Generalizability of Decision Models: An Ecological Cross-Validation Approach

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Introduction

Many people tend to assume that the more information is used in a probabilistic inference task the more likely the resulting decision will be correct. The universality of this assumption has been contested by the results of simulations by Czerlinski, Gigerenzer and Goldstein (1999) which showed that when generalized to a new environment, simpler decision models such as Take The Best (TTB) exhibit less decrease in accuracy than more complex models such as multiple regression. We here present ecological cross-validation (ECV) as a different approach to the examination of generalization performance of decision models.

ECV: Procedure and Results

ECV is based on assumptions regarding the information sampling of subjects in real-world decision situations. Essentially, a distinction in familiar and less familiar environments is used to distinguish data sets for training and testing. Consider, for example, a situation where a stock broker´s investment decisions have been learned in an environment such as the U.S. stock market. Assuming that the Asian stock market has different market properties, the robustness of her investment strategies could be more rigorously tested in this structurally new environment. From this perspective, the cue-criterion relationships in the U.S. market would make up the training set, and those from the Asian market would make up the test set for cross-validation. Such a procedure allows to draw more ecological conclusions regarding generalization performance than the split-half standard procedure.

As an illustration of the approach, we show simulation results for inferences about which of two cities has a higher population, when six dichotomous cues are known. Data on the 50 largest cities from two countries – Austria and Germany – were gathered, including the population size (criterion) and the cues: national capital, state capital, university, intercity train station, soccer team in the major league, and eastern/western part of the country. This approach resembles a situation where an Austrian tourist visits Germany (and generalizes her knowledge about Austrian cities to German cities) and vice versa.

The performance of four decision models was compared. Multiple regression was included as the classic normative benchmark in probabilistic inference, together with Dawes´s Rule (unit-weight regression; Dawes, 1979), TTB, and Minimalist. In each of 1000 simulation trials, 50% of the cities from one country were randomly chosen to estimate the decision model (fitting). Subsequently, the estimated model was validated on 50% randomly chosen cities from the other country (test). Relative frequencies of correct inferences by each of the four models were assessed for each trial and averaged across all simulation trials.

Table 1: % correct for the four decision models.

	Fitting: Germany	Test: Austria	Fitting: Austria	Test: Germany
Take The Best	75	69	68	75
Dawes's Rule	81	74	74	80
Minimalist	75	67	67	74
Mult.Regression	77	70	68	76

Tab. 1 shows the results for the different models. The correctness rates refer to those cases only where the model enabled a prediction (i.e., without simulating random decisions, or "guessing"). Comparing the difference between fitting and test across models, previous results (Czerlinski et al., 1999) are confirmed as TTB shows a high robustness. However, the best absolute performance (without guessing) in fitting and generalization was found for Dawes´s Rule. Interestingly, generalization percentages are higher than in fitting when models are fitted to the Austrian and tested on the German city data (due to level differences in cue validity).

Discussion

The simulation results imply an interesting empirical hypothesis, namely that independently of the decision model used, Austrian subjects should be more accurate when inferring about German cities than German subjects inferring about Austrian cities.

We suggest that the illustrated ecological cross-validation approach provides a more valid framework for probabilistic inferences when decision strategies are applied to less familiar environments.

References

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