The Relationship between Urban Crime Data and Urban Security

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Keywords: Comprehensive method; Cauchy distribution; Analytic Hier-archy Process (AHP); Logarithmic function

Abstract. In order to create a safety rating for My City and specify a measure of how safe My City is a comprehensive method is developed.

In the model, we take into account a variety metrics, and divide them into three categories: The critical matter, Police and The domestic situation. We employ Analytic Hierarchy Process (AHP) to determine the weight allocation to different metrics. In the critical matter, we consider two factors, the number of the critical matter and the critical type. In Police, we consider two factors, the number of patrols and the efforts apprehending criminals. In the efforts apprehending criminals, we employ statistical regression method to process collected data and establish a function to measure the relationship between it and the city security. In consideration of the correlation, the evaluation of Police gives a comprehensive result by weighing results returned by the two functions. In the domestic situations, two factors are considered, they are the number of the case which is related to the domestic situation and the influ-ence of cities around. Similarly to analyze these two factors, we employ the method that the second part uses.

We employ partial large Cauchy distribution and the logarithmic function as the subordinate function to classify the city safety to five levels. We use the comprehensive method to obtain the result of the city safety, its 3.82. According to the classification, my city is safe.

Introduction

The safety of city is related closely to citizens' life and property, which are of upmost importance to a person, so we attach great importance to the city safety. But how to make of the massive amount of crime statistics collected to determine the safeness of a city is urgent to be solved. The problem requires us:

- To use mathematical modeling and analyze the given data to create a safety rating for My City.
- To use the safety rating to specify a measure of how safe My City is.
- To prepare a 1-2 page non-technical report for the Mayor of My City to describe our findings.

Assumptions

- The selected data are valid.
- The given data in two weeks can reflect the general situation of My City and in the process of our study, accidents would not happen.
- My City is an American city, so the rate of migration flow of the city is replaced by the average rate of the transient population in the United States. [2].
- When analyzing the given data, we ignore some data which we think would not have an important impact on our study.
- In the question, My City is impacted by a metropolitan area. When we analyze factors which can give rise to the safeness of our city, we did not pay attention to the distance between the two cities.

Model

Additional Assumption.

- The evaluation system includes three parts: The criminal matter, Police and The domestic situation.
- We assume that each part includes two specific indexes.
- Time and place will only make a difference in the two indexes of the criminal matter. [3]

Evaluation System. The Criminal Matter and City Security. Generally speaking crime always threats to the security of our city. Through the analysis of many events, we found that the severity of the crime and intensity of crime have the worst impact on these treatment of the city among all factors. So we focused on these [4].

The Number of the Criminal Matter**.** From the data given in excel, we can discover that the number of criminal matter varies with time and location. Through processing the data, we conclude that date has little influence on the criminal matter. However, time plays an important role in the criminal matter, so does location. According to the data, and combining with what we have studied, we divide them into four cases: indoor cases in the daytime, outdoor cases at night, indoor cases in the daytime, outdoor cases at night. We define a_1, a_2, a_3, a_4 as the number of each case [5]. Then, the score of each part (here we define G_i as the score) is calculated as follows:

$$G_i = a_i / \sum_{i=0}^{4} a_i$$

As we all know, generally, we work outdoors more in the daytime, so the crimes happen outdoors in the daytime surely do more harm to us. For the same reason, we rest indoors more at night, so the crimes happen indoors at night are larger threats to us. We define Hi as the weight on the four cases. So Hi have different values as follow [6]:

Then the score of each criminal matter is:

$$x_i^{'} = G_i * H_i$$

We would measure the cities safety rating by scores, and the higher the score is [7], the safer the city is. So we should make a processing for the score we have obtained, then

$$x_i^{''} = 1 - x_i^{'}$$

Afterwards, we should definite the weight of each criminal matter. By com- paring the severity of the eight types of crimes, we can construct the pair-wise comparison matrix A_1.

We can obtain the largest eigenvalue of A1=8.4310 and its weight vector:

$$W_i = [0.2897, 0.1594, 0.3812, 0.0538, 0.0320, 0.0320, 0.0310, 0.0209]^{\mathrm{T}}$$

After that, we must check the consistency of matrix A1. The consistency index is calculated as follows:

$$CI_1 = (\gamma - n)/(n-1) = 0.065$$

From the below chart [8], the random consistency index RI_1 = 1.41.

Then, we can obtain consistency ratio:

$$CR_1 = CI_1 / RI_1 = 0.0437 < 0.1$$

In the model, we have defined evaluation indexes and determined the weights of their importance. By searching and selecting needed data [9], we obtained the final amount of evaluation of My City. According to the final result and the standard we set, we can judge the safeness of My City. And in the sensitivity analysis, the result is that my city is safe. Further work of the model should choose more evaluation indexes to judge the safeness of a city in a more fairly way.

Because cities have something in common and given that the algorithm does not need any details,

the model can be applied to any fields that need an e- valuation system [10]. However, the partial coefficient in this algorithm must be determined on a mass of trail and error adjustments, which we cannot ade- quately explain here

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