Neural Network Approach to Fuzzy Minmad Regression

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1. Introduction

In this paper, we propose the Fuzzy Minimum Mean Absolute Deviations (MINMAD or the minimum of sum of absolute errors (MSAE) L1 norm) criterion for estimating the unknown parameters of multiple linear regression model. Using the fuzzy MINMAD criterion the estimation problem can be formulated as linear programming and solved by neural network.

2. Artificial Neural Networks

The Artificial Neural Network is a system that simulates the human brain. In other words, it makes computations by partly realizing some characteristics of the human brain through artificial ways. These computations come out with the help of nodes and connections that together take the form of a tight network. The most basic element in this system is called artificial neuron, only neuron or node in short. Networks consisting of interconnected neurons prove to be functional in the solution of complex problems [5].

Each model of generalized artificial neuron is composed of a single decisive element and a single exit where entries also exist. Networks are also grouped in two categories as feedforward and feedback. A feedback system can be obtained by applying the exit of neurons to entry in a feedforward system. The purpose of a feedback system is the controlled comparison of exit o (t) at the moment (t) with exit o (t + Δ t) at the moment (t + Δ t). In such a network, the system is also called a repetitive system since exit in step k is used as entry in step k +1. And this new entry is subject to same operations as applied to the previous entry. When values in two consecutive steps are the same, the system reaches its balance and the process of solution ends at this stage.

3. Fuzzy Minmad Regression

There is uncertainty that the crisp function in classic regression analysis presents the relationship between the dependent and independent variables, it is more realistic to use fuzzy regression analysis in real world problems. Fuzzy linear regression analysis can be examined in two main subtitles as; "fuzzy linear regression analysis with crisp data and fuzzy parameters" and "fuzzy linear regression analysis with crisp parameters and fuzzy data" [4]. The classical regression model where i=1,...,n and j=1,...,p; is in the form of,

$$Y_i = \sum_{i=1}^{p} X_{ij} \boldsymbol{b}_j + e_j$$

In the regression model above, values of input and output variables are fuzzy numbers, assumed to be triangular and symmetric. The fuzzy regression model is defined by;

$$Min \sum_{k=1}^{3} d^{+-}$$

$$s.t. \sum_{j=1}^{m} \left| s_j - \sum_{i=1}^{n} \left| b_i \right| s_i^{(j)} \right| + d_1^- - d_1^+ = 0$$

$$-\sum_{i=1}^{n} \left| b_i \right| s_i^{(j)} + \sum_{i=1}^{n} b_i x_i^{(j)} + d_2^- - d_2^+ = y^{(j)} - s^{(j)},$$

$$\sum_{i=1}^{n} \left| b_i \right| s_i^{(j)} + \sum_{i=1}^{n} b_i x_i^{(j)} + d_3^- - d_3^+ = y^{(j)} - s^{(j)},$$

$$a_i \in R \ \ for all \ i \in N_n \ and \ all \ \ j \in N_m$$

$$x_i^{(j)} =< x_i^{(j)}, s_i^{(j)} >, \ y^{(j)} =< y^{(j)}, s^{(j)} >$$

4. Neural Network Approach to Fuzzy Minmad Regression

Artificial neural network models have recently started to come to the fore among other methods used in many areas of science. This preference for artificial neural network models derives from its success in allowing desired analyses on complex data. Furthermore, the feasibility of transferring problem solving steps to electronic environment also enhances the attractiveness of neural networks. In this part of the study which addresses the subject of neural networks approach to the simplex algorithm developed for the solution of fuzzy regression problems in which MINMAD criteria are used, the objective is to reach the solution of the problem modeled as a linear programming problem [1]. The solution of this linear programming problem through neural networks approach consists of two phases. The first phase is the remodeling of the problem. In this phase, the linear programming model is reformulated as

P1: $\text{Min } E(\beta, d, \lambda) = C^T d + \lambda p(\beta)$

β is not signified

$d_1, d_2 \geq 0$.

as an unconstrained optimization problem. In the P1 model, $E(\beta, d, \lambda)$; value function, $p(\beta)$; non-negative penalty function, and β; space covering the area necessary for an appropriate solution of the linear programming problem under question [3,2].

The second phase is related to state balancing. In this second phase, the repetitive neural network moves from its original location to a fixed situation. The solution is obtained when balance is established. The penalty function and value functions defined in the model are computed, respectively, by the following equations, where the X and Y are fuzzy number;

$$p(\boldsymbol{b}) = \left(\tilde{X}\boldsymbol{b} - \tilde{Y} \right)^T \left(\tilde{X}\boldsymbol{b} - \tilde{Y} \right) / 2$$

$$E\left[\boldsymbol{b}(t), d(t), \boldsymbol{l}(t) \right] = C^T d(t) + \boldsymbol{l}\, p\left(\boldsymbol{b} \right)$$

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RESUME

Dans ce travaille on determinera l' approche de "Réseaux neuronaux" au probleme de "Fuzzy MINMAD Régression".