MODIFICATION OF DEVELOPING ECONOMIC FORECAST BY AHP

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ABSTRACT

In economic system , forecast is very complex. In general, a regression model based on the least square method is able to fit for the data series good, but its forecast accuracy is not satisfactory, particularly in the developing economic forecast, because future is uncertain, many constraint factors are changed, the principle of continuity is not applicable to here. Therefore, this paper suggests a modification of developing economic forecast by AHP. An apllied example indicates that forecast accuracy is improved greatly.

I. Introduction

In economic system, forecast is very complex. In general, a regression model based on the least square method is able to fit for the data series good, but its forecast accuracy is not satisfied, particularly in the developing economic forecast.

It is well known that an appropriate regression model is identified according to time series, good forecast values can be obtained by the model, if the principle of continuity is practical. However, future is uncertain and many constraint factors are changed in the developing economics, the principle of continuity would no longer be practical so that above forecast values present considerable errors.

Now, some authors have suggested a number of dynamic forecast methods (Box 1976, Han Zhigang 1982, Xia Anbang 1985). Although they take account of dynamic phenomena in economic system, but dynamic rule can not reflect on the significant changes of the future conditions fairly. It is seen that dynamic methods are also not applicable to the developing economic forecast.

Owing to above situation, this paper suggests a modification of developing economic forecast by AHP. An applied example indicates that forecast accuracy is improved greatly.

II. Modified Process

An appropriate regression model is first identified according to time series. For example,

$$\hat{Y}=a+bt \qquad (1)$$

or

$$\hat{Y}=a\,e^{bt} \qquad (2)$$

$$\ln\hat{Y} = \ln a + bt \tag{3}$$

parameters of the model can be estimated by the least square method. Thus, basic forecast values are obtained by the model. Variance is calculated as follows:

$$\delta = \frac{1}{n-2}\sqrt{\sum_{i=1}^{n}(Y_i-\hat{Y}_i)^2} \tag{4}$$

Confidence interval would be given by

$$\tilde{Y}_0 \pm \delta = \tilde{Y}_0 \pm t_{\alpha/2}(n-2)\delta\sqrt{1 + 1/n + \frac{(X_0-\bar{X})^2}{\sum_{i=1}^{n}(X_i-\bar{X})^2}} \tag{5}$$

Where degree of confidence is $100(1-\alpha)\%$, α is level of significance. Set $\alpha=0.01$, it means that forecast values will fall inside the limits of the confidence interval with probability 99%.

Now, let us consider midification problem. As for modification by AHP, we must find the different factors which affect development of economic system. It is clear that these factors will present a hierarchy. Thus, we will analyze the positive effect so that forecast value would be raised, or else. Here they are known as positive and negative factors respectively. Composition weight of each factor can be obtained by AHP. Then, total weights are calculated according to positive or negative factors. The difference of two total weights is known as net. If the net weight is positive, then it means that forecast value would be modified in the increased direction, otherwise in the decreased direction.

For modified amount, it may be calculated as follows: ,the maximum of modified amount be δ. Then, according to polarity of net weight, modified amout is given by

$$(\Delta Y)^+ = \delta \cdot W_p^+ \tag{6}$$

or

$$(\Delta Y)^- = \delta \cdot |W_p^-| \tag{7}$$

where W_p^+, W_p^- are positive and negative net weights.
Finally, forecast vaule would be written as

$$\hat{Y} = \tilde{Y}_0 + (\Delta Y)^+ \tag{8}$$

or

$$\hat{Y} = \tilde{Y}_0 - (\Delta Y)^- \tag{9}$$

III. An applied example

It is known that time-series data of total value of output for some area are shown as table 1.

Table 1.

Year	1977	1978	1979	1980	1981	1982	1983	1984
Y	402.16	464.06	525.26	604.37	673.90	737.23	824.96	1003.75

An appropriate regression model is given by

$$\ln \hat{y} = 5.8861 + 0.1239t \qquad (10)$$

correlation coefficient R is found to be 0.9968 indicatng that the model is able to fit for the time-series data good. Above regression model can be rewritten as

$$\hat{y} = 359.99\, e^{0.1239t} \qquad (11)$$

However, it is found that economic trend for this area is still growing. There are many factors so that total value of output can arise rapidly. Therefore, its forecast values must be modified by AHP. Construction figure of the analytic hierarchy is shown as figure 1.

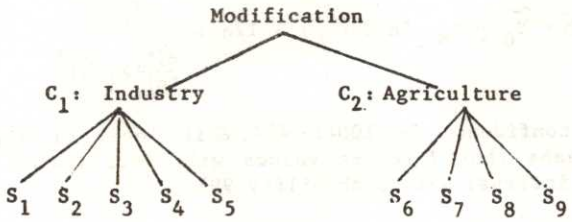

Figure 1. Construction figure of the analytic hierarchy

where S_1, S_2, S_3, S_4, S_5 are town enterprises, petrochemical industry, light-textile industry, electronic industry and energy, respectively, S_6, S_7, S_8, S_9 are village industry, economic policy for village, sideline and energy. All of these factors are positive factors except for S_5 and S_9. In this area, economic development is limited by scarce energy. After analyzing the above factors, calculated results are shown as follows.

	C_1	C_2	W_i	
C_1	1	2	0.6667	C.I.=0
C_2	1/2	1	0.3333	

C_1	S_1	S_2	S_3	S_4	S_5	W_i	
S_1	1	3	7	5	9	0.5608	
S_2	1/3	1	2	1.5	3	0.1775	
S_3	1/7	1/2	1	1/1.5	1.5	0.0840	
S_4	1/5	1/1.5	1.5	1	2	0.1186	C.I.=0.0011
S_5	1/9	1/3	1/1.5	1/2	1	0.0591	

C_2	S_6	S_7	S_8	S_9	W_i	
S_6	1	2	3	7	0.5112	
S_7	1/2	1	1.5	3	0.2459	
S_8	1/3	1/1.5	1	2	0.1640	C.I.=0.001
S_9	1/7	1/3	1/2	1	0.0789	

	C_1	C_2	C.W.	T.W.
	0.6667	0.3333		
S_1	0.5608		0.3739	
S_2	0.1775		0.1183	
S_3	0.0840		0.0560	+ 0.9343
S_4	0.1186		0.0790	
S_5	0.0591		- 0.0394	
S_6		0.5112	0.1704	
S_7		0.2459	0.0820	0.0657
S_8		0.1640	0.0547	
S_9		0.0789	- 0.0263	

Thus, net weight is found to be 0.8686 and positive.
Given α= 0.01, $t_{\alpha/2}(n-2)=3.7074$, $\hat{\sigma}=0.02614$, forecast results are shown as table 2.

Table 2.

		1985	1986	1987	1988
I. E.M.		1097.60	1242.34	1406.17	1591.60
II. M-AHP		1221.26	1392.79	1590.06	1816.39
A.V.		1244.41	1458.17	1735.00	---
R.E.(%)	I.	-11.80	-14.80	-18.95	---
	II.	-1.86	-4.48	-8.35	---

IV. Conclusions

1. An applied example indicates that accuracy of developing economic forecast is greatly improved by modification by AHP.

2. This method has an advantage in simplicity.

3. Making long-term forecast, once actual values fall outside the limits of the confidence interval, then modification by AHP will not be effective. However, based on the short-term forecast (M-AHP), an appropriate regression model may be reconsidered by means of data series and forecast value, thus, modification by AHP is again given.

REFERENCES

Box, G.E.P. and G.M. Jenkins, (1976), Time Series Analysis: Forecasting and Control, rev. ed., Holden-Day, San-Francisco.

Han Zhigang, (1982), The Theory and Practice of Order-Transfer Forecast Method, Heinongjang University, China

Saaty, T.L., (1980), The Analytic Hierarchy Process, McGraw-Hill.

Xia Anbang, (1985), " A Dynamic Approach to Model Socio-Economic System", IFAC/IFORS Conference on Control Science and Technology for Development, August, 20-22, Beijing, China