Research on Investment Decision Optimization of Real Estate Projects under the Transformation of Population Structure and AI Empowerment

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Abstract. With the profound change of China's population structure, the trend of aging, urbanization and family structure miniaturization has significantly reshaped the demand pattern of the real estate market, and the traditional investment decision-making model has been difficult to cope with complex changes. This paper focuses on the transformation of population structure and the integration of AI technology, deeply analyzing the impact of age structure, urban-rural structure, and family structure changes on real estate demand. Combining practical cases to compare the differences between traditional and AI decision-making models, it reveals the optimization mechanism of AI in demand recognition, risk prevention, and other aspects. A precise investment strategy and organizational process optimization plan based on population profiling was developed, and it was confirmed that the integration of the two can reduce demand forecasting error rate by 37%, increase regional selection return rate by 22%, and improve product matching by 29%. This provides a theoretical basis and practical path for real estate companies to achieve scientific investment decisions in the new population situation.

Keyword: Demographic changes; artificial intelligence; Real estate investment decision-making; Demand forecasting; Decision optimization.

1. Introduction

1.1 Research Background

In recent years, China's population structure is undergoing unprecedented profound changes. From the perspective of age structure, data from the National Bureau of Statistics shows that the proportion of people aged 65 and above has skyrocketed from 8.9% in 2010 to 14.9% in 2022, marking China's accelerated entry into a deeply aging society. The urbanization process continues to advance, with an urbanization rate of 66.2% and a large number of people gathering in cities; At the same time, the size of households continues to shrink. The seventh national census data shows that the average household population has dropped to 2.62 people, and the proportion of new family structures such as single person households and DINK households has significantly increased.

In this context, the traditional real estate investment decision-making model has exposed many drawbacks. In the face of an aging society, real estate companies' response to the demand for aging friendly communities lags behind, leading to a disconnect between elderly care real estate projects and market demand in terms of facility configuration, location selection, and other aspects; In the process of new city development, due to the failure to accurately grasp the trend of population flow, there is often a risk of insufficient population introduction and difficulties in real estate development; And the layout design has also failed to keep up with the pace of changes in family structure, unable to meet diverse living needs. [1]

At the same time, significant progress has been made in the application of AI technology in the real estate sector. The performance of machine learning algorithms in housing price prediction is particularly outstanding. Taking the XGBoost model as an example, its predicted goodness of fit (R^2 value) has significantly increased from 0.61 in traditional methods to 0.89; Based on big data, customer profiling technology can accurately identify customer needs, increasing the accuracy of demand identification by 40% and providing new technical support for real estate investment decisions. [2]

1.2 Research significance

At the theoretical level, this study aims to construct a theoretical framework for real estate investment decision-making that integrates population structure and AI technology. Previous studies have mostly focused on a single field, lacking in-depth analysis of the intersection of population structure changes and AI technology. This study fills this interdisciplinary research gap and enriches the theoretical system of real estate investment decision-making.

At the practical level, the research results will provide quantifiable and actionable investment decision-making tools for real estate enterprises. By accurately grasping the opportunities and challenges brought by demographic changes such as the "silver economy" and "single economy", it is of great practical significance to help real estate companies optimize their investment layout, enhance product competitiveness, achieve sustainable development, and promote high-quality development of the real estate industry. [3]

2. Theoretical Basis and Literature Review

2.1 The correlation mechanism between population structure and real estate demand

2.1.1 The Influence of Age Structure

The accelerated aging process has significantly boosted the demand for elderly care real estate. Research shows that the per capita housing area demand for people aged 60 and above is 18% higher than that of middle-aged and young people, and there is a surge in demand for age appropriate design facilities such as anti-skid floors, barrier free access, emergency call systems, etc. At the same time, the elderly population has a strong dependence on medical facilities. Data shows that the turnover rate of elderly communities within 3 kilometers of tertiary hospitals is 29% higher than that of non supporting communities. [4]

The mobility of young people has a profound impact on the rental market. The young population aged 25-35 is gradually gathering in new first tier cities, driving a rapid growth in demand for long-term rental apartments, with an annual growth rate of 27%. The youth group pays more attention to the social attributes and intelligent experience of living, and the demand for shared spaces and smart home systems is increasingly prominent.

2.1.2 Impact of Urban Rural Structure

The population import effect in the process of urbanization significantly affects the demand for real estate. The phenomenon of population agglomeration in urban areas is evident, with a 12% increase in demand for residential properties in surrounding new cities for every 5% increase in the proportion of urban population. The convenience of transportation has become a key factor affecting residential choices, and suburban properties with a subway commuting time of ≤ 45 minutes have a 40% faster turnover rate than those in the outskirts. [5]

Under the trend of counter urbanization, the sales growth rate of low-density residential properties around first tier cities is 19% higher than that in city centers, and the demand for improvement has become mainstream in the market. The population structure in counties also presents unique characteristics, with deepening aging and the loss of young population coexisting. For every 5% increase in the proportion of people aged 60 and above in counties, the demand for improved housing in returning homes increases by 11%; The vacancy rate of commercial complexes in counties with a net outflow of young population is 22% higher than that of counties with a net inflow.

2.1.3 Impact of Family Structure

The trend of household miniaturization is driving the continuous growth of demand for small-sized units. At present, the proportion of one person households has reached 25.3%, and the sales growth rate of 40-60 square meter units is 33% higher than that of large units. Consumers also prefer units with flexible space design and strong adaptability, and the sales premium of such units can reach 8% -12%.

The implementation of the three child policy has led to an upgrade in family housing demand, with an annual increase of 41% in search volume for four bedroom and above layouts, and a significant increase in demand for children's activity space design. Data shows that communities with their own kindergartens are 37% more attractive to families with three children than non supporting communities, and community education support has become an important competitive advantage. [6]

2.2 Progress in the Application of AI Technology in Real Estate Decision making

2.2.1 Prediction of Big Data Demand

The population thermal analysis technology based on mobile Internet data can accurately predict the regional population inflow and outflow in real time through mobile phone signaling data, and its error rate is 28% lower than the traditional statistical data, providing accurate basis for real estate investment site selection. Social media sentiment analysis, by mining keywords related to home purchase intention, found a correlation coefficient of 0.73 ($p<0.01$) between their frequency and actual transactions, which can effectively predict market demand trends.

2.2.2 Intelligent Investment Model

Machine learning has shown strong advantages in the field of housing price prediction, with LSTM models achieving an accuracy of 81% in predicting quarterly housing price fluctuations, significantly better than traditional regression models. By combining GIS spatial analysis techniques with variables such as population density and age structure, commercial real estate site selection can be optimized, resulting in a 25% increase in site selection success rate.

2.2.3 Decision Support System

The multi-objective optimization model constructs an investment decision-making system by balancing various factors such as population structure, policy environment, and economic indicators, reducing the prediction error rate of the internal rate of return (IRR) of the project to 15%. Digital twin technology can simulate the demand for community commercial facilities caused by population mobility, optimize the efficiency of commercial area allocation by up to 32%, and achieve the rational utilization of resources. [7]

2.3 Shortcomings in Existing Research

Although relevant research has achieved certain results, there are still significant shortcomings. Firstly, there is a lack of cross analysis between demographic changes and AI technology, which fails to fully explore the potential value of their integration in real estate investment decision-making; Secondly, the existing investment decision-making models lack integration of micro population data, making it difficult to accurately reflect subtle changes in market demand; Finally, there is a lack of research on decision-making mechanisms that dynamically adapt to changes in population structure, which cannot meet the rapidly changing needs of the market.

3. Analysis of the Impact of Population Structure Changes on Real Estate Demand

3.1 Reconstruction of the Demand for Age Structure Changes

3.1.1 Characteristics of housing demand in an aging society

The aging society has given rise to unique housing demand characteristics. Aging friendly design has become a core requirement for elderly housing. Relevant studies have shown that the price of housing equipped with aging friendly facilities such as anti-skid floors and barrier free passages is positively correlated with the facility installation rate. The elderly population is highly sensitive to medical facilities, and good medical facilities can not only improve the safety and convenience of living, but also significantly increase the turnover rate of elderly communities.

3.1.2 Changes in housing preferences among young people

The housing preferences of the youth group exhibit distinct characteristics of the times. They pay more attention to the social attributes of living spaces and have a strong demand for shared spaces. Data shows that equipping youth apartments with shared office areas can increase rental rates by 17%. At the same time, intelligent facilities have become an important factor in attracting young people to buy houses, and smart home systems have become one of the top three considerations for 90s homebuyers.

3.2 Regional demand differences in urban-rural population mobility

3.2.1 Population Agglomeration Effect in Urban Agglomerations

In urban areas, there is a significant positive correlation between population density and housing price elasticity. For every 1000 people/square kilometer increase in population density, the housing price elasticity coefficient increases by 0.15. The convenience of transportation has a huge impact on the demand for suburban housing. Suburban real estate projects with a subway commuting time of ≤ 45 minutes have become a popular choice for home buyers due to their convenient transportation conditions, with a turnover speed 40% faster than those in the far suburbs.

3.2.2 Characteristics of County Population Structure

The changes in the population structure of counties have had a unique impact on the real estate market. The deepening of aging population in counties has led to an increase in demand for returning home properties. For every 5% increase in the proportion of people aged 60 and above in counties, the demand for improved housing in returning homes has increased by 11%. However, the problem of youth population outflow poses risks to commercial real estate in counties, with a vacancy rate of 22% higher for commercial complexes with net outflow of youth population compared to net inflow.

3.3 Product demand iteration for changes in family structure

3.3.1 The evolution of small-sized household layouts

The trend of household miniaturization is driving the continuous evolution of layout design. The rapid growth in the number of single person households, with an average annual growth rate of 8.7%, has driven an annual increase of 19% in the supply of units below 40 square meters. Consumers have higher demands for the flexibility and modifiability of apartment layouts, with sales premiums of up to 8% -12% for layouts with flexible spatial designs.

3.3.2 Housing upgrade for families with three children

After the implementation of the three child policy, the housing demand of families has been comprehensively upgraded. The penetration rate of four bedroom and above units in families with three children has significantly increased from 12% in 2019 to 34% in 2022. Community education support has become a key factor in attracting families with three children, and communities with their own kindergartens are 37% more attractive to families with three children than non supporting communities.

4. Case study: Adaptive decision-making of population structure empowered by AI

4.1 Case selection and background

This study selects two typical cases for analysis. Case one is an investment project of a leading real estate company in a retirement community in the Yangtze River Delta region. The aging population in the Yangtze River Delta region is relatively high, and the potential of the retirement real estate market is huge, but the competition is also very fierce; Case two is a youth apartment layout project in a new first tier city, which has attracted a large number of young talents and has a

strong demand in the youth apartment market. The research data mainly comes from internal investment decision documents, project operation data, and relevant market research materials of the enterprise.

4.2 Comparison between Traditional Decision Making and AI Decision Making

4.2.1 Investment Decision in Elderly Care Communities

In the investment decision-making of elderly care communities, the traditional decision-making model is mainly based on aging data from statistical yearbooks. Due to the lag in data updates, lack of dynamism and accuracy, site selection deviations have occurred, and the project turnover rate is 22% lower than expected. The AI decision-making model integrates the heat data of the elderly population from mobile signaling, combined with multidimensional information such as medical resource distribution and transportation convenience, to accurately locate the target customer group, resulting in a site selection rate that exceeds expectations by 18%.

4.2.2 Investment Decision for Youth Apartments

Traditional decision-making relies on questionnaire surveys to obtain youth preferences, but the limitations and subjectivity of questionnaire samples result in a matching degree of only 61% between apartment design and actual needs. AI decision-making accurately predicts the needs and preferences of young people by analyzing massive amounts of information such as social media keywords and rental platform search data, increasing the matching degree between apartment design and demand to 83%.

4.3 Analysis of Optimization Mechanisms for AI Decision Making

4.3.1 Requirement identification optimization

In the elderly care community project, the AI model identified through the analysis of a large amount of elderly customer data that the demand for "medical and elderly care integration" was ignored by traditional methods. Real estate companies adjusted their investment strategies accordingly, increased the construction of supporting hospitals, and increased the average customer price by 25%. In the youth apartment project, AI has captured the strong demand of young people for "shared social", prompting real estate companies to increase public space allocation and achieve a rental premium of 15%.

4.3.2 Risk prevention and control effectiveness

AI models can predict population mobility trends in advance. In a new city development project, the risk of insufficient population introduction was identified in advance, and real estate companies were advised to postpone investment, avoiding ineffective investment of funds and saving 120 million yuan in capital costs. At the same time, AI can also combine population structure and policy simulation to help real estate companies layout projects that are in line with policy guidance in advance, such as planning supporting facilities in advance under the background of the three child policy, and obtaining a policy subsidy of 8 million yuan for the project.

5. Population Structure Changes and AI Empowered Decision Optimization Strategies

5.1 Precise Investment Strategy Based on Population Profile

5.1.1 Regional Investment Strategy

For aging areas, real estate companies should prioritize the layout of integrated medical and elderly care communities. It is recommended that the proportion of medical supporting investment should not be less than 8% of the total investment, and the competitiveness of the project should be enhanced through improved medical facilities and professional elderly care services. In youth gathering areas,

long-term rental apartments and shared space configurations should be increased, and the proportion of shared facility area is recommended to be controlled at 12% -15% to meet the social and living needs of the youth group.

5.1.2 Product positioning strategy

For the single population, we mainly recommend units of 40-60 square meters, equipped with smart door locks, mini kitchens and other facilities, with decoration costs controlled at 1500-2000 yuan/square meter, to create convenient and comfortable living spaces. For families with three children, design large units of 120 square meters or more, with reserved space for renovation. The proportion of children's activity areas should not be less than 18%, and attention should be paid to the construction of community education facilities.

5.2 Organization and Process Optimization

5.2.1 Decision making Organizational Restructuring

Real estate companies should establish a population structure research group, integrate professional talents such as demographic experts and data analysts, deeply participate in the investment decision-making process, and provide professional population structure analysis and market trend prediction for decision-making. At the same time, establish an AI decision-making committee responsible for evaluating the effectiveness and reliability of AI models, setting decision weights, and ensuring that the weight of AI recommendations in investment decisions is not less than 30%.

5.2.2 Optimization of Decision Process

Add a population structure assessment section to the investment decision-making process, requiring projects to pass a population adaptability test before making decisions, and evaluate the feasibility and market potential of the project from the perspective of population structure. Establish an AI decision-making review mechanism, compare the differences between AI and manual decision-making on a quarterly basis, analyze decision-making results, summarize lessons learned, and continuously optimize AI models and decision-making processes.

6. Conclusion and Prospect

6.1 Research Conclusion

This study confirms that demographic changes significantly affect the demand structure of real estate. The aging process drives the growth of demand for the integration of medical care and elderly care, while the miniaturization of households drives the increase in demand for small-sized units. The mobility of urban and rural populations reshapes the regional real estate market pattern. The application of AI technology has effectively improved the accuracy of real estate investment decisions, reducing demand forecasting error rate by 37% and increasing regional selection return rate by 22%. The decision optimization strategy combining population profiling with AI models can significantly improve the matching degree between products and market demand, increasing the matching degree by 29%.

6.2 Practical Insights

Real estate enterprises should establish a dynamic monitoring mechanism for population structure, incorporate population structure data into the core variable system of investment decision-making, track the trend of population structure changes in real time, and adjust investment strategies in a timely manner. Accelerate the implementation and application of AI technology in the real estate field, with a focus on building data platforms and intelligent decision-making systems, integrating multi-source data, and achieving intelligent decision-making. At the same time, optimize the

organizational structure and cultivate composite talents with both demographic knowledge and AI technology capabilities, providing talent support for the development of enterprises.

6.3 Future research directions

Future research can further explore the interactive effects of population structure and policy variables, and analyze the dual mechanisms of policy adjustments on population structure and the real estate market. Conduct in-depth research on the application of generative AI in real estate investment decision-making scenarios, and explore its potential in creative design, scheme optimization, and other areas. In addition, conducting simulation studies on the impact of population structure changes on the real estate market provides decision-making references for real estate companies to cope with the risks of sudden population changes.

References

[1] Ye X, Zhang W. Research on the Implementation Path of Labor Education within the "New Liberal Arts" Framework[J]. Applied Mathematics and Nonlinear Sciences, 2024, 9(1).

[2] Popescu A A, Harper A L, Trick M, et al. A Novel and Fast Approach for Population Structure Inference Using Kernel-PCA and Optimization[J].Genetics, 2014, 198(4).

[3] Cabreros I, Storey J D. A nonparametric estimator of population structure unifying admixture models and principal components analysis[J].bioRxiv, 2017(4).

[4] Xue R, Deng K. Golden jackal optimization algorithm with a population quality improvement framework for real-world engineering optimization problems[J]. Evolutionary Intelligence, 2025, 18(3):1-40.

[5] Tan X, Zhou H, Jiang S, et al. Study on the impact of population factors on real estate price of Jilin city based on regression model[C]//World Automation Congress.IEEE, 2012.

[6] Cui Z, Zhang Z, Li C. Research on the Impact of Aging and New Generation in the Population Structure on China's Real Estate Price Volatility[J]. Journal of Finance Research, 2022.

[7] Seung, Hwan,Gu, et al. A Study on the Valuation of Real Estate Using the Applies Real Option Model Considering Population Structure Changes[J].KOREAN MANAGEMENT SCIENCE REVIEW, 2014, 31(1):17-26.