Fuzzy Logic based Model to Calculate the Economic Level of any Country

S. Kumar, Rashmi Singh, Manish K. Srivastava, Ashish K. Srivastava

Abstract: The availability of data for the size of economic level of any country is an important feature for economic policies. It helps World Bank to classify the countries as their economic level e.g. medium or high income countries, and it is really a tough job to decide the same. Sometimes traditional approach is not providing the proper level, therefore we use the concept of fuzzy logic to find out the economic level of any country. The fuzzy logic is an ideal tool to cope with vague, ill-structured and uncertain scenarios, which can be found in both fields business and economics. This is the main reason why fuzzy logic is used in this research. Five input variables are used i.e. Population, GDP, Unemployment Rate, Inflation Rate, Industrial Production Growth Rate. The resulting economic level is compared with previously used benchmarking method.

Keywords: Benchmarking, country's economy, economics, fuzzy logic, Gaussian membership function.

I. INTRODUCTION

There are several divisions of countries in this world, and besides geo-political divisions there also are economic divisions. Economic division plays an important role in ranking countries, and this can have an adverse impact on the international economy. Therefore economic planning is needed in order to achieve efficiency and effectiveness. A conventional approach of economic division for the prediction of any country has three stages: One of the greater challenges in modeling of such a system is selecting the important input variable from all possible input variables. Predict the value of those factors in some specified time period, in last stage, to give an appropriate output after accessing on that factors in that specified time period. Prediction of economic division has received relatively little attention due to the difficulties in formulating a suitable model. A model is adapted by careful analysis of the input factors, because of the very great differences between the economy of developed countries and developing countries. Further as far as the concept of fuzzy logic is concern, one can create an optimum computerized model to evaluate the country's economic level, by which, we can improve our international business. This model distinguishes the countries as low, medium and high developed country.

In common parlance, a country is deemed to be developing or developed depends mainly on the basis of economics, per capita income, industrialization, Literacy rate, living standards etc. According to Wikipedia, "A developed country is a sovereign state that has a highly developed economy and advanced technological infrastructure relative to other less developed nations. Most commonly the criteria for evaluating the degree of economic development is gross domestic product (GDP), the per capita income, level of industrialization, amount of widespread infrastructure and general standard of living. Which criteria are to be used and which countries can be classified as being developed are subjects of debate"**[10].**

In this work, a model is built for evaluating the economic level of any country with the help of Gaussian membership function for the fuzzification of input data. This gives us more appropriate output in comparing to trapezoidal membership function. The proposed system consists of five inputs, one output and eight rules. The comparing system is based on five input variables (i) Population (ii) GDP (iii) Unemployment rate (iv) Inflation rate and (v) Industrial production growth rate. The system output is the probable decision of the countries' rank according to these input factors.

This work is organized as follow: the first section gives a brief literature that defines how fuzzy logic came in the countries' rating system. The second section discusses the difference between developed and developing country. The third section discusses the statement of problem, and the forth section explains the benchmarking method. The fifth section defines the concept of fuzzy logic, and the sixth section presents the application of fuzzy logic while the seventh section presents the use of fuzzy logic in economics. The eighth section presents our database. The ninth section shows the used methodology. The tenth section defines the membership function of the fuzzified input, while the eleventh section presents the output function. The twelfth section represents the process of defuzzify. The thirteenth section takes a case study, and finally the last section concludes the result of our model. The differences of economy between the developed countries and developing countries are illustrated as follows:

Revised Version Manuscript Received on May 13, 2016.

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II. GENERALIZED CHARACTERISTICS

[http://www.differencebetween.info/difference-between-developed-and-developing-countries]:

S. No.	Developed Countries	Developing Countries
1.	Post-industrial economies	In the process of industrialization
2.	High level of industrial development	Low level of affluent citizens
3.	High level of affluent citizens	Higher levels of unemployment
4.	Low levels of unemployment	Lower education rates
5.	Higher education rates	Often contain undeveloped rural villages
6.	Technological advantages	Unstable governments
7.	Better roads	High level of birth rates
8.	Stable governments	High level of death rates
9.	Good health care	High infant mortality rate
10.	Human and natural resources are fully utilized	Dirty, unreliable water supplies
11.	High level of per capita income	Poor housing conditions
12.	High human development index (HDI)	Poor nutrition
13.	Increased life expectancy	Diets that are short in calories and/or protein
14.	Low birth rates	Poor access to medical services
15.	Low death rates	Endemic disease in some countries
16.	Good housing conditions	Own to medium standard of living
17.	Safe water supplies	Limited technological capacity
18.	Abundant food supplies	Unequal distribution of income
19.	Easy to access advanced medical services	Factors of production are not fully utilized

III. STATEMENT OF THE PROBLEM

In last year's, the model for evaluating the economic level of country was based on benchmarking method and this method totally works on linguistic terms. In this method, there is uncertainty about the dynamics of execution, the number of reforms steps taken, the implementation of the defined economic policy, market liberalization, social and political reasons, the willingness of the government structure regarding the implementation of reforms, political changes and so on**[3].** Now because of that uncertainty, benchmarking method does not give an appropriate output.

IV. BENCHMARKING METHOD

Benchmarking is the process of measuring an organization's internal process then identifying, understanding and adapting outstanding practices from other organizations considered to be best-in-class**[1]**. The Benchmarking became very popular as a tool which supports making and sustaining of a competitive advantage. Benchmarking is a continuous process of identification, understanding and adjustment of products, services, equipments and processes of the system with the best practice. It is stated in the European studies from 1994 that 88% of companies were involved in the benchmarking activities. In United Kingdom 85% of companies use benchmarking while in USA 76% of companies use benchmarking as a management tool. Data obtained from research show that benchmarking is more frequently used for performance comparison **[2].**

V. FUZZY LOGIC AND LINGUISTIC VARIABLE

The theory of fuzzy logic is based on the notion of relative graded membership, as inspired by the process of human perception and cognition. Lotfi. A. Zadeh published his first famous research paper on fuzzy sets in 1965. Fuzzy logic can deal with information arising from computational perceptional and cognition, that is uncertain, imprecise, vague, partially true or without sharp boundaries. Fuzzy logic allows for the inclusion of vague human assessments in computing problems. Also, it provides an effective means for conflict resolution of multiple criteria and better assessment of options. Fuzzy logic is an approach to computing based on "degrees of truth" rather than the usual "true or false" (1 or 0) Boolean logic on which the modern computer is based. Natural language (like most other activities in life and indeed the universe) is not easily translated into the absolute terms of 0 and 1. Fuzzy logic includes 0 and 1 as extreme cases of truth (or "the state of matters" or "facts") but also includes the various states of truth in between so that. New computing methods based on fuzzy logic can be used in the development of intelligent system for decision making, identification pattern recognition, optimization and control.

The concept of linguistic variable is a fact which is widely recognized- a fact which relates to the concept of precision. Precision has two distinct meanings- precision in value and precision in meaning. The first meaning is traditional. The second meaning is not. The second meaning is rooted in fuzzy logic. Linguistic variable is an important concept in fuzzy logic, and plays a key role in its application. It is a variable whose values are words in a natural language. For example, "speed is a linguistic variable, which can take the value as "slow", "fast", "very fast" and so on.

VI. APPLICATIONS OF FUZZY LOGIC

Fuzzy logic is extremely useful for many people involved in research and development including engineers (electrical, mechanical, civil, chemical, aerospace, agricultural, biomedical, computer, environmental, geological, industrial and mechatronics), mathematicians, computer software developers and researchers, medical

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researchers, social scientists (economics, management, political science and psychology), public policy analysts, business analysts and jurists.

Indeed, the application of fuzzy logic, once thought to be an obscure mathematical curiosity, can be found in many engineering and scientific works. Fuzzy logic has been used in numerous applications such as facial pattern recognition, air conditioners, washing machines, vacuum cleaners, transmission systems, control of subway systems and unmanned helicopters, knowledge-based systems for multi-objective optimization of power systems, weather forecasting systems, models for new product pricing or project risk assessment, medical diagnosis and treatment plans and stock trading. Fuzzy logic has been successfully used in numerous fields such as control systems, engineering, image processing, power engineering, industrial automation, robotics, consumer electronics and optimization. This branch of mathematics has instilled new life into scientific fields that have been dormant for a long time[4].

VII. FUZZY LOGIC IN ECONOMICS

There is a significant difference between different fields of science, and unlike other sciences economics has many variables and factors that are influenced by human behavior. For example, mathematics and physics have precise variables and relations. Social sciences like for example economics also have variables and relations but it is more difficult to measure and evaluate them. Physics has also variables and relations but it is more difficult to measure and evaluate them. Physics has general laws and rules that are constant and valid at all times. Economics also has laws but the market environment is constantly changing. It is more difficult to make predictions about the future markets than it is to predict the behavior of a system which follows the precise rules of physics. There is a very complex system of many factors that influence the behavior of market. Economics tries to understand the complex behavior of the customers and producers and formulates recommendation and methods that can be used by both managers and customers to optimize their decisions. Economic is an ideal field for the application of fuzzy logic as it has many variables that are difficult to quantify. Fuzzy logic offers multiple ways how to work with imprecise variable and makes the problem solving and decision making easier. It has proven to be very useful for solving economical problems. This work sums up the basic information about variables in economics and about fuzzy logic.

VIII. DATA AND METHODOLOGY

Data for this work is adopted from the World Economic Forum, which played a facilitating role by providing detailed assessments of the productive potential of nations worldwide. The report contributes to an understanding of the key factors that determine economic growth, helps to explain why some countries are more successful than other in raising income levels and providing opportunities for their respective population and offers policymakers and business leaders an important tool for formulating improved economic policies and institutional reforms[5]. The historical data is obtained from the "**CIA World Fact Book**" and http://www.indexmundi.com. The data is obtained from the website http://www.allcountries.org/ranks/ of the global competiveness index.

In this work, the data of input factors (Population, GDP, Unemployment Rate, Inflation Rate, Industrial Growth Rate) of year 2012 but the range of these factors covers the period of 5 years (2008-2012) is considered.

Table 1: Average value of the input criteria's for year 2012:

Factors / Countries	Population (in million)	GDP (in billion)	Unemployment Rate	Inflation Rate	Industrial Growth Rate
AUSTRALIA	22	986	5.2	1.8	3.6
BRAZIL	201	2,394	5.5	5.4	-0.8
CANADA	34	1,513	7.3	1.5	1.8
CHINA	1,349	12,610	6.5	2.6	8.1
FRANCE	65	2,291	10.3	2.2	-1
GERMANY	81	3,250	5.5	2.1	-0.5
INDIA	1,220	4,761	8.5	9.3	3.1
S.AFRICA	48	592	22.7	5.7	0.8
S.KOREA	48	1,640	3.2	2.2	1.7
US	316	15,940	8.1	2.1	-0.5

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8.1 Population

Population describes the number of inhabitants of the same species occupying a particular geographic area. It is determined by the interplay of two factors, one is the birth rate or the number of people born and other is death rate or the number of people who die. The difference of between two is called the rate of natural increase. The word populates means to supply with inhabitants as by colonization to live in inhabit.

8.2 Gross Domestic Product-

The gross domestic product (GDP) is one of the primary indicators used to gauge the health of a country's economy. It is calculated without making deduction for depreciation of fabricated assets or for depletion and degradation of natural resources. It represents the total market value of all goods and services produced over a specific time period. Measuring GDP is complicated, but at its most basic, the calculation can be done in one of two ways: either by adding up what everyone earned in a year (income approach) or by adding up what everyone spent (expenditure method). The expenditure method is the most common approach and is calculated by adding total consumption, investment, government spending and net exports. As one can imagine, economic production and growth what GDP represents has a large impact on nearly within that country. GDP is one of the factor, economists use to determine whether the country is in a recession or not.

8.3 Unemployment Rate

The unemployment rate is a measure of the prevalence of unemployment and it is calculated as a percentage by dividing the number of unemployed individuals by all individuals currently in the labor force. It is widely recognized as a key indicator of labor market performance. A close watched economic indicator, the unemployment rate attracts a great deal of media attention, especially during recession and tough economic times. During period of recession, an economy usually experienced a relative high unemployment rate.

8.4 Inflation Rate

Inflation is defined as a sustained increase in the general level of prices for goods and services. Inflation means either an increase in the money supply or an increase in general price level in an economy. The rate of change of prices (as indicated by a price index) calculated on a monthly or annual basis. The rate at which the general level of prices for goods and services is rising and subsequently, purchasing power decreases and fixed –asset value are affected.

8.5 Industrial Production Growth Rate

This entry gives the annual percentage increase in industrial production (includes manufacturing, mining and construction). Growth is related to consumer demand for the new products or services offered by the firms within the industry. In company across an industry exhibit solid earnings and revenue figures, that industry may be showing signs that it is in its growth stage. Economic growth is the increase in the amount of the goods and services produced by an economy over time.

IX. METHODOLOGY

In this methodology the model is divided into four main parts:

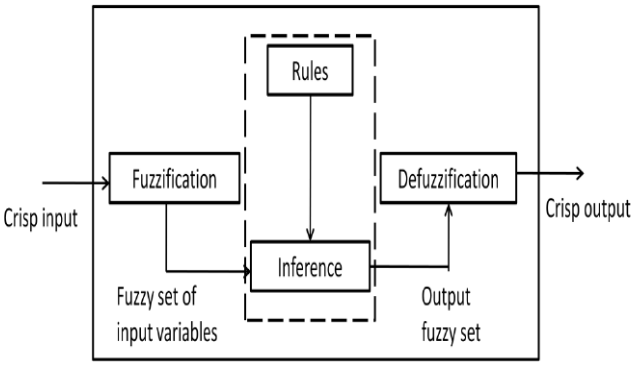

Fig 1: Fuzzy inference system

9.1 Fuzzification

The first step in fuzzy logic processing involves a domain transformation called Fuzzification. Crisp inputs are transformed into fuzzy inputs. To transform crisp input into fuzzy input, membership function must first be defined for each input. Once membership functions are defined, Fuzzification takes a real time input value.

9.2 Fuzzy Inference Engine

Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. The inference engine of a fuzzy expert system operates on a series of production rules and makes fuzzy inferences. Once all crisp input values have been fuzzified into their respective linguistic values. The inference engine will access the fuzzy rule base of the fuzzy expert system to derive linguistic values for the intermediate as well as the output linguistic variables. The two main steps in the inference process are the aggregation and composition. Aggregation is the process of computing the values of the *if* (antecedent) part of the rules while composition is the process of computing the values of the *then* (conclusion) part of the rules. During aggregation, each condition in the *if* part of a rule is assigned a degree of truth based on the degree of membership of the corresponding linguistic term.

9.3 Rule Base

A fuzzy rule base consists of many fuzzy rules, such as "*if-then*" and represents the system relation between input and output. The "*if*" part is known as antecedent or premise, where as the "*then*" part is termed as a consequence or conclusion. Its general formula is given as follow:-

if x_l *is* A_i^l *and . . . and* x_l *is* A_i^l, *Then y is B, where* $i = 1, 2, 3,..., n$.

9.4 Defuzzification

Defuzzification is the process of producing a quantifiable result in fuzzy logic, given fuzzy sets and corresponding

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membership degrees. The purpose of defuzzification is to convert each conclusion obtained by the inference engine, which is expressed in terms of a fuzzy set, to a single real number. There are various techniques for defuzzification such as, centre of maxima, centre of area, mean of maximum, height method, centre of gravity, centre of sums and weighted average method. The method which is used here is centre of gravity method.

X. INPUT FUNCTIONS

i) Population:-For calculating the membership function, we take scale of number of inhabitants in the range of 0 – 1000 million. The membership function for population may be explained as:

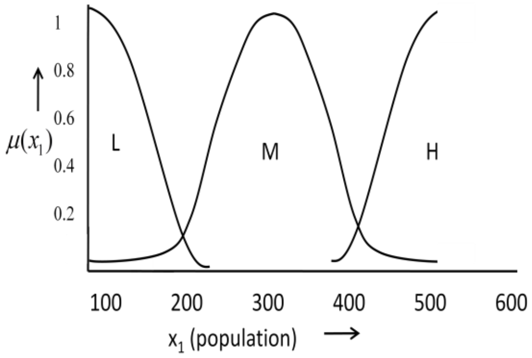

Fig 2. Membership function for population x_1

$$\mu_{POP_L}(x_1)=\begin{cases}1 & x_1 \le 100\\ e^{-\frac{1}{2}\left(\frac{x-100}{58}\right)^2} & 100 < x_1 \le 200\end{cases}$$
...(1)

$$\mu_{POP_M}(x_1)=\begin{cases}e^{-\frac{1}{2}\left(\frac{x-100}{115}\right)^2} & 100 \le x_1 \le 500\end{cases}$$
...(2)

$$\mu_{POP_H}(x_1)=\begin{cases}e^{-\frac{1}{2}\left(\frac{x-500}{58}\right)^2} & 400 \le x_1 < 500\\ 1 & x_1 \ge 500\end{cases}$$
...(3)

ii) Gross Domestic Product:- For calculating the membership function, we take scale of production (in money) in the range of 500 – 4000 billion. The membership function for GDP may be explained as:

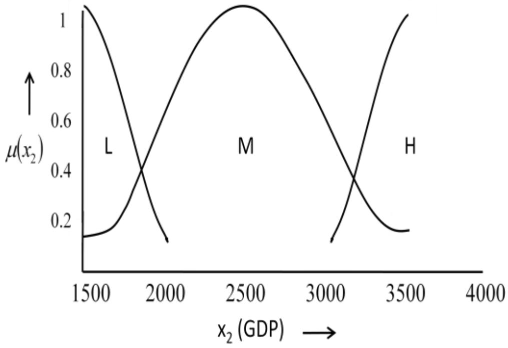

Fig 3. Membership function for GDP x_2

$$\mu_{GDP_L}(x_2)=\begin{cases}1 & x_2 \le 1500\\ e^{-\frac{1}{2}\left(\frac{x-1500}{289}\right)^2} & 1500 < x_2 \le 2000\end{cases}$$
...(4)

$$\mu_{GDP_M}(x_2)=\begin{cases}e^{-\frac{1}{2}\left(\frac{x-2500}{578}\right)^2} & 1500 \le x_2 \le 3500\end{cases}$$
...(5)

$$\mu_{GDP_H}(x_2)=\begin{cases}e^{-\frac{1}{2}\left(\frac{x-3500}{289}\right)^2} & 3000 \le x_2 < 3500\\ 1 & x_2 \ge 3500\end{cases}$$
...(6)

iii) Unemployment Rate:-For calculating the membership function, we take scale of percentage in the range of 0 – 25. The membership function for Unemployment Rate may be defined as:

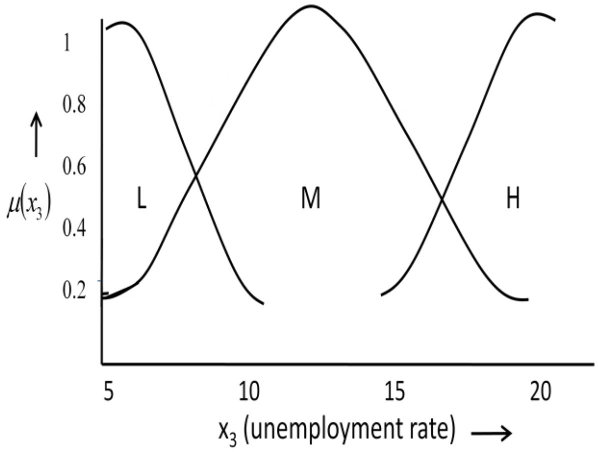

Fig 4. Membership function for unemployment rate x_3

$$\mu_{UER_L}(x_3)=\begin{cases}1 & x_3 \le 5\\ e^{-\frac{1}{2}\left(\frac{x-5}{3}\right)^2} & 5 < x_3 \le 10\end{cases}$$
...(7)

$$\mu_{UER_M}(x_3)=\begin{cases}e^{-\frac{1}{2}\left(\frac{x-12.5}{5}\right)^2} & 5 \le x_3 \le 20\end{cases}$$
...(8)

$$\mu_{UER_H}(x_3)=\begin{cases}e^{-\frac{1}{2}\left(\frac{x-20}{3}\right)^2} & 15 \le x_3 < 20\\ 1 & x_3 \ge 20\end{cases}$$
...(9)

iv) Inflation Rate:-For calculating the membership function we take scale of percentage in the range of -2 – 10. The membership function for Inflation Rate may be defined as:

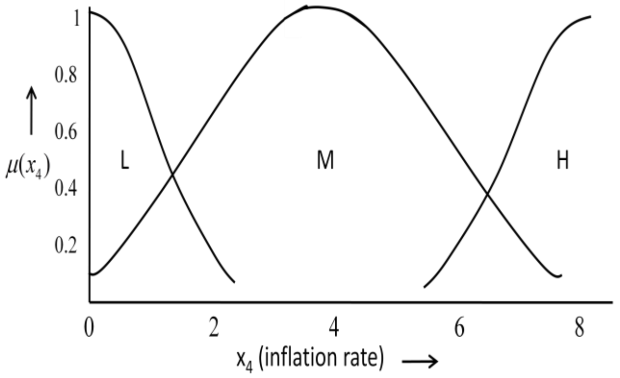

Fig 5. Membership function for inflation rate x_4

$$\mu_{\mathrm{INF}_L}(x_4)=\begin{cases}1 & x_4 \le 0\\ e^{-\frac{1}{2}\left(\frac{x-0}{1.3}\right)^2} & 0 < x_4 \le 2\end{cases}$$

...(10)

$$\mu_{\mathrm{INF}_M}(x_4)=\left\{\; e^{-\frac{1}{2}\left(\frac{x-4}{2.5}\right)^2} \qquad 0 \le x_4 \le 8\right.$$

...(11)

$$\mu_{INF_H}(x_4)=\begin{cases}e^{-\frac{1}{2}\left(\frac{x-8}{1.3}\right)^2} & 6 \le x_4 < 8\\ 1 & x_4 \ge 8\end{cases}$$

...(12)

v) Industrial Production Growth Rate:-For calculating the membership function, we take scale of percentage in the range of -3 – 12.The membership function for Industrial Production Growth Rate may be defined as

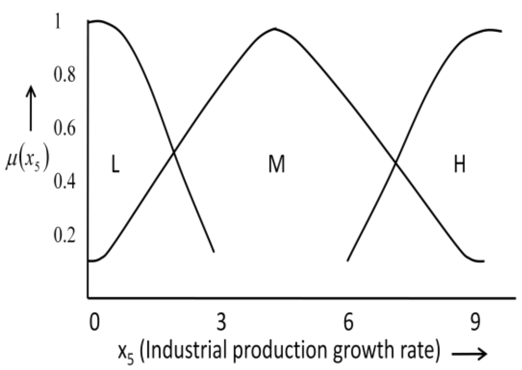

Fig 6. Membership function for Industrial production growth rate x_5

$$\mu_{\mathrm{IPRR}_L}(x_5)=\begin{cases}1 & x_5 \le 0\\ e^{-\frac{1}{2}\left(\frac{x-0}{2}\right)^2} & 0 < x_5 \le 3\end{cases}$$

...(13)

$$\mu_{\mathrm{IPGR}_M}(x_5)=\left\{\; e^{-\frac{1}{2}\left(\frac{x-4.5}{3}\right)^2} \qquad 0 \le x_5 \le 9\right.$$

...(14)

$$\mu_{IPGR_H}(x_5)=\begin{cases}e^{-\frac{1}{2}\left(\frac{x-9}{2}\right)^2} & 6 \le x_5 < 9\\ 1 & x_5 \ge 9\end{cases}$$

...(15)

XI. OUTPUT FUNCTION

For calculating the membership function, we take scale in the range of 0 – 10. The membership function for output may be defined as:

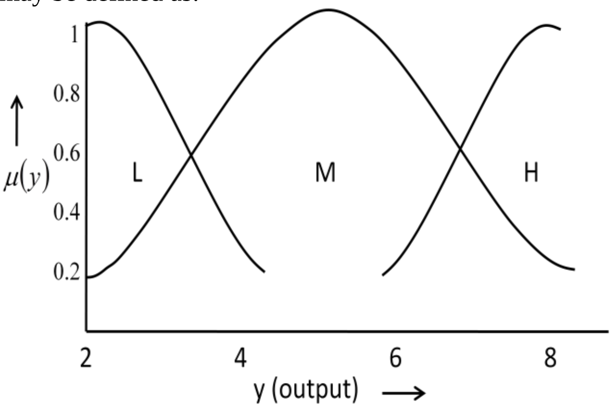

Fig 7: Membership function for output y

XII. DEFUZZIFICATION

Defuzzification is interpreting the membership degrees of the fuzzy sets into a specific decision or real value. A common and useful defuzzification technique is centre of gravity. The centre of gravity (COG) is the most popular defuzzification technique and is widely utilized in actual applications. The defuzzification of the data into a crisp output is accomplished by combining the result of the inference process and then computing the "fuzzy centroid" of the area. The weighted strengths of each output member function are multiplied by their respective output membership function center points and summed. Final output, this area is divided by the sum of the weighted membership function strength and the result is taken as the crisp output.

The COG method can be expressed as:

$$\mathrm{OutputData}=\frac{\sum_{i\in x_{\min}}^{x_{\max}} x_i.\mu(x_i)}{\sum_{i\in x_{\min}}^{x_{\max}} \mu(x_i)} \qquad \text{………….(16)}$$

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XIII. CASE STUDY

Now we take an example in which we consider a country to know that, what is the economic level of that country? Is that country low developed, medium developed or highly developed? Let a country uses the following five inputs – population x_1 , GDP x_2, unemployment rate x_3 , inflation rate x_4 , industrial production growth rate x_5 with the three outputs low, medium and high.

The values of inputs of this country may be consider as:

x_1= 142 million, x_2 = 2555 billion; x_3 = 5.7; x_4 = 5.1;

x_5 = 2.9

Fuzzification of the crisp inputs. Through the use of membership function defined for each fuzzy set for each linguistic variable, the degree of membership of a crisp value in each fuzzy set is determined as follows:

$\mu_L(x_1) = 0.77$, $\mu_M(x_1) = 0.02$, $\mu_H(x_1) = 0$,

$\mu_L(x_2) = 0$, $\mu_M(x_2) = 0.99$, $\mu_H(x_2) = 0$,

$\mu_L(x_3) = 0.97$, $\mu_M(x_3) = 0.33$, $\mu_H(x_3) = 0$,

$\mu_L(x_4) = 0$, $\mu_M(x_4) = 0.95$, $\mu_H(x_4) = 0$,

$\mu_L(x_5) = 0.34$, $\mu_M(x_5) = 0.35$, $\mu_H(x_5) = 0$,

Fire the rule bases that correspond to the above inputs. Based on the value of the fuzzy membership function values for the case under consideration, the following rules apply:

RULE1: if x_1 is l, x_2 is m, x_3 is l, x_4 is m, x_5 is l then y is m.
RULE2: if x_1 is l, x_2 is m, x_3 is l, x_4 is m, x_5 is m then y is m.
RULE3: if x_1 is l, x_2 is m, x_3 is m, x_4 is m, x_5 is l then y is l.
RULE4: if x_1 is l, x_2 is m, x_3 is m, x_4 is m, x_5 is m then y is m.
RULE5: if x_1 is m, x_2 is m, x_3 is l, x_4 is m, x_5 is l then y is m.
RULE6: if x_1 is m, x_2 is m, x_3 is m, x_4 is m, x_5 is l then y is l.
RULE7: if x_1 is m, x_2 is m, x_3 is l, x_4 is m, x_5 is m then y is m.
RULE8: if x_1 is m, x_2 is m, x_3 is m, x_4 is m, x_5 is m then y is l.
where l, m and h are the low, medium and high respectively.

Execute the inference system:-

We use “Root Sum Square” (RSS) method to combine the effects of all applicable rules. Root sum square method scales the function at their respective magnitudes and computes the “fuzzy centroid” of the composite area. This method is more complicated mathematically than other methods.

Low $= \sqrt{\sum_{i \in D_l} (\mu_{R_i})^2} = \sqrt{(0.33)^2 + (0.02)^2 + (0.02)^2} = 0.33$

medium $= \sqrt{\sum_{i \in D_m} (\mu_{R_i})^2} = \sqrt{(0.34)^2 + (0.35)^2 + (0.33)^2 +} (0.02)^2 + (0.02)^2$ =.0.58

high $= \sqrt{\sum_{i \in D_h} (\mu_{R_i})^2} = 0$

Output of the decision of the expert system:-

$$\text{Output} = \frac{0.33 \times 2 + 0.58 \times 5}{0.33 + 0.58} = 3.91 \quad ...(17)$$

Therefore, our crisp output is 3.91. This shows that output is in the set of medium developed more than the set of low developed and high developed. This shows that the country is medium developed country.

XIV. CONCLUSION

To know about the economic level of any country is most useful in many criteria on national or international level. It can be measured by many input factors, that are GDP, GDP per capita, Labour force, Unemployment Rate, Taxes and other Revenues, Industrial Production Growth Rate, Inflation Rate, imports, exports and so on. But some most affected factors GDP, Unemployment Rate, Inflation Rate, and Industrial Production Growth Rate. It helps World Bank to classify the countries as their economic level. i.e. low, medium or high income countries. This data confer the criteria to World Bank, if these countries are in position of financial ability to borrow from them. Not only World Bank but countries, multinational companies and big individual investors are also affected with the economic condition of countries. Countries form their financial policy accordingly. MNC are proactive about the financial information of countries often as their investments are on stake. For example: Before 1991, or before India adopted the foreign policy of Liberalization, Privatization, Globalization, it was facing great difficulty in not only repay is debt but the whole government structure. It was the miserable time of India and neither the many countries not the institutions like World Bank and IMF were ready to lending him. But as the time change after the policy of LPG, India was getting a better financial condition, all these countries changed their glance towards India and Showed interest to deal with. The data about economic level of any country can be significantly important not only for that country but others also.

This work presents a new way of modelling and evaluating the level of economic development of countries on the basis of its parameters by applying the theory of fuzzy sets. The model for the evaluation of the level of economic development, with certain modification on the rules and values of variables, can be applied to other economic sectors such as the assessment of market liberalization or its certain elements: telecommunication, transport, agriculture and so on.

REFERENCES

1. Alarcon, L.F. and Serpell, A. (1996): “Performance measuring, Benchmarking and modelling of project performance”. 5th

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International Conference of the Inernational Group for Lean Construction. The University of Birmingham, UK, 1996.

2. Benchmarking Exchange (2001):www.benchnet.com
3. Stojic, G. (2011): "Using fuzzy logic for evaluating the level of countries' (Regions') Economic Development" Geographica Pannonica, 14(3), 59-66.
4. Harpreet, Madan M., Thomas M., Zeng., Kum Kum, Ashu and Zadeh (2013): "Real-life application of fuzzy-logic", Advances in Fuzzy Systems, 3 pages.
5. World Economic Forum. (2013). "Global Competitiveness Index 2013-2014." http://www.allcountries.org/ranks/.
6. Hndoosh, R.W.; Kumar, S. and Saroa, M.S. (2014) "Mathematical Structure of Fuzzy Modeling of Medical Diagnoses by Using Clustering Models". International Journal of Scientific and Engineering Research (2014), 5(8), 545-554
7. Hndoosh, R.W.; Kumar, S. and Saroa, M.S. (2014) "The derivation of interval type-2 fuzzy sets and systems on continuous domain: theory and application to heart diseases". International Journal of Science (2014) 3,
8. Kumar, S., Sarswat, R. and Chaudhary, S. (2015) "A mathematical model to diagnose the level of diabetes using fuzzy logic system". Jnanabh , 45, 125-136
9. Tiwari, N. and Kumar, S. (2015) "Mathematical model for the risk of cancellation of life insurance policies". SRM Int. Jour. of Engg. & Sc., 3, 1, 19-26
10. http://www.ciaworldfactbook.com.