



RESEARCH ARTICLE

A STUDY ON FUZZY SETS OVER ELIMINATING POVERTY

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ABSTRACT

Poverty is a multi-facet phenomenon in today's globalized world. It is rooted in various causes and there are also multiple ways to do away with it. This paper aims to suggest in solving this problem by making definite rules to get aids/concessions from the Government time to time by applying the Fuzzy Set.

Key words: Poverty, Fuzzy set, Membership etc.

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INTRODUCTION

People from any discipline need a structure for existence on earth. People for such structure, are encountered with many problems in their lives. To represent these problems, several mathematicians have introduced the concept of set in their own ways. These ways of representing problem are more rigid. The solutions using this concept are not so meaningful in many circumstances. This difficulty was overcome by the fuzzy concept, which was first introduced by eminent American cyberneticist Prof. L. A. Zadeh in 1965. According to 2008, World Bank Indicators which is based on the 2004 survey show that at least 80% of the world population lives on less than US\$10 a day and over 3 billion of the world live on less than US\$2 a day. In this paper, demarcation of the poverty is considered of people earning US\$2 a day.

Characteristic Function

For any set A, the characteristic function of A is defined by,

$$X_A(x) = \begin{cases} 1 & \text{if } x \in A \\ 0 & \text{if } x \notin A \end{cases}$$

The characteristic function of a classical set assigns a value of either 1 or 0 to each individual in the universal set. But in the case of Fuzzy concept, this function is generalized in such a way that the values assigned to the elements of universal set fall within a specified range of real numbers in the interval [0, 1] i.e. the mapping $A: X \rightarrow [0, 1]$ is called a fuzzy set A or fuzzy subset A of X for which $A(x) = \alpha$, where $x \in X$ and α is a real number belonging to [0, 1].

Here, A is called the membership function and $A(x)$ is called membership grade of $x \in X$. We also write:

$$A = \{(x, A(x)): x \in X\}$$

Criteria of Membership

- The Set of Poor People,
- The Set of Red Flowers,
- The set of Delicious dishes,
- The set of good cricketers, etc.

In all these sets, the above adjectives bring a situation of ambiguity or vagueness in the listener. In the classical sense, the adjectives are not in sets. The transition from membership to non-membership is abrupt in the classes. We understand these sets as having indefinite boundaries that make possible gradual transition from membership to non-membership. In fact this is basic concept of fuzzy set. Every member of the given universe of discourse is a member of the fuzzy set with different grade of membership. Suppose Mr. A earns US\$2 per day and Mr. B earns US\$2.25 a day.

Then, according to this given rule, A is poor and B is not poor. A is eligible for the concessions while B is not. This is an absurd conclusion. Though a clear line of demarcation defining the jurisdiction of collection of the poor people does not exist but it is obvious that some vague demarcation must exist. A person who earns US\$1.5 a day is surely poor while a person earning US\$20 per day is certainly not poor. So, while moving from the financial status of the former person to later one. This line of demarcation must have been crossed somewhere. Such jurisdiction of collection of poor people may start gradually.

Classical Representation of the Problem

The government wants to solve the poverty (problem) by making a definite rule that “a person is poor if he earns US\$2 or less per day, he will get aids /concessions from the government time to time. Let N be the set of citizens and A be the collection of poorcitizens, $E(x)$ denote the daily earning of citizen x. The mathematical representation of the set A of poor Citizen is viewed as a characteristic function

A: $N \rightarrow \{0, 1\}$ such that if $A(x)$ be the grade of membership of Citizen x then

$$A(x) = 1 \text{ if } E(x) \leq US\$2 \\ = 0 \text{ if } E(x) > US\$2$$

Here, if $E(\text{Ram}) = \$1.7$ then, Ram is poor.
if $E(\text{Shaun}) = \$2$ then, Shaun is poor.
if $E(\text{Mohan}) = \$2.25$ then, Mohan is not poor.
if $E(\text{Karim}) = \$2.3$ then, Karim is not poor.

In this representation, only those Citizen are poor whose membership grade is 1 i.e. whose daily earning is US\$2 or less. But Citizen with daily earning \$2.25; \$2.23; \$2.5; \$3...\$10 and more are not poor. They all have membership grade 0 and they are not members of the set A.

Fuzzy Representation of the Problem

The rigidity of above classical representation of the problem can be viewed with the fact that one can easily understand about a person who earns US\$2 is poor but at the same moment how a person is not poor if he earns a slightly more amount than US\$2. No Government can succeed in solving this problem having such rigid representation. A group of people having earning like \$ 2.25; \$ 2.3; \$2.5 and so on will not be benefitted from the financial aids given by the Government. Fuzzy mathematicians have represented the fuzzy set A of poor Citizen as the function,

A: $N \rightarrow [0, 1]$, where,

$A(x) = 1$ if $E(x) \leq \$2$ means Citizenx is poor by all means.
= 0.99 if $E(x) = \$ 2.25$ means Citizenx is almost surely poor.
= 0.70 if $E(x) = \$4$ means Citizenx is more or less poor.
= 0.50 if $E(x) = \$5$ means Citizenx may or may not be poor.
= 0.30 if $E(x) = \$9$ means Citizenx is definitely not rich but it will be odd to call him poor.

= 0.01 if $E(x) = \$20$ means Citizenx is almost surely not poor.
= 0 if $E(x) = \$50$ means Citizenx is definitely not poor.

As earlier, we have seen that a member of a traditional set A has only two grades 0 and 1.

If $x \in A$ then, $A(x) = 1$
If $x \notin A$ then, $A(x) = 0$

But it does not happen in the case of Fuzzy set. It has a whole range of grades (1, 0.99, 0.70, 0.50, 0.30, 0.01... 0) between 1 and 0. This Fuzzy set of poor Citizen has indefinite boundaries. Every member of 1 i.e. every Citizen is a member of the Fuzzy set A i.e. Every Citizen is poor with different grade of membership.

Conclusion

We can see that the problem of poverty can be solved in a better way by implementation of Fuzzy set than a way by classical set. Each and every Citizen will be benefitted from the above rule. They will get appropriate aid according to their grade of poorness:

If $A(X) = 0.5$ then, X will get 50% of the aid.
If $A(Y) = 0.1$ then, Y will get 10% of the aid and
If $A(Z) = 1$ then, Z will be get 100% of the aid announced by the government.

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