A bilinear programming method of bi-matrix games with intuitionistic fuzzy set payoffs

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The aim of this paper is to develop a bilinear programming method for solving bi-matrix games in which the payoffs are expressed with intuitionistic fuzzy (IF) sets (IFSs), which are called IF bi-matrix games for short. In this method, using the equivalent relation between IFSs and interval-valued fuzzy sets (IVFSs) and the operations of IVFSs, we propose a new order relation of IFSs through introducing a ranking function, which is proven to be a total order relation. Hereby we introduce the concepts of solutions of IF bi-matrix games and parametric bi-matrix games. It is proven that any IF bi-matrix game has at least one satisfying Nash equilibrium solution, which is equivalent to the Nash equilibrium solution of corresponding parametric bi-matrix game. The latter can be obtained through solving the auxiliary parametric bilinear programming model. The method proposed in this paper is demonstrated with a real example of the e-commerce retailers’ strategy choice problem.

Keywords: Noncooperative game; Intuitionistic fuzzy set; Bilinear programming; Fuzzy game