GRADED APPROACHES TO STOCHASTIC DOMINANCE OF RANDOM VARIABLES

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Background

In many settings, random variables need to be ordered, at least partially. To that end, various notions of so-called stochastic dominance have been put forward. Most of them are based on the pairwise comparison of performance functions, such as the cumulative distribution functions of the random variables, and are related to orderings on expected values. Applications can be found in financial mathematics, insurance, social statistics, decision making, machine learning, etc. Despite their attractive mathematical properties, a drawback of all of these notions is their crisp nature and related intolerance for small violations. This calls for graded approaches expressing meaningful degrees of stochastic dominance. Of course, these degrees should still hold attractive mathematical properties.

Over the past years, at KERMIT we have been looking at winning probabilities as an alternative to expectations. The winning probability of a random variable X over a random variable Y expresses the probability that for a randomly drawn joint observation, the observation of X exceeds that of Y (properly accounting for ties). Most of our investigation has gone into the study of the transitivity of winning probability relations.

In this project, we would like to investigate various graded approaches to stochastic dominance of random variables (and generalizations thereof, such as random sets), and establish links with other uncertainty theories, while focusing on practical usefulness. The prospective student should be interested in probability theory, fuzzy set theory as well as discrete mathematics.

Related reading

B. De Baets, H. De Meyer, B. De Schuymer and S. Jenei, *Cyclic evaluation of transitivity of reciprocal relations*, Social Choice and Welfare **26** (2006), 217–238.

B. De Baets and H. De Meyer, *On the cycle-transitive comparison of artificially coupled random variables*, Internat. J. Approximate Reasoning **47** (2008), 306–322.

B. De Schuymer, H. De Meyer and B. De Baets, *A fuzzy approach to stochastic dominance of random variables*, Lecture Notes in Computer Science 2715 (2003), 253–260.

M. Rademaker and B. De Baets, *Aggregation of monotone reciprocal relations with application to group decision making*, Fuzzy Sets and Systems **184** (2011), 29–51.