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Fuzzy Set-Based Risk Evaluation Model for Real Estate Projects*

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Abstract: With the rapid development of residential real estate market, risk evaluation has been an important task in the process of project. This paper describes a risk evaluation method for residential real estate projects based on fuzzy set theory which uses linguistic variables and respective fuzzy numbers to evaluate the factors. The primary weights of factors and evaluation of alternatives are determined by applying linguistic variables and fuzzy numbers. The notion of Shapley value is used to determine the global value of each factor in accomplishing the overall objective of the risk evaluation process, so the primary weights are revised, thus the importance of factors can be reflected more precisely. A major advantage of the method is that it allows experts and engineers to express their opinions on project risk evaluation in linguistic variables rather than crisp values. An illustration is presented to demonstrate the application of the method in risk evaluation. The results are consistent with the results calculated by conventional risk evaluation method. The research demonstrates that the method is objective and accurate, and is of an application value in the risk evaluation for residential real estate project.

Key words: real estate; project risk; fuzzy evaluation; Shapley value

Introduction

The real estate industry has been a support industry in the national economy with the rapid development of housing market since the welfare housing allocation system has been canceled in China. The real estate is an industry with high cost, high profit and high risk, with more and more enterprises paying attention to the risk evaluation.

Risk evaluation is concerned with evaluating the probability and impact of individual risk; the risk evaluation methods which are widely used include expert grade method, Monte Carlo method and analytic hierarchy process (AHP)[1,2]. Despite the successful application of above risk evaluation methods, many problems remain: expert grade method is mainly based on the subjective judgments by the experts and the conclusions are approximate; Monte Carlo method is difficult to identify the correlations among risk factors, and is based on the model selection, thus the model selection has a deep influence on the precision of calculation; meanwhile there is a great calculation amounts and usually the computer is needed to finish the calculation. The AHP has some issues in the application: the imposed inconsistency due to the restriction of pairwise comparisons to a 1-to-9 scale and to the problematic correspondence between the verbal and the numeric scales[3]; the variation in the verbal expressions from one person to another, as well as their dependence on the type of elements involved in the comparison[4]. The application of the methods is limited.

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1 Fuzzy Risk Evaluation

The risk evaluation for real estate projects is to evaluate the risk scale and the degree of their influence. It takes the entire project risk, inter-infection and interaction among risk, and their infection on the project into consideration, as well as the risk capacity of the project. Due to the properties of real estate, the risk must be evaluated to win a better profit of the projects.

The fuzzy risk evaluation is a process based on evaluation model, and combines the fuzzy set with real estate risk evaluation to evaluate the risk comprehensively. Figure 1 shows a process model of fuzzy risk evaluation.

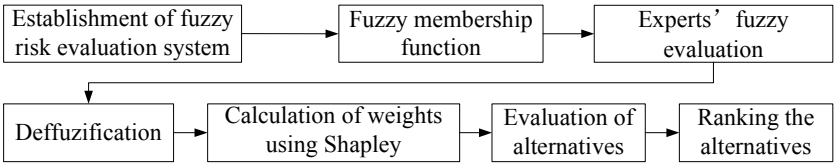

Fig. 1 Process of fussy risk evaluation

1.1 Establishment of a fuzzy risk evaluation system

A theoretical model for risk evaluation is presented to evaluate the risk of a project, as shown in Fig. 2.

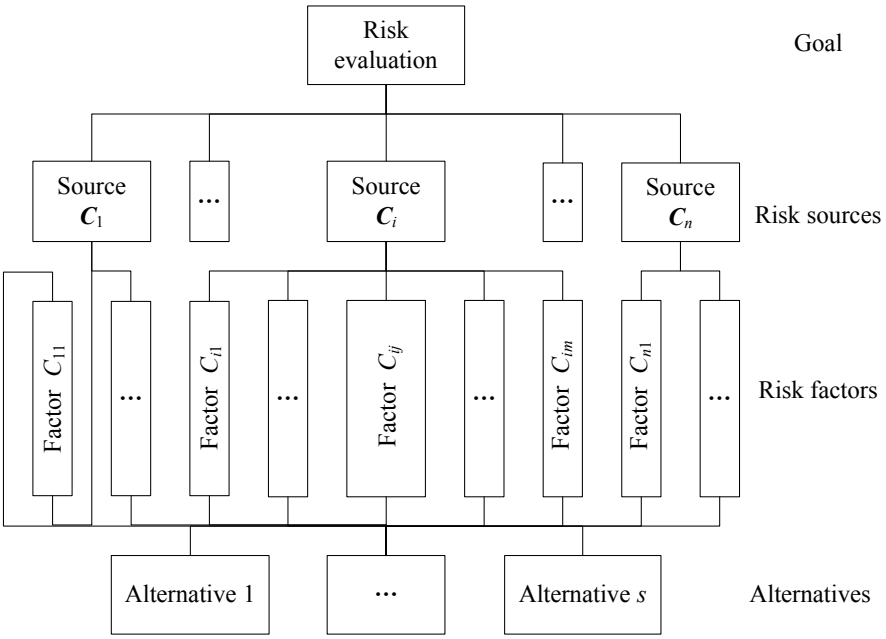

Fig. 2 Theoretical model of risk evaluation

The model consists of levels of goal, risk sources, risk factors and alternatives. The level of goal is to explain the goal of risk evaluation, the risk factors are divided into several groups according to their sources, and every risk source contains some factors. Combined with the alternatives which will be evaluated, an evaluation model is established.

In the model, there are n kinds of risk sources which can be represented as $\boldsymbol{C}=\{\boldsymbol{C}_1, \boldsymbol{C}_2, \ldots, \boldsymbol{C}_i, \ldots, \boldsymbol{C}_n\}$, and there are m factors in the risk source c_i, which can be represented as $\boldsymbol{C}_i=\{C_{i1}, C_{i2}, \ldots, C_{ij}, \ldots, C_{im}\}$.

When a model is established, the principles below should be followed.

(1) Systemic principle. The system is established according to the reality of the project, so the reliability of the evaluation is guaranteed.

(2) Both the quantitative and qualitative factors are taken into consideration, so the objectivity and maneuverability can be guaranteed in the course of evaluation.

(3) Independence principle. The establishment of factors should avoid containing each other among the factors, so the essential factors must be grasped.

(4) Facility principle. The comprehensive factors should be selected, for it is convenient to experts.