Package: mpmm (via r-universe)

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Type Package

Title (Animal) Movement Persistence Mixed-Effects Models

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Description Fit covariates as linear mixed-effects to latent, time-varying movement persistence (autocorrelation).

Depends R (>= 3.5.0)

Imports TMB (>= 1.7.19), lme4 (>= 1.1-15), glmmTMB (>= 1.0.0), Matrix (>= 1.2-12), dplyr (>= 1.0.0), tibble (>= 3.0.0), ggplot2, methods, wesanderson, tidyr

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Encoding UTF-8

LazyData true

LinkingTo RcppEigen, TMB

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Suggests testthat (>= 3.0.0)

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Repository https://ianjonsen.r-universe.dev

RemoteUrl https://github.com/ianjonsen/mpmm

RemoteRef HEAD

RemoteSha 904ce03a8dadb0ca98f491ea7e8685b8f8f20dc7

Contents

`mpmm-package` **mpmm**

Description

fit movement persistence mixed-effects models to animal location data

Author(s)

Ian Jonsen

References

Jonsen ID, McMahon CR, Patterson TA, et al. (2019) Movement responses to environment: fast inference of variation among southern elephant seals with a mixed effects model. Ecology. 100(1):e02566 https://doi.org/10.1002/ecy.2566

See Also

mpmm

`anova.mpmm` *anova tables*

Description

perform likelihood ratio tests on 2 or more mpmm fit objects

Usage

```
## S3 method for class 'mpmm'
anova(object, ...)
```

Arguments

`object`	an mpmm fit object
`...`	additional mpmm fit objects

ellie.ice — *foieGras-filtered Southern elephant seal Argos satellite data with environmental covariates (11 individuals)*

Description

Example elephant seal Argos tracking data with environmental covariates. Data were sourced from the Integrated Marine Observing System (IMOS) - IMOS is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative.

Format

.RData

ellie.ice.short — *foieGras-filtered Southern elephant seal Argos satellite data with environmental covariates (4 individuals)*

Description

Example elephant seal Argos tracking data with environmental covariates. Data were sourced from the Integrated Marine Observing System (IMOS) - IMOS is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative.

Format

.RData

inner_control — *Control Values for* mpmm

Description

`inner_control` allows specification of control parameters for the inner optimization used by `mpmm`

Usage

```
inner_control(...)
```

Arguments

`...`	control parameters for the inner optimizer

Details

See MakeADFun and newton for details and available options. Adapted from S. Wotherspoon https://github.com/SWotherspoon/RWalc/blob/master/R/RWalc.R

Value

Returns a list with components:

control	list of control parameters for inner optimizer

See Also

MakeADFun, newton

Examples

```
fit <- mpmm(~ ice + (ice | id),
data = ellie.ice.short,
inner.control = inner_control(tol = 1e-03))
```

---

logLik.mpmm *Extract log-likelihood*

Description

extract log-likelihood from an mpmm fit object

Usage

```
## S3 method for class 'mpmm'
logLik(object, ...)
```

Arguments

object	an mpmm model fit object
...	additional arguments to be ignored

mpmm *Move Persistence Mixed-Effects Model*

Description

Fit a move persistence random walk via TMB to a pre-filtered/regularized animal track and estimate gamma as a linear function of covariates

Usage

```
mpmm(
  formula = NA,
  data = NULL,
  map = NULL,
  control = mpmm_control(),
  inner.control = inner_control()
)
```

Arguments

formula	a right-hand-side regression formula (no response variable)
data	a data frame of observations (see details)
map	a named list of parameters as factors that are to be fixed during estimation, e.g., list(rho = factor(NA))
control	a list of control parameters for the outer optimization (see mpmm_control)
inner.control	a list of control parameters for the inner optimization (see MakeADFun and newton)

Details

The input track is given as a dataframe where each row is an observed location and columns

'id' individual animal identifier,

'date' observation time (POSIXct,GMT),

'lon' observed longitude,

'lat' observed latitude,

'tid' identifier for tracks if there are more than one track per individual (optional),

'...' named covariates appended to track

Value

a list with components

states	a dataframe of estimated states
fitted	a dataframe of fitted locations
par	model parameter summmary

data	input dataframe
tmb	the tmb object
opt	the object returned by the optimizer

Examples

```
data(ellie.ice.short)
fit <- mpmm(~ ice + (1 | id), data = ellie.ice.short)
summary(fit)
```

---

mpmm_control *Control Values for* mpmm.

Description

mpmm_control selects the numerical minimizer, method, associated control parameters, parameter bounds, and likelihood estimation (REML or ML) used by mpmm.

Usage

```
mpmm_control(
  optim = c("nlminb", "optim"),
  method = c("BFGS", "L-BFGS-B"),
  lower = NULL,
  upper = NULL,
  REML = FALSE,
  profile = FALSE,
  verbose = 2,
  ...
)
```

Arguments

optim	the numerical optimizer used in the fit
method	optimization method to be used - one of "BFGS" or "L-BFGS-B" for bounded optimization (default lower and upper bounds are used if not specified
lower	a list of named parameter lower bounds, if NULL then built in defaults are used when method = "L-BFGS-B", otherwise ignored
upper	a list of named parameter upper bounds, if NULL then built in defaults are used when method = "L-BFGS-B", otherwise ignored
REML	logical; whether to use REML (TRUE) or maximum likelihood
profile	logical; option to improve speed and convergence by using REML parameter estimates as initial values for ML optimization
verbose	integer; report progress during minimization: 0 = silent; 1 = optimizer trace; 2 = parameter trace (default))
...	control parameters for the chosen optimizer

Details

The optimizer used to minimize the objective function is selected by the `optim` argument. Additional control parameters specific to the chosen optimizer are specified via the dots argument. See `nlminb` and `optim` for available options. Adapted from S. Wotherspoon https://github.com/SWotherspoon/RWalc/blob/master/R/RWalc.R

Value

Returns a list with components

`optim`	the name of the numerical optimizer as a string, "nlminb" or "optim"
`method`	optimization method to be used
`lower`	named list of lower parameter bounds
`upper`	named list of upper parameter bounds
`REML`	whether REML is to be used in place of ML
`profile`	whether to enhance convergence robustness
`verbose`	level of tracing information to be reported
`control`	list of control parameters for the optimizer

See Also

`nlminb`, `optim`.

Examples

```
fit <- mpmm(~ ice + (ice | id),
data = ellie.ice.short,
control = mpmm_control(
    optim = "nlminb",
    REML = FALSE,
    eval.max = 2000)
    )
```

`plot.mpmm` *plot*

Description

Visualise fixed and random covariate relationships from an mpmm fit object

Usage

```
## S3 method for class 'mpmm'
plot(x, label = FALSE, lwd = c(0.25, 0.75), ...)
```

Arguments

x	an mpmm fit object
label	add id labels to random effects
lwd	a vector of regression line widths (random effect, fixed effects)
...	additional arguments to be ignored

`residuals.mpmm` *residuals*

Description

Extract one-step-ahead residuals

Usage

```
## S3 method for class 'mpmm'
residuals(
  object,
  method = "oneStepGaussianOffMode",
  trace = FALSE,
  parallel = TRUE,
  ncores = detectCores() - 1,
  ...
)
```

Arguments

object	an mpmm fit object
method	character naming the method to calculate one-step-ahead residuals
trace	logical; print progress to console
parallel	logical; compute in parallel
ncores	integer; number of cores to use (default = total cores detected - 1)
...	additional arguments to be ignored

Details

Wrapper function for modified `oneStepPredict` that calculates one-step-ahead residuals, which are residuals that account for temporal correlation in latent states. The modification allows easier parallel computation.

Value

a list with components

res	a tibble with one-step-ahead residuals for longitude and latitude

References

Thygesen, U. H., C. M. Albertsen, C. W. Berg, K. Kristensen, and A. Neilsen. 2017. Validation of ecological state space models using the Laplace approximation. Environmental and Ecological Statistics 24:317–339.

Examples

```
## Not run:
data(ellie.ice)
fit <- mpmm(~ ice + (1 | id), data = ellie.ice)
summary(fit)
residuals(fit)

## End(Not run)
```

`summary.mpmm` *object summaries*

Description

return a summary of an mpmm fit object

Usage

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

Arguments

`object`	an mpmm fit object
`...`	additional arguments to be ignored

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