m2b tutorial

Laurent Dubroca, Andréa Thiébault

2017-03-06

Introduction

Animal behaviour, including social interactions, are fundamental to the field of ecology. Whereas the direct observation of animal behaviour is often limited due to logistical constraints, collection of movement data have been greatly facilitated through the development of bio-logging. Animal movement data obtained through tracking instrumentation may potentially constitute a relevant proxy to infer animal behaviour. This is, however, based on the premise that a range of movement patterns can be linked to specific behaviours.

Statistical learning constitutes a number of methods that can be used to assess the link between given variables from a fully informed training dataset and then predict the values on a non-informed variable. We chose the random forest algorithm for its capacity to deal with imbalanced data (particularly relevant for behavioural data), its high prediction accuracy and its ease of implementation. The strength of random forest partly relies in its ability to handle a very large number of variables. Hence, our methodology is based on the derivation of multiple predictor variables from the movement data over various temporal scales, in order to capture as much information as possible on the changes and variations of movement.

In this tutorial, the link between behaviour and movement parameters is build using a random forest model based on a seabird track with behavioural observation made by a video camera deployed on the individual. A new class named 'xytb' is implemented in order to provide to the user an object where data, derived information, modelling and results are included in a single object.

Data

The data frame 'track_CAGA_005' contains the information the track and the behavioural observation made on a gannet.

```
library(m2b)
str(track_CAGA_005)
```

```
## 'data.frame':    3597 obs. of  5 variables:
##  $ x : num  26.3 26.3 26.3 26.3 26.3 ...
##  $ y : num  -33.8 -33.8 -33.8 -33.8 -33.8 ...
##  $ t : POSIXct, format: "2010-12-11 08:08:00" "2010-12-11 08:08:13" ...
##  $ b : chr  "3" "3" "3" "3" ...
##  $ id: chr  "CAGA_005" "CAGA_005" "CAGA_005" "CAGA_005" ...
```

Different methods are available to build a 'xytb' object. Here, the track and behavioural information are taken from the data.frame, and derived information related to the track are computed in the same time. The derived information are computed on the moving windows of 3, 5, 7, 9, 11, 13 and 15 locations (the 'winsize' parameters), and with the standard statistical operators (mean, standard deviation and median absolute deviation) available in the methods, the quantile at 0, 25, 50, 75 and 100% are added (the 'idquant' parameter). Then these values are shifted back in time at 5, 10 and 15 points backward (the 'move' parameter), in order to build a dataset of predictor back in time. This is useful if the user is interested to investigate the link of the observed behaviour with previous movement events. The rationale behind this operation is based on the fact that some change in movement can be triggered by behavioural observation made afterward by the scientist but sooner by the animal.

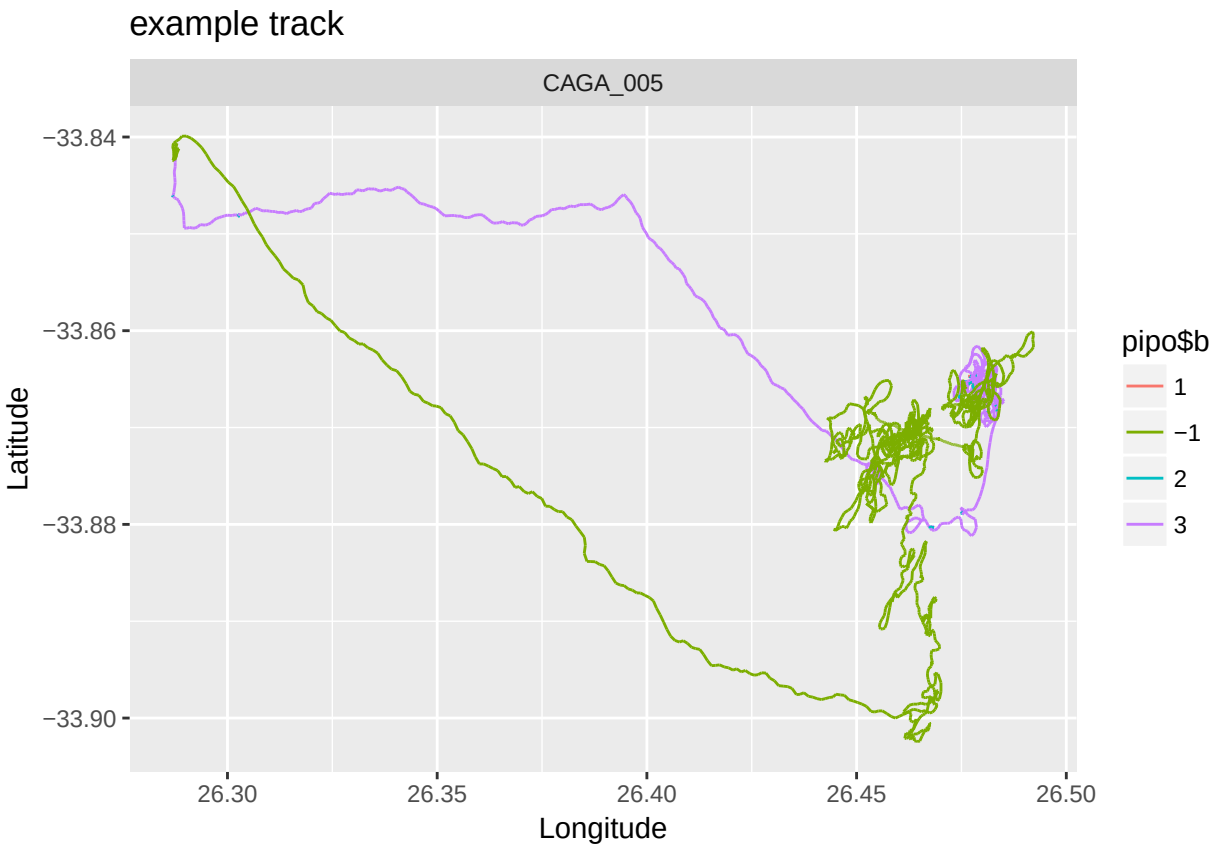
```r
library(m2b)
str(track_CAGA_005)
```

```
## 'data.frame':    3597 obs. of  5 variables:
##  $ x : num  26.3 26.3 26.3 26.3 26.3 ...
##  $ y : num  -33.8 -33.8 -33.8 -33.8 -33.8 ...
##  $ t : POSIXct, format: "2010-12-11 08:08:00" "2010-12-11 08:08:13" ...
##  $ b : chr  "3" "3" "3" "3" ...
##  $ id: chr  "CAGA_005" "CAGA_005" "CAGA_005" "CAGA_005" ...
```

```r
#convert to xybt object with computation of windows operators and some quantiles
xytb<-xytb(track_CAGA_005,desc="example track",
     winsize=seq(3,15,2),idquant=seq(0,1,.25),move=c(5,10,15))
```

```
## [1] "Compute 169 indicators on 7 moving windows"
## [1] "Compute indicators on 3 points"
## [1] "Done"
## [1] "Compute indicators on 5 points"
## [1] "Done"
## [1] "Compute indicators on 7 points"
## [1] "Done"
## [1] "Compute indicators on 9 points"
## [1] "Done"
## [1] "Compute indicators on 11 points"
## [1] "Done"
## [1] "Compute indicators on 13 points"
## [1] "Done"
## [1] "Compute indicators on 15 points"
## [1] "Done"
## [1] "shift value backward"
## [1] "shift backward 5"
## [1] "shift backward 10"
## [1] "shift backward 15"
## [1] "Done"
```

```r
#a simple plot method
plot(xytb)
```

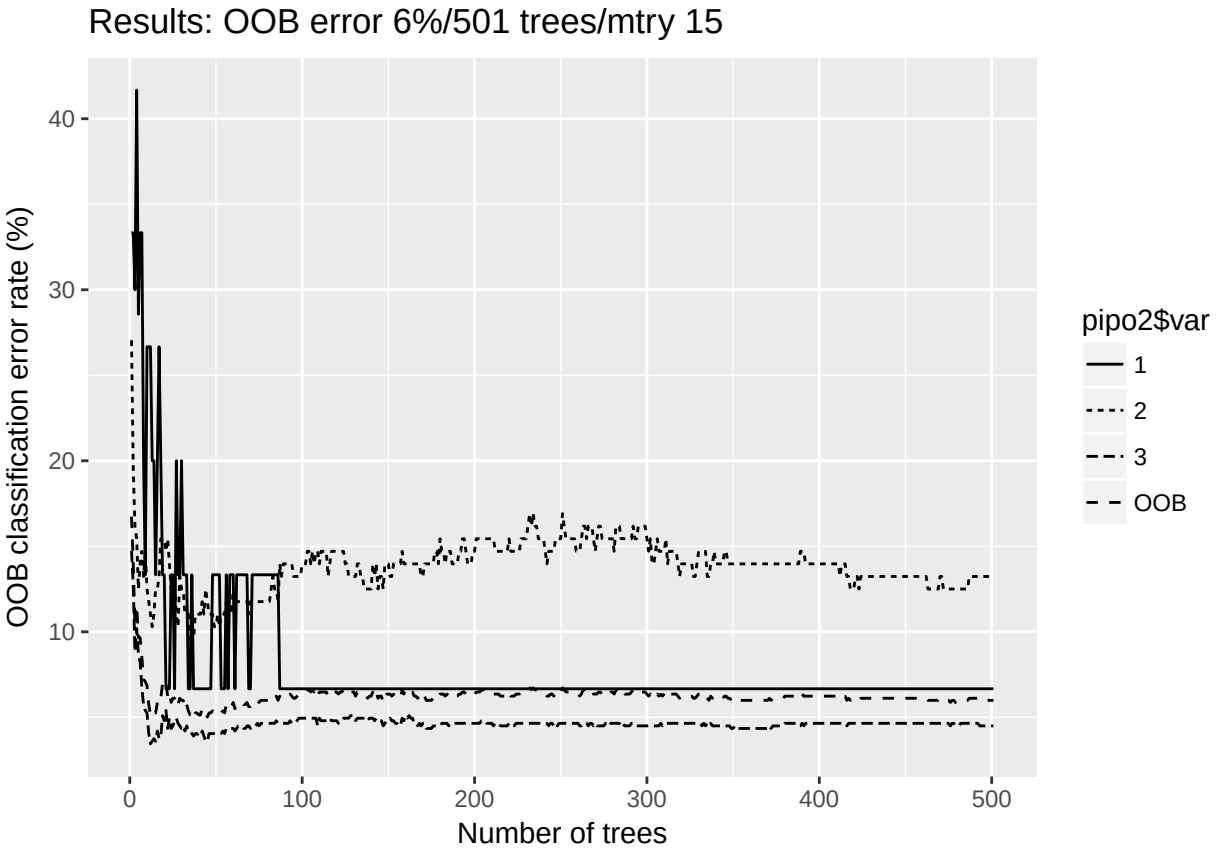


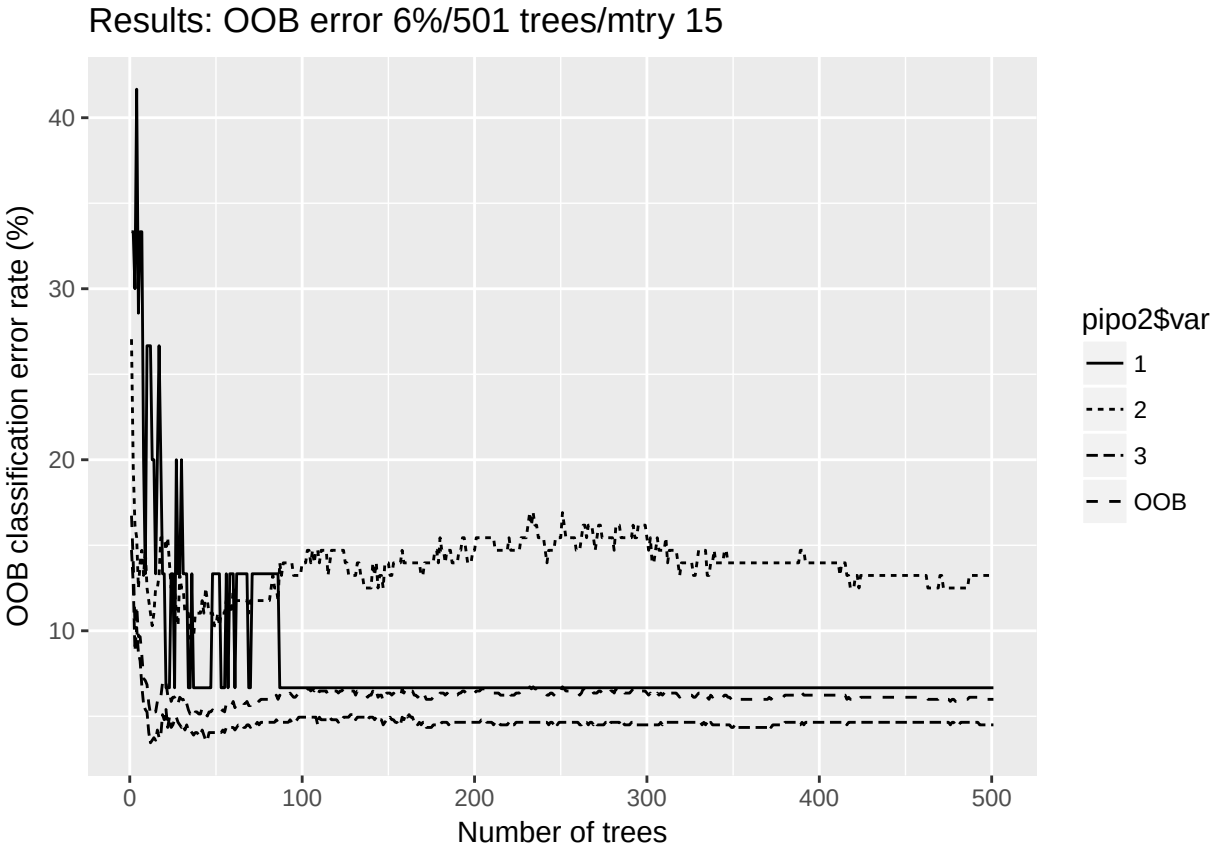
Modelling

```
#a model (the function modelRF update the model inside the xytb object)
xytb<-modelRF(xytb,type="actual",ntree=501,mtry=15)
```

```
## [1] "removing lines with NA values"
## [1] "removing colinearity among predictors"
## [1] "v,dist,thetarel keeped"
## [1] "vmean_w3,distmean_w3,vmean_w5,distmean_w5,vmean_w7,thetarelmean_w7,distmean_w7,vsd_w7,distsd_w7
## [1] "removing near zero variance predictors"
```

```
resRF(xytb)
```


Results: OOB error 6%/501 trees/mtry 15
OOB classification error rate (%)
40
30
20
10
0
100
200
300
400
500
Number of trees
pipo2$var
1
2
3
OOB


Results: OOB error 6%/501 trees/mtry 15
OOB classification error rate (%)
40
30
20
10
0
100
200
300
400
500
Number of trees
pipo2$var
1
2
3
OOB

Results

```
resB(xytb,"time",nob="-1")
```