Meaningful, interpretable and comparable data analyses

BIO 708: Quantitative Methods in Ecology and Evolution

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February 23rd, 2024

1. Measurement

a.

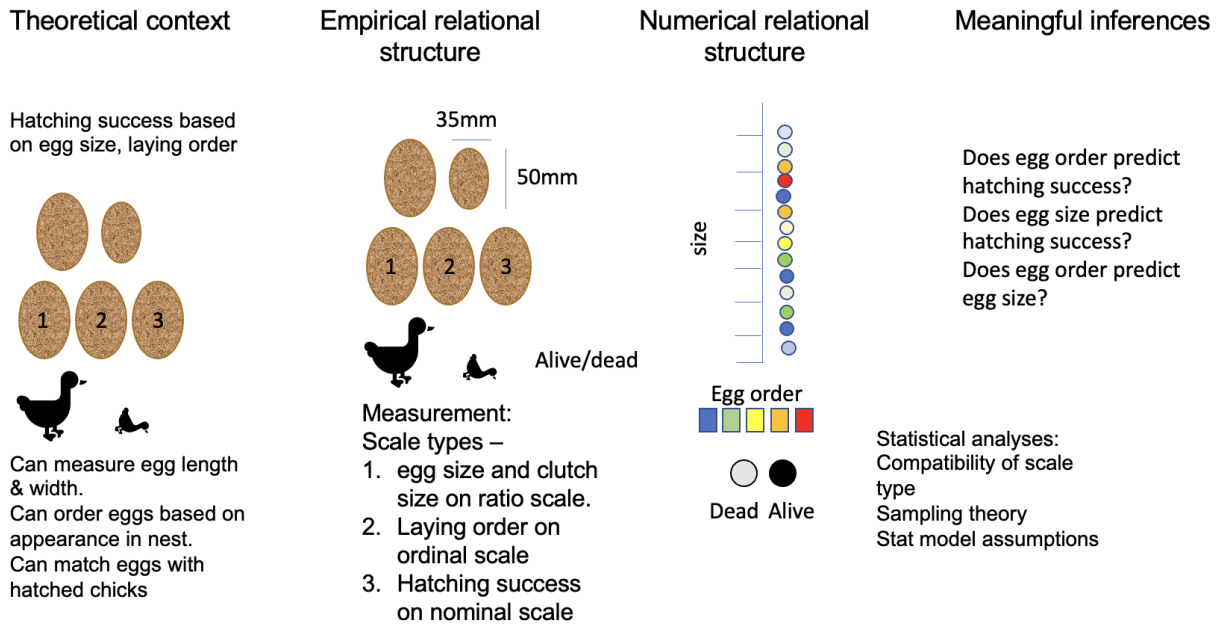


Figure 1: Replicated figure of theoretical context, empirical relational structure, numerical relational structure, meaningful inferences for my own data

b. Each of my scales are different meaning that they cannot be directly compared to one another. My egg measurements are continuous on an interval scale, the egg laying order is on an ordinal scale and the hatching success will be proportions based on a nominal scale of hatched/failed to hatch. Neither the egg measurements or the egg laying order have a relevant 0 so I may have to re-scale the egg measurements to have an meaningful intercept. In terms of interpretations, I can only meaningfully use proportions for my hatching success. For the egg laying order I can use the median but not means or variance. For egg size, I can use the means, standard deviations and standard errors. I may have to standardize my data on the ratio scale.

2. Effect sizes and meaningful magnitudes

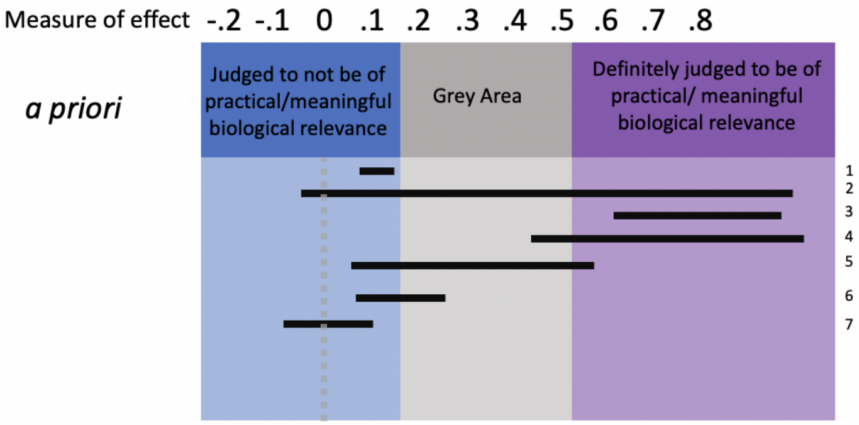
a. I think a logistic regression is the best for my data since I have a nominal dependent variable and ordinal

and ratio predictor variables. I could also use a cumulative odd ratio for my ordinal predictor's effect. Many studies have explored the roles of egg order and egg size, and clutch size on the hatching rates and survival of birds. From what I've seen, GLMM are the most common way to analyze the data and I think that is the way to go for me too. I can make similar models to those that have been done before in other studies. However, nearly all of these studies come from birds that are monogamous and non-cooperative. Statistically, my approach will be the similar to previous studies, but the conclusions for biological relevance will be different to fit my study organism and system.

b. I don't think I can standardize my ordinal or nominal data. The distances between categories for my nominal data are not meaningful if standardized. Again there may not be equal spacing between my ordinal variables. Sure I'll be ranking the order from 1,2,3 etc. but the if I standardize it, it implies that the distance between egg 1 and 2 is the same as between 2 and 3 which is not necessarily the case. I should standardize my data on the egg size and clutch size. That way I could meaningfully compare the effect of small eggs or clutches and large eggs or clutches on the hatching success.

c. Advantages to putting in the time and effort to make a BoMM and choosing my effect size is making the results more comparable and meaningful, really pulling out the biological relevance instead of just looking for something statistically significant. One of the challenges of of using this is that my chosen numbers for effect size and their relevance is certainly useful for me and my study system but as soon as another species with different habits and behaviours is in play, the biological relevence of my study may not be able to be easily compared with other species. Pūkeko have a rare social and breeding system so it would be hard to compare my results with those from another breeding system.

d. There is not much literature out there looking at the effect sizes for bird eggs. Using an odd's ratio, typically a small effect is 1.5, medium effect is 2 and a large effect is 3. Let's say I use the same numbers. I don't quite understand how to make my own BoMM yet. I don't know how to calculate the effect size yet with my data (or simulated data) to make a priori conclusions based the effect sizes so please pardon me if I am being vague or speculative. Let's say I'll consider an effect size of >2 as biological relevant, biological irrelevant would be an effect size of 0-1.5, and grey area would be between 1.5 and 2.



e.

Experiment 1: Small confidence interval entirely located in the area deemed not biological relevant. The effect is positive but and while the p-value may be significant, there is either lots of data or very precise results concluding that the effect is not biologically relevant.

Experiment 2: Very large confidence interval spanning across the the regions of not biological relevant, grey area, and biological relevant as well as crosses 0. There are no meaningful conclusions to be made from this experiment as the effects are not clear.

Experiment 3: Moderate sized confidence interval entirely positive and located in the region of biologically relevant. Can conclude that the effect is positive and biologically relevant, perhaps a larger sample size could

cut the confidence interval a bit smaller.

Experiment 4: Pretty large confidence interval mostly located in the region of biologically relevant but partly located in the region of grey area. The effect is entirely positive (significant p value) but there is uncertainty regarding its relevance.

Experiment 5: Pretty large confidence interval mostly located in the range of grey area with the ends in the biologically irrelevant and biological relevant regions. P-value will be positive but we cannot draw much of a conclusion from this experiment.

Experiment 6: Small confidence interval located partly in the biologically irrelevant region and grey area. Quite precise results that may potentially have some relevance but stating a positive p-value alone would be insufficient to conclude that there is a relevent effect.

Experiment 7: Small confidence interval located entirely in the biologically irrelevant region evenly split between positive and negative. The counternull value is just as well supported by the data as the null hypothesis that the effect is 0.