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Ranking of Discrete Choice

U. Halekoh[1], E. Jørgensen[1]

M. B. Jensen[2], L.J. Pedersen[2] and M. Studnitz[2]

[1]Department of Genetics and Biotechnology

[2]Department of Animal Health, Welfare and Nutrition

Danish Institute of Agricultural Sciences (DIAS)

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1 Study Question and experiment

EU legislation demands for pigs access to rooting material.

⇒ Task: Find rooting materials preferred by pigs.

Experiment: 6 main categories of rooting material with each of 3 different materials.

Within each category a preference ranking of the materials should be determined
(just two categories are here considered)

Option	soil-like	toy-like
1	compost	bite rite
2	peat	sisal rope
3	wood shavings	stick
4	no choice	no choice

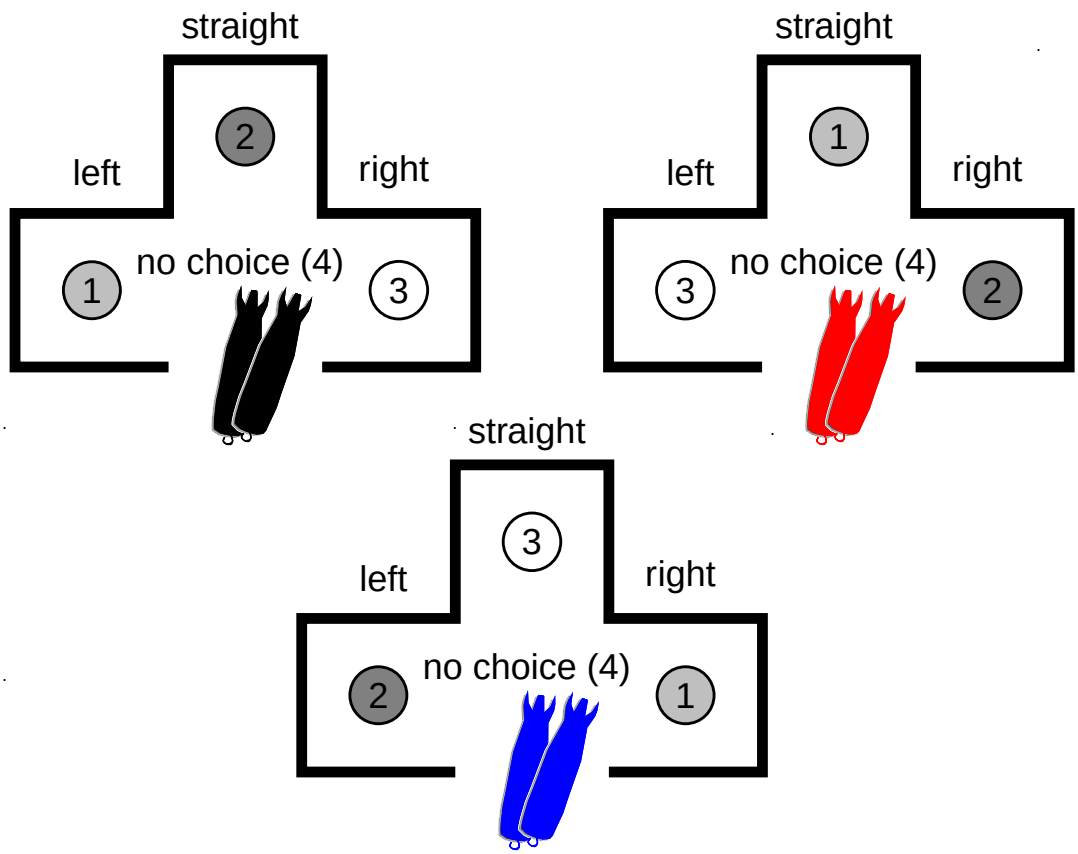
Performance of experiment:

For each of the rooting material categories 12 pairs of pigs were observed at 4 repeated occasions for their choice.

A pair of pig pigs were offered in a 3-arm maze the same combination of

- type of material
- orientation (*left,straight,right)* of the maze-arm, containing the material.

Three combinations of material and maze-arm orientation were used.



2 Ranking problem and modeling

The main goals of the analysis (for each basic rooting material) are

1. Estimation of a ranking of the choices.
2. Description of the variability of an estimated ranking.
3. Taking account of correlations due to repeated measurements.

Often choice experiment are analyzed by non-parametric methods (e.g. Friedman-Test). These methods

- focus on testing the global hypotheses of no preference difference,
- are often not able to reflect the experimental set up.

Proposed model:

The probabilities to choose one of the materials are modeled by a multinomial logistic regression model.

The regression equation contains animal specific random effects to account for the repeated measurement structure.

Ranking of the options $\hat{=}$ Order of the probabilities.

The analysis is based on the Bayesian approach. In this approach it is relatively easy to describe the uncertainty of complex functions (like the ranking) of the regression parameters.

General form of the regression equation for the logits of the probabilities for option k and a reference option K:

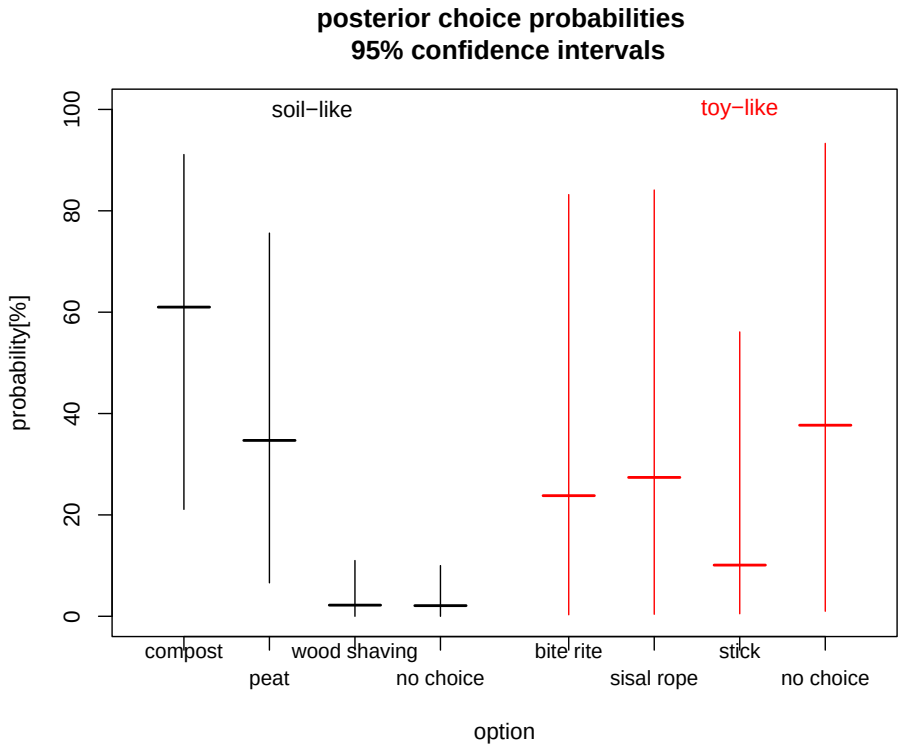
$$\log \frac{P(Y_{at} = k)}{P(Y_{at} = K)} = \boldsymbol{x}'_{atk}\beta + \epsilon_a$$

3 Analysis

The regression equation for the data of the experiment contained

- an effect for the combination of material and maze-arm orientation,
- an effect for the change willingness to make a choice over time.

Aggregating across experimental conditions: Because of the presence of the orientation effect, the ranking was based on the average choice-probabilities of the three different combinations and all observation times.



Uncertainty of the ranking:

For the 'soil like' material the set of rankings with a total of 95% posterior probability is

posterior probability	preference ranking
82%	compost > peat > wood shaving $\approx$ no choice
17%	peat > compost > wood shaving $\approx$ no choice

For the 'toy like' material a 95% posterior confidence set was formed by 20 out of the 24 possible rankings.

4 Resumé

- Modeling choice experiments with a probabilistic model allows
  1. estimating of a ranking (also across several experimental settings)
  2. evaluation of the uncertainty of the ranking
  3. incorporating repeated measurement structures.
- Bayesian computation is feasible with (freely) available software (WinBUGS).
- Points of development:
  1. pairwise experiments for several,options
  2. model choice via Bayes factor

References

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