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Research on the Evaluation of the Impact of Rail Transit on the Price of Residential Real Estate along the Line

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Abstract

With the continuous acceleration of the process of urbanization in our country, the influx of foreign population into the city continues to increase, and with it is the inevitable traffic congestion. Therefore, studying the impact of urban rail transit on the price of residential real estate has very important practical significance for future city subway route planning and residents' house purchase plans. First, construct an index system that affects the price of residential real estate. Supported by the extension theory of matter-element entropy weight, an extension model of the influence of urban rail transit on the price of residential real estate is constructed, and the influence level of subway construction on the price change of residential real estate is obtained. The example analysis of residential real estate projects along Shijiazhuang Metro Line 1 confirms the applicability of the extension evaluation model in the research direction of the influence of urban rail transit on the price of residential real estate.

Keywords

Urban Rail Transit; Residential Real Estate Prices; Extension Theory; Entropy Weight Method.

1. Introduction

Nowadays, the problem of urban traffic congestion is a problem to be solved in the process of China's economic development. Urban rail transit is an urgently needed infrastructure construction that can well solve the problem of urban traffic congestion. The construction of urban rail transit will affect the spatial pattern of the entire city. For real estate developers, the research results can provide the basis for their land plot project layout, investment decisions, development model selection and future product pricing. For home buyers, if it is out of investment consideration, it is necessary to judge whether the real estate will increase in value after purchase, which is the key to deciding whether to invest. The formulation of rent when renting out also plays a key role; if the house is used for self-occupation, the construction and opening of the subway is also of great significance, because it is related to the issue of whether the purchaser's fixed assets can increase in value.

Foreign scholars' research on the impact of urban rail transit on residential real estate prices started earlier than domestic scholars, and the research direction focuses on the impact of rail transit construction on space and time. Dewees[1] and others conducted an empirical study on the urban rail transit system of Toronto in Canada. Using the transportation cost model, the conclusion of the study showed that the construction of the subway had a significant positive effect on the price of residential real estate in the Toronto area. rose. Millen and McDonald[2] analyzed the rail transit in Chicago, USA based on the transportation cost model, and concluded that due to the significant external utility of urban rail transit, the price of residential real estate along the line has fluctuated significantly. Compared with foreign research on the impact of urban rail transit on residential real estate prices, the domestic start is obviously late. Based on the hedonic price model, He Jianhua[3] conducted a research on the residential real estate price of Beijing Metro Line 13 and found that Beijing Residential prices around Metro Line 13 differed by an average of 18% before and after the subway's operation. Chen Tianyi[4] based on the theory of spatial econometrics and economic geography, and based on the Hedonic hedonic price method, using the SEM (spatial error) model and GIS analysis tools to analyze the spatial effect and impact mechanism of the Hangzhou Metro Phase III planning line on surrounding residential prices. The research was carried out, and it was concluded that the spatial effects of subway stations in different intervals were different.

2. A Survey of Extension Theory

2.1 Elementary Theory

The ordered triple $R=(N,c,v)$ composed of the matter N, the characteristic name c and the magnitude v of N with respect to c is taken as the basic element of the description N, which is called a one-dimensional matter element. where c and v constitute $M=(c,v)$ a feature of the representation N. The matter-element composed of matter N and its multiple features $M_i=(c_i,v_i)$ is called a multi-dimensional matter-element, and denoted as:

$$\mathrm{R}=(N_r,c_r,v_r)=\begin{bmatrix} N_r & c_{r1} & v_{r1} \\ & \cdots & \cdots \\ & c_{rn} & v_{rn} \end{bmatrix} \tag{1}$$

Thing N and the inner role of Thing N are called events, which are represented by event elements. N_a denote it as an action, c_a as a feature, v_a as a value, then denote the event as:

$$A=(N_a,c_a,v_a)=\begin{bmatrix} O_a & c_{a1} & v_{a1} \\ & \cdots & \cdots \\ & c_{an} & v_{an} \end{bmatrix} \tag{2}$$

In daily life, people, things and things are inseparable, and there is a relationship between them that transforms and influences each other. In order to describe this relationship, according to the extension primitive theory, the relationship element is written as:

$$\mathrm{Q}=(N_q,c_q,v_q)=\begin{bmatrix} N_q & c_{q1} & v_{q1} \\ & \cdots & \cdots \\ & c_{qn} & v_{qn} \end{bmatrix} \tag{3}$$

2.2 Extension Set Theory

2.2.1 Positive and Negative Extension Domains

Let the domain of universe be U, and k is a mapping from U to the real domain I, let $\tilde{A}=\{(u,y)|u\in U,y=k(u)\}$, $\tilde{\mathrm{A}}$ is called an extension set on U, $y=k(u)$ is the correlation function for $\tilde{\mathrm{A}}$, $k(u)$ is the correlation degree of element u about $\tilde{\mathrm{A}}$. Call $\mathrm{A}=\{u|u\in U,k(u)\geq 0\}$ and $A=\{u|u\in U,k(u)\leq 0\}$ the positive and negative domains of $\tilde{\mathrm{A}}$, respectively. $J(\tilde{A})=\{u|u\in U,k(u)=0\}$

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is the zero bound of $\tilde{A}$.Obviously, if $u \in J(\tilde{A})$, then $u \in A$.If $\tilde{A}$ is an extension set on the universe U, $T(T \in \{T_u, T_k, T_U\})$ is the transformation of the extension set $\tilde{A}$, and $k'(u), u \in U(T)$ is the correlation function about T. respectively:

$$A_+(T) = \{u \mid u \in U(T), k(u) \le 0, k'(Tu) \ge 0\} \tag{4}$$

$$A_-(T) = \{u \mid u \in U(T), k(u) \ge 0, k'(Tu) \le 0\} \tag{5}$$

is the positive and negative extension domain of $\tilde{A}$ with respect to the transformation T.

2.2.2 Correlation Function

In order to describe the degree to which the elements in the universe have the property ρ and its variability, the concept of "association function" is established.The distance between point x_0 and interval $X_0 = \langle a, b \rangle$ on the real axis is specified as:

$$\rho\ (x_0, X_0) = \left| x_0 - \frac{a+b}{2} \right| - \frac{1}{2}(b-a) \tag{6}$$

The relationship between distance $d(x_0, X_0)$ and distance $\rho\ (x_0, X_0)$ between points and intervals is: When $x_0 \overline{\in} X_0$ or $x_0 = a, b$, $\rho = d \ge 0$;When $x_0 \in X_0$ and $x_0 \ne a, b$, $\rho \succ 0,\ d = 0$. For $x_1, x_2 \in X_0$, there is generally $\rho\ (x_1, X_0) \ne \rho(x_2, X_0)$. The correlation function is based on distance, extending the qualitative description of "having a certain property ρ" to the quantitative description of "having the degree of property ρ". Define the elementary function as:

$$k(x) = \frac{\rho(x_0, X_0)}{\rho(x, X) - \rho(x, X_0)} \tag{7}$$

This allows the correlation function to be described using a formula.

2.2.3 Extension Goodness Evaluation

Extension goodness evaluation[5] is a method that combines quantitative research and qualitative research to solve conflicting problems. The steps to use it to evaluate innovative projects are as follows:

Determine the measurement conditions. Suppose that the measurement condition set contains 10 evaluation indicators, which are represented by $O = \{O_1, O_2, O_3, \cdots, O_{10}\}$, where $O_i = (C_i, V_i)$ is the feature element, C_i is the program goodness, and V_i is the quantized value range (i=1,2,3,…,10).

Determine the weight coefficient. Each measurement index $O_1, O_2, \cdots, O_{10}$ for evaluating the pros and cons of a project $N_j (j = 1,2,3,\cdots,m)$ is divided into important and secondary. In order to express the importance of each measurement index, the weight coefficient must be determined. For the metric O_1 that must be met, it is represented by index Λ, and for other measurement indicators, the values between $[0,1]$ are assigned according to the degree of importance. The weight coefficient is denoted as $\alpha = (\alpha_1, \alpha_2, \alpha_3, \cdots, \alpha_{10})$, where $\alpha = \Lambda$, then $\sum_{k=2}^{10} a_k = 1$, the size of the weight coefficient plays a decisive role in the goodness, and the calculation according to different weight coefficients will lead

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to completely different conclusions. However, the formulation of weight coefficients often depends on individuals to a large extent, so the authenticity and reliability of evaluation results are often subject to great subjective influence. In order to determine the weight coefficient as reasonably as possible, AHP is usually used to measure the relative importance of each condition, and then the weight coefficient is determined.

First evaluation: After determining the weight coefficient of each measurement condition, remove the schemes that do not meet the conditions, filter the conditions that must be met, and perform the following steps for the schemes that meet the conditions and must meet the condition Λ:

Establish an association function and calculate the qualification. At this time, the set of measurement conditions becomes $O=\{O_2,O_3,\cdots,O_{10}\}$, $O_i=(C_i,V_i),i=2,3,\cdots,10$, and the weight coefficient is assigned to $\alpha=(\alpha_2, \alpha_3, \Lambda, \alpha_{10})$.

Build an association function with respect to $V_2,V_3,\cdots,V_{10}$:

(1) If V_i is represented by an interval X_{ai}, take

$$k_i(x)=\frac{\rho(x,X_{oi})}{|X_{0i}|}(i=2,3,\Lambda,10) \tag{8}$$

(2) If V_i is described by an interval set composed of X_{0i} and $X_i(X_{0i}\subset X_i)$, take

$$k_i(x)=\frac{\rho(x,X_{0i})}{\rho(x,X_i)-\rho(x,X_{0i})}(i=2,3,\Lambda,10) \tag{9}$$

Abbreviated as $k_i(N_j)$ between the correlation functions of scheme N_j with respect to each measurement index O_i, normalize to:

$$K_{ij}=\begin{cases}\dfrac{K_i(N_j)}{\max K_1(x)},K_i(N_j)\succ 0 \\ x\in(x_{oi})(i=2,3,\cdots,10;j=1,2,\cdots,10) \\ \dfrac{K_i(N_j)}{\max|K_i(x)|},K_i(N_J)\prec 0 \\ x\in(x_{oi})(i=2,3,\cdots,10;j=1,2,\cdots,10)\end{cases} \tag{10}$$

Then the standard qualification of each scheme $N_1,N_2,\cdots,N_{10}$ with respect to M_i is $k_i=(k_{i1},k_{i2},\cdots,k_{im})(i=2,3,\cdots,10)$.

Computational goodness: The standard qualification of each scheme N_j with respect to each measurement index $M_2,M_3,\cdots,M_{10}$ is:

$$k(N_j)=\begin{bmatrix}k_{2j}\\k_{3j}\\M\\k_{10j}\end{bmatrix} \tag{11}$$

So the goodness of option N_j is:

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$$C(N_j)=\alpha k(N_j)=(\alpha_2,\alpha_3,\Lambda,\alpha_{10})\begin{bmatrix}k_{2j}\\k_{3j}\\M\\k_{10j}\end{bmatrix}=\sum_{i=2}^{10}\alpha_1 K_{ij}(j=1,2,\Lambda,m) \tag{12}$$

Compare the goodness of scheme N_j, if $C(N_0)=\max\limits_{j=1,2,\Lambda,m}\{C(N_j)\}$, then scheme N_0 is the best.

3. Construction of Evaluation Model based on Matter-element and Extension Theory

3.1 Construction of Evaluation Index System of Urban Rail Transit's Impact on Residential Real Estate Prices

The real estate industry is an important industry that is related to the basic life of thousands of households. Many domestic and foreign researchers have done a lot of research on the factors that affect real estate prices. However, the actual situation of each country and region has certain differences. Therefore, under the condition of the same general rule, a large number of documents were consulted and summarized, and six aspects of economy, society, policy, location, and parcel community were selected to come to the urban track. Factors that affect the price of residential real estate along the line. In the selection of indicators, the idea of extension engineering should be considered, and all possible factors in the system should be considered, analyzed, and a preliminary list of indicators should be determined, and then these initial indicators should be screened.

3.2 Determination of Section Domain and Classical Domain

In the extension evaluation model, the characteristics of things and the range of standard magnitudes constitute the classical domain R, the price of residential real estate is defined as O, and the magnitude of the characteristic value C is defined as V, and its expression is:

$$R=(O_j,C_j,V_{ji})=\begin{bmatrix}O_j & C_1 & V_{j1}\\ & C_2 & V_{j2}\\ & \cdots & \cdots\\ & C_m & V_{jm}\end{bmatrix}=\begin{bmatrix}O_j & C_1 & (\alpha_{j1},\beta_{j1})\\ & C_2 & (\alpha_{j2},\beta_{j2})\\ & \cdots & \cdots\\ & C_m & (\alpha_{jm},\beta_{jm})\end{bmatrix} \tag{13}$$

In the formula: α_{ji} and β_{ji} are the upper and lower limits of the classical matter-element characteristic value C_i, respectively, $i=1,2,\cdots,m$, the evaluation level of the impact of urban rail transit on residential real estate prices is O_j, and C_i represents the i-th evaluation index, V is the value range of O with respect to C, then the classical domain of the evaluation index of O_j is recorded as (α_{ji},β_{ji}).

The matter-element matrix composed of the classical matter-element and its characteristics correspondingly expanded the range of magnitude is the node field R_p,

$$R_p=(P,C_i,V_{pi})=\begin{bmatrix}P & C_1 & V_{p1}\\ & C_2 & V_{p2}\\ & \cdots & \cdots\\ & C_m & V_{pm}\end{bmatrix}=\begin{bmatrix}P & C_1 & (\alpha_{p1},\beta_{p1})\\ & C_2 & (\alpha_{p2},\beta_{p2})\\ & \cdots & \cdots\\ & C_m & (\alpha_{pm},\beta_{pm})\end{bmatrix} \tag{14}$$

in the formula: α_{pi} and β_{pi} are the upper and lower limits of the matter-element characteristic value C_i of the node domain, respectively, $i=1,2,\cdots,m$, P is the degree of influence of urban rail transit on residential real estate prices, V_{pi} is the range of P_i about C_i, then denote the evaluation index section field of R_p as (α_{pi},β_{pi}).

3.3 Matter Element to Be Evaluated

In this paper, the impact of urban rail transit on residential real estate prices is recorded as thing N, and feature C is recorded as $C=(c_1,c_2,\cdots,c_m)^T$; denote the magnitude V of the feature as $V=(v_1,v_2,\cdots,v_m)^T$. Taking the ordered ternary $R=(N,C_i,V_i)$ as the matter-element, that is:

$$R=(N,C_i,V_i)=\begin{bmatrix} N & C_1 & V_1 \\ & C_2 & V_2 \\ & \cdots & \cdots \\ & C_m & V_m \end{bmatrix}=\begin{bmatrix} N_p & c_1 & [\alpha_{p1},\beta_{p1}] \\ & c_2 & [\alpha_{p2},\beta_{p2}] \\ & \cdots & \cdots \\ & c_m & [\alpha_{pm},\beta_{pm}] \end{bmatrix} \tag{15}$$

In the formula: R represents the matter-element to be evaluated of the residential real estate price O of the evaluation object, and α_{pm} and β_{pm} are the upper and lower limits of the matter-element characteristic value respectively.

3.4 Calculation of Relevance

Taking a point on the real axis, the interval satisfied by the matter-element to be evaluated can be represented by the correlation function. The correlation function of the object to be evaluated is expressed as:

$$K_j(x_i)=\begin{cases} -\dfrac{\rho(x_i,x_{ji})}{|x_{ji}|}, x_i \in x_{ji} \\ 0, \text{the value of x is the endpoint of the interval} \\ \dfrac{\rho(x_i,x_{ji})}{\rho(x_i,x_{pi})-\rho(x_i,x_{ji})}, x_i \notin x_{ji} \end{cases} \tag{16}$$

in:

$$\rho(x_i,x_{ji})=\left|x_i-\frac{1}{2}(\alpha_{ji}+\beta_{ji})\right|-\frac{1}{2}(\beta_{ji}-\alpha_{ji}) \tag{17}$$

$$\rho(x_i,x_{pi})=\left|x_i-\frac{1}{2}(\alpha_{pi}+\beta_{pi})\right|-\frac{1}{2}(\beta_{pi}-\alpha_{pi}) \tag{18}$$

$$x_{ji}=|(\alpha_{pi}-\beta_{pi})| \tag{19}$$

In the formula: $K_j(x_i)$ is the correlation degree of the i-th evaluation index with respect to the j-th grade, ρ is the extension distance function, $\rho(x_i,x_{ji})$ and $\rho(x_i,x_{pi})$ represent the distance

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between the index value and the classical domain and the nodal domain, respectively. x_{ji} is classic and interval.

3.5 Determine the Weight of Evaluation Indicators

The basic data of the indicator weight is determined through a questionnaire survey to obtain the evaluation matrix B_1:

$$B_1 = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ b_{m1} & b_{m2} & \cdots & b_{mn} \end{bmatrix} \tag{20}$$

Then according to the calculation formula:

$$u_{ij} = b_{ij} / \sum_{j=1}^{n} b_{ij} \tag{21}$$

Get the membership matrix U_i:

$$U_i = \begin{bmatrix} u_{11} & u_{12} & \cdots & u_{1n} \\ u_{21} & u_{22} & \cdots & u_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ u_{m1} & u_{m2} & \cdots & u_{mn} \end{bmatrix} \tag{22}$$

When defining the entropy value, the i-th index is defined as v_i, then:

$$v_i = -\frac{1}{\ln n} \times \sum_{j=1}^{n} u_{ij} \ln u_{ij} \tag{23}$$

If $u_{ij} = 0$ in Equation 23, then modify it as:

$$u_{ij} = \frac{(1 + b_{ij})}{(1 + \sum_{j=1}^{n} b_{ij})} \tag{24}$$

From the above calculation results of entropy value, the weight of each index of information entropy is obtained as:

$$\vartheta_i = \frac{1 - v_i}{\sum_{i=1}^{m} (1 - v_i)} \tag{25}$$

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3.6 Extension Evaluation

The correlation degree $K(x_i)$ of the indicators of the index layer about each level and the indicator weight ϑ_{im} of the indicator layer are obtained through mathematical operations, and then the indicator weight is multiplied by the correlation degree matrix $K(x_i)$ to obtain the weighted correlation degree $K(R_i)$ of the indicator layer. The result is:

$$K(R_i) = \vartheta_{im} \bullet K(x_{im}) = [\vartheta_{i1} \quad \vartheta_{i2} \quad \cdots \quad \vartheta_{im}] \begin{bmatrix} K_1(x_{i1}) & K_2(x_{i1}) & \cdots & K_m(x_{i1}) \\ K_1(x_{i2}) & K_2(x_{i2}) & \cdots & K_m(x_{i2}) \\ \cdots & \cdots & \cdots & \cdots \\ K_1(x_{im}) & K_2(x_{im}) & \cdots & K_m(x_{im}) \end{bmatrix} \tag{26}$$

$K(R_i)$ is the comprehensive correlation degree of each index on the grade, and $K(R_I) = \max K(R_i)$ is the evaluation grade of the evaluation object residential real estate price O.

4. Case Analysis

Shijiazhuang Metro Line 1 was built in mid-2013, and the second phase of Shijiazhuang Metro Line 1 (Xizhuang Station to Fuze Station) opened for trial operation on June 26, 2019. Taking Shijiazhuang Metro Line 1 as an example, this paper selects the residential real estate near Beisong Metro Station in Chang'an District, Shijiazhuang - Galaxy Shengshicheng for empirical analysis.

4.1 Confirmation of the Evaluation Index System

Starting from the actual situation of Shijiazhuang City, taking into account the four factors of society, location, parcel land, and community, the following evaluation index system is established:

Table 1. Evaluation example index system of the impact of urban rail transit on residential real estate prices

target layer	Criterion layer	Indicator layer
Evaluation of the Influence of Urban Rail Transit on Residential Real Estate Prices	Social factors C1	Population factor C11 Consumer attitudes C12
	Location factors C2	Ride cost to subway station C21 Time to subway station C22 Time to city center C23 Ease of commuting C24 Convenience of life C25 The degree of business development in the surrounding area C26
	Parcel factors C3	Volume rate C31 Green space configuration C32 Parking space ratio C33 Residential noiseC34 Commercial service C35
	Community factors C4	Resident Satisfaction C41 Sense of belonging C42 Community security C43

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4.2 Determination of Classical and Sectional Domains

Due to the relatively early opening of subway lines in developed cities in China, the impact of subway operations on the residential real estate market has been relatively stable and clear. Therefore, the data of Beijing is selected as the upper limit of the section field, and the data of Shijiazhuang City before the construction of the subway is selected as the data of the classic field. The lower limit, through the investigation, the impact of urban rail transit on the price of residential real estate is divided into three levels, namely "first class", "second class", "third class". The classical domain and section domain in the study are represented as follows:

Table 2. Classical domain and section domain of evaluation indicators

Evaluation Indicators	Classic Domain			Section Field
	Level 1	Level 2	Level 3	
C11	<7.8,10.8>	<10.8,13.8>	<13.8,17>	<7.8,17>
C12	<0.5,1.3>	<1.3,2.1>	<2.1,2.9>	<0.5,2.9>
C21	<0.5,0.65>	<0.65,0.8>	<0.8,1>	<0.5,1>
C22	<0.65,0.75>	<0.75,0.85>	<0.85,0.95>	<0.65,0.95>
C23	<0.8,1.3>	<1.3,1.8>	<1.8,2.3>	<0.8,2.3>
C24	<2,3.5>	<3.5,5>	<5,6.5>	<2,6.5>
C25	<6,7>	<7,8>	<8,9>	<6,9>
C26	<0.6,0.7>	<0.7,0.8>	<0.8,0.9>	<0.6,0.9>
C31	<1.8,2.7>	<2.7,3.6>	<3.6,4.5>	<1.8,4.5>
C32	<7.2,8.64>	<8.64,10.2>	<10.2,12>	<7.2,12>
C33	<1,1.6>	<1.6,2.3>	<2.3,3>	<1,3>
C34	<4.8,5.2>	<5.2,5.6>	<5.6,6>	<4.8,6>
C35	<0.76,0.84>	<0.84,0.92>	<0.92,1>	<0.76,1>
C41	<5,6.6>	<6.6,8.3>	<8.3,10>	<5,10>
C42	<3,4.5>	<4.5,6>	<6,7.5>	<3,7.5>
C43	<5,6.6>	<6.6,8.3>	<8.3,10>	<5,10>

4.3 Determination of Matter Element to be Evaluated

In order to complete data collection for follow-up research, extensive inquiries were conducted using online questionnaire surveys, and normalized according to the average of the obtained data, and the following matter-elements to be evaluated were obtained:

Evaluation indicators under social factors:

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$$R=\begin{bmatrix} N & C_{11} & 13.2 \\ & C_{12} & 2.5 \end{bmatrix}$$

Evaluation indicators under the location factor:

$$R=\begin{bmatrix} N & C_{21} & 0.57 \\ & C_{22} & 0.77 \\ & C_{23} & 1.85 \\ & C_{24} & 5.7 \\ & C_{25} & 7.5 \\ & C_{26} & 0.85 \end{bmatrix}$$

Evaluation indicators under the parcel factor:

$$R=\begin{bmatrix} N & C_{31} & 3.10 \\ & C_{32} & 11.00 \\ & C_{33} & 2.50 \\ & C_{34} & 5.30 \\ & C_{35} & 0.97 \end{bmatrix}$$

Evaluation indicators under the community factor:

$$R=\begin{bmatrix} N & C_{41} & 7.72 \\ & C_{42} & 6.80 \\ & C_{43} & 8.90 \end{bmatrix}$$

4.4 Calculation of Relevance Degree of Evaluation Index

According to the calculation method of the index correlation degree of formula 16, the correlation degree of each evaluation index with respect to the evaluation level is obtained. The specific calculation results are as follows:

The correlation degree of evaluation indicators under social factors is:

$$K(x_1)=\begin{bmatrix} -0.387 & 0.2 & -0.136 \\ -0.75 & -0.5 & 0.5 \end{bmatrix}$$

The correlation degree of the evaluation index under the location factor is:

$$K(x_2)=\begin{bmatrix} 0.467 & -0.533 & -0.766 \\ -0.143 & 0.2 & -0.4 \\ -0.55 & -0.1 & 0.1 \\ -0.733 & -0.467 & 0.467 \\ -0.25 & 0.5 & -0.25 \\ -0.75 & -0.5 & 0.5 \end{bmatrix}$$

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The correlation degree of the evaluation index under the parcel factor is:

$$K(x_3)=\begin{bmatrix}-0.235 & 0.444 & -0.278\\ -0.702 & -0.444 & 0.444\\ -0.643 & -0.286 & 0.286\\ -0.167 & 0.25 & -0.375\\ -0.813 & -0.625 & 0.375\end{bmatrix}$$

The correlation degree of evaluation indicators under the community factor is:

$$K(x_4)=\begin{bmatrix}-0.329 & 0.341 & -0.203\\ -0.767 & -0.533 & 0.467\\ -0.676 & -0.353 & 0.353\end{bmatrix}$$

4.5 Determination of Evaluation Index Weights

Taking the correlation degree of each index under the social factor as the judgment matrix of each index under the social factor, the weight of each index under the social factor is calculated as:

$$\vartheta_1=\begin{bmatrix}\vartheta_{11} & \vartheta_{12}\end{bmatrix}=\begin{bmatrix}0.301 & 0.699\end{bmatrix}$$

Taking the correlation degree of each index under the location factor as the evaluation matrix of each index under the location factor, the weight of each index under the location factor is calculated as:

$$\vartheta_2=\begin{bmatrix}\vartheta_{21} & \vartheta_{22} & \vartheta_{23} & \vartheta_{24} & \vartheta_{25} & \vartheta_{26}\end{bmatrix}=\begin{bmatrix}0.259 & 0.107 & 0.171 & 0.228 & 0.001 & 0.234\end{bmatrix}$$

Taking the correlation degree of each index under the parcel factor as the evaluation matrix of each index under the parcel factor, the weight of each index under the parcel factor is calculated as:

$$\vartheta_3=\begin{bmatrix}\vartheta_{31} & \vartheta_{32} & \vartheta_{33} & \vartheta_{34} & \vartheta_{35}\end{bmatrix}=\begin{bmatrix}0.025 & 0.254 & 0.232 & 0.105 & 0.384\end{bmatrix}$$

Taking the correlation degree of each indicator under the community factor as the evaluation matrix of each indicator under the community factor, the weight of each indicator under the community factor is calculated as:

$$\vartheta_4=\begin{bmatrix}\vartheta_{41} & \vartheta_{42} & \vartheta_{43}\end{bmatrix}=\begin{bmatrix}0.112 & 0.490 & 0.398\end{bmatrix}$$

4.6 Extension evaluation

The weight, relevance and evaluation level of the index layer factors are shown in the following table:

Table 3. Evaluation results of the index layer

Indicator layer factors	Index Weight	Correlation			Evaluation
		Level 1	Level 2	Level 3	
C11 population factor	0.301	-0.387	0.2	-0.136	Level 2
C12 Consumer attitudes	0.699	-0.75	-0.5	0.5	Level 3
C21 Ride cost to subway station	0.259	0.467	-0.533	-0.766	Level 1
C22 Time to subway station	0.107	-0.143	0.2	-0.4	Level 2
C23 Time to city center	0.171	-0.55	-0.1	0.1	Level 3
C24 Ease of commuting	0.228	-0.733	-0.467	0.469	Level 3
C25 Convenience of life	0.001	-0.25	0.5	-0.25	Level 2
C26The degree of business development in the surrounding area	0.234	-0.75	-0.5	0.5	Level 3
C31 Volume rate	0.025	-0.235	0.444	-0.278	Level 2
C32 Green space configuration	0.254	-0.702	-0.444	0.444	Level 3
C33 parking space ratio	0.232	-0.643	-0.286	0.286	Level 3
C34 residential noise	0.105	-0.167	0.25	-0.375	Level 2
C35 commercial service	0.384	-0.813	-0.625	0.375	Level 3
C41 Resident Satisfaction	0.112	-0.329	0.341	-0.203	Level 2
C42 sense of belonging	0.490	-0.767	-0.533	0.467	Level 3
C43 Social Security	0.398	-0.676	-0.353	0.353	Level 3

4.7 Analysis of Evaluation Results

According to the above analysis, the location factor is most affected by the construction of urban rail transit, that is, before and after the construction of the subway, the price of residential real estate is greatly changed by the location factor. Among the 16 indicators selected in this paper, among the social factors: the concept of consumption is greatly affected. Before the completion of the subway, the housing price in Shijiazhuang was in a relatively stable state for a long time. After the completion of the subway, as more people pursued the subway real estate, the corresponding The concept of consumption has also changed, and they are able to accept commodity houses with relatively high unit prices. In terms of location factors: the construction of the subway has led to the birth of a large number of new business districts, such as the construction of Mixc City and Wanda Plaza in Chang'an District. People's commuting convenience and living convenience have also increased accordingly. Before the subway was opened, it was a two-hour bus journey across the east and west ends of Shijiazhuang City. After the subway was opened, this time was shortened to half of the original time. People who originally lived in more remote places can take the subway to the city center at the fastest speed, which greatly improves people's lives. Among the land parcel factors: Since the construction of the subway must occupy part of the land that was originally used for living, the original green space allocation ratio and the parking space allocation ratio are reduced to a certain extent. Among the community factors: due to the completion of the subway, there will be a larger flow of people in the neighborhoods adjacent to the subway than before, which to a certain extent promotes the improvement of the quality of residential property services and security services.

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5. Conclusion

By using the entropy weight matter-element extension analysis method to analyze the factors affecting the price of residential real estate by urban rail transit, the extension model is constructed. The Xinghe Shengshicheng project along Shijiazhuang Metro Line 1 was brought into the extension theory model, the influence degree of 16 indicators was determined, and the ranking of the influence level was obtained, and the operability of the extension model was verified by project examples.

Researches worthy of further expansion include: when selecting evaluation indicators, due to the close connection between the research perspective and the transportation field, the selection of indicators is more refined in terms of location factors, while the selection of indicators under other factors is relatively small. Due to different research directions, the selection of indicators affecting residential real estate prices should also be different. The index system finally selected in this paper is only a personal subjective opinion and cannot cover all indicators affecting residential real estate prices.

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