Package: PMLE4SCR (via r-universe)

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Type Package

Title Pseudo Maximum Likelihood Estimation for Semi-Competing Risks Data

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Description Implements two-stage pseudo maximum likelihood estimation (PMLE) for copula-based regression models with semi-competing risks data. The marginal distributions are modeled by semiparametric transformation regression models, and the dependence between bivariate event times is specified by a parametric copula function. See Arachchige, Chen and Zhou (2025) <doi:10.1007/s10985-024-09640-z> for details.

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`fitSPT` *Fit a semi-parametric transformation (SPT) regression model*

Description

Fit a semiparametric transformation regression model, where the unspecified baseline function is estimated via nonparametric maximum likelihood estimation (NPMLE) method.

Usage

```
fitSPT(data, time, status, formula = ~1, Gfun = "PH")
```

Arguments

`data`	a data frame containing variables names specified in `time`, `status`, and `formula`.
`time`	a character string specifying the variable name in the `data` for the event time.
`status`	a character string specifying the variable name in the `data` for the censoring indicator (taking value 1 if the time is observed, and taking value 0 when it is censored).
`formula`	an object of class `formula`: a symbolic description of the model to be fitted.
`Gfun`	a character string specifying the link function, `Gfun = "PH"` (proportional hazards as default) or `Gfun = "PO"` (proportional odds) in the SPT model.

Value

a list of the following components:

`beta` a data frame containing the estimates, model-based standard erors (SE), and robust SEs for regresson coefficients.

`dLambda` a data frame containing the estimates, model-based SEs, and robust SEs for the jumps of the baseline function at observed time points.

`Lambda` a data frame containing the estimates, model-based SEs, and robust SEs for the baseline function at observed time points.

`varcov` a list of two elements: `model`, the model-based variance-covariance matrix for all regression and baseline function parameter estimators, and `robust`, the robust variance-covariance matrix for parameter estimators.

`Psi.theta` a data frame containing the estimated asymptotic expansion of the NPMLE estimator.

`call` a list containing the specified values of the input arguments.

`convergence` a logical value indicating whether the maximization of the log-likelihood converges or not.

`niter` an interger which is the number of iterations for the maximization of the log-likelihood.

Examples

```
data(BMT, package = "SemiCompRisks")
BMT$g <- factor(BMT$g, levels = c(2, 3, 1),
                labels = c("AML-low", "AML-high", "ALL"))
fitSPT(BMT, time = "T1", status = "delta1",
       formula = ~ g, Gfun = "PH")$beta
```

MLE4SCR *Simultaneous maximum likelihood estimation (MLE) of copula-based regression models for semi-competing risks (SCR) data*

Description

Perform MLE to simultaneously estimate the parameters associated with a copula-based regression models.

Usage

```
MLE4SCR(
  data,
  time,
  death,
  status_time,
  status_death,
  T.fmla = ~1,
  D.fmla = ~1,
  Gfun = list(T = "PH", D = "PH"),
  copula.family,
  copula.control = list(link = NULL, formula = ~1),
  initial = NULL
)
```

Arguments

`data`	a data frame containing variables names specified in `time`, `death`, `status_time`, `status_death`, `T.fmla`, `D.fmla`, and `formula` of `copula.control`.
`time`	a character string specifying the variable name in the `data` for the time to a non-terminal event.
`death`	a character string specifying the variable name in the `data` for the time to a terminal event.
`status_time`	a character string specifying the variable name in the `data` for the censoring indicator for the non-terminal event (take value 1 if the non-terminal event time is observed, and taking value 0 if it is censored).

status_death	a character string specifying the variable name in the data for the censoring indicator for the terminal event (take value 1 if the terminal event time is observed, and taking value 0 if it is censored).
T.fmla	an object of class formula: a symbolic description of the regression model to be fitted for the marginal distribution of the non-terminal event time.
D.fmla	an object of class formula: a symbolic description of the regression model to be fitted for the marginal distribution of the terminal event time.
Gfun	a list of two components T and D, both character strings specifying the link function in the semiparametric transformation (SPT) regression model for the non-terminal and terminal event times, respectively: "PH" (proportional hazards as the default value) or "PO" (proportional odds).
copula.family	a character string: "Clayton", "Gumbel", "Frank", or "Gaussian" specifying the copula family to be used for the dependence between the bivariate event times.
copula.control	a list of two components: link (a character string: "identity", "log", or "log-1", specifying the link function for the regression model of the copula parameter; if link = NULL (default), the link function will be the default function for the specified copula family: "log" for Clayton, "identity" for Frank, "log-1" for Gumbel, and "tanh" for Gaussian), and formula (an object of class formula: a symbolic description of the regression model to be fitted for the copula parameter under the specified link function; if formula = ~ 1 as default, the copula parameter is a constant)
initial	a numerical value or a vector of numerical values for the initial values of the copula parameter or the regression coefficients for the copula parameter. If initial = NULL (default), the initial value is set to be the one corresponding to Kendall's tau being 0.5.

Value

a list of the following components:

gamma: a data frame containing the estimates and robust standard errors (SE) of the copula parameter or regression coefficients for the copula parameter.

gamma.cov: a matrix containing the variance or variance-covariance matrix of the copula parameter estimators.

betaT: a data frame containing the estimates and robust SEs of the regression coefficients for the marginal distribution of the non-terminal event time.

dLambdaT: a data frame containing the estimates and robust SEs of the jumps of the baseline function for the marginal distribution of the non-terminal event time.

thetaT.cov: a matrix containing the variance-covariance matrix of the nonterminal marginal parameter estimators.

betaD: a data frame containing the estimates and robust SEs of the regression coefficients for the marginal distribution of the terminal event time.

dLambdaD: a data frame containing the estimates and robust SEs of the jumps of the baseline function for the marginal distribution of the terminal event time.

thetaD.cov: a matrix containing the variance-covariance matrix of the terminal marginal parameter estimators.

`call`: a list containing the specified values of input arguments `time`, `death`, `status_time`, `status_death`, `T.fmla`, `D.fmla`, `copula.family`, and the following two components:

`copula.link`: a list containing three R functions: "h.fun" (the link function used for the copula parameter), "dot.h.fun" (the first-order derivative of "h.fun"), and "ddot.h.fun" (the second-order derivative of "h.fun").

`copula.fmla`: the specified value of `fomula` of the input argument `copula.control`.

`Par2Tau`: a list containing two R functions: "tau.alpha" (transformation from the copula parameter to Kendall's tau), and "Dtau.alpha" (the first-order derivative of "tau.alpha" function)

Examples

```
data(BMT, package = "SemiCompRisks")
BMT$g <- factor(BMT$g, levels = c(2, 3, 1),
                labels = c("AML-low", "AML-high", "ALL"))
myfit <- MLE4SCR(BMT, time = "T2", death = "T1",
                 status_time = "delta2", status_death = "delta1",
                 T.fmla = ~ g, D.fmla = ~ g,
                 copula.family = "Clayton",
                 copula.control = list(link = NULL, formula = ~ g),
                 initial = NULL)
myfit$gamma
myfit$betaT
```

`PMLE4SCR` *Two-stage pseudo maximum likelihood estimation (PMLE) of copula-based regression models for semi-competing risks (SCR) data*

Description

Perform two-stage PMLE to estimate the parameters associated with a copula-based regression models.

Usage

```
PMLE4SCR(
  data,
  time,
  death,
  status_time,
  status_death,
  T.fmla = ~1,
  D.fmla = ~1,
  Gfun = list(T = "PH", D = "PH"),
  copula.family,
```

```
  copula.control = list(link = NULL, formula = ~1),
  initial = NULL
)
```

Arguments

`data`	a data frame containing variables names specified in `time`, `death`, `status_time`, `status_death`, `T.fmla`, `D.fmla`, and `formula` of `copula.control`.
`time`	a character string specifying the variable name in the `data` for the time to a non-terminal event.
`death`	a character string specifying the variable name in the `data` for the time to a terminal event.
`status_time`	a character string specifying the variable name in the `data` for the censoring indicator for the non-terminal event (take value 1 if the non-terminal event time is observed, and taking value 0 if it is censored).
`status_death`	a character string specifying the variable name in the `data` for the censoring indicator for the terminal event (take value 1 if the terminal event time is observed, and taking value 0 if it is censored).
`T.fmla`	an object of class `formula`: a symbolic description of the regression model to be fitted for the marginal distribution of the non-terminal event time.
`D.fmla`	an object of class `formula`: a symbolic description of the regression model to be fitted for the marginal distribution of the terminal event time.
`Gfun`	a list of two components `T` and `D`, both character strings specifying the link function in the semiparametric transformation (SPT) regression model for the non-terminal and terminal event times, respectively: "PH" (proportional hazards as the default value) or "PO" (proportional odds).
`copula.family`	a character string: "Clayton", "Gumbel", "Frank", or "Gaussian" specifying the copula family to be used for the dependence between the bivariate event times.
`copula.control`	a list of two components: `link` (a character string: "identity", "log", or "log-1", specifying the link function for the regression model of the copula parameter; if `link` = `NULL` (default), the link function will be the default function for the specified copula family: "log" for Clayton, "identity" for Frank, "log-1" for Gumbel, and "tanh" for Gaussian), and `formula` (an object of class `formula`: a symbolic description of the regression model to be fitted for the copula parameter under the specified link function; if `formula` = `~ 1` (default), the copula parameter is a constant)
`initial`	a numerical value or a vector of numerical values for the initial values of the copula parameter or the regression coefficients for the copula parameter. If `initial` = `NULL` (default), the initial value is set to be the one corresponding to Kendall's tau being 0.5.

Value

a list of the following components:

`gamma`**:** a data frame containing the estimates and robust standard errors (SE) of the copula parameter or regression coefficients for the copula parameter.

`gamma.cov`: a matrix containing the variance or variance-covariance matrix of the copula parameter estimators.

`betaT`: a data frame containing the estimates and robust SEs of the regression coefficients for the marginal distribution of the non-terminal event time.

`dLambdaT`: a data frame containing the estimates and robust SEs of the jumps of the baseline function for the marginal distribution of the non-terminal event time.

`thetaT.cov`: a matrix containing the variance-covariance matrix of the nonterminal marginal parameter estimators.

`betaD`: a data frame containing the estimates and robust SEs of the regression coefficients for the marginal distribution of the terminal event time.

`dLambdaD`: a data frame containing the estimates and robust SEs of the jumps of the baseline function for the marginal distribution of the terminal event time.

`thetaD.cov`: a matrix containing the variance-covariance matrix of the terminal marginal parameter estimators.

`call`: a list containing the specified values of input arguments `time`, `death`, `status_time`, `status_death`, `T.fmla`, `D.fmla`, `copula.family`, and the following two components:

`copula.link`: a list containing three R functions: "h.fun" (the link function used for the copula parameter), "dot.h.fun" (the first-order derivative of "h.fun"), and "ddot.h.fun" (the second-order derivative of "h.fun").

`copula.fmla`: the specified value of `fomula` of the input argument `copula.control`.

`Par2Tau`: a list containing two R functions: "tau.alpha" (transformation from the copula parameter to Kendall's tau), and "Dtau.alpha" (the first-order derivative of "tau.alpha" function)

Examples

```
data(BMT, package = "SemiCompRisks")
BMT$g = factor(BMT$g, levels = c(2, 3, 1),
               labels = c("AML-low", "AML-high", "ALL"))
myfit = PMLE4SCR(BMT, time = "T2", death = "T1",
                 status_time = "delta2", status_death = "delta1",
                 T.fmla = ~ g, D.fmla = ~ g,
                 copula.family = "Clayton",
                 copula.control = list(link = NULL, formula = ~ g),
                 initial = NULL)
myfit$gamma
myfit$betaT
```

`predictFitSPT` *Survival estimation under semi-parametric transformation regression model (SPT) for a given data*

Description

Computes survival probability estimates for new data using a fitted `fitSPT` object.

Usage

```
predictFitSPT(obj, newdata)
```

Arguments

`obj`	an object of `fitSPT`.
`newdata`	a data frame containing the same variables in the `formula` of `fitSPT`.

Value

a list of the following components:

`surv` a data frame containing the estimate, model-based standard eror (SE), and robust SE for the survival probabilities for a given data.

`Psi.surv` a data frame containing the estimated asymptotic expansion of the estimator of the survival probabilities.

Examples

```
data(BMT, package = "SemiCompRisks")
BMT$g <- factor(BMT$g, levels = c(2, 3, 1),
                labels = c("AML-low", "AML-high", "ALL"))
fit <- fitSPT(BMT, time = "T1", status = "delta1",
              formula = ~ g, Gfun = "PH")
predictFitSPT(fit, BMT)$surv
```

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