5.statistical_model.R

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Wed Nov 20 12:48:20 2019

ame1 project - studying the relation between home range size and activity 2019/10/04 Adam Kane, Enrico Pirotta & Barry McMahon https://mecoco.github.io/ame1.html statistical model

```
################################################################################
```

load the packages

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 3.5.3
```

```
## -- Attaching packages ---------------------------------------------------------------------------
```

```
## v ggplot2 3.1.0       v purrr   0.2.5
## v tibble  2.1.1       v dplyr   0.8.0.1
## v tidyr   0.8.1       v stringr 1.3.1
## v readr   1.1.1       v forcats 0.3.0
```

```
## Warning: package 'tibble' was built under R version 3.5.3
```

```
## Warning: package 'dplyr' was built under R version 3.5.3
```

```
## -- Conflicts ------------------------------------------------------------------------------------
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(lme4)
```

```
## Warning: package 'lme4' was built under R version 3.5.2
```

```
## Loading required package: Matrix
```

```
##
## Attaching package: 'Matrix'
```

```
## The following object is masked from 'package:tidyr':
##
##     expand
```

load in some helper functions e.g. for calculating VIF

```
source("C:/Users/Adam Kane/Documents/Manuscripts/Eurodeer/eurodeer/code/6.Helper_functions.r")
```

load the data

```
mydata <- read_csv("C:/Users/Adam Kane/Documents/Manuscripts/Eurodeer/eurodeer/results/combined_data.csv
```

```
## Parsed with column specification:
## cols(
##   .default = col_double(),
##   animals_id = col_integer(),
##   sex = col_character(),
##   year_birth = col_integer(),
##   identifier = col_character(),
##   ndvi_Mode = col_integer(),
```

```
##   altitude_Mode = col_integer(),
##   slope_Mode = col_integer(),
##   aspect_Mode = col_integer(),
##   tree_Mode = col_integer(),
##   corine_Mode = col_integer(),
##   year = col_integer(),
##   month = col_character(),
##   n_obs = col_integer(),
##   activity_sensors_id = col_integer(),
##   sensor_type = col_integer(),
##   study_areas_id = col_integer(),
##   gps_sensors_id = col_integer(),
##   id = col_integer(),
##   age = col_integer(),
##   predator = col_integer()
## )
```

```
## See spec(...) for full column specifications.
```

```
head(mydata)
```

```
## # A tibble: 6 x 41
##   animals_id sex   year_birth identifier kdearea    mcp ndvi_Mean
##        <int> <chr>      <int> <chr>        <dbl>  <dbl>     <dbl>
## 1        768 f           2000 768_2005/~   0.904 0.476       141.
## 2        768 f           2000 768_2005/~   0.123 0.0893      172.
## 3        769 m           2004 769_2005/~   0.707 0.643       164.
## 4        769 m           2004 769_2005/~   0.767 0.722       166.
## 5        769 m           2004 769_2005/~   0.381 0.306       228.
## 6        769 m           2004 769_2005/~   0.494 0.396       224.
## # ... with 34 more variables: altitude_Mean <dbl>, slope_Mean <dbl>,
## #   aspect_Mean <dbl>, tree_Mean <dbl>, ndvi_Sd <dbl>, altitude_Sd <dbl>,
## #   slope_Sd <dbl>, aspect_Sd <dbl>, tree_Sd <dbl>, ndvi_Median <dbl>,
## #   altitude_Median <dbl>, slope_Median <dbl>, aspect_Median <dbl>,
## #   tree_Median <dbl>, ndvi_Mode <int>, altitude_Mode <int>,
## #   slope_Mode <int>, aspect_Mode <int>, tree_Mode <int>,
## #   corine_Mode <int>, year <int>, month <chr>, mean_act <dbl>,
## #   sd_act <dbl>, max_act <dbl>, min_act <dbl>, n_obs <int>,
## #   activity_sensors_id <int>, sensor_type <int>, study_areas_id <int>,
## #   gps_sensors_id <int>, id <int>, age <int>, predator <int>
```

```
names(mydata)
```

```
##  [1] "animals_id"          "sex"                 "year_birth"
##  [4] "identifier"          "kdearea"             "mcp"
##  [7] "ndvi_Mean"           "altitude_Mean"       "slope_Mean"
## [10] "aspect_Mean"         "tree_Mean"           "ndvi_Sd"
## [13] "altitude_Sd"         "slope_Sd"            "aspect_Sd"
## [16] "tree_Sd"             "ndvi_Median"         "altitude_Median"
## [19] "slope_Median"        "aspect_Median"       "tree_Median"
## [22] "ndvi_Mode"           "altitude_Mode"       "slope_Mode"
## [25] "aspect_Mode"         "tree_Mode"           "corine_Mode"
## [28] "year"                "month"               "mean_act"
## [31] "sd_act"              "max_act"             "min_act"
## [34] "n_obs"               "activity_sensors_id" "sensor_type"
## [37] "study_areas_id"      "gps_sensors_id"      "id"
```

```
## [40] "age"                  "predator"
```

extract variance inflation factors (VIF) https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/j.2041-210X.2009.00001.x

```
test_vif <- mydata %>% select(ndvi_Mean,altitude_Mean,slope_Mean,aspect_Mean,tree_Mean,mean_act,sd_act)
test_vif <- data.frame(test_vif)
corvif(test_vif)
```

```
## Correlations of the variables
##
##                 ndvi_Mean altitude_Mean  slope_Mean aspect_Mean
## ndvi_Mean      1.00000000   -0.08184592 -0.11206527 -0.10597306
## altitude_Mean -0.08184592    1.00000000  0.85899135  0.14584274
## slope_Mean    -0.11206527    0.85899135  1.00000000  0.05140732
## aspect_Mean   -0.10597306    0.14584274  0.05140732  1.00000000
## tree_Mean     -0.06945471    0.04989553 -0.05967494  0.25033912
## mean_act       0.08095440   -0.39812465 -0.38868062 -0.09897918
## sd_act         0.08422378   -0.33710159 -0.38478129 -0.06958635
##                 tree_Mean    mean_act      sd_act
## ndvi_Mean     -0.06945471  0.08095440  0.08422378
## altitude_Mean  0.04989553 -0.39812465 -0.33710159
## slope_Mean    -0.05967494 -0.38868062 -0.38478129
## aspect_Mean    0.25033912 -0.09897918 -0.06958635
## tree_Mean      1.00000000 -0.04716082  0.05180044
## mean_act      -0.04716082  1.00000000  0.94795046
## sd_act         0.05180044  0.94795046  1.00000000
##
##
## Variance inflation factors
##
##                    GVIF
## ndvi_Mean      1.031672
## altitude_Mean  4.540862
## slope_Mean     4.425788
## aspect_Mean    1.112770
## tree_Mean      1.185292
## mean_act      12.209092
## sd_act        11.946886
```

mean_act is correlated with sd_act and altitude_mean is correlated with slope mean let's remove mean_act and altitude_mean mcp model

```
m1 <- glmer(
  mcp ~
    sex +
    age +
    ndvi_Mean +
#    altitude_Mean +
    slope_Mean +
    aspect_Mean +
    predator +
    corine_Mode +
    tree_Mean +
    age +
  #  mean_act * activity_sensors_id +
```

```
    sd_act * activity_sensors_id +
    (1 | study_areas_id) + (1 | month) +
    (1 | study_areas_id:month) +
    (1 | animals_id),
  data = mydata#,
  #family = Gamma
)
```

```
## Warning in glmer(mcp ~ sex + age + ndvi_Mean + slope_Mean + aspect_Mean
## + : calling glmer() with family=gaussian (identity link) as a shortcut to
## lmer() is deprecated; please call lmer() directly
```

```
## Warning: Some predictor variables are on very different scales: consider
## rescaling
```

```
summary(m1)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula:
## mcp ~ sex + age + ndvi_Mean + slope_Mean + aspect_Mean + predator +
##     corine_Mode + tree_Mean + age + sd_act * activity_sensors_id +
##     (1 | study_areas_id) + (1 | month) + (1 | study_areas_id:month) +
##     (1 | animals_id)
##    Data: mydata
##
## REML criterion at convergence: 12363.9
##
## Scaled residuals:
##    Min     1Q Median     3Q    Max
## -1.118 -0.083 -0.024  0.021 39.442
##
## Random effects:
##  Groups               Name        Variance  Std.Dev.
##  animals_id           (Intercept)  0.322502 0.56789
##  study_areas_id:month (Intercept)  1.714529 1.30940
##  month                (Intercept)  0.003975 0.06305
##  study_areas_id       (Intercept)  0.263059 0.51289
##  Residual                         70.320357 8.38572
## Number of obs: 1730, groups:
## animals_id, 112; study_areas_id:month, 71; month, 12; study_areas_id, 6
##
## Fixed effects:
##                               Estimate Std. Error t value
## (Intercept)                 -2.127e+00  2.975e+00  -0.715
## sexm                         6.233e-01  4.794e-01   1.300
## age                         -2.416e-01  1.565e-01  -1.543
## ndvi_Mean                    2.769e-04  6.732e-03   0.041
## slope_Mean                   2.194e-02  3.472e-02   0.632
## aspect_Mean                  1.987e-03  3.733e-03   0.532
## predator                     4.282e-02  5.907e-01   0.072
## corine_Mode                  3.639e-02  7.487e-02   0.486
## tree_Mean                   -2.572e-03  1.383e-02  -0.186
## sd_act                       6.980e-02  7.629e-02   0.915
## activity_sensors_id          2.770e-03  5.037e-03   0.550
## sd_act:activity_sensors_id -8.959e-05  1.496e-04  -0.599
```

```
##
## Correlation of Fixed Effects:
##             (Intr) sexm   age    ndv_Mn slp_Mn aspc_M predtr crn_Md tre_Mn
## sexm        -0.068
## age         -0.108  0.226
## ndvi_Mean   -0.384  0.081  0.021
## slope_Mean   0.019 -0.100 -0.035  0.084
## aspect_Mean -0.102  0.041 -0.155  0.081  0.076
## predator    -0.204  0.162  0.035  0.079 -0.212 -0.046
## corine_Mode -0.295 -0.029  0.095 -0.097 -0.086 -0.020 -0.080
## tree_Mean    0.072 -0.049 -0.123  0.083 -0.001 -0.174 -0.031 -0.601
## sd_act      -0.633 -0.123 -0.031 -0.083 -0.049 -0.076 -0.164 -0.036  0.034
## actvty_sns_ -0.701 -0.061 -0.067 -0.041 -0.132 -0.129 -0.068 -0.064  0.135
## sd_ct:ctv__  0.636  0.087  0.024  0.069  0.115  0.097  0.105  0.047 -0.041
##             sd_act actv__
## sexm
## age
## ndvi_Mean
## slope_Mean
## aspect_Mean
## predator
## corine_Mode
## tree_Mean
## sd_act
## actvty_sns_  0.894
## sd_ct:ctv__ -0.978 -0.926
## fit warnings:
## Some predictor variables are on very different scales: consider rescaling
```