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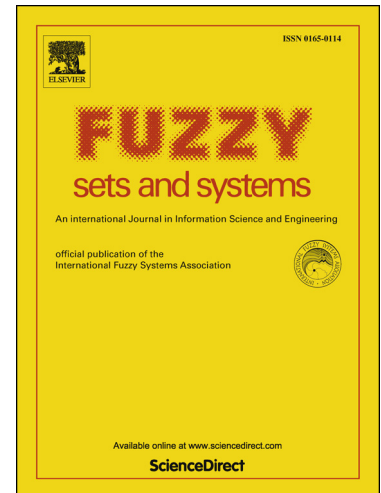
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Possibilistic Linear Regression with Fuzzy Data: Tolerance Approach with Prior Information

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Abstract

We introduce the tolerance approach to the construction of fuzzy regression coefficients of a possibilistic linear regression model with fuzzy data (both input and output). The method is very general: the only assumption is that α -cuts of the fuzzy data are efficiently computable. We take into account possible prior restrictions of the parameters space: we assume that the restrictions are given by linear and quadratic constraints. The method for construction of the possibilistic regression coefficients is in a reduction of the fuzzy-valued model to an interval-valued model on a given α -cut, which is further reduced to a linear-time method (i.e., running in $O(np)$) computing with endpoints of the intervals. The speed of computation makes the method applicable for huge datasets.

Unlike various approaches based on mathematical programming formulations, the tolerance-based construction preserves central tendency of the resulting regression coefficients. In addition, we prove further properties: if inputs are crisp and outputs are fuzzy, then the construction preserves piecewise linearity and convex shape of fuzzy numbers. We derive an $O(n^2p)$ -algorithm for enumeration of breakpoints of the membership function of the estimated coefficients. (Here, n is the number of observations and p is the number of regression parameters). Similar results are also derived for the fuzzy input-and-output model.

We illustrate the theory for the case of triangular and asymmetric Gaussian fuzzy inputs and outputs of an inflation-consumption model.

Keywords: Possibilistic regression, fuzzy regression, linear regression, constrained regression, tolerance quotient

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