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A fuzzy regression model based on finite fuzzy numbers and its application to real-world financial data

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Abstract

Different sources of imprecision and uncertainty are encountered in practical problems and, thus, many elements may need to be imprecisely observed, defined or treated. In this setting, one of the most successfully applied techniques to describe possible relationships between fuzzy variables is the regression methodology. In this paper, we introduce a fuzzy regression procedure involving a class a fuzzy numbers defined by some level sets called finite fuzzy numbers. We give a characterization of the image of a finite fuzzy number in terms of the extremes of its level sets and we present a parametric family of fuzzy semidistances between them that let us to consider a total fuzzy error of estimation (described as a fuzzy sum of squares of residuals in particular cases). The estimation process consist in finding a regression model that minimizes, in a fuzzy sense, such fuzzy error. Although spreads of finite fuzzy numbers can take some values very close to zero, which complicate the task of finding nonnegative models, the presented algorithm is able to guarantee that the predicted response is a fuzzy variable. Finally a numerical example based on fuzzy economic data of China is given to illustrate the use of the proposed method.

Keywords: Finite fuzzy numbers, Fuzzy random variable, Fuzzy distance measure, Fuzzy regression

1. Introduction

In many real-life situations the information associated with some random experiments is perfectly measurable but, in many cases, is only valuable. Nowadays the management of uncertainty (also called imprecision, vagueness or ambiguity) has two approaches that are not competitive each other but complementary: the probabilistic approach and fuzzy approach.

The theory of fuzzy sets (introduced in 1965 by Zadeh [22]) is a very useful tool for modeling these situations. To give a fuzzy approach to a classical problem allows the incorporation of

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