Introduction to PointedSDMs

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Introduction

- Point 1
- ▶ Point 2
- ► Point 3



Process model

The underlying process model is a log-Gaussian cox process (LGCP) with a spatially varying intensity function, $\lambda(s) = exp\{\eta(s)\}$, where:

$$\eta(s) = \alpha_0 + \sum_{k=1}^{p} \beta_k X_k(s) + \zeta(s),$$

where:

- $ightharpoonup \alpha_0$ is an intercept term,
- β_k is the k^{th} coefficient for the k^{th} environmental covariate, which varies in space (denoted by the index, s),
- $ightharpoonup \zeta(s)$ is a zero-mean Gaussian random field determined by a Matèrn covariance function.

Observation models

Observation models are chosen based on the underlying sampling protocols of a given dataset.

Distribution
Binomial (with a cloglog link)
Thinned Poisson
Poisson
Variety

PointedSDMs R package

- ▶ Package is designed to simplify the construction of ISDMs using a joint-likelihood framework.
- ▶ Wrapper around *R-INLA* and *inlabru* packages.

Installation of the package

▶ Install from either *CRAN* or *Github*.

```
install.packages("PointedSDMs")
# or
devtools::install_github("PhilipMostert/PointedSDMs")
```

Package structure



startISDM

NULL

args(startISDM)

startSpecies

```
args(startSpecies)
## function (..., spatialCovariates = NULL, Projection
   , Mesh, speciesSpatial = "replicate",
       speciesIntercept = TRUE, speciesEnvironment =
##
   TRUE, speciesName,
       IPS = NULL, Boundary = NULL, pointCovariates =
##
   NULL, Offset = NULL,
##
       pointsIntercept = TRUE, pointsSpatial = "copy",
    responseCounts = "counts",
##
       responsePA = "present", trialsPA = NULL,
   temporalName = NULL,
       Formulas = list(covariateFormula = NULL,
##
   biasFormula = NULL))
## NULL
```

startMarks

```
args(startMarks)
## function (..., spatialCovariates = NULL, Projection
   , Mesh, IPS = NULL,
##
       Boundary = NULL, markNames = NULL, markFamily =
    NULL, marksSpatial = TRUE,
##
       pointCovariates = NULL, pointsIntercept = TRUE,
    marksIntercept = TRUE,
       Offset = NULL, pointsSpatial = "copy",
##
   responseCounts = "counts",
       responsePA = "present", trialsPA = NULL,
##
   trialsMarks = NULL.
##
       temporalName = NULL, Formulas = list(
   covariateFormula = NULL.
##
         biasFormula = NULL))
## NULL
```

Specifying model

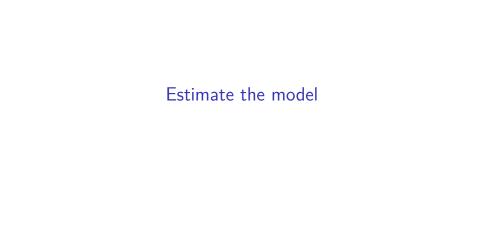
Available slot functions

Name	Use
<pre>\$plot()</pre>	Plot data
<pre>\$addBias()</pre>	Add second spatial effect
<pre>\$updateFormula()</pre>	Update a likelihood's formula
\$changeComponents(()Update model components
<pre>\$priorsFixed()</pre>	Specify priors for the fixed effects
<pre>\$specifySpatial()</pre>	Specify the spatial effects
<pre>\$changeLink()</pre>	Change the link function of a process
<pre>\$spatialBlock()</pre>	Initiate spatial-block cross-validation
<pre>\$addSamplers()</pre>	Change the integration domain for a
-	likelihood
<pre>\$specifyRandom()</pre>	Specify the priors for other random effects

Information about slot functions

▶ Obtain documentation through the .\$help() function.

```
obj <- startISDM(...)
obj$help()</pre>
```



fitISDM

```
args(fitISDM)
```

```
## function (data, options = list())
## NULL
```



Predict and plot

Model evaluation

Spatial block

```
args(blockedCV)
```

```
## function (data, options = list())
## NULL
```

Leave-one-out

```
args(datasetOut)
```

```
## function (model, dataset, predictions = TRUE)
## NULL
```

Quick example

Next steps

- Questions and discussions.
- ▶ Pull Github repository: PhilipMostert/PointedSDMs_Workshop.
- ▶ We will through *Vignette 1: Basic model* together.