Package 'invGauss'

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Type Package

Title Threshold Regression that Fits the (Randomized Drift) Inverse
Gaussian Distribution to Survival Data

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Depends survival

Imports optimx

Description Fits the (randomized drift) inverse Gaussian distribution to survival data. The model is described in Aalen OO, Borgan O, Gjessing HK. Survival and Event History Analysis. A Process Point of View. Springer, 2008. It is based on describing time to event as the barrier hitting time of a Wiener process, where drift towards the barrier has been randomized with a Gaussian distribution. The model allows covariates to influence starting values of the Wiener process and/or average drift towards a barrier, with a user-defined choice of link functions.

License GPL (>= 2)

URL http://www.uib.no/smis/gjessing/projects/invgauss/

NeedsCompilation no

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R topics documented:

`d.oropha.rec`	*Carcinoma of the oropharynx*

Description

An example from clinical medicine given by Kalbfleisch and Prentice (2002), a clinical trial on 195 patients with carcinoma of the oropharynx carried out by the Radiation Therapy Oncology Group in the United States. The patients were randomized into two treatment groups ("standard" and "test" treatment), and survival times were measured in days (rather, years in this recoded data set) from diagnosis.

Usage

```
data(d.oropha.rec)
```

Format

A number of covariates were recorded for each patient at the entry to the study:

sex (1 = male, 2 = female)

treatment group (1 = standard, 2 = test)

grade (1 = well differentiated, 2 = moderately differentiated, 3 = poorly differentiated)

age in years at diagnosis

condition (1 = no disability, 2 = restricted work, 3 = requires assistance with self-care, 4 = confined to bed)

T-stage (an index of size and infiltration of tumor ranging from 1 to 4, with 1 indicating a small tumor and 4 a massive invasive tumor)

N-stage (an index of lymph node metastasis ranging from 0 to 3, with 0 indicating no evidence of metastases and 3 indicating multiple positive nodes or fixed positive nodes)

References

Aalen OO, Borgan O, Gjessing HK. Survival and Event History Analysis: A Process Point of View. Springer-Verlag, 2008.
Web page for invGauss: http://www.uib.no/smis/gjessing/projects/invgauss/

invGauss	*Threshold regression that fits the (randomized drift) inverse Gaussian distribution to survival data.*

Description

invGauss fits the (randomized drift) inverse Gaussian distribution to survival data. The model is described in Aalen OO, Borgan O, Gjessing HK. Survival and Event History Analysis. A Process Point of View. Springer, 2008. It is based on describing time to event as the barrier hitting time of a Wiener process, where drift towards the barrier has been randomized with a Gaussian distribution. The model allows covariates to influence starting values of the Wiener process and/or average drift towards a barrier, with a user-defined choice of link functions.

Usage

```
invGauss(formula.mu, formula.c = ~1, link.mu = identity,
link.c = exp, data, mu = TRUE, tau = TRUE, verbose = FALSE,
protect = FALSE, opti.method = "BFGS", use.gradient = TRUE,
link.mu.deriv = function(x) 1, link.c.deriv = exp)
```

Arguments

formula.mu	Standard survival formula, like formula.mu = Surv(time, status) ~ covar1 + covar2.
formula.c	Formula without the left hand side, like formula.c = ~ covar1 + covar2.
link.mu	Link function used with formula.mu. Default is identity. Note that it should be the function itself, not the name of the function.
link.c	Link function used with formula.c Default is exp. Note that it should be the function itself, not the name of the function.
data	Data frame to be used.
mu	If you need to supply your own initial value for mu. If mu is numeric, invGauss will use it as the initial value, otherwise (if mu = TRUE) it will provide a rough estimate for an initial value.
tau	Like mu above.
verbose	If TRUE, invGauss prints some information along the way.
protect	Somewhat experimental. If TRUE, possible negative values in the likelihood are "eliminated" to avoid crashes. Probably most useful when link is identity.
opti.method	invGauss uses the optimx package to provide a selection of optimization tools. Default is "BFGS", which calls the optim function with method = "BFGS". The standard optim default of "Nelder-Mead" seems at times unreliable when used in invGauss. See the optimx package documentation for other options.
use.gradient	By default, invGauss uses analytical gradients in the optimization.
link.mu.deriv	If the user modifies link.mu and use.gradient = TRUE, the derivative of the link function must also be supplied. See Details.
link.c.deriv	If the user modifies link.c and use.gradient = TRUE, the derivative of the link function must also be supplied. See Details.

Details

`invGauss` uses by default analytical gradients in the optimization, although this does not appear to make much difference. When `use.gradient = TRUE`, if the user changes one of the link functions, the corresponding derivative must also be supplied. For instance, if `link.mu` is set to `exp`, so should `link.mu.deriv`. Similarly, if, for instance, `link.c` is changed to `identity`, then `link.c.deriv` should be `function(x) 1`.
See web page <http://www.uib.no/smis/gjessing/projects/invgauss/> for more details.

Value

An object of class `invGauss` is returned. This is a list, where the most important elements are:

coefficients: Estimated coefficients

cov.unscaled: The variance-covariance matrix of the estimated coefficients

loglik: The maximized log-likelihood

AIC: AIC value

The `summary` function provides more details about the result, in particular coefficient values with standard errors, Z statistic, and Wald tests.
(There is also an undocumented `invGauss:::predict.invGauss` function, but use it at your own risk...)

Warning

For some datasets, `invGauss` may have a hard time converging. This may be due to either inappropriate parameter starting values or a hazard shape that is incompatible with the hitting time distribution. Running a simpler model or setting the starting values manually may help. Sometimes, the exact choice of zero on the time scale may be important since some of the model hazards increase steeply immediately after zero. Adding or subtracting a small value from all event/censoring times may help. The new default optimization method "BFGS" seems to do a better job than "Nelder-Mead".

Note

Further information is found on the web page.

Author(s)

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References

Aalen OO, Borgan O, Gjessing HK. Survival and Event History Analysis: A Process Point of View. Springer-Verlag, 2008.

Aalen OO and Gjessing HK. Understanding the Shape of the Hazard Rate: A Process Point of View. Statistical Science, 2001, Vol. 1, No. 1, 1-22.

Aalen OO. Phase type distributions in survival analysis. Scandinavian Journal of Statistics, 1995, Vol. 22, Issue 4, 447-463.

Web Site: <http://www.uib.no/smis/gjessing/projects/invgauss/>

See Also

summary.invGauss

Examples

```
# Simple run:
data(d.oropha.rec)
res <- invGauss(formula.mu = Surv(time, status) ~ 1, data = d.oropha.rec)
summary(res)

# Use covariates for c, with exponential link function
data(d.oropha.rec)
res <- invGauss(formula.mu = Surv(time, status) ~ 1, formula.c = ~ cond + nstage + tstage,
data = d.oropha.rec) # MODEL 5 (TABLE 10.2, page 412) IN SPRINGER BOOK
summary(res)
```

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summary.invGauss	*Summarize the estimation result from invGauss*

Description

To be used on a result from `invGauss`. The summary function provides estimates, standard errors etc.

Usage

```
## S3 method for class 'invGauss'
summary(object, covariance = FALSE, ...)
```

Arguments

object	Result from running `invGauss`.
covariance	Logical, indicates whether the asymptotic variance-covariance matrix for the parameter estimates should be returned.
...	Other arguments (ignored).

Details

See web page <http://www.uib.no/smis/gjessing/projects/invgauss/> for more details.

Value

Returns a list with the most important results from invGauss, including coefficients with standard errors and Wald tests:

coefficients: Estimated coefficients, with standard errors and Wald tests

cov.unscaled: The variance-covariance matrix of the estimated coefficients

loglik: The maximized log-likelihood

AIC: AIC value

Note

Further information is found on the web page

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Web Site: <http://www.uib.no/smis/gjessing/projects/invgauss/>

See Also

invGauss

Examples

```
# Simple run:
data(d.oropha.rec)
res <- invGauss(formula.mu = Surv(time, status) ~ 1, data = d.oropha.rec)
summary(res)
```

```
# Use covariates for c, with exponential link function
data(d.oropha.rec)
res <- invGauss(formula.mu = Surv(time, status) ~ 1, formula.c = ~ cond + nstage + tstage,
data = d.oropha.rec) # MODEL 5 (TABLE 10.2) IN SPRINGER BOOK
summary(res)
```

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