Imprecise Probabilities: Also a New Paradigm for Statistical Modelling?

Thomas Augustin, Department of Statistics, LMU Munich

The statistical analysis of incomplete data, like nonrandomly coarsened data, typically needs strong further assumptions beyond the basic regression model, in order to make the statistical model identifiable, i.e., for instance, to make parameter estimators unique. Currently, a different way to proceed is gathering momentum. Refraining from strong additional assumptions, sets (!) of models are considered that are optimally compatible with the data (partially identified models, e.g., Manski (2003), Tamer (2010)).

This can be understood as a prototypical example for a set-valued perspective on statistical modeling. It makes the analysis more reliable, and adds imprecision as a new modelling dimension, naturally reflecting data quality: Only ideally precise data lead to precise models, while the reliable analysis of very imprecise data leads to high imprecision in the result. A unifying methodological framework for set-valued models is the theory of imprecise probability, where generally sets of probabilities are understood as the basic entity to describe uncertainty (e.g., Walley (1991), Weichselberger (2001), Augustin et al. (2014)). Imprecise probabilities have proven successful in artificial intelligence ('Dempster Shafer theory') and in reliability analysis in engineering (e.g., Fellin et al (2005)). The talk argues that imprecise probabilities also provide a solid fundament for a general theory for the reliable statistical analysis of complex data, and discusses some basic examples to corroborate this claim. We consider the role of imprecise probabilities as a framework for robustness issues, their ability to model prior data-conflict in Bayesian inference and some models for regression analysis under interval data.

References

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