

# Package ‘spatialSPsurv’

September 4, 2020

**Type** Package

**Title** Bayesian Spatial Split Population Survival Model

**Version** 0.1.7

## Description

Bayesian parametric spatial split-population survival models for clustered event processes. The models account for both structural and spatial heterogeneity among “at risk” and “immune” populations, and incorporates time-varying covariates.

This package currently implements Weibull, Exponential and Loglogistic forms for the duration component. It allows for the creation of spatial weights matrix objects from point patterns by distance and presents a series of diagnostic tests and plots for easy visual diagnostics of convergence and spatial effects.

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**Encoding** UTF-8

**LazyData** true

**Depends** R (>= 3.6.0)

**RoxygenNote** 7.1.0

**LinkingTo** Rcpp,  
RcppArmadillo

**Imports** MCMCpack,  
FastGP,  
stats,  
Rcpp,  
RcppArmadillo,  
coda,  
dplyr,  
reshape2

**Suggests** spduraton

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capdist

*Gleditsch and Ward Distance data***Description**

Dyadic dataset extracted from [Gleditsch and Ward \(2001\)](#). The dataset contains information on the distance between capital cities among independent nation-states.

**Usage**

```
data(capdist)
```

**Format**

A data frame with 41006 rows and 6 variables

**Details**

**numa** COW code – country A.

**ida** Three letter ISO code – country A.

**numb** COW code – country B.

**idb** Three letter ISO code – country B.

**kmdist** Distance between capital cities in the kilometers.

**midist** Minimal distance between capital cities in the kilometers.

**Source**

Gleditsch, Kristian S., and Michael D. Ward. (2001). "Measuring Space: A Minimum-Distance Database and Applications to International Studies." *Journal of Conflict Resolution* 38(6): 739-758.

exchangeSPsurv

*exchangeSPsurv***Description**

Markov Chain Monte Carlo (MCMC) to run Bayesian split population survival model with exchangeable frailties.

Returns a summary of a exchangeSPsurv object via [summary.mcmc](#).

Print method for a [exchangeSPsurv](#) x.

Returns a plot of a exchangeSPsurv object via [plot.mcmc](#).

**Usage**

```
exchangeSPsurv(
  duration,
  immune,
  Y0,
  LY,
  S,
  data,
  N,
  burn,
  thin,
  w = c(1, 1, 1),
  m = 10,
  form = c("Weibull", "exponential", "loglog"),
  prop.var
)

## S3 method for class 'frailtySPsurv'
summary(object, parameter = c("betas", "gammas", "lambda"), ...)

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

## S3 method for class 'frailtySPsurv'
plot(x, ...)
```

**Arguments**

duration	survival stage equation written in a formula of the form $Y \sim X1 + X2 + \dots$ where Y is duration until failure or censoring.
immune	split stage equation written in a formula of the form $C \sim Z1 + Z2 + \dots$ where C is a binary indicator of immunity.
Y0	the elapsed time since inception until the beginning of time period (t-1).
LY	last observation year (coded as 1; 0 otherwise) due to censoring or failure.
S	spatial information (e.g. district ID) for each observation that matches the spatial matrix row/column information.
data	data.frame.
N	number of MCMC iterations.
burn	burn-in to be discarded.
thin	thinning to prevent from autocorrelation.
w	size of the slice in the slice sampling for (betas, gammas, rho). Write it as a vector. E.g. c(1,1,1).
m	limit on steps in the slice sampling. A vector of values for beta, gamma, rho.
form	type of parametric model (Weibull, Exponential, or Log-Logistic).
prop.var	proposed variance for Metropolis-Hastings.
object	an object of class frailtySPsurv, the output of <a href="#">exchangeSPsurv</a> .
parameter	one of three parameters of the pooledSPsurv output. Indicate either "betas," "gammas," or "lambda."

... additional parameter.  
 x an object of class frailtySPsurv, the output of `exchangeSPsurv`.

### Value

chain of the variables of interest.  
 list. Empirical mean, standard deviation and quantiles for each variable.  
 list. Empirical mean, standard deviation and quantiles for each variable.

### Examples

```
walter <- spduration::add_duration(Walter_2015_JCR,"renewed_war",
                                  unitID = "id", tID = "year",
                                  freq = "year", ongoing = FALSE)

# add S
walter <- spatialSPsurv::spatial_SA(data = walter, var_ccode = "ccode", threshold = 800L)

set.seed(782566)

model <-
  exchangeSPsurv(
    duration = duration ~ fhcompor1 + lgdpl + comprehensive + victory +
    instabl + intensityln + ethfrac + unpko,
    immune   = cured ~ fhcompor1 + lgdpl + victory,
    Y0       = 't.0',
    LY       = 'lastyear',
    S        = 'sp_id' ,
    data     = walter[[1]],
    N        = 100,
    burn     = 10,
    thin     = 10,
    w        = c(1,1,1),
    m        = 10,
    form     = "loglog",
    prop.var = 1e-05
  )

print(model)

summary(model, parameter = "betas")

plot(model)
```

## Description

Markov Chain Monte Carlo (MCMC) to run Bayesian split population survival model with no frailties.

Returns a summary of a SPsurv object via `summary.mcmc`.

Print method for a `pooledSPsurv` x.

Returns a plot of a pooledSPsurv object via `plot.mcmc`.

## Usage

```
pooledSPsurv(
  duration,
  immune,
  Y0,
  LY,
  data,
  N,
  burn,
  thin,
  w = c(1, 1, 1),
  m = 10,
  form = c("Weibull", "exponential", "loglog")
)

## S3 method for class 'SPsurv'
summary(object, parameter = c("betas", "gammas", "lambda"), ...)

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

## S3 method for class 'SPsurv'
plot(x, ...)
```

## Arguments

duration	survival stage equation written in a formula of the form $Y \sim X1 + X2 + \dots$ where Y is duration until failure or censoring.
immune	split stage equation written in a formula of the form $C \sim Z1 + Z2 + \dots$ where C is a binary indicator of immunity.
Y0	the elapsed time since inception until the beginning of time period (t-1).
LY	last observation year (coded as 1; 0 otherwise) due to censoring or failure.
data	data.frame.
N	number of MCMC iterations.
burn	burn-in to be discarded.
thin	thinning to prevent from autocorrelation.
w	size of the slice in the slice sampling for (betas, gammas, rho). Write it as a vector. E.g. <code>c(1,1,1)</code> .
m	limit on steps in the slice sampling. A vector of values for beta, gamma, rho.
form	type of parametric model (Weibull, Exponential, or Log-Logistic).

object	an object of class SPsurv, the output of <code>pooledSPsurv</code> .
parameter	one of three parameters of the pooledSPsurv output. Indicate either "betas," "gammas," or "lambda."
...	additional parameter.
x	an object of class SPsurv, the output of <code>pooledSPsurv</code> .

### Value

chain of the variables of interest

list. Empirical mean, standard deviation and quantiles for each variable.

list. Empirical mean, standard deviation and quantiles for each variable.

### Examples

```
walter <- spduration::add_duration(Walter_2015_JCR, "renewed_war",
                                  unitID = "id", tID = "year",
                                  freq = "year", ongoing = FALSE)

set.seed(782566)

model <-
  pooledSPsurv(
    duration ~ fhcompor1 + lgdp1 + comprehensive + victory +
      instabl + intensityln + ethfrac + unpk0,
    immune   = cured ~ fhcompor1 + lgdp1 + victory,
    Y0       = 't.0',
    LY       = 'lastyear',
    data     = walter,
    N        = 100,
    burn     = 10,
    thin     = 10,
    w        = c(1,1,1),
    m        = 10,
    form     = "Weibull"
  )

print(model)

summary(model, parameter = "betas")

plot(model)
```

## Description

Markov Chain Monte Carlo (MCMC) to run time-varying Bayesian split population survival model with spatial frailties.

Returns a summary of a exchangeSPsurv object via `summary.mcmc`.

Print method for a `spatialSPsurv` x.

Returns a plot of a spatialSPsurv object via `plot.mcmc`.

## Usage

```
spatialSPsurv(
  duration,
  immune,
  Y0,
  LY,
  S,
  A,
  data,
  N,
  burn,
  thin,
  w = c(1, 1, 1),
  m = 10,
  form = c("Weibull", "exponential", "loglog"),
  prop.var
)

## S3 method for class 'spatialSPsurv'
summary(object, parameter = c("betas", "gammas", "lambda"), ...)

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

## S3 method for class 'spatialSPsurv'
plot(x, ...)
```

## Arguments

duration	survival stage equation written in a formula of the form $Y \sim X_1 + X_2 + \dots$ where Y is duration until failure or censoring.
immune	split stage equation written in a formula of the form $C \sim Z_1 + Z_2 + \dots$ where C is a binary indicator of immunity.
Y0	the elapsed time since inception until the beginning of time period (t-1).
LY	last observation year (coded as 1; 0 otherwise) due to censoring or failure.
S	spatial information (e.g. district ID) for each observation that matches the spatial matrix row/column information.
A	an a times a spatial weights matrix where a is the number of unique spatial units (S) load as a separate file.
data	dataframe.
N	number of MCMC iterations.

burn	burn-in to be discarded.
thin	thinning to prevent from autocorrelation.
w	size of the slice in the slice sampling for (betas, gammas, rho). Write it as a vector. E.g. c(1,1,1).
m	limit on steps in the slice sampling. A vector of values for beta, gamma, rho.
form	type of parametric model (Exponential, Weibull or Log-Logistic).
prop.var	proposal variance for Metropolis-Hastings.
object	an object of class spatialSPsurv, the output of <a href="#">spatialSPsurv</a> .
parameter	one of three parameters of the pooledSPsurv output. Indicate either "betas", "gammas" or "lambda".
...	additional parameter
x	an object of class spatialSPsurv, the output of <a href="#">spatialSPsurv</a> .

### Value

chain of the variables of interest

list. Empirical mean, standard deviation and quantiles for each variable.

list. Empirical mean, standard deviation and quantiles for each variable.

### Examples

```
walter <- spduration::add_duration(Walter_2015_JCR,"renewed_war",
                                  unitID = "id", tID = "year",
                                  freq = "year", ongoing = FALSE)

walter <- spatial_SA(data = walter, var_ccode = "ccode", threshold = 800L)

set.seed(782566)

model <-
  spatialSPsurv(
    duration = duration ~ fhcompor1 + lgdp1 + comprehensive + victory +
      instabl + intensityln + ethfrac + unpko,
    immune   = cured ~ fhcompor1 + lgdp1 + victory,
    Y0       = 't.0',
    LY       = 'lastyear',
    S        = 'sp_id',
    data     = walter[[1]],
    N        = 500,
    burn     = 10,
    thin     = 10,
    w        = c(1,1,1),
    m        = 10,
    form     = "Weibull",
    prop.var = 1e-05,
    A        = walter[[2]]
  )

print(model)
```



```
summary(model, parameter = "betas")

plot(model)
```

spatial_SA	<i>spatial_SA</i>
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**Description**

matrix A and sp\_id (S)

**Usage**

```
spatial_SA(data, var_ccode, threshold = 800L)
```

**Arguments**

- data                      data.frame.
- var\_ccode                name of the variable that contains the country codes.
- threshold                distance in kilometers.

**Value**

list. Contains database with variable sp\_id (S) and matrix A

SPstats	<i>SPstats</i>
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**Description**

A function to calculate the deviance information criterion (DIC) and Log-likelihood for fitted model outputs of pooled, exchangeable, and spatial Split Population survival models for which a log-likelihood can be obtained, according to the formula  $DIC = -2 * (L - P)$ , where  $L$  is the log likelihood of the data given the posterior means of the parameter and  $P$  is the estimate of the effective number of parameters in the model.

**Usage**

```
SPstats(object)
```

**Arguments**

- object                    An object of the output of pooled, exchangeable, or spatial Split Population survival model .

**Value**

List.

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Walter\_2015\_JCR

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*Walter\_2015\_JCR*


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## Description

Subsetted version of a time-series-cross-sectional (TSCS) dataset used in [Walter \(2015\)](#). It has data on duration of post-war peace as well as information on other relevant economic and political data. The variables `duration`, `cured`, `t.0` and `lastyear` added by the authors of this package using the function `add_duration`.

## Usage

```
data(Walter_2015_JCR)
```

## Format

A data frame with 1562 rows and 13 variables

## Details

**duration** duration until failure or censoring.

**immune** binary indicator of immunity.

**fhcompor1** Freedom House civil liberties index.

**lgdpl** log of per capita GDP in 2005 dollars.

**comprehensive** combatants signed comprehensive peace agreement.

**victory** end of previous war with outright victory.

**instabl** dummy that indicates whether there was a positive or negative change in the Polity 2 score in the previous country-year.

**intensityln** deaths per year – logged.

**ethfrac** index of ethnic fractionalization.

**unpko** number of UN peacekeepers on the ground.

**t.0** duration of peace spell.

**lastyear** year of last country observation in dataset.

**sp\_id** country unique id.

**A** time-invariant binary adjacency matrix

## Source

Walter, Barbara F. (2015), Why Bad Governance Leads to Repeat Civil War, *Journal of Conflict Resolution* 59(7), 1242 - 1272.

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