

Package: maxnet (via r-universe)

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Type Package

Title Fitting 'Maxent' Species Distribution Models with 'glmnet'

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Imports utils, stats, glmnet, dplyr

Suggests stars, terra

Description Procedures to fit species distributions models from occurrence records and environmental variables, using 'glmnet' for model fitting. Model structure is the same as for the 'Maxent' Java package, version 3.4.0, with the same feature types and regularization options. See the 'Maxent' website <http://biodiversityinformatics.amnh.org/open_source/maxent> for more details.

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URL <https://github.com/mrmaxent/maxnet>

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Contents

maxnet-package	2
bradypus	2
categorical	3
maxnet	4
plot.maxnet	6
predict.maxnet	7
response.plot	8

Index	10
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maxnet-package	<i>Maxent over glmnet</i>
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Description

Procedures to fit species distributions models from occurrence records and environmental variables, using 'glmnet' for model fitting. Model structure is the same as for the 'Maxent' Java package, version 3.4.0, with the same feature types and regularization options. See the 'Maxent' website http://biodiversityinformatics.amnh.org/open_source/maxent for more details.

Author(s)

Steve Phillips

References

Phillips & Dudik, Fithian & Hastie, glmnet

See Also

Useful links:

- <https://github.com/mrmaxent/maxnet>

bradypus	<i>Occurrence records and background data for the brown-throated three-toed sloth, Bradypus variegatus</i>
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Description

A dataset containing environmental data at 116 Bradypus variegatus occurrence points and 1000 background points in South and Central America. Occurrence data are from Anderson and Handley (2001); see Phillips et al. (2006) for descriptions of the predictor variables.

Usage

bradypus

Format

A data frame with 1116 observation of 14 variables with a presence/absence flag

- presence numeric 1 = presence, 0 = absence
- cld6190_ann integer
- dtr6190_ann integer
- ecoreg factor
- frs6190_ann integer
- h_dem integer
- pre6190_ann integer
- pre6190_11 integer
- pre6190_110 integer
- pre6190_14 integer
- pre6190_17 integer
- tmn6190_ann integer
- tmp6190_ann integer
- tmx6190_ann integer
- vap6190_ann integer

References

Anderson, R. P. and Handley, Jr., C. O. (2001). A new species of three-toed sloth (Mammalia: Xenarthra) from Panama, with a review of the genus *Bradypus*. *Proceedings of the Biological Society of Washington* 114, 1-33.

Phillips, S. J. et al. (2006). Maximum entropy modeling of species geographic distributions. *Ecological Modelling* 190, 231-259

categorical

Maxent feature classes

Description

Create and evaluate Maxent's feature classes.

These functions are typically called by `model.matrix` rather than directly by a user.

`hinge` creates $2 * \text{knots} - 2$ hinge features, half with $\text{min} = \text{min}(x)$ and half with $\text{max} = \text{max}(x)$, and knots evenly spaced between $\text{min}(x)$ and $\text{max}(x)$. A hinge feature $h(\text{min}, \text{knot})$ or $h(\text{knot}, \text{max})$ is 0 if the predictor is below the first argument, 1 if the predictor is above the second argument, and linearly interpolated inbetween.

A threshold feature is 1 if the predictor is above the knot, 0 otherwise.

A categorical feature is 1 if the predictor matches the category and 0 otherwise.

Usage

```
categorical(x)

hinge(x, nknots = 50)

thresholds(x, nknots = 50)
```

Arguments

x	a predictor: a factor for categorical, otherwise numeric
nknots	number of knots

Value

hinge, threshold and categorical return a matrix with a column for each feature of the specified type.

Author(s)

Steve Phillips

Examples

```
## Not run:
library(maxnet)
data(bradypus)
hinge(bradypus$tmp6190_ann, nknots=10)
categorical(bradypus$coreg)

## End(Not run)
```

maxnet

Maxent over glmnet

Description

Maxent species distribution modeling using glmnet for model fitting

Using lp for the linear predictor and entropy for the entropy of the exponential model over the background data, the values plotted on the y-axis are:

- lp if type is "link"
- exp(lp) if type is "exponential"
- $1 - \exp(-\exp(\text{entropy} + \text{lp}))$ if type is "cloglog"
- $1 / (1 + \exp(-\text{entropy} - \text{lp}))$ if type is "logistic"

Usage

```

maxnet(
  p,
  data,
  f = maxnet.formula(p, data),
  regmult = 1,
  regfun = maxnet.default.regularization,
  addsamplestobackground = T,
  ...
)

maxnet.default.regularization(p, m)

maxnet.formula(p, data, classes = "default")

```

Arguments

p	numeric, a vector of 1 (for presence) or 0 (for background)
data	a matrix or data frame of predictor variables
f	formula, determines the features to be used
regmult	numeric, a constant to adjust regularization
regfun	function, computes regularization constant for each feature
addsamplestobackground	logical, if TRUE then add to the background any presence sample that is not already there
...	not used
m	a matrix of feature values
classes	character, continuous feature classes desired, either "default" or any subset of "lqpht" (for example, "lh")

Value

Maxnet returns an object of class maxnet, which is a list consisting of a glmnet model with the following elements added:

betas nonzero coefficients of the fitted model
alpha constant offset making the exponential model sum to one over the background data
entropy entropy of the exponential model
penalty.factor the regularization constants used for each feature
featuremins minimum of each feature, to be used for clamping
featuremaxs maximum of each feature, to be used for clamping
varmin minimum of each predictor, to be used for clamping
varmax maximum of each predictor, to be used for clamping
samplemeans mean of each predictor over samples (majority for factors)
levels levels of each predictor that is a factor

Author(s)

Steve Phillips

Examples

```
## Not run:
library(maxnet)
data(bradypus)
p <- bradypus$presence
data <- bradypus[,-1]
mod <- maxnet(p, data)
plot(mod, type="cloglog")
mod <- maxnet(p, data, maxnet.formula(p, data, classes="lq"))
plot(mod, "tmp6190_ann")

## End(Not run)
```

plot.maxnet

Create response plots for user selected predictors in a maxnet model

Description

Create response plots for user selected predictors in a maxnet model

Usage

```
## S3 method for class 'maxnet'
plot(
  x,
  vars = names(x$samplemeans),
  common.scale = TRUE,
  type = c("link", "exponential", "cloglog", "logistic"),
  ylab = NULL,
  plot = TRUE,
  mar = c(5, 5, 4, 2),
  N = 100,
  ...
)
```

Arguments

x	an object of class maxnet, i.e., a fitted model.
vars	character, vector of predictors for which response plots are desired.
common.scale	logical, if true, all plots use the same scale on the y-axis.
type	character, type of response to plot on y-axis.
ylab	character, label for y-axis

plot	logical, if TRUE render a plot, if FALSE return a list of data frames with variable and response columns
mar	numeric, 4 element value for margins (lines, in order of bottom, left, top, right) See par for details.
N	numeric, the number of intervals over which to sample the response
...	other arguments passed to plot or barplot

Value

if plot is FALSE then return a list of data frames that contain variable and response columns otherwise NULL invisibly

See Also

[response.plot](#)

predict.maxnet	<i>Predict using a maxnet model</i>
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Description

Prediction can be on a spatial raster or vector space.

Usage

```
## S3 method for class 'maxnet'
predict(
  object,
  newdata,
  clamp = T,
  type = c("link", "exponential", "cloglog", "logistic"),
  ...
)
```

Arguments

object	an object of class "maxnet", i.e., a fitted model.
newdata	values of predictor variables to predict to, possibly matrix, data.frame, SpatRaster or stars object.
clamp	logical, if true, predictors and features are restricted to the range seen during model training.
type	character, type of response required. Using lp for the linear predictor and entropy for the entropy of the exponential model over the background data, the values returned are determined by the value of type. <ul style="list-style-type: none"> • "link" yields lp

- "exponential" yields $\exp(lp)$
 - "cloglog" yields $1 - \exp(-\exp(\text{entropy} + lp))$
 - "logistic" yields $1 / (1 + \exp(-\text{entropy} - lp))$
- ... not used

Value

vector with predicted values (one per input row), SpatRaster or stars object of predicted values

response.plot

Compute and plot a single response variable

Description

Compute and plot a single response variable

Usage

```
response.plot(
  mod,
  v,
  type,
  mm = mod$samplemeans,
  min = mod$varmin[v],
  max = mod$varmax[v],
  levels = unlist(mod$levels[v]),
  plot = T,
  xlab = v,
  ylab = tools::toTitleCase(type),
  N = 100,
  ...
)
```

Arguments

mod	a fitted model, must be of type maxnet if default values used for other arguments.
v	character, name of variable to be plotted.
type	character, type of response to plot on y-axis.
mm	numeric, sample means (or majorities for factors) for predictors; predictors other than v are given these values.
min	numeric, minimum value of v; determines range of x-axis
max	numeric, maximum value of v; determines range of x-axis
levels	vector, if v is a factor, determines levels to be plotted
plot	logical, if TRUE render the plot (or barplot) if FALSE then compute the response and return a data.frame

<code>xlab</code>	character, label for x-axis
<code>ylab</code>	character, label for y-axis
<code>N</code>	numeric, the number of intervals over which to sample the response
<code>...</code>	other argument passed to <code>plot</code> or <code>barplot</code>

Value

if `plot` is `FALSE` a data frame that contains variable and response columns otherwise `NULL` invisibly

See Also

[plot.maxnet](#)

Index

- * **datasets**

- bradypus, [2](#)

- * **internals**

- maxnet-package, [2](#)

- _PACKAGE (maxnet-package), [2](#)

- bradypus, [2](#)

- categorical, [3](#)

- hinge (categorical), [3](#)

- maxnet, [4](#)

- maxnet-package, [2](#)

- plot.maxnet, [6](#), [9](#)

- predict.maxnet, [7](#)

- response.plot, [7](#), [8](#)

- thresholds (categorical), [3](#)