Package ‘DWreg’

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Title Parametric Regression for Discrete Response

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

Depends R (>= 3.2)

Imports maxLik, DiscreteWeibull, Ecdat,survival

License GPL (>= 2)

LazyLoad yes

NeedsCompilation yes

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Contents

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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