

Package: Distributacalcul (via r-universe)

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Type Package

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Description Calculates expected values, variance, different moments (kth moment, truncated mean), stop-loss, mean excess loss, Value-at-Risk (VaR) and Tail Value-at-Risk (TVaR) as well as some density and cumulative (survival) functions of continuous, discrete and compound distributions. This package also includes a visual 'Shiny' component to enable students to visualize distributions and understand the impact of their parameters. This package is intended to expand the 'stats' package so as to enable students to develop an intuition for probability.

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URL https://alec42.github.io/Distributacalcul_Package/

BugReports https://github.com/alec42/Distributacalcul_Package/issues

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 Beta

Beta Distribution

Description

Beta distribution with shape parameters α and β .

Usage

```

expValBeta(shape1, shape2)

varBeta(shape1, shape2)

kthMomentBeta(k, shape1, shape2)

expValLimBeta(d, shape1, shape2)

expValTruncBeta(d, shape1, shape2, less.than.d = TRUE)

stopLossBeta(d, shape1, shape2)

meanExcessBeta(d, shape1, shape2)

VatRBeta(kap, shape1, shape2)

TVatRBeta(kap, shape1, shape2)

mgfBeta(t, shape1, shape2, k0)

```

Arguments

| | |
|-------------|---|
| shape1 | shape parameter α , must be positive. |
| shape2 | shape parameter β , must be positive. |
| k | kth-moment. |
| d | cut-off value. |
| less.than.d | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| kap | probability. |
| t | t. |
| k0 | point up to which to sum the distribution for the approximation. |

Details

The Beta distribution with shape parameters α and β has density:

$$f(x) = \frac{\Gamma(\alpha + \beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha-1} (1-x)^{\beta-1}$$

for $x \in [0, 1]$, $\alpha, \beta > 0$.

Value

Function :

- `expValBeta` gives the expected value.

- `varBeta` gives the variance.
- `kthMomentBeta` gives the kth moment.
- `expValLimBeta` gives the limited mean.
- `expValTruncBeta` gives the truncated mean.
- `stopLossBeta` gives the stop-loss.
- `meanExcessBeta` gives the mean excess loss.
- `VatRBeta` gives the Value-at-Risk.
- `TVatRBeta` gives the Tail Value-at-Risk.
- `mgfBeta` gives the moment generating function (MGF).

Invalid parameter values will return an error detailing which parameter is problematic.

Note

Function `VatRBeta` is a wrapper for the `qbeta` function from the stats package.

Examples

```
expValBeta(shape1 = 3, shape2 = 5)

varBeta(shape1 = 4, shape2 = 5)

kthMomentBeta(k = 3, shape1 = 4, shape2 = 5)

expValLimBeta(d = 0.3, shape1 = 4, shape2 = 5)

expValTruncBeta(d = 0.4, shape1 = 4, shape2 = 5)

# Values less than d
expValTruncBeta(d = 0.4, shape1 = 4, shape2 = 5, less.than.d = FALSE)

stopLossBeta(d = 0.3, shape1 = 4, shape2 = 5)

meanExcessBeta(d = .3, shape1 = 4, shape2 = 5)

VatRBeta(kap = .99, shape1 = 4, shape2 = 5)

TVatRBeta(kap = .99, shape1 = 4, shape2 = 5)

mgfBeta(t = 1, shape1 = 3, shape2 = 5, k0 = 1E2)
```

 binom *Binomial Distribution*

Description

Binomial distribution with size n and probability of success p .

Usage

`expValBinom(size, prob)`

`varBinom(size, prob)`

`expValTruncBinom(d, size, prob, less.than.d = TRUE)`

`VatRBinom(kap, size, prob)`

`TVatRBinom(kap, size, prob)`

`pgfBinom(t, size, prob)`

`mgfBinom(t, size, prob)`

Arguments

| | |
|--------------------------|---|
| <code>size</code> | Number of trials (0 or more). |
| <code>prob</code> | Probability of success in each trial. |
| <code>d</code> | cut-off value. |
| <code>less.than.d</code> | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| <code>kap</code> | probability. |
| <code>t</code> | t. |

Details

The binomial distribution with probability of success p for n trials has probability mass function :

$$Pr(X = k) = \binom{n}{k} p^k (1 - p)^{n-k}$$

for $k = 0, 1, 2, \dots, n$, $p \in [0, 1]$, and $n > 0$

Value

Function :

- `mgfBinom` gives the moment generating function (MGF).

- `pgfBinom` gives the probability generating function (PGF).
- `expValBinom` gives the expected value.
- `varBinom` gives the variance.
- `expValTruncBinom` gives the truncated mean.
- `TVatRBinom` gives the Tail Value-at-Risk.
- `VatRBinom` gives the Value-at-Risk.

Invalid parameter values will return an error detailing which parameter is problematic.

Note

Function `VatRBinom` is a wrapper of the `qbinom` function from the stats package.

Examples

```
expValBinom(size = 3, prob = 0.5)
```

```
varBinom(size = 3, prob = 0.5)
```

```
expValTruncBinom(d = 2, size = 3, prob = 0.5)
```

```
expValTruncBinom(d = 0, size = 3, prob = 0.5, less.than.d = FALSE)
```

```
VatRBinom(kap = 0.8, size = 5, prob = 0.2)
```

```
TVatRBinom(kap = 0.8, size = 5, prob = 0.2)
```

```
pgfBinom(t = 1, size = 3, prob = 0.5)
```

```
mgfBinom(t = 1, size = 3, prob = 0.5)
```

bivariateAMH

Bivariate Ali-Mikhail-Haq Copula

Description

Computes CDF, PDF and simulations of of the bivariate Ali-Mikhail-Haq copula.

Usage

```
cBivariateAMH(u1, u2, dependencyParameter, ...)
```

```
cdBivariateAMH(u1, u2, dependencyParameter, ...)
```

```
crBivariateAMH(numberSimulations = 10000, seed = 42, dependencyParameter)
```

Arguments

u1, u2 points at which to evaluate the copula.
 dependencyParameter correlation parameter.
 ... other parameters.
 numberSimulations Number of simulations.
 seed Simulation seed, 42 by default.

Details

The bivariate Ali-Mikhail-Haq copula has CDF :

Value

Function :

- `cBivariateAMH` returns the value of the copula.
- `cdBivariateAMH` returns the value of the density copula.
- `crBivariateAMH` returns simulated values of the copula.

Examples

```
cBivariateAMH(u1 = .76, u2 = 0.4, dependencyParameter = 0.4)
```

```
cdBivariateAMH(u1 = .76, u2 = 0.4, dependencyParameter = 0.4)
```

```
crBivariateAMH(numberSimulations = 10, seed = 42, dependencyParameter = 0.2)
```

 bivariateCA

Bivariate Cuadras-Augé Copula

Description

Computes CDF and simulations of the bivariate Cuadras-Augé copula.

Usage

```
cBivariateCA(u1, u2, dependencyParameter, ...)
```

```
crBivariateCA(numberSimulations = 10000, seed = 42, dependencyParameter)
```

Arguments

| | |
|---------------------|---|
| u1, u2 | points at which to evaluate the copula. |
| dependencyParameter | correlation parameter. |
| ... | other parameters. |
| numberSimulations | Number of simulations. |
| seed | Simulation seed, 42 by default. |

Details

The bivariate Cuadras-Augé copula has CDF :

$$C(u_1, u_2) = u_1 u_2^{1-\alpha} \times \mathbf{1}_{\{u_1 \leq u_2\}} + u_1^{1-\alpha} u_2 \times \mathbf{1}_{\{u_1 \geq u_2\}}$$

for $u_1, u_2, \alpha \in [0, 1]$. It is the geometric mean of the independence and upper Fréchet bound copulas.

Value

Function :

- `cBivariateCA` returns the value of the copula.
- `crBivariateCA` returns simulated values of the copula.

Examples

```
cBivariateCA(u1 = .76, u2 = 0.4, dependencyParameter = 0.4)
```

```
crBivariateCA(numberSimulations = 10, seed = 42, dependencyParameter = 0.2)
```

bivariateClayton *Bivariate Clayton Copula*

Description

Computes CDF, PDF and simulations of the bivariate Clayton copula.

Usage

```
cBivariateClayton(u1, u2, dependencyParameter, ...)
```

```
cdBivariateClayton(u1, u2, dependencyParameter, ...)
```

```
crBivariateClayton(numberSimulations = 10000, seed = 42, dependencyParameter)
```

Arguments

`u1, u2` points at which to evaluate the copula.
`dependencyParameter`
 correlation parameter.
`...` other parameters.
`numberSimulations`
 Number of simulations.
`seed` Simulation seed, 42 by default.

Details

The bivariate Clayton copula has CDF :

Value

Function :

- `cBivariateAMH` returns the value of the copula.
- `cdBivariateAMH` returns the value of the density function associated to the copula.

Examples

```

cBivariateClayton(u1 = .76, u2 = 0.4, dependencyParameter = 0.4)

cdBivariateClayton(u1 = .76, u2 = 0.4, dependencyParameter = 0.4)

crBivariateClayton(numberSimulations = 10, seed = 42, dependencyParameter = 0.2)
  
```

bivariateEFGM

Bivariate Eyrraud-Farlie-Gumbel-Morgenstern (EFGM) Copula

Description

Computes CDF, PDF and simulations of the EFGM copula.

Usage

```

cBivariateEFGM(u1, u2, dependencyParameter)

cdBivariateEFGM(u1, u2, dependencyParameter)

crBivariateEFGM(numberSimulations = 10000, seed = 42, dependencyParameter)
  
```

Arguments

`u1, u2` points at which to evaluate the copula.
`dependencyParameter` correlation parameter.
`numberSimulations` Number of simulations.
`seed` Simulation seed, 42 by default.

Details

The EFGM copula has CDF :

Value

Function :

- `cBivariateEFGM` returns the value of the copula.
- `cdBivariateEFGM` returns the value of the density function associated to the copula.
- `crBivariateEFGM` returns simulated values of the copula.

Examples

```
cBivariateEFGM(u1 = .76, u2 = 0.4, dependencyParameter = 0.4)
```

```
cdBivariateEFGM(u1 = .76, u2 = 0.4, dependencyParameter = 0.4)
```

```
crBivariateEFGM(numberSimulations = 10, seed = 42, dependencyParameter = 0.2)
```

| | |
|----------------|-------------------------------|
| bivariateFrank | <i>Bivariate Frank Copula</i> |
|----------------|-------------------------------|

Description

Computes CDF, PDF and simulations of the bivariate Frank copula.

Usage

```
cBivariateFrank(u1, u2, dependencyParameter, ...)
```

```
cdBivariateFrank(u1, u2, dependencyParameter, ...)
```

```
crBivariateFrank(numberSimulations = 10000, seed = 42, dependencyParameter)
```

Arguments

| | |
|---------------------|---|
| u1, u2 | points at which to evaluate the copula. |
| dependencyParameter | correlation parameter. |
| ... | other parameters. |
| numberSimulations | Number of simulations. |
| seed | Simulation seed, 42 by default. |

Details

The bivariate Frank copula has CDF :

Value

Function :

- `cBivariateFrank` returns the value of the copula.
- `cdBivariateFrank` returns the value of the density function associated to the copula.
- `crBivariateFrank` returns simulated values of the copula.

Examples

```
cBivariateFrank(u1 = .76, u2 = 0.4, dependencyParameter = 0.4)
```

```
cdBivariateFrank(u1 = .76, u2 = 0.4, dependencyParameter = 0.4)
```

```
crBivariateFrank(numberSimulations = 10, seed = 42, dependencyParameter = 0.2)
```

| | |
|-----------------|--------------------------------|
| bivariateGumbel | <i>Bivariate Gumbel Copula</i> |
|-----------------|--------------------------------|

Description

Computes CDF, PDF and simulations of the bivariate Gumbel copula.

Usage

```
cBivariateGumbel(u1, u2, dependencyParameter, ...)
```

```
cdBivariateGumbel(u1, u2, dependencyParameter, ...)
```

```
crBivariateGumbel(numberSimulations = 10000, seed = 42, dependencyParameter)
```

Arguments

`u1, u2` points at which to evaluate the copula.
`dependencyParameter`
 correlation parameter.
`...` other parameters.
`numberSimulations`
 Number of simulations.
`seed` Simulation seed, 42 by default.

Details

The bivariate Gumbel copula has CDF :

Value

Function :

- `cBivariateGumbel` returns the value of the copula.
- `cdBivariateGumbel` returns the value of the density function associated to the copula.
- `crBivariateGumbel` returns simulated values of the copula.

Examples

```

cBivariateGumbel(u1 = .76, u2 = 0.4, dependencyParameter = 1.4)

cdBivariateGumbel(u1 = .76, u2 = 0.4, dependencyParameter = 1.4)

crBivariateGumbel(numberSimulations = 10, seed = 42, dependencyParameter = 1.2)
  
```

 bivariateMO

Bivariate Marshall-Olkin Copula

Description

Computes CDF and simulations of the bivariate Marshall-Olkin copula.

Usage

```

cBivariateMO(u1, u2, dependencyParameter, ...)

crBivariateMO(numberSimulations = 10000, seed = 42, dependencyParameter)
  
```

Arguments

| | |
|---------------------|---|
| u1, u2 | points at which to evaluate the copula. |
| dependencyParameter | correlation parameters, must be vector of length 2. |
| ... | other parameters. |
| numberSimulations | Number of simulations. |
| seed | Simulation seed, 42 by default. |

Details

The bivariate Marshall-Olkin copula has CDF :

$$C(u_1, u_2) = u_1 u_2^{1-\beta} \times \mathbf{1}_{\{u_1^\alpha \leq u_2^\beta\}} + u_1^{1-\alpha} u_2 \times \mathbf{1}_{\{u_1^\alpha \geq u_2^\beta\}}$$

for $u_1, u_2, \alpha, \beta \in [0, 1]$. It is the geometric mean of the independence and upper Fréchet bound copulas.

Value

Function :

- `cBivariateMO` returns the value of the copula.
- `crBivariateMO` returns simulated values of the copula.

Examples

```
cBivariateMO(u1 = .76, u2 = 0.4, dependencyParameter = c(0.4, 0.3))
```

```
crBivariateMO(numberSimulations = 10, seed = 42, dependencyParameter = c(0.2, 0.5))
```

Description

Computes various risk measures (mean, variance, Value-at-Risk (VaR), and Tail Value-at-Risk (TVaR)) for the compound Binomial distribution.

Usage

```
pCompBinom(  
  x,  
  size,  
  prob,  
  shape,  
  rate = 1/scale,  
  scale = 1/rate,  
  k0,  
  distr_severity = "Gamma"  
)
```

```
expValCompBinom(  
  size,  
  prob,  
  shape,  
  rate = 1/scale,  
  scale = 1/rate,  
  distr_severity = "Gamma"  
)
```

```
varCompBinom(  
  size,  
  prob,  
  shape,  
  rate = 1/scale,  
  scale = 1/rate,  
  distr_severity = "Gamma"  
)
```

```
VatRCompBinom(  
  kap,  
  size,  
  prob,  
  shape,  
  rate = 1/scale,  
  scale = 1/rate,  
  k0,  
  distr_severity = "Gamma"  
)
```

```
TVatRCompBinom(  
  kap,  
  size,  
  prob,  
  shape,  
  rate = 1/scale,  
  scale = 1/rate,
```

```

    vark,
    k0,
    distr_severity = "Gamma"
)

```

Arguments

| | |
|----------------|---|
| x | vector of quantiles |
| size | Number of trials (0 or more). |
| prob | Probability of success in each trial. |
| shape | shape parameter α , must be positive. |
| rate | rate parameter β , must be positive. |
| scale | alternative parameterization to the rate parameter, scale = 1 / rate. |
| k0 | point up to which to sum the distribution for the approximation. |
| distr_severity | Choice of severity distribution. <ul style="list-style-type: none"> • "gamma" (default) • "lognormal" only for the expected value and variance. |
| kap | probability. |
| vark | Value-at-Risk (VaR) calculated at the given probability kap. |

Details

The compound binomial distribution has density

Value

Function :

- [pCompBinom](#) gives the cumulative density function.
- [expValCompBinom](#) gives the expected value.
- [varCompBinom](#) gives the variance.
- [TVatRCompBinom](#) gives the Tail Value-at-Risk.
- [VatRCompBinom](#) gives the Value-at-Risk.

Returned values are approximations for the cumulative density function, TVaR, and VaR.

Examples

```

pCompBinom(x = 2, size = 1, prob = 0.2, shape = log(1000) - 0.405,
           rate = 0.9^2, k0 = 1E2, distr_severity = "Gamma")

```

```

expValCompBinom(size = 1, prob = 0.2, shape = log(1000) - 0.405, rate = 0.9^2,
                distr_severity = "Lognormale")

```

```

varCompBinom(size = 1, prob = 0.2, shape = log(1000) - 0.405, rate = 0.9^2,
              distr_severity = "Lognormale")

```

```
VatRCompBinom(kap = 0.9, size = 1, prob = 0.2, shape = log(1000) - 0.405,
              rate = 0.9^2, k0 = 1E2, distr_severity = "Gamma")

vark_calc <- VatRCompBinom(kap = 0.9, size = 1, prob = 0.2, shape = 0.59,
                          rate = 0.9^2, k0 = 1E2, distr_severity = "Gamma")
TVatRCompBinom(kap = 0.9, size = 1, prob = 0.2, shape = 0.59, rate = 0.9^2,
               vark = vark_calc, k0 = 1E2, distr_severity = "Gamma")
```

 CompNBinom

Compound Negative Binomial Distribution

Description

Computes various risk measures (mean, variance, Value-at-Risk (VatR), and Tail Value-at-Risk (TVatR)) for the compound Negative Binomial distribution.

Usage

```
pCompNBinom(
  x,
  size,
  prob,
  shape,
  rate = 1/scale,
  scale = 1/rate,
  k0,
  distr_severity = "Gamma"
)

expValCompNBinom(
  size,
  prob,
  shape,
  rate = 1/scale,
  scale = 1/rate,
  distr_severity = "Gamma"
)

varCompNBinom(
  size,
  prob,
  shape,
  rate = 1/scale,
  scale = 1/rate,
  distr_severity = "Gamma"
)
```

```
VatRCompNBinom(
  kap,
  size,
  prob,
  shape,
  rate = 1/scale,
  scale = 1/rate,
  k0,
  distr_severity = "Gamma"
)
```

```
TVatRCompNBinom(
  kap,
  vark,
  size,
  prob,
  shape,
  rate = 1/scale,
  scale = 1/rate,
  k0,
  distr_severity = "Gamma"
)
```

Arguments

| | |
|----------------|---|
| x | vector of quantiles |
| size | Number of successful trials. |
| prob | Probability of success in each trial. |
| shape | shape parameter α , must be positive. |
| rate | rate parameter β , must be positive. |
| scale | alternative parameterization to the rate parameter, scale = 1 / rate. |
| k0 | point up to which to sum the distribution for the approximation. |
| distr_severity | Choice of severity distribution. <ul style="list-style-type: none"> • "gamma" (default) • "lognormal" only for the expected value and variance. |
| kap | probability. |
| vark | Value-at-Risk (VaR) calculated at the given probability kap. |

Details

The compound negative binomial distribution has density

Value

Function :

- `pCompNBinom` gives the cumulative density function.
- `expValCompNBinom` gives the expected value.
- `varCompNBinom` gives the variance.
- `TVatRCompNBinom` gives the Tail Value-at-Risk.
- `VatRCompNBinom` gives the Value-at-Risk.

Returned values are approximations for the cumulative density function, TVatR, and VatR.

Examples

```
pCompNBinom(x = 2, size = 1, prob = 0.2, shape = log(1000) - 0.405,
             rate = 0.9^2, k0 = 1E2, distr_severity = "Gamma")
```

```
expValCompNBinom(size = 4, prob = 0.2, shape = 0, scale = 1,
                  distr_severity = "Lognormal")
```

```
varCompNBinom(size = 1, prob = 0.2, shape = log(1000) - 0.405, rate = 0.9^2,
               distr_severity = "Lognormale")
```

```
VatRCompNBinom(kap = 0.9, size = 1, prob = 0.2, shape = 0.59,
                rate = 0.9^2, k0 = 1E2, distr_severity = "Gamma")
```

```
vark_calc <- VatRCompNBinom(kap = 0.9, size = 1, prob = 0.2, shape = 0.59,
                             rate = 0.9^2, k0 = 1E2, distr_severity = "Gamma")
```

```
TVatRCompNBinom(kap = 0.9, size = 1, prob = 0.2, shape = 0.59, rate = 0.9^2,
                 vark = vark_calc, k0 = 1E2, distr_severity = "Gamma")
```

CompPois

Compound Poisson Distribution

Description

Computes various risk measures (mean, variance, Value-at-Risk (VaR), and Tail Value-at-Risk (TVaR)) for the compound Poisson distribution.

Usage

```
pCompPois(
  x,
  lambda,
  shape,
  rate = 1/scale,
  scale = 1/rate,
```

```
    k0,  
    distr_severity = "Gamma"  
  )  
  
  expValCompPois(  
    lambda,  
    shape,  
    rate = 1/scale,  
    scale = 1/rate,  
    distr_severity = "Gamma"  
  )  
  
  varCompPois(  
    lambda,  
    shape,  
    rate = 1/scale,  
    scale = 1/rate,  
    distr_severity = "Gamma"  
  )  
  
  VatRCompPois(  
    kap,  
    lambda,  
    shape,  
    rate = 1/scale,  
    scale = 1/rate,  
    k0,  
    distr_severity = "Gamma"  
  )  
  
  TVatRCompPois(  
    kap,  
    lambda,  
    shape,  
    rate = 1/scale,  
    scale = 1/rate,  
    vark,  
    k0,  
    distr_severity = "Gamma"  
  )
```

Arguments

| | |
|--------|---|
| x | vector of quantiles |
| lambda | Rate parameter λ . |
| shape | shape parameter α , must be positive. |
| rate | rate parameter β , must be positive. |
| scale | alternative parameterization to the rate parameter, scale = 1 / rate. |

| | |
|-----------------------------|---|
| <code>k0</code> | point up to which to sum the distribution for the approximation. |
| <code>distr_severity</code> | Choice of severity distribution. <ul style="list-style-type: none"> • "gamma" (default) • "lognormal" only for the expected value and variance. |
| <code>kap</code> | probability. |
| <code>vark</code> | Value-at-Risk (VaR) calculated at the given probability <code>kap</code> . |

Details

The compound Poisson distribution with parameters ... has density

Value

Function :

- `pCompPois` gives the cumulative density function.
- `expValCompPois` gives the expected value.
- `varCompPois` gives the variance.
- `TVatRCompPois` gives the Tail Value-at-Risk.
- `VatRCompPois` gives the Value-at-Risk.

Returned values are approximations for the cumulative density function, TVaR, and VaR.

Examples

```
pCompPois(x = 2, lambda = 2, shape = log(1000) - 0.405,
          rate = 0.9^2, k0 = 1E2, distr_severity = "Gamma")

expValCompPois(lambda = 2, shape = log(1000) - 0.405, rate = 0.9^2,
               distr_severity = "Lognormale")

varCompPois(lambda = 2, shape = log(1000) - 0.405, rate = 0.9^2,
            distr_severity = "Lognormale")

VatRCompPois(kap = 0.9, lambda = 2, shape = log(1000) - 0.405,
             rate = 0.9^2, k0 = 1E2, distr_severity = "Gamma")

vark_calc <- VatRCompPois(kap = 0.9, lambda = 2, shape = 0.59,
                        rate = 0.9^2, k0 = 1E2, distr_severity = "Gamma")
TVatRCompPois(kap = 0.9, lambda = 2, shape = 0.59, rate = 0.9^2,
              vark = vark_calc, k0 = 1E2, distr_severity = "Gamma")
```

Erl

*Hypergeometric Distribution***Description**

Hypergeometric distribution where we have a sample of k balls from an urn containing N , of which m are white and n are black.

Usage

`expValErl(N = n + m, m, n = N - m, k)`

`varErl(N = n + m, m, n = N - m, k)`

Arguments

| | |
|-----|--|
| N | Total number of balls (white and black) in the urn. $N = n + m$ |
| m | Number of white balls in the urn. |
| n | Number of black balls in the urn. Can specify n instead of N . |
| k | Number of balls drawn from the urn, $k = 0, 1, \dots, m + n$. |

Details

The Hypergeometric distribution for N total items of which m are of one type and n of the other and from which k items are picked has probability mass function :

$$Pr(X = x) = \frac{\binom{m}{x} \binom{n}{k-x}}{\binom{N}{k}}$$

for $x = 0, 1, \dots, \min(k, m)$.

Value

Function :

- `expValErl` gives the expected value.
- `varErl` gives the variance.

Invalid parameter values will return an error detailing which parameter is problematic.

Examples

```
# With total balls specified
expValErl(N = 5, m = 2, k = 2)

# With number of each colour of balls specified
expValErl(m = 2, n = 3, k = 2)

# With total balls specified
varErl(N = 5, m = 2, k = 2)

# With number of each colour of balls specified
varErl(m = 2, n = 3, k = 2)
```

erlang

Erlang Distribution

Description

Erlang distribution with shape parameter n and rate parameter β .

Usage

```
dErlang(x, shape, rate = 1/scale, scale = 1/rate)
pErlang(q, shape, rate = 1/scale, scale = 1/rate, lower.tail = TRUE)
expValErlang(shape, rate = 1/scale, scale = 1/rate)
varErlang(shape, rate = 1/scale, scale = 1/rate)
kthMomentErlang(k, shape, rate = 1/scale, scale = 1/rate)
expVallimErlang(d, shape, rate = 1/scale, scale = 1/rate)
expValTruncErlang(d, shape, rate = 1/scale, scale = 1/rate, less.than.d = TRUE)
stopLossErlang(d, shape, rate = 1/scale, scale = 1/rate)
meanExcessErlang(d, shape, rate = 1/scale, scale = 1/rate)
VatRErlang(kap, shape, rate = 1/scale, scale = 1/rate)
TVatRErlang(kap, shape, rate = 1/scale, scale = 1/rate)
mgfErlang(t, shape, rate = 1/scale, scale = 1/rate)
```

Arguments

| | |
|-------------|---|
| x, q | vector of quantiles. |
| shape | shape parameter n , must be a positive integer. |
| rate | rate parameter β , must be positive. |
| scale | alternative parameterization to the rate parameter, scale = 1 / rate. |
| lower.tail | logical; if TRUE (default), probabilities are $P[X \leq x]$, otherwise, $P[X > x]$. |
| k | kth-moment. |
| d | cut-off value. |
| less.than.d | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| kap | probability. |
| t | t. |

Details

The Erlang distribution with shape parameter n and rate parameter β has density:

$$f(x) = \frac{\beta^n}{\Gamma(n)} x^{n-1} e^{-\beta x}$$

for $x \in \mathcal{R}^+$, $\beta > 0$, $n \in \mathcal{N}^+$.

Value

Function :

- [dErlang](#) gives the probability density function (PDF).
- [pErlang](#) gives the cumulative density function (CDF).
- [expValErlang](#) gives the expected value.
- [varErlang](#) gives the variance.
- [kthMomentErlang](#) gives the kth moment.
- [expValLimErlang](#) gives the limited mean.
- [expValTruncErlang](#) gives the truncated mean.
- [stopLossErlang](#) gives the stop-loss.
- [meanExcessErlang](#) gives the mean excess loss.
- [VatRErlang](#) gives the Value-at-Risk.
- [TVatRErlang](#) gives the Tail Value-at-Risk.
- [mgfErlang](#) gives the moment generating function (MGF).

Invalid parameter values will return an error detailing which parameter is problematic.

Note

Function [VatRErlang](#) is a wrapper of the [qgamma](#) function from the stats package.

Examples

```

dErlang(x = 2, shape = 2, scale = 4)

pErlang(q = 2, shape = 2, scale = 4)

expValErlang(shape = 2, scale = 4)

varErlang(shape = 2, scale = 4)

kthMomentErlang(k = 3, shape = 2, scale = 4)

expValLimErlang(d = 2, shape = 2, scale = 4)

# With rate parameter
expValTruncErlang(d = 2, shape = 2, scale = 4)

# Values greater than d
expValTruncErlang(d = 2, shape = 2, scale = 4, less.than.d = FALSE)

stopLossErlang(d = 2, shape = 2, scale = 4)

meanExcessErlang(d = 3, shape = 2, scale = 4)

# With scale parameter
VatRErlang(kap = .2, shape = 2, scale = 4)

# With rate parameter
VatRErlang(kap = .2, shape = 2, rate = 0.25)

# With scale parameter
TVatRErlang(kap = .2, shape = 3, scale = 4)

# With rate parameter
TVatRErlang(kap = .2, shape = 3, rate = 0.25)

mgfErlang(t = 2, shape = 2, scale = .25)

```

Exp

Exponential Distribution

Description

Exponential distribution with rate parameter β .

Usage

```
expValExp(rate = 1/scale, scale = 1/rate)
```

```

varExp(rate = 1/scale, scale = 1/rate)
kthMomentExp(k, rate = 1/scale, scale = 1/rate)
expValLimExp(d, rate = 1/scale, scale = 1/rate)
expValTruncExp(d, rate = 1/scale, scale = 1/rate, less.than.d = TRUE)
stopLossExp(d, rate = 1/scale, scale = 1/rate)
meanExcessExp(d, rate = 1/scale, scale = 1/rate)
VatRExp(kap, rate = 1/scale, scale = 1/rate)
TVatRExp(kap, rate = 1/scale, scale = 1/rate)
mgfExp(t, rate = 1/scale, scale = 1/rate)

```

Arguments

| | |
|-------------|---|
| rate | rate parameter β , must be positive. |
| scale | alternative parameterization to the rate parameter, scale = 1 / rate. |
| k | kth-moment. |
| d | cut-off value. |
| less.than.d | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| kap | probability. |
| t | t. |

Details

The Exponential distribution with rate parameter β has density:

$$f(x) = \frac{1}{\beta} e^{-\beta x}$$

for $x \in \mathcal{R}^+$, $\beta > 0$.

Value

Function :

- `expValExp` gives the expected value.
- `varExp` gives the variance.
- `kthMomentExp` gives the kth moment.
- `expValLimExp` gives the limited mean.
- `expValTruncExp` gives the truncated mean.

- `stopLossExp` gives the stop-loss.
- `meanExcessExp` gives the mean excess loss.
- `VatRExp` gives the Value-at-Risk.
- `TVatRExp` gives the Tail Value-at-Risk.
- `mgfExp` gives the moment generating function (MGF).

Invalid parameter values will return an error detailing which parameter is problematic.

Note

Function `VatRExp` is a wrapper of the `qexp` function from the `stats` package.

Examples

```
# With scale parameter
expValExp(scale = 4)

# With rate parameter
expValExp(rate = 0.25)

# With scale parameter
varExp(scale = 4)

# With rate parameter
varExp(rate = 0.25)

# With scale parameter
kthMomentExp(k = 2, scale = 4)

# With rate parameter
kthMomentExp(k = 2, rate = 0.25)

# With scale parameter
expValLimExp(d = 2, scale = 4)

# With rate parameter
expValLimExp(d = 2, rate = 0.25)

# With scale parameter
expValTruncExp(d = 2, scale = 4)

# With rate parameter, values greater than d
expValTruncExp(d = 2, rate = 0.25, less.than.d = FALSE)

# With scale parameter
stopLossExp(d = 2, scale = 4)

# With rate parameter
stopLossExp(d = 2, rate = 0.25)

# With scale parameter
```

```

meanExcessExp(d = 2, scale = 4)

# With rate parameter
meanExcessExp(d = 5, rate = 0.25)

# With scale parameter
VatRExp(kap = .99, scale = 4)

# With rate parameter
VatRExp(kap = .99, rate = 0.25)

# With scale parameter
TVatRExp(kap = .99, scale = 4)

# With rate parameter
TVatRExp(kap = .99, rate = 0.25)

mgfExp(t = 1, rate = 5)

```

 frechet

Fréchet Copula

Description

Computes CDF and simulations of the Fréchet copula.

Usage

```
cFrechet(u1, u2, dependencyParameter, ...)
```

```
crFrechet(numberSimulations = 10000, seed = 42, dependencyParameter)
```

Arguments

| | |
|---------------------|---|
| u1, u2 | points at which to evaluate the copula. |
| dependencyParameter | correlation parameters, must be vector of length 2. |
| ... | other parameters. |
| numberSimulations | Number of simulations. |
| seed | Simulation seed, 42 by default. |

Details

The Fréchet copula has CDF :

$$C(u_1, u_2) = (1 - \alpha - \beta)(u_1 \times u_2) + \alpha \min(u_1, u_2) + \beta \max(u_1 + u_2 - 1, 0)$$

for $u_1, u_2, \alpha, \beta \in [0, 1]$ and $\alpha + \beta \leq 1$.

Value

Function :

- `cFrechet` returns the value of the copula.
- `crFrechet` returns simulated values of the copula.

Examples

```
cFrechet(u1 = .76, u2 = 0.4, dependencyParameter = c(0.2, 0.3))
```

```
crFrechet(numberSimulations = 10, seed = 42, dependencyParameter = c(0.2, 0.3))
```

| | |
|-------------------|-----------------------------------|
| frechetLowerBound | <i>Fréchet Lower Bound Copula</i> |
|-------------------|-----------------------------------|

Description

Computes CDF and simulations of the Fréchet lower bound copula.

Usage

```
cFrechetLowerBound(u1, u2, ...)
```

```
crFrechetLowerBound(numberSimulations = 10000, seed = 42)
```

Arguments

| | |
|--------------------------------|---|
| <code>u1, u2</code> | points at which to evaluate the copula. |
| <code>...</code> | other parameters. |
| <code>numberSimulations</code> | Number of simulations. |
| <code>seed</code> | Simulation seed, 42 by default. |

Details

The Fréchet lower bound copula has CDF :

$$C(u_1, u_2) = \max(u_1 + u_2 - 1, 0)$$

for $u_1, u_2 \in [0, 1]$.

Value

Function :

- `cFrechetLowerBound` returns the value of the copula.
- `crFrechetLowerBound` returns simulated values of the copula.

Examples

```
cFrechetLowerBound(u1 = .76, u2 = 0.4)
```

```
crFrechetLowerBound(numberSimulations = 10, seed = 42)
```

```
frechetUpperBound      Fréchet Upper Bound Copula
```

Description

Computes CDF and simulations of the Fréchet upper bound copula.

Usage

```
cFrechetUpperBound(u1, u2, ...)
```

```
crFrechetUpperBound(numberSimulations = 10000, seed = 42)
```

Arguments

`u1, u2` points at which to evaluate the copula.

`...` other parameters.

`numberSimulations`
Number of simulations.

`seed` Simulation seed, 42 by default.

Details

The Fréchet upper bound copula has CDF :

$$C(u_1, u_2) = \min(u_1, u_2)$$

for $u_1, u_2 \in [0, 1]$.

Value

Function :

- `cFrechetUpperBound` returns the value of the copula.
- `crFrechetUpperBound` returns simulated values of the copula.

Examples

```
cFrechetUpperBound(u1 = .56, u2 = 0.4)
```

```
crFrechetUpperBound(numberSimulations = 10, seed = 42)
```

Gamma

*Gamma Distribution***Description**

Gamma distribution with shape parameter α and rate parameter β .

Usage

```
expValGamma(shape, rate = 1/scale, scale = 1/rate)
varGamma(shape, rate = 1/scale, scale = 1/rate)
kthMomentGamma(k, shape, rate = 1/scale, scale = 1/rate)
expVallimGamma(d, shape, rate = 1/scale, scale = 1/rate)
expValTruncGamma(d, shape, rate = 1/scale, scale = 1/rate, less.than.d = TRUE)
stopLossGamma(d, shape, rate = 1/scale, scale = 1/rate)
meanExcessGamma(d, shape, rate = 1/scale, scale = 1/rate)
VatRGamma(kap, shape, rate = 1/scale, scale = 1/rate)
TVatRGamma(kap, shape, rate = 1/scale, scale = 1/rate)
mgfGamma(t, shape, rate = 1/scale, scale = 1/rate)
```

Arguments

| | |
|-------------|---|
| shape | shape parameter α , must be positive. |
| rate | rate parameter β , must be positive. |
| scale | alternative parameterization to the rate parameter, scale = 1 / rate. |
| k | kth-moment. |
| d | cut-off value. |
| less.than.d | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| kap | probability. |
| t | t. |

Details

The Gamma distribution with shape parameter α and rate parameter β has density:

$$f(x) = \frac{\beta^\alpha}{\Gamma(\alpha)} x^{\alpha-1} e^{-\beta x}$$

for $x \in \mathcal{R}^+, \beta, \alpha > 0$.

Value

Function :

- [expValGamma](#) gives the expected value.
- [varGamma](#) gives the variance.
- [kthMomentGamma](#) gives the kth moment.
- [expValLimGamma](#) gives the limited mean.
- [expValTruncGamma](#) gives the truncated mean.
- [stopLossGamma](#) gives the stop-loss.
- [meanExcessGamma](#) gives the mean excess loss.
- [VatGamma](#) gives the Value-at-Risk.
- [TVatGamma](#) gives the Tail Value-at-Risk.
- [mgfGamma](#) gives the moment generating function (MGF).

Invalid parameter values will return an error detailing which parameter is problematic.

Note

Function [VatGamma](#) is a wrapper for the [qgamma](#) function stats package.

Examples

```
# With scale parameter
expValGamma(shape = 3, scale = 4)

# With rate parameter
expValGamma(shape = 3, rate = 0.25)

# With scale parameter
varGamma(shape = 3, scale = 4)

# With rate parameter
varGamma(shape = 3, rate = 0.25)

# With scale parameter
kthMomentGamma(k = 2, shape = 3, scale = 4)

# With rate parameter
```

```
kthMomentGamma(k = 2, shape = 3, rate = 0.25)

# With scale parameter
expValLimGamma(d = 2, shape = 3, scale = 4)

# With rate parameter
expValLimGamma(d = 2, shape = 3, rate = 0.25)

# With scale parameter
expValTruncGamma(d = 2, shape = 3, scale = 4)

# With rate parameter
expValTruncGamma(d = 2, shape = 3, rate = 0.25)

# values greather than d
expValTruncGamma(d = 2, shape = 3, rate = 0.25, less.than.d = FALSE)

# With scale parameter
stopLossGamma(d = 2, shape = 3, scale = 4)

# With rate parameter
stopLossGamma(d = 2, shape = 3, rate = 0.25)

# With scale parameter
meanExcessGamma(d = 2, shape = 3, scale = 4)

# With rate parameter
meanExcessGamma(d = 2, shape = 3, rate = 0.25)

# With scale parameter
VatGamma(kap = .2, shape = 3, scale = 4)

# With rate parameter
VatGamma(kap = .2, shape = 3, rate = 0.25)

# With scale parameter
TVatGamma(kap = .2, shape = 3, scale = 4)

# With rate parameter
TVatGamma(kap = .2, shape = 3, rate = 0.25)

mgfGamma(t = 1, shape = 3, rate = 5)
```

 IG *Inverse Gaussian Distribution*

Description

Inverse Gaussian distribution with mean μ and shape parameter β .

Usage

```

expValIG(mean, shape = dispersion * mean^2, dispersion = shape/mean^2)
varIG(mean, shape = dispersion * mean^2, dispersion = shape/mean^2)
expValLimIG(d, mean, shape = dispersion * mean^2, dispersion = shape/mean^2)
expValTruncIG(
  d,
  mean,
  shape = dispersion * mean^2,
  dispersion = shape/mean^2,
  less.than.d = TRUE
)
stopLossIG(d, mean, shape = dispersion * mean^2, dispersion = shape/mean^2)
meanExcessIG(d, mean, shape = dispersion * mean^2, dispersion = shape/mean^2)
VatRIG(kap, mean, shape = dispersion * mean^2, dispersion = shape/mean^2)
TVatRIG(kap, mean, shape = dispersion * mean^2, dispersion = shape/mean^2)
mgfIG(t, mean, shape = dispersion * mean^2, dispersion = shape/mean^2)

```

Arguments

| | |
|-------------|---|
| mean | mean (location) parameter μ , must be positive. |
| shape | shape parameter β , must be positive |
| dispersion | alternative parameterization to the shape parameter, dispersion = 1 / rate. |
| d | cut-off value. |
| less.than.d | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| kap | probability. |
| t | t. |

Details

The Inverse Gaussian distribution with

Value

Function :

- `expValIG` gives the expected value.
- `varIG` gives the variance.
- `expValLimIG` gives the limited mean.
- `expValTruncIG` gives the truncated mean.
- `stopLossIG` gives the stop-loss.
- `meanExcessIG` gives the mean excess loss.
- `VatRIG` gives the Value-at-Risk.
- `TVatRIG` gives the Tail Value-at-Risk.
- `mgfIG` gives the moment generating function (MGF).

Invalid parameter values will return an error detailing which parameter is problematic.

Note

Function `VatRIG` is a wrapper for the `qinvgauss` function from the `statmod` package.

Examples

```
expValIG(mean = 2, shape = 5)
```

```
varIG(mean = 2, shape = 5)
```

```
expValLimIG(d = 2, mean = 2, shape = 5)
```

```
expValTruncIG(d = 2, mean = 2, shape = 5)
```

```
stopLossIG(d = 2, mean = 2, shape = 5)
```

```
meanExcessIG(d = 2, mean = 2, shape = 5)
```

```
VatRIG(kap = 0.99, mean = 2, shape = 5)
```

```
TVatRIG(kap = 0.99, mean = 2, shape = 5)
```

```
mgfIG(t = 1, mean = 2, shape = .5)
```

| | |
|-------------|----------------------------|
| independent | <i>Independence Copula</i> |
|-------------|----------------------------|

Description

Computes CDF and simulations of the independence copula.

Usage

```
cIndependent(u1, u2, ...)
```

```
crIndependent(numberSimulations = 10000, seed = 42)
```

Arguments

| | |
|-------------------|---|
| u1, u2 | points at which to evaluate the copula. |
| ... | other parameters. |
| numberSimulations | Number of simulations. |
| seed | Simulation seed, 42 by default. |

Details

The independence copula has CDF :

$$C(u_1, u_2) = u_1 \times u_2$$

for $u_1, u_2 \in [0, 1]$.

Value

Function :

- `cIndependent` returns the value of the copula.
- `crIndependent` returns simulated values of the copula.

Examples

```
cIndependent(u1 = .76, u2 = 0.4)
```

```
crIndependent(numberSimulations = 10, seed = 42)
```

llogis *Loglogistic Distribution*

Description

Loglogistic distribution with shape parameter τ and scale parameter λ .

Usage

```

dLlogis(x, shape, rate = 1/scale, scale = 1/rate)

pLlogis(q, shape, rate = 1/scale, scale = 1/rate, lower.tail = TRUE)

expValLlogis(shape, rate = 1/scale, scale = 1/rate)

varLlogis(shape, rate = 1/scale, scale = 1/rate)

kthMomentLlogis(k, shape, rate = 1/scale, scale = 1/rate)

expValLimLlogis(d, shape, rate = 1/scale, scale = 1/rate)

expValTruncLlogis(d, shape, rate = 1/scale, scale = 1/rate, less.than.d = TRUE)

stopLossLlogis(d, shape, rate = 1/scale, scale = 1/rate)

meanExcessLlogis(d, shape, rate = 1/scale, scale = 1/rate)

VatRLlogis(kap, shape, rate = 1/scale, scale = 1/rate)

TVatRLlogis(kap, shape, rate = 1/scale, scale = 1/rate)

```

Arguments

| | |
|-------------|---|
| x, q | vector of quantiles. |
| shape | shape parameter τ , must be positive |
| rate | rate parameter β , must be positive. |
| scale | alternative parameterization to the rate parameter, scale = 1 / rate. |
| lower.tail | logical; if TRUE (default), probabilities are $P[X \leq x]$, otherwise, $P[X > x]$. |
| k | kth-moment. |
| d | cut-off value. |
| less.than.d | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| kap | probability. |

Details

The loglogistic distribution with shape parameter τ and scale parameter λ has density:

$$\frac{\tau \lambda^\tau x^{\tau-1}}{(\lambda^\tau + x^\tau)^2}$$

for $x \in \mathcal{R}^+$, $\lambda, \tau > 0$.

Value

Function :

- `dLlogis` gives the probability density function (PDF).
- `pLlogis` gives the cumulative density function (CDF).
- `expValLlogis` gives the expected value.
- `varLlogis` gives the variance.
- `kthMomentLlogis` gives the kth moment.
- `expValLimLlogis` gives the limited mean.
- `expValTruncLlogis` gives the truncated mean.
- `stopLossLlogis` gives the stop-loss.
- `meanExcessLlogis` gives the mean excess loss.
- `VatRLlogis` gives the Value-at-Risk.
- `TVatRLlogis` gives the Tail Value-at-Risk.

Invalid parameter values will return an error detailing which parameter is problematic.

Examples

```
dLlogis(x = 2, shape = 2, scale = 4)

# With scale parameter
pLlogis(q = 3, shape = 3, scale = 5)

# With rate parameter
pLlogis(q = 3, shape = 3, rate = 0.2)

# Survival function
pLlogis(q = 3, shape = 3, rate = 0.2, lower.tail = FALSE)

expValLlogis(shape = 2, scale = 4)

varLlogis(shape = 3, scale = 4)

kthMomentLlogis(k = 3, shape = 5, scale = 4)

expValLimLlogis(d = 2, shape = 2, scale = 4)

# With rate parameter
```

```

expValTruncLlogis(d = 2, shape = 2, scale = 4)

# Values greater than d
expValTruncLlogis(d = 2, shape = 2, scale = 4, less.than.d = FALSE)

stopLossLlogis(d = 2, shape = 2, scale = 4)

meanExcessLlogis(d = 3, shape = 2, scale = 4)

# With scale parameter
VatRLlogis(kap = .2, shape = 2, scale = 4)

# With rate parameter
VatRLlogis(kap = .2, shape = 2, rate = 0.25)

# With scale parameter
TVatRLlogis(kap = .2, shape = 3, scale = 4)

# With rate parameter
TVatRLlogis(kap = .2, shape = 3, rate = 0.25)

```

Lnorm

Lognormal Distribution

Description

Lognormal distribution with mean μ and variance σ .

Usage

```

expValLnorm(meanlog, sdlog)

varLnorm(meanlog, sdlog)

kthMomentLnorm(k, meanlog, sdlog)

expValLimLnorm(d, meanlog, sdlog)

expValTruncLnorm(d, meanlog, sdlog, less.than.d = TRUE)

stopLossLnorm(d, meanlog, sdlog)

meanExcessLnorm(d, meanlog, sdlog)

VatRLnorm(kap, meanlog, sdlog)

TVatRLnorm(kap, meanlog, sdlog)

```

Arguments

| | |
|-------------|---|
| meanlog | location parameter μ . |
| sdlog | standard deviation σ , must be positive. |
| k | kth-moment. |
| d | cut-off value. |
| less.than.d | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| kap | probability. |

Details

The Log-normal distribution with mean μ and standard deviation σ has density:

$$\frac{1}{\sqrt{2\pi}\sigma x} e^{-\frac{1}{2}\left(\frac{\ln(x)-\mu}{\sigma}\right)^2}$$

for $x \in \mathcal{R}^+$, $\mu \in \mathcal{R}$, $\sigma > 0$.

Value

Function :

- `expValLnorm` gives the expected value.
- `varLnorm` gives the variance.
- `kthMomentLnorm` gives the kth moment.
- `expValLimLnorm` gives the limited mean.
- `expValTruncLnorm` gives the truncated mean.
- `stopLossLnorm` gives the stop-loss.
- `meanExcessLnorm` gives the mean excess loss.
- `VatRLnorm` gives the Value-at-Risk.
- `TVatRLnorm` gives the Tail Value-at-Risk.

Invalid parameter values will return an error detailing which parameter is problematic.

Note

Function `VatRLnorm` is a wrapper of the `qlnorm` function from the stats package.

Examples

```
expValLnorm(meanlog = 3, sdlog = 5)
varLnorm(meanlog = 3, sdlog = 5)
kthMomentLnorm(k = 2, meanlog = 3, sdlog = 5)
expValLimLnorm(d = 2, meanlog = 2, sdlog = 5)
```

```

expValTruncLnorm(d = 2, meanlog = 2, sdlog = 5)

# Values greater than d
expValTruncLnorm(d = 2, meanlog = 2, sdlog = 5, less.than.d = FALSE)

stopLossLnorm(d = 2, meanlog = 2, sdlog = 5)

meanExcessLnorm(d = 2, meanlog = 2, sdlog = 5)

VatRLnorm(kap = 0.8, meanlog = 3, sdlog = 5)

TVatRLnorm(kap = 0.8, meanlog = 2, sdlog = 5)

```

Logarithmic

Logarithmic Distribution

Description

Logarithmic distribution with probability parameter γ .

Usage

```

dLogarithmic(x, prob)

pLogarithmic(q, prob, lower.tail = TRUE)

expValLogarithmic(prob)

varLogarithmic(prob)

VatRLogarithmic(kap, prob)

mgfLogarithmic(t, prob)

pgfLogarithmic(t, prob)

```

Arguments

| | |
|------------|---|
| x, q | vector of quantiles. |
| prob | probability parameter γ . |
| lower.tail | logical; if TRUE (default), probabilities are $P[X \leq x]$, otherwise, $P[X > x]$. |
| kap | probability. |
| t | t. |

Details

The Logarithmic distribution with probability parameter γ has probability mass function :

$$Pr(X = k) = \frac{-\gamma^k}{\ln(1 - \gamma)k}$$

, for $k = 0, 1, 2, \dots$, and $\gamma \in (0, 1]$.

Value

Function :

- `dLogarithmic` gives the probability density function (PDF).
- `pLogarithmic` gives the cumulative density function (CDF).
- `expValLogarithmic` gives the expected value.
- `varLogarithmic` gives the variance.
- `VatRLogarithmic` gives the Value-at-Risk.
- `mgfLogarithmic` gives the moment generating function (MGF).
- `pgfLogarithmic` gives the probability generating function (MGF).

Invalid parameter values will return an error detailing which parameter is problematic.

Examples

```
dLogarithmic(x = 3, prob = 0.2)
```

```
pLogarithmic(q = 3, prob = 0.2)
```

```
expValLogarithmic(prob = 0.50)
```

```
varLogarithmic(prob = 0.50)
```

```
VatRLogarithmic(kap = 0.99, prob = 0.2)
```

```
mgfLogarithmic(t = .2, prob = 0.50)
```

```
pgfLogarithmic(t = .2, prob = 0.50)
```

NBinom

Negative Binomial Distribution

Description

Negative binomial distribution with parameters r (number of successful trials) and p (probability of success).

Usage

```

expValNBinom(
  size,
  prob = (1/(1 + beta)),
  beta = ((1 - prob)/prob),
  nb_tries = FALSE
)

varNBinom(
  size,
  prob = (1/(1 + beta)),
  beta = ((1 - prob)/prob),
  nb_tries = FALSE
)

mgfNBinom(
  t,
  size,
  prob = (1/(1 + beta)),
  beta = ((1 - prob)/prob),
  nb_tries = FALSE
)

pgfNBinom(
  t,
  size,
  prob = (1/(1 + beta)),
  beta = ((1 - prob)/prob),
  nb_tries = FALSE
)

```

Arguments

| | |
|----------|--|
| size | Number of successful trials. |
| prob | Probability of success in each trial. |
| beta | Alternative parameterization of the negative binomial distribution where beta = (1 - p) / p. |
| nb_tries | logical; if FALSE (default) number of trials until the rth success, otherwise, number of failures until the rth success. |
| t | t. |

Details

When k is the number of failures until the r th success, with a probability p of a success, the negative binomial has density:

$$\binom{r+k-1}{k} (p)^r (1-p)^k$$

for $k \in \{0, 1, \dots\}$

When k is the number of trials until the r th success, with a probability p of a success, the negative binomial has density:

$$\binom{k-1}{r-1} (p)^r (1-p)^{k-r}$$

for $k \in \{r, r+1, r+2, \dots\}$

The alternative parameterization of the negative binomial with parameter β , and k being the number of trials, has density:

$$\frac{\Gamma(r+k)}{\Gamma(r)k!} \left(\frac{1}{1+\beta}\right)^r \left(\frac{\beta}{1+\beta}\right)^{k-r}$$

for $k \in \{0, 1, \dots\}$

Value

Function :

- `expValNBinom` gives the expected value.
- `varNBinom` gives the variance.
- `mgfNBinom` gives the moment generating function (MGF).
- `pgfNBinom` gives the probability generating function (PGF).

Invalid parameter values will return an error detailing which parameter is problematic.

Examples

```
# Where k is the number of trials for a rth success
expValNBinom(size = 2, prob = .4)

# Where k is the number of failures before a rth success
expValNBinom(size = 2, prob = .4, nb_tries = TRUE)

# With alternative parameterization where k is the number of trials
expValNBinom(size = 2, beta = 1.5)

# Where k is the number of trials for a rth success
varNBinom(size = 2, prob = .4)

# Where k is the number of failures before a rth success
varNBinom(size = 2, prob = .4, nb_tries = TRUE)

# With alternative parameterization where k is the number of trials
varNBinom(size = 2, beta = 1.5)

mgfNBinom(t = 1, size = 4, prob = 0.5)

pgfNBinom(t = 5, size = 3, prob = 0.3)
```

 Norm

Normal Distribution

Description

Normal distribution

Usage

`expValNorm(mean, sd)`

`varNorm(mean, sd)`

`expValLimNorm(d, mean = 0, sd = 1)`

`expValTruncNorm(d, mean = 0, sd = 1, less.than.d = TRUE)`

`stopLossNorm(d, mean = 0, sd = 1)`

`meanExcessNorm(d, mean = 0, sd = 1)`

`VatRNorm(kap, mean = 0, sd = 1)`

`TVatRNorm(kap, mean = 0, sd = 1)`

`mgfNorm(t, mean = 0, sd = 1)`

Arguments

| | |
|--------------------------|---|
| <code>mean</code> | mean (location) parameter μ . |
| <code>sd</code> | standard deviation σ , must be positive. |
| <code>d</code> | cut-off value. |
| <code>less.than.d</code> | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| <code>kap</code> | probability. |
| <code>t</code> | t. |

Details

The Normal distribution with mean μ and standard deviation σ has density:

$$\frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

for $x \in \mathcal{R}, \mu \in \mathcal{R}, \sigma > 0$.

Value

Function :

- `expValNorm` gives the expected value.
- `varNorm` gives the variance.
- `expValLimNorm` gives the limited mean.
- `expValTruncNorm` gives the truncated mean.
- `stopLossNorm` gives the stop-loss.
- `meanExcessNorm` gives the mean excess loss.
- `VatRNorm` gives the Value-at-Risk.
- `TVatRNorm` gives the Tail Value-at-Risk.
- `mgfNorm` gives the moment generating function (MGF).

Invalid parameter values will return an error detailing which parameter is problematic.

Note

Function `VatRNorm` is a wrapper of the `qnorm` function from the `stats` package.

Examples

```
expValNorm(mean = 3, sd = 5)
```

```
varNorm(mean = 3, sd = 5)
```

```
expValLimNorm(d = 2, mean = 2, sd = 5)
```

```
expValTruncNorm(d = 2, mean = 2, sd = 5)
```

```
stopLossNorm(d = 2, mean = 2, sd = 5)
```

```
meanExcessNorm(d = 2, mean = 2, sd = 5)
```

```
VatRNorm(kap = 0.8, mean = 3, sd = 5)
```

```
TVatRNorm(kap = 0.8, mean = 2, sd = 5)
```

```
mgfNorm(t = 1, mean = 3, sd = 5)
```

Pareto

*Pareto Distribution***Description**

Pareto distribution with shape parameter α and rate parameter λ .

Usage

```

dPareto(x, shape, rate = 1/scale, scale = 1/rate)
pPareto(q, shape, rate = 1/scale, scale = 1/rate, lower.tail = TRUE)
expValPareto(shape, rate = 1/scale, scale = 1/rate)
varPareto(shape, rate = 1/scale, scale = 1/rate)
kthMomentPareto(k, shape, rate = 1/scale, scale = 1/rate)
expValLimPareto(d, shape, rate = 1/scale, scale = 1/rate)
expValTruncPareto(d, shape, rate = 1/scale, scale = 1/rate, less.than.d = TRUE)
stopLossPareto(d, shape, rate = 1/scale, scale = 1/rate)
meanExcessPareto(d, shape, rate = 1/scale, scale = 1/rate)
VatRPareto(kap, shape, rate = 1/scale, scale = 1/rate)
TVatRPareto(kap, shape, rate = 1/scale, scale = 1/rate)

```

Arguments

| | |
|-------------|---|
| x, q | vector of quantiles. |
| shape | shape parameter α , must be positive. |
| rate | rate parameter λ , must be positive. |
| scale | alternative parameterization to the rate parameter, $scale = 1 / rate$. |
| lower.tail | logical; if TRUE (default), probabilities are $P[X \leq x]$, otherwise, $P[X > x]$. |
| k | kth-moment. |
| d | cut-off value. |
| less.than.d | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| kap | probability. |

Details

The Pareto distribution with rate parameter λ as well as shape parameter α has density:

$$f(x) = \frac{\alpha \lambda^\alpha}{(\lambda + x)^{\alpha+1}}$$

for $x \in \mathcal{R}^+$, $\alpha, \lambda > 0$.

Value

Function :

- `dPareto` gives the probability density function (PDF).
- `pPareto` gives the cumulative density function (CDF).
- `expValPareto` gives the expected value.
- `varPareto` gives the variance.
- `kthMomentPareto` gives the kth moment.
- `expValLimPareto` gives the limited mean.
- `expValTruncPareto` gives the truncated mean.
- `stopLossPareto` gives the stop-loss.
- `meanExcessPareto` gives the mean excess loss.
- `VatRPareto` gives the Value-at-Risk.
- `TVatRPareto` gives the Tail Value-at-Risk.

Invalid parameter values will return an error detailing which parameter is problematic.

Examples

```
# With scale parameter
dPareto(x = 2, shape = 2, scale = 5)

# With rate parameter
dPareto(x = 2, shape = 2, rate = .20)

# With scale parameter
pPareto(q = 2, shape = 2, scale = 5)

# With rate parameter
pPareto(q = 2, shape = 2, rate = 0.20)

# Survival function
pPareto(q = 2, shape = 2, rate = 0.20, lower.tail = FALSE)

# With scale parameter
expValPareto(shape = 5, scale = 0.5)

# With rate parameter
expValPareto(shape = 5, rate = 2)
```

```
# With scale parameter
varPareto(shape = 5, scale = 0.5)

# With rate parameter
varPareto(shape = 5, rate = 2)

# With scale parameter
kthMomentPareto(k = 4, shape = 5, scale = 0.5)

# With rate parameter
kthMomentPareto(k = 4, shape = 5, rate = 2)

# With scale parameter
expValLimPareto(d = 4, shape = 5, scale = 0.5)

# With rate parameter
expValLimPareto(d = 4, shape = 5, rate = 2)

# With scale parameter
expValTruncPareto(d = 4, shape = 5, scale = 0.5)

# With rate parameter
expValTruncPareto(d = 4, shape = 5, rate = 2)

# With scale parameter
stopLossPareto(d = 2, shape = 5, scale = 0.5)

# With rate parameter
stopLossPareto(d = 2, shape = 5, rate = 2)

# With scale parameter
meanExcessPareto(d = 6, shape = 5, scale = 0.5)

# With rate parameter
meanExcessPareto(d = 6, shape = 5, rate = 2)

# With scale parameter
VatRPareto(kap = .99, shape = 5, scale = 0.5)

# With rate parameter
VatRPareto(kap = .99, shape = 5, rate = 2)

# With scale parameter
TVatRPareto(kap = .99, shape = 5, scale = 0.5)

# With rate parameter
TVatRPareto(kap = .99, shape = 5, rate = 2)
```

Description

Poisson distribution with rate parameter λ .

Usage

`expValPois(lambda)`

`varPois(lambda)`

`expValTruncPois(d, lambda, k0, less.than.d = TRUE)`

`TVatRPois(kap, lambda, k0)`

`mgfPois(t, lambda)`

`pgfPois(t, lambda)`

Arguments

| | |
|--------------------------|---|
| <code>lambda</code> | Rate parameter λ . |
| <code>d</code> | cut-off value. |
| <code>k0</code> | point up to which to sum the distribution for the approximation. |
| <code>less.than.d</code> | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| <code>kap</code> | probability. |
| <code>t</code> | t. |

Details

The Poisson distribution with rate parameter λ has probability mass function :

$$Pr(X = k) = \frac{\lambda^k e^{-\lambda}}{k!}$$

for $k = 0, 1, 2, \dots$, and $\lambda > 0$

Value

Function :

- `expValPois` gives the expected value.
- `varPois` gives the variance.
- `expValTruncPois` gives the truncated mean.
- `TVatRPois` gives the Tail Value-at-Risk.
- `mgfPois` gives the moment generating function (MGF).
- `pgfPois` gives the probability generating function (PGF).

Invalid parameter values will return an error detailing which parameter is problematic.

Examples

```
expValPois(lambda = 3)

varPois(lambda = 3)

expValTruncPois(d = 0, lambda = 2, k0 = 2E2, less.than.d = FALSE)
expValTruncPois(d = 2, lambda = 2, k0 = 2E2, less.than.d = TRUE)

TVatRPois(kap = 0.8, lambda = 3, k0 = 2E2)

mgfPois(t = 1, lambda = 3)

pgfPois(t = 1, lambda = 3)
```

Unif

Uniform Distribution

Description

Uniform distribution with min a and max b .

Usage

```
expValUnif(min = 0, max = 1)

varUnif(min = 0, max = 1)

kthMomentUnif(k, min = 0, max = 1)

expValLimUnif(d, min = 0, max = 1)

expValTruncUnif(d, min = 0, max = 1, less.than.d = TRUE)

stopLossUnif(d, min = 0, max = 1)

meanExcessUnif(d, min = 0, max = 1)

VatRUnif(kap, min = 0, max = 1)

TVatRUnif(kap, min = 0, max = 1)

mgfUnif(t, min = 0, max = 1)
```

Arguments

min, max lower and upper limits of the distribution. Must be finite.

| | |
|-------------|---|
| k | kth-moment. |
| d | cut-off value. |
| less.than.d | logical; if TRUE (default) truncated mean for values $\leq d$, otherwise, for values $> d$. |
| kap | probability. |
| t | t. |

Details

The (continuous) uniform distribution with min and max parameters a and b respectively has density:

$$f(x) = \frac{1}{b-a} \times \mathbf{1}_{\{x \in [a,b]\}}$$

for $x \in [a, b]$.

Value

Function :

- `expValUnif` gives the expected value.
- `varUnif` gives the variance.
- `kthMomentUnif` gives the kth moment.
- `expValLimUnif` gives the limited mean.
- `expValTruncUnif` gives the truncated mean.
- `stopLossUnif` gives the stop-loss.
- `meanExcessUnif` gives the mean excess loss.
- `VatRUnif` gives the Value-at-Risk.
- `TVatRUnif` gives the Tail Value-at-Risk.

Invalid parameter values will return an error detailing which parameter is problematic.

Examples

```
expValUnif(min = 3, max = 4)

varUnif(min = 3, max = 4)

kthMomentUnif(k = 2, min = 3, max = 4)

expValLimUnif(d = 3, min = 2, max = 4)

expValTruncUnif(d = 3, min = 2, max = 4)

# Values greather than d
expValTruncUnif(d = 3, min = 2, max = 4, less.than.d = FALSE)

stopLossUnif(d = 3, min = 2, max = 4)
```

```
meanExcessUnif(d = 2, min = 2, max = 4)
```

```
VatRUnif(kap = .99, min = 3, max = 4)
```

```
TVatRUnif(kap = .99, min = 3, max = 4)
```

```
mgfUnif(t = 2, min = 0, max = 1)
```

unifDiscr

Discrete Uniform Distribution

Description

Discrete uniform distribution with min a and max b .

Usage

```
pUnifD(q, min = 0, max = 1)
```

```
dUnifD(x, min = 0, max = 1)
```

```
varUnifD(min = 0, max = 1)
```

```
expValUnifD(min = 0, max = 1)
```

Arguments

| | |
|----------|---|
| min, max | lower and upper limits of the distribution. Must be finite. |
| x, q | vector of quantiles. |

Details

The (discrete) uniform distribution with min and max parameters a and b respectively has density:

$$\Pr(X = x) = \frac{1}{b - a + 1}$$

for $x \in \{a, a + 1, \dots, b - 1, b\}$.

Value

Function :

- `dUnifD` gives the probability density function (PDF).
- `pUnifD` gives the cumulative density function (CDF).
- `expValUnifD` gives the expected value.
- `varUnifD` gives the variance.

Invalid parameter values will return an error detailing which parameter is problematic.

Examples

```

pUnifD(q = 0.2, min = 0, max = 1)

dUnifD(min = 0, max = 1)

varUnifD(min = 0, max = 1)

expValUnifD(min = 0, max = 1)

```

Weibull

Weibull Distribution

Description

Weibull distribution with shape parameter τ and rate parameter β .

Usage

```

expValWeibull(shape, rate = 1/scale, scale = 1/rate)

varWeibull(shape, rate = 1/scale, scale = 1/rate)

kthMomentWeibull(k, shape, rate = 1/scale, scale = 1/rate)

expValLimWeibull(d, shape, rate = 1/scale, scale = 1/rate)

expValTruncWeibull(
  d,
  shape,
  rate = 1/scale,
  scale = 1/rate,
  less.than.d = TRUE
)

stopLossWeibull(d, shape, rate = 1/scale, scale = 1/rate)

meanExcessWeibull(d, shape, rate = 1/scale, scale = 1/rate)

VatRWeibull(kap, shape, rate = 1/scale, scale = 1/rate)

TVatRWeibull(kap, shape, rate = 1/scale, scale = 1/rate)

```

Arguments

| | |
|-------|--|
| shape | shape parameter τ , must be positive |
| rate | rate parameter β , must be positive. |

| | |
|-------------|---|
| scale | alternative parameterization to the rate parameter, scale = 1 / rate. |
| k | kth-moment. |
| d | cut-off value. |
| less.than.d | logical; if TRUE (default) truncated mean for values <= d, otherwise, for values > d. |
| kap | probability. |

Details

The Weibull distribution with shape parameter τ and rate parameter β has density:

$$f(x) = \beta\tau (\beta x)^{\tau-1} e^{-(\beta x)^\tau}$$

for $x \in \mathcal{R}^+$, $\beta > 0$, $\tau > 0$

Value

Function :

- `expValWeibull` gives the expected value.
- `varWeibull` gives the variance.
- `kthMomentWeibull` gives the kth moment.
- `expValLimWeibull` gives the limited mean.
- `expValTruncWeibull` gives the truncated mean.
- `stopLossWeibull` gives the stop-loss.
- `meanExcessWeibull` gives the mean excess loss.
- `VatRWeibull` gives the Value-at-Risk.
- `TVatRWeibull` gives the Tail Value-at-Risk.

Invalid parameter values will return an error detailing which parameter is problematic.

Examples

```
# With scale parameter
expValWeibull(shape = 2, scale = 5)

# With rate parameter
expValWeibull(shape = 2, rate = 0.2)

# With scale parameter
varWeibull(shape = 2, scale = 5)

# With rate parameter
varWeibull(shape = 2, rate = 0.2)

# With scale parameter
kthMomentWeibull(k = 2, shape = 2, scale = 5)
```

```
# With rate parameter
kthMomentWeibull(k = 2, shape = 2, rate = 0.2)

# With scale parameter
expValLimWeibull(d = 2, shape = 2, scale = 5)

# With rate parameter
expValLimWeibull(d = 2, shape = 2, rate = 0.2)

# With scale parameter
expValTruncWeibull(d = 2, shape = 2, scale = 5)

# With rate parameter
expValTruncWeibull(d = 2, shape = 2, rate = 0.2)

# Mean of values greater than d
expValTruncWeibull(d = 2, shape = 2, rate = 0.2, less.than.d = FALSE)

# With scale parameter
stopLossWeibull(d = 2, shape = 3, scale = 4)

# With rate parameter
stopLossWeibull(d = 2, shape = 3, rate = 0.25)

# With scale parameter
meanExcessWeibull(d = 2, shape = 3, scale = 4)

# With rate parameter
meanExcessWeibull(d = 2, shape = 3, rate = 0.25)

# With scale parameter
VatRWeibull(kap = .2, shape = 3, scale = 4)

# With rate parameter
VatRWeibull(kap = .2, shape = 3, rate = 0.25)

# With scale parameter
TVatRWeibull(kap = .2, shape = 3, scale = 4)

# With rate parameter
TVatRWeibull(kap = .2, shape = 3, rate = 0.25)
```

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