Decision-making (DM) is undoubtedly one of the most fundamental activities of human life. It is an absolute fact that various problems demand decisions to be taken even if the outcomes are uncertain or the probability of the occurrences of the outcomes is unknown. Therefore, the necessity of a standard decision-making framework cannot be denied. The problem of decision-making can be viewed from two aspects: firstly, how decisions are made and secondly, the characteristics of the underlying context i.e. decision-making under certainty, risk, uncertainty, ignorance. Decision-making was greatly dominated for centuries by normative decision-making theories that deal with how decisions should be made and rely on the rationalistic ideology. Empirical studies have proved that human beings are not always rational in making decisions and often violate the axioms of the normative decision theory. Therefore, another type of decision-making model has been researched in order to explain the paradoxes that violate the basic tenets of the normative models. This stream of decision-making is known as ‘descriptive’ decision-making model. The descriptive decision-making models seek to explain and predict how people actually make decisions. The second aspect of decision-making is the underlying context of the decision problem that explains whether the decision-making is being done under certainty, risk, uncertainty or ignorance. Due to the widespread presence of risk and uncertainty in decision-making problems of various disciplines, decision-making under risk and decision-making under uncertainty have grasped the attention of the research communities. Yet, significant shortcomings have been observed in the existing researches that motivated us to focus on developing a standard decision-making framework.

Inspired by the fundamental characteristics of descriptive decision theory, this research hypothesizes that different attitudes of human being towards uncertainty may have a significant impact on the decision-making paradigm. For proving the hypothesis, a descriptive decision-making framework under uncertainty using Dempster-Shafer Theory (DST) and Prospect Theory (PT) has been proposed in this research which is the major contribution of this study. The proposed framework is capable of dealing with uncertainty present in any decision-making problem and demonstrating the decision varieties of people in different decision attitudes. The decision-making problem is defined using the conventional yet popular representation approach including alternative, states of nature, outcomes and corresponding utilities. The uncertainty has been represented using Dempster-Shafer Theory of Evidence where a basic belief assignment (bba) is associated to each subset of the set of states of nature. This representation of uncertainty is more robust compared to the existing theories of decision-making under uncertainty. In the process of deriving the decisions, the problem is first transformed into a decision-making problem under risk by approximating the probabilities from bba in three different attitudes of a human decision-maker by the use of Ordered Weighted Averaging (OWA) operators. Considering the importance of human attitude in decision-making, this research has incorporated human attitude within the proposed DM framework in order to explain decision variety depending on attitudes toward uncertainty and demonstrates how numerous attitudes of human can be mathematically expressed by changing the parameters of OWA operator which was unexplored by contemporary researches. The mathematical expressions for explaining human attitudes can also be considered as one of the contributions of the research. Apart from this, the
proposed framework solves the previously unsolved problem of lack of consideration between the probability weighting function and that of bba.

While dealing with uncertainty, it is required to take into account the existence of multiple information sources providing evidences for the hypothesis in question. Evidence combination implies the aggregation of uncertain pieces of information issued from different sources dealing with the same problem. This research considers this issue and contributes by proposing a new method of evidence combination based on weighted average and reliability of the information sources.

From the very onset, the objective of this research has been to demonstrate the decision variety of people in decision-making under uncertainty by proposing a descriptive decision-making model. To reach the ultimate goal, Prospect Theory has been applied to the decision-making problem for deriving people’s decisions under uncertainty. For validation of our approach, it has been applied to an example problem of decision-making about lung cancer treatment where the patients and/or their caregivers are the decision-makers. In the example application problem, a patient whose stage of lung cancer is yet unknown is provided with the possible treatment alternatives along with their corresponding outcomes. Based on the patient’s real-life circumstances as well as his viewpoint towards uncertainty, a patient may choose a treatment from the available set of alternatives. It has been evident from this example problem that human beings are not always rational and their decisions often vary on the basis of their attitudes or outlooks toward uncertainty. This type of decision-making framework can readily be used in the shared-decision-making area which is an emerging trend of today’s health-care decision-making.

The summary of the key contributions of the research are as follows: (i) it proposes a descriptive decision-making framework (named as NY-DDM) that is superior to the descriptive DM frameworks presented in the past. This model can explain many forms of human attitudes observed in human life which were unexplored by the existing researches but have significant impact on the decision-making process. (ii) Furthermore, NY-DDM solves the problem of the lack of consideration about the difference between the weighting function of probability and the one of bba by converting the EDMP into a probabilistic decision-making problem. As a result, this simplifies the calculation. (iii) The presence of multiple information sources is considered in this research and a new method of evidence combination is proposed which is based on weighted averaging and the reliability of the information sources. The proposed combination method has shown improved performance than the existing evidence combination rules for uncertainty representation in this research. (iv) This research also proposes the values of three coefficients used in value function and weighting function of PT for the domain of health that explains the risk attitudes of people in decision-making. (v) Last but not the least, the example application of lung cancer treatment DM problem proves that the framework is efficient enough to understand and analyze the decision psychology of a decision-maker. Therefore, not only from the theoretical viewpoint, this research also has important social contribution.

Compared to the contemporary DM models, our proposed model is more robust in uncertainty expression which makes it more efficient in explaining human attitudes and decisions. Therefore, this research is possible to be applied to the decision support systems requiring the analysis of human attitudes and human decision-making.