Contributions to Nonparametric Predictive Inference for Bernoulli Data with Applications in Finance

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Abstract

Imprecise probability is a more general probability theory which has many advantages over precise probability theory in uncertainty quantification. Many statistical methodologies within imprecise probability framework have been developed today, one of which is nonparametric predicted inference (NPI). NPI has been developed to handle various data type and has many successful applications in different fields.

This thesis firstly further developed NPI for Bernoulli data to address two current challenging issues, the computation of imprecise expectation for a general function of multiple future stages observations and handling of imprecise Bernoulli data. To achieve the former, we introduce the concept of mass function from Weichselberger's axiomatization of imprecise probability theory and Shafer's notion of basic probability assignment. Based on the concept of mass function, an algorithm to find the imprecise expectation measure for a general function of a finite random variable is proposed. We then construct mass function of single and multiple future stages observations in NPI for Bernoulli data by its underlying latent variable representation, which leads to the applicability of the proposed algorithm in NPI for Bernoulli data. To achieve the later, we extend the original NPI path counting method in its underlying lattice representation. This leads to the development of mass function and the imprecise probabilities of NPI for imprecise Bernoulli data. The property of NPI for imprecise Bernoulli data is illustrated with a numerical example.

Subsequently, under the binomial tree model, NPI for Bernoulli data and impre-

cise data are applied to asset and European options trading and NPI for Bernoulli data is applied to portfolio assessment. The performances of both applications are evaluated via simulations. The predictive nature and ability of noise recognition of NPI for precise and imprecise Bernoulli data are validated. The viability for application of NPI in portfolio assessment is confirmed.