

# Package: DWreg (via r-universe)

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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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dw *Discrete Weibull*

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### 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 Weibull distribution has density

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

for  $x = 0, 1, 2, \dots$ . 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:

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

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

**Value**

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

**Author(s)**

Veronica Vinciotti

**References**

Khan M, Khaliq 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)
```

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dw.parest

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*Parameter estimation for discrete Weibull*


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**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 Araujo 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
```

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dw.reg	<i>DW regression</i>
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### 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 <code>as.data.frame</code> to a data frame) containing the variables in the model. If not found in data, the variables are taken from <code>environment(formula)</code> , typically the environment from which <code>dw.qr</code> 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 <code>maxLik</code> function

### Details

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

If `para.q1=TRUE`,

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

If `para.q2=TRUE`,

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

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`,

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

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$table
fit$survreg

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

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res.dw

*DW regression: Diagnostics*

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### 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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