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Study on Forecast and Warning System of Social Security Risk for Community in China

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Abstract: In China today social security for community is the important thing because it affects the development and stability of society and government. Social security for community should be studied including about the methods and measures. In this study, forecast and early warning system of social security for community in China is proposed. Firstly the framework of forecast and early warning system of social security for community is studied. Then the assessment method of social security risk for community is proposed and applied to forecasts and warning. The principle and method of forecast and warning of social security is studied based on assessment of risk. Lastly the case of forecast and early warning system of social security for community is given. The results show that forecast and early warning system of social security for community can more satisfactorily execute the forecast and warning for social security risk of community.

Key words: Social security risk, forecast and warning system, risk assessment

INTRODUCTION

Social security is related with the public safety. Social security is always the import content considered by many people and scholars. An evaluation of the social security is a study content in early year (Wentworth *et al.*, 1983). Human security is an lasting topic including about many contents (King and Murray, 2001). The research studied the risk of social security benefit-rule changes: Some International Evidence (McHale, 2001). Risk perception and management are important content for us to do. Risk perception, public education and disaster risk management is studied by researcher (Twigg, 2013). Risk is relative with security and disaster (Comfort, 2005). The social risk is relative with the public satisfactory. Relative scholar gives the public perceptions of environmental risk in China (Zhang *et al.*, 2013). Risk assessment is key content in risk forecast and warning. Relative research gives Public security risk factors and defense measures of 2014 Nanjing Youth Olympic Games (Zhang, 2012). Assessment support system can support the risk management and forecast. Researchers proposed the decision systems for debris flow hazard assessment (Lin *et al.*, 2012). Warning system of risk can provide early warning on the risk (Lu and Xu, 2013).

The assessment of risk is the basis of forecast and warning of risk. Research proposed the web-based assessment for flood forecasting and warning systems (Kang *et al.*, 2010). Researchers studied warning and forecast system of potential thunderstorm based on weather patterns in Beijing (Xiong *et al.*, 2012).

From the above researches it can be seen that the risk research of social security is important and the relative researches are inadequate. So this study proposed the forecast and warning system of risk of social security.

FRAMEWORK OF SYSTEM OF FORECAST AND EARLY WARNING OF SOCIAL SECRURITY RISK

The forecast and early warning system of social security are composed of assessment sub-system, forecast sub-system and early warning sub-system. The assessment sub-system uses the methods to assess the risk of social security for every period. The period may be the days, months and years. The assessment can use the objective methods for example AHP and so on. The assessment sub-system including the assessment indexes set, methods of assessment and computation methods. The forecast sub-system use the forecast method to forecast the risk of social security in the future based on the assessment data produced by assessment sub-system. Forecast sub-system can forecast the future risk of social security for next month, next quarterly or next year. The forecast sub-system can use the threshold value of warning to warning the future risk grades.

The framework of system of forecast and warning of risk of social security is shown in Fig. 1 in the following.

The framework of system of forecast and warning of risk of social security can be implemented by the computer system based on the web application program. The relation among sub-system is that the sub-system of forecast and the sub-system of warning use the result of
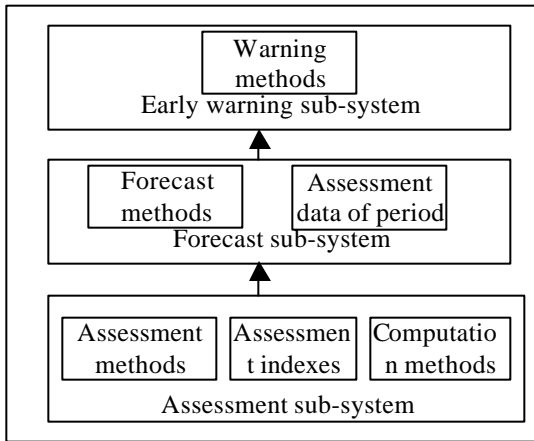
Fig. 1: Framework of system of forecast and warning of risk of social security
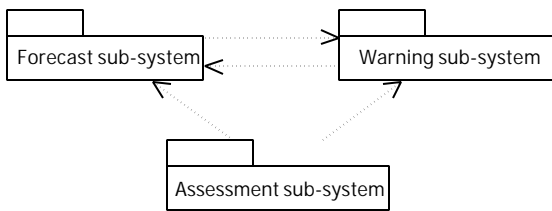

Fig. 2: Relations among sub-system of forecast and warning of risk of social security
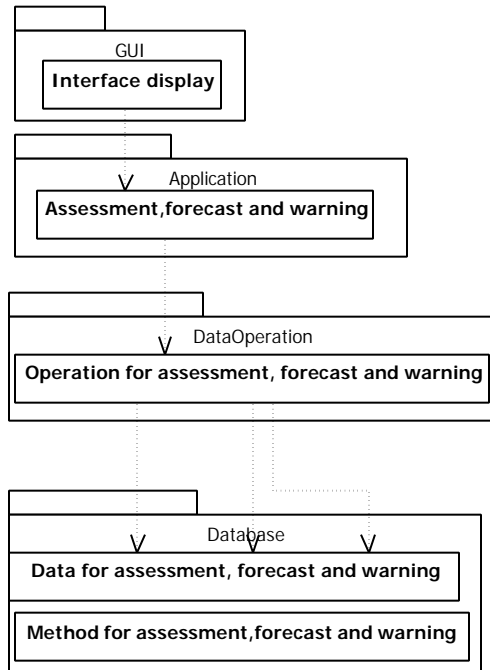

Fig. 3: Implement structure of computer system of forecast and warning of risk of social security

sub-system of assessment. Relations among sub-system of forecast and warning of risk of social security are shown in Fig. 2.

In computer information system the implement structure of system of risk forecast and warning is that the system is divided into four layers including interface display, application, data operation and database. The implement structure of computer system of forecast and warning of risk of social security is shown in Fig. 3.

METHODS FOR ASSEMENT, FORECAST AND WARNING OF RISK OF SOCIAL SECURITY IN SYSTEM

The method for assessment of risk of social security and modeling: In community the mass data on the situation of social securoty are accumulated in the database. The data on the situation of social security are recorded. The teams of police and security and the times for patrol are recorded.

The assessment index set can be created as the following in Table 1.

The index set includes the three levels. The one level includes three indexes instability index, stability index and Public satisfaction. The two level includes about serious crime, common crime, security incident, minor crime, power of police, power of security team, detection of crime, control of situation, the complain, the suggestion and the praise. The three levels includes about numbers of robbery, numbers of theft, numbers of killings, numbers of rape, numbers of arson, numbers of fight, numbers of failure, numbers of other accident, numbers of polices, numbers of patrols, numbers of security team, numbers of propagations, number of detection, ratio of detection, number of opinions of the masses, number of complain of the masses, number of praise of masses.

Table 1: Assessment index set

One level index	Two level index	Three level index
Instability index	Serious crime	1.Numbers of robbery
	Common crime	2.Numbers of theft
	Security incident	3.Numbers of killings
	Minor crime	4.Numbers of rape
		5.Numbers of arson
		6.Numbers of fight
		7.Numbers of failure
		8.Numbers of other accident
Stability index	Power of police	1.Numbers of polices
	Power of security team	2.Numbers of patrols
	Detection of crime	3.Numbers of security team
	Control of situation	4.Numbers of propagations
		5.Number of detection
		6.Ratio of detection
Public satisfaction	The complain	1.Number of opinions of the masses
	The suggestion	2. Number of complain of the masses
	The praise	3. Number of praise of the masses

In the following the determination methods of weights of indexes is studied. The classic AHP method uses the pairwise comparison method to determine the weights. The subjective weights method determines the weights by the experts.

Coefficient of variation method is the direct using of indicators contained in the information obtained by calculating the index weights. The basic approach is that in the evaluation index system the greater the difference between the value of the indicator index which is more difficult to achieve the targets. Such indicators reflect the gap between evaluated. For example, in the evaluation of each people's career development selecting the person ability as an indicator of the evaluation criteria because person ability not only reflect each person's level of development but also reflect a person's degree of working. As the evaluation index system of the indicators of different dimensions, not directly compare the degree of difference. Evaluation in order to eliminate the influence of different dimensions , the indicators needed to measure the coefficient of variation values of the indicators of the degree of difference . The coefficient of variation of the index equation is as follows (Faber and Korn, 1991):

$$V_i = \frac{\sigma_i}{x_i} \ (i = 1, 2, ..., n)$$

In the equation V_i is the No.i coefficient of variation of indicators also known as the standard deviation coefficient. σ_i is the first indicators of the standard deviation. $\overline{x_i}$ is the first indicators of the average.

The weights of indexes can be calculated by the following equation:

$$W_i = \frac{V_i}{\sum_{i=1}^{n} V_i}$$

The Analytic Hierarchy Process (AHP) is a structured technique for organizing and analyzing complex decisions. Based on mathematics and psychology, it was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined since then.

AHP method uses the following matrix of importance degree for experts to judge the relative importance degree (Table 4).

In the above matrix there is the following relation:

$$a_{ij} = 1/a_{ji}$$

The value of a_{ij} and its meaning are given in Table 5 (Mustafa and Al-Bahar, 1991; Lee and Chan, 2008).
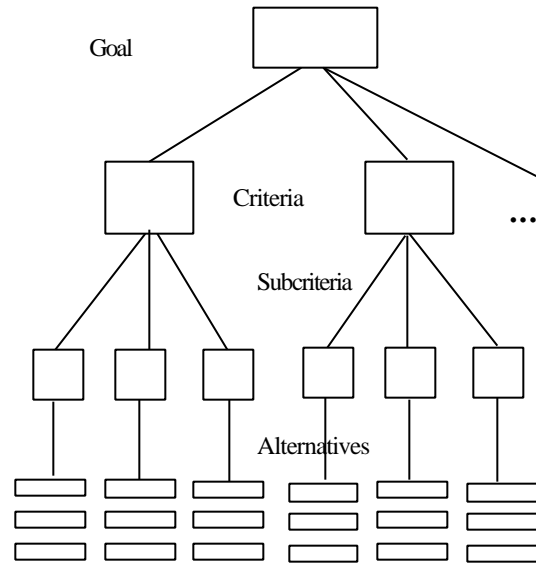

Fig. 4: Typical simple decision hierarchy for AHP

A typical simple decision hierarchy involves a goal, criteria or objectives and alternatives of choice (Fig. 4). We make judgements on the elements of the hierarchy in pairs with respect to their parent element to derive priorities then synthesise the priorities into an overall result.

The weights are calculated by the following equation (Mustafa and Al-Bahar, 1991; Lee and Chan, 2008):

$$W_i = \sum_{j=1}^{m} b_j a_{ij} \ (i = 1, \cdots, n)$$

b_j is the weights of upper layer.

Consistency Index (CI) can be calculated by using equation as follows (Mustafa and Al-Bahar, 1991; Lee and Chan, 2008):

$$CI = \frac{V - n}{n - 1}$$

$$V = \sum_i wi \bullet ci$$

After acquiring Consistency Index (CI), the next step is calculating Consistency Ratio (CR) by using equation (Mustafa and Al-Bahar, 1991; Lee and Chan, 2008):

$$CR = \frac{CI}{RI}$$

In the above equation, the n is Amount of items compared, wi is Weight, Ci is Sum of column, CR is

Consistency Ratio, CI is Consistency Index and RI is Random Consistency Index. If CR = 10%, the data acquired is inconsistent. If CR<10%, the data acquired is consistent.

In the study the mixture weight methods is used to calculate the weight of indexes which consider the subjection and objection. Firstly the coefficient of variation method is used to calculate the weight of indexes which is remarked as $w_{objective}$. Then the AHP method is used to calculated the subjective weight which is remarked as $w_{subjective}$. Lastly the weight is calculated as follows:

$$w_{last} = \frac{w_{subjective} + w_{objective}}{2}$$

After the weights of indexes are calculated the assessment value can be calculated.

The method for forecast of risk of social security and modeling based on grey grey forecast model: In the following the grey GM(1,1) forcast method is used to forecast the future risk value. The grey GM(1,1) method refers the thesis and resaerch (Deng, 1989; Liu and Lin, 2011). For the future forecast, the initial time serial datum data $x^{(0)}$ on risk assessment of social security:

$$x^{(0)} = (x^{(0)}(1), x^{(0)}(2), ..., x^{(0)}(n))$$

In above following, $x^{(1)}$ is calculated by following equation:

$$x^{(1)}(k) = x^{(0)}(k+1) + x^{(0)}(k) \quad k = 1, 2, ..., n$$

$X^{(0)}$ and $X^{(1)}$ can be verified by the following method: $X^{(0)}$ is verified the standard smooth test and $X^{(1)}$ is verified the accurate index test.

Assuming:

$$\rho(k) = \frac{x^{(0)}(k)}{x^{(0)}(k-1)} \quad k = 2, 3...n$$

If:

$$\rho(k) < 1 \bigcup_{i=1}^{n} X_i \quad \rho(k) \in [0, \varepsilon] \, \varepsilon < 0.5 \quad \rho(k)$$

has the decreasing trend. Then $X^{(0)}$ is called the standard smooth sequence. And $X^{(1)}$ has the regulation of accurate index.

Else $X^{(0)}$ and $X^{(1)}$ is proceeded by the following method:

$$x^{\prime(0)}(k) = \frac{1}{n-k+1}(x(k) + x(k+1) + ... + x(n)) \quad k = 1, 2...n \quad (5)$$

Ordering $X^{(0)}(k) = x^{\prime(0)}(k)$. $X^{(0)}$ is replaced by $X^{\prime(0)}$.

Then $X^{(1)}$ is executed the first order even generation operation to generate x:

$$x = (x(2), x(3), ... x(n))$$

In above sequence, $x^{(k)}$ is calculated by the following method:

$$x(k) = -1/2(x^{(1)}(k-1) + x^{(1)}(k))$$

Then the following differential equation can be created:

$$\frac{dX_1^{(1)}}{dt} + aX_1^{(1)} = b_1$$

In the differential equation the parameters are represented as:

$$\alpha = (a, b_1)^T$$

$$Y_N = B\hat{\alpha}$$

The following equation can be induced:

$$\hat{\alpha} = (B^T B)^{-1} B^T Y_N$$

Then the forecast may be the following equation:

$$x_{k+1}^{(1)} = [x_1 - \frac{b_1}{a}]e^{-ak} + \frac{b_1}{a}$$

The above can be used to forecast the future value.

The method for warning of risk of social security: The grade of risk of social security can be defined by the following methdod:

When the value R of assessment of risk of social security is 0<R<=0.3 then the risk of social security is low. When the value R of assessment of risk of social security is 0.3<R<=0.6 then the risk of social security is medium. When the value R of assessment of risk of social security is 0.7<R<=1 then the risk of social security is high.

The warning of risk of social security can automaticly be sent to tell us the grade of risk of social security.

CASE OF FORECAST AND WARNING SYSTEM OF SOCIAL SECURITY FOR COMMUNITY

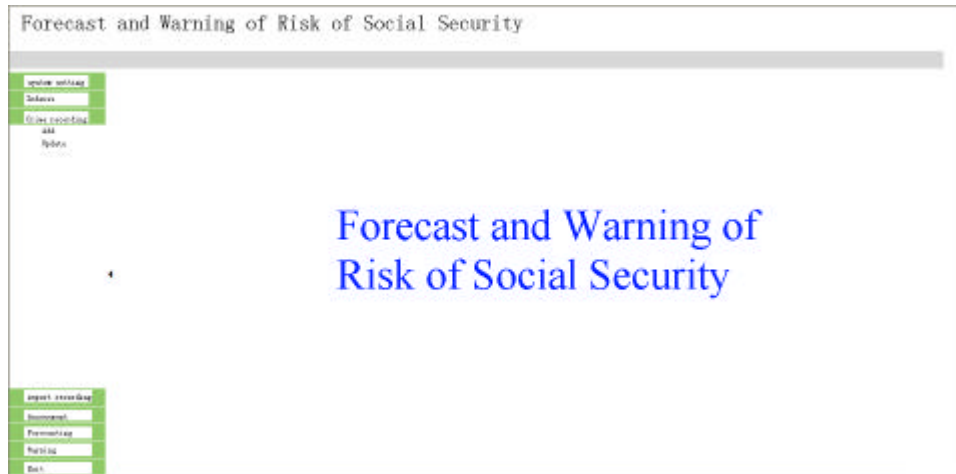**Case:** In the following the application case of risk assessment, forecast and warning is appied to the community.

Fig. 5: Information system of web on risk forecast and warning in Chinese

Table 2: Data on the situation of social security

Numbers of robbery	46
Numbers of theft	38
Numbers of killings	6
Numbers of rape	21
Numbers of arson	18
Numbers of fight	56
Numbers of failure	29
Numbers of other accident	126

Table 3: Power of police and security team

Numbers of polices	50
Numbers of patrols	240
Numbers of security team	20
Numbers of propagations	21
Number of detection	25
Ratio of detection	31%

Table 4: Risk value R of previous four quarterlies

Quarterly	1	2	3	4	Next
R(risk value)	0.27	0.36	0.49	0.37	?

Table 4: Matrix of importance degree

	B1	B2	…	Bj
A1	a11	a12	…	
A2	a12	a22	…	
…	…	…	…	…
Ai	ai1	ai2	…	aij

Table 5: Value of a_{ij} and its meaning

Relative importance (more)	Value	Relative importance (Less)	Value
Equal importance	1	Equal importance	1
Slightly more important	3	Slightly less important	1/3
Strongly more important	5	Strongly less important	1/5
Very strongly more important	7	Very strongly less important	1/7
Absolutely more important	9	Absolutely less important	1/9
Intermediate values	2,4,6,8	1/2,1/4,1/6,1/8	

In community the mass data on the situation of social securoty are accumulated in the database. The Table 1 and 2 gives the sample data that shows the the situation of social securoty for some periods in community.

The teams of police and security and the times for patrol are in the following (Table 3).

The public satisfaction on risk of social security is executed and stored in the database.

The risk of social security can be assessed by the following data. By the same method the previous The information system can more exactly execute the task of assessment of risk. periods' risk can be calculated. In Table 4 the risk value R of previous four quarterlies is given.

How to forecast the next quarterly's risk value is the next step. The above method of grey forecast be used to gain the next quarterly's value of risk is 0.41.

The system implement: The prototype of information system of web on risk forecast and warning based on the method proposed in this study is implemented (Fig. 5 in Chinese).

CONCLUSION

This article proposed the forecast and warning system of social security in community of China. The assessment methods of social security are given. Then the forecast and warning methods are studied based on the assessment of social security. The case risk forecast and warning of social security is given. The information system of web on risk forecast and warning based on the method proposed in this study is implemented.

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