Package 'bcfrailph'

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Type Package

Title Semiparametric Bivariate Correlated Frailty Models Fit

Version 0.1.1

Description Fit and simulate a semiparametric bivariate correlated frailty models with proportional hazard structure. Frailty distributions, such as gamma and lognormal models are supported. Bivariate gamma fit is obtained using the approach given in Iachine (1995) and lognormal fit is based on the approach by Ripatti and Palmgren (2000) <doi:10.1111/j.0006-341X.2000.01016.x>.

Depends R (>= 4.0.0),survival

Imports stats

License GPL (>= 2)

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Contents

`bcfrailph` *Semi-parametric bivariate correlated frailty model.*

Description

Fit a semiparametric Bivariate correlated frailty model with Proportional Hazard structure.

Usage

```
bcfrailph(
  formula,
  data,
  initfrailp = NULL,
  frailty = c("gamma", "lognormal"),
  weights = NULL,
  control = bcfrailph.control(),
  ...
)
```

Arguments

`formula`	A formula object, with the response on the left of a ~ operator, and the terms on the right. The response must be a survival object as returned by the Surv function.
`data`	A dataframe contain survival time, censor, covariate etc with data in columns.
`initfrailp`	Initial estimates for the frailty parameters. If not specified, initial frailty variance will be obtained from coxph with univariate frailty model and for correlation c(0.5) will be used.
`frailty`	A type of frailty distribution to be used in fit. Either gamma or lognormal. The default is gamma.
`weights`	vector of case weights for gamma model. the default is NULL.
`control`	Arguments to control bcfrailph fit. The default is `bcfrailph.control`.
`...`	further arguments

Value

An object of that contains the following components.

- `coefficients` - A vector of estimated Covariate coefficients.
- `frailparest` - A vector of estimated Frailty parameters i.e. frailty variance and correlation.

- stderr-A vector containing the Standard error of the Estimated parameters both covariate coefficients and frailty parameters.
- loglilk0- Log likelihood of without frailty model or loglik of coxph fit.
- loglilk-Log likelihood of Cox PH model with frailty.
- Iloglilk- Log likelihood of with frailty. For gamma fit it is I-likelihood or the likelihood after integrating out the frailty term.For lognormal fit it is the approximate likelihood.
- bhaz- an array containing unique event times and estimated baseline hazard.
- X-Matrix of observed covariates.
- time-the observed survival time.
- censor-censoring indicator.
- resid-the martingale residuals.
- lin.prid-the vector of linear predictors.
- frail-estimated Frailty values.
- iteration-Number of outer iterations.
- e.time-the vector of unique event times.
- n.event- the number of events at each of the unique event times.
- convergence-an indicator, 1 if converge and 0 otherwise.
- history-an array containing records of estimates and other information on each iterations.

Note

Parameters of Bivariate correlated gamma frailty model was estimated using a modified EM approach given in Kifle et al (2022). Parameters of Bivariate correlated lognormal frailty model is based on the penalized partial likelihood approach by Rippatti and Palmgren (2000).

References

Kifle YG, Chen DG, Haileyesus MT (2022). Multivariate Frailty Models using Survey Weights with Applications to Twins Infant Mortality in Ethiopia. Statistics and Its Interface,106(4), 1\-10.

Rippatti, S. and Palmgren, J (2000). Estimation of multivariate frailty models using penalized partial likelihood. Biometrics, 56: 1016-1022.

See Also

bcfrailph.control,simbcfrailph

Examples

```
set.seed(4)
simdata<-simbcfrailph(psize=300, cenr= c(0.3),beta=c(2),frailty=c("gamma"),
frailpar=c(0.5,0.5),bhaz=c("weibull"),
bhazpar=list(shape =c(5), scale = c(0.1)),
covartype= c("B"),covarpar=list(fargs=c(1),sargs=c(0.5)))
dataa<-simdata$data
```

```
fitbcfrgam=bcfrailph(Surv(time,censor)~ X1+frailty(PID) ,data=dataa,frailty="gamma")
fitbcfrgam


# for lognormal

set.seed(18)
simdata<-simbcfrailph(psize=100, cenr= c(0.2),beta=c(1,-0.7,0.5),
frailty=c("lognormal"),frailpar=c(0.5,-0.25),bhaz=c("exponential"),
bhazpar=list(scale = c(0.1)),covartype= c("N","N","B"),
covarpar=list(fargs=c(0,0,1),sargs=c(1,1,0.5)),comncovar=2)
dataa<-simdata$data

#fit
fitbcfrlogn=bcfrailph(Surv(time,censor)~ X1+X2+X3+frailty(PID) ,data=dataa,frailty="lognormal")
fitbcfrlogn

## one can set the initial parameter for the frailty parameters
fitbcfrailph=bcfrailph(Surv(time,censor)~ X1+frailty(PID),data=dataa,initfrailp = c(0.1,0.5),
frailty="lognormal")
fitbcfrailph

# Not run

#if covariates are not included
fitmoe=try(bcfrailph(Surv(time,censor)~0+frailty(PID),data=dataa,
frailty="lognormal"),silent = TRUE)

fitmoe=try(bcfrailph(Surv(time,censor)~1+frailty(PID),data=dataa),silent = TRUE)

# if control is not specified correctly.
# if one needs to change only max.iter to be 100,

fitmoe=try(bcfrailph(Surv(time,censor)~ X1+frailty(PID),data=dataa,
control=c(max.iter=100)),silent = TRUE)

#the correct way is
fitmoe=bcfrailph(Surv(time,censor)~ X1+frailty(PID),data=dataa,
control=bcfrailph.control(max.iter=100))
fitmoe

#if initial frailty parameters are in the boundary of parameter space
fitmoe=try(bcfrailph(Surv(time,censor)~ X1+frailty(PID),data=dataa,
initfrailp=c(0.2,1)),silent = TRUE)

fitmoe=try(bcfrailph(Surv(time,censor)~ X1+frailty(PID),data=dataa,
initfrailp=c(0,0.1)),silent = TRUE)

#if a frailty distribution other than gamma and lognormal are specified

fitmoe=try(bcfrailph(Surv(time,censor)~ X1,data=dataa,,frailty="exp"),silent = TRUE)

# End Not run
```

`bcfrailph.control` *Arguments for controlling bcfrailph fits.*

Description

This is used to set various numeric parameters controlling a bcfrailph model fits.

Usage

```
bcfrailph.control(
  max.iter = 400,
  tol = 1e-04,
  eval.max = 500,
  iter.max = 500,
  trace = 0,
  abs.tol = 1e-20,
  rel.tol = 1e-10,
  x.tol = 1.5e-08,
  xf.tol = 2.2e-14,
  step.min = 1,
  step.max = 1
)
```

Arguments

`max.iter`	Maximum number of outer iterations. The default is 400.
`tol`	A tolerance for convergence i.e the maximum differences of loglikelihood between succssive iterations.The default is 1e-04.
`eval.max`	argument used to control nlminb fits used.
`iter.max`	argument used to control nlminb fits used.
`trace`	argument used to control nlminb fits used.
`abs.tol`	argument used to control nlminb fits used.
`rel.tol`	argument used to control nlminb fits used.
`x.tol`	argument used to control nlminb fits used.
`xf.tol`	argument used to control nlminb fits used.
`step.min`	argument used to control nlminb fits used.
`step.max`	argument used to control nlminb fits used.

Value

A list of control parameters.

See Also

bcfrailph

`fitbccv.gammasp` *Bivariate correlated gamma frailty model fitting function.*

Description

Semi-parametric Bivariate correlated gamma frailty model fitting function.

Usage

```
fitbccv.gammasp(
  X,
  Y,
  initfrailp,
  weights = NULL,
  control = bcfrailph.control(),
  SE = TRUE
)
```

Arguments

X	Matix of predictors. This should not include an intercept.
Y	a Surv object containing 2 columns (coxph.fit).
initfrailp	Initial estimates for the frailty parameters. If not specified, initial frailty variance will be obtained from coxph with univariate gamma frailty model and for correlation c(0.5) will be used.
weights	vector of case weights. the default is NULL.
control	Arguments to control the fit. The default is bcfrailph.control.
SE	a logical statement whether standard errors are obtained from the mariginal log likelihood.The default is TRUE.

Value

An object of that contains the following components.

- `coefficients` - A vector of estimated Covariate coefficients.
- `frailparest` - A vector of estimated Frailty parameters i.e. frailty variance and correlation.
- `stderr`-A vector containing the Standard error of the Estimated parameters both covariate coefficients and frailty parameters.
- `loglilk0`- Log likelihood of without frailty model or loglik of coxph fit.
- `loglilk`-Log likelihood of Cox PH model with frailty.

- `Iloglilk`- Log likelihood of with frailty. For gamma fit it is I-likelihood or the likelihood after integrating out the frailty term.For lognormal fit it is the approximate likelihood.
- `bhaz`- an array containing unique event times and estimated baseline hazard.
- `X`-Matrix of observed covariates.
- `time`-the observed survival time.
- `censor`-censoring indicator.
- `resid`-the martingale residuals.
- `lin.prid`-the vector of linear predictors.
- `frail`-estimated Frailty values.
- `iteration`-Number of outer iterations.
- `e.time`-the vector of unique event times.
- `n.event`- the number of events at each of the unique event times.
- `convergence`-an indicator, 1 if converge and 0 otherwise.
- `history`-an array containing records of estimates and other information on each iterations.

Note

This function is important especially for simulation studies as it reduced checking time. Parameters of Bivariate correlated gamma frailty model was estimated using a modified EM approach given in Kifle et al (2022).

References

Kifle YG, Chen DG, Haileyesus MT (2022). Multivariate Frailty Models using Survey Weights with Applications to Twins Infant Mortality in Ethiopia. Statistics and Its Interface,106(4), 1\-10.

See Also

`bcfrailph`

Examples

```
set.seed(4)
simdata<-simbcfrailph(psize=300, cenr= c(0.3),beta=c(2),frailty=c("gamma"),
frailpar=c(0.5,0.5),bhaz=c("weibull"),
bhazpar=list(shape =c(5), scale = c(0.1)),
covartype= c("B"),covarpar=list(fargs=c(1),sargs=c(0.5)))
Y<-simdata$Y;X<-simdata$X

bcspfit<-fitbccv.gammasp(X=X,Y=Y,initfrailp=NULL)
bcspfit$coef
bcspfit$frailpar
```

`fitbccv.lognsp` *Bivariate correlated lognormal frailty model fitting function.*

Description

Semi-parametric Bivariate correlated lognormal frailty model fitting function.

Usage

```
fitbccv.lognsp(X, Y, initfrailp, control = bcfrailph.control())
```

Arguments

`X`	Matix of predictors. This should not include an intercept.
`Y`	a Surv object containing 2 columns (coxph.fit).
`initfrailp`	Initial estimates for the frailty parameters. If not specified, initial frailty variance will be obtained from coxph with univariate lognormal frailty model and for correlation c(0.5) will be used.
`control`	Arguments to control the fit. The default is `bcfrailph.control`.

Value

An object of that contains the following components.

- `coefficients` - A vector of estimated Covariate coefficients.
- `frailparest` - A vector of estimated Frailty parameters i.e. frailty variance and correlation.
- `stderr`-A vector containing the Standard error of the Estimated parameters both covariate coefficients and frailty parameters.
- `loglilk0`- Log likelihood of without frailty model or loglik of coxph fit.
- `loglilk`-Log likelihood of Cox PH model with frailty.
- `Iloglilk`- Log likelihood of with frailty. For gamma fit it is I-likelihood or the likelihood after integrating out the frailty term.For lognormal fit it is the approximate likelihood.
- `bhaz`- an array containing unique event times and estimated baseline hazard.
- `X`-Matrix of observed covariates.
- `time`-the observed survival time.
- `censor`-censoring indicator.
- `resid`-the martingale residuals.
- `lin.prid`-the vector of linear predictors.
- `frail`-estimated Frailty values.
- `iteration`-Number of outer iterations.
- `e.time`-the vector of unique event times.
- `n.event`- the number of events at each of the unique event times.
- `convergence`-an indicator, 1 if converge and 0 otherwise.
- `history`-an array containing records of estimates and other information on each iterations.

Note

This function is important especially for simulation studies as it reduced checking time. Parameters of Bivariate correlated lognormal frailty model is based on the penalized partial likelihood approach by Rippatti and Palmgren (2000).

References

Rippatti, S. and Palmgren, J (2000). Estimation of multivariate frailty models using penalized partial likelihood. Biometrics, 56: 1016-1022.

See Also

bcfrailph

Examples

```
set.seed(18)
simdata<-simbcfrailph(psize=100, cenr= c(0.2),beta=c(1,-0.7,0.5),frailty=c("lognormal"),
frailpar=c(0.5,-0.25),bhaz=c("exponential"),
bhazpar=list(scale = c(0.1)),covartype= c("N","N","B"),
covarpar=list(fargs=c(0,0,1),sargs=c(1,1,0.5)),comncovar=2)
Y<-simdata$Y;X<-simdata$X

bcspfit<-fitbccv.lognsp(X=X,Y=Y,initfrailp=NULL)
bcspfit$coef
bcspfit$frailpar
```

---

plot.bcfrailph *Plot bcfrailph*

Description

Generics to print the S3 class bcfrailph.

Usage

```
## S3 method for class 'bcfrailph'
plot(
  x,
  lty = 1,
  col = 1,
  type = "l",
  xlim = NULL,
  ylim = NULL,
  xlab = NULL,
  main = NULL,
  conf.int = FALSE,
```

```
  ...
)
```

Arguments

x	A class bcfrailph object.
lty	Line type line type 1 is a solid line (the default).
col	Colors to be used for points.
type	The type of plot produced. type="l" Plot lines (the default) and type="p" Plot individual points.
xlim	range of variable on the x axis.
ylim	range of variable on the y axis.
xlab	Axis label for the x axis.
main	main is a string for figure title, placed at the top of the plot in a large font.
conf.int	whether confidence interval is included in the plot the deafault is FALSE.
...	ignored

Details

Calls plot.bcfrailph().

Value

An plot of plot.bcfrailph object.

Note

The plot of cumulative baseline hazard function.

See Also

bcfrailph

Examples

```
set.seed(24)
simdata<-simbcfrailph(psize=100, cenr= c(0),beta=c(-1),frailty=c("gamma"),
frailpar=c(0.4,0.5),bhaz=c("weibull"),
bhazpar=list(shape =c(0.9), scale = c(2)),
covartype= c("B"),covarpar=list(fargs=c(1),sargs=c(0.5)))
dataa<-simdata$data ## the generated data set.

#fit
bcfit=bcfrailph(Surv(time, censor) ~ X1+frailty(PID),data=dataa)
plot(bcfit)
```

print.bcfrailph *Print bcfrailph*

Description

Generics to print the S3 class bcfrailph.

Usage

```
## S3 method for class 'bcfrailph'
print(x, ...)
```

Arguments

x	A class bcfrailph object.
...	ignored

Details

Calls print.bcfrailph().

Value

An object of print.bcfrailph, with some more human-readable results from bcfrailph object.

Note

The summary function is currently identical to the print function.

See Also

bcfrailph

Examples

```
set.seed(4)
simdata<-simbcfrailph(psize=300, cenr= c(0.3),beta=c(2),frailty=c("gamma"),
frailpar=c(0.5,0.5),bhaz=c("weibull"),
bhazpar=list(shape =c(5), scale = c(0.1)),
covartype= c("B"),covarpar=list(fargs=c(1),sargs=c(0.5)))
dataa<-simdata$data

fitbcfrailph=bcfrailph(Surv(time,censor)~ X1+frailty(PID) ,data=dataa,frail_distrn=c("gamma"))
fitbcfrailph
```

print.shrgamsp *Print shrgamsp*

Description

Generics to print the S3 class shrgamsp.

Usage

```
## S3 method for class 'shrgamsp'
print(x, ...)
```

Arguments

x	A class shrgamsp object.
...	ignored

Details

Calls print.shrgamsp().

Value

An object of print.shrgamsp, with some more human-readable results from shrgamsp object.

Note

The summary function is currently identical to the print function.

See Also

bcfrailph

shrgamsp *Cox PH model with univariate and bivariate shared gamma frailty model.*

Description

Fit Cox PH model with univariate and bivariate shared gamma frailty model.

Usage

```
shrgamsp(
  formula,
  data,
  weights = NULL,
  initfrailp = NULL,
  control = bcfrailph.control(),
  ...
)
```

Arguments

formula	A formula object, with the response on the left of a ~ operator, and the terms on the right. The response must be a survival object as returned by the Surv function.
data	A dataframe contain survival time, censor, covariate etc with data in columns.
weights	vector of case weights for gamma model. the default is NULL.
initfrailp	Initial estimates for the frailty parameters. The default is c(0.5).
control	Arguments to control the fit. The default is bcfrailph.control.
...	further arguments

Value

An object of shrgamsp contains the following components.

- coefficients - A vector of estimated Covariate coefficients.
- frailparest - A vector of estimated Frailty parameters i.e. frailty variance and correlation.
- vcov- Variance Covariance matrix of the Estimated Covariate coefficients obtained from the observed information matrix.
- stderr-A vector containing the Standard error of the Estimated parameters both covariate coefficients and frailty parameter.
- loglik0- Log likelihood of without frailty model.
- loglik-Log likelihood of Cox PH model with frailty.
- Iloglilk- Log likelihood of with frailty model after integrating out the frailty term.
- bhaz- an array containing unique event times and estimated baseline hazard.
- X-Matrix of observed covariates.
- time-the observed survival time.
- censor-censoring indicator.
- resid-the martingale residuals.
- lin.prid-the vector of linear predictors.
- frail-estimated Frailty values.
- iteration-Number of outer iterations.
- e.time-the vector of unique event times.
- n.event- the number of events at each of the unique event times.
- convergence-an indicator of convergence . see nlminb.

Note

This is just a coxph model with gamma frailty and the differences between coxph with gamma frailty fit and shrgamsp fit is on the standard errors of the covariates cofficients. Here, the standard errors of the estimated covariate coefficients and the frailty variance parameter are obtained using the standard errors estimation approach given in Klein and Moeschberger (2003).

References

Duchateau, L., Janssen, P. (2008) The Frailty Model. Springer, New York.

Klein, J. P., and Moeschberger, M. L. (2003), Survival analysis: techniques for censored and truncated data, New York: Springer.

See Also

bcfrailph

Examples

```
set.seed(2)
n1=500;IID=array(1:n1)
X1<-runif(n1,  min=0, max=1)
z=rgamma(n1,shape=2,scale=0.5)
u1<-runif(n1,  min=0, max=1)
time<- 1/0.1*log(1-0.1*log(u1)/(0.0001*exp(3*X1)*z))
censor=rep(1,n1)
dataa <- data.frame(time=time, X1=X1,censor=censor,IID=IID)

fitcoxfr=shrgamsp(Surv(time,censor)~ X1+frailty(IID) ,data=dataa)
fitcoxfr
```

---

simbcfrailph *Simulate data from bivariate correlated frailty models.*

Description

Simulate data from bivariate correlated gamma or lognormal frailty models with or without covariates.

Usage

```
simbcfrailph(
  psize,
  cenr = c(0),
  beta = c(0.5),
  frailty,
  frailpar = c(0.5, 0.25),
  bhaz = c("weibull"),
```

```
  bhazpar = list(shape = c(0.5), scale = c(0.01)),
  covartype = c("B"),
  covarpar = list(fargs = c(1), sargs = c(0.5)),
  inpcovar = NULL,
  inpcen = NULL,
  comncovar = NULL
)
```

Arguments

psize	pair size.
cenr	censored rate. The default is zero..
beta	Covariate coefficient.
frailty	A type of frailty distribution to be used. Either gamma or lognormal.
frailpar	vector of frailty parameters, variance and correlation respectively. The default is c(0.5,0.25) meaning variance 0.5 and correlation 0.25.
bhaz	A type of baseline hazard distribution to be used. it can be weibull, gompertz or exponential.
bhazpar	is a list containing scale andshape of the specified baseline hazard distribution.
covartype	specified the distribution from which covariate(s) are goining to be sampled. covartype can be c("B","N","U")denoting binomial, normal or uniform, respectively. For example, covartype=c("B","B") to generate two covariates both from a binomial distribution.
covarpar	is a list containing parmeters of the specified covariate distribution with first and second arguments denoted by fargs and sargs, respectively. For example, if covartype=c("B","U") and covarpar=list(fargs=c(1,0.3),sargs=c(0.5,1.3)), generates two independent covariates from a binomial distribution (with parameters size=1 and probs=0.5) and from uniform distributions (with parameters min=0.3 and max=1.3).
inpcovar	is a list i.e,list(covar1=x1,covar2=x2) to input covariates with both x1 and x2 is in matrix form.
inpcen	is a list containing cent1 and cent2 denoting censoring time for the first and the second subjects in pairs respectively.
comncovar	if common covariates are needed.

Value

An object of class simbcfrailph that contain the following:

- data A data frame i.e, the simulated data set. IID is individual Id, PID is pair ID, time is the simulated survival time, censor is censoring indicator and X1 denote the simulated covariate.
- X Covariates in Matrix form.
- Y A matrix contains generated survival time and censoring.
- numberofpair The specified number of pairs.

- censoredrate The specified censored rate.
- fraildist The specified frailty distribution.
- frailpar The specified frailty parameters.

See Also

bcfrailph

Examples

```
set.seed(4)
simdata<-simbcfrailph(psize=300, cenr= c(0.3),beta=c(2),frailty=c("gamma"),
frailpar=c(0.5,0.5),bhaz=c("weibull"),
bhazpar=list(shape =c(5), scale = c(0.1)),
covartype= c("B"),covarpar=list(fargs=c(1),sargs=c(0.5)))
dataa<-simdata$data
head(dataa)


# If data generation is from bivariate correlated lognormal frailty model,
set.seed(18)
simdata<-simbcfrailph(psize=100, cenr= c(0.2),beta=c(1,-0.7,0.5),frailty=c("lognormal"),
frailpar=c(0.5,-0.25),bhaz=c("exponential"),
bhazpar=list(scale = c(0.1)),covartype= c("N","N","B"),
covarpar=list(fargs=c(0,0,1),sargs=c(1,1,0.5)))
dataa<-simdata$data
head(dataa)

# If common covariate is desired, i.e., here out of
#the three covariates covariate 2 is common for the pair.
set.seed(18)
simdata<-simbcfrailph(psize=100, cenr= c(0.2),beta=c(1,-0.7,0.5),frailty=c("lognormal"),
frailpar=c(0.5,-0.25),bhaz=c("exponential"),
bhazpar=list(scale = c(0.1)),covartype= c("N","N","B"),
covarpar=list(fargs=c(0,0,1),sargs=c(1,1,0.5)),comncovar=2)
dataa<-simdata$data
head(dataa)

# If the data generation is from bivariate correlated gamma
# frailty model, weibull baseline and without covariate,
set.seed(4)
simdata<-simbcfrailph(psize=300, cenr= c(0.3),beta=NULL,frailty=c("gamma"),
frailpar=c(0.5,0.5),bhaz=c("weibull"),bhazpar=list(shape =c(5), scale = c(0.1)))
dataa<-simdata$data
head(dataa)
```

simstdybcf *Simulation study for bivariate correlated frailty models.*

Description

Simulation study for bivariate correlated gamma and lognormal frailty models with and without covariates.

Usage

```
simstdybcf(
  Rep,
  mfit = NULL,
  psize,
  cenr = c(0),
  beta = c(0.5),
  frailty,
  frailpar = c(0.5, 0.25),
  bhaz = c("weibull"),
  bhazpar = list(shape = c(0.5), scale = c(0.01)),
  covartype = c("B"),
  covarpar = list(fargs = c(1), sargs = c(0.5)),
  inpcovar = NULL,
  inpcen = NULL,
  comncovar = NULL
)
```

Arguments

Rep	number of replications.
mfit	A type of frailty model to be fit in addition to bcfrailph. mfit can be c("cox","shrg") where cox is for univariate or bivariate shared lognormal and gamma model fit using coxph and shrg is for univariate or bivariate shared gamma model fit using shrgamsp.
psize	pair size.
cenr	censored rate. The default is zero..
beta	Covariate coefficient.
frailty	A type of frailty distribution to be used. Either gamma or lognormal.
frailpar	vector of frailty parameters, variance and correlation respectively. The default is c(0.5,0.25) meaning variance 0.5 and correlation 0.25.
bhaz	A type of baseline hazard distribution to be used. it can be weibull, gompertz or exponential.
bhazpar	is a list containing scale andshape of the specified baseline hazard distribution.

covartype	specified the distribution from which covariate(s) are goining to be sampled. covartype can be c("B","N","U")denoting binomial, normal or uniform, respectively. For example, covartype=c("B","B") to generate two covariates both from a binomial distribution.
covarpar	is a list containing parmeters of the specified covariate distribution with first and second arguments denoted by fargs and sargs, respectively. For example, if covartype=c("B","U") and covarpar=list(fargs=c(1,0.3),sargs=c(0.5,1.3)), generates two independent covariates from a binomial distribution (with parameters size=1 and probs=0.5) and from uniform distributions (with parameters min=0.3 and max=1.3).
inpcovar	is a list i.e,list(covar1=x1,covar2=x2) to input covariates with both x1 and x2 is in matrix form.
inpcen	is a list containing cent1 and cent2 denoting censoring time for the first and the second subjects in pairs respectively.
comncovar	if common covariates are needed.

Value

An object of class simstdybcf that contain the following:

- Result a summary result containing true parameter, mean of estimates, mean of the standard errors of the estimates, standard deviation of estimates, and 95% CI coverage probability.
- estimates a matrix containing estimates of parameters at each replications.
- estimateSE a matrix containing standard error of estimates at each replications.
- coverage a matrix containing an indicator whether the true parameter lies within a 95% CI at each replications or not.
- TMAT a matrix containing the generated artificial unique event times at each replications for gamma model.
- h0MAT a matrix containing the estimated baseline hazards at each replications for gamma model.
- h0SEMAT a matrix containing SE of the estimated baseline hazards at each replications for gamma model.

See Also

simbcfrailph

Examples

```
set.seed(2)
sim<-simstdybcf(Rep=5,psize=100, cenr= c(0.2),beta=c(1,-0.7,0.5),
frailty=c("lognormal"),frailpar=c(0.5,-0.25),bhaz=c("exponential"),
bhazpar=list(scale = c(0.1)),covartype= c("N","N","B"),
covarpar=list(fargs=c(0,0,1),sargs=c(1,1,0.5)),comncovar=2)
Res<-sim$Result
Res
```

```
# In addition to bcfrailph fit, if coxph with univariate lognormal frailty model is desired to run,

sim<-simstdybcf(Rep=5,mfit="cox",psize=100, cenr= c(0.2),beta=c(1,-0.7,0.5),
frailty=c("lognormal"),frailpar=c(0.5,-0.25),bhaz=c("exponential"),
bhazpar=list(scale = c(0.1)),covartype= c("N","N","B"),
covarpar=list(fargs=c(0,0,1),sargs=c(1,1,0.5)),comncovar=2)
Res<-sim$Result # bcfrailph fit result
Res
Resc<-sim$Resultc # coxph with univariate lognormal frailty model fit result
Resc
```

`summary.bcfrailph` *Print bcfrailph*

Description

Generics to print the S3 class bcfrailph.

Usage

```
## S3 method for class 'bcfrailph'
summary(object, ...)
```

Arguments

`object`	A class `bcfrailph` object.
`...`	ignored

Details

Calls `print.bcfrailph()`.

Value

An object of `summary.bcfrailph`, with some more human-readable results from `bcfrailph` object.

Note

The summary function is currently identical to the print function.

See Also

`bcfrailph`

Examples

```
set.seed(4)
simdata<-simbcfrailph(psize=300, cenr= c(0.3),beta=c(2),frailty=c("gamma"),
frailpar=c(0.5,0.5),bhaz=c("weibull"),
bhazpar=list(shape =c(5), scale = c(0.1)),
covartype= c("B"),covarpar=list(fargs=c(1),sargs=c(0.5)))
dataa<-simdata$data

fitbcfrailph=bcfrailph(Surv(time,censor)~ X1+frailty(PID) ,data=dataa,frail_distrn=c("gamma"))
fitbcfrailph
summary(fitbcfrailph)
```

`summary.shrgamsp` *Print shrgamsp*

Description

Generics to print the S3 class shrgamsp.

Usage

```
## S3 method for class 'shrgamsp'
summary(object, ...)
```

Arguments

`object`	A class `shrgamsp` object.
`...`	ignored

Details

Calls `print.shrgamsp()`.

Value

An object of `summary.shrgamsp`, with some more human-readable results from `shrgamsp` object.

Note

The summary function is currently identical to the print function.

See Also

`bcfrailph`

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