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Comprehensive evaluation system of intelligent urban growth

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Comprehensive evaluation system of intelligent urban growth

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Abstract. With the rapid urbanization of the world, urban planning has become increasingly important and necessary to ensure people have access to equitable and sustainable homes, resources and jobs.This article is to talk about building an intelligent city evaluation system.First,using System Analysis Model(SAM) which concludes literature data analysis and stepwise regression analysis to describe intelligent growth scientifically and obtain the evaluation index .Then,using the improved entropy method to obtain the weight of the evaluation index.Afterwards, establishing a complete Smart Growth Comprehensive Evaluation Model(SGCEM).Finally,testing the correctness of the model.Choosing Otago(New Zealand)and Yumen(China) as research object by data mining and SGCEM model,then we get Yumen and Otago's rational degree's values are 0.3485 and 0.5376 respectively. It's believed that the Otago's smart level is higher,and it is found that the estimated value of rationality is consistent with the reality.

1 Introduction

With the development of the world economy and the acceleration of the urbanization process, the world's urban population will increase rapidly in the next 40 years[1]. Consequently, urban planning has become increasingly important and necessary to ensure that people have access to equitable and sustainable homes, resources and jobs. Many communities are implementing smart growth initiatives in an effort to consider long range, sustainable planning goals. Smart growth is a new urban development model for urban sprawl, which aims to protect the ecological environment, promotes the coordinated development of urban and rural areas, improves people's quality of life through rational planning and integrates the use of land.In a word,it emphasizes the transformation of the existing community investment to avoid the disorderly expansion of the city, provides a new way of thinking to solve the problem of urban land use.Thus, we define a metric to measure the success of smart growth of a city,it can help us realize our city's growth more rationally.

2 Matters and methods

2.1The screening of indicators

In order to define the measure of urban intelligence growth successful rate, set the "Rationality". Rationality is the rational degree of urban planning and development. Establish a new index system and evaluate the comprehensive benefits of urban intelligent growth.

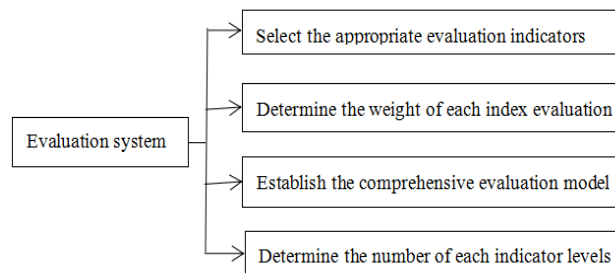Model building steps are as followed:

Figure1: Model building steps

2.2 Indicator settings

Smart growth focuses on building sustainable cities - economic prosperity, social equality, and environmental sustainability. In view of this, under the guidance of rational growth's concept, the intelligent growth index system has constructed. It is flexible to choose from the factors of land resources, ecological resources, economic resources and all aspects of society. Based on the combination of three methods which are system analysis, expert consultation and literature analysis, taking the rational employment growth rate, the residents' satisfaction rate and the per capita public service facilities as the indicators, which can reflect the level of the rational growth and the principle of "three-effect unification" .At the end, an evaluation index system of intelligent growth successful rate has built[2].

2.3 Screening evaluation indicators

To make every indicator more reasonable, use the stepwise introducing variable into the model, each introduced variable need to be processed in F inspection , and the variables which has been selected need to carry on T test next, when the original variables due to the new variables become no longer significantly, it is deleted. Until all significant variables has in the regression equation, and all insignificant variables has removed from the regression equation. The circulation can stop,it ensures the selection of variables and the results are optimal.Using stepwise regression method to select the main influencing factors which are selected before. The test result is as follows:
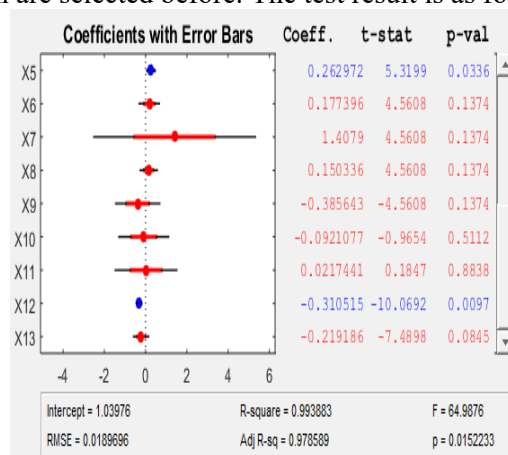

Figure2: the test result

2.4 Indicator hierarchy

After screening and sorting, the index system is as follows:

Table 1: Indicator hierarchy

	Social	Qualiy of life in urban area
		Urban public facilities
Rational degree	Ecology	Harmony cities
		Pullution status indicators
	Economy	Economic indicators
		Economic structures

2.5 Rationality evaluation system

The evaluation indicators which based on the above analysis and the concept of rational growth are got.The overall goal is rationality, that is, the comprehensive benefits of urban land use,and sub-goals are social, ecological and economic benefits.The sub-targets of the index system have different evaluation criteria. For example, there are three criteria: the basic living quality of urban residents, the urban public infrastructure and the harmonious city. The economic benefits include economic criteria and economic structure. Specific criteria for evaluation are under the indicators,such as "per capita disposable income" , "walking to the average area of life service area" and so on.

2.6 Calculate the weight of each index

Standardize the index system by using the normalization method.

(1) Positive indicators do not have to be dealt with. If there are reverse indicators, the first through the reverse index into a positive indicator:

$$x_{ij}^{'} = \max x_{ij} + \min x_{ij} - x_{ij}(1 \le i \le m, 1 \le j \le n)$$

Among them, x_{ij} is the first j index value of the first I program.

(2) If there is the first j index value $x_{ij} \le 0$, you can use the following formula for coordinate translation, so that all the indicators are not assigned:

$$x_{ij}^{'} = x_{ij} - \min x_{ij}$$

For the sake of convenience, we put the $x_{ij}^{'}$ as x_{ij}. If all the indicators are not negative, it is unnecessary to do with this.

(3) Finally, the normalization method is used to normalize the column and equal to 1.

$$p_{ij} = \frac{x_{ij}}{\sum\limits_{i=1}^{m} x_{ij}} (1 \le i \le m, 1 \le j \le n)$$

Then, the weight of each index is determined by using entropy value method.

(1) Calculate the j index of entropy:

$$e_j = -k \sum\limits_{i=1}^{m} p_{ij} \ln p_{ij}(1 \le i \le m, 1 \le j \le n)$$

(2) Adjustment coefficient $k = \dfrac{1}{\ln m}$, then：

$$e_j = -\frac{1}{\ln m} \sum\limits_{i=1}^{m} p_{ij} \ln p_{ij}(1 \le i \le m, 1 \le j \le n)$$

Calculate the difference of index in coefficient. If the difference is large, the index to the evaluation scheme have a great effect, so the entropy is small. Otherwise,the difference is small, the evaluation scheme have a small effect,the entropy can be greater .Therefore,the difference coefficient is:

$$g_j = 1 - e_j (1 \le j \le n)$$

(3) Determine the weight of the first j index:

$$w_j = \frac{g_j}{\sum_{j=1}^{n} g_j} (1 \le j \le n)$$

Finally, calculate the rationality of land:
(1) Calculate target score:

$$F_i = \sum_{j=1}^{n} (p_{ij} \times w_{ij})$$

Among them, F_{ij} is the rational growth and rational value of I target city, which is the weight value of j sub objective with respect to I .
(2) Calculate the comprehensive rationality score :

$$F = \sum_{i=1}^{m} (F_i \times w_i)$$

2.7 Application of Model
In this section,we choose Chinese Yumen [3]and Otago [4][5]as the research object. Then, according to the above model, the first index values are normalized:

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} (1 \le i \le m, 1 \le j \le n)$$

Then, determine the weight of the j index by using entropy method:

$$w_j = \frac{g_j}{\sum_{j=1}^{n} g_j} (1 \le j \le n)$$

Through the data mining and reference for the government work report, when all kinds of parameter's values have got, taking each index generation into the formula, then calculating the rational comprehensive score, the results are as followed:

The cities	Rational degree
Yumen	0.3485
Otago	0.5376

According to the results, it is clear that the rational value of Otago is bigger than Yumen, meaning that its rational growth is greater than Yumen,which is consistent with the actual situation.

3 Conclusions
Firstly, set up the index system of intelligent growth evaluation with rationality as the evaluation target. Secondly, select Yumen and Otago as the research object, analyze and measure the indicators of two cities. Finally, calculate the rational values of Yumen and Otago,they are 0.3485 and 0.5376. Therefore, it is believe that Yumen and Otago both have a higher degree of rational, namely rational growth and better efficiency, and the Otago's rational growth level is better than Yumen City. Due to time constraints, it is difficult to obtain comprehensive data resources and quantify indicators accurately. That may causes the calculation result inaccurate. If there is enough time and resources, it

will be able to get more realiable results. For example, obtain the selection of index by using a variety of methods and get the satisfactory professional interpretation. Then, priority will be given to those indicators which are selected at the same time by using a variety of methods. Meanwhile, determine a reasonable weight. At last, a complete evaluation system will be established.

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