Package 'Rwtdttt'

April 30, 2025

Type Package

Title Parametric Waiting Time Distribution estimation

Version 0.5.0

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Description Estimation of prescription durations and treatment
probability based on the parametric Waiting Time Distribution.
Pharmacoepidemiologic databases contains information on medication
dispensings at pharmacies. Studies using such data typically require
some estimate of duration of treatment after a dispensing (known as
the prescription duration), which can be estimated using the
parametric Waiting Time Distribution.

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Roxygen list(markdown = TRUE)

Imports bbmle,
Deriv,
data.table (>= 1.15.0),
methods,
graphics,
rlang,
stats

Suggests testthat (>= 3.0.0),
haven

Config/testthat/edition 3

Encoding UTF-8

LazyData true

RoxygenNote 7.3.1

Collate 'Rwtdttt-package.R'
'dfunctions.R'
'wtd-class.R'
'plot.R'
'pred_dur_prob.R'
'wtdttt.R'
'ranwtdttt.R'
'sandwich.R'
'summary_wtd-class.R'
'summaryWtd.R'

Contents

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coef,wtd-method   *Extract coefficients*

Description

Extract the coefficients from an object of class inheriting from "wtd"

Usage

```
## S4 method for signature 'wtd'
coef(object)
```

Arguments

object   a fitted object of class inheriting from "wtd"

Value

A summary of the fitted object

dexp *The Exponential distribution*

Description

The Exponential distribution

Usage

```
dexp(x, logitp, lnbeta, delta = 1, log = FALSE)
```

Arguments

x	vector of event times (must be between (0; delta))
logitp	log-odds of being a prevalent user
lnbeta	log of beta (scale)
delta	width of interval with positive support (x in (0; delta))
log	logical; if TRUE, probabilities p are given as log(p)

Value

Density. The length of the result is the maximum of the lengths of the numerical arguments.

dlnorm *The Lognormal distribution*

Description

The Lognormal distribution

Usage

```
dlnorm(x, logitp, mu, lnsigma, delta = 1, log = FALSE)
```

Arguments

x	vector of event times (must be between (0; delta))
logitp	log-odds of being a prevalent user
mu	mean on log-scale
lnsigma	log of standard deviation on log-scale
delta	width of interval with positive support (x in (0; delta))
log	logical; if TRUE, density values are returned on log-scale.

Value

Density. The length of the result is the maximum of the lengths of the numerical arguments.

---

dweib   *The Weibull distribution*

Description

The Weibull distribution

Usage

```
dweib(x, logitp, lnalpha, lnbeta, delta = 1, log = FALSE)
```

Arguments

x	vector of event times (must be between (0; delta))
logitp	log-odds of being a prevalent user
lnalpha	log of alpha (shape)
lnbeta	log of beta (scale)
delta	width of interval with positive support (x in (0; delta))
log	logical; if TRUE, probabilities p are given as log(p)

Value

Density. The length of the result is the maximum of the lengths of the numerical arguments.

---

plot,wtd,ANY-method   *Make WTD diagnostic plots*

Description

Make diagnostic plots showing the fit of an estimated parametric Waiting Time Distribution (WTD) with respect to the observed histogram of prescription redemptions.

Usage

```
## S4 method for signature 'wtd,ANY'
plot(wtd, x = NULL, y = NULL, ...)
```

Arguments

wtd	wtd object, typically result of wtdttt
x	ignored
y	ignored
...	other graphical parameters (see par)

---

predict,wtd-method *Make WTD predictions*

Description

Make predictions based on an estimated parametric Waiting Time Distribution (WTD) model, either the probability of a person still being in treatment or the duration of observed prescription redemptions.

Usage

```
## S4 method for signature 'wtd'
predict(
  object,
  prediction.data = NULL,
  type = "dur",
  iadmean = F,
  distrx = NULL,
  quantile = 0.8,
  se.fit = FALSE,
  na.action = na.pass,
  ...
)
```

Arguments

object	a fitted object of class inheriting from "wtd"
prediction.data	
	An optional data frame in which to look for variables with which to predict. If omitted, the fitted values are used.
type	"dur" or "prob". Default "dur".
iadmean	logical; if T, mean duration is predicted.
distrx	For type="prob", a vector of dispensing gaps.
quantile	For type="dur", quantile of distribution. Default 0.8
se.fit	A switch indicating if standard errors are required
na.action	function determining what should be done with missing values in newdata. The default is to predict NA
...	further arguments passed to or from other methods

Details

#' @section Data format: Covariates in the data provided for wtdttt, used for estimation, must be in the prediction data as well -if used- with identical names The class of the covariate must be the same in the dataset used for estimation and in the one used for prediction - if different - i.e. packsize used as a factor.

Value

A vector of predictions

---

ranwtdttt   *Fit Waiting Time Distribution with random index times*

Description

ranwtdttt() estimates maximum likelihood estimates for parametric Waiting Time Distribution (WTD) based on observed prescription redemptions with adjustment for covariates using one or more random index times for each individual. It reports estimates of prevalence fraction and specified percentile of inter-arrival density together with regression coefficients.

Usage

```
ranwtdttt(
  data,
  form,
  parameters = NULL,
  start = NA,
  end = NA,
  reverse = F,
  id = NA,
  nsamp = 1,
  subset = NULL,
  robust = T,
  na.action = na.omit,
  init = NULL,
  control = NULL,
  ...
)
```

Arguments

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 wtdttt is called.
form	an object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted. The details of the model specification are given under 'Details'
parameters	model formulae for distribution parameters
start	start of observation window
end	end of observation window
reverse	logical; Fit the reverse waiting time distribution.
id	the name of the variable that identifies distinct individuals
nsamp	number of samples to take.
subset	an optional vector specifying a subset of observations to be used in the fitting process.
robust	logical; compute a robust estimate of variance.

na.action	a function which indicates what should happen when the data contain NAs. The default is set by the na.action setting of options, and is na.fail if that is unset. The 'factory-fresh' default is na.omit. Another possible value is NULL, no action. Value na.exclude can be useful.
init	starting values for the parameters.
control	a list of parameters for controlling the fitting process.
...	further arguments passed to other methods.

Value

ranwtdttt returns an object of class "wtd" inheriting from "mle".

---

sand_vcov	*Calculate a robust variance-covariance matrix using the sandwich estimator*

Description

Calculate a robust variance-covariance matrix using the sandwich estimator

Usage

```
sand_vcov(fit)
```

Arguments

fit	an object of class "wtd" returned by ranwtdttt()

Value

sand_vcov returns a matrix

---

show	*Show*

Description

Show

Usage

```
show(object)
```

Arguments

object	Any R object

---

show,summary.wtd-method

Formatting of the summary of the model object and the prevalence of drug use

---

Description

Formatting of the summary of the model object and the prevalence of drug use

Usage

```
## S4 method for signature 'summary.wtd'
show(object)
```

Arguments

object   a fitted object of class inheriting from "wtd"

Value

A summary of the fitted object along with the estimated prevalence and its 95% CI

---

summary,wtd-method   *Summarise model object and prevalence of drug use*

Description

Summarise model object from wtdttt and print the estimated prevalence of drug use along with its 95% confidence interval .

Usage

```
## S4 method for signature 'wtd'
summary(object)
```

Arguments

object   a fitted object of class inheriting from "wtd"

Value

A summary of the fitted object

---

summary.wtd-class   *summary.wtd-class - R class definition*

Description

Register a 'summary.wtd' class, inheriting from 'summary.mle2'

Slots

call call of the model formula

coef matrix of coefficients estimated through wtdttt function

m2logL log-likelihood

prev_fin estimate of prevalence of drug use and its 95% confidence interval

---

vcov,wtd-method   *Extract variance-covariance matrix*

Description

Extract variance-covariance matrix from an object of class inheriting from "wtd"

Usage

```
## S4 method for signature 'wtd'
vcov(object)
```

Arguments

object   a fitted object of class inheriting from "wtd"

Value

A vector of coefficients

wtd-class	*An S4 class representing the result of maximum likelihood estimation for a WTD*

Description

This class encapsulates results of maximum likelihood estimation for a waiting time distribution.

Slots

delta value of the delta parameter

start window's start

end window's end

dist name of the WTD distribution family: "lnorm", "weib" or "exp"

depvar name of the dependent variable

idvar (optional) name of the id variable

isreverse logical; indicates whether a forward or backward distribution is used

wtdttt	*Fit Waiting Time Distribution*

Description

Estimates the maximum likelihood estimate for a parametric Waiting Time Distribution (WTD) based on observed prescription redemptions with adjustment for covariates. Reports estimates of prevalence fraction and specified percentile of inter-arrival density together with regression coefficients.

Usage

```
wtdttt(
  data,
  form,
  parameters = NULL,
  start = NA,
  end = NA,
  reverse = F,
  id = NA,
  preprocess = T,
  subset = NULL,
  na.action = na.omit,
  init = NULL,
  control = NULL,
  ...
)
```

Arguments

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 wtdttt is called.
form	an object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted. The details of the model specification are given under 'Details'
parameters	optional model formulae for distribution parameters
start	start of observation window (date or real number)
end	end of observation window (date or real number)
reverse	logical; Fit the reverse waiting time distribution (default F).
id	name of the id variable (optional)
preprocess	logical; Pre-process the data to limit to one observation per id. If id is omitted, defaults to F (default T).
subset	an optional vector specifying a subset of observations to be used in the fitting process. If the variable for which you want to create the subset is a factor, it is necessary to use both double and single quotation marks in the following way: i.e., subset = 'sex=="F"'
na.action	a function which indicates what should happen when the data contain NAs. The default is set by the na.action setting of options, and is na.fail if that is unset. The 'factory-fresh' default is na.omit. Another possible value is NULL, no action. Value na.exclude can be useful.
init	starting values for the parameters.
control	a list of parameters for controlling the fitting process.
...	further arguments passed to other methods.

Value

wtdttt returns an object of class "wtd" inheriting from "mle".

Model formula

The model formula form follows the pattern obstime ~ dist(alpha, beta, gamma) with

- obstime: the redemption time variable (date or real number)
- dist: the parametric distribution for the forward or backward recurrence density (FRD/BRD), which must be dexp(), dweib() or dlnorm() i.e named after their corresponding interarrival density (IAD).

The model formula parameters follows the pattern list(alpha ~ "covariate", beta ~ "covariate", gamma ~ 1) with

- covariate: the variable that is informative about the duration to the next prescription redemption and that will affect the estimate of the parameters of the model In the pattern reported above the covariaste only affect alpha and beta, but not gamma (since 1 is supplied after ~)

Data format

The WTD is fit to the first prescription redemption of each individual within an observation window (ordinary WTD), or the last (reverse WTD), respectively.

You may prepare the data to this format, or optionally specify the name of an id variable to select the first or last redemption automatically.

If the redemption time data are of type date, a continuity correction will be applied automatically.

Examples

```
# Fit the WTD with a lognormal distribution ----------------------------------------------------

# load data
df <- haven::read_dta(system.file("extdata", "wtddat_dates.dta", package="Rwtdttt"))

# fit the model
fit1 <- wtdttt(data = df,
               form = rx1time ~ dlnorm(logitp, mu, lnsigma),
               id = "pid",
               start = as.Date('2014-01-01'),
               end = as.Date('2014-12-31')
)

# Fit a reverse WTD with covariates ------------------------------------------------------------

# load data
df <- haven::read_dta(system.file("extdata", "wtddat_covar.dta", package="Rwtdttt"))

# make packsize a factor
df$packsize <- as.factor(df$packsize)

# fit the model
fit1 <- wtdttt(data = df,
               form = last_rxtime ~ dlnorm(logitp, mu, lnsigma),
               start = 0,
               end = 1,
               reverse = TRUE,
               parameters = list(logitp ~ packsize, mu ~ packsize, lnsigma ~ packsize)
)
```

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