Abstract

This thesis considers new directions of *two-person zero-sum and two-person non-zero-sum game problems* through various uncertain environments, and employs solution methodologies to expertly and decently solve these problems. Game theory, as a part of the decision-making problems of applied science, contributes knowledge into financial matters like shopping-marketing management problems, humanism like sentimental analysis, in medical diagnoses, etc., with numerous different orders in different fields. Game theory effectively affects the hypothesis of economics, financial aspects, and the literature on applying game theoretical and related ways to economics is developing exponentially, yet numerous hypothetical and observational challenges remain in this field. The main causes of these theoretical-empirical challenges are due to the environments under realization. The focal point of this thesis is the utilization of game theories to issues in financial aspects, including monetary hypothesis where production, online shopping-marketing management of economy-field pull the attractive parts of game theory; to issues in business analyses; to problems in socio-economic structures like strike-policy; to everyday issues in human-centric like environment oriented problems, e.g., water management; to socio-political problems like human trafficking in different uncertain environments. Crisp set, as a whole, is not possible to depict the causes and effects of the problems. That's why fuzzy set, intuitionistic fuzzy set, hesitant fuzzy set, interval-valued fuzzy set, neutrosophic set, linguistic term set, and their collaborative forms are raised.

The objective of the thesis is to explore the game theory under the shadow of different uncertain environments. The all possible outcomes of the players in game are arranged and displayed in matrix or matrices, termed as payoff matrix or matrices with elements as payoff elements. In this thesis the payoff elements are defined under uncertainty with various types of uncertain environments with their pros and cons and applicability in real-world examples.

Initially, two-person zero-sum game in triangular intuitionistic fuzzy entities with a newly proposed robust ranking technique, the related advantages and disadvantages with others are described and verified by real-life problems. Secondly, extended version of triangular intuitionistic fuzzy number as triangular type-2 intuitionistic fuzzy number is discussed with a new ranking function having an application to real-life problems as a game problem. Two-person zero-sum game phenomenon in linguistic neutrosophic environment and in hesitant triangular intuitionistic fuzzy numbers are discussed thereafter. Matrix method of 2×2 two-person zero-sum game and artificial hybrid neural net based structures to these two different game problems are generated towards optimal solutions of game problems, separately. Consequently, problems from real-world are taken arbitrarily as examples. After discussing on two-person zero-sum games, two-person non-zero-sum games are introduced in uncertain environments like hesitant interval-valued intuitionistic fuzzy linguistic term set. Nash equilibrium concept is originated here with Prisoners' Dilemma game theory. Lastly, two-person non-zero-sum game in single-valued triangular neutrosophic environment is treated with related cut-set approach. Several methods, approaches like

maximin-minimax principle based method, mixed strategy method, methods of linear programming problem and quadratic programming problem, TOPSIS, cut-set approach, interval analysis, ranking function, robust ranking technique; and their extended forms are used in this thesis to achieve the optimal situations in each cases through realistic examples.

Key Words: Two-Person Zero-Sum Game (Matrix Game), Two-Person Non-Zero-Sum Game (Bi-matrix Game), Nash Equilibrium Strategy and Outcome, Fuzzy Matrix Game, Prisoners' Dilemma, Triangular Fuzzy Number, Triangular Intuitionistic Fuzzy Number, Triangular Type-2 Intuitionistic Fuzzy Number, Hesitant Interval-Valued Intuitionistic Fuzzy Set, Neutrosophic Set, Single-Valued Triangular Neutrosophic Number, (α, β, γ)-cut set, Linguistic Term Set, Linguistic Neutrosophic Number, Artificial Neural Network, Logic Gates, Ranking Function, Robust Ranking Technique, Score and Accuracy Functions, TOPSIS, Takagi-Sugeno Model, Water Management, Medical Diagnosis, Human Trafficking, Shopping-Marketing Management Problem.