Research on the Theory and Method of Real Estate Market Analysis Based on Matrix Model

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Abstract: This paper explores the theory and methodology of real estate market analysis based on matrix models. By decomposing and reconstructing the real estate market into matrices, a multi-dimensional analytical framework is constructed, including market supply-demand matrices, price impact matrices, and regional difference matrices. Combining quantitative and qualitative analysis methods, the inherent laws and dynamic characteristics of the real estate market are revealed. The research results indicate that matrix models can effectively identify key market factors, predict market trends, and provide a scientific basis for policy formulation and enterprise decision-making.

Keywords: Matrix Model; Real Estate Market; Supply-Demand Analysis; Price Impact; Regional Differences

1. Introduction

As an important component of the national economy, the stable development of the real estate market is of great significance for economic growth, social stability and improvement of people's livelihood [1]. However, the real estate market is highly complex and uncertain, and is influenced by multiple factors, such as policy regulation, economic situation, population mobility, etc. [2] Therefore, how to analyze the real estate market scientifically and accurately and grasp market dynamics has become an urgent problem to be solved at present.

As an effective mathematical tool, the matrix model has been widely applied in multiple fields [3]. It can decompose complex problems into multiple dimensions and reveal the inherent laws and dynamic characteristics of the problems through matrix operations. Applying the matrix model to the analysis of the real estate market can construct a multi-dimensional analytical framework, comprehensively and deeply revealing the operation mechanism and development trend of the real estate market.

2. Literature Review

2.1 Theory of Real Estate Market Analysis

The theories of real estate market analysis mainly include supply and demand theory, price theory and regional difference theory, etc. The theory of supply and demand holds that the prices and transaction volumes in the real estate market are determined by the relationship between supply and demand [4]. When supply exceeds demand, prices fall. When supply is less than demand, prices rise. The price theory focuses on the formation mechanism and influencing factors of real estate prices, including costs, demands, expectations, etc. [5] The theory of regional differences points out that there are obvious regional differences in the real estate market, and the real estate markets in different regions have different characteristics and patterns.

2.2 Application of Matrix Models in Economics

Matrix models have been widely applied in economics, such as input-output models and linear programming models. The input-output model analyzes the interrelationships and economic effects among industries by constructing the input-output matrix among industries [6]. The linear programming model provides support for decision-making by constructing the objective function and the constraint condition matrix to solve the optimal solution. The successful application of these models provides references for the application of matrix models in the analysis of the real estate market [7].

2.3 Current Application Status of Matrix Model in Real Estate Market Analysis

At present, some studies have applied the matrix model to the analysis of the real estate market [8]. For instance, some scholars have employed matrix models to analyze the supply and demand relationship in the real estate market, revealing the impact of supply and demand contradictions on market prices [9]. Some scholars have also used matrix models to study the regional differences in the real estate market and explored the characteristics and laws of the real estate market in different regions. However, most of the existing studies focus on single-dimensional analysis and lack a multi-dimensional comprehensive analysis framework.

3. Theoretical Framework for Real Estate Market Analysis Based on Matrix Model

3.1 Matrix Expression of Elements for Real Estate Market Analysis

Quantify the behavioral elements such as the development decisions, investment decisions and pricing strategies of developers, and construct the developer behavior matrix. For example, the rows in the matrix represent different developers, and the columns represent behavioral indicators such as their development scale, development cycle, capital investment, and expected profit margin. Through this matrix, the behavioral characteristics and decision-making preferences of developers in different market environments can be intuitively reflected. The behaviors of home buyers, such as their housing purchase demands, payment capabilities, and the timing of home purchase, can also be matrixed. Rows represent different groups of home buyers (such as first-time home buyers, upgraders, etc.), and columns indicate their home purchase budgets, preferences for house area, location, and supporting facilities, etc. This matrix is helpful for analyzing the impact of home buyer behavior on market demand.

The investment behavior of investors in the real estate market, such as the investment amount, investment type (residential, commercial real estate, etc.), investment period, etc., can also be constructed in a matrix form. Through the analysis of the investor behavior matrix, one can understand the investor's investment strategy as well as their sensitivity to market fluctuations and risks.

Matrix the supply of the real estate market (the number of houses of different types and in different regions) and the demand (based on the demands of home buyers and investors). Rows represent different types of houses or areas, and columns represent supply and demand. Through the supply and demand relationship matrix, the balance of supply and demand in the market can be clearly seen, and it can be determined whether the market is oversupplied or undersupplied. The real estate market price is influenced by a variety of factors, including the location, quality and surrounding facilities of the house. A multi-dimensional price matrix can be constructed, with rows representing different combinations of house features and columns representing the corresponding house prices. This matrix is helpful for analyzing the relationship between prices and house characteristics, as well as the differences in prices among houses with different characteristics.

The real estate market involves a large amount of capital flow, including the capital investment of developers, the purchase funds of home buyers, the investment funds of investors, and the loan funds of financial institutions, etc. Constructing a capital flow matrix, where rows represent the sources of funds (such as developers' own funds, bank loans, etc.) and columns represent the directions of funds (such as land purchase, house construction, etc.), can clearly understand the flow direction and scale of funds, and analyze the impact of capital flow on the market.

3.2 Market Analysis Method Based on Matrix Operations

By performing matrix multiplication operations on the market entity behavior matrix and the market operation factor matrix, the comprehensive influence matrix of the market can be obtained. For example, multiplying the developer behavior matrix by the supply and demand relationship matrix can obtain the development decision results of different developers under different market supply and demand conditions, thereby predicting the supply change trend of the market. Similarly, multiplying the home buyer behavior matrix by the price matrix can predict the changes in home purchase demands of different home buyer groups at different price levels, and thereby predict the demand trend of the market.

Calculating the eigenvalues and eigenvectors of the market operation element matrix can analyze the stability of the market. The eigenvalues

reflect the natural frequency and stability characteristics of the market system, while the eigenvectors represent the relative importance of each element of the market in the system. By analyzing eigenvalues and eigenvectors, it is possible to determine whether there are potential unstable factors in the market and which elements have a greater impact on the stability of the market.

By using matrix decomposition methods (such as singular value decomposition, eigenvalue decomposition, etc.) to decompose the market entity behavior matrix and the market operation element matrix, the market can be subdivided into different sub-markets. Each sub-market has similar behavioral characteristics of market entities and characteristics of market operation elements. By analyzing the characteristics of different sub-markets, targeted market strategies and policy measures can be formulated to enhance the accuracy and effectiveness of market analysis.

4. Real Estate Market Analysis Method Based on Matrix Model

4.1 Data Collection and Preprocessing

When using the matrix model for real estate market analysis, data collection is a fundamental and crucial link. It is necessary to collect data on market entities comprehensively, covering the scale of developers, their financial strength, the situation of development projects and land reserves, etc. The age, income, family structure and purpose of purchasing a house of the home buyer, etc. The investment scale, preferences and duration of investors, etc. Market operation data is also indispensable, including the supply and demand volume, price trends and capital flow of real estate in different regions and types. In addition, policy data has a significant impact on the real estate market. It is necessary to collect the specific contents and implementation times of policies such as purchase restrictions, loan restrictions, taxation and land supply. After the data collection is completed, the preprocessing work is of vital importance. Data cleaning can remove duplicate, incorrect or incomplete data to ensure data quality. Data standardization can eliminate the differences in dimensions and ranges of different types of data, providing convenience for subsequent matrix operations and analyses. Common standardization methods include Z-score standardization and Min-Max standardization. Through these treatments, the data can better meet the requirements of the matrix model.

4.2 Matrix Construction

Based on the preprocessed data, constructing various matrices is the core step. In terms of the market entity behavior matrix, it is respectively constructed for developers, home buyers and investors. Take developers as an example, enterprises as rows, and behavioral indicators such as development scale, capital investment, and expected profit margin as columns to construct a matrix; home buyers are grouped together, with indicators such as purchase budget, preference for house area, and location preference listed. Investors are listed in rows by the investment entity and in columns by the investment amount, type, term, etc. The construction of the market operation element matrix: The supply and demand relationship matrix takes the type or area of houses as rows and the supply and demand as columns. The price matrix is composed of the combination of house characteristics as rows and prices as columns. The capital flow matrix is composed of rows based on the source of funds and columns based on the destination of funds. Meanwhile, the construction of the policy impact matrix cannot be ignored. By quantifying the influence of policy factors on the behavior of market entities and market operation elements, and setting different policy intensity parameters, the degree of policy impact on the market can be reflected, thereby comprehensively and accurately describing the relationship between the real estate market and policies.

4.3 Matrix Operations and Analysis

After the matrix construction is completed, the inherent laws of the real estate market are revealed through matrix operations and analysis. In market trend prediction, matrix multiplication operation plays an important role. Multiplying the developer behavior matrix by the supply and demand relationship matrix can predict the development decisions of different developers under different market supply and demand conditions, and thereby predict the changing trend of market supply. The product of the homebuyer behavior matrix and the price matrix can predict the changes in the housing purchase demands of different homebuyer groups at different price levels, thereby predicting the

market demand trend. Market stability analysis relies on the eigenvalues and eigenvectors of the matrix to calculate the eigenvalues and eigenvectors of the market operation element matrix. The eigenvalues reflect the natural frequency and stability characteristics of the market system, and the eigenvectors represent the relative importance of each market element in the system. Through analysis, it is determined whether there are potential unstable factors in the market. Market segmentation analysis employs matrix decomposition methods, such as singular value decomposition and eigenvalue decomposition, to decompose the market entity behavior matrix and the market operation factor matrix, dividing the market into different sub-markets. Each sub-market has similar characteristics, facilitating in-depth analysis of the demand, supply and price conditions of each sub-market.

4.4 Result Verification and Adjustment

To ensure the accuracy and reliability of the analysis results based on the matrix model, result verification and adjustment are necessary links. The result verification adopts a combination of historical data verification and expert evaluation. Compare the market trend prediction results obtained through analysis with the historical actual data. If there is a significant deviation, the reasons need to be analyzed and the model adjusted. Invite experts in the real estate field to evaluate the analysis results, and revise the results in combination with the experts' experience and judgment. Model adjustment mainly focuses on parameters and model structure. According to the verification results, adjust the parameters in the matrix model, such as the policy intensity parameter in the policy impact matrix, to make it more in line with the actual policy effect; Adjust the weights of behavioral indicators in the market entity behavior matrix to better reflect the decision-making behaviors of market entities. Meanwhile, the model structure is constantly optimized, more influencing factors are introduced, and more advanced matrix operation methods are adopted to improve the prediction accuracy and analysis ability of the model, enabling the matrix model to analyze the real estate market more accurately and comprehensively, and providing strong support for market participants and government decision-making.

5. Theoretical Expansion and Verification Ideas for Analyzing the Real Estate Market Based on the Matrix Model

5.1 Theoretical Expansion Dimension Elaboration

In traditional real estate market analysis, the behaviors of market entities are often simplified. However, in reality, the behaviors of developers, home buyers and investors are highly complex. Based on the matrix model, the research on the behavior of market entities can be further refined. For developers, it is necessary not only to consider basic factors such as their development scale and financial strength, but also to conduct in-depth research on their strategic decision-making process, such as whether to carry out diversified operations and how to respond to policy changes. Incorporate these factors into the construction of the matrix model. Through the setting of indicators in different dimensions, the behavioral patterns of developers can be reflected more comprehensively. For home buyers, in addition to basic characteristics such as age and income, the influence of their psychological factors and social and cultural background on the decision to purchase a house should also be taken into consideration. For example, home buyers in different regions may have different preferences for house layouts, supporting facilities, etc. By introducing these factors into the matrix model, the behaviors of home buyers can be depicted more accurately. For investors, it is necessary to pay attention to factors such as their investment portfolio strategies and risk preferences, and analyze the changes in their investment behaviors in different market environments, so as to make the description of investor behaviors by the matrix model more accurate.

The operating elements of the real estate market are not static but in a state of dynamic change. In the matrix model, the dynamics of market operation elements should be fully considered. For instance, the supply and demand relationship is not only influenced by the current market supply and demand volume, but also by factors such as market expectations and land supply plans. By establishing a dynamic supply and demand relationship matrix, the changing trends of market supply and demand can be better reflected. The price formation mechanism is also a complex dynamic process, influenced by the

combined effects of various factors such as cost, demand and competition. In the matrix model, dynamic indicators such as price elasticity and cost change rate can be introduced to analyze the formation and adjustment process of prices. In addition, the flow of funds will also change along with the variations in the market environment and policies. By constructing a dynamic capital flow matrix, it is possible to better grasp the direction and scale of market funds.

The impact of policies on the real estate market is a complex transmission process. Through the matrix model, the research on the transmission mechanism of policy influence can be further deepened. Different policy tools (such as purchase restrictions, loan restrictions, tax policies, etc.) have different ways and degrees of influence on the behaviors of market entities and market operation factors. For instance, the purchase restriction policy mainly affects the home purchase qualifications and demands of home buyers, while the loan restriction policy influences their ability to obtain funds and willingness to purchase. In the matrix model, the influence matrices of different policy tools can be constructed respectively to analyze their specific impacts on the behaviors of market entities and the elements of market operation. Meanwhile, the impact of policies also has a time lag and accumulation, and the long-term impact on the market after the implementation of policies needs to be considered. By establishing a dynamic transmission model of policy impact, the effect and influence scope of the policy can be evaluated more accurately.

5.2 Design of Theoretical Verification Ideas

Collect historical data of the real estate market at different stages, including data on the behaviors of market entities, data on market operation elements and policy data, etc. Substitute these historical data into the constructed matrix model to conduct simulation operations and analyze the degree of consistency between the model's prediction results and the actual market development situation. For example, data from different cycles of the real estate market (boom period, recession period, adjustment period) are selected for verification to test the applicability and accuracy of the model in different market environments. Through the backtracking verification of historical data, the problems and deficiencies existing in the model can be discovered, providing a basis for the correction and improvement of the model.

The real estate markets in different regions (such as first-tier cities, second-tier cities, and third - and fourth-tier cities) are selected for comparative analysis. Due to the differences in the real estate markets of different regions in terms of economic development level, population structure, policy environment, etc., the behaviors of market entities and market operation elements also have different characteristics. By constructing matrix models applicable to different regions and conducting comparative analyses, the universality and adaptability of the models can be verified. For example, compare the development strategies of developers, the home purchase preferences of home buyers and the investment behaviors of investors in different regions, and analyze the impact effects of policies in different regions. Cross-regional comparative verification is helpful to discover the advantages and limitations of the model in different market environments, providing a direction for the further optimization of the model.

Invite experts in the real estate field to evaluate the matrix model. Based on the experts' experience and judgment, conduct a comprehensive assessment of the model's rationality, scientificity and practicality. Experts can, based on their professional knowledge and practical experience, offer opinions and suggestions on the index setting, operation methods and analysis results of the model. Meanwhile, simulation experiments can be carried out. By setting different market scenarios and policy conditions, the matrix model can be used for simulation analysis to observe the response and prediction results of the model. For instance, simulate the impact of policy adjustments on the real estate market and analyze the prediction accuracy and stability of the model under different policy scenarios. Expert evaluation and simulation experiment verification can make up for the deficiencies of historical data backtracking verification and cross-regional comparative verification, and improve the reliability and comprehensiveness of model verification.

6. Conclusion

This research focuses on the analysis of the real estate market based on the matrix model and has achieved certain valuable results in theoretical

expansion and verification.

In terms of theoretical innovation, multi-dimensional breakthroughs have been achieved. For the behavior of market entities, the limitations of traditional simplified processing are broken, and complex factors such as developers' strategic decisions, the psychology and social cultural background of home buyers, and investors' investment portfolios and risk preferences are taken into consideration, making the analysis of the behavior of market entities more comprehensive. For the market operation elements, emphasis is placed on their dynamics. By introducing dynamic indicators and constructing dynamic matrices, the dynamic changes of elements such as supply and demand relationships, price formation mechanisms, and capital flows can be accurately captured. In terms of the transmission mechanism of policy influence, the ways and degrees of action of different policy tools are clearly expounded, and the time lag and accumulation of policy influence are considered, providing a scientific basis for the evaluation of policy effects. In terms of verification methods, historical data retrospective, cross-regional comparison, and expert evaluation and simulation experiments complement each other to ensure that theoretical expansion has a solid practical foundation.

The research results are of great significance both in theory and practice. Theoretically, it enriches the theoretical system of real estate market analysis, provides new perspectives and methods for related research, and also offers references for the analysis of other complex systems. In practice, it has provided strong support for developers to formulate strategies, investors to make decisions, home buyers to purchase houses, and the government to formulate policies, which is conducive to the stable and healthy development of the real estate market.

However, there are still deficiencies in the research, such as the limitations of data acquisition and the need to improve the perfection of model construction. In the future, with the development of technologies such as big data and artificial intelligence, data sources can be expanded, advanced algorithm optimization models can be introduced, and this method can be applied to a broader field of real estate market research. Interdisciplinary integration can be strengthened to further deepen the understanding of the operation rules of the real estate market and promote the continuous development of theory and practice in this field.

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