

Research on Chinese Citizens' Happiness Based on B-P Neural Networks

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Abstract—The Chinese citizen's happiness became a hot issue in recent years, however, few of the scholars researched this issue from the angle of a quality method. Based on this phenomenon, we firstly analyzed the significance of evaluating the Chinese Citizens' happiness, then, we intended to find out the most important elements which may influence our research objects, according to the results of analysis, we selected a series representative indicators and established the evaluation system. The B-P neural networks (BPNN) we applied in this paper is an advanced method of evaluating, we described the mechanism of the BPNN and then tested the evaluation system by using the practical data. The results proved that the evaluation system is an effective way of appraisal the citizens' happiness, it also showed us what kind of indicators would bring us happiness mostly, therefore, we believed this paper may be a guidance of constructing the harmonious society in China.

Keywords- Chinese citizens' happiness ; indicators system ; B-P neural networks ; Performance evaluation

I. INTRODUCTION

As the global economy developing rapidly and persistently, there is no time has our material civilization been more prosperous than at present, the welfare also accumulated in an enormous speed according to the calculating of the GDP, but the global economic booming is accompanied by more and more social problems: environment pollution, high unemployment rate, the enlargement of the income gap between the poor and the rich, degradation of the public credit, etc. These entire phenomenon remind us one thing, the GDP is not the only criteria to measure the civilization of our human beings, just as the Senate Robert Kennedy [1] commented, "[GDP] does not allow for the health of our children, the quality of their education, or the joy of their play. It does not include the beauty of our poetry or the strength of our

marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our courage, nor our wisdom, nor our devotion to our country. It measures everything, in short, except that which makes life worthwhile". Based on this opinion, we decided to construct a different system which could evaluate the happiness of the citizens.

The happiness is a kind of abstract notion; it is a subjective mental satisfaction from the experience of our real life. The happiness comes from both living environment and our personal requirements. Raphael Di Tella and Robert MacCulloch [2] [3] found that the happiness responses of around 350,000 people living in OECD (Organization for Economic Cooperation and Development) between 1975 and 1997 are positively correlated with the level of income, the welfare state and (weakly) with life expectancy; they are negatively correlated with the average number of hours worked, environmental degradation (measured by SO_x emissions), crime, openness to trade, inflation and unemployment; all controlling for country and year dummies.

Haoyong Zhong [4] believed that the happiness data should include: living space, the consumption of the commodities, social and family security, health situation, personal education and career, marriage situation and the satisfaction of the environment, etc.

The king of Bhutan, Wangchuck [5], proposed a happiness evaluation system, he believed happiness data should comprising four elements: Sustainable and equitable socio-economic development, Conservation of environment, Preservation and promotion of culture, Promotion of good governance.

In a seminal paper, Easterlin [6] showed that one could approach their happiness by using what are now called "happiness data", namely the responses that individuals give concerning a simple well-being question such as "Are you Happy?" Using data for the

US, he showed that happiness responses in a particular year were positively correlated with an individual's income. More recently, Blanchflower and Oswald [7] showed a similar pattern for the period following the publication of Easterlin's paper.

Through the analysis above, we will not only select the traditional happiness indicators, but also some other elements to evaluate the citizens' happiness. Using these more scientific and systematic indicators, we can get an accurate, objective results, and the process of evaluation can hardly be manipulated, meanwhile we select the neural networks model to evaluate the performance, this model applying the self-adapt model to predict and evaluate the targets, it can evaluate in a large-scale.

II. EVALUATION INDICATOR SYSTEM

After comprehensive consideration the consultants from the experts, we believe that the citizens' happiness indicators should comprise the factors as following: (a) social welfare indicators; (b) social health indicators; (c) social civilization indicators; and (d) ecological environment. We also put forward a three-layer evaluation indicators system.

(1) Social welfare indicator. This indicator reflects the situation of all kinds of welfare that citizens can have, it is a key indicator among the whole system, and it formed a bridge between the happiness data and the citizens. The social welfare indicator includes: satisfaction of the life services; endowment insurance; the construction of the leisure time; the ratio of the unemployment; Engel's Coefficient, etc.

(2) Social health indicator. This indicator is one of the most important elements of evaluating the citizen's happiness. It is hardly to believe a citizen could obtain his or her happiness without a healthy body. In other words, the happiness of the citizens is on the premise of their health and the relevant insurance system, therefore, the social health is the basic indicator of the whole system. This indicator usually includes the mortality rate of the infant; popularizing rate of the health insurance; popularizing rate of the medical insurance; incidence of the infectious disease; the treatment rate of the patients, etc. In this paper, we select three representative indicators; they are popularizing rate of the health insurance; popularizing rate of the medical insurance; incidence of the infectious disease.

(3) Social civilization indicator. The social civilization is an important indicator when measuring a country or a nation. An advanced civilization does not only imply the improvement of the technology and culture, but also represent the peaceful relationship of the family, the friendship of the people, or even the

harmonious of the whole society. Therefore the social civilization is the cornerstone of the citizens' happiness. The social civilization indicator includes the ratio of divorce; frequency of the violence; the suicide ratio of the adolescent; political and socially useful activity participation and government credit. Since the social civilization indicator mainly measures the harmonious of the whole society, we decide to choose frequency of the violence and government credit as our indicators.

(4) Ecological environment indicator. The so-called ecological environment comprises the natural environment and human environment of where the local citizens reside. Since our society developed continuously, people promote their requirements for the ecological environment they are dwelling and nearby, The ecological environment becomes a key element of the citizens' happiness, hence, we believe it should comprises the utilization of the natural resources; frequency of the natural disaster; satisfaction of geographical conditions. In this paper, we choose the satisfaction of the living environment; the level of environmental protection and the frequency of the natural disaster.

TABLE I. COMPREHENSIVE INDICATORS OF CHINESE CITIZENS' HAPPINESS EVALUATION

Comprehensive indicators of Chinese citizens' happiness evaluation	Social welfare indicators	satisfaction of the life services
		endowment insurance
		the ratio of the unemployment
		Engel's Coefficient
	Social health indicators	popularizing rate of the health insurance
		popularizing rate of the medical insurance
		incidence of the infectious disease
	Social civilization indicators	frequency of the violence
		government credit
	Ecological environment	satisfaction of the living environment
		level of environmental protection
		frequency of the natural disaster

III. THE EVALUATION MODEL

B-P neural networks (BPNs), due to their excellent ability of non-linear mapping, generalization, self-organization and self-learning, have been proved to be of widespread utility in engineering, management and are steadily advancing into new areas [8].

The input numbers of B-P neural networks propagate back to the hidden spot first, and then trained by functions, finally, the information at the

hidden spot transfer to the output spot. In this paper, we use BPNNs with n_1 input spot, n_2 hidden spot and single output spot, Fig.1 is the framework.

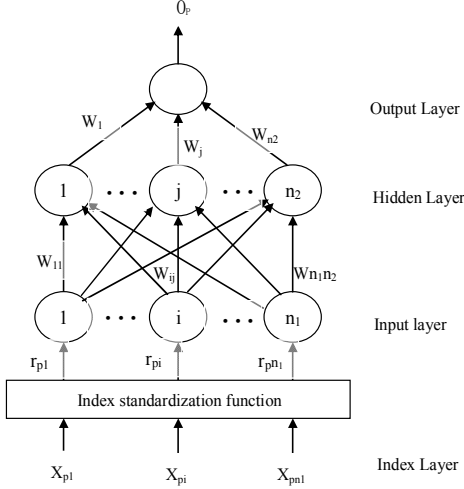


Fig.1. A typical back-propagation ANNs model

In the Fig.1, $x_{p1}, x_{p2} \dots x_{pn1}$ are the universe of discourse

$$U = \{u_1, u_2, \dots, u_s\} \quad (1)$$

The performance measurement mode of sample p is:

$$X_p = (x_{p1}, x_{p2}, \dots, x_{pn1}) \quad (2)$$

$rp_1, rp_2 \dots rp_{n1}$ are the evaluation vectors quantified at universe of discourse U by X_p

$$r_p = (r_{p1}, r_{p2}, \dots, r_{pn1}) \quad (3)$$

$W_{ij}(i=1,2,\dots,n_1; j=1,2,\dots,n_2)$ are the connection coefficient of the input layer i to layer j ;

$W_j(j=1,2,\dots,n_1)$ are the connection coefficient of the input layer i to layer j ; o_p is the pattern of the output). Generally, suppose there are s sample pattern, the indicators matrix and expecting output are:

$$X = [\bar{X}_1, \bar{X}_2, \dots, \bar{X}_s]^T = [X_{pi}]_{s \times n_1} \quad (4)$$

$$B = [b_1, b_2, \dots, b_s]^T = [b_p]_{s \times 1} \quad (5)$$

Where $b_p(p=1,2,\dots,s)$ are the measurement results of the sample pattern p , and also the expecting output results.

Because the different indicators have different units, we should change them into the same form, that is the range between zero to one, suppose there are n samples, and there are p indicators, we can get the matrix

$X = (X_{ij})_{n \times p}$ ($i=1, 2, \dots, p$) stands for the number of the sample, $j=1, 2, \dots, p$ represents the

number of the indicators, x_{ij} delegates the indicators j in sample i . Generally, n_1 indicators can be divided into $U = \{u_1, u_2, \dots, u_{n_1}\}$

$$\begin{aligned} &= \{u_{i2} | i_1 \in \{1, 2, \dots, n_1\}\} \cup \{u_{i2} | i_2 \in \{1, 2, \dots, n_1\}\} \\ &\cup \{u_{i3} | i_3 \in \{1, 2, \dots, n_1\}\} \cup \{u_{i4} | i_4 \in \{1, 2, \dots, n_1\}\} \\ &= U_1 \cup U_1 \cup U_1 \cup U_1 \end{aligned} \quad (6)$$

Where U_1 is the cost indicators subset, U_2 is the benefit indicators subset, U_3 is the medium indicators subset, and U_4 is the interval indicators subset.

(1) If the indicators are bigger, the effect is better; we can change the indicators as below:

$$r'_{ij} = \frac{x_{ij} - \min\{x_{ij}\}}{\max\{x_{ij}\} - \min\{x_{ij}\}} \quad j=1, 2, \dots, p \quad (7)$$

(2) If the indicators are smaller, the effect is better, we can change the indicators as below:

$$r'_{ij} = \frac{\max\{x_{ij}\} - x_{ij}}{\max\{x_{ij}\} - \min\{x_{ij}\}} \quad j=1, 2, \dots, p \quad (8)$$

(3) if the indicator is in the range between $[a_1, a_2]$, and when the indicators are closer to that rang, the effect is better; we can change the indicators as below:

$$r'_{ij} = \begin{cases} \frac{x_{ij} - \min\{x_{ij}\}}{\max\{x_{ij}\} - \min\{x_{ij}\}}, & \min\{x_{ij}\} \leq x_{ij} < a_1 \\ 1, & a_1 \leq x_{ij} \leq a_2 \\ \frac{\max\{x_{ij}\} - x_{ij}}{\max\{x_{ij}\} - \min\{x_{ij}\}}, & a_2 < x_{ij} \leq \max\{x_{ij}\} \end{cases} \quad j=1, 2, \dots, p \quad (9)$$

After selecting the neural networks, we can find a reflect \hat{F} , and then access the F through the training:

$$\hat{F} : R^{n_1} \rightarrow R^1 \quad B = \hat{F}(R) \quad (10)$$

IV. APPLICATION ON EVALUATION OF CITIZENS HAPPINESS

The urbanization developed rapidly these years, we select ten representative cities in China as our samples, all the data comes from their annual reports or calculated by the relevant experts.

All the original data of various cities are shown in the table II, the capital P represents the level of citizens' happiness, and A represents the excellent performance; B delegates the good performance; C means the normal performance.

TABLE II. ORIGINAL DATA OF CITIZENS' HAPPINESS

indicator	a ¹	a ²	a ³	a ⁴	a ⁵	a ⁶	a ⁷	a ⁸	a ⁹	a ¹⁰	a ¹¹	a ¹²	P
C.1	0.293	1.35	0.15	0.12	0.25	0.64	0.78	0.24	0.21	0.32	0.12	0.32	A
C.2	0.055	1.68	0.07	0.25	0.30	0.79	0.42	0.29	0.35	0.41	0.18	0.31	B
C.3	0.040	0.97	0.03	0.04	0.40	0.87	0.35	0.31	0.30	0.22	0.15	0.36	B
C.4	0.080	0.82	0.10	0.11	0.35	0.72	0.46	0.26	0.31	0.37	0.15	0.35	C
C.5	0.136	1.33	0.12	0.03	0.22	0.76	0.52	0.34	0.25	0.36	0.13	0.21	A
C.6	0.076	0.67	0.08	0.06	0.56	0.70	0.61	0.18	0.31	0.27	0.16	0.30	C
C.7	0.320	1.95	0.14	0.04	0.37	0.85	0.53	0.35	0.29	0.25	0.08	0.37	C
C.8	0.051	1.21	0.20	0.15	0.28	0.82	0.46	0.17	0.36	0.35	0.12	0.25	A
C.9	0.022	0.96	0.11	0.21	0.31	0.91	0.43	0.20	0.27	0.28	0.07	0.30	C
C.10	0.040	0.93	0.15	0.17	0.26	0.89	0.57	0.26	0.33	0.30	0.13	0.20	B

Table III is the predictive results (A represents the excellent performance; B stands for the good performance; C delegates the normal performance)

TABLE III. REDICTIVE RESULTS

indicator	real output 1	real output 2	real output 3	ideal output	performance
C.1	0.999453	0.000271	0.000236	[1, 0, 0]	A
C.2	0.000192	0.999266	0.000226	[0, 1, 0]	B
C.3	0.234192	0.999096	0.000267	[0, 1, 0]	B
C.4	0.000111	0.000873	0.99938	[0, 0, 1]	C
C.5	0.999455	0.000255	0.000269	[1, 0, 0]	A
C.6	0.000916	0.112006	0.999254	[0, 0, 1]	C
C.7	0.000917	0.000691	0.999013	[0, 0, 1]	C
C.8	0.999458	0.000116	0.000267	[1, 0, 0]	A
C.9	0.000919	0.000840	1.022513	[0, 0, 1]	C
Co.10	0.000171	0.999022	0.000266	[0, 1, 0]	B

From the discussion above, we can draw the conclusion that the city 1, 5, 8 have an excellent level of happiness, because their social welfare data are in good situation, meanwhile the administrators of these cities pay more attention to the social civilization and ecological environment, these make the cities obtaining benefits not only at present but also in the future. Although the city 7 focus on the social health, the administrators of the city doesn't has pay more attention to the social civilization, which has a intimate connection to the potential development in the future, city 4 and 9 have the bad situation at the social welfare because of the inefficient strategy decision. Besides, the citizens at those cities without any construction on the social health or social civilization always have less happiness.

V. CONCLUSIONS

According to the researches of many experts, the function of the GDP is not as effective as we expected before, that is the reason we established a newly evaluation system to measure the quality of our daily life, we hope to inform the administrators and citizens which elements are the most important to their happiness.

In this thesis, our evaluation system including the traditional financial indicators and some newly built indicators, using these comprehensive indicators and BPNN model, the evaluation will be more scientific and objective.

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