Package ‘good’
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Description Fit Good regression models to count data (Tur et al., 2021) <arXiv:2105.01557>. The package provides functions for model estimation and model prediction. Density, distribution function, quantile function and random generation for the Good distribution are also provided.
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Probability mass function for the Good distribution

Description

Probability mass function for the Good distribution with parameters \( z \) and \( s \).

Usage

\[ \text{dgood} \left( x, z, s \right) \]

Arguments

- \( x \): vector of non-negative integer quantiles.
- \( z \): vector of first parameter for the Good distribution.
- \( s \): vector of second parameter for the Good distribution.

Details

The Good distribution has the probability mass function (pmf):

\[
P(X = x) = \frac{1}{F(z, s)} \cdot \frac{z^{(x+1)}}{(x+1)^s},
\]

where \( x = 0, 1, 2, \ldots \). Parameter \( z \) should be within the interval \((0, 1)\), and parameter \( s \) in the reals. \( F(z, s) \) is the polylogarithm function:

\[
F(z, s) = \sum_{i=1}^{\infty} \frac{z^n}{n^s},
\]

and acts in the pmf as the normalizing constant.

If \( F(z, s) \) does not converge (e.g., for large negative values of the parameter \( s \)), the following approximation is used instead:

\[
F(z, s) \approx \Gamma(1 - s) \cdot (-\log(z))^{(s-1)},
\]

and \text{dgood} returns approximated probabilities:

\[
P(X = x) \approx \exp((x + 1) \cdot \log(z) - s \cdot \log(x + 1) - \log(\Gamma(1 - s)) - (s - 1) \cdot \log(-\log(z))).
\]

Value

dgood gives the probability mass function for the Good distribution with parameters \( z \) and \( s \). \( x \) should be a vector of non-negative integer quantiles. If \( x \) is non-integer and/or negative, dgood returns 0 with a warning. \( z \) and \( s \) can be vectors with values within the interval \((0, 1)\) and the reals respectively. If vector \( z \) has negative values and/or outside the interval \((0, 1)\), dgood returns NaN with a warning.

If function polylog from package \text{copula} returns Inf (e.g., for large negative values of parameter \( s \)), dgood uses the approximation described above for probabilities, and additionally returns an informative warning.
**Author(s)**

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**References**


**See Also**

See also polylog from copula, pgood, and qgood and rgood from good.

**Examples**

```r
# if x is not a non-negative integer, dgood returns 0 with a warning
dgood(x = -3, z = c(0.6, 0.5), s = -3)
dgood(x = 4.5, z = c(0.6, 0.5), s = -3)

# if z is not within 0 and 1, dgood returns NaN with a warning
dgood(x = 4, z = c(0.6, 0.5, -0.9), s = -3)

# if the approximation is used, dgood returns a warning
dgood(x = 330:331, z = c(0.6, 0.5), s = -170)
dgood(x = 4, z = 0.6, s = -3)
dgood(x = 4:5, z = c(0.6, 0.5), s = c(-3,-10))
dgood(x = 4:6, z = c(0.6, 0.5), s = c(-3,-10))
dgood(x = 3:5, z = c(0.6, 0.5, 0.9, 0.4), s = c(-3,-10))
```
glm.good

Maximum Likelihood Estimation and Good Regression

Description

glm.good is used to fit generalized linear models with a response variable following a Good distribution with parameters $z$ and $s$. glm.good allows incorporating predictors in the model with a link function (log, logit and identity) that relates parameter $z$ and predictors. A summary method over an object of class glm.good provides essential information regarding the fitted model such as parameters estimates, standard errors, and some goodness-of-fit measures. A prediction method over an object of class glm.good provides the fitted values with the estimated model and optionally standard errors and predictions for a new data set.

Usage

glm.good ( formula , data , link = "log" , start = NULL )

Arguments

formula symbolic description of the model to be fitted. A typical predictor has the form response $\sim$ terms where the response is the integer-valued response vector following a Good distribution with parameters $s$ and $z$, and terms is a series of predictors.
data an optional data frame with the variables in the model.
link character specification of link function: "logit", "log" or "identity". By default link="log".
start a vector with the starting values for the model parameters. Used for numerically maximize the likelihood function for parameters estimation. By default start = NULL.

Value

glm.good returns an object of class glm.good that is a list including:

coefs The vector of coefficients.
loglik Log-likelihood of the fitted model.
vcov Variance-covariance matrix of all model parameters (derived from the Hessian matrix returned by nlm() ).
hess Hessian matrix, returned by nlm().
fitted.values The fitted mean values. These are obtained by transforming the linear predictors by the link function inverse.

Author(s)

Jordi Tur, David Moriña, Pere Puig, Alejandra Cabaña, Argimiro Arratia, Amanda Fernández-Fontelo


**References**


**See Also**

See also polylog from copula, dgood, and pgood, qgood and rgood from good, and maxLik from maxLik.

**Examples**

```r
c = c ( rep ( 0, 46 ) , rep ( 1, 76 ) , rep ( 2, 24 ) , rep ( 3, 9 ) , rep ( 4, 1 ) )
mle <- glm.good ( c ~ 1 , link = "log" )
names ( mle )
mle$coefficients
mle$fitted.values
mean ( c )
summary ( mle )
predict ( mle , newdata = NULL , se.fit = TRUE )
```

**pgood**

*Distribution function for the Good distribution*

**Description**

Distribution function for the Good distribution with parameters z and s.

**Usage**

`pgood ( q , z , s , lower.tail = TRUE )`
Arguments

- `q`: vector of non-negative integer quantiles.
- `z`: vector of first parameter for the Good distribution.
- `s`: vector of second parameter for the Good distribution.
- `lower.tail`: logical; if TRUE (default), probabilities are \( P(X \leq x) \). Otherwise, \( P(X > x) \).

Value

`pgood` returns the cumulative distribution function (cdf) for the Good distribution with parameters `z` and `s`. Parameter `z` should be within the interval \((0, 1)\), and parameter `s` in the reals. If `q` is non-integer, `pgood` returns the cdf of `floor(q)` with a warning. If `q` is negative, `pgood` returns 0 with a warning. `pgood` calls `dgood` from package `good`.

Author(s)

Jordi Tur, David Moriña, Pere Puig, Alejandra Cabaña, Argimiro Arratia, Amanda Fernández-Fontelo

References


See Also

See also `polylog` from `copula`, `dgood`, and `qgood` and `rgood` from `good`.

Examples

```r
# if q < 0, pgood returns NaN with a warning
pgood ( q = -3 , z = 0.6 , s = -3 )

# if q is non-integer, pgood returns the cdf of floor(q) with a warning
pgood ( q = 3.4 , z = 0.6 , s = -3 )

# if z is not within 0 and 1, pgood returns returns NaN with a warning
```
polar ( q = 3.4 , z = c(-0.6, 0.6), s = -3 )
pgood ( q = 0 : 2 , z = 0.6 , s = -3 )
pgood ( q = 0 : 1 , z = c(0.6, 0.9), s = -3 )
pgood ( q = 0 : 1 , z = c(0.6, 0.9), s = -3 , lower.tail = FALSE )
pgood ( q = 0 : 2 , z = c(0.6, 0.9), s = c(-3, -4, -5) )

---

**polar**  
*Polar bear litter size data set*

**Description**

This data set corresponds to live-captured polar bears from late March 1992 to beginning of May 2017 at Svalbard, Norway.

**Usage**

data(polar)

**Format**

A data frame with 231 rows and 7 columns.

- **year** Catch year
- **days** Number of the day of the catch year
- **id** Unique specimen id
- **age** Age of the specimen, estimated using premolar tooth
- **agecat** Categorized age of the specimen
- **length** Body straight length (cm)
- **cubnumber** Litter size

**Source**

Folio, Dorinda Marie et al. (2019), Data from: How many cubs can a mum nurse? Maternal age and size influence litter size in polar bears, Dryad, Dataset.

**References**


**Examples**

data(polar)
head(polar)
qgood  

Quantile function for the Good distribution

Description

Quantile function for the Good distribution with parameters z and s.

Usage

qgood ( p , z , s , lower.tail = TRUE )

Arguments

p  
vector of non-negative integer quantiles.

z  
vector of first parameter for the Good distribution.

s  
vector of second parameter for the Good distribution.

lower.tail  
logical; if TRUE (default), probabilities are $P(X \leq x)$. Otherwise, $P(X > x)$.

Value

The smallest integer x such that $P(X \leq x) \geq p$ (or such that $P(X \leq x) \geq 1 - p$ if lower.tail is FALSE), where X is a random variable following a Good distribution with parameters z and s. Parameter z should be within the interval (0, 1), and parameter s in the reals. Vector p should have values between 0 and 1. If vector p has negative values and/or outside the interval (0, 1), qgood returns NaN with a warning. If vector p contains 1, qgood returns Inf. qgood calls dgood from package good.

Author(s)

Jordi Tur, David Moriña, Pere Puig, Alejandra Cabaña, Argimiro Arratia, Amanda Fernández-Fontelo

References


See Also

See also \texttt{polylog} from \texttt{copula}, \texttt{dgood}, and \texttt{pgood} and \texttt{rgood} from \texttt{good}.

Examples

```r
# if p is not within \([0, 1]\), NaN is returned with a warning
qgood ( p = c ( -0.6 , 1.3 ) , z = 0.5 , s = -3 )

# if z is not within \(0\ and 1\), NaN is returned with a warning
qgood ( p = 0.5 , z = c(-0.6, -9, 0.5) , s = -3 )

qgood ( p = 0.5 , z = 0.6 , s = -3 )
qgood ( p = c ( 0.025 , 0.5 , 0.975 ) , z = 0.6 , s = -3 )
qgood ( p = c ( 0.025 , 0.5 , 0.975 ) , z = c ( 0.6 , 0.3 , 0.1 ) , s = -5 )
qgood ( p = c ( 0.025 , 0.5 , 0.975 ) , z = c ( 0.6 , 0.3 , 0.5 ) , s = -3 , lower.tail = FALSE )
qgood ( p = c ( 0.025 , 0.5 , 0.975 ) , z = c ( 0.6 , 0.3 ) , s = -3 )
```

---

\texttt{rgood} \hspace{1cm} \textit{Random generation for the Good distribution}

Description

Random generation for the Good distribution with parameters \(z\) and \(s\).

Usage

\texttt{rgood ( n , z , s , th = 10^{-6} )}

Arguments

\begin{itemize}
  \item \texttt{n} \hspace{1cm} vector of number of observations to be generated
  \item \texttt{z} \hspace{1cm} vector of first parameter for the Good distribution
  \item \texttt{s} \hspace{1cm} vector of second parameter for the Good distribution
  \item \texttt{th} \hspace{1cm} defines the lower (\(q_1\)) and upper (\(q_2\)) quantiles such that \(P(X \leq q_1) = th\) and \(P(X \leq q_2) = 1 - th\) respectively.
\end{itemize}

Value

A vector containing \(n\) random deviates from a Good distribution with parameters \(z\) and \(s\). Parameter \(z\) should be within the interval \((0, 1)\), and parameter \(s\) in the reals. \texttt{rgood} returns NaN if either arguments \(n\) or \(th\) are negative. \texttt{rgood} calls \texttt{qgood} and \texttt{pgood} from package \texttt{good}. 
References


See Also

See also polylog from copula, dgood, and pgood and qgood from good.

Examples

# if n is not a non-negative integer, function returns NaN with a warning
rgood ( n = -100 , z = 0.5 , s = -3 )

# if th is not positive, th is replaced by 1e-06 and a warning is provided
rgood ( n = 1 , z = 0.5 , s = -3 , th = -9 )

# if z is not within 0 and 1, NaN is returned with a warning
rgood ( n = 2 , z = c( -0.5, 0.5 ) , s = -3 )

rgood ( n = 10 , z = 0.6 , s = -3 )
rgood ( n = 1000 , z = 0.6 , s = -3 )
rgood ( n = c ( 3 , 10 ) , z = 0.6 , s = -3 )
rgood ( n = c ( 3 , 10 , 6 ) , z = c ( 0.2 , 0.8 ) , s = -3 )
rgood ( n = c ( 3 , 10 , 6 ) , z = c ( 0.2 , 0.8 ) , s = c ( -3 , -2 ) )
rgood ( n = 1000 , z = 0.3 , s = -170 )
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