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Research Article

A CRITICAL STUDY OF FUZZY LOGIC AS A SCIENTIFIC METHOD IN SOCIAL SCIENCES

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ABSTRACT

The logic of the social sciences, from its inception, has been certain and classic. By advent of Fuzzy logic, gradually making use of it was common because of frequent capabilities and applications that in resolving problems of this science was been attributed to it.

Changing of logic in a science or epistemic system has many consequences that affect other components. This paper attempts after studying of this logic and identifying its consequences, answer to the fundamental question: "Does fuzzy logic adhere to the requirements of the scientific method?"

The findings of this study show that Fuzzy logic doesn't have basic and necessary features of a scientific method and in other words it cannot be considered as logic alongside of other logics.

Keywords: fuzzy logic; social science; critical review; scientific method.

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1. PROBLEM DEFINING

Components of an epistemological apparatus are related and partly in conjunction with each other and form a unique and coherent whole that change in any component leads to changes in the

other components[1]. Changing Logic[2] (general methodology) from classic to fuzzy in the study of social phenomena has consequences that are essential to review[3]. These outcomes could be pursued in the section "assumptions", "Methods" and "Results". Having a clear image of the consequences helps a better and more realistic understanding of the logic and its ability to meet expectations that expect as an alternative method in social sciences. The purpose of this paper is to examine fuzzy logic[4] as a scientific method and response to the fundamental question whether fuzzy logic has basic and necessary features of scientific method?

Fuzzy logic was as an extremely value logic in order to solve the problem and describing fuzziness[5] in natural language[6] as it is, rather than reducing it to border (Nabavi, 2011: 179-178). Applying this logic in the engineering sciences has led to significant achievements and that was grounding for entry and using it in other sciences. Entry of fuzzy logic to the social sciences is in a way reminiscent of the positivist method in these sciences in era of Comte. At the time, the success of a method in experimental science led to its application in the social sciences.[7]

Social sciences more than other sciences and in two facets is dealing with the issue of vagueness. One of the reasons for this extremity is that there is vagueness in the social sciences aside from natural language, which is interface of fuzziness among sciences, in language of the field; in a

[1] Length and width (extent and depth) of this chage depending on the importance of the role that the part plays in the whole set.

[2] In this article general sense of logic, that's mean the general methodology is used, not special meaning of logic with the principles, syntax and so on in formal.

[3]The main components of a knowledge set are respectively ontology, epistemology, methodology and method (Iman, 2012:45). Each level is greatly preceded by pre-level. Methodology is divided into two parts of general methodology (logic) and methodology (such as Mathematics). It should be noted that the methodology is different from the Meta method.

[4] What is famous as a "fuzzy logic", more than "logic" of its exact sense, is an approach or a method. There are clear conceptual distinctions among logic, approach, specific methodology, method and so on but in scientific literature related to fuzzy logic these distinctions have been little considered. It may be that rather than logicians and methodologists to be dealt with fuzzy, engineers do it and have developed it. With awareness of this, because of multiple references to the sources in the article, I refuse to change the words, in order not to further fuel the turmoil. However, the two factors of discussion level and its attachments completely determine the clear conceptual distinction and the considered concept of the used word.

[5] Fuzzy statements in which there are imprecise predicates. Fuzziness topic is Sub-chapter in topic of uncertainty and uncertainty is in turn a subset of vagueness topic (Ghayoomi, 2003: 27). In other words, if we couldn't draw the exact boundary between phenomena they will be vagueness in some aspects (Ghayoomi 2003: 28).

[6] Natural languages are spoken languages in the world, and they have been spontaneously emerged and evolved such as Persian, English, German, and Chinese languages. Typically, this name is used against artificial languages such as formal logic (http://fa.wikipedia.org).

[7] In this article it is assumed that the reader is familiar with the totality of fuzzy logic, such as roots, formation, historical development and most importantly how to use it. Thus it will not rehash. There are many books written about fuzzy logic and informing of the issues of "fuzzy systems and fuzzy control" by Li Wang as well as chapter 6 of the book "Foundations of philosophical logic" by Lotfolah Nabavi is enough to understand the content of this article.

way that in many social concepts, regardless of consensus or disagreement of scholars and experts on their definitions, they basically do not have precise definitions to them. Fuzziness is in social sciences is not limited in concept level and language of expressing them but it also pierce in examples and includes them in a way that precision in concepts also do not help to clarification of concepts and their borders . This make necessity of addressing methodology further, as if there would be a way by which we can solve the problem of vagueness –at least in level of concepts and linguistic variables, or improve it, it would be possible to provide dramatic improvements in social sciences. Fuzzy logic claims to do this expediency. On the other hand, changes in the logic of a science create major changes in assumptions and other components of the science and its epistemological set and leads in creation of new problems and a lot of consequences for social sciences which is not less than the issue of vagueness in making complexity and difficulty. Therefore, it is essential to check the performance of fuzzy logic as a scientific method. In fact, the aim of this paper is to estimate cost-benefit of changing social sciences logic into fuzzy logic.
In this paper, I try to answer the following questions:

1. What are changes due to changing classic logic into fuzzy logic changes for assumptions, results as well as main components of method, namely concepts and indicators, modeling and mathematics?
2. Do these changes have led to goals of fuzzy logic? In other word, does fuzzy logic have solved deficiencies related to classical logic?
3. Does fuzzy logic itself has not led to emergence of new problems? What are these problems?

The article argues that using fuzzy logic in social studies not only resolve ascribed deficiencies of classical logic, but also has caused to emerge some other methodological problems and deficiencies.

2. RESEARCH METHOD

There are two possible paths to analysis a scientific theory or method. The first course reviews theory or method independently and freely from other theories in terms of accordance with standards or essential features of a theory or method. These features are expressed in frame of two general criteria of having objectivity, and realization or attainment determined goals as well as criteria of internal stability or compatibility. In fact, these criteria are telling that what is been introduced as a scientific theory or method, has initial and necessary features of a theory or

method and essentially can count it as a theory or method, or not. The second path is comparing studying scientific method with other scientific methods. In this way it is supposed that quoted method meet the criteria listed in the first path and is a method along with other scientific methods. Then compare this method with other methods in terms of advantages and disadvantages in relation to them. In this study, only first route is traced.

Methodologists and philosophers of science introduce different criteria to a scientific method. In one hand, these differences are upon on considered issue and in other hand due to their different approaches to category of science; but despite the differences, there are important commonalities between their views. In fact, there are general characteristics that a method is necessary to have them regardless of its subject. There are a few criteria which there are total consensus on them, but there are criteria that there is maximum agreement between methodologists and philosophers of science (for more details see Nola and Sankey, 2007). This paper examines whether fuzzy logic exists three important criteria of objectivity, goal attainment and internal consistency. Following, the three criteria are introduced brief. It should also be noted that only the criteria presented and reviewed. Arguments for and against using of any criterion is not subject of this article.

Criterion 1; Objectivity: objectivity in a method means acceptance and commitment to an apparatus of being a regular world, independent of mind, in that method. Every logic in nature and only because of being logic, has accepted existence or reality of independent world of mind - at least, reality of that logic - and because of presenting a method or methods to discover and access to it, see independent reality or world of mind regular and having a rule. Here, reality independence of mind means independence of all minds and specific individual characteristics. In other words, reality here is generalized.

Criterion 2; Stability (internal consistency): Components of a logic including assumptions, techniques, and results should be consistent with each other and not contradictory.

Criterion 3; Goal attainment: any scientific method or theory corresponding to an issue and arise to resolve it. The scientific method or theory must be able to solve a problem that has emerged concerning it. In fact, the measure analyzes ability of a method in solving a problem that has been created for it.

This article first studies fuzzy logic in a three-part of concepts and indicators, mathematics, and modeling. Then I review existence and realization of these criteria at levels of assumptions, method (specific methodology and techniques) and results.

3. EXPRESSING FUZZY LOGIC IN FRAMEWORK OF AN EPISTEMOLOGICAL SET

Components of an epistemological set are associated with each other. To achieve a clearer understanding of changes in other components of an epistemological set through changing logic from classic to fuzzy it is required differences between these two logics and changes in other components to be expressed. This issue will be discussed following briefly.

Fuzzy logic believes in conjunction of phenomena, in a way in terms of maximum precision one can't consider characteristic and decisive border among them; however, classic logic believes that in terms of enough precision one can discover characteristic border among phenomena (Kosko, 1999: 23). Classical logic sees summation between two contradictories impossible. In other words, A ~ Av is always true, but it is not true in fuzzy logic.

Epistemologically, classical logic is based on two values of truth and false, while fuzzy is infinite-valued logic. In other words, a proposition is truth or falseness in classical logic, but the same proposition in fuzzy logic may be true to some extent.

These two logics have also differences in general level of methodology (logic). In addition to accepting graduated truth, fuzzy logic has different and more quantifiers, restraints, possibilities, and possibilities than classical logic. In fact, these provide necessary language possibilities to express what Fuzzy logic calls description of vagueness. Moreover, predicates also in fuzzy logic, unlike classical logic, are vague and imprecise.

At level of particular methodology, fuzzy thinkers believe "classical mathematics where we deal with divalent world is a suitable tool to express different concepts, but with the growth of human thought and scientific and technological advances, it is cleared a need to better scientific tools for more complex concepts of life and Human environment. The concepts that revealing them with usual mathematic that is based on divalent criteria is no longer appropriate and not able. Fuzzy mathematics is to meet this need, the need for a multivalued concepts rather than divalent concepts, the need for expressing realities of the world as it is rather than expressing the world in forms that do not fit in it" (Ghaffari et al, 1999: 7-8).

There are differences between fuzzy mathematics and classical mathematics, for example, in fuzzy logic there is no laws of Contradiction and Excluded Middle so that we have $A \cap \bar{A} \neq \varphi$, $A \cup \bar{A} \neq X$ (X is reference set) or operators of summation and multiplication that are different in fuzzy with classic (However, roots of all operators returns to summation and multiplication in classical mathematics) or membership functions in the set.

Technically, in fuzzy logic because of graduated concepts and predicates it is required in addition to values of present (1) and absent (0) concepts, the transition points will be also considered where there is uncertainty. These points, in terms of type of model and precision can be considered one or more which converts divalent concepts into multivalent concepts. Here the concepts are ranging and as the ranging is more (more transition points), to be more precise concepts.

Result analysis is done based on used models. Thus, analysis and conclusions are made based on form of membership function and degree of membership in sets.

In short, fuzzy logic claims the natural world is continuous and phenomena don't have clear border, so has vagueness (philosophical claims). The vagueness can be resolved (logical claim), but by using the fuzzy set theory – advancement of the classical set theory (applied claim).

4. FUZZY LOGIC AS A SCIENTIFIC METHOD

Here, I address fuzzy logic according to three criteria of objectivity, internal consistency, and goals attainment. To do this, it is required to express main stages of solving a problem by Fuzzy. The stages are three parts of "concepts and indicators", "fuzzy mathematic" and "fuzzy modeling" that are investigated following.

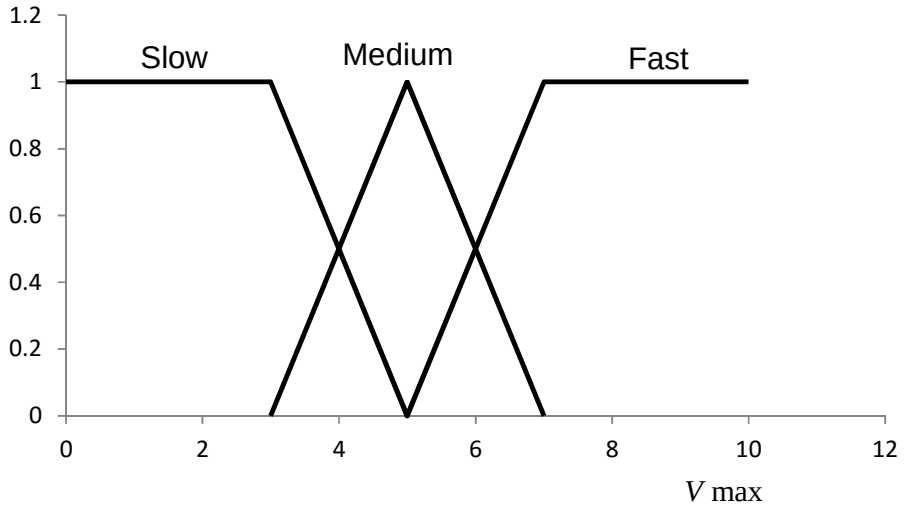
4.1. Concepts and Indicators

Fuzzy concepts and indicators have three major differences with classical ones. First, variables are linguistic in fuzzy. Second they are graduated, and third difference that is result of two previous differences is the possibility of combining qualitative and quantitative variables. The three differences are described below.

In slang words, if a variable could be valued by words of natural language, then it is called a linguistic variable. Words are characterized by fuzzy sets in a scope that variables are defined, for

example, speed[8] of car is X variable that receives values in scope of $[0, V\max]$ that $V\max$ is maximum speed of the car. Now we have three sets of "slow", "medium" and "fast" are defined as shown in figure at scope of $[0, V\max]$. If we see X as a linguistic variable, then X can receive "slow", "medium" and "fast" in terms of its value. This means that we can say "X is slow", "X is average" and "X fast". X may also receive numbers in scope of $[0, V\max]$.

Speed of car as a linguistic variable



A linguistic variable is determined with four parameters (X, T, U, M):

- X is name of the linguistic variable.
- T is a set of linguistic values that X receives. In example above T= {slow, medium, fast} -- U is actual physical scope in which the linguistic variable X, receives its quantitative values.
- M is a lexical rule that links every linguistic value at T with a fuzzy set of U. In this example, M links values of "slow", "medium" and "fast" with shown membership functions in Figure.

In fact, linguistic variables are development of numerical variables and can accept fuzzy sets by their values (Wang 2013: 70-72). In classical logic, rather than linguistic variables, there are numerical variables. In example above, if speed variable rather than described by terms such as "slow", " medium " and "fast" with numbers three, five and seven were shown, then they were

[8] Rather than speed of car, we can use concepts such as height, youth, and even gender.

numeric variables, namely instead of words, numbers were used. In fact, usage of linguistic variable causes two main differences: first, linguistic variable is an intermediate between concept and number which this intermediation is that, according to fuzzy thinkers, creates ability of combining quality and quantity in fuzzy variables. Second, every linguistic variable, instead of receiving a specific value, receives a fuzzy set (function) of value. Qasemi said " emphasis on verbal nature and set-based of theorizing, implicitly is an emphasizing on linguistic variables in set analysis. Human life, social relations and related phenomena have qualitative nature and nonnumeric. "(2011: 20).

Qasemi also because sees sociological structures, inherently and naturally, qualitative, considers effective in more successful evaluation of these structures, methods and tools that can measure constructs in combination and at the same time at both qualitative and quantitative ways (2011: 21). Using linguistic variable is one of two factors that cause combination of quality and quantity. Fuzzy logic are members of a specific set namely concept, moreover, they lonely are sets that have members with different memberships and specific functions; in other words, in one hand, they are qualitative sets and at the other hand, membership degree of their members is quantitative. Fuzzy logic combines through "fuzzy sets, qualitative and quantitative measurements in a single tool. All fuzzy sets consist of two quality modes, complete membership and complete no membership and all quantitative variability (diversity) between the two qualitative situations. "(Ragin, quoted by Sotudeh, 2007: 45).

It should be noted that the concept of fuzzy membership is different from general idea of categorized variables and only has superficial similarity with them. Because they include both qualitative complete membership and complete no membership, are simultaneously both quantitative and qualitative (Ragin, quoted by Sotudeh, 2007: 57-58).

Another difference of fuzzy indicators with classic ones is their gradualness; but it should be noted that the gradation does not mean identity of fuzzy sets with ordinal scale. Graduating is a kind of triangulating outlined unites in reference set or scale of measurement. Units that have an attribute (one degree), units that are lacking attribute (zero degree), and units between them (with degree in scope of zero to one). At first glance this may seem like that three set are similar ordinal or nominal approaches to variables; but given that the third set, the set is not completely lacking and not quite have features, in terms of distance or near the two first sets are divided numerous subsets, it couldn't be reduced into ordinal or nominal concepts in terms meaning

(Qasemi, 2011:22-24). It should be noted that for testing fuzzy models (the most common type are called Mamdani systems) requires quantitative and accurate data that is collected by valid and reliable means (Qasemi, 2011:38).

Ragin believes as fuzzy sets on the one hand like ratio scale has a significant zero (no membership = zero) and on the other hand has a significant and stationary maximum (complete membership = one), membership of fuzzy sets, has a higher level of measurement than conventional ratio scale (a ratio scale with a significant maximum and minimum). However, both have the same purpose (specify membership in a set) (Ragin, quoted by the Sotudeh, 2007: 59).

Ordinal scale is merely classification of categories and usually is considered without reference to external factors such as membership in the set. To measure Ordinal scales, researcher typically does not establish categories for membership degree in sets. Instead, categories only ordered in relation with each other and convert to a classified order; for example, a researcher may make a synthetic five Classes plan of job status and uses it to unemployed people. By usage of a kind of categorization that is ranging from very low to great. It is unlikely that the plan automatic and by reconsideration zero scores, 0.17 and so on to be translated into a fuzzy set with five values. In fact, this method [Classification and making set] is one of ways to conversion or translation ordinal scale into fuzzy scale (Sotudeh, 2007: 59).

4.1.1. Critical review of concepts and indicators in fuzzy approach

As mentioned before, linguistic variables have two different with numeric variables. First, these variables are an intermediary between concepts and values and in addition, instead of membership of the same numbers as their value to them, receive fuzzy sets. Consider concept of speed. If you look at this concept in form of a set, this set has members that their own could become independent or interrelated sets[9]. Number of members of this set depends on its use, but it can be extended to infinity. In the example mentioned above it was limited to three members T = {slow, medium, fast}. If one looks speed in terms of fuzzy, speed is a set with three set members. Since Members are sets, can have its own members and continue ad infinitum, and whenever the researcher feels saturation in terms of accuracy, attributing fuzzy functions instead of single values to final sets.

Suppose that instead of one concept of speed there would be three set concepts of "fast speed", "medium speed" and "slow speed".

[9] Difference of fuzzy and classical sets will be described in the following.

$T_{fast} = \{T_{fast1}, T_{fast2}, T_{fast3}\}$

$T_{medium} = \{T_{medium1}, T_{medium2}, T_{medium3}\}$

$T_{slow} = \{T_{slow1}, T_{slow2}, T_{slow3}\}$

Here T_{xi} are values of speed that could be single or set. As is clear by removing linguistic variable, it was used directly from numerical variables for concepts. Perhaps criticism here is that linguistic variables are not removed, but are used as a concept. In contrast, we could say that linguistic variables are separated as a part of a concept and take an independent role, but if also defines abstract concept of common features of phenomena (objective or subjective), so a linguistic variable whether presented as "fast speed" or as "fast", both are concepts. Moreover, even in terms of abstraction level, they don't have significant difference with concept of "speed". For example, "fast" is a set concept that its fuzziness is in the following form:

Z = {slightly fast, relatively fast, very fast}

What is considered a concept is contractual if it is true in definition, and it depends on expected application of it; so role of linguistic variable is not an intermediary of a new role and it has a clear alternative in classical sets.

It should be noted that zero position in certain series (since is contractual) may vary. For example of zero, membership in certain set of "fast" could be 80, 100 or 150 according to application. In this condition, if you need to take advantage of all these sets, you could achieve function of fuzzy sets without involving to its objections by using separately, not simultaneously, each (with different minimums and zeros), and analyzing its relationship with other variables.

Second role of linguistic variables is that instead of single values receive fuzzy sets. By adoption advantages and supremacy of a set analysis against of correlation analysis[10], it approves necessity of existence of sets rather than single values not necessity of receiving fuzzy sets.

To justify necessity of application of fuzzy numbers which are a kind of function, degree issue is raised. In fact, since assumption of fuzzy logic is conjunction of phenomena, so it needs membership sets of continuous value to describe these phenomena. Apart from anti-intuitive

[10] Verifying authenticity of this claim is not subject of this study. Here fuzzy sets compares with classical sets.

results that arise as a result of adoption of this assumption, given adopting it, there are still problems in usage of fuzzy numbers. According to fuzzy thinkers, since phenomena are continuous, using certain sets leads to simplification of reality and missing data, but does usage of fuzzy numbers resolve this problem?

Reconsider concept of "speed". Assuming set of speed has three members of "fast", "medium" and "slow" and also has zero and one, which fuzzy number is proper to describe membership function of this set? In fact, by accepting conjunction of speed concept, which number, describe pattern and form of this conjunction? , Triangular number, Gaussian, trapezoidal or another number? What is selection criterion? Two criteria can be considered for selecting descriptor fuzzy number: First theory and second accommodation with empirical evidence. According to first criterion, researcher suppositions form of phenomena conjunction based on his/her knowledge. Since data are scattered and thus there is possibility of infinitive analyses[11], however the suspects are expertly, are not valid, moreover it is still possibility of ordering all data on one function near to zero[12]. Furthermore, missing data in using fuzzy numbers based on expert knowledge and theory is certain, but its amount can vary which is discussed below. Second criterion is that fuzzy numbers being selected according to empirical evidence. In this sense, data are limited which arise prior objection, or data are not limited. Meaning of this that data are not limited is that there should be a data for each point on axes to meeting condition of conjunction. On the other hand, data are linguistic that means what is position of people's understanding of each concept. For example, each person's understanding of concept "slow speed" with what value can be expressed. The value is single amount or a set (with special function). In the first criterion, as number of persons is finite and number of points on coordinate axis are non-finite, in terms of measure of all people's understanding of slow speed concept, it doesn't lead to conjunction and there is need to refer to first criterion. In the second criterion, each person also has a mental mode of slow speed concept. All problems mentioned in the first case, here are for every people and therefore counting every person mental paradigm of slow speed concept is basically impossible; it is rare to count a common paradigm to all people.

[11] There are infinite lines to connect two points together.
[12] Logically, it is possible, but in this case also, since there are infinite lost or absent data, it doesn't have any effect on outcome of this debate.

Question that arises here is whether is equal amount of lost data by using fuzzy numbers that have been selected based on expert conjecture with amount of lost information when using certain sets? Answer depends on size (scope) of set. A triangular number (with a breakpoint) is likely to have less lost points than a certain set; but compared to two certain sets (a two criterion function) is not[13]. Of course, it should be noted comparing a triangular number that is a two criterion function with a certain function as a one criterion and linear function doesn't have justification and if a comparison is made it must consider type of functions. It should also be noted that issue of amount of information is presented here only about inputs, while in output of fuzzy models or use of kinds of defuzzification, fuzzy method exactly does what certain method does about inputs; in other words, although fuzzy like certain method misses some information when entering data, it do it in a different way. But when presenting outputs by defuzzification, it doesn't have any difference with certain method even in way of losing data by fuzzy. How to act defuzzification is discussed in fuzzy modeling part below.

Suppose number of certain sets tends to infinity and their scope toward zero, similar to what happens in integral calculation. In this case, the sets are so small that each matches one point (and not data) and totally form a function like a step function with $[0,1]$ scope[14].

That is goal that infinite-valued fuzzy logic follows and it could be attained by using small certain sets without experiencing problems caused by reception fuzzy logic assumptions. Fuzzy claims conjunction, but in practice scope is defined by one or two or more breakpoints that is topic of making more precise certain and is discrete in nature. As long as there is not really conjunction, whatever it becomes more break points, analysis space is still discrete space and there are still shortcomings of discrete space and vagueness is dominated and only discrete space is closer. Issue of become more precise is because fuzzy assumes infinite disconjunction and thus conjunction. So the higher number of points the more precise. However, a fuzzy set, if really has less than a certain set missing data is simply replaceable by making smaller and adding certain sets (without accepting anti-intuition presuppositions); Although, as noted, essentially comparing

[13] If triangular number has one breakpoint in 0.5 it can be defined two certain sets so that point 0.5 being considered for first set 1 and second 0. Of course it must be met condition of functional. It means one side of scope should be open.

[14] That is similar to 'completeness' in fuzzy rules.

number of sets in classic and fuzzy is not correct because of their various functions in terms of criterion and complexity.

As mentioned, both linguistic variables and gradualness of membership in fuzzy sets causes simultaneously both qualitative and quantitative potential of analysis of phenomena (social). Ragin (2000) and Saei (2010, 2014) by using fuzzy method have combined variable-oriented and case-oriented approaches in social sciences. While there was trying to combine qualitative and quantitative approaches in advance and for example, Skocpol (1998) in his book "States and Social Revolutions" see her reading of comparative method successful to combine two approaches of nomothetic and idiographic and carried her research based on it[15].

Qasemi believes "human life, social relationships and related phenomena have qualitative and nonnumeric nature." (2011: 20). As well as sociological concepts and structures are qualitative in nature (2011: 21). Philosophy of linguistic variables was because of verbal nature of theories. In fact, on the one hand nature of social phenomena is qualitative and on the other hand concepts and theories are also qualitative; so not only one should use qualitative and nonnumeric indicators to measure qualitative concepts and phenomena, but there isn't other way and one can't use quantitative and numbers variables. For example, suppose A> B and A> C. Here, there is no relation between B and C. By giving a numerical value to concepts of A, B and C, there is unconscious relationship between B and C, while in fact this relationship is not established. Many phenomena or modes of phenomena have ordinal relationship with each other and so one can measure them with numeric truth; but there isn't this relationship among many of them and there is a so-called tree relationship in which to measure them one need nonnumeric truth. By presenting illusion of spatial and linguistic dimensions of intelligence, Williamson shows that to maintain independence of dimensions even by not applying an contractual weighting, one can't use numeric degrees and must use nonnumeric degrees; because these dimensions are essentially incomparable and sees semantic theories about nonnumeric truth halfway (see Williamson 2001: 131-135). Fuzzy logic inevitably requires numerical grades for gradualness, and the problem of fuzzy logic in measuring phenomena is qualitative in nature.

It should be noted that in the literature, qualitative and quantitative terms in order to three purposes are used.

[15] It should be noted that in case-oriented and variable-oriented approaches more than issue of quality and quantity, discussion is over possibility of generality otherwise case-oriented studies also use tables and statistical data.

1. Nature of phenomena. Here qualitative phenomena mean nonnumeric phenomena; it is impossible to measure them by numbers because there is not ordinal relationship among them[16].
2. Categorization. Here quantitative phenomena that have been measured using quantitative variables are categorized. In fact, in the same kind linguistic variables do the same classifying although using fuzzy sets and functions. Fuzzy thinkers, as stated, strongly denies the identity of categorization in certain ways and what will be done by using linguistic variables in fuzzy sets; but they do not offer a good reason. For example Qasemi (2011) see existence of third set and its subsets as prevention of its identity with ordinal or nominal concepts. While with independence of each subset in the third set as a set along others and increasing their number, ultimately we will have the same nominal and ordinal concepts. It should be noted that quantitative phenomena are not measured by qualitative indicators but with quantitative indicators and finally have been named with concepts that there is ranking among them. Another point is that categorizing quantitative criteria does not need any concept has single value, but it will be a scope.
3. Membership and not membership in sets namely significant zero and one. Fuzzy logic through "fuzzy sets, combines of qualitative and quantitative measurements in a single tool. All fuzzy sets consist of two qualitative modes, complete membership and complete not membership and all quantitative variability (diversity) that there is between the two qualitative situations."(Ragin, quoting by Sotudeh, 2007: 45). Fuzzy sets not only have a significant zero point (not membership = zero) as ratio scale, but also a significant and constant maximum (complete member = one). In light of this understanding one could argue that membership of fuzzy sets, shows measurement levels higher than conventional ratio scale (a ratio scale with a significant maximum and minimum). However, goal of a fuzzy set is in line with objective of nominal scale (specifying membership in a set) (Ragin, quoted by Sotudeh, 2007: 59).

[16] It should be noted that numbers means not only natural numbers set or sets that are expressed in numeric, but all sets that meet condition of counting possibility. These sets can have nonnumeric symbolling and at the same time are counted; there could be ordinal relationship among members of the set. By considering existence of extensive sets for numbers, it is unlikely could find a phenomenon which doesn't have possibility of describing these sets. But, however, if one couldn't give an example to refuse this claim, there is no longer exclusion of this specific definition of quantity and quality and simply the definition does not say important thing because it can't differentiate and all phenomena can be considered quantitative.

Contrary to what Ragin argue, ration variable with zero and one means complete membership and not complete membership. For example, in variable of speed, $V = 0$ in fact, represents station and not complete in speed set and $V \neq 0$ represents a complete membership. It should be noted that value of one has two meanings in fuzzy. First meaning is greatest member and second belonging to the set. Combination of these both signifies one into maximum of belonging to the set. In fact, admission nature of gradient membership in a set causes this meaning. While in certain sets as incomplete membership doesn't have meaning in set, so maximum of belonging to or membership in the set is meaningless. But by dividing members of the set on $V \max$, one can limit amount of members in $[0,1]$ scope. Furthermore complete membership in certain sets and also in what ratio scale measures is represented with not zero. Moreover, meaningless of one for maximum of belonging to set as essentially has not defined in certain sets, is not considered a deficit for it and an advantage for fuzzy method.

Fuzzy method tools namely making variables linguistic and gradient, and have clear alternatives in classical logic and don't create new capacity in outlined concepts and indicators and also measuring social phenomena. It is not also a step ahead of certain method in combining quality and quantity. Fuzzy is not loyalty to philosophical assumptions and establishment of conjunction condition and does not go beyond of possible kinds of modifying disconjunction in certain method.

4.2. Fuzzy mathematics

In framework of classical mathematics, fuzzy mathematics has formed. although, the four main actions, as well as numbers, have taken a different definition, since these definitions also relies on classical mathematics, one could be argued that foundation of fuzzy mathematics is the same classical mathematics. Detailed and conceptual examination of this mathematics (for example, concept of summation in fuzzy and conformity with intuition) is an interesting subject that is not within scope of this research[17].

4.2.1. Fuzzy sets

[17] What is named fuzzy mathematic, more than "Mathematics", is applied techniques that has been formed under classical mathematics.

A fuzzy set A is determined in global space of U by a function $\ll_A(x)$ that takes values in a scope of $[0,1]$. A classic set can only have two values zero and one while membership function of a fuzzy set is a continuous function in $[0,1]$ scope. A fuzzy set A in U can be presented with a set of arranged couples of X and their membership value:

$$A = \{(x, \ll_A(x)) \mid x \in U\}$$

Three important points on fuzzy sets:

- Properties and features that a fuzzy set is used to specify members are usually fuzzy. For example, "the number close to zero" is not an accurate description; so we can use different membership functions to describe a same characteristic. However, membership functions are not fuzzy, but are exact mathematical functions.
- In general, there are two ways to determine membership functions. First solution is using knowledge of experts. This means that we want experts determine appropriate membership functions in field of their knowledge and expertise. Because fuzzy sets are often used for formulating human knowledge, membership functions are representing part of human knowledge. Usually this solution can only be a naive formula for membership functions and to use it, it should be set and adjusted. In second solution, we use collected sets to determine membership functions. Specifically, we first determine structure of membership functions then set parameters of membership functions based on collected data accurately.
-Each fuzzy set has a one by one corresponding with its membership function. This means that when we say a fuzzy set, there is only a single membership function corresponding to it, and vice versa, when we provide a membership function, the membership function displays a fuzzy set. So based on this notion, fuzzy sets and membership functions are equivalent (Wang, 2013: 21-26).

4.2.2. fuzzy operators

If A and B are fuzzy sets that are defined in the same world set, so there are different operators to compliment, intersection and union of these two sets. While in non-fuzzy sets, there is only operator for compliment, union or intersection. Possibility of not being satisfied in some circumstances is reason of need to other operators in fuzzy sets. Different operators have some axioms. Every function that these axioms are true about it can be used instead of the specific

function; for example, there are two classes of Yager and Sugeno for fuzzy compliment. Also for fuzzy union, there are different s-norms that satisfy the axioms such as Dombi class, Dubois-Prade class, Yager Class, Drastic sum, Einstein sum, algebraic sum and maximum. There are S-norms corresponding to t-norms and vice versa, so corresponding with Dombi class norms, Dubois-Prade and Yager s-norms, there are t- norms of Dombi class, Dubois-Prade and Yager as well as multiplications of Drastic, Einstein, algebraic and minimum (Wang 2013: 31-45).

These functions are all expansion of union concept in non-fuzzy sets and they become all the same when membership values limit to zero and one.

4.2.3. Fuzzy (numbers) functions

Functions fuzzy, especially in two fields of fuzzy inference systems help social researcher. One field when determining membership degree of a study case in a fuzzy set based on the case score of a particular variable and the other when defining fuzzy sets for input and output variables in a fuzzy inference system (Qasemi, 2011: 93).

Actually available Functions and used of fuzzy are step membership function, S-shaped Membership Function, Triangular-shaped Membership Function, Gaussian-shaped Membership Function and Trapezoidal-shaped Membership Function.

4.2.4. Critical and conceptual review of fuzzy mathematics

One of the actual weaknesses of the fuzzy research is unclearness of extent of fuzzy logic influence on that research. For example, many of fuzzy researches see sufficient only usage of fuzzy numbers in determining set for making research fuzzy and in fact have minimum view to fuzzy and in contrast, some of other researches add a fuzzy suffix to all mathematics factors and so have a maximum view to fuzzy. With regarding quoted arguments, it is known that second view is a correct view, and if you accept using fuzzy logic, it is essential to use it in all stages. It is possible by using simultaneously both fuzzy numbers and four main fuzzy operators.

Another point is, as mentioned, that using fuzzy functions and more importantly results of fuzzy functions are highly dependent on opinions of experts. In other words, it seems that more than realities forming expert opinions, ideas shape reality and impose on them. For example, in trapezoidal function, it is needed to determine 4 variables based on expert opinions in structure of function. Errors and deficits of the view were discussed in previous section (concepts and indicators) and those criticisms are also relevant here. The basic objection of fuzzy logic to classical logic was vagueness of boundaries of some concepts, and thus inability to determine the

membership definitely and distinctly. While if in certain set there is one time[18] certain delimiting for each set, in fuzzy there are times and times that the delimiting and decisive judgments are done by determining scopes and breakpoints.

As mentioned, not only fuzzy functions (numbers), but the main operators of union, intersection and compliment have present actual alternatives in fuzzy itself, and can be increased potentially. But what is criterion of selecting and making prefer one of these functions or operators on others? For example, why one must use Yager class t-norm and in another use multiplication of Drastic or Minimum? Qasemi (2011) and Wang (2013) have mentioned to vague concepts _which initially need to clarify _ such as more consistency, meaning more and more applications of a number or operator in study of particular phenomena as selection criteria. But they have not said anything about what are diagnosis features and criteria of these things. Regardless of nature of these concepts and how to recognize, with a general understanding of these concepts, it becomes clear that these three characteristics are not often distinctive of fuzzy numbers and operators, while these numbers and operators are not also measurable with empirical test. For example, one can't approach to a specific result by empirical test and scattered data (points) about appropriateness, concept and application of three triangular, Gaussian and trapezoidal fuzzy numbers because of their proximity (similarity) to each other. It should be noted that if these numbers has small differences in the results, this difference couldn't be ignored because depending on dominated relations and criteria on the concept (and in macro level of analyzing phenomenon) as well as necessity sensitive and accurate, little difference may lead to big difference in result; so it is important that which fuzzy operators and numbers used in analysis of a concept. About three fuzzy numbers mentioned above as example, obtained numbers can have little differences that cause each number has the same meaning, appropriateness and application and one couldn't argue in favor of one. Given that empirical test also couldn't help, it is only criteria of taste that cause selecting a fuzzy operator or function.

Shortly, there is no specific and distinctive criterion in selecting fuzzy operators and functions, and selecting and using them is more followed by researcher opinion and subjectivity instead of a specific rule or objective evidences.

[18] As in a certain set membership degree is meaningless, by determining boundary of membership and non-membership, another state is determined automatically.

4.3- Fuzzy modeling

Basically fuzzy systems describe uncertain and vague phenomena, fuzzy theory, however, is an accurate theory. In this article, there are two types of justifications for theory of fuzzy systems:

- The real world is much more complex than we could obtain a precise description and definition for it, so it should be introduced an approximately description or the same acceptable and measurable fuzzy for a model.
- In era of information, human knowledge is very important; so we need a hypothesis that could formulate human knowledge systematically and put it alongside other mathematical models in engineering systems.

First justification is correct, but it would not cause a distinction between fuzzy systems with other systems. In fact, all theories describe real world in a proximate way; for example, in reality, all systems are nonlinear, but almost all studies and analyses about systems are linear. Second justification describes a single characteristic of fuzzy systems and justifies existence of fuzzy systems theory.

In practical systems important data come from two sources. One of sources is experts that define their knowledge and cognition about system by natural language. Another source is mathematical measurements and models that are derived from physical rules; so an important issue is combining these two types of information in designing systems. Transformation of human knowledge into a precise mathematical formula is basically what does a fuzzy system (Wang 2013: 1-2).

Input, fuzzy rules and output, each one constitutes one main component in a Fuzzy Inference System. A Fuzzy Inference System (FIS) can be considered a set of fuzzy input or inputs, fuzzy rules and fuzzy output or outputs (Qasemi, 2011: 143-144).

4.3.1. Inputs and outputs

Initial inputs of a fuzzy system are exact values that are provided based on valid and reliable measurements; so it must not be assumed that approaching quantitative and qualitative models in fuzzy modeling reduce importance of precise measuring variables in social studies (Qasemi, 2011: 168).

In social research, input is mainly a complex of variables or concepts that researcher based on theoretical studies, literature, interviews with experts and himself/herself ideas, select them and would like to show how different combinations of these variables could play a role in forming or

intensity and weakness of an (or several) other phenomenon. It is necessary to define determiner function of membership degree in a fuzzy set separately. It is also possible to use different membership functions to define fuzzy sets associated with an input variable used (Qasemi, 2011: 143-144).

Scope and number of fuzzy sets directly related to researcher assumption of accuracy of expert or experts who participated in interviews about using of terms such as always, never or rarely or terms such as, very little ,very much, medium or little (here are called fuzzy numbers). The more precise research hypothesis is based on, can reduce this range more (Qasemi, 2011: 155).

Outputs like inputs are fuzzy concepts which consist of a number of fuzzy set in role of its different levels (Qasemi, 2011: 145).

4.3.2. Fuzzy rules

Logic is methods and principles of reasoning, and reasoning means obtaining statements and new results from current statements and clauses (Wang, 2013: 88). In part of fuzzy rules, fuzzy like other parts such as sets, operators and so on, has different rules with classical logic which often have derived[19] from development of classical logic rules and infer relations that sometimes are not valid in classical logic.

Fuzzy systems are knowledge-based or rule based-systems. Heart of a fuzzy system is a knowledge base that is made of fuzzy if-then rules. An if-then fuzzy rule is an if-then statement that some words are marked by continuous membership functions (Wang, 2013: 2).

Wang considers table of if-then rules in fuzzy logic as intuitive and sensory criteria because it does not correct for a particular fuzzy set and names it approximate reasoning. He believes measures are not absolutely true; however, they give us an idea and should be considered as a guide to design a specific inference. Using synthetic rules of inference one can determine conclusion membership functions from premise membership functions (Wang, 2013: 95).

4.3.3. Fuzzy systems

Starting point of constructing a fuzzy system is to obtain a series of fuzzy if-then rules from expert knowledge or knowledge of studying field. Next step is combining these rules in a single system. Different fuzzy systems use different principles and methods for synthesis the rules.

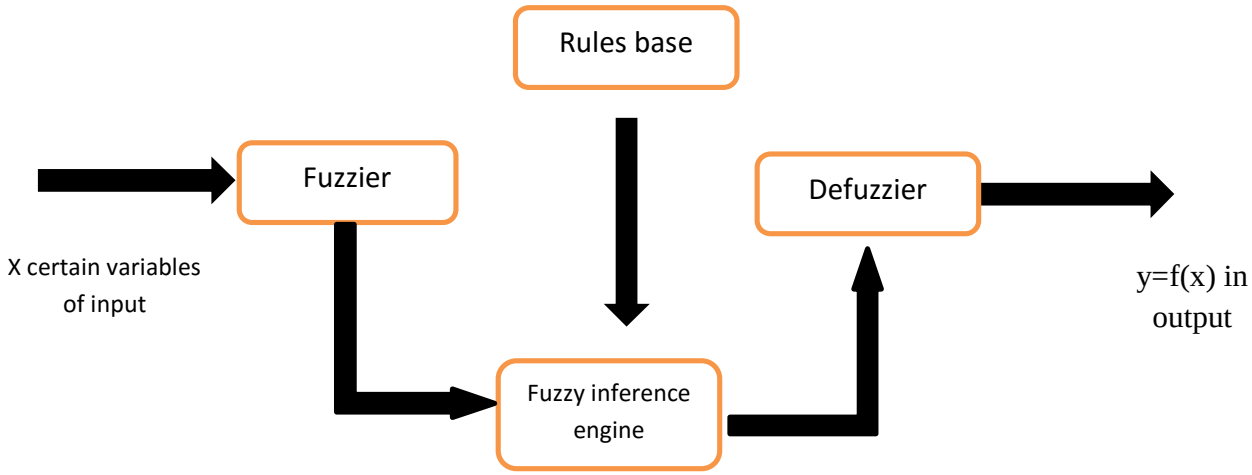
In books and articles often spoken of three fuzzy systems:

[19] Such as generalized modus ponens rules, generalized modus tollens and generalized hypothetical syllogism.

1. Net Fuzzy Systems
2. Takagi-Sugeno and Kang (TSK) Fuzzy Systems
3. Fuzzy Systems with fuzzier and defuzzier

Net and TSK fuzzy systems have their own problems that hinder using them. For example, as output of net fuzzy systems is a fuzzy set and not an exact value, one couldn't easily use them for planning and policymaking; thus Mamdani[20] systems are used. These systems have a fuzzier in input which transforms variables with real values into a fuzzy set and a defuzzier which transform a fuzzy set into a real variable or value in output. This fuzzy system blankets disadvantages of Net and TSK fuzzy systems and our meaning of fuzzy systems is the latter type.

Basic Structure of Fuzzy Systems with Fuzzier and Defuzzier



In one hand, fuzzy Systems are maps as some inputs and one output of a vector with real values into a scalar whit real values (multi-output map can be created by synthesizing several one output maps) that precise mathematical relations of these maps are measurable. In the other hand, fuzzy systems are knowledge-based systems which are made in form of If-Then rules. An important aspect of fuzzy systems theory is that a systematic process provides for transforming a knowledge base into a non-linear map. Because we could use mathematical models, so analysis and design system can be done as a dry mathematical model (Wang, 2011: 4-7).

[20] Name of these systems has been getting from Ebrahim Mamdani. An engineer of Queen Mary College, London, showed the first application of fuzzy sets presented by Lotfali Aliasgharzadeh in industry early 1970s.

Fuzzy Inference Engine

There are two ways to concluding from a series of rules, inference based on synthesizing rules and inference based on separate rules. In inference based on separate rules, each rule in fuzzy rules base determines fuzzy output and final output is a synthesizing of M separate outputs of fuzzy sets. Synthesis could be done by union or intersection.

There are several choices for fuzzy inference engine. In particular we have the following options:

1. Inference based on synthesis and Inference based on of separate rules and among synthesis-based inference, Mamdany or Godel inference.

2. Dienes-Rescher entailment, Łukasiewicz entailment, Aliasker Zadeh entailment, Godel entailment or Mamdani entailment

3. Different Operators for S-norms and T-norms

In general, there are three criteria for selecting inference engine: existence of intuitive sense, computational efficiency and specific characteristics of particular engines. Product inference engines, minimum, Łukasiewicz, Zadeh and Dienes-Rescher mainly are used (Wang, 2013: 117-122).

Fuzziers and defuzziers

Fazzier is defined as a map of a point of $X^* \in U \subset R^n$ to a fuzzy set A' in U. Criteria of designing fuzzier include high membership of certain data in input, omitting Noise and simplicity of calculation. Singleton, Gaussian and triangular fuzzier are used more in the research.

Defuzzification means transforming fuzzy set resulted in concentrated output (into a single and accurate value. Defuzzification is possible in different methods. Three criteria could be considered for selecting defuzzier: justifiability, simplicity of calculation and conjunction. Here are mainly used famous defuzziers: center of gravity, center average and maximum.

We saw there are numerous options for fuzzy inference engine (particularly five types of engines), fuzzier (particularly three types) and defuzzier (particularly three types); so by combining different types of engines, fuzziers and defuzzifiers, we could have $3 \times 3 \times 5 = 45$ types different fuzzy system (Wang, 2013: 135-147).

4.3.3.1. Critical review of fuzzy systems

Wang (2013) states two justifications for using fuzzy systems. First justification _as he believes_ is also true about certain systems and therefore is not an advantage for Fuzzy Systems. But second criterion that he believes cause justifying fuzzy systems instead of certain systems, is

possibility of synthesizing human knowledge or in his reading "knowledge of experts" with mathematics measurements and models and in other word formulating human knowledge. It mentioned in concepts and indicators part that fuzzy resolution to formulating human knowledge is using language variables. Linguistic variables had two features. First mediating between concepts and numerical variables, and second taking fuzzy sets instead of single values as a value. It mentioned that first feature is become unjustifiable by using certain sets as number as fuzzy subsets (namely excluding fuzzy subsets within the set as independent sets) and second feature is only justifies using the set instead of single values not necessarily fuzzy sets. So, linguistic variables basically do not create new capacity in using concepts and indicators.

The question that arises is how does fuzzy provide possibility of formulating human knowledge and the possibility becomes characteristic and justification of using fuzzy systems. It may be a question raised earlier stage. Was it impossible for certain systems to use human knowledge and somehow formulating human knowledge? As Wang says in practical systems, information, originates from two major sources. One of them is human knowledge about the system and another mathematical measurements and models[21]. Using methods such as AHP, Delphi, structured, semi-structured and unstructured interviews and so on in development of certain models represents using knowledge of experts and professionals or human knowledge in the research with certain models. Even methods seemingly separated of human knowledge like Regression or Correlation as there is theory and selecting variables and constructing model by researcher and theorists, are a kind of formulating human knowledge.in other words, all the certain research use human knowledge because of using theory and model, and otherwise methods like ones were mentioned, is dedicated to using and formulating knowledge of experts and professional. So answer to the former question is negative. Certain systems are also engaged in formulating human knowledge. We can argue that given accepting formulating human knowledge in both methods, the fusion is more in fuzzy method. The argument is based on the assumption that in certain systems because of using double division of zero and one, there are a lot of missing data; while in fuzzy systems by using infinite-valued logic there is no missing data or at least less than certain systems. In parts of concepts and indicators I showed that this claim

[21] This division is not very accurate. Due to dialectical relationship between the two sources and not engaging in vicious circle, researcher have to choosing one of these two –in terms of epistemological approach- as an independent variable; so in a more deep view, there are no two sources and one is affiliate to another, so basically combining of these two is not justifiable. Here the mentioned division is accepted.

more than be based on reason is based on a superficial and inaccurate view on fuzzy and classic methods. So second justification of Wang is not also justifiable for using fuzzy systems and doesn't lead to difference with certain systems and even improve it.

As stated, inputs and data are precise and certain in fuzzy systems and by using fuzzier become fuzzy functions. Justification of using fuzzy functions was inaccurate and vagueness of concepts and impossibility of their classification. It is clear that before collecting data, we need use concepts and scaling them and date are collected based on the same concepts and their indicators. But why it is possible to collect and exact classification of data in this stage and not in the next stage and in next stage there is need to making concepts fuzzy? The question fuzzy thinkers must answer.

In fuzzification, in fact, researcher executes a conjunction model for data that doesn't allow them to empirical measurement, at least, among proximate models. But this is objection of any model, whether certain or fuzzy. However, in certain model the practice happen just one time and at the time of basic modelling, while in fuzzy occurs twice, once when fuzzification and again at the time of basic modelling.

Qasemi (2011) with giving an example on vague concept of "average", describes how valued the concept by fuzzy functions. He says, for example, one can't value exactly value of three for the concept that has been used by experts; because they have given nearly different meanings which are in a scope. The more range the scope that is determined by the investigator, the less accuracy of experts in using the term and vice versa.

For the concept of "vagueness" two senses could be considered. One is that because of lack of knowledge, border of concept or phenomenon is unclear and other that border of phenomenon or concept because of not having clear boundary is unclear. According to what was said about ontology and epistemology of fuzzy logic, it is clear that fuzzy meaning of the concept of "vagueness" is this latter sense. Fuzzy practical models have not been faithful to the philosophical patronage, because it is impossible and due to realization of zero and one concept in infinity, there is no possibility to measure and somehow it is simplified. It means fuzzy concepts and variables have certain and specific zero and one.

On the other hand, it must distinguish between accuracy and semantic union of concepts. Shortness of range means much semantic union among people while accuracy means less error in space between common meaning among individuals with meaning itself. Scope means accuracy

just when concepts are subjectively and contractually intersubjective. Because if they were objective, become measurable and so accuracy is a distance with meaning itself, not common subjective meanings range and if it is individual subjectivity and contractual, determining range in sense of accuracy is meaningless.

Suppose "social capital" variable to be measured in Iran. A five-point scale of very little to very much is considered. Experts whether speak about "social capital" variable and amount it in Iran or give a particular score. Result of the expert opinion poll becomes 'average'; namely outcome of talks with experts is that "social capital is medium in Iran." Now scholar or expert should determine that "the average social capital" include what scope. Here question is why an expert should determine this domain. The answer is that specialist has expertise and knowledge on the subject; but another question that arises is that what is expert knowledge about exactly? On "social capital", "medium social capital", "other experts ideas about social capital" or" other experts senses of medium social capital "? it seems that answer is in two first options while to determine range of "medium" concept there is need to have expertise in two latter options and only way to become skillful and expert in this field is access to mind of experts and using intuition and telepathy. There is no criterion to determine these domains.

Consistency is not essential condition in fuzzy systems. For example, higher education at a high level and low level of materialism may lead to both high cultural intelligence and low cultural intelligence. If there is the same load for both of them, result of fuzzy system is that higher education at a high level and low level of materialism lead to medium cultural intelligence (the number that its membership in average cultural intelligence set is one). It is clear that the interpretation is not come from the theory. In fact, fuzzy systems do not show theoretical incoherence and weakness of theory and interpret it arbitrarily (here mean operation). It is obvious that such a theory is opposed to intuition.

Fuzzy rules are not absolutely correct. That is why it is called approximate reasoning. But what are appropriateness criteria of rules with considered fuzzy sets? What Wang greatly emphasized is consistency of the rules with intuition. Intuition is a good criterion to verify authenticity of rules. But it must be considered that don't apply everywhere, especially in border situations. In other words, intuition is good for extreme moments and its authenticity is as clear as that is not deniable. After that one must move by unassailable argument toward the border which includes

the disputed states. It means in border situations, intuition is the same contractual interpretation criterion that one couldn't argue about its approval or denial.

Wang consider intuition as main criterion of fuzzy rules, inference engines, fuzziers and defuzzifiers which describe it sometimes as justifiability and sometimes meaningfulness. Of course, he does not specify that the comparison of justifiability or meaningfulness occurs is only among fuzzy inference engines or it also needs to be done with defuzzifiers engines. However, it seems that intuition criteria or simplicity of calculations are appropriate criteria. But it also must be payed attention to its limitations and their use conditions, and even ranking them in terms of each other. While indicators of calculations simplicity should also be checked and determined. This is especially true about defuzziers. In fact, defuzziers introduces a number as representative and recommender of a scope that calculating the recommender is dissimilar in different defuzziers. In other words, defuzziers act in a way that was causing criticism of certain methods and classical logic: Choosing a number as an introducer and representative of a scope of numbers that cause missing of information. However, if it is to happen simplification that sometimes is necessary, this simplification should be methodical and in order to relation of defuzziers with reality. The key point here is that how proposed criteria how can deifferientiate and remove undesirable systems to study a special fuzzy set. In other words, to study a fuzzy set, how many actual possible combinations remove and remain of actual possible combinations 45 in fuzzy systems by implementing the standards (given possibility of creating distinction)? Is the result of remaining systems are not different from each other? If so which result is accurate and reliable?

Number of operators, rules of inference and so on arise also the question that given the differences, whether is possible compare results of two surveys that have been conducted in fuzzy method? And whether science does not lose its cumulative nature? For example, in classic method, there is no question about calculating mean, standard deviation and any other mathematical operation, and just scrutinize and compare results. While in fuzzy one must initially determine operator for the smallest and most elementary operations. First it should be noted because fuzzy cause no limitation in order to using different operators and so on and also variability of them during process a research except what mentioned and it stated that the criteria don't make distinction let alone detail. So infinite possible combinations are actually created for a fuzzy research method that makes it impossible to compare results of researches unless the

fuzzy researcher, first agree about using specific operators and secondly do not use possibility of various variability of the same operator during a research process.

Fuzzy Systems are not more powerful than certain systems in formulating human knowledge. As well as experts ideas are been too unconventional and unfounded involved in designing and solving the systems which originate to some extent of lack of clear criterion in choosing components of the system like defuzziers and so on. In fact, lack of clear and distinctive criterion allows the researcher imposing personal taste in research process.

5. SUMMARY AND CONCLUSIONS

1- In every knowledge set, logic of the set is firmly related with other parts of the set in a way that changing in it causes extensive changes in other components. This is also true for fuzzy logic. This research was trying to study the outcome of a change of logic classic into fuzzy on three parts of assumptions, methods and results according to three criteria of objectivity, internal consistency and goals realization as primary and essential criteria of a scientific method.

2-It seems that fuzzy logic lacks basic features of a scientific method. Two general objections of non-objectivity and more important inability in realizing goals as well as lack of internal consistency are of reasons for the argument. On the other hand, it seems that the second objection, namely inability in realizing goals is intrinsic in this logic and does not resolve only by deviating of assumptions and principles of the logic (the reason of its emergence).

3- The first question of the article was "what are changes caused by changing classic to logic into in assumptions, results as well as the main components of method, namely concepts and indicators, modeling and mathematics". Fuzzy logic, in assumptions has different ontology from classical logic and believes conjunction between phenomena. It views also possible the laws of Contradiction and Excluded Middle. Fuzzy logic requires a different epistemology in a way that statements are valued an infinite. The analysis process of results in fuzzy logic is related to membership function and membership degree of the answer. In methodology, fuzzy logic also cause several changes which the most important of them are: using linguistic variables, gradualness of membership in sets, using multiple formulas for fuzzy operators such as compliments, union and intersection, using multiple fuzzy functions for inputs and outputs of system, using multiple and sometimes inconsistence rules and also inference engines, various fuzziers and defuzziers.

4- Another question was, "Are these changes have led to realizing fuzzy logic goals? In other words, does fuzzy logic could have solved ascribed deficiencies to classical logic?" as claimed by fuzzy logic, problem of classical logic is disjunction[22]. Despite claim of fuzzy logic, the logic is actually due to realization of concept zero and one in an infinite, and impossibility of its operationalizing come to determine breakpoints for a concept and is not loyal to its ontological assumptions. In fact, fuzzy logic has not been success in solving the problem.

5- Another question of the research was "Does fuzzy logic has not led to emergence of new problems? What are the problems?" new problems that Fuzzy logic creates include internal inconsistency and explanatory heterogeneity.

6-as well as, the results affirms this claim of the study that " using fuzzy logic in social studies not only has not resolved ascribed deficiencies to classical logic but itself has caused emergence of some problems and other methodological deficiencies".

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[22] Another problem of classical logic is in relation to disjunction is vagueness. Fuzzy logic has not achieved a success in solving vagueness more than classical logic and only has been transferred it from one level to another. In other words, fuzzy logic is deal withed higher vagueness (for further details see Williamson, 2001: 128).

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