

# Package ‘extrafrail’

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**Type** Package

**Title** Estimation and Additional Tools for Alternative Shared Frailty Models

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**Description** Provide estimation and data generation tools for some new multivariate frailty models. This version includes the gamma, inverse Gaussian, weighted Lindley, Birnbaum-Saunders and truncated normal as the distribution for the frailty terms. For the basal model, it is considered a parametric approach based on the exponential, Weibull and the piecewise exponential distributions as well as a semiparametric approach. For details, see Gallardo and Bourguignon (2022) <[arXiv:2206.12973](https://arxiv.org/abs/2206.12973)>.

**Depends** R (>= 4.0.0), stats

**Imports** survival, pracma, expint, msm

**Suggests** frailtypack

**License** GPL (>= 2)

**NeedsCompilation** no

**Repository** CRAN

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## R topics documented:

baseCH . . . . .	2
frailty.fit . . . . .	3
rWL . . . . .	4
tools.extrafrail . . . . .	5

<b>Index</b>	<b>7</b>
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 baseCH

*Computes the baseline cumulative hazard function.*


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**Description**

Provides the baseline cumulative hazard function ( $\Lambda_0$ ) for an object with extrafrail class.

**Usage**

```
baseCH(t, fit)
```

**Arguments**

<code>t</code>	the vector of times for which the baseline cumulative hazard function should be computed.
<code>fit</code>	an object with extrafrail class.

**Details**

Provides the baseline cumulative hazard function. When the baseline distribution is assumed as the Weibull model, this function is  $\Lambda_0(t) = \lambda t^\rho$ . For the piecewise exponential model, this function is  $\Lambda_0(t) = \sum_{j=1}^L \lambda_j \nabla_j(t)$ , where  $\nabla_j(t) = 0$ , if  $t < a_{j-1}$ ,  $\nabla_j(t) = t - a_{j-1}$ , if  $a_{j-1} \leq t < a_j$  and  $\nabla_j(t) = a_j - a_{j-1}$ , if  $t \geq a_j$ , with  $a = (a_0 = 0, a_1, \dots, a_{j-1})$ , the corresponding partition time.

**Value**

a vector with the same length that `t`, including the baseline cumulative hazard function related to `t`.

**Author(s)**

Diego Gallardo and Marcelo Bourguignon.

**References**

Gallardo, D.I., Bourguignon, M. (2022) The multivariate weighted Lindley frailty model for cluster failure time data. Submitted.

**Examples**

```
#require(frailtypack)
require(survival)
data(readmission, package="frailtypack")
#Example for WL frailty model
fit.WL <- frailty.fit(survival::Surv(time, event) ~ dukes + survival::cluster(id),
  dist.frail="WL", data = readmission)
baseCH(c(500,1000,1500),fit.WL)
```

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frailty.fit	<i>Fitted different shared frailty models</i>
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### Description

frailty.fit computes the maximum likelihood estimates based on the EM algorithm for the shared gamma, inverse gaussian and weighted Lindley frailty models.

### Usage

```
frailty.fit(formula, data, dist.frail="gamma", dist = "np", prec = 1e-04,
            max.iter = 1000, part=NULL)
```

### Arguments

formula	A formula that contains on the left hand side an object of the type Surv and on the right hand side a +cluster(id) statement, possibly with the covariates definition.
data	A data.frame in which the formula argument can be evaluated
dist.frail	the distribution assumed for the frailty. Supported values: gamma (GA also is valid), IG (inverse gaussian), WL (weighted Lindley), BS (Birnbaum-Saunders) and TN (truncated normal).
dist	the distribution assumed for the basal model. Supported values: weibull, pe (piecewise exponential), exponential and np (non-parametric).
prec	The convergence tolerance for parameters.
max.iter	The maximum number of iterations.
part	partition time (only for piecewise exponential distribution).

### Details

For the weibull, exponential and piecewise exponential distributions as the basal model, the M1-step is performed using the optim function. For the non-parametric case, the M1-step is based on the coxph function from the survival package.

### Value

an object of class "extrafrail" is returned. The object returned for this functions is a list containing the following components:

coefficients	A named vector of coefficients
se	A named vector of the standard errors for the estimated coefficients.
t	The vector of times.
delta	The failure indicators.
id	A variable indicating the cluster which belongs each observation.
x	The regressor matrix based on cov.formula (without intercept term).

dist	The distribution assumed for the basal model.
dist.frail	The distribution assumed for the frailty variable.
tau	The Kendall's tau coefficient.
logLik	The log-likelihood function (only when the Weibull model is specified for the basal distribution).
Lambda0	The observed times and the associated cumulative hazard function (only when the non-parametric option is specified for the basal distribution)
part	the partition time (only for piecewise exponential model).

### Author(s)

Diego Gallardo and Marcelo Bourguignon.

### References

Gallardo, D.I., Bourguignon, M. (2022) The shared weighted Lindley frailty model for cluster failure time data. Submitted.

### Examples

```
require(survival)
#require(frailtypack)
data(readmission, package="frailtypack")
#Fit for WL frailty model
fit.WL <- frailty.fit(survival::Surv(time, event) ~ dukes + survival::cluster(id),
  dist.frail="WL", data = readmission)
summary(fit.WL)
#Fit for gamma frailty model
fit.GA <- frailty.fit(survival::Surv(time, event) ~ dukes + survival::cluster(id),
  dist.frail="gamma", data = readmission)
summary(fit.GA)
```

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rWL

*Generated random variables from the weighted Lindley distribution.*

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### Description

Generated random variables from the weighted Lindley distribution with mean 1.

### Usage

```
rWL(n, theta = 1)
```

**Arguments**

n	number of observations. If length(n) > 1, the length is taken to be the number required.
theta	variance of the variable.

**Details**

The weighted Lindley distribution has probability density function

$$f(z; \theta) = \frac{\theta}{2\Gamma(\theta)} a_{\theta}^{-b_{\theta}-1} z^{b_{\theta}-1} (1+z) \exp\left(-\frac{z}{a_{\theta}}\right), \quad z, \theta > 0,$$

where  $a_{\theta} = \frac{\theta(\theta+4)}{2(\theta+2)}$  and  $b_{\theta} = \frac{4}{\theta(\theta+4)}$ . Under this parametrization,  $E(Z)=1$  and  $\text{Var}(Z)=\theta$ .

**Value**

a vector of length n with the generated values.

**Author(s)**

Diego Gallardo and Marcelo Bourguignon.

**References**

Gallardo, D.I., Bourguignon, M. (2022) The multivariate weighted Lindley frailty model for cluster failure time data. Submitted.

**Examples**

```
rWL(10, theta=0.5)
```

---

```
tools.extrafrail      Print a summary for a object of the "extrafrail" class.
```

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**Description**

Summarizes the results for a object of the "extrafrail" class.

**Usage**

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

**Arguments**

object	an object of the "extrafrail" class.
...	for extra arguments.

**Details**

Supported frailty models are: - gamma frailty model - inverse gaussian frailty model - weighted frailty model

**Value**

A complete summary for the coefficients extracted from a "extrafrail" object.

**Author(s)**

Diego Gallardo and Marcelo Bourguignon.

**References**

Gallardo and Bourguignon (2022).

**Examples**

```
#require(frailtypack)
require(survival)
data(readmission, package="frailtypack")
fit <- frailty.fit(survival::Surv(time, event) ~ dukes + survival::cluster(id),
dist.frail="WL", data = readmission)
summary(fit)
```

# Index

`baseCH`, 2

`frailty.fit`, 3

`print.extrafrail (tools.extrafrail)`, 5

`rWL`, 4

`summary.extrafrail (tools.extrafrail)`, 5

`tools.extrafrail`, 5