ABSTRACT

Decision making in any given problem first requires the mathematical formulation of the model. In the field of operations research, many problems have been solved by allocating them into multi-stage decision-making problems. In multi-stage decision-making problem, the actual problem is partitioned into multi-stage problems. Where each stage contains its own problem, which needs to optimize by taking the suitable decision at that stage. A transformation equation unites all the stages which use the optimal return from its previous stages and gives the optimal return of the actual problem at its last stage.

The modeling of the real life data into mathematical form requires as much information as possible. The information by which a model is constructed contains a lot of uncertainty. There are mainly two types of uncertainty present in the literature (i) Uncertainty due to impreciseness (or vagueness) i.e. fuzziness and (ii) Uncertainty due to randomness. For solving an optimization model, decision-makers have to deal with the situations where the parameters of the model contain the information which is either fuzzy imprecise or probabilistic random or simultaneously contains both of them. The objective of this thesis, therefore, is to deals with the situation where decision makers need to take the decisions in multiple stages and the information known to the decision makers is either fuzzy imprecise or probabilistic random or simultaneously contains both of them.

Now there are various optimization models (either contain the fuzzy parameter or contains both fuzzy and random) which can be solved by multi-stage decision making using dynamic programming. Dynamic programming is an optimization technique, it is used when decisions are made in stages. At every stage, it takes the decisions which are based on the sum of the immediate return and the approximate return of the future stage, assuming the optimal decision has been made for the following stages. In modern life, industry, economic and engineering, the decision makers are surrounded by the optimization problems which are too vast in prediction and due to the expansion, it is difficult to solve. Thus keeping this difficulty and application of these type of problem in different areas in mind, the methods based on multi-stage decision-making have been given to solve these type of optimization problem in this thesis. The principal features in different models which are discussed in this thesis are as follows:

Knapsack Problem (Deterministic and Fuzzy weights):

- Studied the case where the weights are fuzzy and to compare the weights an index of possibility has been given.

Bi-level Programming:

- Studied the case where the coefficients of objective functions and constraints are fuzzy random variable.
- Studied the case where the functional relation between the objectives and constraints are defined linguistically.

Fuzzy rule-base in multi-objective programming:

- Studied and analyzed the case where fuzzy implications are used to express the control rule between the objective functions and constraints in multi-objective programming.

Separable fuzzy non-linear programming problem:

- Studied the separable fuzzy non-linear programming problem where the coefficients of objective function and constraints are fuzzy number.

Keywords: Multi-stage decision making, Dynamic programming, Imprecision, Uncertainty, Knapsack problem, Fuzzy random variable, Linguistic variable, Fuzzy stochastic bi-level programming, Fuzzy rule base, Fuzzy inequality, Fuzzy rule-based multi-objective Optimization.