

# Synthetic Analysis on Transportation Safety of China's Main Cities

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## 1. Introduction

Transportation safety, as the base of urban survival and development, is very important and necessary for sustainable development of a city. Recently more and more cities are facing the problem of road congestion and safety, so it is urgent for us know the situation of transportation of safety of our main cities and to take active actions to solve it.

## 2. Evaluation method

To evaluate transportation safety of a city is a complicated problem. Evaluation method includes many methods such as expert evaluation, AHP, etc. Comparing to other methods, factor analysis has several strongpoint: At first, evaluation of factor analysis has used all information of each variable and are more general than other methods. The second, the results of factor analysis are more reasonable and comparable. The original data are standardized and score of each case can be calculated. So we take factor analysis as our main method. Factor analysis is a multivariate statistical approach that can be used to analyze interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimensions (factors). The statistical approach involving finding a way of condensing the information contained in a number of original variables into a smaller set of dimensions (factors) with a minimum loss of information.

This family of techniques uses an estimate of common variance among the original variables to generate the factor solution. Because of this, the number of factors will always be less than the number of original variables. So, choosing the number of factors to keep for further analysis is more problematic using common factor analysis than in principle components.

Basic steps in conducting a factor analysis:

- 1) data collection and generation of the correlation matrix
- 2) extraction of initial factor solution
- 3) rotation and interpretation
- 4) construction of scales or factor scores to use in further analyses

The output of a factor analysis will give us several things. The table below shows how output helps to determine the number of components/factors to be retained for further analysis. One good rule of thumb for determining the number of factors, is the "eigenvalue greater than 1" criteria. For the moment, let's not worry about the meaning of eigenvalues, however this criteria allows us to be fairly sure that any factors we keep will account for at least the variance of one of the variables used in the analysis. However, when applying this rule, keep in mind that when the number of variables is small, the analysis may result

in fewer factors than "really" exist in the data, while a large number of variables may produce more factors meeting the criteria than are meaningful. It is possible to do several things with factor analysis results, but the most common are to use factor scores, or to make summated scales based on the factor structure. In our analysis, factor scores are used to compute score of each case by summated factor scores weighted by factor's contribution to the total variation of data.

### 3. Choice of indicators

Transportation in a city is a synthetic system. So indicator system is needed to describe transportation safety. To evaluate the transportation safety problem accurately in different cities, we choose as many as indicators to describe the safety. But in China the statistic information of city's transportation safety is rather limited. From the public information, we collect 6 indicators of 32 main cities from China Statistical Yearbook 1999. Data includes number of transportation accidents, deaths in traffic accident, injuries in traffic accident, number of urban population, amount of passenger transportation, amount of freight transportation. The cities include: Beijing, Shanghai, Tianjin, Nanjing, Hangzhou, Hefei, Nanchang, Fuzhou, Jinan, Xuzhou, Qingdao, Shijiazhuang, Taiyuan, Baotou, Shenyang, Changchun, Harbin, Dalian, Anshan, Guangzhou, Changsha, Wuhan, Zhengzhou, Chengdu, Chongqing, Xi'an, Lanzhou, Kunming, Guiyang, Hohhot, Xining, Urumqi. Considering the difference of scale of population, level of transportation flux in each city, 6 relative indicators are calculated based on above 6 indicators. The 6 relative indicators are: probability of accident per 10K persons (X1), death rate in accident per 10K persons (X2), injury rate in accident per 10K persons (X3), probability of accident per 10K passengers (X4), death rate in accident per 10K passengers (X5), injury rate in accident per 10K passengers (X6). All these indicators are reserve index, the less the index value is, the larger safety degree of this aspect is.

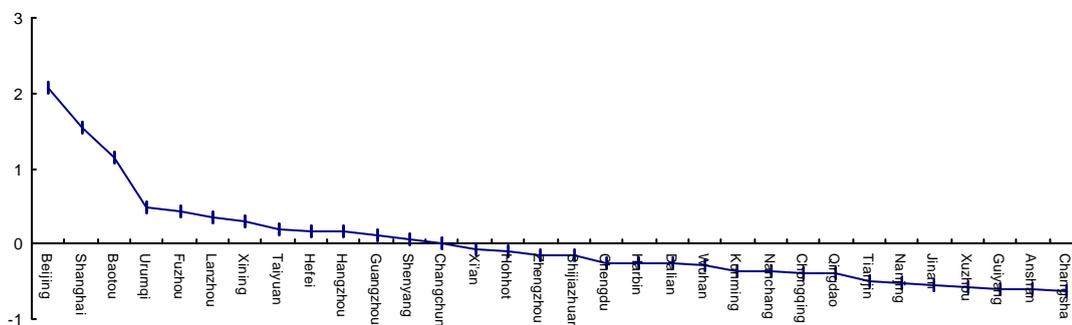
### 4. Calculation results

At first, data are standardized to make data comparable. Then correlation analysis is taken in these indicators. It is found that the correlation coefficients of X1 and X3, X4, X6 are rather high. It indicates that probability of accident (X1) is a very important factor in transportation safety in a city.

Based on factor analysis method, the plot of eigenvalues can be calculated. According to the choice criteria, the first 3 factors are extracted because they have explained over 90% of the total variance. Based on the extracted factors, the factor score can be computed. Then synthetic score of a certain city can be calculated with the weight of contribution rate of each factor. Then we rank the synthetic score of each city and make it a graph (Seeing chart 1). Because indicators are all reverse indicators, so the higher the synthetic score of a city is, the lower transportation safety level in this city is.

**Table 1 Factor Coefficient Table**

	Factor 1	Factor 2	Factor 3
X1	0.825	-0.012	0.480
X2	-0.127	0.873	0.379
X3	0.313	0.121	0.900
X4	0.975	0.036	0.061
X5	0.487	0.803	-0.252
X6	0.891	0.242	0.267



### **Chart 1 Rank of synthetic score of each city**

#### **5. Main conclusions**

Based on above analysis, it is found that transportation safety level of Beijing, Shanghai, Baotou, Lanzhou, Fuzhou are relatively low, and transportation safety level Changsha, Anshan, Guizhou, Xuzhou are relatively high. It is important and urgent for management department to take active actions to improve the transportation safety level in Beijing and Shanghai, etc .

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#### **Resume**

Liu Yanping, professor, vice dean of School of Economics and Management, Northern Jiaotong University. In recent years he focused on the economics research in transportation industry. And he had promulgated over 40 papers on publications.

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#### **Abstract**

In this paper transportation safety of China's 32 main cities are evaluated based on factor analysis method. Beijing, Shanghai are ranked behind and Changsha and Anshan ranked first and second in our analysis. So it is urgent for us to solve the transportation safety problem in Beijing and Shanghai, etc large cities.

#### **Abstract**

Cette article evalue la situation de la securite de transport dans 32 principales villes en Chine selon le methode d'analyse des facteurs. Notre resultat montre Beijing, Shanghai se sont trouves numero trois et quatre suivant Changsha and Anshan. Donc il est urgent de chercher les moyens de resoudre le problem de la securite de transport dans les grandes villes comme Beijing Shanghai etc.