambda^{-a} \right], \\
F(x) = 1 - \exp \left[ 1 - \lambda^{-a} \right], \\
\text{VaR}_p(X) = \left\{ \frac{\log \left[ 1 - \log(1 - p) \right]}{\log \lambda} \right\}^{1/a}, \\
\text{ES}_p(X) = \frac{1}{p \left( \log \lambda \right)^{1/a}} \int_0^p \left\{ \log \left[ 1 - \log(1 - v) \right]\right\}^{1/a} dv
\]

for \( x > 0 \), \( 0 < p < 1 \), \( a > 0 \), the shape parameter, and \( \lambda > 1 \), the scale parameter.

**Usage**

\[
d\loglog(x, a=1, \lambda=2, \log=false)\\
p\loglog(x, a=1, \lambda=2, \log.p=false, \text{lower.tail}=true)\\
\text{varloglog}(p, a=1, \lambda=2, \log.p=false, \text{lower.tail}=true)\\
\text{esloglog}(p, a=1, \lambda=2)
\]
loglogis

Arguments

- `x`: scaler or vector of values at which the pdf or cdf needs to be computed
- `p`: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `lambda`: the value of the scale parameter, must be greater than 1, the default is 2
- `a`: the value of the shape parameter, must be positive, the default is 1
- `log`: if TRUE then log(pdf) are returned
- `log.p`: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail`: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x=runif(10, min=0, max=1)
dloglogHx)
ploglogHx)
varloglogHx)
esloglogHx)
```

loglogis  

Log-logistic distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the log-logistic distribution given by

\[
 f(x) = \frac{ba^bx^{b-1}}{(a^b + x^b)^2}, \\
 F(x) = \frac{x^b}{a^b + x^b}, \\
 \text{VaR}_p(X) = a \left( \frac{p}{1-p} \right)^{1/b}, \\
 \text{ES}_p(X) = \frac{a}{p} B_p \left( 1 + \frac{1}{b}, 1 - \frac{1}{b} \right)
\]
for \( x > 0, \ 0 < p < 1, \ a > 0, \) the scale parameter, and \( b > 0, \) the shape parameter, where

\[
B_x(a, b) = \int_0^x t^{a-1}(1 - t)^{b-1} \, dt
\]

denotes the incomplete beta function.

Usage

\[
\begin{align*}
&\text{dloglogis}(x, a=1, b=1, \ log=FALSE) \\
&ploglogis(x, a=1, b=1, \ log.p=FALSE, \ lower.tail=TRUE) \\
&\text{varloglogis}(p, a=1, b=1, \ log.p=FALSE, \ lower.tail=TRUE) \\
&\text{esloglogis}(p, a=1, b=1)
\end{align*}
\]

Arguments

- \( x \) : scaler or vector of values at which the pdf or cdf needs to be computed
- \( p \) : scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \( a \) : the value of the scale parameter, must be positive, the default is 1
- \( b \) : the value of the shape parameter, must be positive, the default is 1
- \( \log \) : if TRUE then log(pdf) are returned
- \( \log.p \) : if TRUE then log(cdf) are returned and quantiles are computed for \( \exp(p) \)
- \( \text{lower.tail} \) : if FALSE then \( 1-\text{cdf} \) are returned and quantiles are computed for \( 1-p \)

Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\[
\begin{align*}
x &= \text{runif}(10, \ min=0, \ max=1) \\
&\text{dloglogis}(x) \\
&ploglogis(x) \\
&\text{varloglogis}(x) \\
&\text{esloglogis}(x)
\end{align*}
\]
Description

Computes the pdf, cdf, value at risk and expected shortfall for the lognormal distribution given by

\[ f(x) = \frac{1}{\sigma x} \phi \left( \frac{\log x - \mu}{\sigma} \right), \]
\[ F(x) = \Phi \left( \frac{\log x - \mu}{\sigma} \right), \]
\[ \text{VaR}_p(X) = \exp \left[ \mu + \sigma \Phi^{-1}(p) \right], \]
\[ \text{ES}_p(X) = \frac{\exp(\mu)}{p} \int_0^p \exp \left[ \sigma \Phi^{-1}(v) \right] dv \]

for \( x > 0, 0 < p < 1, -\infty < \mu < \infty \), the location parameter, and \( \sigma > 0 \), the scale parameter.

Usage

\[
\begin{align*}
& \text{dlognorm}(x, \text{mu}=0, \text{sigma}=1, \text{log}=\text{FALSE}) \\
& \text{plognorm}(x, \text{mu}=0, \text{sigma}=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
& \text{varlognorm}(p, \text{mu}=0, \text{sigma}=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
& \text{eslognorm}(p, \text{mu}=0, \text{sigma}=1)
\end{align*}
\]

Arguments

- \( x \) : scaler or vector of values at which the pdf or cdf needs to be computed
- \( p \) : scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \( \text{mu} \) : the value of the location parameter, can take any real value, the default is zero
- \( \text{sigma} \) : the value of the scale parameter, must be positive, the default is 1
- \( \text{log} \) : if \( \text{TRUE} \) then \( \log(\text{pdf}) \) are returned
- \( \text{log.p} \) : if \( \text{TRUE} \) then \( \log(\text{cdf}) \) are returned and quantiles are computed for \( \exp(p) \)
- \( \text{lower.tail} \) : if \( \text{FALSE} \) then \( 1-\text{cdf} \) are returned and quantiles are computed for \( 1-p \)

Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah
References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\[ x = \text{runif}(10, \text{min}=0, \text{max}=1) \]
\[ \text{dlognorm}(x) \]
\[ \text{plognorm}(x) \]
\[ \text{varlognorm}(x) \]
\[ \text{eslognorm}(x) \]

---

### lomax

#### Lomax distribution

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the Lomax distribution due to Lomax (1954) given by

\[
    f(x) = \frac{a}{\lambda} \left(1 + \frac{x}{\lambda}\right)^{-a-1},
\]
\[
    F(x) = 1 - \left(1 + \frac{x}{\lambda}\right)^{-a},
\]
\[
    \text{VaR}_p(X) = \lambda \left[(1 - p)^{-1/a} - 1\right],
\]
\[
    \text{ES}_p(X) = -\lambda + \frac{\lambda(1 - p)^{1-1/a}}{p - p/a}
\]

for \( x > 0, 0 < p < 1, a > 0 \), the shape parameter, and \( \lambda > 0 \), the scale parameter.

**Usage**

\[
    \text{dlomax}(x, a=1, \lambda=1, \log=\text{FALSE})
\]
\[
    \text{plomax}(x, a=1, \lambda=1, \log.p=\text{FALSE}, \text{lower.tail=\text{TRUE}})
\]
\[
    \text{varlomax}(p, a=1, \lambda=1, \log.p=\text{FALSE}, \text{lower.tail=\text{TRUE}})
\]
\[
    \text{eslomax}(p, a=1, \lambda=1)
\]

**Arguments**

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **lambda**: the value of the scale parameter, must be positive, the default is 1
- **a**: the value of the shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p
Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\( \text{x=runif(10, min=0, max=1)} \)
\( \text{dlomax(x)} \)
\( \text{plomax(x)} \)
\( \text{varlomax(x)} \)
\( \text{eslomax(x)} \)

\[ Mlaplace \]

McGill Laplace distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the McGill Laplace distribution due to McGill (1962) given by

\[
f(x) = \begin{cases} 
\frac{1}{2\psi} \exp\left(\frac{x - \theta}{\psi}\right), & \text{if } x \leq \theta, \\
\frac{1}{2\phi} \exp\left(\frac{\theta - x}{\phi}\right), & \text{if } x > \theta, \\
\frac{1}{2} \exp\left(-\frac{x - \theta}{\psi}\right), & \text{if } x \leq \theta,
\end{cases}
\]

\[
F(x) = \begin{cases} 
1 - \frac{1}{2} \exp\left(\frac{\theta - x}{\phi}\right), & \text{if } x > \theta, \\
\theta + \psi \log(2p), & \text{if } p \leq 1/2, \\
\theta - \phi \log\left(2(1-p)\right), & \text{if } p > 1/2,
\end{cases}
\]

\[
\text{VaR}_p(X) = \begin{cases} 
\psi + \theta \log(2p) - \theta p, & \text{if } p \leq 1/2, \\
\theta - \phi \log\left(2(1-p)\right), & \text{if } p > 1/2,
\end{cases}
\]

\[
\text{ES}_p(X) = \begin{cases} 
\theta + \phi + \frac{\psi - \phi - 2\theta}{2p} + \frac{\phi}{p} \log 2 - \phi \log 2 \\
+ \frac{\phi}{p} \log(1-p) - \phi \log(1-p), & \text{if } p > 1/2
\end{cases}
\]
for \(-\infty < x < \infty, 0 < p < 1, -\infty < \theta < \infty,\) the location parameter, \(\phi > 0,\) the first scale parameter, and \(\psi > 0,\) the second scale parameter.

Usage

\[
\begin{align*}
\text{dmlaplace}(x, \text{theta}=0, \text{phi}=1, \text{psi}=1, \text{log}=\text{FALSE}) \\
pmlaplace(x, \text{theta}=0, \text{phi}=1, \text{psi}=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
\text{varMlaplace}(p, \text{theta}=0, \text{phi}=1, \text{psi}=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
esMlaplace(p, \text{theta}=0, \text{phi}=1, \text{psi}=1)
\end{align*}
\]

Arguments

\(x\) scaler or vector of values at which the pdf or cdf needs to be computed

\(p\) scaler or vector of values at which the value at risk or expected shortfall needs to be computed

\(\text{theta}\) the value of the location parameter, can take any real value, the default is zero

\(\text{phi}\) the value of the first scale parameter, must be positive, the default is 1

\(\text{psi}\) the value of the second scale parameter, must be positive, the default is 1

\(\text{log}\) if TRUE then \(\log(\text{pdf})\) are returned

\(\text{log.p}\) if TRUE then \(\log(\text{cdf})\) are returned and quantiles are computed for \(\exp(p)\)

\(\text{lower.tail}\) if FALSE then \(1-\text{cdf}\) are returned and quantiles are computed for \(1-p\)

Value

An object of the same length as \(x,\) giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p,\) giving the values at risk or expected shortfall computed at \(p.\)

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\[
\begin{align*}
x=\text{runif}(10, \text{min}=0, \text{max}=1) \\
dmlaplace(x) \\
pmlaplace(x) \\
\text{varMlaplace}(x) \\
esMlaplace(x)
\end{align*}
\]
**Marshall-Olkin exponential distribution**

### Description

Computes the pdf, cdf, value at risk and expected shortfall for the Marshall-Olkin exponential distribution due to Marshall and Olkin (1997) given by

\[
\begin{align*}
f(x) &= \frac{\lambda \exp(\lambda x)}{(\exp(\lambda x) - 1 + a)^2}, \\
F(x) &= \frac{\exp(\lambda x) - 2 + a}{\exp(\lambda x) - 1 + a}, \\
\text{VaR}_p(X) &= \frac{1}{\lambda} \log \frac{2 - a - (1 - a)p}{1 - p}, \\
\text{ES}_p(X) &= \frac{1}{\lambda} \log [2 - a - (1 - a)p] - \frac{2 - a}{\lambda(1 - a)p} \log \frac{2 - a - (1 - a)p}{2 - a} + \frac{1 - p}{\lambda p} \log(1 - p)
\end{align*}
\]

for \( x > 0, \; 0 < p < 1, \; a > 0 \), the first scale parameter and \( \lambda > 0 \), the second scale parameter.

### Usage

- dmoexp(x, lambda=1, a=1, log=FALSE)
- pmoexp(x, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)
- varmoexp(p, lambda=1, a=1, log.p=FALSE, lower.tail=TRUE)
- esmoexp(p, lambda=1, a=1)

### Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **a**: the value of the first scale parameter, must be positive, the default is 1
- **lambda**: the value of the second scale parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for \( \exp(p) \)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for \( 1-p \)

### Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

### Author(s)

Saralees Nadarajah
References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x = runif(10, min = 0, max = 1)
dmoexp(x)
mmoexp(x)
varmoeexp(x)
esmoeexp(x)
```

**moweibull**

*Marshall-Olkin Weibull distribution*

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the Marshall-Olkin Weibull distribution due to Marshall and Olkin (1997) given by

\[
f(x) = b\lambda^a e^{b-1} \left[ \exp \left( (\lambda x)^b \right) - 1 + a \right]^{-2},
\]

\[
F(x) = \exp \left[ \left( (\lambda x)^b \right) - 2 + a \right] - \exp \left[ \left( (\lambda x)^b \right) - 1 + a \right],
\]

\[
\text{VaR}_p(X) = \frac{1}{\lambda} \left[ \log \left( \frac{1}{1 - p} + 1 - a \right) \right]^{1/b},
\]

\[
\text{ES}_p(X) = \frac{1}{\lambda p} \int_0^p \left[ \log \left( \frac{1}{1 - v} + 1 - a \right) \right]^{1/b} dv
\]

for \( x > 0, 0 < p < 1, a > 0, b > 0, \) the first scale parameter, \( b > 0, \) the shape parameter, and \( \lambda > 0, \) the second scale parameter.

**Usage**

```r
dmoweibull(x, a=1, b=1, lambda=1, log=FALSE)
pmoweibull(x, a=1, b=1, lambda=1, log.p=FALSE, lower.tail=TRUE)
varmoweibull(p, a=1, b=1, lambda=1, log.p=FALSE, lower.tail=TRUE)
esmoweibull(p, a=1, b=1, lambda=1)
```

**Arguments**

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **a**: the value of the first scale parameter, must be positive, the default is 1
- **lambda**: the value of the second scale parameter, must be positive, the default is 1
- **b**: the value of the shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=rnorm(100,
        pmweibull(x)
        varmweibull(x)
        esmweibull(x)

Description

Computes the pdf, cdf, value at risk and expected shortfall for the McDonald-Richards beta distribution due to McDonald and Richards (1987a, 1987b) given by

\[ f(x) = \frac{x^{a-1} (bq^r - x^r)^{b-1}}{(bq^r)^{a+b-1} B(a, b)}, \]

\[ F(x) = I_{x^{r}}(a, b), \]

\[ \text{VaR}_p(X) = b^{1/r} q \left[ I_p^{-1}(a, b) \right]^{1/r}, \]

\[ \text{ES}_p(X) = \frac{b^{1/r} q}{p} \int_0^p \left[ I_v^{-1}(a, b) \right]^{1/r} dv \]

for \( 0 \leq x \leq b^{1/r} q, 0 < p < 1, q > 0, \) the scale parameter, \( a > 0, \) the first shape parameter, \( b > 0, \) the second shape parameter, and \( r > 0, \) the third shape parameter.
Usage

dMRbeta(x, a=1, b=1, r=1, q=1, log=FALSE)
pMRbeta(x, a=1, b=1, r=1, q=1, log.p=FALSE, lower.tail=TRUE)
varMRbeta(p, a=1, b=1, r=1, q=1, log.p=FALSE, lower.tail=TRUE)
esMRbeta(p, a=1, b=1, r=1, q=1)

Arguments

x scaler or vector of values at which the pdf or cdf needs to be computed
p scaler or vector of values at which the value at risk or expected shortfall needs to be computed
q the value of the scale parameter, must be positive, the default is 1
a the value of the first shape parameter, must be positive, the default is 1
b the value of the second shape parameter, must be positive, the default is 1
r the value of the third shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dMRbeta(x)
pMRbeta(x)
varMRbeta(x)
esMRbeta(x)
**Nakagami distribution**

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the Nakagami distribution due to Nakagami (1960) given by

\[
f(x) = \frac{2m^m}{\Gamma(m)a^m} x^{2m-1} \exp\left(-\frac{mx^2}{a}\right),
\]

\[
F(x) = 1 - Q\left(m, \frac{mx^2}{a}\right),
\]

\[
\text{VaR}_p(X) = \sqrt{\frac{a}{m}} \sqrt{Q^{-1}(m, 1-p)},
\]

\[
\text{ES}_p(X) = \frac{\sqrt{a}}{p\sqrt{m}} \int_0^p \sqrt{Q^{-1}(m, 1-v)} dv
\]

for \(x > 0, 0 < p < 1, a > 0\), the scale parameter, and \(m > 0\), the shape parameter.

**Usage**

- `dnakagami(x, m=1, a=1, log=FALSE)`
- `pnakagami(x, m=1, a=1, log.p=FALSE, lower.tail=TRUE)`
- `varnakagami(p, m=1, a=1, log.p=FALSE, lower.tail=TRUE)`
- `esnakagami(p, m=1, a=1)`

**Arguments**

- **x** scaler or vector of values at which the pdf or cdf needs to be computed
- **p** scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **a** the value of the scale parameter, must be positive, the default is 1
- **m** the value of the shape parameter, must be positive, the default is 1
- **log** if TRUE then log(pdf) are returned
- **log.p** if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail** if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

**Author(s)**

Saralees Nadarajah
References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dnakagami(x)
pnakagami(x)
varnakagami(x)
esnakagami(x)

normal Normal distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the normal distribution due to de Moivre (1738) and Gauss (1809) given by

\[
f(x) = \frac{1}{\sigma} \phi \left( \frac{x - \mu}{\sigma} \right),
\]

\[
F(x) = \Phi \left( \frac{x - \mu}{\sigma} \right),
\]

\[
\text{VaR}_p(X) = \mu + \sigma \Phi^{-1}(p),
\]

\[
\text{ES}_p(X) = \mu + \sigma \int_0^p \Phi^{-1}(v) dv
\]

for \(-\infty < x < \infty\), \(0 < p < 1\), \(-\infty < \mu < \infty\), the location parameter, and \(\sigma > 0\), the scale parameter, where \(\phi(\cdot)\) denotes the pdf of a standard normal random variable, and \(\Phi(\cdot)\) denotes the cdf of a standard normal random variable.

Usage

\[
dnormal(x, mu=0, sigma=1, log=FALSE)
\]

\[
ptonormal(x, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
\]

\[
varnormal(p, mu=0, sigma=1, log.p=FALSE, lower.tail=TRUE)
\]

\[
esnormal(p, mu=0, sigma=1)
\]

Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **mu**: the value of the location parameter, can take any real value, the default is zero
- **sigma**: the value of the scale parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p
Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\begin{verbatim}
x=runif(10, min=0, max=1)
dpareto(x)
ppareto(x)
varpareto(x)
espareto(x)
\end{verbatim}

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Pareto distribution due to Pareto (1964) given by

\[
f(x) = cK^c x^{-c-1},
\]

\[
F(x) = 1 - \left( \frac{K}{x} \right)^c,
\]

\[
\text{VaR}_p(X) = K(1 - p)^{-1/c},
\]

\[
\text{ES}_p(X) = \frac{Kc}{p(1-c)}(1 - p)^{1-1/c} - \frac{Kc}{p(1-c)}
\]

for \( x \geq K, 0 < p < 1, K > 0 \), the scale parameter, and \( c > 0 \), the shape parameter.

Usage

\begin{verbatim}
dpareto(x, K=1, c=1, log=FALSE)
ppareto(x, K=1, c=1, log.p=FALSE, lower.tail=TRUE)
varpareto(p, K=1, c=1, log.p=FALSE, lower.tail=TRUE)
espareto(p, K=1, c=1)
\end{verbatim}
Arguments

x  scaler or vector of values at which the pdf or cdf needs to be computed
p  scaler or vector of values at which the value at risk or expected shortfall needs to be computed
K  the value of the scale parameter, must be positive, the default is 1
c  the value of the shape parameter, must be positive, the default is 1
log  if TRUE then log(pdf) are returned
log.p  if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail  if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value
An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10, min=0, max=1)
dpareto(x)
ppareto(x)
varpareto(x)
espareto(x)

Description
Computes the pdf, cdf, value at risk and expected shortfall for the Pareto positive stable distribution due to Sarabia and Prieto (2009) and Guillen et al. (2011) given by

\[ f(x) = \frac{\nu \lambda}{x} \left[ \log \left( \frac{x}{\sigma} \right) \right]^{\nu-1} \exp \left\{ -\lambda \left[ \log \left( \frac{x}{\sigma} \right) \right]^{\nu} \right\}, \]

\[ F(x) = 1 - \exp \left\{ -\lambda \left[ \log \left( \frac{x}{\sigma} \right) \right]^{\nu} \right\}, \]

\[ \text{VaR}_p(X) = \sigma \exp \left\{ \left[ -\frac{1}{\lambda} \log(1 - p) \right]^{1/\nu} \right\}, \]

\[ \text{ES}_p(X) = \frac{\sigma}{p} \int_0^p \exp \left\{ \left[ -\frac{1}{\lambda} \log(1 - v) \right]^{1/\nu} \right\} dv. \]
for $x > 0$, $0 < p < 1$, $\lambda > 0$, the first scale parameter, $\sigma > 0$, the second scale parameter, and $\nu > 0$, the shape parameter.

Usage

dparetostable(x, lambda=1, nu=1, sigma=1, log=FALSE)
pparetostable(x, lambda=1, nu=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
vparetostable(p, lambda=1, nu=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
esparetostable(p, lambda=1, nu=1, sigma=1)

Arguments

x        scaler or vector of values at which the pdf or cdf needs to be computed
p        scaler or vector of values at which the value at risk or expected shortfall needs to be computed
lambda   the value of the first scale parameter, must be positive, the default is 1
sigma    the value of the second scale parameter, must be positive, the default is 1
nu       the value of the shape parameter, must be positive, the default is 1
log      if TRUE then log(pdf) are returned
log.p    if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail  if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x = runif(10, min=0, max=1)
dparetostable(x)
pparetostable(x)
vparetostable(x)
esparetostable(x)
Description

Computes the pdf, cdf, value at risk and expected shortfall for the Poiraud-Casanova-Thomas-Agnan Laplace distribution due to Poiraud-Casanova and Thomas-Agnan (2000) given by

\[
\begin{align*}
    f(x) &= \begin{cases} 
        a(1-a) \exp \{(1-a)(x-\theta)\}, & \text{if } x \leq \theta, \\
        a(1-a) \exp \{a(\theta-x)\}, & \text{if } x > \theta, \\
        a \exp \{(1-a)(x-\theta)\}, & \text{if } x \leq \theta,
    \end{cases} \\
    F(x) &= \begin{cases} 
        a \exp \{(1-a)(x-\theta)\}, & \text{if } x \leq \theta, \\
        1 - (1-a) \exp \{a(\theta-x)\}, & \text{if } x > \theta,
    \end{cases} \\
    \text{VaR}_p(X) &= \begin{cases} 
        \theta + \frac{1}{1-a} \log \left( \frac{p}{a} \right), & \text{if } p \leq a, \\
        \theta - \frac{1}{a} \log \left( \frac{1-p}{1-a} \right), & \text{if } p > a,
    \end{cases} \\
    \text{ES}_p(X) &= \begin{cases} 
        \theta - \frac{1}{a} + \frac{a}{1-a} \log \left( \frac{1-p}{1-a} \right) + \frac{1}{ap} \log \left( \frac{1-p}{1-a} \right), & \text{if } p > a
    \end{cases}
\]

for \(-\infty < x < \infty, 0 < p < 1, -\infty < \theta < \infty,\) the location parameter, and \(a > 0,\) the scale parameter.

Usage

\[
\begin{align*}
    \text{dPCTAlaplace}(x, \text{a}=0.5, \text{theta}=0, \text{log}=\text{FALSE}) \\
    \text{pPCTAlaplace}(x, \text{a}=0.5, \text{theta}=0, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
    \text{varPCTAlaplace}(p, \text{a}=0.5, \text{theta}=0, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
    \text{esPCTAlaplace}(p, \text{a}=0.5, \text{theta}=0)
\end{align*}
\]

Arguments

- \(x\) scaler or vector of values at which the pdf or cdf needs to be computed
- \(p\) scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- \(\text{theta}\) the value of the location parameter, can take any real value, the default is zero
- \(a\) the value of the scale parameter, must be in the unit interval, the default is 0.5
- \(\text{log}\) if TRUE then log(pdf) are returned
- \(\text{log.p}\) if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- \(\text{lower.tail}\) if FALSE then 1-cdf are returned and quantiles are computed for 1-p
Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x=runif(10, min=0, max=1)
dperks(x, a=1, b=1, log=FALSE)
pperks(x, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
varperks(p, a=1, b=1, log.p=FALSE, lower.tail=TRUE)
esperks(p, a=1, b=1)
```

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Perks distribution due to Perks (1932) given by

\[
f(x) = \frac{a \exp(bx) [1 + a]}{[1 + a \exp(bx)]^2},
\]

\[
F(x) = 1 - \frac{1 + a \exp(bx)}{1 + a},
\]

\[
\text{VaR}_p(X) = \frac{1}{b} \log \frac{a + p}{a(1 - p)},
\]

\[
\text{ES}_p(X) = -\left( 1 + \frac{a}{p} \right) \frac{\log a}{b} + \frac{(a + p) \log(a + p)}{bp} + \frac{(1 - p) \log(1 - p)}{bp}
\]

for \( x > 0, 0 < p < 1, a > 0, \) the first scale parameter and \( b > 0, \) the second scale parameter.
Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **a**: the value of the first scale parameter, must be positive, the default is 1
- **b**: the value of the second scale parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as **x**, giving the pdf or cdf values computed at **x** or an object of the same length as **p**, giving the values at risk or expected shortfall computed at **p**.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x = runif(10, min=0, max=1)
dperks(x)
pperks(x)
varperks(x)
esperks(x)
```

Description

Computes the pdf, cdf, value at risk and expected shortfall for the power function I distribution given by

\[ f(x) = ax^{a-1}, \]
\[ F(x) = x^a, \]
\[ \text{VaR}_p(X) = p^{1/a}, \]
\[ \text{ES}_p(X) = \frac{p^{1/a}}{1/a + 1} \]

for \( 0 < x < 1 \), \( 0 < p < 1 \), and \( a > 0 \), the shape parameter.
power1

Usage

dpower1(x, a=1, log=FALSE)
ppower1(x, a=1, log.p=FALSE, lower.tail=TRUE)
varpower1(p, a=1, log.p=FALSE, lower.tail=TRUE)
espower1(p, a=1)

Arguments

x scaler or vector of values at which the pdf or cdf needs to be computed
p scaler or vector of values at which the value at risk or expected shortfall needs to be computed
a the value of the shape parameter, must be positive, the default is 1
log if TRUE then log(pdf) are returned
log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dpower1(x)
ppower1(x)
varpower1(x)
espower1(x)
**Power function II distribution**

**Description**
Computes the pdf, cdf, value at risk and expected shortfall for the power function II distribution given by

\[
    f(x) = b(1 - x)^{b-1},
\]
\[
    F(x) = 1 - (1 - x)^b,
\]
\[
    \text{VaR}_p(X) = 1 - (1 - p)^{1/b},
\]
\[
    \text{ES}_p(X) = 1 + \frac{b[(1 - p)^{1/b+1} - 1]}{p(b + 1)}
\]

for \(0 < x < 1, 0 < p < 1\), and \(b > 0\), the shape parameter.

**Usage**
```
dpower2(x, b=1, log=FALSE)
ppower2(x, b=1, log.p=FALSE, lower.tail=TRUE)
varpower2(p, b=1, log.p=FALSE, lower.tail=TRUE)
espower2(p, b=1)
```

**Arguments**
- `x` : scaler or vector of values at which the pdf or cdf needs to be computed
- `p` : scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `b` : the value of the shape parameter, must be positive, the default is 1
- `log` : if TRUE then log(pdf) are returned
- `log.p` : if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` : if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**
An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

**Author(s)**
Saralees Nadarajah

**References**
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted
Examples

\[ \begin{align*}
  x &= \text{runif}(10, \min=\emptyset, \max=1) \\
  d\text{quad}(x) \\
  p\text{quad}(x) \\
  \text{var}\text{quad}(x) \\
  \text{es}\text{quad}(x)
\end{align*} \]

---

**quad**  
*Quadratic distribution*

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the quadratic distribution given by

\[
\begin{align*}
  f(x) &= \alpha(x - \beta)^2, \\
  F(x) &= \frac{\alpha}{3} [(x - \beta)^3 + (\beta - a)^3], \\
  \text{VaR}_p(X) &= \beta + \left[ \frac{3p}{\alpha} - (\beta - a)^3 \right]^{1/3}, \\
  \text{ES}_p(X) &= \beta + \frac{\alpha}{4p} \left\{ \left[ \frac{3p}{\alpha} - (\beta - a)^3 \right]^{4/3} - (\beta - a)^4 \right\}
\end{align*}
\]

for \( a \leq x \leq b, 0 < p < 1, -\infty < a < \infty \), the first location parameter, and \(-\infty < a < b < \infty\), the second location parameter, where \( \alpha = \frac{12}{(b-a)^3} \) and \( \beta = \frac{a+b}{2} \).

**Usage**

\[
\begin{align*}
  \text{dquad}(x, a=\emptyset, b=1, \text{log}=\text{FALSE}) \\
  \text{pquad}(x, a=\emptyset, b=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
  \text{varquad}(p, a=\emptyset, b=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
  \text{esquad}(p, a=\emptyset, b=1)
\end{align*}
\]

**Arguments**

\[
\begin{align*}
  x & \quad \text{scaler or vector of values at which the pdf or cdf needs to be computed} \\
  p & \quad \text{scaler or vector of values at which the value at risk or expected shortfall needs to be computed} \\
  a & \quad \text{the value of the first location parameter, can take any real value, the default is zero} \\
  b & \quad \text{the value of the second location parameter, can take any real value but must be greater than } a, \text{ the default is } 1 \\
  \text{log} & \quad \text{if TRUE then log(pdf) are returned} \\
  \text{log.p} & \quad \text{if TRUE then log(cdf) are returned and quantiles are computed for exp(p)} \\
  \text{lower.tail} & \quad \text{if FALSE then } 1-cdf \text{ are returned and quantiles are computed for } 1-p
\end{align*}
\]
Value
An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
\[
x = \text{runif}(10, \text{min} = 0, \text{max} = 1)
\]
\[
dquad(x)
\]
\[
pquad(x)
\]
\[
\text{varquad}(x)
\]
\[
\text{esquad}(x)
\]

Description
Computes the pdf, cdf, value at risk and expected shortfall for the reflected gamma distribution due to Borgi (1965) given by

\[
f(x) = \frac{1}{2\phi \Gamma(a)} \left\{ \frac{x-\theta}{\phi} \right\}^{a-1} \exp \left\{ -\frac{x-\theta}{\phi} \right\},
\]

\[
F(x) =\begin{cases} 
\frac{1}{2} Q \left( a, \frac{\theta - x}{\phi} \right), & \text{if } x \leq \theta, \\
1 - \frac{1}{2} Q \left( a, \frac{x - \theta}{\phi} \right), & \text{if } x > \theta,
\end{cases}
\]

\[
\text{VaR}_p(X) =\begin{cases} 
\theta - \phi Q^{-1}(a, 2p), & \text{if } p \leq 1/2, \\
\theta + \phi Q^{-1}(a, 2(1-p)), & \text{if } p > 1/2,
\end{cases}
\]

\[
\text{ES}_p(X) =\begin{cases} 
\theta - \frac{\phi}{p} \int_0^{1/2} Q^{-1}(a, 2v) \, dv, & \text{if } p \leq 1/2, \\
\theta - \frac{\phi}{p} \int_0^{1/2} Q^{-1}(a, 2v) \, dv + \frac{\phi}{p} \int_{1/2}^p Q^{-1}(a, 2(1-v)) \, dv, & \text{if } p > 1/2
\end{cases}
\]

for \(-\infty < x < \infty, 0 < p < 1, -\infty < \theta < \infty,\) the location parameter, \(\phi > 0,\) the scale parameter, and \(a > 0,\) the shape parameter.
Usage

\[
\begin{align*}
\text{drgamma}(x, a=1, \theta=0, \phi=1, \log=\text{FALSE}) \\
\text{prgamma}(x, a=1, \theta=0, \phi=1, \log.p=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
\text{varrgamma}(p, a=1, \theta=0, \phi=1, \log.p=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
\text{esrgamma}(p, a=1, \theta=0, \phi=1)
\end{align*}
\]

Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **\(\theta\)**: the value of the location parameter, can take any real value, the default is zero
- **\(\phi\)**: the value of the scale parameter, must be positive, the default is 1
- **a**: the value of the shape parameter, must be positive, the default is 1
- **\(\log\)**: if TRUE then log(pdf) are returned
- **\(\log.p\)**: if TRUE then log(cdf) are returned and quantiles are computed for \(\exp(p)\)
- **\(\text{lower.tail}\)**: if FALSE then 1-cdf are returned and quantiles are computed for 1-\(p\)

Value

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\[
\begin{align*}
x=\text{runif}(10, \text{min}=0, \text{max}=1) \\
\text{drgamma}(x) \\
\text{prgamma}(x) \\
\text{varrgamma}(x) \\
\text{esrgamma}(x)
\end{align*}
\]
**Ramberg-Schmeiser distribution**

**Description**
Computes the pdf, cdf, value at risk and expected shortfall for the Rambert-Schmeiser distribution due to Ramberg and Schmeiser (1974) given by

\[
\begin{align*}
\text{VaR}_p(X) &= p^b - (1 - p)^c, \\
\text{ES}_p(X) &= \frac{p^b}{d(b + 1)} + \frac{(1 - p)^{c+1} - 1}{pd(c + 1)}
\end{align*}
\]

for $0 < p < 1$, $b > 0$, the first shape parameter, $c > 0$, the second shape parameter, and $d > 0$, the scale parameter.

**Usage**

```r
varRS(p, b=1, c=1, d=1, log.p=FALSE, lower.tail=TRUE)
esRS(p, b=1, c=1, d=1)
```

**Arguments**

- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **d**: the value of the scale parameter, must be positive, the default is 1
- **b**: the value of the first shape parameter, must be positive, the default is 1
- **c**: the value of the second shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**
An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

**Author(s)**
Saralees Nadarajah

**References**
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted
Examples

```r
x = runif(10, min = 0, max = 1)
varRS(x)
esRS(x)
```

Schabe distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Schabe distribution due to Schabe (1994) given by

\[
\begin{align*}
    f(x) &= \frac{2\gamma + (1 - \gamma)x}{\theta(\gamma + x/\theta)^2}, \\
    F(x) &= \frac{(1 + \gamma)x}{x + \gamma \theta}, \\
    \text{VaR}_p(X) &= \frac{p\gamma\theta}{1 + \gamma - p}, \\
    \text{ES}_p(X) &= -\theta \gamma - \frac{\theta \gamma(1 + \gamma)}{p} \log \frac{1 + \gamma - p}{1 + \gamma}
\end{align*}
\]

for \(x > 0\), \(0 < p < 1\), \(0 < \gamma < 1\), the first scale parameter, and \(\theta > 0\), the second scale parameter.

Usage

```r
dschabe(x, gamma = 0.5, theta = 1, log = FALSE)
pschabe(x, gamma = 0.5, theta = 1, log.p = FALSE, lower.tail = TRUE)
varschabe(p, gamma = 0.5, theta = 1, log.p = FALSE, lower.tail = TRUE)
esschabe(p, gamma = 0.5, theta = 1)
```

Arguments

- `x` scaler or vector of values at which the pdf or cdf needs to be computed
- `p` scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `gamma` the value of the first scale parameter, must be in the unit interval, the default is 0.5
- `theta` the value of the second scale parameter, must be positive, the default is 1
- `log` if TRUE then log(pdf) are returned
- `log.p` if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail` if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`. 
secant

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
```r
x=rnorm(10, min=0, max=1)
dsech(x)
psech(x)
varsech(x)
essech(x)
```

Description
Computes the pdf, cdf, value at risk and expected shortfall for the hyperbolic secant distribution given by

\[
f(x) = \frac{1}{2} \text{sech} \left( \frac{\pi x}{2} \right),
\]

\[
F(x) = \frac{1}{\pi} \arctan \left[ \exp \left( \frac{\pi x}{2} \right) \right],
\]

\[
\text{VaR}_p(X) = \frac{2}{\pi} \log \left[ \tan \left( \frac{\pi p}{2} \right) \right],
\]

\[
\text{ES}_p(X) = \frac{2}{\pi p} \int_0^p \log \left[ \tan \left( \frac{\pi v}{2} \right) \right] dv
\]

for \(-\infty < x < \infty\), and \(0 < p < 1\).

Usage
```r
dsech(x, log=FALSE)
psech(x, log.p=FALSE, lower.tail=TRUE)
varsech(p, log.p=FALSE, lower.tail=TRUE)
essech(p)
```

Arguments
- `x`: scaler or vector of values at which the pdf or cdf needs to be computed
- `p`: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `log`: if TRUE then log(pdf) are returned
- `log.p`: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail`: if FALSE then 1-cdf are returned and quantiles are computed for 1-p
stacygamma

Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

\[
\begin{align*}
x & = \text{runif}(10, \min=0, \max=1) \\
d\text{secant}(x) \\
p\text{secant}(x) \\
v\text{arsecant}(x) \\
es\text{secant}(x)
\end{align*}
\]

Description

Computes the pdf, cdf, value at risk and expected shortfall for Stacy distribution due to Stacy (1962) given by

\[
\begin{align*}
f(x) &= \frac{ex^{c-1}\exp[-(x/\theta)^c]}{\theta^{c\gamma}\Gamma(\gamma)}, \\
F(x) &= 1 - Q\left(\gamma, \left(\frac{x}{\theta}\right)^c\right), \\
\text{VaR}_p(X) &= \theta \left[Q^{-1}(\gamma, 1 - p)\right]^{1/c}, \\
\text{ES}_p(X) &= \frac{\theta}{p} \int_0^p \left[Q^{-1}(\gamma, 1 - v)\right]^{1/c} dv
\end{align*}
\]

for \( x > 0, 0 < p < 1, \theta > 0 \), the scale parameter, \( c > 0 \), the first shape parameter, and \( \gamma > 0 \), the second shape parameter.

Usage

\[
\begin{align*}
d\text{stacygamma}(x, \gamma=1, c=1, \theta=1, \log=FALSE) \\
p\text{stacygamma}(x, \gamma=1, c=1, \theta=1, \log.p=FALSE, \text{lower.tail}=TRUE) \\
\text{varstacygamma}(p, \gamma=1, c=1, \theta=1, \log.p=FALSE, \text{lower.tail}=TRUE) \\
es\text{stacygamma}(p, \gamma=1, c=1, \theta=1)
\end{align*}
\]
Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed.
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed.
- **theta**: the value of the scale parameter, must be positive, the default is 1.
- **c**: the value of the first scale parameter, must be positive, the default is 1.
- **gamma**: the value of the second scale parameter, must be positive, the default is 1.
- **log**: if TRUE then log(pdf) are returned.
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p).
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p.

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x = runif(10, min = 0, max = 1)
dstacygamma(x)
pstacygamma(x)
varstacygamma(x)
esstacygamma(x)
```

---

\( T \)  
*Student's t distribution*
Description

Computes the pdf, cdf, value at risk and expected shortfall for the Student’s t distribution due to Gosset (1908) given by

\[
f(x) = \frac{\Gamma\left(\frac{n+1}{2}\right)}{\sqrt{n\pi} \Gamma\left(\frac{n}{2}\right)} \left(1 + \frac{x^2}{n}\right)^{-\frac{n+1}{2}},
\]

\[
F(x) = \frac{1 + \text{sign}(x)}{2} \cdot \frac{\text{sign}(x)}{2} \int_{1}^{\frac{n}{2}} a^{-\frac{n}{2}} I_{-\frac{1}{2}}^{-1}\left(\frac{n}{2}, \frac{1}{2}\right) - 1,
\]

\[
\text{VaR}_p(X) = \sqrt{n} \text{sign}\left(\frac{p - \frac{1}{2}}{2}\right) \sqrt{\frac{1}{I_{a}^{-1}\left(\frac{n}{2}, \frac{1}{2}\right)}} - 1,
\]

where \(a = 2p\) if \(p < 1/2\), \(a = 2(1 - p)\) if \(p \geq 1/2\),

\[
\text{ES}_p(X) = \frac{\sqrt{n}}{p} \int_{0}^{\frac{p}{2}} \text{sign}\left(\frac{v - \frac{1}{2}}{2}\right) \sqrt{\frac{1}{I_{a}^{-1}\left(\frac{n}{2}, \frac{1}{2}\right)}} - 1 dv,
\]

where \(a = 2v\) if \(v < 1/2\), \(a = 2(1 - v)\) if \(v \geq 1/2\)

for \(-\infty < x < \infty\), \(0 < p < 1\), and \(n > 0\), the degree of freedom parameter.

Usage

\[
dT(x, n=1, \text{log}=\text{FALSE})
\]

\[
pT(x, n=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE})
\]

\[
\text{varT}(p, n=1, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE})
\]

\[
\text{esT}(p, n=1)
\]

Arguments

\(x\) scaler or vector of values at which the pdf or cdf needs to be computed

\(p\) scaler or vector of values at which the value at risk or expected shortfall needs to be computed

\(n\) the value of the degree of freedom parameter, must be positive, the default is 1

\(\text{log}\) if \(\text{TRUE}\) then \(\log(\text{pdf})\) are returned

\(\text{log.p}\) if \(\text{TRUE}\) then \(\log(\text{cdf})\) are returned and quantiles are computed for \(\exp(p)\)

\(\text{lower.tail}\) if \(\text{FALSE}\) then 1-cdf are returned and quantiles are computed for \(1-p\)

Value

An object of the same length as \(x\), giving the pdf or cdf values computed at \(x\) or an object of the same length as \(p\), giving the values at risk or expected shortfall computed at \(p\).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted
Examples

```r
x = runif(10, min=0, max=1)
dT(x)
pT(x)
varT(x)
estT(x)
```

---

**Tukey-Lambda distribution**

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Tukey-Lambda distribution due to Tukey (1962) given by

\[
\text{VaR}_p(X) = \frac{p^\lambda - (1 - p)^\lambda}{\lambda},
\]

\[
\text{ES}_p(X) = \frac{p^{\lambda+1} + (1 - p)^{\lambda+1} - 1}{p\lambda(\lambda + 1)}
\]

for \(0 < p < 1\), and \(\lambda > 0\), the shape parameter.

Usage

```r
varTL(p, lambda=1, log.p=FALSE, lower.tail=TRUE)
estTL(p, lambda=1)
```

Arguments

- `p`: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `lambda`: the value of the shape parameter, must be positive, the default is 1
- `log`: if TRUE then log(pdf) are returned
- `log.p`: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail`: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.

Author(s)

Saralees Nadarajah
References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x = runif(10, min = 0, max = 1)
varTL(x)
esTL(x)
```

**Topp-Leone distribution**

**Description**

Computes the pdf, cdf, value at risk and expected shortfall for the Topp-Leone distribution due to Topp and Leone (1955) given by

\[
f(x) = 2b(x(2-x))^{b-1}(1-x),
F(x) = (x(2-x))^b,
\text{VaR}_p(X) = 1 - \sqrt{1 - p^{1/b}},
\text{ES}_p(X) = 1 - \frac{b}{p}B_p^{1/b} \left( b, \frac{3}{2} \right)
\]

for \(x > 0\), \(0 < p < 1\), and \(b > 0\), the shape parameter.

**Usage**

```r
dTL2(x, b=1, log=FALSE)
pTL2(x, b=1, log.p=FALSE, lower.tail=TRUE)
varTL2(p, b=1, log.p=FALSE, lower.tail=TRUE)
esTL2(p, b=1)
```

**Arguments**

- `x`: scaler or vector of values at which the pdf or cdf needs to be computed
- `p`: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- `b`: the value of the shape parameter, must be positive, the default is 1
- `log`: if TRUE then log(pdf) are returned
- `log.p`: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- `lower.tail`: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

**Value**

An object of the same length as `x`, giving the pdf or cdf values computed at `x` or an object of the same length as `p`, giving the values at risk or expected shortfall computed at `p`.
triangular

Author(s)
Saralees Nadarajah

References
S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples
x=runif(10,min=0,max=1)
dTL2(x)
pTL2(x)
varTL2(x)
esTL2(x)

triangular

Triangular distribution

Description
Computes the pdf, cdf, value at risk and expected shortfall for the triangular distribution given by

\[
f(x) = \begin{cases} 
0, & \text{if } x < a, \\
\frac{2(x - a)}{(b - a)(c - a)}, & \text{if } a \leq x \leq c, \\
\frac{2(b - x)}{(b - a)(b - c)}, & \text{if } c < x \leq b, \\
0, & \text{if } b < x, \\
0, & \text{if } x < a, 
\end{cases}
\]

\[
F(x) = \begin{cases} 
0, & \text{if } x < a, \\
\frac{(x - a)^2}{(b - a)(c - a)}, & \text{if } a \leq x \leq c, \\
1 - \frac{(b - x)^2}{(b - a)(b - c)}, & \text{if } c < x \leq b, \\
1, & \text{if } b < x, 
\end{cases}
\]

\[
\text{VaR}_p(X) = \begin{cases} 
a + \sqrt{p(b-a)(c-a)}, & \text{if } 0 < p < \frac{c-a}{b-a}, \\
b - \sqrt{(1-p)(b-a)(b-c)}, & \text{if } \frac{c-a}{b-a} \leq p < 1, \\
a + \frac{2}{3}\sqrt{p(b-a)(c-a)}, & \text{if } 0 < p < \frac{c-a}{b-a}, 
\end{cases}
\]

\[
\text{ES}_p(X) = \begin{cases} 
b + \frac{a - c}{p} + \frac{2(c - a - b)}{3p} + 2\sqrt{(b-a)(b-c)}(1-p)^{3/2}, & \text{if } \frac{c-a}{b-a} \leq p < 1 
\end{cases}
\]
for $a \leq x \leq b$, $0 < p < 1$, $-\infty < a < \infty$, the first location parameter, $-\infty < a < c < \infty$, the second location parameter, and $-\infty < c < b < \infty$, the third location parameter.

Usage

dtriangular(x, a=0, b=2, c=1, log=FALSE)
ptriangular(x, a=0, b=2, c=1, log.p=FALSE, lower.tail=TRUE)
vartriangular(p, a=0, b=2, c=1, log.p=FALSE, lower.tail=TRUE)
estriangular(p, a=0, b=2, c=1)

Arguments

x scaler or vector of values at which the pdf or cdf needs to be computed

p scaler or vector of values at which the value at risk or expected shortfall needs to be computed

a the value of the first location parameter, can take any real value, the default is zero

c the value of the second location parameter, can take any real value but must be greater than a, the default is 1

b the value of the third location parameter, can take any real value but must be greater than c, the default is 2

log if TRUE then log(pdf) are returned

log.p if TRUE then log(cdf) are returned and quantiles are computed for exp(p)

lower.tail if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x=runif(10, min=0, max=1)
dtriangular(x)
ptriangular(x)
vartriangular(x)
estriangular(x)
Two sided power distribution

Description

Computes the pdf, cdf, value at risk and expected shortfall for the two sided power distribution due to van Dorp and Kotz (2002) given by

\[ f(x) = \begin{cases} \frac{a}{\theta} \left(\frac{x}{\theta}\right)^{a-1}, & \text{if } 0 < x \leq \theta, \\ \frac{a}{1-x} \left(\frac{1-x}{1-\theta}\right)^{a-1}, & \text{if } \theta < x < 1, \end{cases} \]

\[ F(x) = \begin{cases} \theta \left(\frac{x}{\theta}\right)^a, & \text{if } 0 < x \leq \theta, \\ 1 - (1-\theta) \left(\frac{1-x}{1-\theta}\right)^a, & \text{if } \theta < x < 1, \end{cases} \]

\[ \text{VaR}_p(X) = \begin{cases} \theta \left(\frac{p}{\theta}\right)^{1/a}, & \text{if } 0 < p \leq \theta, \\ 1 - (1-\theta) \left(\frac{1-p}{1-\theta}\right)^{1/a}, & \text{if } \theta < p < 1, \end{cases} \]

\[ \text{ES}_p(X) = \begin{cases} \frac{a\theta}{a+1} \left(\frac{p}{\theta}\right)^{1/a}, & \text{if } 0 < p \leq \theta, \\ 1 - \frac{\theta}{p} + \frac{a(2\theta-1)}{(a+1)p} + \frac{a(1-\theta)^2}{(a+1)p} \left(\frac{1-p}{1-\theta}\right)^{1+1/a}, & \text{if } \theta < p < 1 \end{cases} \]

for \(0 < x < 1, 0 < p < 1, a > 0\), the shape parameter, and \(-\infty < \theta < \infty\), the location parameter.

Usage

\[
\text{dtsp}(x, a=1, \theta=0.5, \text{log}=\text{FALSE}) \\
\text{ptsp}(x, a=1, \theta=0.5, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
\text{vartsp}(p, a=1, \theta=0.5, \text{log.p}=\text{FALSE}, \text{lower.tail}=\text{TRUE}) \\
\text{estsp}(p, a=1, \theta=0.5)
\]

Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **theta**: the value of the location parameter, must take a value in the unit interval, the default is 0.5
- **a**: the value of the shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p
Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x=runif(10,min=0,max=1)
dtsp(x)
ptsp(x)
vartsp(x)
estsp(x)
```

uniform  

**Uniform distribution**

Description

Computes the pdf, cdf, value at risk and expected shortfall for the uniform distribution given by

\[
\begin{align*}
    f(x) &= \frac{1}{b-a}, \\
    F(x) &= \frac{x-a}{b-a}, \\
    \text{VaR}_p(X) &= a + p(b-a), \\
    \text{ES}_p(X) &= a + \frac{p}{2}(b-a)
\end{align*}
\]

for \( a < x < b, \ 0 < p < 1, \ -\infty < a < \infty \), the first location parameter, and \(-\infty < a < b < \infty \), the second location parameter.

Usage

```r
duniform(x, a=0, b=1, log=FALSE)
puniform(x, a=0, b=1, log.p=FALSE, lower.tail=TRUE)
vartsp(p, a=0, b=1, log.p=FALSE, lower.tail=TRUE)
estsp(p, a=0, b=1)
```
Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **a**: the value of the first location parameter, can take any real value, the default is zero
- **b**: the value of the second location parameter, can take any real value but must be greater than a, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x = runif(10, min=0, max=1)
duniform(x)
puniform(x)
varuniform(x)
esuniform(x)
```

Description

Computes the pdf, cdf, value at risk and expected shortfall for the Weibull distribution due to Weibull (1951) given by

\[
 f(x) = \frac{\alpha x^{\alpha-1}}{\sigma^\alpha} \exp \left\{ -\left( \frac{x}{\sigma} \right)^\alpha \right\}, \\
 F(x) = 1 - \exp \left\{ -\left( \frac{x}{\sigma} \right)^\alpha \right\}, \\
 \text{VaR}_p(X) = \sigma \left[ -\log(1-p) \right]^{1/\alpha}, \\
 \text{ES}_p(X) = \frac{\sigma}{p} \gamma \left( 1 + 1/\alpha, -\log(1-p) \right)
\]
for $x > 0$, $0 < p < 1$, $\alpha > 0$, the shape parameter, and $\sigma > 0$, the scale parameter.

Usage

dweibull(x, alpha=1, sigma=1, log=FALSE)
pweibull(x, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
varWeibull(p, alpha=1, sigma=1, log.p=FALSE, lower.tail=TRUE)
esWeibull(p, alpha=1, sigma=1)

Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **sigma**: the value of the scale parameter, must be positive, the default is 1
- **alpha**: the value of the shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as x, giving the pdf or cdf values computed at x or an object of the same length as p, giving the values at risk or expected shortfall computed at p.

Author(s)

Saralees Nadarajah

References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

```r
x=runif(10, min=0, max=1)
dweibull(x)
pweibull(x)
varWeibull(x)
esWeibull(x)
```
Description

Computes the pdf, cdf, value at risk and expected shortfall for the Xie distribution due to Xie et al. (2002) given by

\[ f(x) = \lambda b \left( \frac{x}{a} \right)^{b-1} \exp \left[ (x/a)^b \right] \exp (\lambda a) \exp \left\{ -\lambda a \exp \left[ (x/a)^b \right] \right\}, \]

\[ F(x) = 1 - \exp (\lambda a) \exp \left\{ -\lambda a \exp \left[ (x/a)^b \right] \right\}, \]

\[ \text{VaR}_p(X) = a \left\{ \log \left[ 1 - \frac{\log(1 - p)}{\lambda a} \right] \right\}^{1/b}, \]

\[ \text{ES}_p(X) = \frac{a}{p} \int_0^p \left\{ \log \left[ 1 - \frac{\log(1 - v)}{\lambda a} \right] \right\}^{1/b} dv \]

for \( x > 0, 0 < p < 1, a > 0, \) the first scale parameter, \( b > 0, \) the shape parameter, and \( \lambda > 0, \) the second scale parameter.

Usage

\[ \text{dxie}(x, a=1, b=1, \lambda a=1, \log=FALSE) \]
\[ \text{pxie}(x, a=1, b=1, \lambda a=1, \log.p=FALSE, \text{lower.tail}=TRUE) \]
\[ \text{varxie}(p, a=1, b=1, \lambda a=1, \log.p=FALSE, \text{lower.tail}=TRUE) \]
\[ \text{esxie}(p, a=1, b=1, \lambda a=1) \]

Arguments

- **x**: scaler or vector of values at which the pdf or cdf needs to be computed
- **p**: scaler or vector of values at which the value at risk or expected shortfall needs to be computed
- **a**: the value of the first scale parameter, must be positive, the default is 1
- **lambda**: the value of the second scale parameter, must be positive, the default is 1
- **b**: the value of the shape parameter, must be positive, the default is 1
- **log**: if TRUE then log(pdf) are returned
- **log.p**: if TRUE then log(cdf) are returned and quantiles are computed for exp(p)
- **lower.tail**: if FALSE then 1-cdf are returned and quantiles are computed for 1-p

Value

An object of the same length as \( x \), giving the pdf or cdf values computed at \( x \) or an object of the same length as \( p \), giving the values at risk or expected shortfall computed at \( p \).

Author(s)

Saralees Nadarajah
References

S. Nadarajah, S. Chan and E. Afuecheta, An R Package for value at risk and expected shortfall, submitted

Examples

x = runif(10, min=0, max=1)
dxie(x)
pxie(x)
varxie(x)
esxie(x)
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