

Package ‘ruf’

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Title Estimates of the Resource Utilization Function

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Description The library contains R-functions to determine maximum likelihood fits of the Resource Utilization Function based on a Matern covariance function.

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Depends

URL <http://www.csde.washington.edu/~handcock/ruf>

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d412

Data for a test Jay in 'ruf'

Description

Data set in standard data.frame form for a Jay to test maximum likelihood fits of the Resource Utilization Function using on a Matern covariance function.

Arguments

`data.frame` a data.frame containing columns for the spatial coordinates, covariates, and RUF values as described. The variables can have any names and are specified in the formula and 'space' formula in the 'ruffit' call.

`coordinates`: Two variables where each row has the 2-D coordinates of the n RU locations.

`RUF`: a vector of the RU values at the n locations given by the `coordinates`.

`covariates`: a set of p vectors of covariates to be fit

Note

See the 'ruf' library for details.

References

"Resource utilization by an avian nest predator: relating resources to a probabilistic measure of animal space use," by John M. Marzluff, J. J. Millsaugh, P. Hurvitz, and Mark S. Handcock. *Ecology*, 2004, 85:1411-1427.

Examples

```
#
# attach the "ruf" library
#
library(ruf)
#
# attach the small test data within the library
#
data(d412)
```

Description

This is an older version of the `ruf.fit` function retained for legacy purposes. It is a function to calculate maximum likelihood fits of the Resource Utilization Function using on a Matern covariance function.

Usage

```
maternmle(
  geodata,
  theta=NULL,
  cov=1:ncol(geodata$covariate),
  standardized=FALSE,
  sample=500,
  trace=0,
  reltol=1e-05, factr=1e-05,
  results = "maternresults.out",
  birdname=NULL,
  fixrange=FALSE)
```

Arguments

<code>geodata</code>	a list containing elements ‘coords’, ‘covariates’, and ‘data’. The componets are: coords: an $n \times 2$ matrix where each row has the 2-D coordinates of the n RU locations. data: a vector of the RU values at the n locations given by ‘coords’. covariates: an $n \times p$ matrix of covariates to be fit
<code>theta</code>	2-vector of Matern correlation parameters: spatial range and smoothness.
<code>cov</code>	indices of the columns of ‘covariates’ to include in the model.
<code>standardized</code>	logical: Compute standardized coefficients?
<code>sample</code>	If numerical, the number of values of the data to subsample. Default is no subsampling, i.e., use the full data.
<code>trace</code>	level of diagnostics to print during the search.
<code>reltol</code>	Relative convergence tolerance. The algorithm stops if it is unable to reduce the value by a factor of $\text{reltol} * (\text{abs}(\text{val}) + \text{reltol})$ at a step. Defaults to $\sqrt{.Machine\$double.eps}$, typically about ‘1e-8’.
<code>factr</code>	controls the convergence of the “L-BFGS-B” method. Convergence occurs when the reduction in the objective is within this factor of the machine tolerance. Default is ‘1e7’, that is a tolerance of about ‘1e-8’.
<code>results</code>	name of the file to store the formatted results.
<code>birdname</code>	Name of the bird to report in the formatted results.
<code>fixrange</code>	logical: if TRUE the range of the model is fixed at the starting value rather than estimated.

Value

par	MLE of the spatial range and smoothness
value	Value of the log-likelihood at the MLE.
counts	number of log-likelihood and gradient evaluations taken.
convergence	0: converged. See 'optim' for details.
message	Message associated with the type of convergence.
hessian	Hessian matrix of the ML estimates.
pplik	MLE of the spatial range and smoothness
beta	MLE of the regression coefficients
value	Value of the log-likelihood at the MLE.
asycor	asymptotic correlation matrix of the MLE.
asyse	asymptotic standard errors of the MLE.

Note

The code uses the 'optim' function to maximize the log-likelihood.

References

"Resource utilization by an avian nest predator: relating resources to a probabilistic measure of animal space use," by John M. Marzluff, J. J. Millspaugh, P. Hurvitz, and Mark S. Handcock. *Ecology*, 2004, 85:1411-1427.

See Also

ruf.fit

Examples

```
#
# attach the "ruf" library
#
library(ruf)
#
# attach the small test data within the library
#
data(s412)
#
# Set initial estimates at the spatial range and smoothness
#
hval <- c(0.2, 1.5)
#
# Estimate the maximum likelihood values
# with unstandardized coefficients
#
s412.fit <- maternmle(s412,theta=hval,
                    cov=-c(1,2), birdname="412",
```

```

        standardized=FALSE,
        results = "s412.out")
#
# Show the details of the results
# The formatted output has been sent to the file "s412.out"
#
s412.fit
#
# Estimate the maximum likelihood values
# with standardized coefficients
#
s412.fit <- maternmle(s412,theta=hval,
                    cov=-c(1,2), birdname="412",
                    standardized=TRUE,
                    results = "s412.out")
s412.fit

```

rnf.fit

Estimates of the Resource Utilization Function

Description

Function to calculate maximum likelihood fits of the Resource Utilization Function using on a Matern covariance function.

Usage

```

rnf.fit(
  formula,
  space,
  data,
  subset,
  na.action,
  theta=NULL,
  standardized=FALSE,
  algorithm.control=list(),
  name="",
  fixrange=FALSE, fixsmoothness=TRUE, ...)

```

Arguments

formula	An R formula object, of the form $RU \sim \langle \text{covariate terms} \rangle$, where RU is the name of the RU values. The $\langle \text{model terms} \rangle$ are a list of variables that are covariates. All variables must be in the data.frame specified by the data argument.
space	An R formula object, of the form $\sim x + y$, where x and y are the names of the variables containing the two coordinates of the RU variable.

<code>data</code>	a <code>data.frame</code> containing columns for the spatial coordinates, covariates, and RUF values as described. The variables can have any names and are specified in the formula and 'space' formula in the <code>ruf.fit</code> call. coordinates: Two variables where each row has the 2-D coordinates of the <code>n</code> RU locations. RUF: a vector of the RU values at the <code>n</code> locations given by the coordinates. covariates: a set of <code>p</code> vectors of covariates to be fit
<code>subset</code>	an optional vector specifying a subset of observations to be used in the fitting process.
<code>na.action</code>	a function which indicates what should happen when the data contain NAs. The default is set by the <code>na.action</code> setting of <code>options</code> , and is <code>na.fail</code> if that is unset. The "factory-fresh" default is <code>na.omit</code> .
<code>theta</code>	2-vector of Matern correlation parameters: spatial range and smoothness.
<code>standardized</code>	logical: Compute standardized coefficients?
<code>algorithm.control</code>	An optional list of control parameters. See the Algorithm Tuning section below for the options.
<code>name</code>	Name of the bird to report in the formatted results.
<code>fixrange</code>	logical: if TRUE the range of the model is fixed at the starting value rather than estimated.
<code>fixsmoothness</code>	logical: if TRUE the smoothness of the model is fixed at the starting value rather than estimated.
<code>...</code>	further arguments passed to or from other methods.

Value

<code>par</code>	MLE of the spatial range and smoothness
<code>value</code>	Value of the log-likelihood at the MLE.
<code>counts</code>	number of log-likelihood and gradient evaluations taken.
<code>convergence</code>	0: converged. See 'optim' for details.
<code>message</code>	Message associated with the type of convergence.
<code>hessian</code>	Hessian matrix of the ML estimates.
<code>pplik</code>	MLE of the spatial range and smoothness
<code>beta</code>	MLE of the regression coefficients
<code>value</code>	Value of the log-likelihood at the MLE.
<code>asycor</code>	asymptotic correlation matrix of the MLE.
<code>asyse</code>	asymptotic standard errors of the MLE.

Algorithm Tuning

There are a large number of parameters that can be modified to change the computational aspects. These are specified via the `algorithm.control` argument. The `algorithm.control` argument is a list that can supply any of the following components:

`maxit` count; The maximum number of iterations in the Newton-Raphson optimization. Defaults to 15. `maxit` gives the total number of likelihood function evaluations.

sample The number of values of the data to subsample for the re-sampled MLE method for large data sets. Default is no sub-sampling, i.e., use the full data unless the data set has over 2000 points in it.

nresamples The number of re-samples of the full dataset to take. This is for use with the re-sampled MLE method for large data sets. Default is no sub-sampling, i.e., use the full data unless the data set has over 2000 points in it.

reitol Relative convergence tolerance. The algorithm stops if it is unable to reduce the value by a factor of $\text{reitol} * (\text{abs}(\text{val}) + \text{reitol})$ at a step. Defaults to $\sqrt{\text{Machine}\$double.eps}$, typically about $1e-8$.

factr controls the convergence of the "L-BFGS-B" method. Convergence occurs when the reduction in the objective is within this factor of the machine tolerance. Default is $1e7$, that is a tolerance of about $1e-8$.

`trace` non-negative integer; If positive, tracing information on the progress of the optimization is produced. Higher values may produce more tracing information: for method "L-BFGS-B" there are six levels of tracing. (To understand exactly what these do see the source code for `optim`: higher levels give more detail.)

`method` character; The name of the optimization method to use for the maximum likelihood estimation. See `optim` for the options. The default method for the maximization of the smoothness and range is "BFGS", a quasi-Newton method (also known as a variable metric algorithm). It is attributed to Broyden, Fletcher, Goldfarb and Shanno. This uses function values and gradients to build up a picture of the surface to be optimized. The default method for one-dimensional searches is that of Nelder and Mead `Nelder-Mead`.

Note

The code uses the `optim` function to maximize the log-likelihood. If the `fixrange` or `fixsmoothness` options are used the one-dimensional `optimize` is used instead.

References

"Resource utilization by an avian nest predator: relating resources to a probabilistic measure of animal space use," by John M. Marzluff, J. J. Millsbaugh, P. Hurvitz, and Mark S. Handcock. *Ecology*, 2004, 85:1411-1427.

Examples

```
#
# attach the "rnf" library
#
library(rnf)
#
```

```

# attach the small test data within the library
#
data(d412)
#
# Set initial estimates at the spatial range and smoothness
#
hval <- c(0.2, 1.5)
#
# Estimate the maximum likelihood values
# with unstandardized coefficients
#
d412.fit <- ruf.fit(ruf ~ CWED + IJI + NP + MSI,
                  space= ~ x + y,
                  data=d412, theta=hval,
                  name="Bird 412",
                  standardized=FALSE)
#
# Show the details of the results
#
summary(d412.fit)
#
# Estimate the maximum likelihood values
# with standardized coefficients
#
d412.fit <- ruf.fit(ruf ~ CWED + IJI + NP + MSI,
                  space= ~ x + y,
                  data=d412, theta=hval,
                  name="Bird 412 standardized",
                  standardized=TRUE)
summary(d412.fit)

```

s412

Data for a test Jay in 'ruf'

Description

Data set in 'geodata' form for a Jay to test maximum likelihood fits of the Resource Utilization Function using on a Matern covariance function.

Arguments

geodata	a list containing elements 'coords', 'covariates', and 'data' as described coords: an n x 2 matrix where each row has the 2-D coordinates of the n RU locations. data: a vector of the RU values at the n locations given by 'coords'. covariates: an n x p matrix of covariates to be fit
---------	--

Note

See the 'ruf' library for details.

References

“Resource utilization by an avian nest predator: relating resources to a probabilistic measure of animal space use,” by John M. Marzluff, J. J. Millspaugh, P. Hurvitz, and Mark S. Handcock. *Ecology*, 2004, 85:1411-1427.

Examples

```
#
# attach the "ruf" library
#
library(ruf)
#
# attach the small test data within the library
#
data(s412)
```

summary.ruf

Summarizing RUF Model Fits

Description

These functions are all [methods](#) for class `ruf` or `summary.ruf` objects.

Usage

```
## S3 method for class 'ruf'
summary(object, results = "", ...)
```

Arguments

<code>object</code>	an object of class "ruf", usually, a result of a call to ruf.fit .
<code>results</code>	name of the file to store the formatted results. The default is to the console.
<code>...</code>	further arguments passed to or from other methods.

Details

`summary.ruf` tries to be smart about formatting the coefficients, standard errors, etc. and additionally gives “significance stars” if `signif.stars` is TRUE.

Value

`summary.ruf` returns an nothing.

References

“Resource utilization by an avian nest predator: relating resources to a probabilistic measure of animal space use,” by John M. Marzluff, J. J. Millspaugh, P. Hurvitz, and Mark S. Handcock. *Ecology*, 2004, 85:1411-1427.

See Also

[ruf.fit](#), [summary](#).

Examples

```
## --- Continuing the Example from '?ruf.fit':%\code{\link{ruf.fit}}:
## Not run:
summary(d412.fit)
## End(Not run)
```

vmatcov

Matern Correlation for the Resource Utilization Function

Description

Function to calculate Matern correlation matrix for Resource Utilization Function using on a Matern covariance function.

Usage

```
vmatcov(
  geodata,
  theta)
```

Arguments

geodata	a list containing elements 'coords', 'covariates', and 'data' as described coords: an n x 2 matrix where each row has the 2-D coordinates of the n RU locations. data: a vector of the RU values at the n locations given by 'coords'. covariates: an n x p matrix of covariates to be fit
theta	2-vector of Matern correlation parameters: spatial range and smoothness.

Value

value	n x n Matern correlation matrix for theta
-------	---

Note

The code uses the FORTRAN code for speed.

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