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A new neural network model for solving random interval linear programming problems

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Abstract

This paper presents a neural network model for solving random interval linear programming problems. The original problem involving random interval variable coefficients is first transformed into an equivalent convex second order cone programming problem. A neural network model is then constructed for solving the obtained convex second order cone problem. Employing Lyapunov function approach, it is also shown that the proposed neural network model is stable in the sense of Lyapunov and it is globally convergent to an exact satisfactory solution of the original problem. Several illustrative examples are solved in support of this technique.

1 Introduction

Theory of probability is an important tool for describing the complexity of uncertain parameters. The occurrence of randomness in the parameters can be modeled as stochastic programming problem. Uncertain parameters in stochastic programming are often random variables with known probability distribution. Random variable parameters have been applied in such different fields as economy Hildenbrand (1974), stochastic geometry Mathéron (1975) or dealing with imprecise information Kruse & Meyer (1987). The concept of satisfactory solution for stochastic problems are based on transforming the stochastic objectives by using some statistical features such as variance, expected value, quantiles, etc. The obtained function which can be replaced by the origin stochastic objective is called the deterministic equivalent function. There are many approaches in the literature which can be used for solving stochastic programming Sakawa et al. (2011) and Kall & Mayer (2005).

Among random sets, random interval variables are especially interesting and popular. One of their advantages respect to other types of random sets is their easy interpretation as a model for uncertainty and imprecision. In these variables, each value of the random variable is expressed within an interval. In other words, this kind of variable simultaneously involves properties of random variables and intervals. An important work which has investigated these variables, completely, is presented by Miranda et al. (2005). They have regarded the random interval variable as the imprecise observation of a random variable, and studied some information about the probability distribution of this random variable.

Some studies about random intervals in statistics and engineering exist in the literature, see Dempster (1968), Dubois & Prade (1987) and Lu et al. (2015). Moreover, some basic studies about the main characters of random intervals such as the range of the expectation value, variance, covariance, and correlation coefficient have been done in the literature, see Ferson & Ginzburg (2005), Hansen (1997), and Kearfott (1996). In addition to these works, optimization problems involving random interval parameters have been investigated in Arjmandzadeh & Safi (2016b) and Arjmandzadeh & Safi (2016a). In these studies, such characters as variance and mean value of random interval parameters have been used for

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