Package: dsmextraLite (via r-universe)

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Type Package

Title A Toolkit for Extrapolation Assessments in Density Surface Models

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Description This is a user-friendly tools for the detection and assessment of extrapolation in multivariate environmental space (Bouchet et al. 2019), with applications to density surface models of line transect data. It provides convenience functions for summarising and visualising extrapolation in prediction areas. This is a streamlined version of the dsmextras package (https://github.com/densitymodelling/dsmextra) that uses update spatial data packages.

Imports lpSolve, pbmcapply, purrr, sf, terra, dplyr, knitr, tibble

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Encoding UTF-8

LazyData true

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Depends R (>= 3.5)

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

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Contents

`compute_extrapolation` *Quantify extrapolation in multivariate environmental space*

Description

Assesses univariate (Type I) and combinatorial (Type II) extrapolation in spatial ecological models such as density surface models of line transect data. Models are built in a reference (calibration) system and projected into one or more target (prediction) system(s). The function is based on original code from the ecospat package (Broennimann et al. 2016). Although the required inputs mirror those of the dsm package (Miller et al. 2015), the function is not restricted to line/strip-transect data and can be applied to other survey types and predictive modelling scenarios. See the 'Examples' section and Bouchet et al. (2019) for more information.

Usage

```
compute_extrapolation(
  samples,
  covariate.names,
  prediction.grid,
  coordinate.system,
  resolution = NULL,
  verbose = TRUE
)
```

Arguments

`samples`	Sample (reference) `sf` dataset used for model building and calibration. This corresponds to the `segment.data` used when building density surface models in `dsm`. It must contain one column for each of the covariates in `covariate.names`.
`covariate.names`	Character string. Names of the covariates of interest.
`prediction.grid`	Prediction data.frame. This contains both geographic coordinates (`x`, `y`) and covariate values associated with the target locations for which predictions are desired. Typically, these locations are taken as the centroids of the grid cells in a spatial prediction grid/raster. See `predict.dsm`.
`coordinate.system`	Projected coordinate system relevant to the study location. Can be either a character string or an object of class `CRS`.
`resolution`	Resolution of the output raster (in units relevant to `coordinate.system`). Only required if `prediction.grid` is irregular, and thus needs to be rasterised. Defaults to `NULL`.
`verbose`	Logical. Show or hide possible warnings and messages.

Details

The function calculates values of the ExDet (EXtrapolation DETection) metric as originally proposed by Mesgaran et al. (2014). ExDet takes on strictly negative values during univariate extrapolation (i.e. when predictions are made outside the range of individual covariates), is strictly >1 during combinatorial extrapolation (i.e. when predictions are made within the range of individual covariates, but for combinations of environmental conditions not encountered in the sample), and lies within the range 0-1 when predictions are made in conditions analogous to those found in the reference system. The function also determines which covariates make the largest contribution to each type of extrapolation; this is the most influential covariate (MIC). See Mesgaran et al. (2014) for details.

Note that `compute_extrapolation` returns results in both numerical and raster format. The latter is used to support mapping functions and requires the locations in `prediction.grid` to be evenly spaced. If this is not the case, `dsmextra` will attempt to automatically generate a raster with a resolution given by the `resolution` argument (and expressed in the units of `coordinate.system`). An error may be returned if no `resolution` is specified.

The `data` list captures ExDet values at prediction locations (i.e. cells in `prediction.grid`) and is organised into multiple `data.frame` objects, as follows:

`all`	All prediction locations
`univariate`	Prediction locations subject to univariate extrapolation (only)
`combinatorial`	Prediction locations subject to combinatorial extrapolation (only)
`analogue`	Prediction locations where conditions are analogous to sampled conditions (only)

Each `data.frame` contains four columns:

`ExDet`	ExDet values
`mic_univariate`	Integer identifying the univariate MIC
`mic_combinatorial`	Integer identifying the combinatorial MIC
`mic`	Integer identifying the MIC

The `rasters` list comprises two elements, named `ExDet` and `mic`. Each contains individual rasters mapping ExDet and MIC values, respectively.

Value

A list object containing extrapolation values in both `data.frame` and `raster` format. Also included are a summary object of class `extrapolation_results_summary` and a copy of function inputs (i.e, `coordinate.system`, `covariate.names`, and `prediction.grid`).

Author(s)

Phil J. Bouchet and Devin S. Johnson

References

Bouchet PJ, Miller DL, Roberts JJ, Mannocci L, Harris CM and Thomas L (2019). From here and now to there and then: Practical recommendations for extrapolating cetacean density surface models to novel conditions. CREEM Technical Report 2019-01, 59 p. https://research-repository.st-andrews.ac.uk/handle/10023/18509

Broennimann O, Di Cola V, Guisan A (2016). ecospat: Spatial Ecology Miscellaneous Methods. R package version 2.1.1. https://CRAN.R-project.org/package=ecospat

Mesgaran MB, Cousens RD, Webber BL (2014). Here be dragons: a tool for quantifying novelty due to covariate range and correlation change when projecting species distribution models. Diversity & Distributions, 20: 1147-115. DOI: 10.1111/ddi.12209

Miller DL, Rexstad E, Burt L, Bravington MV, Hedley S (2015). dsm: Density Surface Modelling of Distance Sampling Data. R package version 2.2.9. https://CRAN.R-project.org/package=dsm

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`sf_to_rast` *Convert an sf points data frame grid to a SpatRaster object*

Description

Convert an sf points data frame grid to a SpatRaster object

Usage

```
sf_to_rast(x, digits = 6)
```

Arguments

`x`	An sf points data frame with locations on a grid
`digits`	The number of significant digits in the coordinate values for snapping to a grid

Author(s)

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