

Package ‘SSNbayes’

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Type Package

Title Bayesian Spatio-Temporal Analysis in Stream Networks

Version 0.0.1

Depends R (>= 3.5.0)

Imports plyr, dplyr, rstan, SSN

Description Fits Bayesian spatio-temporal models and makes predictions on stream networks using the approach by Santos-Fernandez, Edgar, et al. (2021). “Bayesian spatio-temporal models for stream networks” <[arXiv:2103.03538](https://arxiv.org/abs/2103.03538)>. In these models, spatial dependence is captured using stream distance and flow connectivity, while temporal autocorrelation is modelled using vector autoregression methods.

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Encoding UTF-8

RoxygenNote 7.1.1

Suggests rmarkdown, knitr

VignetteBuilder knitr

URL <https://github.com/EdgarSantos-Fernandez/SSNbayes>

BugReports <https://github.com/EdgarSantos-Fernandez/SSNbayes/issues>

NeedsCompilation no

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R topics documented:

collapse	2
dist_wei_mat	2
dist_wei_mat_preds	3
krig	4

mylm	5
predict.ssnbayes	5
pred_ssnbayes	7
ssnbayes	8

Index	11
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collapse	<i>Collapses a SSN object into a data frame</i>
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Description

Collapses a SSN object into a data frame

Usage

```
collapse(t, par = "afvArea")
```

Arguments

t	Path to a SSN object
par	A spatial parameter

Value

A data frame

Examples

```
require("SSN")
path <- system.file("extdata/clearwater.ssn", package = "SSNbayes")
n <- importSSN(path, predpts = "preds", o.write = TRUE)
t.df <- collapse(n)
```

dist_wei_mat	<i>Creates a list of distances and weights</i>
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Description

Creates a list of distances and weights

Usage

```
dist_wei_mat(path = path, net = 1, addfunccol = "addfunccol")
```

Arguments

path Path to the files
net (optional) A network from the SSN object
addfunccol (optional) A parameter to compute the spatial weights

Value

A list of matrices

Examples

```
path <- system.file("extdata/clearwater.ssn", package = "SSNbayes")
mat_all <- dist_wei_mat(path, net = 2, addfunccol='afvArea')
```

dist_wei_mat_preds *Creates a list of distances and weights between observed and prediction sites*

Description

The output matrices are symmetric except the hydrologic distance matrix D.

Usage

```
dist_wei_mat_preds(path = path, net = 1, addfunccol = "addfunccol")
```

Arguments

path Path with the name of the SSN object
net (optional) A network from the SSN object
addfunccol (optional) A parameter to compute the spatial weights

Value

A list of matrices

Examples

```
path <- system.file("extdata/clearwater.ssn", package = "SSNbayes")
mat_all_pred <- dist_wei_mat_preds(path, net = 2, addfunccol='afvArea')
```

krig	<i>Internal function used to perform spatial prediction in R using a stanfit object from ssnbayes()</i>
------	---

Description

Use `predict.ssnbayes()` instead. It will take an observed and a prediction data frame. It requires the same number of observation/locations per day. It requires location id (`locID`) and points id (`pid`). The `locID` are unique for each site. The `pid` is unique for each observation. Missing values are allowed in the response but not in the covariates.

Usage

```
krig(
  object = object,
  mat_all_preds = mat_all_preds,
  nsamples = 10,
  start = 1,
  chunk_size = 50,
  obs_data = obs_data,
  pred_data = pred_data,
  net = net,
  seed = seed
)
```

Arguments

<code>object</code>	A stanfit object returned from <code>ssnbayes</code>
<code>mat_all_preds</code>	A list with the distance/weights matrices
<code>nsamples</code>	The number of samples to draw from the posterior distributions. (<code>nsamples <= iter</code>)
<code>start</code>	(optional) The starting location id
<code>chunk_size</code>	(optional) the number of <code>locID</code> to make prediction from
<code>obs_data</code>	The observed data frame
<code>pred_data</code>	The predicted data frame
<code>net</code>	(optional) Network from the SSN object
<code>seed</code>	(optional) A seed for reproducibility

Value

A data frame

Author(s)

Edgar Santos-Fernandez

mylm	<i>A simple modeling function using a formula and data</i>
------	--

Description

A simple modeling function using a formula and data

Usage

```
mylm(formula, data)
```

Arguments

formula	A formula as in <code>lm()</code>
data	A <code>data.frame</code> containing the elements specified in the formula

Value

A list of matrices

Author(s)

Jay ver Hoef

Examples

```
options(na.action='na.pass')
data("iris")
out_list = mylm(formula = Petal.Length ~ Sepal.Length + Sepal.Width, data = iris)
```

predict.ssnbayes	<i>Performs spatial prediction in R using an ssnbayes object from a fitted model.</i>
------------------	---

Description

It will take an observed and a prediction data frame. It requires the same number of observation/locations per day. It requires location id (locID) and points id (pid). The locID are unique for each site. The pid is unique for each observation. Missing values are allowed in the response but not in the covariates.

Usage

```
## S3 method for class 'ssnbayes'
predict(
  object = object,
  ...,
  path = path,
  obs_data = obs_data,
  pred_data = pred_data,
  net = net,
  nsamples = nsamples,
  addfunccol = addfunccol,
  locID_pred = locID_pred,
  chunk_size = chunk_size,
  seed = seed
)
```

Arguments

object	A stanfit object returned from ssnbayes
...	Other parameters
path	Path with the name of the SSN object
obs_data	The observed data frame
pred_data	The predicted data frame
net	(optional) Network from the SSN object
nsamples	The number of samples to draw from the posterior distributions. (nsamples <= iter)
addfunccol	The variable used for spatial weights
locID_pred	(optional) the location id for the predictions. Used when the number of pred locations is large.
chunk_size	(optional) the number of locID to make prediction from
seed	(optional) A seed for reproducibility

Value

A data frame

Author(s)

Edgar Santos-Fernandez

Examples

```
#require('SSNdata')
#clear_preds <- readRDS(system.file("extdata/clear_preds.RDS", package = "SSNdata"))
#clear_preds$y <- NA
```

```
#pred <- predict(object = fit_ar,
#               path = path,
#               obs_data = clear,
#               pred_data = clear_preds,
#               net = 2,
#               nsamples = 100, # numb of samples from the posterior
#               addfunccol = 'afvArea', # var for spatial weights
#               locID_pred = locID_pred,
#               chunk_size = 60)
```

pred_ssnbayes	<i>Internal function used to perform spatial prediction in R using a stanfit object from ssnbayes()</i>
---------------	---

Description

Use predict.ssnbayes() instead. It will take an observed and a prediction data frame. It requires the same number of observation/locations per day. It requires location id (locID) and points id (pid). The locID are unique for each site. The pid is unique for each observation. Missing values are allowed in the response but not in the covariates.

Usage

```
pred_ssnbayes(
  object = object,
  path = path,
  obs_data = obs_data,
  pred_data = pred_data,
  net = 1,
  nsamples = 100,
  addfunccol = "afvArea",
  locID_pred = locID_pred,
  chunk_size = chunk_size,
  seed = seed
)
```

Arguments

object	A stanfit object returned from ssnbayes
path	Path with the name of the SSN object
obs_data	The observed data frame
pred_data	The predicted data frame
net	(optional) Network from the SSN object
nsamples	The number of samples to draw from the posterior distributions. (nsamples <= iter)

addfunccol	The variable used for spatial weights
locID_pred	(optional) the location id for the predictions. Used when the number of pred locations is large.
chunk_size	(optional) the number of locID to make prediction from
seed	(optional) A seed for reproducibility

Value

A data frame

Author(s)

Edgar Santos-Fernandez

Examples

```
#pred <- pred_ssnbayes(path = path,
#obs_data = clear,
#stanfit = fit_ar,
#pred_data = preds,
#net = 2,
#nsamples = 100, # number of samples to use from the posterior in the stanfit object
#addfunccol = 'afvArea') # variable used for spatial weights
```

ssnbayes

Fits a mixed regression model using Stan

Description

It requires the same number of observation/locations per day. It requires location id (locID) and points id (pid). The locID are unique for each site. The pid is unique for each observation. Missing values are allowed in the response but not in the covariates.

Usage

```
ssnbayes(
  formula = formula,
  data = data,
  path = path,
  time_method = time_method,
  space_method = space_method,
  iter = 3000,
  warmup = 1500,
  chains = 3,
  refresh = max(iter/100, 1),
  net = 1,
  addfunccol = addfunccol,
```

```

    loglik = FALSE,
    seed = seed
  )

```

Arguments

formula	A formula as in <code>lm()</code>
data	A long data frame containing the locations, dates, covariates and the response variable. It has to have the <code>locID</code> and <code>date</code> . No missing values are allowed in the covariates.
path	Path with the name of the SSN object
time_method	A list specifying the temporal structure (<code>ar</code> = Autorregressive; <code>var</code> = Vector autorregression) and column in the data with the time variable.
space_method	A list defining if use or not of an SSN object and the spatial correlation structure. The second element is the spatial covariance structure. A 3rd element is a list with the <code>lon</code> and <code>lat</code> for Euclidean distance models.
iter	Number of iterations
warmup	Warm up samples
chains	Number of chains
refresh	Sampler refreshing rate
net	The network id (optional). Used when the SSN object contains multiple networks.
addfunccol	Variable to compute the additive function. Used to compute the spatial weights.
loglik	Logic parameter denoting if the <code>loglik</code> will be computed by the model.
seed	(optional) A seed for reproducibility

Details

Missing values are not allowed in the covariates and they must be imputed before using `ssnbayes()`. Many options can be found in <https://cran.r-project.org/web/views/MissingData.html>

Value

A list with the model fit

Author(s)

Edgar Santos-Fernandez

Examples

```

## Not run:
#options(mc.cores = parallel::detectCores())
# Import SpatialStreamNetwork object
#path <- system.file("extdata/clearwater.ssn", package = "SSNbayes")
#n <- importSSN(path, predpts = "preds", o.write = TRUE)
## Imports a data.frame containing observations and covariates

```

```
#clear <- readRDS(system.file("extdata/clear_obs.RDS", package = "SSnbayes"))
#fit_ar <- ssnbayes(formula = y ~ SLOPE + elev + cumdrainag + air_temp + sin + cos,
#                  data = clear,
#                  path = path,
#                  time_method = list("ar", "date"),
#                  space_method = list('use_ssn', c("Exponential.taildown")),
#                  iter = 2000,
#                  warmup = 1000,
#                  chains = 3,
#                  net = 2, # second network on the ssn object
#                  addfunccol='afvArea')
#space_method options examples
#use list('no_ssn', 'Exponential.Euclid', c('lon', 'lat')) if no ssn object is available
## End(Not run)
```

Index

`collapse`, 2

`dist_wei_mat`, 2

`dist_wei_mat_preds`, 3

`krig`, 4

`mylm`, 5

`pred_ssnbayes`, 7

`predict.ssnbayes`, 5

`ssnbayes`, 8