Package ‘DiscreteInverseWeibull’

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`DiscreteInverseWeibull-package` *Discrete Inverse Weibull Distribution*

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References

Jazi M.A., Lai C.-D., Alamatsaz M.H. (2010) A discrete inverse Weibull distribution and estimation of its parameters, Statistical Methodology 7: 121-132

Khan M.S., Pasha G.R., Pasha A.H. (2008) Theoretical Analysis of Inverse Weibull Distribution, WSEAS Trabsactions on Mathematics 2(7): 30-38

Drapella A. (1993) Complementary Weibull distribution: unknown or just forgotten, Quality Reliability Engineering International 9: 383-385

Dutang, C., Goulet, V., Pigeon, M. (2008) actuar: An R package for actuarial science, Journal of Statistical Software 25(7): 1-37

`ahrdiweibull` *Alternative hazard rate function*

Description

Alternative hazard rate function for the discrete inverse Weibull distribution

Usage

```
ahrdiweibull(x, q, beta)
```

Arguments

x	a vector of values
q	the value of the q parameter
beta	the value of the β parameter

Details

The alternative hazard rate function is defined as $h(x) = \log(P(X > x-1)/P(X > x)) = \log[(1-q^{(x-1)^{-\beta}})/(1-q^{x^{-\beta}})]$

Value

the value of the alternative hazard rate function in the x values

See Also

hrdiweibull

Examples

```
q<-0.5
beta<-2
x<-1:10
y<-ahrdiweibull(x, q, beta)
y
plot(x,y,ylab="alt.hazard rate")
```

Discrete Inverse Weibull — *The discrete inverse Weibull distribution*

Description

Probability mass function, distribution function, quantile function and random generation for the discrete inverse Weibull distribution with parameters q and β

Usage

```
ddiweibull(x, q, beta)
pdiweibull(x, q, beta)
qdiweibull(p, q, beta)
rdiweibull(n, q, beta)
```

Arguments

`x`	a vector of quantiles
`p`	a vector of probabilities
`q`	the value of the first parameter, q
`beta`	the value of the second parameter, β
`n`	the sample size

Details

The discrete inverse Weibull distribution has probability mass function given by $P(X = x; q, \beta) = q^{(x)^{-\beta}} - q^{(x-1)^{\beta}}$, $x = 1, 2, 3, \ldots$, $0 < q < 1, \beta > 0$. Its cumulative distribution function is $F(x; q, \beta) = q^{x^{-\beta}}$

Value

`ddiweibull` gives the probability, `pdiweibull` gives the distribution function, `qdiweibull` gives the quantile function, and `rdiweibull` generates random values. See the reference below for the continuous inverse Weibull distribution.

References

Dutang, C., Goulet, V., Pigeon, M. (2008) actuar: An R package for actuarial science, Journal of Statistical Software 25(7): 1-37

Examples

```
# Ex.1
x<-1:10
q<-0.6
beta<-0.8
ddiweibull(x, q, beta)
t<-qdiweibull(0.99, q, beta)
t
pdiweibull(t, q, beta)
# Ex.2
q<-0.4
beta<-1.7
n<-100
x<-rdiweibull(n, q, beta)
tabulate(x)/sum(tabulate(x))
y<-1:round(max(x))
# compare with
ddiweibull(y, q, beta)
```

`Ediweibull` *First and second order moments*

Description

First and second order moments of the discrete inverse Weibull distribution

Usage

```
Ediweibull(q, beta, eps = 1e-04, nmax = 1000)
```

Arguments

`q`	the value of the q parameter
`beta`	the value of the β parameter
`eps`	error threshold for the approximated computation of the moments
`nmax`	a first maximum value of the support considered for the approximated computation of the moments

Details

For a discrete inverse Weibull distribution we have $E(X;q,\beta) = \sum_{x=0}^{+\infty} 1-F(x;q,\beta)$ and $E(X^2;q,\beta) = 2\sum_{x=1}^{+\infty} x(1-F(x;q,\beta)) + E(X;q,\beta)$. The expected values are numerically computed considering a truncated support: integer values smaller than or equal to $\min(nmax; F^{-1}(1-eps;q,\beta))$, where F^{-1} is the inverse of the cumulative distribution function (implemented by the function `qdiweibull`). Increasing the value of `nmax` or decreasing the value of `eps` improves the approximation, but slows down the calculation speed

Value

a list comprising the (approximate) first and second order moments of the discrete inverse Weibull distribution. Note that the first moment is finite iff β is greater than 1; the second order moment is finite iff β is greater than 2

References

Khan M.S., Pasha G.R., Pasha A.H. (2008) Theoretical Analysis of Inverse Weibull Distribution, WSEAS Trabsactions on Mathematics 2(7): 30-38

Examples

```
# Ex.1
q<-0.75
beta<-1.25
Ediweibull(q, beta)
# Ex.2
q<-0.5
```

```
beta<-2.5
Ediweibull(q, beta)
# Ex.3
q<-0.4
beta<-4
Ediweibull(q, beta)
```

---

estdiweibull *Estimation of parameters*

Description

Sample estimation of the parameters of the discrete inverse Weibull distribution

Usage

```
estdiweibull(x, method="P", control=list())
```

Arguments

`x`	a vector of sample values
`method`	the estimation method that will be carried out: `"P"` method of proportion, `"M"` method of moments, `"H"` heuristic-maximum likelihood method, `"PP"` graphical method-probability plot
`control`	a list of additional parameters: `eps`, `nmax` for the method of moments; `beta1`, `z`, `r`, `Leps` for the heuristic method

Details

For a description of the methods, have a look at the reference. Note that they may be not applicable to some specific samples. For examples, the method of proportion cannot be applied if there are no 1s in the samples; it cannot be applied for estimating β if all the sample values are ≤ 2. The method of moments cannot be applied for estimating β if all the sample values are ≤ 2; besides, it may return unreliable results since the first and second moments can be computed only if $\beta > 2$. The heuristic method cannot be applied for estimating β if all the sample values are ≤ 2.

Value

a vector containing the two estimates of q and β

See Also

`heuristic`, `Ediweibull`

Examples

```
n<-100
q<-0.5
beta<-2.5
# generation of a sample
x<-rdiweibull(n, q, beta)
# sample estimation through each of the implemented methods
estdiweibull(x, method="P")
estdiweibull(x, method="M")
estdiweibull(x, method="H")
estdiweibull(x, method="PP")
```

---

heuristic — *Heuristic method of estimation*

Description

Heuristic method for the estimation of parameters of the discrete inverse Weibull

Usage

```
heuristic(x, beta1=1, z = 0.1, r = 0.1, Leps = 0.01)
```

Arguments

x	a vector of sample values
beta1	launch value of the β parameter
z	initial value of width
r	initial value of rate
Leps	tolerance error for the likelihood function

Details

For a detailed description of the method, have a look at the reference

Value

a list containig the two estimates of q and β

References

Jazi M.A., Lai C.-D., Alamatsaz M.H. (2010) A discrete inverse Weibull distribution and estimation of its parameters, Statistical Methodology, 7: 121-132

Drapella A. (1993) Complementary Weibull distribution: unknown or just forgotten, Quality Reliability Engineering International 9: 383-385

See Also

estdiweibull

Examples

```
n<-50
q<-0.25
beta<-1.5
x<-rdiweibull(n, q, beta)
# estimates using the heuristic algorithm
par0<-heuristic(x)
par0
# change the default values of some working parameters...
par1<-heuristic(x, beta1=2)
par1
par2<-heuristic(x, z=0.5)
par2
par3<-heuristic(x, r=0.2)
par3
par4<-heuristic(x, Leps=0.1)
par4
# ...there should be just light differences among the estimates...
# ... and among the corresponding values of the loglikelihood functions
loglikediw(x, par0[1], par0[2])
loglikediw(x, par1[1], par1[2])
loglikediw(x, par2[1], par2[2])
loglikediw(x, par3[1], par3[2])
loglikediw(x, par4[1], par4[2])
```

---

hrdiweibull *Hazard rate function*

Description

Hazard rate function for the discrete inverse Weibull distribution

Usage

```
hrdiweibull(x, q, beta)
```

Arguments

x	a vector of values
q	the value of the q parameter
beta	the value of the β parameter

Details

The hazard rate function is defined as $r(x) = P(X = x)/P(X \geq x) = (q^{x^{-\beta}} - q^{(x-1)^{-\beta}})/(1 - q^{(x-1)^{-\beta}})$

Value

the hazard rate function computed on the x values

See Also

ahrdiweibull

Examples

```
q<-0.5
beta<-2.5
x<-1:10
hrdiweibull(x, q, beta)
```

---

loglikediw *likelihood function*

Description

Log-likelihood function of the discrete inverse Weibull

Usage

```
loglikediw(x, q, beta)
```

Arguments

x	a vector of sample values
q	the value of the q parameter
beta	the value of the β parameter

Value

the value of the log-likelihood function (changed in sign) of the discrete inverse Weibull distribution with parameters q and β computed on a sample x

See Also

heuristic

Examples

```
n<-100
q<-0.4
beta<-2
x<-rdiweibull(n, q, beta)
# loglikelihood function (changed in sign) computed on the true values
loglikediw(x, q, beta)
par<-estdiweibull(x, method="H")
par
# loglikelihood function (changed in sign) computed on the ML estimates
loglikediw(x, par[1], par[2])
# it should be smaller than before...
```

---

lossdiw *Loss function*

Description

Quadratic loss function for the method of moments

Usage

```
lossdiw(x, par, eps = 1e-04, nmax=1000)
```

Arguments

x	a vector of sample values
par	a vector of parameters (q and β)
eps	a tolerance error for the computation of first order moments
nmax	a first maximum value for the computation of first order moments

Value

the value of the quadratic loss function $L(x; q, \beta) = (E(X; q, \beta) - m_1)^2 + (E(X^2; q, \beta) - m_2)^2$ where m_1 and m_2 are the first and second order sample moments.

See Also

Ediweibull

Examples

```
n<-100
q<-0.5
beta<-2.5
x<-rdiweibull(n, q, beta)
# loss function computed on the true values
lossdiw(x, c(q, beta))
```

```
par<-estdiweibull(x, method="M")
# estimates of the parameters through the method of moments
par
# loss function computed on the estimates derived through
# the method of moments
lossdiw(x, par)
# it should be zero (however, smaller than before...)
```

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