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.

Depends

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URL https://github.com/handcock/ruf

RoxygenNote 7.1.1

R topics documented:

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d412   *Data for a test Jay*

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.

data.frame: a data.frame containing colums 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 coordinatess. covariates: a set of p vectors of covariates to be fit

Format

An data.frame object

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 small test data within the library
#
data(d412)
```

---

maternmle   *Older Style Interface to the Resource Utilization Function*

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

geodata	a list containing elements 'coords', 'covariates', and 'data'. The componets are:
	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.
cov	indices of the columns of 'covariates' to include in the model.
standardized	logical: Compute standardized coeffients?
sample	If numerical, the number of values of the data to subsample. Default is no subsampling, i.e., use the full data.
trace	level of diagnostics to print during the search.
reltol	Relative convergence tolerance. The algorithm stops if it is unable to reduce the value by a factor of 'reltol * (abs(val) + reltol)' at a step. Defaults to 'sqrt(.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'.
results	name of the file to store the formatted results.
birdname	Name of the bird to report in the formatted results.
fixrange	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 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
```

---

ruf   *Software to Implement Resource Utilization Function Estimation*

Description

This package provides functionality to determine maximum likelihood fits of the Resource Utilization Function based on a Matern covariance function.

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ruf.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

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

Arguments

formula	An formula object, of the form RU ~ <covariate terms>, where RU is the name of the RU values. The <model terms> are a list of variables that are covariates. All variables must be in the data.frame specified by the data argument.
space	An formula object, of the form ~ x + y, where x and y are the names of the variables containing the two coordinates of the RU variable.
data	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 ruf.fit 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
subset	an optional vector specifying a subset of observations to be used in the fitting process.
na.action	a function which indicates what should happen when the data contain NAs. The default is set by the na.action setting of [options](), and is [na.fail]() if that is unset. The "factory-fresh" default is [na.omit]().
theta	2-vector of Matern correlation parameters: spatial range and smoothness.
standardized	logical: Compute standardized coefficients?
algorithm.control	
	An optional list of control parameters. See the **Algorithm Tuning** section below for the options.
name	Name of the bird to report in the formatted results.
fixrange	logical: if TRUE the range of the model is fixed at the starting value rather than estimated.
fixsmoothness	logical: if TRUE the smoothness of the model is fixed at the starting value rather than estimated.
...	further arguments passed to or from other methods.

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.

Algorithm Tuning

There are a large number of parameters that can modified 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:

list("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.

reltol Relative convergence tolerance. The algorithm stops if it is unable to reduce the value by a factor of 'reltol * (abs(val) + reltol)' at a step. Defaults to 'sqrt(.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'.

list("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.)

list("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 maximixation 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 searchs 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. Millspaugh, P. Hurvitz, and Mark S. Handcock. *Ecology*, 2004, 85:1411-1427.

Examples

```
#
# 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.

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 RUF 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

Format

An data.frame object

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 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

object	an object of class `"ruf"`, usually, a result of a call to [ruf.fit](ruf.fit).
results	name of the file to store the formatted results. The defualt is to the console.
...	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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