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A New Model for the Valuation of Social Dynamical Systems

(*Abstract*)

The purpose of this article is that of proposing a complex pattern for the evaluation of the achievement degree for the criteria of social nature, economic nature, and so on. It is attained a classification of studied entities and also an evaluation of the distance from the target objective of the appointed criteria In the same time, a choosing modality of the significant information that participates to the quantification of the criteria mentioned earlier, is presented.

1. Introduction

Within the human development program run by UNO, in the initial version, the world development / welfare concepts were assimilated only with those of economic growth. After that, successive refinements had been made and other criteria taken into consideration, such as life expectancy, educational level and so on. In this context a certain specification should be made about the "life expectancy" indicator, another version being introduced under the concept of "life expectancy under acceptable conditions from the health point of view". In the same time it should be necessary a just and equitable appropriation of the revenues.

A step forward is proposed by Amartya Sen [1,2], throughout so called theory of capability and ability that a human being is owing the social environment that he lives in.

This factor implies taking into consideration, in order to evaluate the human development, of some coordinates or dimensions such as philosophical, psychological, political and religious ones.

In this context, pups up the issue of finding the evaluation mechanisms for the above mentioned important indicators, and for the aggregation of information, in order to attain a global index of characterization of the studied entity (country / region / community).

2. Evaluation model

Starting from the observation made by H. J. Zimmermann [3] that the relation between physical reality and the perception of this reality has an exponential form we will translate the degree of satisfaction of a criterion, in relation with a given objective, as having the expression $d(x) = e^{ax+b}$. In this context, as an allocated function of the criterion taken into consideration, we will have the function given by

$$\mu(x) = \frac{1}{1+e^{ax+b}}.$$

In a concrete manner, let a target objective related to a given criterion. We will suppose that the target objective can be numerically expressed and has the value A. For example for the life span we can

choose $A = 90$ years and for the education level we will state that $A = 1$. We will note with m and M respectively, the smallest (greatest) value that expresses, according to the official statistics, the satisfaction degree for the appointed objective of the studied entities. For example, the biggest life span is to be found in Japan and it is situated at age of 81, while the smallest one is to be found in Sierra Leone and it is situated at 39 years old. From the education level perspective we will have the value 1 for Swiss and 0,002 for Niger.

Let α and β the percentage cottas of m and M numbers in relation with A.

Then the parameters α and β from the allocated function of the appointed criterion $(\mu(x) = \frac{1}{1 + e^{ax+b}})$ are deduced from

$$a = \frac{1}{M-m} \ln \frac{\alpha - \alpha\beta}{\beta - \alpha\beta};$$

$$b = \frac{1}{M-m} \left(m \ln \frac{\beta}{1-\beta} - M \ln \frac{\alpha}{1-\alpha} \right)$$

For the deduction of these formulas it was used the fact that

$$\mu(x) = \frac{1}{1 + e^{ax+b}} \Leftrightarrow ax + b = \ln \frac{1 - \mu(x)}{\mu(x)}.$$

3. The choosing of significant information

The starting point is made up by the official statistics where information can be found (we will say that these are affirmations of level 1) generally in the form of percentage cottas. For example we will found: the number of computers / 100 persons, the number of graduates / 100 persons, and so on)

Then, the new criteria are established (level 2 information, for example, the technological level, educational level and so on) for which the satisfaction degree is attained through the aggregation of some information of level 1). The choosing of this information can be made as it follows:

We note $I_1, \ldots, I_n$ the information of level 1 and let C the appointed criterion;

- a poll is being made (statistic survey), for a significant sample of studied entity where the answers of type YES / NO are required, for the questions regarding the satisfaction of the contained demands in $I_1, \ldots, I_n$ and C, being attained a table like this:

	I_1	I_2		I_n	C
1	x_1^1	x_2^1		x_n^1	y^1
2	x_1^2	x_2^2		x_n^2	y^2
			…….		
m	x_1^m	x_2^m		x_n^m	y^m

- then, are picked those information I_k, for which coincidences $x_k^i = y^i =$ YES occur for at least $\left[\frac{m}{2} \right]$ cases;

- afterwards, the triplets such as (I_k, I_e, C) are analyzed, then the quadruplets (I_k, I_e, I_n, C) and so on, in the following way: if, for an example, the coincidences percentage cotta

$$x_k^i = x_e^i = x_n^i = y^i = YES$$

it is the same with the percentage cotta

$$x_k^i = x_e^i = y^i = YES$$

results that I_m it is not a significant information for the C criterion; Thus, it comes to pointing out the information with an impact over C.

- through the aggregation of former selected information (for example, using the weighted arithmetic mean) the evaluation of C criterion is attained.

For example, for the information:

I_1 – the revenue level;

I_2 – economic growth tendency;

I_3 – the number of automobiles / 100 persons;

I_4 – the number of graduates / 100 persons;

I_5 – the number of sold books;

I_6 – the number of libraries;

I_7 – the number of computers / 100 persons;

I_8 – the number of internet points / 100 persons;

I_9 – life span;

I_{10} – the health;

I_{11} – civil rights;

I_{12} – political rights;

could be taken into considered the following criteria:

C_1 – the material prosperity (I_1, I_2, I_3);

C_2 – education level (I_4, I_5, I_6);

C_3 – technological level (I_7, I_8);

C_4 – biological level (I_9, I_{10});

C_5 – psychological level (I_{11}, I_{12}).

As it follows, the allocated functions are made up for the appointed criteria in the same way as presented in the previous paragraph. This way, it is attained the degree of satisfaction for the target objectives settled for those criteria, and thus, a classification of studied entities is also, attained. More important though, is to determine the distance which is to be completed in order to reach those target objectives.

Finally, using the criteria indexes previously attained, throughout an aggregation procedure (for example, weighted arithmetic mean) can be also attained the global development index for each studied entity. Making up the allocated function (allocated in order to meet the satisfaction degree of a global target objective) it comes to a classification and also to whereness of the appointed entities which are in relation with the desired development degree.

4. Evaluation algorithm

Here are the actual steps that were followed:

- the choosing of the criteria;

- picking up the relevant information for the appointed criteria;

- attaining the criterial indexes (through the aggregation of the chosen information);

- the identification of the allocated functions (for the satisfaction degree of the target objectives);

- the attaining of the global index (through the criterial indexes aggregation);

- the identification of the allocated global function (in order to determine the distance till the desired level);

5. Comment

A new step forward could be represented by taking into consideration some new elements such as information (criteria) interdependence, the relevance (importance) degree, and so on.

Thus are put the bases of a causal pattern for the development of the social, technical, natural, and other systems.

Bibliography

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[3] Hans Jurgen Zimmermann, *Fuzzy Sets, Decision Making and Expert Systems*, Kluwer Academic Publishers, 1987.