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Multiple Axiomatics Method and the Fuzzy Logic

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ABSTRACT

This paper is about the classic methods which are used in the analysis of economics. Therefore in this work are submitted the most common methodological approaches, which are used in economics. Thence, the terminology of axiomatic methods is scrutinized extendedly in this paper. Hence, the multiple axiomatics method is an improved model of the classic form of the Axiomatics Method. This means that the multiple axiomatics method uses repetitions to its structure to succeed to have more accurate hypotheses and finally better results. The fuzzy logic shows that behavioral economics and neo-classical economics are plausible to have simultaneously the rationality of neo-classical models and the imperfection of behavioral economics in a full agreement between assumption and results. The generator has a key role in the development and application of fuzzy logic to the models.

KEYWORDS: *multiple axiomatics, fuzzy logic.*

1. Introduction

In this section are described the fundamental principles of Axiomatics and the Q.E. method. The axiomatics stands on the assumption that we don't know the result of one hypothesis. This is the key to the scrutiny of an economic theory that is under examination. The hypothesis of an economic theory is the basis for the further study of each economic model that is under examination. Therefore, the axiomatics are trying to answer the background of an economic analysis and to confirm that the initial hypothesis of the model is satisfied. If the hypothesis is satisfied then the model is consistent with the principles of the model that is under examination. Thence there are two cases for the results of the axiomatics. According to the first case, the axiomatics are satisfied because the hypothesis of the model after the examination of the model is satisfied. The second case is about the incident that the axiomatics are not satisfied, because the initial hypothesis of the model is not satisfied. Therefore, in this case, we conclude that the economic model is not sufficient. Then, the main concept of axiomatics stands on the correspondence of the initial hypothesis to the mathematical and economic result of the scrutiny. Since is plausible for the scientist to clarify the theory about the chosen model.

The concept of the Q.E. theory is based on a methodology that stands on the determination of mathematic equations subject to conditions that are also considered (Miljand, 2020). One more important thing is the determination of the upper and the lower limit of the values of the independent variables. Forasmuch as, the dependent variable represents the behavior of the selected model, pending on a generator which produces random values to all the independent variables to configure the interaction between them and their behavior under different conditions. At least the basic study includes two facets which are:

- The analysis of the behavior of the model stands on the scrutiny of the structural characteristics of each model accordingly allowing with that way the extraction of general conclusions about the model which is under examination.
- The frequency analysis behavior scrutinizes the behavior of the dependent variables, but from the view of the number of appearances of a variable than another, estimating the impact that one independent variable has with one or more other independent variables.

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The dependent variables are these which are modified for the generator. Thereupon, the generator produces values for the dependent variables. The extracted values of the generator allow the creation of magnitudes, which are the base for comparisons, and for the analysis of mathematical equations. In that way is plausible to quantify quality data and theoretical terms. Moreover, according to this methodology, the created magnitudes allow us to proceed furthermore to econometrical analyses. In general, is a methodology for the quantification of quality data. Thus, using the Quantification of Everything (Q.E.) methodology is plausible to clarify the behavior of any model and to determine its standalone behavior, or its comparative behavior, between different models. Therefore, this methodology as an index permits the study of the following issues:

- Is possible the scrutiny and the examination of theoretical themes, from a qualitative analysis to a quantitative analysis.
- The creation of magnitudes can be used for any other analysis using that data as an axis for further estimations with different scientific tools, and sciences.
- Consequently, the created magnitudes permit an econometric analysis.
- These units initially if not determined are "virtual units". The term "virtual units" means that are used only for each study and for comparability analysis.
- This methodology of transformation of quality data into quantitative data allows a completely different approach to theoretical studies, as it permits the mathematical determination of terminologies and the study of them in a different scientific field.

Hence, the Q.E. methodology follows as index four basic steps. These steps are described in the next units.

The fuzzy logic represents the relationship between precision and uncertainty. As the uncertainty in a theme is high, then less precise we can be in our conception. A binary logic admits only the opposites of true and false, a logic which does not admit digress of truth and there are no variations in magnitudes, but only two possible results. As more complex a system is, the more imprecise or inexact the information that we have about the system (Ruiz *et al.*, 2017; Challoumis, 2019b, 2020, 2021). Aristotle mentioned that "It is the mark of an instructed mind to rest satisfied with that degree of precision which the nature of the subject admits, and not to seek exactness where only an approximation of the truth is possible". So, Aristotelian logic does not admit imprecision in truth.

However, Aristotle's quote is so relevant to the approach that admits uncertainty. The theme is the balance between precision the uncertainty in a concept(Gabbay, 1996; Páez, 2009; Foster E. J.; Greer J. & Thorbecke, 2010; Foster, Greer and Thorbecke, 2010; Amigó *et al.*, 2018; Kolosov, 2022).

The case of imprecision comes up from physical processes upon imprecise human reasoning. Requiring precision in engineering models and economics means high costs and long lead times in production and development. So, considering the use of fuzzy logic then ponder the need for exploiting the tolerance for imprecision. According to the traditional view of science, uncertainty represents an undesirable situation and must be excluded at any cost.

Max Black referred to vagueness, where the possible states are not clear (Boland, 2014). His essay in 1937 known as "Vagueness: An exercise in logical analysis" presented some remarks by Plato about Uncertainty in geometry. Bertrand Russell in 1923 pointed out that "all traditional logic habitually assumes that precise symbols are being employed". So, follow some proposals.

2. Methodology

The methodology of the current papers is based on historical sources and logical analysis from the Axiomatic Method to the application of the Quantification of Everything (Q.E.) Methodology. This method is used for the first time in the case of methods of controlled transactions, because there is

black money, and only by use of the Q.E. method is plausible to convert a quality and mathematical approach into quantitative results, as black money is not identifiable to make a specific hypothesis (Beer, 1995; Challoumis, 2018b, 2018c, 2018a, 2019b). Then the Multiple Axiomatics Method – Q.E. method solves this problem (Lal *et al.*, 2018; Challoumis, 2019a).

3. Consistency, contradictions of Axiomatics, completeness, weakness and independence of axiomatics

The consistency of Axiomatics is placed on the consistency of the hypothesis. The interpretation is that the hypothesis and the axioms used in the economic model are fine with the proposed theory. The consistency pends on the result of the economic analysis. If the conclusions satisfy the initial assumptions of the economic model, then the theory exists, otherwise the theory doesn't exist. Forasmuch as the proven connection between the hypothesis and the results is crucial for the definition of the theory. If there is not any connection, means that the scientist should reexamine some things and reestablish the theory appropriately.

The contradictions are the spot that the theory and the analysis of the economic model need reform and therefore the scientist should reconsider the assumptions or the data which uses for the study. Thence, the classic instance is that used a system of equations for the scrutiny of the economic model. In most cases, some more conditions support the system of equations that are under examination. If the results do not comply with the mathematical structure of the model in combination with the theory, thence we have a contradiction. Whilst there should be adjustments on the theoretical background or the mathematical conditions used in the economic model. If there we obtain that there are adjustments needed to the model, then there we have contradictions. The contradictions are between the hypothesis and the results of the economic model. Then, the two more classic ways to readjust the system of equations of the model is by the addition of more conditions, or subtraction of some conditions. Forasmuch as the economic model could be consistent if there are modified conditions that are used in combination with the equations of the analysis.

The term completeness of Axiomatics in an economic theory is about the uniqueness of the solutions that are derived after the analysis. Thence, we mean that the system of equations used in the economic model should give a different result when changing the input values to the system. This makes the economic model complete, as the results are unique according to the changes in the variables. Thus, if there is the same solution with different inputs to the model, probably should be a reconsideration of the system of equations subject to the conditions used in this model.

The Axiomatics should be as weak as possible. The interpretation of this is that the axioms should be as general as possible. The reason is that the economic model should represent as widely as possible one economic situation because in that way could be more possible to clarify a rule about the subject of examination.

The independence of Axiomatics placed on that none of the axioms should be the product of the other expressing with that way repetitiveness between them. Thence, the main thought is that the axioms should not contain parts of the other axioms used in the model. Thus, the results could be specific allowing the scientist to have precise conclusions.

4. The procedure of quantification of quality data

Initially should be noted that the mathematic approach is that which creates the range of data, and not the opposite. But, the initial determination of the upper and the lower limit of value is for the clarification of the independent variables, so it is irrelevant from the range of data. Then for this reason is not possible to have from the range of data the mathematical determination. Technically is plausible to make this opposite approach, but is out of the scope of this methodology; strictly point of view. Ergo, each study of quantification of quality data has as an initial point the mathematical determination, which comes from the theoretical approach. for this reason, the mathematic equation

consists and a hypothesis. This means that after the application of this methodology should be checked the consistency of the theory with the quantitation transformation. Otherwise, should be made appropriate adjustments to comply with the mathematical analysis with the theoretical principles. Thereupon, in a different if the theory is not determined and the basis point is the mathematical point of view the analysis initiates from a different point of view. But, always we have feedback before and after the application of the Q.E. methodology. The collateral of this procedure is the consistency between the results, and the hypothesis, and this happens through feedback, which always should be considered after the establishment of a theory using a hypothesis or check of an existing theory. Therefore in this point, we conclude the three basic points that the hypothesis and the mathematical determination need to complete their simplest form for the establishment of quality data:

- The first step is about the hypothesis. Hence, at this point is determined what is under thought, and what is the scope of the analysis that follows. Thus, the mathematical determination is the main point of this step.
- The second step is about the generator, which produces the values for the independent variable. The key element is the upper and lower limit, which is used for the production of values under randomization. This technique allows the formation, of the variables in a quantity control, which is not directed by the scientist. Thereupon, after a critical number of irritations is plausible to sketch the mathematical equation. Since concluded the behavior of the equation. This procedure needs at least one mathematical equation, but an appropriate analysis needs at least two mathematical equations, with a lack of some variables, or more variables to the existing equation to understand how the equation reacts in different forms.
- The third step is very critical, as it is the point where is plausible to determine conclusions.
- The fourth step is crucial for the repetitions. Thence, this step is needed for the re-modification of the model through the repetitions between the hypotheses and the conclusions.

Consequently, the three steps illustrated above show the general concept of quantification of quality data.

5. The mechanism of classic Axiomatics, multiple Axiomatics, and fuzzy logic

In this are represented the cases between the classic case of Axiomatics and the case of Multiple Axiomatics. Therefore, initially is presented the classic form of Axiomatics and then it is improved with Multiple Axiomatics. According to the prior analysis we have established a general model as verification of the adequacy of any economic model. Using Axiomatics we have that:

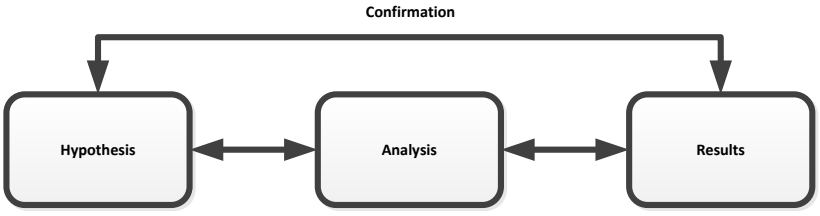

Figure 1: The mechanism of classic Axiomatics

According to the previous figure we have that the procedure of the analysis functions as a connector between the hypotheses and the results. Hence, the results are used as indicators for the hypotheses. The establishment of a theory pends on the compatibility of results to the initial assumptions of each economic model. In the next figure, we see the case of Multiple Axiomatics, which is the case in that we re-modification the model through the re-establishment and the model, using the Axiomatics method, then with the readjustment of the hypotheses and the conclusions. Thence, we have that:

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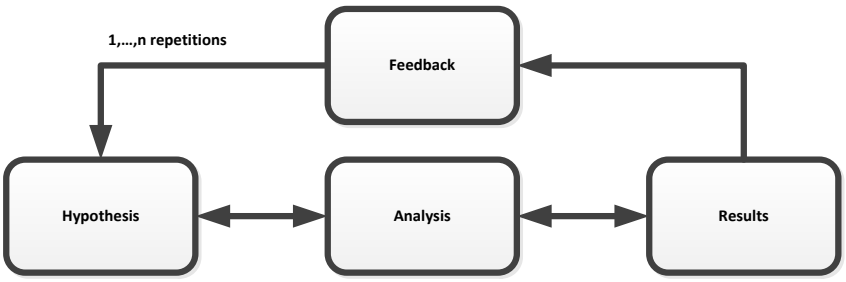

Figure 2: The mechanism of multiple Axiomatics

As we obtain from the previous figure the model of the Multiple Axiomatics has through the Q.E. method a new form, which is determined by a series of repetitions. Therefore the model passes through a huge count of repetitions of the hypotheses and the conclusions.

Then we obtain that exist some basic characteristics in the case of Multiple Axiomatics:

- The first characteristic is that the in the classic form of Axiomatics we have only a confirmation. On the other hand in the case of the Multiple Axiomatics, we have that there is not only a confirmation, but a feedback.
- One more crucial element is that in Multiple Axiomatics we have repetitions. The repetitions allow re-modification of the model and thence can make a better and more accurate model, a model that is adjusted properly through these repetitions.

The fuzzy model is established in the generator (step of analysis as is obvious in the previous figure). The generator uses random numbers which generates in a procedure of adding and subtracting variables. In that way, the scientist can administrate equations and define the behavior of the model through the comparisons that makes. Thence, we have the next scheme:

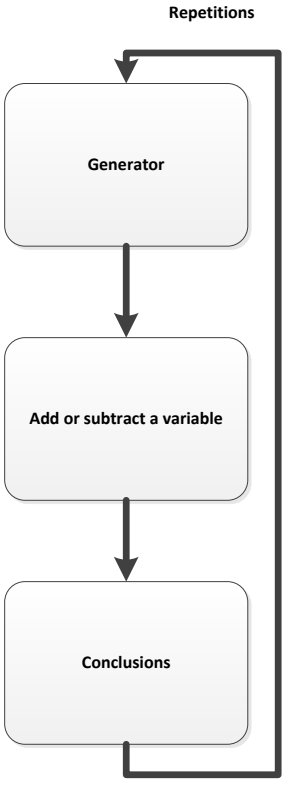

Figure 3: Mechanism of the generator using fuzzy logic

Then, according to Fig. 3, we can determine the behavior of the model. With these repetitions, the model becomes more accurate and adjusted appropriately. We have the application of fuzzy logic through the generator, because of the use of random numbers. The application of fuzzy logic allows the implication of more accurate models and well-adjusted models.

6. Conclusions

This paper showed the mainstream idea of the economic methods which based their analyses on Axiomatics. Therefore, the assumptions and the results are the key elements of the adequacy of the method of Axiomatics. This is plausible through the consistency and completeness of Axiomatics. Moreover, we have the quantification of quality data, using the Q.E. method. This means that the Q.E. method that allows the transformation of any theoretical approach which doesn't have mathematical characteristics to a form that has mathematical characteristics. Therefore, the transformation of the quality data into quantity form permits any other analysis in a completely different approach. The generator according to this thesis is the source of the application of fuzzy logic for the production of more accurate and well-adjusted models.

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