Maximum likelihood conjoint measurement: From GLM to GAM

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Résumé

Conjoint measurement is a psychophysical paradigm in which an observer is presented with pairs of stimuli varying independently along several dimensions and is required to order them according to one of those dimensions. Including noise in the decision model makes it possible to estimate the respective contributions of each dimension by maximum likelihood, producing Maximum Likelihood Conjoint Measurement (MLCM). Knoblauch and Maloney (2012) have also shown that this analysis can be reformulated as a special case of the Generalized Linear Model (GLM) with a Bernoulli distribution. These analyses are simplified in R using the MLCM package. In most applications, the number of levels tested along each dimension is small, and they are treated as categorical variables, which ignores the continuous nature of the physical scales and underlying psychophysical functions. If a sufficient number of levels is tested for each dimension, this issue can be addressed by reformulating the problem as a Generalized Additive Model (GAM). A GAM is a penalized GLM resulting in a smooth curve defined by a regression spline where the complexity is constrained by a criterion related to cross-validation. We demonstrate the method using data from a gender comparison task in which the voices and faces of video stimuli varied through morphing along a gender continuum over nearly 20 levels. The use of GAM models is a promising approach for characterizing and testing the contributions of different stimulus dimensions to perception.

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