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# Statistical Models with Interactions: Tools to Improve Empirical Analyses

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## Extended Abstract

Interaction effects in the statistical analysis of natural systems play a key role in understanding biological processes. One of the forms for modelling the interactions is a linear regression analysis allowing to study the relationship between the dependent variable and explanatory variables under the influence of a moderating variable [1]. Researchers commonly focus on whether the interaction term's coefficient in regression is statistically significant. However, in many cases, it is useful to evaluate the marginal effect of the independent variable for all ranges of the moderating variable [2].

To illustrate the different scenarios of the interaction in GLMs the empirical data from 320 host individuals of six gammarid species was used. The survival time of gammarids was a dependent variable and the three subsets of symbiotic communities (the whole community (Whole), the endobiotic (Endo) and the epibiotic species assemblages (Ecto)) were used as explanatory covariates and the host body length was a moderator variable. The three GLMs were estimated. Model 1: *Survival Time ~ Host Species + Endo : Body Length*. Model 2: *Survival Time ~ Host Species + Whole : Body Length*. Model 3: *Survival Time ~ Host Species + Endo : Body Length + Ecto : Body Length*. Statistical analyses were performed using the functions *glm()* and *interplot()* in *R* version 4.3.3.

According to the first model in which all estimated coefficients were statistically significant, researchers can infer that the relationship between the endoparasites and the survival time of gammarids is significant for all values of host body size. However, the marginal effect of endoparasites on the survival time of gammarids is statistically different from zero (at the 95% level) over the range of body length from 7.7 mm to 15 mm and this effect seems to become weaker with increasing values of body length. The marginal effect is zero for body length from 15 mm to 21.8 mm. From the empirical data, approximately 66% of the observations have a body size of less than 15 mm. In the case of model 2 where the interaction term was not significant, one may suggest that the body length does not influence on the interaction between the survival time and the number of parasites. However, the marginal effect plot showed the effect of the number of parasites on the survival time for values of body length in range (7.7; 15). For model 3 in which both, the coefficients for variable *Ecto* and interaction term *Ecto : Body Length* were not significant, the marginal effect plot indicates the lack of an impact of ectoparasites on the survival time because the confidence interval includes zero for all values of the body size.

When dealing with interaction models, it is useful to combine a marginal effect plot with the histogram of the moderating variable, to investigate the changes in the GLMs by the range of the moderating variable.

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