Chapter 108
Fuzzy Logic Approach in Risk Assessment

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ABSTRACT

Risk is the likelihood of occurrence of any event that may obstruct the ability of organizations to achieve their strategic, financial, and operational goals. It is of profound importance for the business management to detect risks and determine appropriate actions in time. Risk assessment is a continuous and recursive process aimed at maximization of the use of opportunities while minimizing threats. There is a tendency in the field of risk assessment to prefer more quantitative methods to reduce unclarity. One such method is fuzzy logic. This chapter investigates fuzzy logic as an alternative to the classical methods that have been used for the purposes of risk assessment, which plays a crucial role in business action plans. Due to its similarity to the process of human reasoning and its success in cases of unclarity, fuzzy logic offers a number of advantages in this regard.

INTRODUCTION

As an intuitively subjective and ambiguous notion, risk requires a detailed and attentive study, though. Since risk involves the events likely to occur in the future, risk assessment is an area where uncertainty is prevalent. Therefore, making use of experience, previous statistics and prediction ability is crucial in risk studies. The field of risk management is enriched with new techniques and methodologies, which serve the purposes of discovering more data, reducing subjectivity through more quantitative models and building flexible systems conducive to be updated with the obtained data. One of these new tools is fuzzy logic representing the uncertainty and to study with imprecise and uncertain knowledge.

This paper discusses the application of fuzzy logic to risk assessment process as an alternative to the traditional models due to its similarity to human reasoning and its accuracy in interpreting uncertainty. A fuzzy logic-based algorithm is developed for the purposes of enhancing risk assessment accuracy. Impact and likelihood factors, which are fundamental elements of risk, measured by the fuzzy logic-based approach. Beyond the impact and likelihood values, the factors directly effecting impact and likelihood also considered in this study and these factors included in fuzzy operations, in order to reduce subjectivity and increase precision.

In this study, an approach is explained for risk assessment. The aim of this approach is providing insight as a powerful alternative to traditional methods. A comparison between the risk values measured by the new model and those measured by the classical model supports the view that using fuzzy logic in risk assessment helps to produce more effective outcomes.

BACKGROUND

The concept of fuzzy logic was first introduced in 1965 by Prof. Lotfi A. Zadeh who developed Lukasiewicz's multivalued logic to set theory and created what he called fuzzy sets – sets whose elements belong to it in different degrees. At the start, fuzzy logic was a theoretical concept with little practical application. In the 1970's, Prof. Edrahim Mamdani of Queen Mary College, London, built the first fuzzy system, a steam-engine controller, and he later designed the first fuzzy traffic lights. His work led to an extensive development of fuzzy control applications and products (Cirstea, Dinu, McCormick & Khor, 2002, pp. 113-114).

Bellman and Zadeh (1970) developed an initial general theory on decision making in fuzzy environment which include three basic concepts as fuzzy goals, fuzzy constraints and fuzzy decisions. It is concluded that the proposed theory is generally has advantages according to the traditional probability theory.

Tah and Carr (1999) claimed that the current risk management techniques mostly based on the operational research techniques developed in 1960s and usually had failed to meet the needs of project managers. They introduced a fuzzy risk analysis model for a construction project to eliminate the past studies' concentration on particular risks and proposed a model which have a generic and generally practicable representation.

The development of fuzzy set theory to fuzzy technology during the first half of the 1990s has been very fast. More than 16,000 publications have appeared since 1965. Most of them have advanced the theory in many areas. Quite a number of these publications describe, however, applications of fuzzy set theory to existing methodology or to real problems. In addition, the transition from fuzzy set theory to fuzzy technology has been achieved by providing numerous software and hardware tools that considerably improve the design of fuzzy systems and make them more applicable in practice (Zimmerman, 2001, p. xxi).

Hajiha, Roodposhti and Askary (2009) provided a risk assessment approach conducted on the basis of fuzzy logic for audit risk, inherent risk and control risk. The results are compared to a real case and the accuracy level of the results is discovered to be relatively higher.

Keropyan and Gil-Lafuente (2011) place the emphasis on the importance of the ability of making right decisions and provide examples of use of fuzzy logic in selection of the decision-making styles within the scope of strategic management.

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