A FUZZY LOGIC APPLICATION TO ANALYZE LACK OF FINANCIAL CONTROL IN CONSUMER BEHAVIOR

Fabio Luiz Peres Krykhtine

Federal University of Rio de Janeiro

Sheila de Barcellos Maia

High School of Propaganda and Marketing

Carlos Alberto Nunes Cosenza

Federal University of Rio de Janeiro

Armando Celestino Gonçalves Neto

Federal University of Rio de Janeiro

Abstract

This article research aims to report the progress on the investigation of the factors, under the dimensions of social, psychological, and economical, that collaborate on lack of financial control motive attached to individual control. The research applied fuzzy logic to collect data, process, and translate in fuzzy number graphics the level of selected variables in terms of agreement/ disagreement from two self-declared research groups. As a result, some of the variables present more similarities between opinions helping in a better understanding of the motive of the lack of financial control.

Keywords

Lack of financial control, indebtedness, fuzzy logic.

INTRODUCTION

The lack of financial control is a behavior that affects individual lives and families all over the world. Especially Brazil, a country that holds great discrepancies in social and economic populations groups, the financial lack of control is a common event that coexists with a major population part that self declares in indebtedness situation. Although it happens in Brazil in an intense way, it is a global problem that involves culture, education, values and logics.

The investigation's objective is to find, in a wider approach, the attributes that affect people involved by the financial lack of control and why it is a current problem among the families, especially Brazil where the social discrepancies are high.

Particularly in moments when the interest tax and inflationary pressure in Brazil bring uncertainty to the whole economical system, the individual players are exposed to a major financial risk involving a set of decisions, taken in different ways, expecting to protect them from a financial lack of control situation.
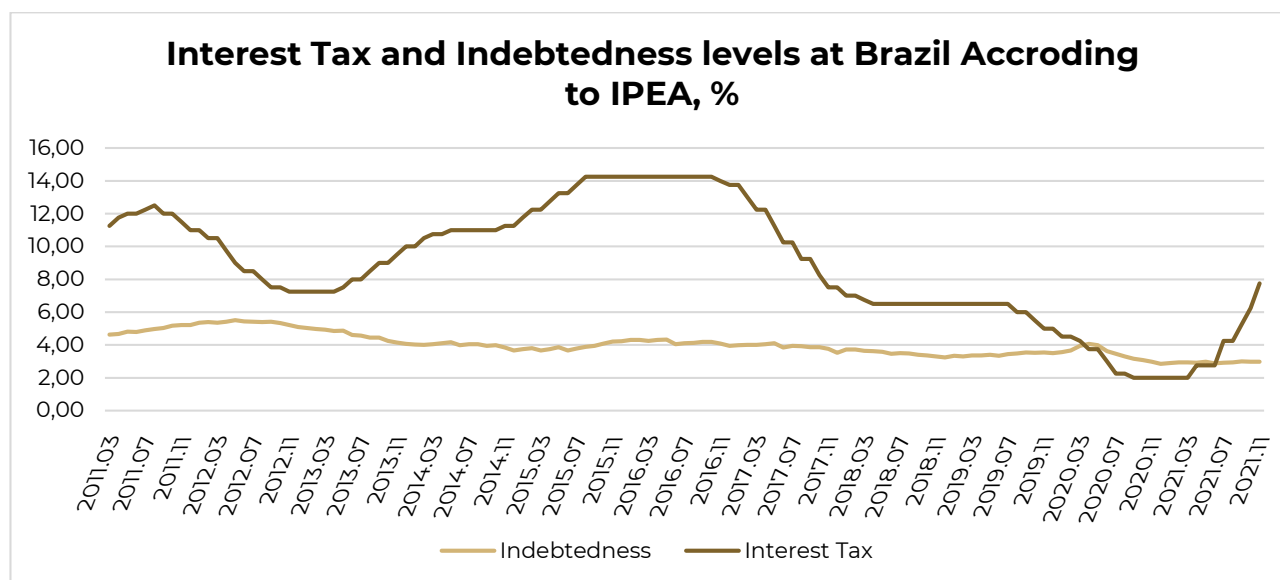

Fig. 1. Interest Tax and Indebtedness levels at Brazil according to IPEA.
Source: compiled by the authors based on IpeaData, available at: http://www.ipeadata.gov.br/ Default.aspx (Accessed 25 October 2023).

The research is a composition of qualitative and quantitative collecting methods joined by fuzzy logic techniques processing respecting a methodological path designed to identifying the causes and principal factors that affect populations to the condition of indebtedness.

MATERIALS AND METHODS

MATERIALS AND METHODS
INVESTIGATION OF FINANCIAL LACK OF CONTROL: DEFINING FACTORS DIMENSIONS FOR ANALYSIS

The objective of this phase was to promote a wide review of press media, narratives, and preliminary interviews with specialists in different areas observing the financial lack of control environment as a set. It phase organized a matrix that was applied to develop a cloud of terms connected by relations between words frequency and thematic. The first result can be observed in the figure below demonstrating some of the data plotted and its connections.

The identification of these dimensions was the result of a pre-research process investigation. The process utilized a Cmap Tools software constructed by narratives and textual research about financial lack of control. The main nodes gave references to divide the financial lack of control and guide the research in finding literature references observing three main topics oriented in the fields of psychological, social, and economic.

By dividing topics, the fields could be better explored in oriented research by dividing fields into subsets referenced by literature as presented.

It is important to emphasize that the elaboration of a factorial structure segmented into criteria considers what must be monitored in terms of information, collecting consumer behavior, and its relevant aspects to overcome the lack of financial control.

Once the dimensions were delimited and it factors identified, a survey was developed and applied observing two groups: self-declared as controlled and uncontrolled in term of manage individual finances

To build a processing algorithm aiming to deal with subjective and imprecise information, in the field of uncertainty, a fuzzy logic algorithm was developed and the research followed a framework methodology with steps and phases guiding a software development:
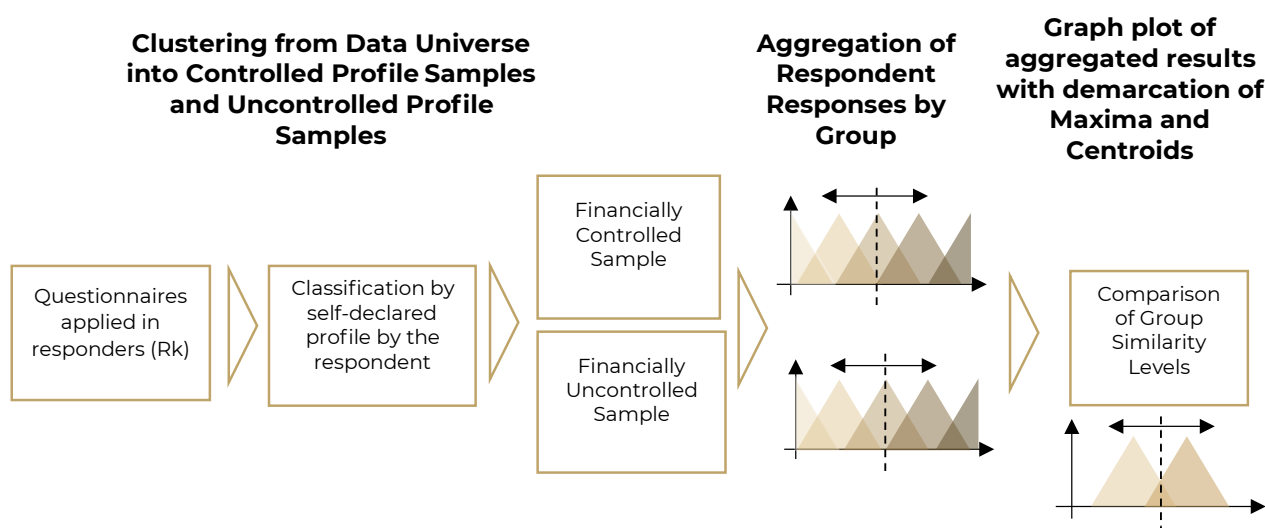

Fig. 2. Research Framework Methodology driving the Data Visualization Software.

Source: compiled by the authors based on klam.com, available at https://klam.com.br/clientes/descontrole/ (Accessed 03 November 2023).

PSYCHOLOGICAL FACTORS EXPLORATION

Psychological factors, which can explain how consumer behavior relates to internal issues and the development of psychological compensation mechanisms, encompass seven criteria: overconfidence, need for achievement, oneomania (compulsion to consume), immediacy (intertemporal discount), vanity, guilt, seeking compensation (self-indulgence).

1. Overconfidence: many consumers make consumption decisions relying on future income. The problematic issue is that they very often have a poorly dimension expectation of this future income.

«Subjective confidence in a judgment is not a reasoned evaluation of the probability that this judgment is correct. Confidence is a feeling, which reflects the coherence of the information and the cognitive ease of processing it. It is wise to take admissions of uncertainty seriously, but declarations of high confidence mainly tell you that an individual has constructed a coherent story in his mind, not necessarily that the story is true» [1].

Optimism is a positive trait for human beings. But optimism must be tied to what a person can control and also grounded in something a person can achieve. People must not use optimism to get into debt without having a certain income in the future. «Optimists are normally cheerful and happy, and therefore popular; they are resilient in adapting to failures and hardships, their chances of clinical depression are reduced, their immune system is stronger, they take better care of their health, they feel healthier than others and are in fact likely to live longer. A study of people who exaggerate their expected life span beyond actuarial predictions showed that they work longer hours, are more optimistic about their future income, are more likely to remarry after divorce (the classic «triumph of hope over experience») and are more prone to bet on individual stocks» [1].

When people project the future, they are performing the exercise of predicting something. However, the future is unpredictable and prediction errors are extremely common. People cannot adopt a subjective conviction as necessary [1].

2. Need for achievement: to feel fulfilled, some people need to be with friends, family, working, studying, among other activities. Many people need to consume goods and/or services to feel fulfilled.

According to [2], it is acceptable for people to seek happiness in consumption and not find it, it is also possible that they compensate for their dissatisfaction in life through consumption. The frequent pursuit of happiness through consumption can also occur if materialism has a negative effect on happiness, that is, the more a person consumes, the greater the unhappiness. But consumers cannot discern this relationship and, instead of reducing consumption, consume more and more.

3. Oneomania (compulsion to consume): many consumers cannot resist the act of consuming. «It is when a person notices that it is very difficult to turn back when faced with temptation, it is perceived that a better strategy would be to move away from the attraction of desire before getting too close to the point of succumbing. Accepting this advice is not easy, but the reality is that it is much easier to completely avoid temptation than to overcome it when it is present all the time at the kitchen counter» [3].

This situation can even worsen if it is considered that oneomaniacs are exposed to the same facilities and stimuli as consumers who do not have this type of internal factor.

«The excessive exposure of images and continuous marketing studies aim to convince consumers at different socioeconomic levels. On the other hand, Economic Psychology seeks to understand the relationship that exists between rational purchases and purchases caused by the temptation to consume impulsively. In this sense, individuals are named by the psychology of oneomaniacs, who are characterized by indiscriminate purchases. This behavior is due to several factors, such as age, education, gender, income, etc.» [4].

4. Immediacy (intertemporal discount): in general, consumers make immediate decisions to purchase goods that they could consume in the future. In these cases, the pleasure comes immediately, and the consequences later [5].

«People are prone to immediacy often because they place more value on an asset in the present than in the future. Something great for us «but that won't arrive until days, weeks, months, or years from now» is not as valuable as something that's satisfying but is available now. The future simply does not tempt us as much as the present» [6].

People often use credit to purchase goods immediately and payment occurs or will occur in the future. When payment is made at a distant date, people tend not to see time value of money.

«Money in the future has a discounted value. When people plan to pay in the future, it hurts less than when people pay the amount now. And the more

in the future it is paid, the less pain is generated in the consumer at the present moment. In some cases, it feels almost free now. It will only be paid when the wonderful and unknown future arrives when people can be lottery winner, movie stars, or inventors of the solar-powered jet turbine» [6].

5. Vanity: people are overly concerned about being attractive to other people. The standards of beauty established by society generate the consumption of goods and services. «Default options, therefore, act as powerful incentives. In many contexts, they are even more powerful because they make consumers think «correctly or not» that they have the implicit support of the standard-setter, be it a business, government, or channel scheduler» [5].

To fit the established standards, individuals make decisions without thinking and do not question whether the standard could be another. «Their Reflective Systems do not seek to verify whether the answers would be different if the questions were reformulated» [5].

To fit in, people consume aesthetic resources, plastic surgery, clothing, and accessories. «...we all pay a price for counterfeits in terms of moral currency; Pretending changes our behavior, our self-image and the way we see others» [6].

6. Guilt: many people, for having activities that make them absent from family members (children/partners) end up trying to make it up for this lack with rewards.

According to [7], when a psychological need such as building relationships with others is not met, a feeling of insecurity develops, some people try to appease with material objects in the belief that these objects can replace love and affection.

7. Compensation Search/Self-Indulgence: through a psychological compensation mechanism, some people with dissatisfaction in life compensate with consumption [2].

People often feel overwhelmed from working, studying, etc. When people are in this condition any kind of decision shouldn't be made. Generally, the actions that demand control must be taken before we are exhausted. For [3], this advice is not easy to follow considering that commercial forces constantly accentuate temptation and exhaustion.

«This mysterious connection between being tired and eating junk food is not a figment of the imagination, and it is why so many diets end in a time of stress and why so many people return to smoking after a crisis» [3].

SOCIAL FACTORS EXPLORATION

The social factors can be attached to the question about why and how the consumer interacts with its social environment and in the research can be divided into eight criteria that involve: communication tools, professional rise, seasonal events, status/need for identity, apathy, impulse purchases, social pressure, high standard of living.

1. Communication tools: communication tools can lead us to certain choices. Every day people are overwhelmed by brands that invade our fields of vision and hearing through advertisements. These advertisements have the main objective of transmitting the offer's perception of value to the consumer and encouraging an increasing consumption of their product.

The language used in communication can increase or decrease the quality of the consumption experience and influence the way people perceive and value a product. Through the vocabulary of consumption, professionals in the advertising area draw attention to the experience they want to be incorporated into our habits and to the one they want us to stop adopting [6].

In addition to language, communication often creates rituals for certain products. Rituals add extra meaning to a consumption experience. People can

pay more for a product depending on how it is presented. If a wine is served in a crystal glass, it will aggregate more value than when served in a cup of coffee. «Our consumption habit in this aspect is not economically rational, although it is understandable and, in certain cases, even desirable» [6].

2. Professional rise: often, when individuals become part of a new professional position, they want to convey this rise through more expensive habits and consumption than they were used to consuming before and try to meet the expectations and standards that they believe are required by the new position. «Expectations also shape stereotypes. A stereotype, after all, is a way of categorizing information, in the hope of predicting experiences» [8]. Most of the time, when people assume a stereotype and come to believe that they are obliged to change their consumption.

3. Seasonal Events: it involves persons who have a robust consumption calendar: Carnival, Easter, Valentine's Day, Grandparent's Day, Father's Day, Black Friday, Christmas and New Year's. In addition to these dates: birthdays, vacations, get-togethers and so on. All these dates have the appeal of mandatory consumption and also give us a certain sense of freedom to increase our spending with justification.

4. Status/need for identity: some people start dressing differently, owning goods, and creating habits to convey a certain image and convince others of the position they aspire to appear in. They believe that spending more and investing in appearance demonstrates their status/identity.

The image people seek to convey with their consumption habits is not always intended to show a certain social status, it is often the desire to assume an identity for themselves and they end up indebted for that. «More generally, I started wondering about the relationship between what we wear and how we behave, and it made me think about a concept that social scientists call self-signaling» [3].

5. Apathy: lack of knowledge about a certain subject and/or lack of time due to many daily commitments, makes people follow a pattern that is determined by the providers of products and/or services that are offered to them all the time. The speed of the world does not allow people to have reflections on basic attitudes and this habit of not reflecting is often taken to consumption. «... In many situations, people put themselves into an «automatic pilot» mode, in which they are not actively paying attention to the task at hand. (The Automatic System is very comfortable that way.) On a Saturday morning when we set out to run an errand, we can easily find ourselves driving our usual route to work — until we realize we are headed in the opposite direction from our intended destination, the grocery store» [5].

6. Impulse Purchases: impulse can be distinguished from apathy in that it is a reaction to a stimulus. Apathy is something individual does without reaction, the impulse is almost a disobedience to self-control when people cannot resist the desire to consume something.

«When it comes to impulsive consumption, Stern (1962) highlights the existence of several types of impulsive consumption: reminder impulsive consumption, suggestive impulsive consumption, planned impulsive consumption, and pure impulsive consumption. In addition, Chang, Stansbie, and Rood (2014) find that the impulsive consumption of the reminder makes buyers purchase a product, reminding them of a need when they see it. Suggestive impulsive consumption is characterized by the situation in which the individual, when faced with a product for the first time, feels the need to make the purchase. Planned impulse consumption occurs when individuals decide to spend a certain amount of money but do not have any specific type of product in mind to buy» [4].

7. Social pressure: people are constantly seeking to adapt to the environment in which they live. The medium is not always suitable for the

financial conditions of the person in which they want to feel they belong. But even so, they have non-standard consumption habits to be «accepted».

«An important problem here is 'pluralistic ignorance' – that is, ignorance, on the part of all or most, about what other people think. We may follow a practice or a tradition not because we like it, or even think it defensible, but merely because we think that most other people like it. Many social practices persist for this reason, and a small shock, or nudge, can dislodge them» [5].

8. High standard of living: during life, it is very possible for a person that the income fluctuates. In times of high income, people can have a higher consumption pattern, but in times of low income, they need to reduce consumption once it is not feasible to maintain the same consumer pattern. The main problem is the difficulty for any person to adjust consumption habits to a lower standard.

At certain times, individual needs to change their consumption pattern, and often, even when it is interesting for our lives, loss aversion prevents us from making changes [5].

«Loss aversion produces inertia, in this case, a strong desire to keep your current pos- sessions. If people are reluctant to give up what you have because they don't want to lose, they end up rejecting exchanges that would have been made in a different situation» [5].

ECONOMIC FACTORS EXPLORATION

The economic factors, which can relate to how consumer behavior reacts to the effects of changes in the prices of goods and products, credit, and financial reserves, encompass four criteria: perception of gain, ease of credit, lack of provisions and the wealth effect on the economy (valuation of goods).

1. Perception of gain: people are induced to consume when they have a perception of gain. This occurs when a product, which people often do not intend to buy at a given time, finds itself at a lower price and even free, inducing them to consume it.

«»Free» is a strange «price», however, it is a price.   When something is free, the individual tends not to apply cost-benefit analysis. That is, people choose something free over something that is not, which is not always the best choice» [6].

2. Ease of credit: to consume today (on the present day) what people's income would only allow in the future, individuals use an available credit. When people use credit, they pay a price. In addition to interest, which is the price of the money they borrow, they may pay credit service fees. Credit has the effect of separating the moment of consumption from the moment of payment. «The main psychological strength of the credit card is the fact that it separates the moment of consumption from the moment it is paid, so the payment becomes less painful» [6]. People walk into a clothing store and ask how much the various items that are available for sale cost. When it comes to the price of credit offered by banks, people are not in the habit of getting informed and trying to understand the products and services. To be used, these products and services have fees that are often complex. «And credit card companies aren't the only ones with complex fee systems that are neither transparent nor understandable to consumers. Think about mortgages, cell phone plans, and car insurance» [5].

3. Lack of provisions: many people tend to be optimistic and believe that if a problem occurs, they will always be able to solve it. They have the thought that they will always find a way. «Unrealistic optimism is a pervasive feature of human life; it characterizes most people in most social categories. When they overestimate their personal immunity from harm, people may fail to take sensible preventive steps» [5].

Due to medical advances, life expectancy is increasing more and more.

With advancing age, people's productive capacity declines. Together these two factors reveal the importance of long-term planning. For most of their time on Earth, humans didn't have to worry about saving for retirement because most didn't live long enough to retire. In almost all societies, the few who reached old age were cared for by their children. In the 20th century, however, with the increase in life expectancy and the geographical dispersion of families, people began to have to prepare for their retirement, without having to depend on their children [5].

4. Wealth effect on the economy (asset appreciation): some people change their consumption pattern when assets become more valued. Income does not increase, but psychologically they feel greater purchasing power.

For [9] the impact of the wealth effect on the recent US real estate mortgage bubble was considerable. Income and wealth stimulate consumption and generate cyclical fluctuations in household consumption. Once these elements were highlighted and classified into factors group the present criterion can be placed in the factors group, giving the current organizations for factors and criteria.

Table 1

Factors and Criteria Group

Psychological Factors	Social Factors	Economic Factors
1. Overconfidence 2. Need for achievment 3. Oneomania 4. Immediacy 5. Vanity 6. Guilt 7. Compensation Search	1. Communication tools 2. Professional rise 3. Seasonal events 4. Status / need for identity 5. Apathy 6. Impulse purchases 7. Social pressure 8. High standard of living	1. Perception of gain 2. Ease of credit 3. Lack of provisions

Source: compiled by the authors based on Coskun, Y. et al. Multi-Horizon Financial and Housing Wealth Effects Across the U.S. States. Sustainability, Basel, Switzerland. 2021. Vol. 13. №1. p. 202-208.

EXPLORING DATA COLLECTION TO CONTOUR FINANCIAL LACK OF CONTROL

The research involves the mission of collecting data from people, by the use of an electronic questionnaire applied in a campaign.

The present working article covers the follow methodological phases: the literature review, survey, modelling, data collection, processing and analyse results.

The identification of factors and criteria capable of providing a better understanding of the Lack of Financial Control gave the research a basis for the construction of a questionnaire with the objective of collecting information from people and dividing them into two groups: controlled and uncontrolled group. This division was proposed to compare the groups and identify a common profile that could translate the behavior of lack of financial control.

The use of fuzzy logic tools was discussed at this moment as a way to collect people's data by observing the vagueness and uncertainty [10] which copes with the natural language, perception, and limits between terms that would reveal a trend in the group of opinions provided over the data collection campaign.

The fuzzy logic was selected to be applied in the survey because of its capacity to deal with imprecision and, to develop the current research, a group of specialists were accessed to support algorithm modeling and software programming.

CONSTRUCTING A SURVEY QUESTIONNAIRE TO COLLECT INFORMATION ABOUT THE LACK OF FINANCIAL CONTROL

A questionnaire was built using the Google Forms tool. It was structured with 34 questions that cover an informant identification and a group of questions to the factors and criterions presented as a result of the previous research stage.

To answer the questions based on factors and criteria, the informant should attach a level of agreement or disagreement, crossing a neutral position. By these principles a five steps scale was created varying from the term: Totally Disagree, Disagree, Neither Agree nor Disagree, Agree, Totally Agree.

The questionnaire runs open to collect data for one month and was distributed through social networks and collected a random sample of about 869 people, who could be stratified into sets. By utilizing the informant identification, the results could be divided into two sets: extreme uncontrolled and extreme controlled people, which formed a subset of 359 individuals.

FUZZY LOGIC APPLICATION

The fuzzy logic is a kind of approach presented by [11] as an extension of Cantor Set Theory where a membership function is introduced connecting to levels by a continuous function that performs a transition between different sets. Before Zadeh, many philosophers as Bertrand Russel [12] and Max Black [13] discussed that special attention was needed to the vagueness of thematic [10].

The use of linguistic terms to construct a tool capable to cope with the challenge to obtain perceptions, feelings, and vagueness, considering the natural uncertainty in the data source [14] fits the present work objectives, allowing the research group to evaluate results in a thematic full of vagueness.

The relation and similarities technique has been explored by many authors, especially in fuzzy applications, by the use of maximums and minimums sets, and even in more modern approaches oriented to a fuzzy dual methodology presented by [15].

In the current application, the five steps that describe the range from totally disagreement and totally agreement can be demonstrated in the figure below where the fuzzy numbers are attached to the linguistic terms. As seen, the uncertainty at the data source is considered and the transition zone between maximum values in the sets is represented. Moreover, by a project modelling decision, the linguistic terms associated with the terms are shown and expressed by membership equations functions (1) to (5) and in the matrix.

Totally Disagree

$$\mu(x) = \begin{cases} 1 & if & x \leq 0{,}1 \\ -\left(\dfrac{1}{0{,}2}\right)x + 1{,}5 & if & 0{,}1 \leq x \leq 0{,}3 \end{cases} \quad (1)$$

Disagree

$$\mu(x) = \begin{cases} \left(\dfrac{1}{0{,}2}\right)x - 0{,}5 & if & 0{,}1 \leq x \leq 0{,}3 & else \\ -\left(\dfrac{1}{0{,}2}\right)x + 2{,}5 & if & 0{,}3 \leq x \leq 0{,}5 \end{cases} \quad (2)$$

Neither Agree nor Disagree

$$\mu\,(x)\;=\;\begin{cases}\left(\dfrac{1}{0,2}\right)x\,-\,1,5 & if & 0,3\leq x\,\leq\,0,5 & else \\[2ex] -\left(\dfrac{1}{0,2}\right)x\,+\,3,5 & if & 0,5\,\leq\,x\,\leq\,0,7\end{cases}$$ (3)

Agree

$$\mu\,(x)\;=\;\begin{cases}\left(\dfrac{1}{0,2}\right)x\,-\,2,5 & if & 0,5\leq x\,\leq\,0,7 & else \\[2ex] -\left(\dfrac{1}{0,2}\right)x\,+\,4,5 & if & 0,7\,\leq\,x\,\leq\,0,9\end{cases}$$ (4)

Totally Agree

$$\mu\,(x)\;=\;\begin{cases}\left(\dfrac{1}{0,2}\right)x\,-\,3,5 & if & 0,7\leq x\,\leq\,0,9 & else \\[2ex] 1 & if & x\,\geq\,0,9\end{cases}$$ (5)

0,0	0,0	0,1	0,3
0,1	0,3	0,3	0,5
0,3	0,5	0,5	0,7
0,5	0,7	0,7	0,9
0,7	0,9	1,0	1,0

Fig. 3. Computational matrix representing fuzzy numbers.

Source: compiled by the authors.
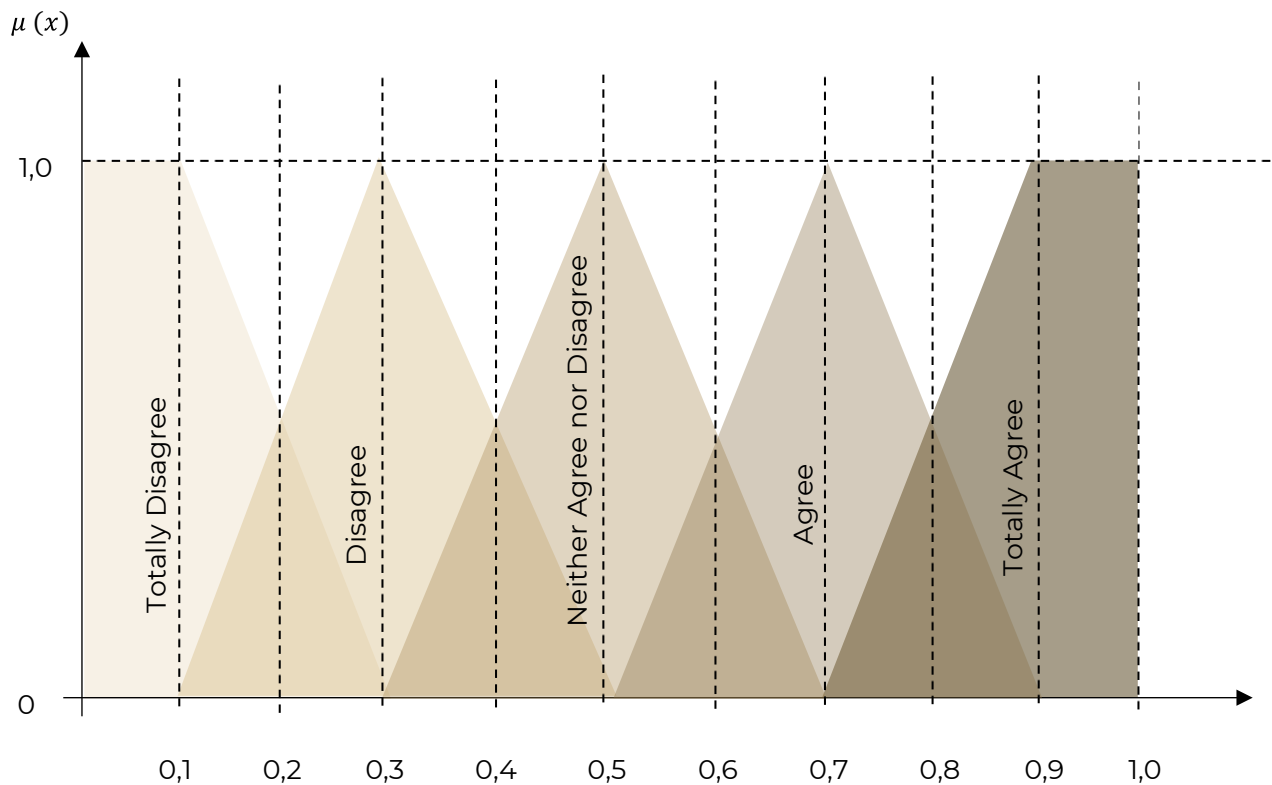
Fig. 4. Fuzzy number graphic representation.

Source: compiled by the authors based on klam.com, available at: klam.com.br/clientes/ descontrole/ (Accessed 13 November 2023).

AGGREGATING RESULTS WITH FUZZY LOGIC ALGORITHM

The algorithm that joins the data collected is based on the [16] and [17] approach where the result is a fuzzy average from the fuzzy numbers declared by the informants. It was applied in the two sets and utilized to compare similarities between the two groups.

$$\delta_q = \sum_1^n \frac{\mu_q(x)}{n}$$

where:
n = the number of informants,
q = the question identifier attached to the financial lack control linguistic variable,
μ = the membership function given for an informant n to the question q, associated to the linguistic variable x.

By the use of the equation (6), a custom software was applied to plot the aggregated fuzzy numbers of graphics where the similarities between the two groups can be evaluated. The values near 0,00 (zero) represent «Totally Disagree», near 1,0 (one) represent «Totally Agree». The 0,5 membership value represents a neutral position.

In addition, the dual defuzzification was applied to give the centroid and the maximum observing not only the result but also, it centroid [18]. The shape of the triangle demonstrates through its base the uncertainty incorporated in the result.

Additionally, when the triangle is more similar to an isosceles triangle, it represents a greater concentration of responses associated with the centroid result. In this way, the trend can be visualized by observing a marked distance on the x-axis, between the maximum point and the centroid.

RESULTS

In the end of the paper the 19 criterion's graphics are presented where the red sets are the controlled persons consolidated opinions and blue sets are the uncontrolled persons consolidated opinions about the level of agreement of the criterion membership as a component of the factors involving the lack of financial control.
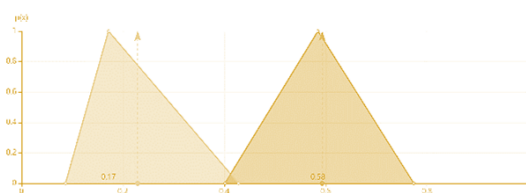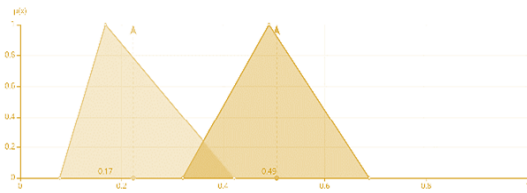

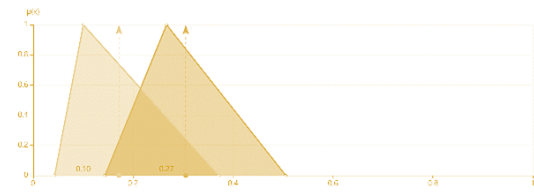(a) Overconfidence
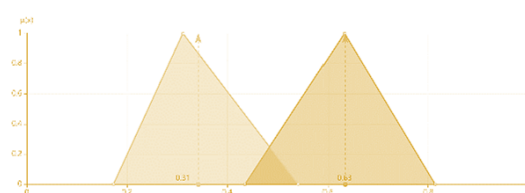
(b) Need for achievement
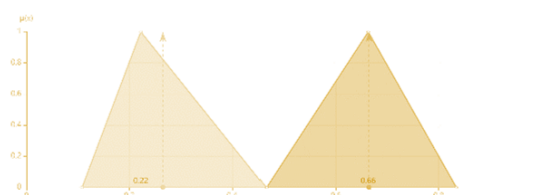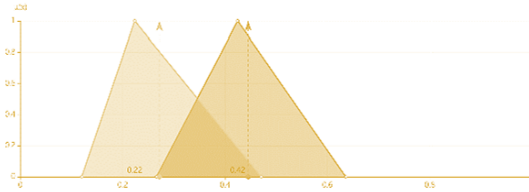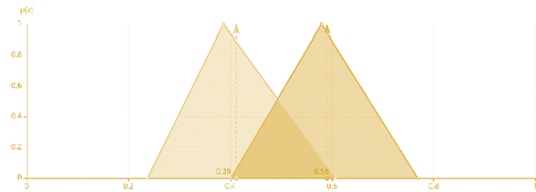

(c) Oneomania (compulsion to
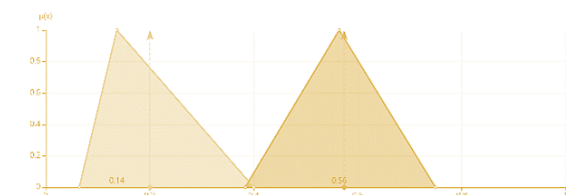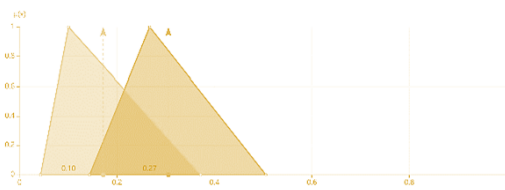

(d) Immediacy
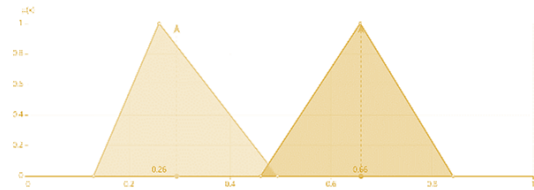
(a) Vanity

(b) Guilt

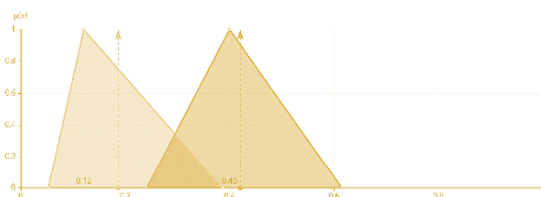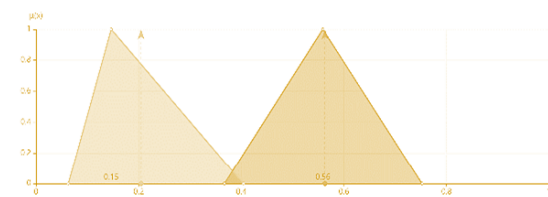(c) Compensation Search/ Self-Indulgence
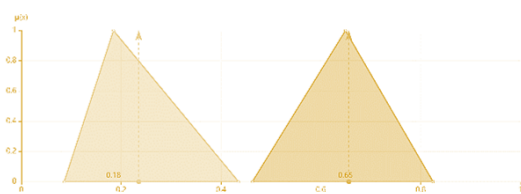

(d) Communication tools
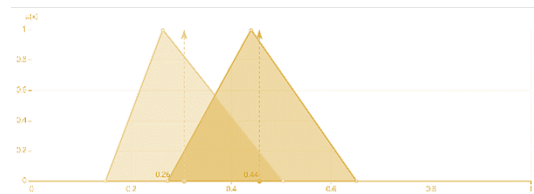

(a) Professional rise

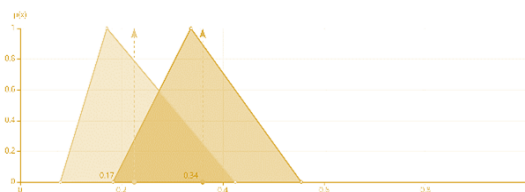(b) Seasonal Events

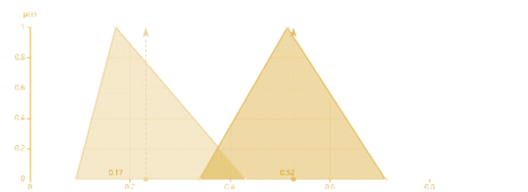(c) Status/ Need for identity

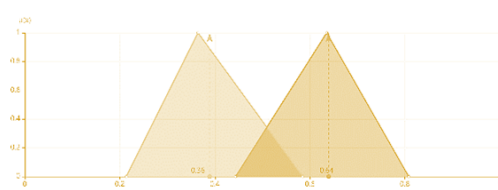
(d) Apathy

(a) Impulse Purchase
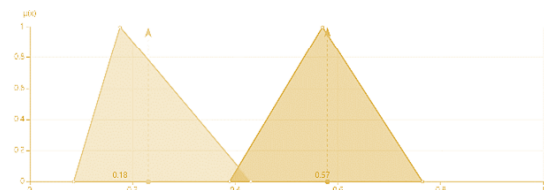

(b) Social pressure

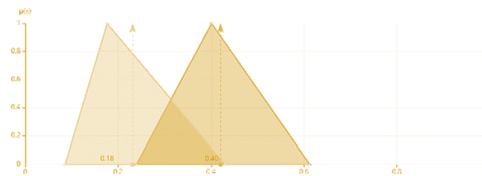(c) High standard of living

(d) Perception of gain

(a) Ease of credit

(b) Lack of provisions

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(c) Wealth effect on the economy (asset appreciation)

Fig. 5. Level of agreement of the criterion membership as a component of the factors involving the lack of financial control.
Source: compiled by the authors based on klam.com, available at: klam.com.br/clientes/ descontrole/ (Accessed 15 November 2023).

DISCUSSION

By the identification of the two groups profiles and it perceptions in terms of agreement level for the criterion, the present research identified opportunities to better understand the difference between financial controlled persons and uncontrolled persons.

By observing the graphics, the controlled group presents some behaviours that are important to not get in indebtedness situation while the uncontrolled group sometimes do not recognize some behaviours as reasons that put them in indebtedness situation.

It suggests that uncontrolled persons ignore some of the traps presented by the company's marketing strategies or put themselves in traps believing and that the discipline is not relevant to maintain financial control in their lives.

It is crucial to identify some of the reasons that deeply affects a great part of world population and future lives in financial planning, situation that get worse as these individuals get old and retired, with incomes limited to government social contributions and also affected by crisis and other disturbances.

Moreover, it comprehension is important to benefit people and provide a product port- folio attached correctly to financial risk management considering both sides composed by clients and credit institutions as financial players. It involves not only the products but also education programs focused on the problem of indebtedness.

The credit institutions as responsible for providing credit products to consumers must understand that developing strategies to reduce portfolio risk only can be achieved by providing segmented education focused on the group of criterion that really contribute to the indebtedness grown.

By interpreting the graphics, some information can be identified as described below:

The only criterion for the lack of financial control that was pointed by the two groups as "Disagree" was "Guilt".

«Oneomenia», «Seasonal events», «Impulse purchases», «Perception of gain», «Need for achievement», «Overconfidence», «Communication tools», «Lack of provisions», «Immediacy» (inter temporal discount), «Apathy» and «Ease of credit» are in the fuzzy transition zone between «Agree» and «Neither disagree nor agree».

«Seasonal events», «Impulse purchases», «Overconfidence», «Communication tools», «Lack of provisions» and «Immediacy» tend to «Agree» zone.

The criteria «Vanity», «Social pressure», «Compensation Search/Self-Indulgence», «wealth effect», «Status/need for identity», «High standard of living» and «Professional rise» tends to «Neither agree nor disagree» zone.

To assess the opposition of behavior of the study criteria for the two segments, the difference between the fuzzy sets centroids measure was

calculated.

The Fuzzy logic modeling to analyze the lack of financial control in consumer behavior brought significant results for the criterions study.

From the perspective of financial lack of control individuals, the 10 criteria with the highest degree of relevance are: «Oneomania», «Seasonal events», «Impulse purchases», «Perception of gain», «Need for achievement», «Overconfidence», «Communication tools», «Lack of provision», «Immediacy (intertemporal discount)», «Apathy» and «Ease of credit».

From the point of view of financial controlled individuals, the analysis is made of how far they are removed from the behavior of the financially uncontrolled, and the 10 criteria with the greatest difference in fuzzy sets centroids measure are: «Impulse purchases», «Oneomania», «Immediacy (intertemporal discount)», «Seasonal events», «Overconfidence», «Apathy», «Lack of provisions», «Ease of credit», «Need for achievement» and «Vanity».

The criteria that appear in the top 10 for the financially uncontrolled group and the greatest distances between the behavior of the controlled group and the financially uncontrolled group are: «Oneomania (compulsion to consume)», «Seasonal events», «Impulse purchases», «Need for achievement», «Overconfidence», «Lack of provision», «Immediacy (intertemporal discount)» and «Apathy».

The criteria from the perspective of the uncontrolled group that appear among the top 10 and can affect the behavior of the controlled are: «Communication tools» and «Perception of gain». Due to the proximity of the degree of relevance and similarity of behavior for the two criteria between the controlled and uncontrolled financial segments, it suggests that can be identified an influence about communication strategies and also about better expectations about economic scenarios, sometimes not concrete in future times.

CONCLUSION

The Fuzzy Logic application had shown very usefully in revealing in the graphic interface a clear data visualization about the similarities and dissimilarities between the two groups. The figures resulting from the two sets overlapping formed a third set revealing similarities in the profiles. The analyst can easily identify similarities and dissimilarities between the groups and point some critical factors aiming to promote actions in financial education to help the groups and actuate the portfolio indebtedness levels.

A suggestion for future work is to generate an intelligent analysis of the criteria covered in the study. To this end, the model proposed in the study, serving as a basis for this intelligent system, can be active in order to understand consumer behavior and contribute to generate guidelines for credit policies, economic policies and, mainly, to guide financial education.

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About the authors:

Fabio Luiz Peres Krykhtine – PhD in Production Engineering, Professor of the Industrial Engineering Department at the Polytechnic School, Coordinator of International Affairs at the Federal University of Rio de Janeiro, 22290-240, Brazil, Rio de Janeiro, Avenida Pedro Calmon, 550.
ORCID-id: 0000-0002-3318-4892

Sheila de Barcellos Maia – PhD in Production Engineering, Professor at the High School of Propaganda and Marketing (ESPM), 04018-010, Brazil, Rio de Janeiro, Ladeira da Glória, 26.
ORCID-id: 0000-0003-3897-6589

Carlos Alberto Nunes Cosenza – Production Engineering, Professor, Head of the Fuzzy Logic Laboratory at the Federal University of Rio de Janeiro, 22290-240, Brazil, Rio de Janeiro, Avenida Pedro Calmon, 550.
ORCID-id: 0000-0002-2911-6184

Armando Celestino Gonçalves Neto – Production Engineering, Professor of the Industrial Engineering Department at the Polytechnic School at the Federal University of Rio de Janeiro, 22290-240, Brazil, Rio de Janeiro, Avenida Pedro Calmon, 550.
ORCID-id: 0000-0002-0022-5432