Package 'DWreg'

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Title Parametric Regression for Discrete Response

Version 3.0

Description Regression for a discrete response, where the conditional distribution is modelled via a discrete Weibull distribution.

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Imports maxLik, DiscreteWeibull, Ecdat,survival

NeedsCompilation no

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dw *Discrete Weibull*

Description

Density, distribution function, quantile function and random generation for the discrete Weibull distribution with parameters q and beta.

Usage

```
ddw(x,q=exp(-1),beta=1)
pdw(x,q=exp(-1),beta=1)
qdw(p,q=exp(-1),beta=1)
rdw(n,q=exp(-1),beta=1)
```

Arguments

x	quantile
p	probability
n	number of observations
q, beta	Parameters of the distribution

Details

The discrete Weibulll distribution has density

$$p(x, q, \beta) = q^{x^\beta} - q^{(x+1)^\beta}$$

for $x = 0, 1, 2, \ldots$. If q or beta are not specified they assume the default values of exp(-1) and 1, respectively. In this case, DW corresponds to a geometric distribution with p=1-q.

Value

ddw gives the density, pdw gives the distribution function, qdw gives the quantile function, and rdw generates random samples from a DW distribution with parameters q and beta.

Author(s)

Veronica Vinciotti

References

Nagakawa T, Osaki S. The discrete Weibull distribution. IEEE transactions on reliability 1975; R-24(5).

Examples

```
x<-rdw(1000,q=0.9,beta=1.5)
hist(x)
plot(x,unlist(lapply(x,ddw,q=0.9,beta=1.5)),ylab="density")
plot(x,unlist(lapply(x,pdw,q=0.9,beta=1.5)),ylab="cdf")
```

dw.meanvar *Mean and Variance of Discrete Weibull*

Description

Mean and variance of a discrete Weibull distribution with parameters q and beta.

Usage

```
dw.meanvar(q,beta,M)
```

Arguments

q, beta	Parameters of the distribution
M	Maximum value of the summation. Default value is 1000.

Details

The mean and variance are computed using the following approximations:

$$E(X) = \sum_{k=1}^{M} q^{k^\beta}$$

$$E(X^2) = \sum_{k=1}^{M} (2k-1) q^{k^\beta} = 2 \sum_{k=1}^{M} k q^{k^\beta} - E(X)$$

Value

The function returns the mean and variance of a DW distribution with parameters q and beta.

Author(s)

Veronica Vinciotti

References

Khan M, Khalique A, Abouammoth A. On estimating parameters in a discrete Weibull distribution. IEEE transactions on Reliability 1989; 38(3):348-350.

Examples

```
dw.meanvar(q=0.9,beta=1.5)
#compare with sample mean/variance from a random sample
x<-rdw(1000,q=0.9,beta=1.5)
mean(x)
var(x)
```

dw.parest *Parameter estimation for discrete Weibull*

Description

Estimation of the parameters q and beta of a discrete Weibull distribution

Usage

```
dw.parest(data,method,method.opt)
```

Arguments

data	Vector of observations
method	Either "likelihood" or "proportion"
method.opt	Optimization criterion used in maxLik (default is "NR")

Details

If method="likelihood", the parameters q and beta are estimated by maximum likelihood.

If method="proportion", the method of Araujio Santos and Fraga Alves (2013) is used, based on count frequencies.

Value

The function returns the parameter estimates of q and beta.

Author(s)

Veronica Vinciotti

References

Araujo Santos P, Fraga Alves M. Improved shape parameter estimation in a discrete Weibull model. Recent Developments in Modeling and Applications in Statistics . Studies in Theoretical and Applied Statistics. Springer-Verlag, 2013; 71-80.

Examples

```
x<-rdw(1000,q=0.9,beta=1.5)
dw.parest(x) #maximum likelihood estimates
dw.parest(x,method="proportion") #proportion estimates
```

dw.reg *DW regression*

Description

Parametric regression for discrete response data. The conditional distribution of the response given the predictors is assumed to be DW with parameters q and beta dependent on the predictors.

Usage

```
dw.reg(formula, data,tau=0.5,para.q1=NULL,para.q2=NULL,para.beta=NULL,...)
```

Arguments

formula	An object of class "formula": a symbolic description of the model to be fitted.
data	An optional data frame, list or environment (or object coercible by as.data.frame to a data frame) containing the variables in the model. If not found in data, the variables are taken from environment(formula), typically the environment from which dw.qr is called.
tau	Quantile value (default 0.5). This is used only to extract the conditional quantile from the fitted distribution.
para.q1, para.q2	logical flag. If TRUE, the model includes a dependency of q on the predictors, as explained below.
para.beta	logical flag. If TRUE, the model includes a dependency of beta on the predictors, as explained below.
...	Additional arguments to the maxLik function

Details

The conditional distribution of Y (response) given x (predictors) is assumed a DW(q(x),beta(x)).

If para.q1=TRUE,

$$log(q/(1-q)) = \theta_0 + \theta_1 X_1 + \ldots + \theta_p X_p.$$

If para.q2=TRUE,

$$log(-log(q)) = \theta_0 + \theta_1 X_1 + \ldots + \theta_p X_p.$$

This is equivalent to a continuous Weibull regression model with interval-censored data.

If para.q1=NULL and para.q2=NULL, then q(x) is constant.

If para.beta=TRUE,

$$log(\beta) = \gamma_0 + \gamma_1 X_1 + \ldots + \gamma_p X_p.$$

Otherwise beta(x) is constant.

Value

A list of class dw.reg containing the following components:

`call`	the matched call.
`data`	the input data as a list of response and covariates.
`coefficients`	the theta and gamma estimated coefficients.
`loglik`	the log-likelihood of the model.
`fitted.values`	fitted values (on the response scale) for the specified quantile tau.
`fitted.q`	fitted q values.
`fitted.beta`	fitted beta values.
`residuals`	randomised quantile residuals of the fitted model.
`tTable`	coefficients, standard errors, etc.
`tTable.survreg`	Only for the model para.q2=TRUE. Coefficients, standard errors, etc from the survreg parametrization. These estimates are linked to changes of log(Median+1).

Author(s)

Veronica Vinciotti, Hadeel Kalktawi, Alina Peluso

References

Kalktawi, Vinciotti and Yu (2016) A simple and adaptive dispersion regression model for count data.

Examples

```
#simulated example (para.q1=TRUE, beta constant)
theta0 <- 2
theta1 <- 0.5
beta<-0.5
n<-500
x <- runif(n=n, min=0, max=1.5)
logq<-theta0 + theta1 * x - log(1+exp(theta0  + theta1 * x))
y<-unlist(lapply(logq,function(x,beta) rdw(1,q=exp(x),beta),beta=beta))
data.sim<-data.frame(x,y) #simulated data
fit<-dw.reg(y~x,data=data.sim,para.q1=TRUE)
fit$tTable

#simulated example (para.q2=TRUE, beta constant)
theta0 <- -2
theta1 <- -0.5
beta<-0.5
n<-500
x <- runif(n=n, min=0, max=1.5)
logq<--exp(theta0  + theta1 * x)
y<-unlist(lapply(logq,function(x,beta) rdw(1,q=exp(x),beta),beta=beta))
data.sim<-data.frame(x,y) #simulated data
fit<-dw.reg(y~x,data=data.sim,para.q2=TRUE)
```

```
fit$tTable
fit$survreg

#real example
library(Ecdat)
data(StrikeNb)
fit<-dw.reg(strikes~output,data=StrikeNb,para.q2=TRUE)
fit$tTable
fit$survreg
```

`res.dw` *DW regression: Diagnostics*

Description

Quantile-Quantile plot of the randomised quantile residuals of a DW regression fitted model with 95% simulated envelope.

Usage

```
res.dw(obj,k)
```

Arguments

`obj`	An object of class "dw.reg": the output of the dw.reg function.
`k`	The number of iterations for the simulated envelope.

Details

Diagnostic check for a DW regression model. The randomised quantile residuals should follow a standard normal distribution.

Value

A q-q plot of the residuals with 95% simulated envelope

Author(s)

Veronica Vinciotti, Hadeel Kalktawi

References

Kalktawi, Vinciotti and Yu (2016) A simple and adaptive dispersion regression model for count data.

Examples

```
#simulated example (para.q2=TRUE, beta constant)
theta0 <- -2
theta1 <- -0.5
beta<-0.5
n<-500
x <- runif(n=n, min=0, max=1.5)
logq<--exp(theta0  + theta1 * x)
y<-unlist(lapply(logq,function(x,beta) rdw(1,q=exp(x),beta),beta=beta))
data.sim<-data.frame(x,y) #simulated data
fit<-dw.reg(y~x,data=data.sim,para.q2=TRUE)
res.dw(fit,k=5)
ks.test(fit$residuals,"pnorm")

#real example
library(Ecdat)
data(StrikeNb)
fit<-dw.reg(strikes~output,data=StrikeNb,para.q2=TRUE)
res.dw(fit,k=5)
ks.test(fit$residuals,"pnorm")
```

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