

Package ‘MPLikelihoodWB’

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Type Package

Title Modified Profile Likelihood Estimation for Weibull Shape and Regression Parameters

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Description Computing modified profile likelihood estimates for Weibull Shape and Regression Parameters. Modified likelihood estimates are provided.

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MPLikelihoodWB-package

Modified Profile Likelihood Estimation for Weibull Shape and Regression Parameters

Description

Makes adjustment of profile likelihood function of parameter of interest in presence of many nuisance parameters under Weibull regression models. Modified profile likelihood technique is developed by extending the Barndorff-Nielsen's approach for Weibull regression models. Modified likelihood estimates are provided.

Details

A modification to profile likelihood is introduced to overcome from this type of problems. Several adjustments have been proposed to modify the profile likelihood function. In an earlier paper named Conditionality resolutions by Barndorff-Nielsen published in *Biometrika* (1980, 1983), the construction of ancillary statistics and the expressions for the conditional distribution of the maximum likelihood estimate, was discussed for transformation models and exponential models, with most emphasis on the latter.

The main goal is to obtain adjustment to the profile likelihood function when the parameters of interest are, firstly, shape parameter β (or, alternatively, κ) and secondly, regression parameter ϕ in Weibull regression model, even in presence of collinearity among the covariates. Note that practically correlated covariates are found in many areas of biostatistics including microarray, genetics, medical statistics. The presence of collinearity makes sometimes the estimation and inference procedure problematic and complex and the model as a whole can be found as statistically significant but the individual regression coefficients can not be (e.g. Khan and Shaw (2015)). The modified profile likelihood estimators outperform the profile likelihood estimators in terms of three statistical measures as comparison criterion: mean squared errors, bias and standard errors for weibull shape parameter.

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Author(s)

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References

- Barndorff-Nielsen (1980). Conditionality resolutions. *Biometrika*, 67(2) : 293-310.
Barndorff-Nielsen (1983). On a formula for the distribution of the maximum likelihood estimator. *Biometrika*, 70(2) : 343-365.

Khan M. H. R. and Shaw J. E. H (2016). Variable selection for survival data with a class of adaptive elastic net techniques. *Statistics and Computing*, 26(3): 725-741.

Islam, M. M. , Khan, M. H. R. and Hawlader T. (2015). Modified profile likelihood estimation for the weibull regression models in survival analysis. Submitted.

Examples

```
# For modified profile likelihood estimation
dat <- data.weibull(n = 40, shape=2, regco=c(2,1.5,3,2.5))
Mprofile.wb(formula=ftime~x1+x2+x3+x4, censor="delta", data=dat)
survreg(Surv(ftime,delta)~x1+x2+x3+x4, data=dat, dist="weibull")

# For random dataset creation
data.weibull(n = 20)
data.weibull(n = 20, shape=1.7, regco=c(2,1,3,4))
data.weibull(n = 20, shape=1.5, ncorvar=4, correlated=TRUE)
```

data.weibull	<i>Random data set generating function.</i>
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Description

Generate random data set of weibull distributed failure time, covariates and corresponding censoring status with a given shape and a set of regression parameters. Correlated covariates can also be drawn with a given number of correlated covariates.

Usage

```
data.weibull(n, shape = 2, regco = c(1, 3), rcen = 0.25, ncorvar = 3,
  correlated = FALSE)
```

Arguments

n	sample size
shape	value of shape parameter
regco	vector of regression parameters that corresponds to covariates, for correlated = FALSE
rcen	censoring rate
ncorvar	no of correlated covariates, for correlated = TRUE. See details below.
correlated	logical; if true correlated covariates will be generated with a given no of correlated covariates

Details

ncorvar is non required if correlated = FALSE and regco is not required if correlated = TRUE.

Value

Data frame with columns:

f _{time}	lifetime data from weibull distribution
x	covariates
delta	censoring status, 0 or 1. A value 0 indicates corresponding observation is censored

Author(s)

Mazharul Islam and Hasinur Rahaman Khan

Examples

```
data.weibull(n = 20)
data.weibull(n = 20, shape=1.7, regco=c(2,1,3,4))
data.weibull(n = 20, shape=1.5, ncorvar=4, correlated=TRUE)
```

infm.weibul	<i>Observed information matrix for fixed regression parameter of interest</i>
-------------	---

Description

Matrix as a component of modifying part of regression parameters: observed information matrix for fixed number of parameter of interest

Usage

```
infm.weibul(Y, X, sigma, phi, delta, whc)
```

Arguments

Y	log of Weibull distributed failure times
X	covariate matrix
sigma	given value of scale parameter of extreme value distribution
phi	given values of regression parameters of extreme value distribution
delta	Censoring status, coded as 0 (censored observation) and 1 (uncensored observation) binary integer variable
whc	Set position of regression parameter of interest corresponding predefined covariate matrix. It will take integer value from 1 to number of regression parameters

Value

Symmetric matrix of dimension $n \times n$ (n is number of regression parameter).

Author(s)

Mazharul Islam and Hasinur Rahaman Khan

References

Barndorff-Nielsen (1980). Conditionality resolutions. *Biometrika*, 67(2): 293-310.

Barndorff-Nielsen (1983). On a formula for the distribution of the maximum likelihood estimator. *Biometrika*, 70(2): 343-365.

Khan M. H. R. and Shaw J. E. H (2016). Variable selection for survival data with a class of adaptive elastic net techniques. *Statistics and Computing*, 26(3): 725-741.

Islam, M. M., Khan, M. H. R. and Hawlader T. (2015). Modified profile likelihood estimation for the weibull regression models in survival analysis. Submitted.

See Also

LX.mat.weibull

Examples

```
dat <- data.weibull(n = 20, shape=2, regco=c(2,1.5,3,2.5))

par=c(1,1,1,1,1,1)

infm.weibul(Y=log(dat$ftime),X=model.matrix(ftime~x1+x2+x3+x4,data=dat),
sigma=2,phi=matrix(par[-1],ncol=1),delta=dat$delta,whc=2)

par=c(1,1,1)
infm.weibul(Y=log(dat$ftime),X=model.matrix(ftime~x1,data=dat),sigma=2,
phi=matrix(par[-1],ncol=1),delta=dat$delta,whc=2)
```

LX.mat.weibull

Compensating factor for a possible mathematical disturbance

Description

Matrix as a component of modifying part of regression parameters :compensating factor for a possible mathematical disturbance

Usage

```
LX.mat.weibull(Y, X, sigma, phi, delta, whc)
```

Arguments

Y	log of Weibull distributed failure times
X	covariate matrix
sigma	given value of scale parameter of extreme value distribution
phi	given values of regression parameters of extreme value distribution
delta	Censoring status, coded as 0(censored observation) and 1(uncensored observation) binary integer variable
whc	Set position of regression parameter of interest corresponding predefined covariate matrix. It will take integer value from 1 to number of regression parameters.

Value

Matrix of dimension $n \times n$ (n is number of regression parameter).

Author(s)

Mazharul Islam and Hasinur Rahaman Khan

References

Barndorff-Nielsen (1980). Conditionality resolutions. *Biometrika*, 67(2) : 293-310.

Barndorff-Nielsen (1983). On a formula for the distribution of the maximum likelihood estimator. *Biometrika*, 70(2) : 343-365.

Khan M. H. R. and Shaw J. E. H (2016). Variable selection for survival data with a class of adaptive elastic net techniques. *Statistics and Computing*, 26(3): 725-741.

Islam, M. M., Khan, M. H. R. and Hawlader T. (2015). Modified profile likelihood estimation for the weibull regression models in survival analysis. Submitted.

See Also

J.inf.weibul

Examples

```
dat <- data.weibull(n = 20, shape=2, regco=c(2,1.5,3,2.5))
```

```
par=c(1,1,1,1,1,1)
```

```
LX.mat.weibull(Y=log(dat$ftime),X=model.matrix(ftime~x1+x2+x3+x4,data=dat),
sigma=2,phi=matrix(par[-1],ncol=1),delta=dat$delta,whc=2)
```

```
par=c(1,1,1)
```

```
LX.mat.weibull(Y=log(dat$ftime),X=model.matrix(ftime~x1,data=dat),sigma=2,
phi=matrix(par[-1],ncol=1),delta=dat$delta,whc=2)
```

 mplik.wb.bi

Modified profile likelihood function of Weibull regression parameters

Description

Modified profile likelihood function of Weibull regression parameters. The function considers one regression parameter at a time as parameter of interest and remaining parameters as nuisance parameters. Standard optimization procedures are required to find the estimate of certain regression parameter at a time.

Usage

```
mplik.wb.bi(par, Y, X, delta, whc)
```

Arguments

par	Initial value of parameters to be estimated by optimization
Y	Weibull distributed failure times
X	covariate matrix
delta	Censoring status, coded as 0(censored observation) and 1(uncensored observation) binary integer variable
whc	Set position of regression parameter of interest corresponding predefined covariate matrix. It will take integer value from 1 to number of regression parameters.

Value

Negative log likelihood of the function at given value of parameters and data. Optimization of this function will produce maximum likelihood estimate of regression parameter of Extreme value distribution. Transformation will be required to obtain estimate of Weibull regression parameter.

Author(s)

Mazharul Islam and Hasinur Rahaman Khan

References

- Barndorff-Nielsen (1980). Conditionality resolutions. *Biometrika*, 67(2) : 293-310.
- Barndorff-Nielsen (1983). On a formula for the distribution of the maximum likelihood estimator. *Biometrika*, 70(2) : 343-365.
- Khan M. H. R. and Shaw J. E. H (2016). Variable selection for survival data with a class of adaptive elastic net techniques. *Statistics and Computing*, 26(3): 725-741.
- Islam, M. M., Khan, M. H. R. and Hawlader T. (2015). Modified profile likelihood estimation for the weibull regression models in survival analysis. Submitted.

See Also

mplik.wb.s

Examples

```
dat <- data.weibull(n = 40, shape=2, regco=c(2,1.5,3,2.5))

mplik.wb.bi(par=c(1,1,1,1,1),Y=dat$time,X=model.matrix(ftime~x1+x2+x3+x4,data=dat),
delta=dat$delta,whc=2)
```

mplik.wb.s

Modified profile likelihood function of Weibull shape parameter

Description

Modified profile likelihood function of Weibull shape parameter. The function considers shape parameter as parameter of interest and remaining parameters as nuisance parameters. Standard optimization procedures are required to find the estimate of shape parameter. The estimate will be less biased comparing to existing methods when sample size is considerably small.

Usage

```
mplik.wb.s(par, Y, X, delta)
```

Arguments

par	Initial value of parameters to be estimated by optimization
Y	Weibull distributed failure times
X	covariate matrix
delta	Censoring status, coded as 0(censored observation) and 1(uncensored observation) binary integer variable.

Value

Negative log likelihood of the function at given value of parameters and data. Optimization of this function will produce maximum likelihood estimate of scale parameter of Extreme value distribution. Transformation will be required to obtain estimate of Weibull shape parameter.

Author(s)

Mazharul Islam and Hasinur Rahaman Khan

References

- Barndorff-Nielsen (1980). Conditionality resolutions. *Biometrika*, 67(2) : 293-310.
- Barndorff-Nielsen (1983). On a formula for the distribution of the maximum likelihood estimator. *Biometrika*, 70(2) : 343-365.
- Khan M. H. R. and Shaw J. E. H (2016). Variable selection for survival data with a class of adaptive elastic net techniques. *Statistics and Computing*, 26(3): 725-741.
- Islam, M. M., Khan, M. H. R. and Hawlader T. (2015). Modified profile likelihood estimation for the weibull regression models in survival analysis. Submitted.

See Also

mplik.wb.bi

Examples

```
dat <- data.weibull(n = 40, shape=2, regco=c(2,1.5,3,2.5))

mplik.wb.s(par=c(1,1,1,1,1),Y=dat$ftime,X=model.matrix(ftime~x1+x2+x3+x4,data=dat),
delta=dat$delta)
```

Mprofile.wb

Modified profile likelihood estimation of Weibull shape and regression parameter

Description

Modified profile likelihood estimation of Weibull shape and regression parameter. The methodology was adopted from 'Conditionality resolutions' which is actually "the construction of ancillary statistics and expressions for the conditional distribution of the maximum likelihood estimate of a statistical model". The result will produce less bias with minimum mean square error; at least for Weibull shape parameter. Performances of profile and modified profile likelihood estimation are differentiable when sample size is reasonably small.

Usage

```
Mprofile.wb(formula, censor, data, method = "BFGS", initial = 1)
```

Arguments

formula	an object of class "formula".
censor	censoring status, coded as 0(censored observation) and 1(uncensored observation) binary integer variable in the data frame.
data	data frame of weibull distributed failure time, covariates and censoring variable.
method	method under which optimization is performed. Other methods are "Nelder-Mead", "CG", "L-BFGS-B", "SANN", and "Brent".

initial Initial values of the parameters at which likelihood function will be optimized. Default value is 1 for all parameters. To change initial values input a vector of numeric values with length of number of parameters to be optimized. First initial value is attributed for shape parameter. For example, use vector `c(2,3,2,3,4)` as initial value for shape and four regression parameters.

Value

The function is a list with atleast the following component:

Formula	an object of class "formula"
Coefficients	estimates of the regression parameters
Scale	estimate of scale parameter

Author(s)

Mazharul Islam and Hasinur Rahaman Khan

References

Barndorff-Nielsen (1980). Conditionality resolutions. *Biometrika*, 67(2) : 293-310.

Barndorff-Nielsen (1983). On a formula for the distribution of the maximum likelihood estimator. *Biometrika*, 70(2) : 343-365.

Khan M. H. R. and Shaw J. E. H (2015). Variable selection for survival data with a class of adaptive elastic net techniques. *Statistics and Computing*, DOI: 10.1007/s11222-015-9555-8.

Islam, M. M., Khan, M. H. R. and Hawlader T. (2015). Modified profile likelihood estimation for the weibull regression models in survival analysis. Submitted.

See Also

`optim`

Examples

```
dat <- data.weibull(n = 40, shape=2, regco=c(2,1.5,3,2.5))
Mprofile.wb(formula=ftime~x1+x2+x3+x4, censor="delta", data=dat)
survreg(Surv(ftime,delta)~x1+x2+x3+x4, data=dat, dist="weibull")
```

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