Prologue

1.1 Introduction

Selecting a best suitable from a set of available alternatives is called Multi-criteria Decision-Making (MCDM). Incredible efforts have been spent and significant advances have been made towards the development of numerous MCDM methodologies for solving different types of problems. Classical MCDM methods along the line of multi-attribute utility theory require the determination of alternative ratings and criteria weights by eliciting the decision maker's judgments/preferences. Crisp values are commonly used to represent these ratings and weights, which are implicitly or explicitly aggregated by a utility function. The overall utility of an alternative represents how well the alternative satisfies the DM's objective. Alternatives with higher utilities are said to be preferred. In practical applications, alternative ratings and criteria weights cannot always be assessed precisely. Subjectiveness and vagueness are often involved which may come from various sources, including unquantifiable information, incomplete information, unobtainable information and partial ignorance. Classical MCDM methods cannot effectively handle problems with such imprecise information.

Decision making is the process of choosing from a set of alternatives. It is a fundamental aspect of everyday's mental processes. Decisions are often made under conditions of uncertainty, when the payoffs are probabilistic unknown. The study of decision making has been approached from different perspectives, including philosophical, behavioural, biological, mathematical and computational approaches, yet a large number of challenges remain in understanding this important of higher cognition (Mohanty, Suar, 2014). Why and how do people make decisions under uncertainty situations? From an evolutionary perspective, decision making under uncertainty may be adoptive in certain circumstance; for example, decision makers shift from risk aversion to risk preference in situations of a high need, where a need describes inconsistency between and individual's existing state and desire state. Problems in decision making result due to their vagueness, lack of information, having less time to think, partial information etc. Given the magnitude of a decision, people think less under certain situations and more under uncertain situations.

MCDM analysis has some unique characteristics such as the presence of multiple and conflicting criteria, different units of measurement among the criteria, and the presence of quite different alternatives. It is an attempt to review the various MCDM methods and need was felt of further advanced methods for empirical validation and testing of the various available approaches for the extension of MCDM into group decision-making situations for the treatment of uncertainty.

The application of fuzzy sets theory to MCDM models provides an effective way of dealing with the subjectiveness and vagueness of the decision-making process for the general MCDM problem [1]. By using linguistic terms with fuzzy number representation, the DM can effectively express his/her subjective assessments. The DM's preference in comparing alternatives or criteria can be better modelled. Most fuzzy MCDM models based on classical utility theory involve two phases

- The aggregation of the fuzzy assessment with respect to all criteria for each alternative and
- The ranking of alternatives based on their aggregated overall assessments (fuzzy utilities).

Life insurance policy provides you the assurance that your family will get financial security and support even when you are not around. This is the best way where the insured person can save his family from financial crisis at the time of any misshapen or after death [37]. Life insurance policies are broadly categorized into two types: Life Insurance Product and Non-Life Insurance Product. Life insurance products are like Term Life insurance, Whole Life insurance, Endowment life insurance, Money Back insurance, Unit Linked insurance, Retirement plans, saving and investment plans, Child insurance and Health insurance etc.

Online term plan give you regular intervals to make your moments even more memorable. This plan gives you a double benefit of guaranteed money back at regular intervals along with protection in case of an unforeseen eventuality [39]. An important feature of this type of policies is that in the event of death at any time within the policy term, the death claim

comprises full sum assured without deducting any of the survival benefit amounts, which have already been paid. Similarly, the bonus is also calculated on the full sum assured.

The work is related to ten criteria: Average claim ratio, Entry age, Maturity, Policy term, Premium, Sum assured, Premium payment term, Premium payment frequency, Rebate on the large sum assured, Riders. Fuzzy TOPSIS is applied for ranking of online term policy of different insurance companies. The companies that are under consideration are ICICI, LIC, HDFC, SBI, MAX, BAJAJ ALLIANZ, BHARTI AXA, CANARA HSBC, RELIANCE, KOTAK MAHINDRA, AEGON RELIGARE, and AVIVA. The results show that Life Insurance Corporation Company is the best for online term policy and provides the best facility to the customer.

1.2   Problem Statement

Insurance is one of the most developed activities in the world today, with remarkable financial capacities and funds. By issuing life insurance policies as financial instruments and through the long-term placement of free funds, insurance companies occupy a significant place in developed financial markets as institutional investors. Life insurance growth, i.e. the transfer of insured risks to an insurance company by means of life insurance premiums, increases total available funds insurance companies can place on a financial market. The goal of insurance funds placement is protecting insurance policyholders from the risk insured against and generating maximum profit on placed funds.

Early detection of diabetes has attracted significant research interest. Detection and diagnosis of diabetes at an early stage is the need of the day. A classifier is required and needed to be designed that is cost effective, continent and accurate. So we have concluded to examine **"Machine Learning Approach for Classification of Diabetes disease"**. This problem is chosen because Diabetes has now become a major public health concern associated with increase morbidity, mortality and cost of health services. Therefore machine learning techniques have been considered to design automatic diagnosis system for diabetes. Supervised learning techniques like ANFIS, ANN with Levenberg-Marquardt (LM) back propagation approach, Scaled Conjugate Gradient (SCG) back propagation approach and SVM are used.

With the continuing proliferation of decision methods and their modifications, it is important to have an understanding of their comparative value. Each of the methods uses numeric techniques to help decision makers choose among a discrete set of alternative decisions. This is achieved on the basis of the impact of the alternatives on certain criteria and thereby on the overall utility of the decision makers.

Despite the criticism that multi-dimensional methods have received, some of them are widely used. The weighted sum model (WSM) is the earliest used method. The weighted product model (WPM) can be considered as a modification of the WSM, and has been proposed in order to overcome some of its weaknesses [1]. The analytic hierarchy process (AHP), as proposed by Saaty is a later development and it has recently become increasingly popular [14][15]. Professors Belton and Gear suggested a modification to the AHP that appears to be more powerful than the original approach. Some other widely used methods are the ELECTRE and TOPSIS [21].

Multi-Criteria Decision-Making (MCDM) plays a critical role in many real life problems. It is not an exaggeration to argue that almost any local, industry or business activity involves in one way or the other, the evaluation of a set of alternatives in terms of a set of decision criteria. Very often these criteria are conflicting with each other. Even more often the pertinent data are very expensive to collect.

Insurance is the most significant technique for reducing risk [37]. The insurance concept has many possible definitions, which emerge from various viewpoints. In the economic and legal sense, insurance provides a contract that is used to protect the policyholder (the insured) against risks and uncertain losses. From a business viewpoint, insurance is a risk management plan that allows a business to transfer all risks and losses to an insurance company [38][43]. By paying a relative premium (fee) to the insurance company (the insurer), this company can protect the policyholder (the insured) against the possibility of risk and large financial loss. In addition, the insured obtains a contract, which is called an insurance plan. It includes all circumstances, terms and conditions under which the insured is indemnified during the period of insurance. The insurance market is made up of many different branches, like most other markets and business. For example, but not exclusively, the insurance industry includes home insurance, life insurance, vehicle (car) insurance, health (medical) insurance, travel insurance etc.

1.3 Research objectives

With the continuing proliferation of decision methods and their modifications, it is important to have an understanding of their comparative value. Each of the methods uses numeric techniques to help decision makers choose among a discrete set of alternative decisions. This is achieved on the basis of the impact of the alternatives on certain criteria and thereby on the overall utility of the decision makers. Despite the criticism that multi-dimensional methods have received, some of them are widely used. The weighted sum model (WSM) is the earliest used method. The weighted 3 product model (WPM) can be considered as a modification of the WSM, and has been proposed in order to overcome some of its weaknesses [1]. The analytic hierarchy process (AHP), as proposed by Saaty is a later development and it has recently become increasingly popular [14][15]. Professors Belton and Gear suggested a modification to the AHP that appears to be more powerful than the original approach. Some other widely used methods are the ELECTRE and TOPSIS [21]. Multi-Criteria Decision-Making (MCDM) plays a critical role in many real life problems. It is not an exaggeration to argue that almost any local, industry or business activity involves in one way or the other, the evaluation of a set of alternatives in terms of a set of decision criteria. Very often these criteria are conflicting with each other. Even more often the pertinent data are very expensive to collect. Insurance is the most significant technique for reducing risk [37]. The insurance concept has many possible definitions, which emerge from various viewpoints. In the economic and legal sense, insurance provides a contract that is used to protect the policyholder (the insured) against risks and uncertain losses. From a business viewpoint, insurance is a risk management plan that allows a business to transfer all risks and losses to an insurance company [38][43]. By paying a relative premium (fee) to the insurance company (the insurer), this company can protect the policyholder (the insured) against the possibility of risk and large financial loss. In addition, the insured obtains a contract, which is called an insurance plan. It includes all circumstances, terms and conditions under which the insured is indemnified during the period of insurance. The insurance market is made up of many different branches, like most other markets and business. For example, but not exclusively, the insurance industry includes home insurance, life insurance, vehicle (car) insurance, health (medical) insurance, travel insurance etc.

Classification is one of the most important decision making technique in real world problem. The main objective of this study is to classify the data as diabetic or non-diabetic and

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improve predictive performance of various machine learning approaches. In this study we have considered various machine learning approaches and ensemble them to find the best results in terms of accuracy, specificity and sensitivity.

Research findings provide useful insight for consumers for selecting insurance company for purchasing insurance under conflict situation. A mathematical model have been introduce with MCDM approach having following steps, In step 1, we select the insurance policy from different policies. In step 2, we identify the criteria for selecting the best life insurance company for purchasing an online term policy. These criteria are Average claim ratio, Entry age, Policy term, Maturity, Sum assured Premium, Premium payment term, Premium payment frequency, Rebate on the large sum assured, Riders etc. In step 3, the alternatives of companies are determined. The decision makers provide a judgement for the criteria and alternatives of companies in step 4. We evaluate the aggregated score for all alternatives by using fuzzy TOPISS methodology. Finally, we have chosen the highest score for implementation. In last step sensitivity analysis is performed on the decision making process to evaluate the effectiveness of criteria weights. Finally, we conclude that our propose model is the ability to deal with the MCDM problem and it can be applied to choose the best insurance company for purchasing an online term policy

1.4 Organization of thesis

This dissertation consists of two independent studies on multi-criteria decision making. The first study based on the multi-criteria decision in ranking of Life Insurance Companies in India by using fuzzy TOPSIS. The second study fuzzy multi-criteria decision making using machine learning approach for classification of diabetics' disease. In Chapter-2 extensive survey carried out on multi-criteria decision making. Chapter 3 covers research design, results, analysis and conclusion of the first study. The result summary of the first study was discussed in chapter4.

Chapter 5 introduce about fuzzy decision making for classification of diabetic disease. In this chapter, comparative risk analysis also discussed on the prediction of diabetes disease using ANFIS and ANN approach. In chapter 6 other to approach using ANN and SVM for classification of diabetic disease elaborated. Summary of findings of the second study discussed in chapter 7. In last chapter 8 summary of the findings, discussion the implication of findings,

contributes and state of the agenda for future research, limitation of the research are also discussed.

This section briefly overviews the structure of the thesis. The thesis consists of Eight chapters. The thesis structure is presented in Figure 1.1 and a brief description of each chapter is summarised below:
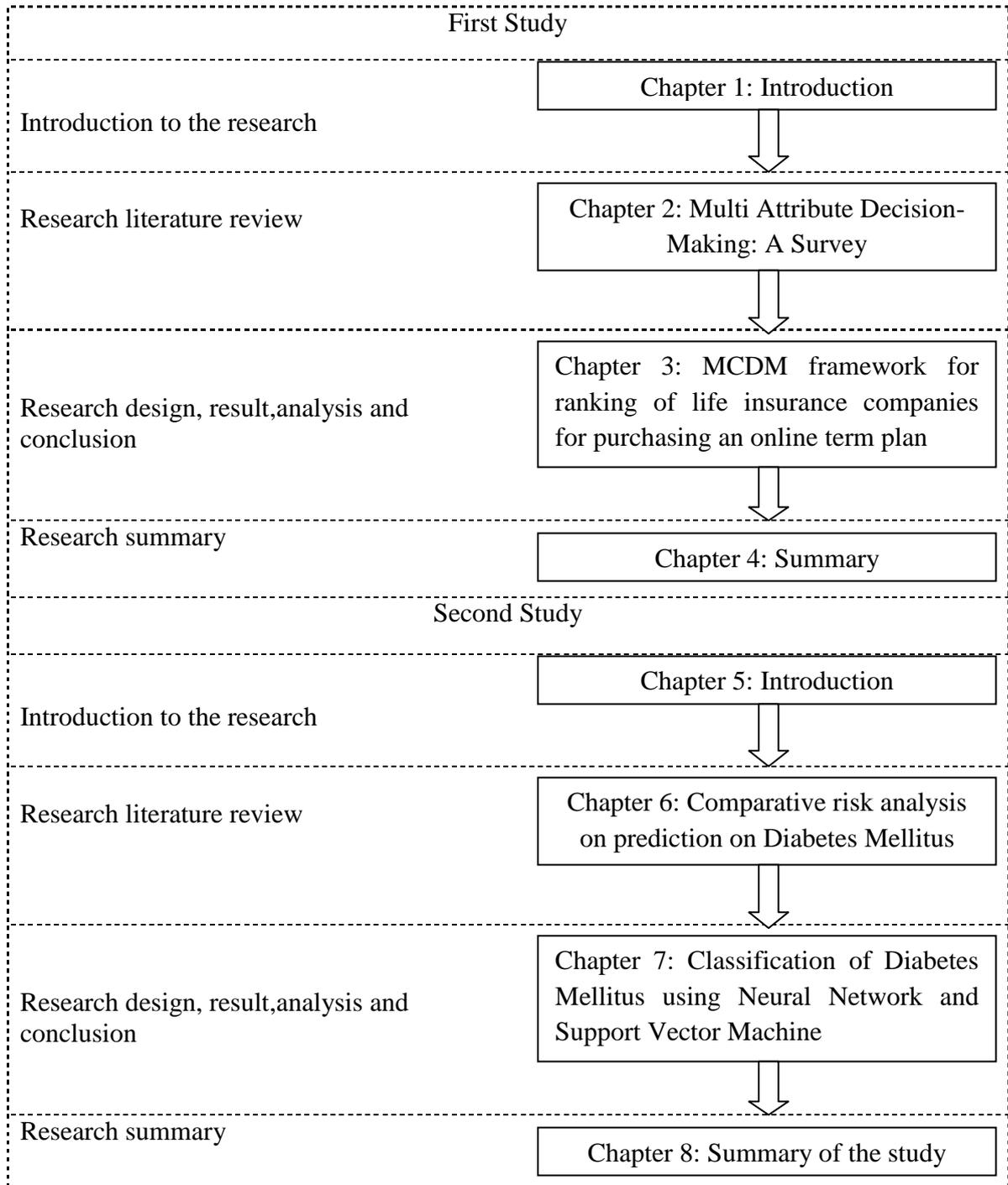
First Study	
Introduction to the research	Chapter 1: Introduction
Research literature review	Chapter 2: Multi Attribute Decision-Making: A Survey
Research design, result,analysis and conclusion	Chapter 3: MCDM framework for ranking of life insurance companies for purchasing an online term plan
Research summary	Chapter 4: Summary
Second Study	
Introduction to the research	Chapter 5: Introduction
Research literature review	Chapter 6: Comparative risk analysis on prediction on Diabetes Mellitus
Research design, result,analysis and conclusion	Chapter 7: Classification of Diabetes Mellitus using Neural Network and Support Vector Machine
Research summary	Chapter 8: Summary of the study

Figure1.1Organization of thesis