Fast & Frugal Models of Decision Making with Continuous Data

Gwendolyn E. Campbell (Gwendolyn.Campbell@navy.mil)
Amy E. Bolton (Amy.Bolton@navy.mil)
NAVAIR Orlando TSD, Code 4961
12350 Research Parkway, Orlando, FL 32826-3275

Brian Griepentrog (Brian.Griepentrog@pdri.com)
David Dorsey (David.Dorsey@pdri.com)
Personnel Decisions Research Institutes (PDRI)
1300 N. 17th Street, Suite 1010, Arlington, VA 22209

Introduction

There is compelling evidence that simple heuristics are as capable of predicting many real world phenomena as computationally complex models (e.g., Gigerenzer and Todd, 1999), however not all investigations have found similar results. Campbell and Bolton (2003) evaluated the capability of four Fast & Frugal (F&F) heuristics to fit decision-making data from a military task, and found that more complex modeling techniques yielded statistically significantly better fits. One possible explanation has to do with the technique used in that study to deal with continuous cue variables. Campbell and Bolton (2003) applied the technique proposed by Slegers, Brake and Doherty (2000) to divide continuous variables into a set of decile-based intervals (DBI) using logistic regression analyses. One limitation of this approach is that logistic regression is only appropriate when the relationship between cues and a predictor is monotonic. In this paper we investigate an alternative technique for dividing continuous variables into intervals; the use of fuzzy logic, which is capable of capturing both monotonic and non-monotonic relationships.

Fuzzy Set-Based Intervals (FSBI)

A primary component of a fuzzy model is a set of membership functions, each of which can be expressed as a probabilistic mapping between values along a continuous variable and a particular set or outcome (see Figure 1). Once a model has been derived, the continuous variable can be easily divided into intervals by establishing a threshold probability value. Figure 1 illustrates this approach.

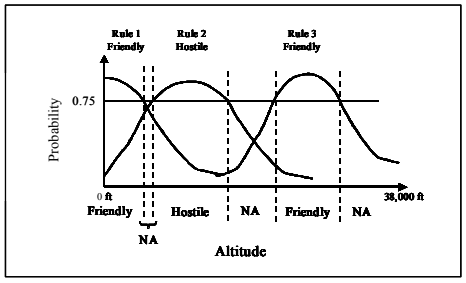

Figure 1: FSBIs Illustrated

In this pilot study, we evaluated the impact of using DBI versus FSBI to identify intervals for continuous variables, on the ability of one particular F&F heuristic (Take-the-Best or TTB) to fit decision-making data.

Method and Results

Description of Data Set

A single, experienced participant completed 98 out of a possible 120 decisions during a military training simulation, with a score of 98% accuracy. There were two categorical and four continuous cues available in the environment.

Model Development

We followed the steps proposed by Slegers and his colleagues (2000) to establish the decile-based intervals. The FSBIs were developed by using a probability threshold of 75% on the fuzzy categories that were derived using the genfis2 algorithm from MatLab©'s fuzzy logic toolkit. Once the intervals were defined, the resulting F&F model was applied to make decision predictions on the data set.

Fit to Decision-Making Data

The fit to decision-making data of the TTB model was statistically significantly higher when FSBI was applied than when DBI was applied (r=0.63, r=0.33).

Summary

While promising, this is a highly preliminary pilot investigation and significant further investigation is required before any conclusions should be drawn.

References

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