Exercices on session *Statistics with R session* 2/3

Load the packages of the tidyverse and ggeffects

Data on vascular plants in the British Islands

The Arrhenius relationship (1921) predicts that the number of species in an ecosystem increases with its area to the power z according to the equation

$$S = cA^z$$

where S(A) is the number of species observed on area A, c is a constant that depends on the ecosystems and the taxon considered, and z is the parameter of interest.

We are going to explore this relationship using data on the number of vascular species in the British Islands (Johnson et Simberloff, 1974), available here.

• Load the data as a tibble and look at their structure

The data contains the number of species of vascular plants (variable *species*) for different *island*. The other variables give some characteristics of these islands, including the *area* in km².

Simple linear regression

The Arrhenius relation can be linearised by taking the logarithm of S and A:

$$log(S) = \beta_0 + \beta_1 log(A)$$

• Explore graphically the relationship between the log-transformed area and the log-transformed number of species

• Fit the following log-log model, look at the model results and interpret them

$$log(S) \sim \mathcal{N}(\beta_0 + \beta_1 \times log(A), \sigma^2)$$

• Do the model validation

Multiple linear regression

The goodness of fit of the previous model could probably be improved. As the variables elevation, latitude, dist_britain and soil_types could also be influencing the number of species, we could add them as explanatory variables in our model.

- Let's first explore graphically the correlation between all pairs of numerical variables, area (log-transformed), elevation, latitude, dist_britain, using the package GGally. What do you conclude?
- Let's also make boxplots to explore graphically the relationship between these 4 variables and the type of soil (don't forget to transform the variable *soil_types* to a factor). What do you conclude?
- Fit the following model (without standardising the variables), look at the model results and interpret them

$$log(S) \sim \mathcal{N}(\beta_0 + \beta_1 \times log(A) + \beta_2 \times latitude, \sigma^2)$$

- Do the model validation
- Check the VIF (from library car) to check for the absence of collinarity between the explanatory variables

Presenting the result of the best model

- Compare the AIC of the two models. Which is the best one?
- Present the coefficients in a table
- Present the result graphically: first, represent the predicted relationship between A and S, setting the latitude to its mean
- then the predicted relationship between latitude and S, setting the area to its mean

For next time

• Make sure the following packages are already installed: vegan, tidyverse

Acknowledgments

- Marchand P. Analyses et modélisation des données écologiques
- Marcon E. cours-R-Geeft