FUZZY APPROACH IN ECONOMIC DEVELOPMENT FORECASTING OF THE ISLAMIC REPUBLIC OF IRAN

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Nowadays, according to economical crisis in the world economy, forecasting is very important in managing of social-economical development of the different countries. One of the important factors of the world economic crisis is a low price of oil in the oil-exports countries. Iran is also one of such countries. In accordance with above-mentioned, such as using fuzzy sets and fuzzy logic, we have calculated variants of forecast for 2010-2015 years period economical development of Iran.

By four main data GDP forecast of Islamic Republic of Iran for period of 2010-2015 as foreign investment, oil price in the world market, inflation level and growth rate of world economy to construct the dependence of these factors, we used fuzzy logic inference rules. These rules are generated on the base data of Islamic Republic statistics and experts ideas which prescribed in the following Table 1.

Table 1. Fuzzy logic inference rules

Variables for input								Output	
Foreign investment		Price for 1 barrel of oil in the world market		Inflation level		Growth rate of world Economy		Gross domestic product	
FIN	Low	WDP	Low	INF	Low	WOE	Low	GDP	Low
FIN	Average	WDP	Low	INF	Average	WOE	Average	GDP	Low
FIN	High	WDP	Low	INF	High	WOE	High	GDP	Average
FIN	Average	WDP	Low	INF	Low	WOE	Low	GDP	Low
FIN	High	WDP	Low	INF	Low	WOE	Average	GDP	Average
FIN	High	WDP	Low	INF	Average	WOE	Average	GDP	Average
FIN	Low	WDP	Average	INF	Low	WOE	Low	GDP	Low
FIN	Average	WDP	Average	INF	Average	WOE	Average	GDP	Average
FIN	High	WDP	Average	INF	High	WOE	High	GDP	High
FIN	Average	WDP	Average	INF	Low	WOE	Low	GDP	Average
FIN	High	WDP	Average	INF	Low	WOE	Average	GDP	Average
FIN	High	WDP	Average	INF	Average	WOE	Average	GDP	Average
FIN	Low	WDP	High	INF	Low	WOE	Low	GDP	Average
FIN	Average	WDP	High	INF	Average	WOE	Average	GDP	High
FIN	High	WDP	High	INF	High	WOE	High	GDP	High
FIN	Average	WDP	High	INF	Low	WOE	Low	GDP	Average
FIN	High	WDP	High	INF	Low	WOE	Average	GDP	High
FIN	High	WDP	High	INF	Average	WOE	Average	GDP	High

In order to solve the problem, we use the Mamdani algorithm with using these rules and find the fuzzy set. After finding fuzzy set, we should calculate result of problem as crisp. The value of the fuzzy set may be used as the centroid method for calculation of crisp. But we use the WABL method for deffuzification of fuzzy set.

In order to solve the problem, requiring parameters were constructed on the basis of world economy indicators as in Table 2.

Table 2. Iranian Statistic information [] Parameters of the model

Indicator	Low	Average	High
1. Foreign investment - FIN	0 – 2	1.5 - 4	3.5 →
2. Price for 1 barrel of oil in the world market - WDP	40 – 60	55 - 80	75 – 100
3. Inflation level - INF	0 – 9	8.5 - 12	11.5 →
4. Growth rate of world Economy - WOE	0 – 0.5	0.3 - 3	2.5 →
5. Difference Gross domestic product - Δ GDP	0.8 – 5	4.5 - 11	10 →

On the basis of obtained with the help of fuzzy logic inference and analyze of macroeconomic indicators of Iran economics for 1998-2007 years, three forecasting variants of economy were calculated for the country for 2010-2015 years.

In the first forecast, the price for 1 barrel of oil was shown as USD 40-60, in the second forecast as USD 55-80 and in third – between USD 75-100.

The WABL defuzzification method [3] were used for obtaining of lower and upper borders of forecast.

Mathematical form of WABL is as following:

$$I_W(Z) = \int_0^1 (c_L L_A(\alpha) + c_R R_A(\alpha))\, p(\alpha) d\alpha$$
$$\mu_{\uparrow}^{-1}(\alpha) = L(\alpha) = a - b(1-\alpha) \qquad (1)$$
$$\mu_{\downarrow}^{-1}(\alpha) = R(\alpha) = a + c(1-\alpha)$$

WABL parameters C_L and C_R are the weights of the left and right sides of fuzzy number respectively. $L_A(\alpha)$ and $R_A(\alpha)$ define the forms of left and right sides of fuzzy numbers respectively. $L_A(\alpha)$ is non-decreasing function and $R_A(\alpha)$ is non-decreasing function both with respect to α . C_L and C_R meet the following conditions:

$$c_L = \frac{b}{b+c},\ c_R = \frac{c}{b+c}$$
$$c_L \geq 0,\ c_R \geq 0, \qquad (2)$$
$$c_L + c_R = 1.$$

$p(\alpha)$ – is distribution function of level sets weights and creates weights for all level sets. $p : [0,1] \to E_+ \equiv [0,+\infty]$ and is satisfied to the next terms:

$$p(\alpha) = (k+1)\alpha^k, k \geq 0$$
$$\int_0^1 p(\alpha) d\alpha = 1 \qquad \text{where} \qquad (3)$$

Figure 1 displays simple graphical view of the WABL defuzzification method.

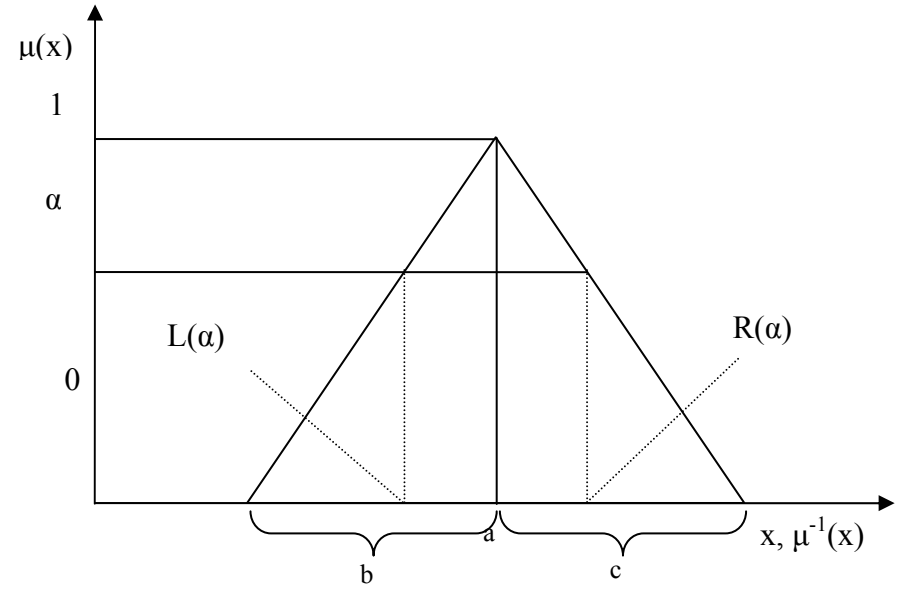

Figure 1. LR-represents fuzzy number for $\mu_{\uparrow}^{-1}(\alpha) = L(\alpha), \mu_{\downarrow}^{-1}(\alpha) = R(\alpha)$.

We calculate weighted estimation of left and right parts of fuzzy set with using following formula

$$Z_L = \int_0^1 L(\alpha)\, p(\alpha) d\alpha, \qquad Z_R = \int_0^1 R(\alpha)\, p(\alpha) d\alpha. \tag{4}$$

Then we obtain weighted average levels of Z_L and Z_R.

$$I_W(Z) = c_L Z_L + c_R Z_R, \tag{5}$$

On the basis of the levels Z_L and Z_R obtained width of fuzzy number:

$$D(Z) = I_R(Z) - I_L(Z) \tag{6}$$

The D(z) interval is probable segment, where we can get meaning of output parameter of the model and this segment has great value for the decision-making expert. From other side, by changing the parameters C_L ,C_R and $p(\alpha)$ in formula (1) with supporting it, we can choose average deffuzification number.

In accordance with it, we can say that WABL deffuzification method is a subjective method and it gives us possibility for taking into account the strategy of decision-maker. If the results of deffuzification are not meeting expert requirements, then by changing parameters C_L, C_R and $p(\alpha)$, we can change the average weighted number and move it to the left and right with supporting its value. We should underline that WABL methods are additive, i.e.:

$$I_W(Z_1 + Z_2) = I_W(Z_1) + I_W(Z_2) \tag{7}$$

Applicate the WABL defuzzification method. The values of forecast variants are in the following Table 3.

Table 3 Forecasts variants

Variants	Variant 1			Variant 2			Variant 3		
Years	low	average	high	low	average	high	low	average	high
2010	0.477	3.580	6.683	5.948	11.200	16.452	5.948	11.200	16.452
2011	0.706	3.580	6.454	6.336	11.200	16.064	16.436	21.300	26.164
2012	5.544	11.200	16.856	5.544	11.200	16.856	15.644	21.300	26.956
2013	5.948	11.200	16.452	5.948	11.200	16.452	16.048	21.300	26.552
2014	6.756	11.200	15.644	6.756	11.200	15.644	16.856	21.300	25.744
2015	5.948	11.200	16.452	5.948	11.200	16.452	16.048	21.300	26.552

The forecast variants, obtained by fuzzy approach, can be used for decision-making on the different levels of economic development of the Islamic Republic of Iran.

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