Package ‘survstan’

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survstan-package

The 'survstan' package.

Description

The aim of the R package survstan is to provide a toolkit for fitting survival models using Stan. The R package survstan can be used to fit right-censored survival data under independent censoring. The implemented models allow the fitting of survival data in the presence/absence of covariates. All inferential procedures are currently based on the maximum likelihood (ML) approach.

References


aftreg

Fitting Accelerated Failure Time Models

Description

Function to fit accelerated failure time (AFT) models.

Usage

aftreg(formula, data, baseline = "weibull", dist = NULL, init = 0, ...)

Arguments

formula an object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted.

data 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 function is called.
ahreg

baseline the chosen baseline distribution; options currently available are: exponential, weibull, lognormal, loglogistic and Birnbaum-Saunders (fatigue) distributions.
dist alternative way to specify the baseline distribution (for compatibility with the \texttt{survreg} function); default is NULL.
init initial values specification (default value is 0); see the detailed documentation for \texttt{init} in \texttt{optimizing}.
...

Value

\texttt{ahreg} returns an object of class "\texttt{aftreg}" containing the fitted model.

Examples

\begin{verbatim}
library(survstan)
fit <- ahreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull")
summary(fit)
\end{verbatim}

\hline
\textbf{ahreg} & \textit{Fitting Accelerated Hazard Models} \\
\hline

Description

Function to fit accelerated hazard (AH) models.

Usage

\texttt{ahreg(formula, data, baseline = "weibull", dist = NULL, init = 0, ...)}

Arguments

\begin{itemize}
  \item \texttt{formula} an object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted.
  \item \texttt{data} 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 function is called.
  \item \texttt{baseline} the chosen baseline distribution; options currently available are: exponential, weibull, lognormal, loglogistic and Birnbaum-Saunders (fatigue) distributions.
  \item \texttt{dist} alternative way to specify the baseline distribution (for compatibility with the \texttt{survreg} function); default is NULL.
  \item \texttt{init} initial values specification (default value is 0); see the detailed documentation for \texttt{init} in \texttt{optimizing}.
  \item ... further arguments passed to other methods.
\end{itemize}
Value

ahreg returns an object of class "ahreg" containing the fitted model.

Examples

```r
library(survstan)
fit <- ahreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull")
summary(fit)
```

AIC.survstan

Akaike information criterion

Description

Akaike information criterion

Usage

```r
## S3 method for class 'survstan'
AIC(object, ..., k = 2)
```

Arguments

- `object`: an object of the class survstan.
- `...`: further arguments passed to or from other methods.
- `k`: numeric, the penalty per parameter to be used; the default `k = 2` is the classical AIC.

Value

the Akaike information criterion value when a single model is passed to the function; otherwise, a data.frame with the Akaike information criterion values and the number of parameters is returned.

Examples

```r
library(survstan)
fit1 <- aftreg(Surv(futime, fustat) ~ 1, data = ovarian, baseline = "weibull", init = 0)
fit2 <- aftreg(Surv(futime, fustat) ~ rx, data = ovarian, baseline = "weibull", init = 0)
fit3 <- aftreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull", init = 0)
AIC(fit1, fit2, fit3)
```
anova.survstan  

**anova method for survstan models**

**Description**

Compute analysis of variance (or deviance) tables for one or more fitted model objects.

**Usage**

```r
## S3 method for class 'survstan'
anova(...)
```

**Arguments**

- `...` further arguments passed to or from other methods.

**Value**

the ANOVA table.

**Examples**

```r
library(survstan)
fit1 <- aftreg(Surv(futime, fustat) ~ 1, data = ovarian, baseline = "weibull", init = 0)
fit2 <- aftreg(Surv(futime, fustat) ~ rx, data = ovarian, baseline = "weibull", init = 0)
fit3 <- aftreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull", init = 0)
anova(fit1, fit2, fit3)
```

calc.survstan  

**Estimated regression coefficients**

**Description**

Estimated regression coefficients

**Usage**

```r
## S3 method for class 'survstan'
coef(object, ...)
```

**Arguments**

- `object` an object of the class survstan
- `...` further arguments passed to or from other methods
the estimated regression coefficients

Examples

```r
library(survstan)
fit <- aftreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull", init = 0)
coef(fit)
```

Confidence intervals for the regression coefficients

```r
confint(fit)
```

Description

Confidence intervals for the regression coefficients

Usage

```r
## S3 method for class 'survstan'
confint(object, parm = NULL, level = 0.95, ...)
```

Arguments

- `object`: an object of the class survstan.
- `parm`: a specification of which parameters are to be given confidence intervals, either a vector of numbers or a vector of names. If missing, all parameters are considered.
- `level`: the confidence level required.
- `...`: further arguments passed to or from other methods.

Value

100(1-alpha) confidence intervals for the regression coefficients.

Examples

```r
library(survstan)
fit <- aftreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull", init = 0)
confint(fit)
```
cross_time

Generic S3 method cross_time

Usage

cross_time(object, ...)

Arguments

object: a fitted model object

... further arguments passed to or from other methods.

Value

the crossing survival time

cross_time.survstan

Computes the crossing survival times

Description

Computes the crossing survival times

Usage

## S3 method for class 'survstan'
cross_time(
  object,
  newdata1,
  newdata2,
  conf.level = 0.95,
  nboot = 1000,
  cores = 1,
  ...
)

ehreg

Arguments

object an object of class survstan
newdata1 a data frame containing the first set of explanatory variables
newdata2 a data frame containing the second set of explanatory variables
conf.level level of the confidence/credible intervals
nboot number of bootstrap samples (default nboot=1000).
cores number of cores to be used in the bootstrap sampling; default is 1 core;
... further arguments passed to or from other methods.

Value

the crossing survival time

Examples

library(survstan)
data(ipass)
fit <- ypreg(Surv(time, status)~arm, data=ipass, baseline = "weibull")
summary(fit)
newdata1 <- data.frame(arm=0)
newdata2 <- data.frame(arm=1)
tcross <- cross_time(fit, newdata1, newdata2, nboot = 10)
tcross

ehreg Fitting Extended Hazard Models

Description

Function to fit Extended Hazard (EH) models.

Usage

ehreg(formula, data, baseline = "weibull", dist = NULL, init = 0, ...)

Arguments

formula an object of class "formula" (or one that can be coerced to that class): 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 function is called.
baseline the chosen baseline distribution; options currently available are: exponential, weibull, lognormal, loglogistic and Birnbaum-Saunders (fatigue) distributions.
dist alternative way to specify the baseline distribution (for compatibility with the `survreg` function); default is NULL.
init initial values specification (default value is 0); see the detailed documentation for `init` in `optimizing`.
... further arguments passed to other methods.

Value
ehreg returns an object of class "ehreg" containing the fitted model.

Examples

```r
library(survstan)
fit <- ehreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull")
summary(fit)
```

---

**Description**

Functions required for compatibility of `survstan` with `emmeans`. Users are not required to call these functions themselves. Instead, they will be called automatically by the `emmeans` function of the `emmeans` package.

**Usage**

```r
recover_data.survstan(object, ...)
recover_data.ypreg(object, term = c("short", "long"), ...)
```

**Arguments**

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>object</td>
<td>An object of the same class as is supported by a new method.</td>
</tr>
<tr>
<td>...</td>
<td>Additional parameters that may be supported by the method.</td>
</tr>
<tr>
<td>term</td>
<td>character specifying whether short or long term regression coefficients are to be used.</td>
</tr>
</tbody>
</table>
estimates

**Description**

Parameters estimates of a survstan model

**Usage**

estimates(object, ...)

**Arguments**

- **object**: an object of the class survstan.
- **...**: further arguments passed to or from other methods.

**Value**

the parameters estimates of a given survstan model.

**Examples**

```r
library(survstan)
fit <- aftreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull", init = 0)
estimates(fit)
```

---

extractAIC.survstan

**Extract AIC from a Fitted Model**

**Description**

Computes the (generalized) Akaike An Information Criterion for a fitted parametric model.

**Usage**

```r
## S3 method for class 'survstan'
extractAIC(fit, scale, k = 2, ...)
```
Arguments

- `fit`: a fitted model of the class `survstan`
- `scale`: optional numeric specifying the scale parameter of the model. Currently only used in the "lm" method, where scale specifies the estimate of the error variance, and scale = 0 indicates that it is to be estimated by maximum likelihood.
- `k`: numeric specifying the ‘weight’ of the equivalent degrees of freedom part in the AIC formula.
- `...`: further arguments passed to or from other methods.

Value

the ANOVA table.

Examples

```r
library(survstan)
fit1 <- aftreg(Surv(futime, fustat) ~ 1, data = ovarian, baseline = "weibull", init = 0)
fit2 <- aftreg(Surv(futime, fustat) ~ rx, data = ovarian, baseline = "weibull", init = 0)
fit3 <- aftreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull", init = 0)
extractAIC(fit1)
extractAIC(fit2)
extractAIC(fit3)
```

---

**gastric**

*Gastric cancer data set*

Description

Data set from a clinical trial conducted by the Gastrointestinal Tumor Study Group (GTSG) in 1982. The data set refers to the survival times of patients with locally nonresectable gastric cancer. Patients were either treated with chemotherapy combined with radiation or chemotherapy alone.

Format

A data frame with 90 rows and 3 variables:

- `time`: survival times (in days)
- `status`: failure indicator (1 - failure; 0 - otherwise)
- `trt`: treatments (1 - chemotherapy + radiation; 0 - chemotherapy alone)

Author(s)

Fabio N. Demarqui <fndemarqui@est.ufmg.br>
References


---

**ggresiduals**

**Generic S3 method ggresiduals**

### Description

Generic S3 method ggresiduals

### Usage

```r
ggresiduals(object, ...)  
```

### Arguments

- `object` a fitted model object.
- `...` further arguments passed to or from other methods.

### Details

Generic method to plot residuals of survival models.

### Value

the desired residual plot.

---

**ggresiduals.survstan**

**ggresiduals method for survstan models**

### Description

ggresiduals method for survstan models

### Usage

```r
## S3 method for class 'survstan'

ggresiduals(object, type = c("coxsnell", "martingale", "deviance"), ...)
```

### Arguments

- `object` a fitted model object of the class survstan.
- `type` type of residuals used in the plot: coxsnell (default), martingale and deviance.
- `...` further arguments passed to or from other methods.
Details

This function produces residuals plots of Cox-Snell residuals, martingale residuals and deviance residuals.

Value

the desired residual plot.

Examples

```r
library(survstan)
ovarian$rx <- as.factor(ovarian$rx)
fit <- aftreg(Surv(futime, fustat) ~ age + rx, data = ovarian, baseline = "weibull", init = 0)
ggresiduals(fit, type = "coxsnell")
ggresiduals(fit, type = "martingale")
ggresiduals(fit, type = "deviance")
```

---

**ipass**

*IRESSA Pan-Asia Study (IPASS) data set*

**Description**

Reconstructed IPASS clinical trial data reported in Argyropoulos and Unruh (2015). Although reconstructed, this data set preserves all features exhibited in references with full access to the observations from this clinical trial. The data base is related to the period of March 2006 to April 2008. The main purpose of the study is to compare the drug gefitinib against carboplatin/paclitaxel doublet chemotherapy as first line treatment, in terms of progression free survival (in months), to be applied to selected non-small-cell lung cancer (NSCLC) patients.

**Format**

A data frame with 1217 rows and 3 variables:

- **time**: progression free survival (in months)
- **status**: failure indicator (1 - failure; 0 - otherwise)
- **arm**: (1 - gefitinib; 0 - carboplatin/paclitaxel doublet chemotherapy)

**Author(s)**

Fabio N. Demarqui <fndemarqui@est.ufmg.br>

**References**

logLik.survstan

Extract Log-Likelihood from a Fitted Model

Description

Extracts the log-likelihood function for a fitted parametric model.

Usage

## S3 method for class 'survstan'
logLik(object, ...)

Arguments

object 

a fitted model of the class survstan

... 

further arguments passed to or from other methods.

Value

the log-likelihood value when a single model is passed to the function; otherwise, a data.frame with the log-likelihood values and the number of parameters is returned.

Examples

library(survstan)
fit1 <- aftreg(Surv(futime, fustat) ~ 1, data = ovarian, baseline = "weibull", init = 0)
fit2 <- aftreg(Surv(futime, fustat) ~ rx, data = ovarian, baseline = "weibull", init = 0)
fit3 <- aftreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull", init = 0)
logLik(fit1, fit2, fit3)

model.matrix.survstan

Model.matrix method for survstan models

Description

Reconstruct the model matrix for a survstan model.

Usage

## S3 method for class 'survstan'
model.matrix(object, ...)
Fitting Proportional Hazards Models

Function to fit proportional hazards (PH) models.

**Usage**

```r
phreg(formula, data, baseline = "weibull", dist = NULL, init = 0, ...)
```

**Arguments**

- `formula`: an object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted.
- `data`: 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 function is called.
- `baseline`: the chosen baseline distribution; options currently available are: exponential, weibull, lognormal, loglogistic and Birnbaum-Saunders (fatigue) distributions.
- `dist`: alternative way to specify the baseline distribution (for compatibility with the `survreg` function); default is NULL.
- `init`: initial values specification (default value is 0); see the detailed documentation for `init` in `optimizing`.
- `...`: further arguments passed to other methods.

**Value**

`phreg` returns an object of class "phreg" containing the fitted model.
Examples

library(survstan)
fit <- phreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull")
summary(fit)

poreg                  Fitting Proportional Odds Models

Description

Function to fit proportional odds (PO) models.

Usage

poreg(formula, data, baseline = "weibull", dist = NULL, init = 0, ...)

Arguments

formula an object of class "formula" (or one that can be coerced to that class): 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 function is called.
baseline the chosen baseline distribution; options currently available are: exponential,
weibull, lognormal, loglogistic and Birnbaum-Saunders (fatigue) distributions.
dist alternative way to specify the baseline distribution (for compatibility with the
survreg function); default is NULL.
init initial values specification (default value is 0); see the detailed documentation
for init in optimizing.
... further arguments passed to other methods.

Value

poreg returns an object of class "poreg" containing the fitted model.
rank_models

Description

Rank a collection of survstan models

Usage

rank_models(formula, data, survreg, baseline, dist = NULL, ...)

Examples

library(survstan)
fit <- poreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull")
summary(fit)

print.summary.survstan

Print the summary.survstan output

Description

Produces a printed summary of a fitted survstan model.

Usage

## S3 method for class 'summary.survstan'
print(x, ...)

Arguments

x

an object of the class summary.survstan.

... further arguments passed to or from other methods.

Value

No return value, called for side effects.
Arguments

- **formula**: an object of class "formula" (or one that can be coerced to that class): 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 function is called.
- **survreg**: survival regression models to be fitted (AFT, AH, PH, PO, YP and EH).
- **baseline**: baseline distributions to be fitted; options currently available are: exponential, weibull, lognormal, loglogistic and Birnbaum-Saunders (fatigue) distributions.
- **dist**: alternative way to specify the baseline distributions (for compatibility with the `survreg` function); default is NULL.
- **...**: further arguments passed to other methods.

Value

A tibble containing the fitted models ranked according to their AICs.

Examples

```r
library(survstan)
library(dplyr)

veteran <- veteran %>%
  mutate(across(c(trt, prior, celltype), as.factor))
fits <- rank_models(
  formula = Surv(time, status) ~ celltype+karno,
  data = veteran,
  survreg = c("aftreg", "ahreg", "phreg", "poreg", "ypreg", "ehreg"),
  baseline = c("exponential", "weibull", "lognormal", "loglogistic", "fatigue", "gamma", "rayleigh")
)
```

residuals.survstan

residuals method for survstan models

Description

residuals method for survstan models

Usage

```r
## S3 method for class 'survstan'
residuals(object, type = c("coxsnell", "martingale", "deviance"), ...)
```
Arguments

object  
a fitted model object of the class survstan.

type  
type of residuals desired: coxsnell (default), martingale and deviance.

...  
further arguments passed to or from other methods.

Details

This function extracts the residuals, martingale residuals and deviance residuals of a survstan object.

Value

a vector containing the desired residuals.

Examples

```r
library(survstan)
ovarian.rx <- as.factor(ovarian.rx)
fit <- aftreg(Surv(futime, fustat) ~ age + rx, data = ovarian, baseline = "weibull", init = 0)
residuals(fit, type = "coxsnell")
residuals(fit, type = "martingale")
residuals(fit, type = "deviance")
```

se

Generic S3 method se

Description

Generic S3 method se

Usage

se(object, ...)

Arguments

object  
a fitted model object.

...  
further arguments passed to or from other methods.

Value

the standard errors associated with a set of parameter estimators for a given model.
se.survstan  

---

**Estimated standard errors**

### Description

Estimated standard errors

### Usage

```r
## S3 method for class 'survstan'
se(object, ...)
```

### Arguments

- `object`: an object of the class survstan.
- `...`: further arguments passed to or from other methods.

### Value

a vector with the standard errors.

### Examples

```r
library(survstan)
fit <- aftreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull", init = 0)
se(fit)
```

---

### Summary for a survstan object

#### Description

Summary for a survstan object

#### Usage

```r
## S3 method for class 'survstan'
summary(object, conf.level = 0.95, ...)
```

#### Arguments

- `object`: the result of a call to summary.survstan
- `conf.level`: the confidence level required.
- `...`: further arguments passed to or from other methods.
Value

an object of the class summary.survstan containing a summary of the fitted model.

Description

Computes the predicted survivor function for a phpe model.

Usage

## S3 method for class 'survstan'
survfit(formula, newdata, ...)

Arguments

- formula: an object of the class survstan
- newdata: a data frame containing the set of explanatory variables.
- ...: further arguments passed to or from other methods.

Value

a list containing the estimated survival probabilities.

Examples

library(survstan)
library(ggplot2)
data(ipass)
ipass$arm <- as.factor(ipass$arm)
fit <- ypreg(Surv(time, status)~arm, data=ipass, baseline = "weibull")
summary(fit)
newdata <- data.frame(arm=as.factor(0:1))
surv <- survfit(fit, newdata)
ggplot(surv, aes(x=time, y=surv, color = arm)) + geom_line()
Description

Tidy a survstan object

Usage

```r
## S3 method for class 'survstan'
tidy(x, conf.int = FALSE, conf.level = 0.95, ...)
```

Arguments

- `x`: a fitted model object.
- `conf.int`: Logical indicating whether or not to include a confidence interval in the tidied output. Defaults to FALSE.
- `conf.level`: the confidence level required.
- `...`: further arguments passed to or from other methods.

Details

Convert a fitted model into a tibble.

Value

a tibble with a summary of the fit.

Examples

```r
library(survstan)
fit <- aftreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull")
tidy(fit)
```
vcov.survstan  Variance-covariance matrix

Description

This function extracts and returns the variance-covariance matrix associated with the regression coefficients when the maximum likelihood estimation approach is used in the model fitting.

Usage

## S3 method for class 'survstan'
vcov(object, all = FALSE, ...)

Arguments

object  an object of the class survstan.
all  logical; if FALSE (default), only covariance matrix associated with regression coefficients is returned; if TRUE, the full covariance matrix is returned.
...  further arguments passed to or from other methods.

Value

the variance-covariance matrix associated with the parameters estimators.

Examples

library(survstan)
fit <- aftreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull", init = 0)
vcov(fit)

ypreg  Fitting Yang and Prentice Models

Description

Function to fit Yang and Prentice (YP) models.

Usage

ypreg(formula, data, baseline = "weibull", dist = NULL, init = 0, ...)

ypreg
Arguments

formula an object of class "formula" (or one that can be coerced to that class): 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 function is called.

baseline the chosen baseline distribution; options currently available are: exponential,
weibull, lognormal, loglogistic and Birnbaum-Saunders (fatigue) distributions.

dist alternative way to specify the baseline distribution (for compatibility with the
survreg function); default is NULL.

init initial values specification (default value is 0); see the detailed documentation
for init in optimizing.

... further arguments passed to other methods.

Value

ypreg returns an object of class "ypreg" containing the fitted model.

Examples

library(survstan)
fit <- ypreg(Surv(futime, fustat) ~ ecog.ps + rx, data = ovarian, baseline = "weibull")
summary(fit)
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