A Neutrosophic Analysis of Alimony in Students of Legal Age as a Fundamental Right to Education

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Abstract

The right to food is closely related to the parent-child relationship and constitutes a right of the children and an obligation of the parents. Ecuadorian regulations seek to guarantee studies even when the children become adults and need to continue their academic training. University students are often forced to abandon their studies due to a lack of financial incentives. The objective of this study is to determine the factors that affect students' right to education when they reach the age of majority and the negative effects caused by the suspension of alimony. As a result, it is obtained through the use of the neutrosophic TOPSIS method to propose implementing legal reforms to extend alimony up to 24 years of age.

Keywords: the right to food; education; alimony; neutrosophic TOPSIS

1. Introduction

The alimony has the function of solving the basic needs of the food that the minor has. The right to food is an imprescriptible, non-transferable, inalienable, and unattachable right. It is a right that is born and is permanently renewed as the needs change. This definition includes the essential resources for a person's subsistence and the means to allow a decent existence[1].

In such virtue, article 129 of the Organic Code of Childhood and Youth of the Constituent National Assembly of Ecuador establishes a logical order of taxes to fulfill this obligation with minors and their exceptions. On the other hand, the Civil Code of the Constituent National Assembly of Ecuador in article 349 regulates this issue in general and introduces the reciprocal nature of the benefit. Furthermore, the Constitution of Ecuador guarantees the protection of the rights of children and adolescents within the current Constitutional State of Rights and Social Justice[2].

The State and the family are in charge of making prevail the rights of children or adults up to the age of 21 who are studying. To protect the right to food without leaving them without it because it is a fundamental right, they must acquire a way of life that allows them to have a comprehensive life development, safeguarding the other rights that derive from the right mentioned above.

Doi : https://doi.org/10.54216/IJNS.180405
Received: February 27, 2022 Accepted: June 18, 2022

In January, a Legal Reform was proposed to extend the payment of alimony to the age of 24 to support university students. It was cataloged as totally wrong since it is about adults who must learn to earn a living by their own means. The thesis generated controversy and divergent positions. On the one hand, those who claim this will encourage a generation of irresponsible young people supported by their divorced parents. On the other hand, those who ensure that parents should support their children's university studies, even if they do not live with them.

It is worth mentioning that Private Universities receive enormous economic resources from the state even though they are companies destined to do an education business. A faithful example of that is the cost of Master's degrees in the country. We must be objective and observe that they are not minors or adolescents and that they are harmed by preventing them from having the power to learn to earn a living by their means [3].

Economics and education are two fields that maintain a close correlation. Teaching has a fundamental effect on the economic life of people and, in turn, financial phenomena affect the present and future of education [3]. Among the most prominent problems of school dropout in higher education is that it has been violated by the extinction of alimony to young people who have reached 21 years of age, see [4-7].

Analyzing the factors that affect the right to education is defined as a problematic situation: alimony to students over 21 years of age. The main objective is to define the main factors that affect the right to education. Then, specific objectives: determine the factors that affect the analyzed variable, perform the measurement and modeling of the variable and finally define the potential alternatives based on eradicating the variables that affect the fulfillment of the right to education.

2. Materials and methods

2.1 Neutrosophic statistics

Neutrosophic Statistics has been applied in many fields, e.g. [8-12]. Neutrosophic probabilities and statistics generalize classical and imprecise probabilities and statistics [13-15]. For example, the Neutrosophic Probability of an event E is the probability that event E will occur, the probability that event E will not occur, and the probability of indeterminacy (not knowing whether event E will occur or not). In classical probability $n_{sup} \leq 1$, while in neutrosophic probability $n_{sup} \leq 3+$.

The function that models the neutrosophic probability of a random variable x is called the neutrosophic distribution: $NP(x) = (T(x), I(x), F(x))$. Where T(x) represents the probability that value x occurs, F(x) represents the probability that value x does not occur, and $I(x)$, represents the undetermined or unknown probability of value x. Neutrosophic Statistics analyzes neutrosophic events and deals with neutrosophic numbers, the neutrosophic probability distribution [15-17], neutrosophic estimation, neutrosophic regression, etc.

It refers to a set of data formed totally or partially by data with some degree of indeterminacy and to the methods to analyze them. Neutrosophic statistical methods allow neutrosophic data (data that may be ambiguous, vague, imprecise, incomplete, or even unknown) to be interpreted and organized to reveal underlying patterns [18]. Finally, the Neutrosophic Logic [16, 17, 19], the Neutrosophic Sets, and Neutrosophic Probabilities and Statistics have a wide application in various research fields and constitute a novel study reference in full development. Neutrosophic Descriptive Statistics comprises all the techniques for summarizing and describing the characteristics of neutrosophic numerical data [20-22].

Doi : https://doi.org/10.54216/IJNS.180405
Received: February 27, 2022 Accepted: June 18, 2022

Neutrosophic Numbers are numbers of the form where a and b are real or complex numbers [23], while "I" is the indeterminacy part of the neutrosophic number N. The study of neutrosophic statistics refers to a neutrosophic random variable where X_l and $X_u I_N$ represents the lower and correspondingly higher level that the studied variable can reach in an indeterminate interval $[I_l, I_u]$. The neutrosophic mean of the variable $(\underline{x}_N)$ is calculated as follows:

$$X_N = X_l + X_u I_N;\ I_N \in [I_l, I_u] \tag{1}$$

$$\text{Where, } \underline{x}_a = \frac{1}{n_N}\sum_{i=1}^{n_N} X_{il},\ \ \underline{x}_b = \frac{1}{n_N}\sum_{i=1}^{n_N} X_{iu},\ n_N \in [n_l, n_u] \tag{2}$$

Is a neutrosophic random sample. However, for the calculation of neutral squares (NNS) it can be calculated as follows:

$$\sum_{i=1}^{n} N(X_i - \underline{X}_{iN})^2 = \sum_{i=1}^{n} N\big[\big((a_i + b_i I_L)(\underline{a} + \underline{b} I_L), (a_i + b_i I_L)(\underline{a} + \underline{b} I_U)\ (a_i + b_i I_U)(\underline{a} + \underline{b} I_L), (a_i + b_i I_U)(\underline{a} + \underline{b} I_U)\big)\ \big((a_i + b_i I_L)(\underline{a} + \underline{b} I_L), (a_i + b_i I_L)(\underline{a} + \underline{b} I_U)\ (a_i + b_i I_U)(\underline{a} + \underline{b} I_L), (a_i + b_i I_U)(\underline{a} + \underline{b} I_U)\big)\ \big], I \in [I_L, I_U] \tag{3}$$

Where $a_i = X_l b_i = X_u$. The variance of the neutrosophic sample can be calculated by:

$$S_N^2 = \frac{\sum_{i=1}^{n_N} (X_i - \underline{X}_{iN})^2}{n_N};\ S_N^2 \in [S_L^2, S_U^2] \tag{4}$$

The neutrosophic coefficient (NCV) measures the consistency of the variable. The lower the value of the NCV, the more consistent the performance of the factor is than that of the other factors. The NCV can be calculated as follows [14].

$$CV_N = \frac{\sqrt{S_N^2}}{\underline{X}_N} \times 100;\ CV_N \in [CV_L, CV_U] \tag{5}$$

2.2 TOPSIS method

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) is characterized by its effectiveness and the simplicity of its principle in solving multi-criteria decision problems. In the case of TOPSIS, the selection is based on finding the alternative that is closest to the ideal solution and, in turn, is further away from the worst solution. It allows combining several heterogeneous attributes in a single dimensionless index, and this is because the attributes under evaluation are very possibly expressed in different units or scales [24-26]. It is based on the concept that the selected alternative must have the smallest Euclidean distance to an ideal solution and the largest Euclidean distance to an anti-ideal solution. So, the order of preference of the alternatives can be determined through a series of comparisons of these distances. Both solutions, the ideal and the anti-ideal, are fictitious solutions.

The ideal solution is a solution for which all attribute values correspond to the optimal values of each attribute contained in the alternatives; the anti-ideal solution is the solution for which all attribute values correspond to the least desired values of each attribute contained in the alternatives. In this

Doi : https://doi.org/10.54216/IJNS.180405
Received: February 27, 2022 Accepted: June 18, 2022

way, TOPSIS provides a solution that is not only the closest to a hypothetically better solution but also the farthest from the hypothetically worse one. The process is described below [27-35]:

1. Determine the objective and identify the attributes to be evaluated.
2. Prepare a matrix based on the information available on the attributes. Each row corresponds to an alternative and each column to an attribute. The element $x_j$of the array represents the non-normalized value of the j_{th}attribute for the i_{th}alternative.
3. Calculate the normalized decision matrix R_{ij} this is obtained by dividing each attribute value x_j by the square root of the sum of the squares of each attribute value x_j. This is represented mathematically by equation (6):

$$Rij = \frac{x_{ij}}{\sqrt{\sum_{m=1}^{k} x_{mj}^2}} \quad (6)$$

4. Determine the relative importance or weight of each attribute with respect to the objective. This gives rise to a set of weights $w_j (for\ j = 1,2,\dots,J)$ such that $\sum w_j = 1$. The weights are generally based on expert judgment and should reflect the relative importance assigned to the attributes. The range of possible values of w_j will only be limited by the ability of the decision group elements to distinguish the relative importance of the analyzed performance attributes.
5. Obtain the normalized and weighted matrix V_{ij}. This is done by multiplying each element in the columns of the matrix R_{ij} by its corresponding weight w_j. Therefore, the elements of the normalized and weighted matrix are expressed by equation 7:

$$V_{ij} = w_j * R_{ij} \quad (7)$$

6. Obtain the ideal and anti-ideal solution: The ideal solution can be expressed as (8) and the anti-ideal as (9). V_j^+ indicates the ideal value of the attribute considered among the values of the attributes for the different alternatives, while V_j^- Indicates the worst value of the attribute considered among the values of the attributes for the different alternatives [14].

$$V^+ = \{V_1^+, V_2^+, V_3^+, \dots., V_j^+\} \quad (8)$$

$$V^- = \{V_1^-, V_2^-, V_3^-, \dots., V_j^-\} \quad (9)$$

7. Calculate the Euclidean distances of each alternative to the ideal and anti-ideal solutions using the following equations:

$$D_i^+ = \sqrt{\sum_{j=1}^{j} (V_{ij} - V_j^+)^2} \quad (10)$$

$$D_i^- = \sqrt{\sum_{j=1}^{j} (V_{ij} - V_j^-)^2} \quad (11)$$

Doi : https://doi.org/10.54216/IJNS.180405
Received: February 27, 2022 Accepted: June 18, 2022

8. The relative closeness P_i of a particular alternative to the ideal solution is expressed by (12):

$$P_i = \frac{D_i^-}{(D_i^+ + D_i^-)} \tag{12}$$

In this step, a set of alternatives is generated in descending order according to the value of P_i having as the best alternative the one with the highest value of P_i. In this article, linguistic terms will be associated with SVNN, so the experts can carry out their evaluations according to the corresponding scale (table 1).

Table 1: Linguistic terms according to the strength of the weight in the alternatives.

Linguistic term	SVNN
Very Weak (VW)	(0.10, 0.75, 0.85)
Weak (W)	(0.25, 0.60, 0.80)
Medium Weak (MW)	(0.40, 0.70, 0.50)
Medium (M)	(0.50, 0.40, 0.60)
Medium Strong (MS)	(0.65, 0.30, 0.45)
Strong (F)	(0.80, 0.10, 0.30)
Very Strong (VS)	(0.95, 0.05, 0.05)

3 Results

After analyzing the different approaches, the techniques described above are applied as follows. For the right to education and due to the complexity and indeterminacy of the data, it was decided to apply neutrosophic statistics for the modeling of the analyzed variable. From the information processing and the experts' consensus, the factors that most affect the right to education (table 2) and the variable to be modeled were determined. Variable analyzed: right to education, for a sample of n=150 for each factor (f).

Table 2: Determining factors in the right to education.

Code	Initials	Factors affecting the right to education
a	RLPF	Reform legal and political frameworks
b	PFME	Provide free and mandatory education
c	ED	Eliminate differences
d	EF	Education financing
e	LC	Lack of compromise

For the development of the statistical study, the neutrosophic frequencies of the determining factors in the right to education are analyzed, mainly in students of legal age. For each factor, an affectation is analyzed in days that make up the set of affectations to ensure that education is for everyone.

Doi : https://doi.org/10.54216/IJNS.180405
Received: February 27, 2022 Accepted: June 18, 2022

Table 3: Factors that affect the fulfillment of the right to education.

Days	Neutrosophic Frequencies				
	RLPF	PFME	ED	EF	LC
1	[1 ; 2]	[1 ; 2]	[0 ; 0]	[0 ; 0]	[0 ; 1]
2	[1 ; 2]	[0 ; 0]	[0 ; 1]	[0 ; 0]	[0 ; 1]
3	[1 ; 1]	[0 ; 0]	[1 ; 2]	[1 ; 1]	[1 ; 1]
4	[0 ; 0]	[1 ; 1]	[1 ; 2]	[0 ; 1]	[1 ; 1]
5	[1 ; 1]	[1 ; 1]	[0 ; 1]	[0 ; 1]	[1 ; 2]
6	[1 ; 1]	[0 ; 0]	[1 ; 2]	[1 ; 1]	[1 ; 1]
7	[1 ; 1]	[1 ; 2]	[0 ; 1]	[0 ; 0]	[1 ; 1]
8	[0 ; 0]	[0 ; 1]	[1 ; 2]	[0 ; 0]	[1 ; 1]
9	[1 ; 2]	[0 ; 1]	[0 ; 0]	[0 ; 1]	[1 ; 2]
10	[1 ; 2]	[1 ; 1]	[0 ; 1]	[0 ; 0]	[1 ; 1]
11	[1 ; 2]	[0 ; 0]	[0 ; 0]	[0 ; 1]	[0 ; 0]
12	[1 ; 2]	[0 ; 1]	[0 ; 0]	[0 ; 0]	[1 ; 1]
13	[0 ; 0]	[1 ; 1]	[1 ; 1]	[0 ; 0]	[0 ; 0]
14	[1 ; 1]	[0 ; 1]	[1 ; 2]	[0 ; 1]	[0 ; 1]
15	[0 ; 0]	[0 ; 0]	[0 ; 1]	[1 ; 1]	[1 ; 2]
16	[1 ; 1]	[1 ; 2]	[1 ; 1]	[1 ; 2]	[1 ; 1]
17	[0 ; 0]	[1 ; 1]	[1 ; 1]	[1 ; 2]	[0 ; 1]
18	[1 ; 2]	[0 ; 1]	[0 ; 1]	[0 ; 0]	[0 ; 1]
19	[0 ; 0]	[0 ; 1]	[1 ; 2]	[1 ; 1]	[1 ; 1]
20	[1 ; 1]	[1 ; 1]	[1 ; 1]	[0 ; 1]	[1 ; 2]
0-150	[83 ; 159]	[73 ; 140]	[72 ; 147]	[75 ; 155]	[83 ; 150]

Table 3 studies the factor effects on the fulfillment of the right to education, for 150 days, with an occurrence level of [0; 2] for each factor per day. There is a total indeterminacy level of a=76, b=67, c=75, d=80, e=67, with a representativeness level of $[44.66\% < 51.61\%]$ on days when 2 affectations per factor were recorded. A 50% higher incidence is observed in eliminating differences and providing free and mandatory education. As a result of the existing indeterminacy, the use of classical statistics is not possible, so the use of neutrosophic statistics is necessary for its greater understanding.

3.1. Neutrosophic Statistical Analysis

In the modeling of the data of the affectations that alter education for all young people (table 4), it will be possible to understand what factor implies a representative mean $\underline{x} = \in [\underline{x}_I; \underline{x}_U]$, the values of the neutrosophic means are calculated, and for the study of the variations of the affectations, the values of the neutrosophic standard deviation $S_N \in [S_L; S_U]$. The values are calculated to determine which affectation requires a greater incidence in the right to education.

Doi : https://doi.org/10.54216/IJNS.180405
Received: February 27, 2022 Accepted: June 18, 2022

Table 4: Neutrosophic statistical analysis of the incidences of education.

Factors	$\underline{x}_N$	S_N	CV_N
Reform legal and political frameworks	[0.553 ; 1.06]	[0.126 ; 0.988]	[0.228 ; 0.932]
Provide free and mandatory education	[0.487 ; 0.933]	[0.125 ; 1,015]	[0.257 ; 1,088]
Eliminate differences	[0.48 ; 0.98]	[0.125 ; 0.965]	[0.26 ; 0.985]
Education financing	[0.5 ; 1,033]	[0.125 ; 1,028]	[0.25 ; 0.995]
Lack of compromise	[0.553 ; 1]	[0.126 ; 1,018]	[0.228 ; 1,018]

Table 4 shows that *reforming legal and political frameworks* has higher incidence values than the other factors. This means that for the RLPF factor is, on average, the one that has the most impact and compliance with the rights of older students to education. In affirmation of the value of for this factor CV_{No}, is lower compared to the others. This means that the result of RLPF has a negative and more significant impact than other factors on the right to education.

3.2. Comparative analysis

To determine the associated referent uncertainty measure for para $\underline{x} = \in [\underline{x}_L; \underline{x}_U], S_N \in [S_L; S_U]$ and $CV_N \in [CV_L\ ;\ CV_U]$ to the form of neutrosophic numbers (Table 5), it is observed that the values vary from 0.228 to 0.932, with a measure of indeterminacy of 75.5. This generates a negative impact to comply with the reforms to the legal frameworks for better fulfillment of the right to education and its influence on the other affectations. The governing bodies are required to focus on regulations and policies for student training.

Table 5: Neutrosophic forms with a measure of indeterminacy.

Factors	$\underline{x}_N$	S_N	CV_N
RLPF	0.553 + 1.06 I; $I \in [0; 47.8]$	0.126 + 0.988 I; $I \in [0; 87.2]$	0.228 + 0.932 I; $I \in [0; 75.5]$
PFME	0.487 + 0.933 I; $I \in [0; 47.8]$	0.125 + 1.015 I; $I \in [0; 87.7]$	0.257 + 1.088 I; $I \in [0; 76.4]$
ED	0.48 + 0.98 I; $I \in [0; 51.0]$	0.125 + 0.965 I; $I \in [0; 87.0]$	0.26 + 0.985 I; $I \in [0; 73.6]$
EF	0.5 + 1.033 I; $I \in [0; 51.6]$	0.125 + 1.028 I; $I \in [0; 87.8]$	0.25 + 0.995 I; $I \in [0; 74.9]$

Doi : https://doi.org/10.54216/IJNS.180405
Received: February 27, 2022 Accepted: June 18, 2022

LC	0.553 + 1I; $I \in [0; 44.7]$	0.126 + 1.018 I; $I \in [0; 87.6]$	0.228 + 1.018 I; $I \in [0; 77.6]$

TOPSIS analysis

TOPSIS modeling is used to determine possible alternatives using regulations and policies for student training. The strategies to be evaluated are focused on monitoring standards and policies for student training and potentiate the following parameters:

- There is no economic policy in favor of university students over 21 years of age
- Pensions only protect university students up to 21 years of age
- Student desertion from universities
- Change in living standards that facilitated access to universities with the support of parents
- Entry into the labor regime, which limits compliance with permanence in classrooms and university school activities
- Cuts aimed at economic aid to the education sector with a negative impact on university students

The results are shown in the following Tables:

Table 6: Table of the weights assigned by the experts to each criterion.

Alternatives	**Submit economic policies**	**Increase personal income**	**Maintain pensions until age 24**	**Equity of resources between universities**	**Extension of maintenance scholarships to third-level students**	**Present policies of a social nature**
Economic policy	(0.95, 0.05, 0.05)	(0.95, 0.05, 0.05)	(0.25, 0.60, 0.80)	(0.95, 0.05, 0.05)	(0.95, 0.05, 0.05)	(0.80, 0.10, 0.30)
Pensions	(0.65, 0.30, 0.45)	(0.80, 0.10, 0.30)	(0.50, 0.40, 0.60)	(0.65, 0.30, 0.45)	(0.65, 0.30, 0.45)	(0.65, 0.30, 0.45)
Student desertion	(0.95, 0.05, 0.05)	(0.25, 0.60, 0.80)	(0.25, 0.60, 0.80)	(0.95, 0.05, 0.05)	(0.95, 0.05, 0.05)	(0.95, 0.05, 0.05)
Change of standards	(0.65, 0.30, 0.45)	(0.10, 0.75, 0.85)	(0.10, 0.75, 0.85)	(0.80, 0.10, 0.30)	(0.10, 0.75, 0.85)	(0.10, 0.75, 0.85)
Entry into the labor regime	(0.95, 0.05, 0.05)	(0.80, 0.10, 0.30)	(0.25, 0.60, 0.80)	(0.10, 0.75, 0.85)	(0.10, 0.75, 0.85)	(0.10, 0.75, 0.85)
Cuts	(0.95, 0.05, 0.05)	(0.65, 0.30, 0.45)	(0.50, 0.40, 0.60)	(0.10, 0.75, 0.85)	(0.10, 0.75, 0.85)	(0.10, 0.75, 0.85)

Table 7: Weighted normalized matrix. Source: own elaboration

Alternatives	**Submit economic policies**	**Increase personal income**	**Maintain pensions until age 24**	**Equity of resources between universities**	**Extension of maintenance scholarships to third-**	**Present policies of a social nature**

Doi : https://doi.org/10.54216/IJNS.180405
Received: February 27, 2022 Accepted: June 18, 2022

					level students	
Economic policy	0.12909	0.03907	0.08025	0.01111	0.01252	0.12867
Pensions	0.19466	0.04639	0.04494	0.01676	0.01888	0.16339
Student desertion	0.19466	0.01367	0.04494	0.01676	0.01888	0.19402
Change of standards	0.12909	0.00781	0.02568	0.01411	0.00318	0.03268
Entry into the labor regime	0.19466	0.03907	0.04494	0.00282	0.00318	0.03268
Cuts	0.19466	0.03077	0.08025	0.00282	0.00318	0.03268

Table 8: Matrix of the distances and calculation of the R_i for each alternative.

Alternative	**d-**	**d+**	**Ri**	**Order**
Economic policy	0.05099	0.06597	0.43595	5
Pensions	0.11550	0	1	1
Student desertion	0.11198	0.03272	0.77387	4
Change of standards	0.04739	0.07607	0.38385	6
Entry into the labor regime	0.11391	0.00732	0.93957	2
Cuts	0.11265	0.01562	0.87818	3

From the results obtained, it is preferred to promote alternative 1, relative to alimony, or alternative 2, entry into the labor regime, depending on the deficiency to be eradicated. Once they reach the age of majority, third-level students are often forced to drop out and others to look for work, which ultimately end up leaving the university because their economic solvency does not allow them to continue their university program.

- Propose a legal reform to the governing bodies and the State with the proposal to extend up to 24 years the payment of alimony for supporting college students
- Propose aid programs for university students over 21 years of age who are backed by a difficult economic situation.

Doi : https://doi.org/10.54216/IJNS.180405
Received: February 27, 2022 Accepted: June 18, 2022

4. Conclusions

Any decision method that implies the criteria of experts imposes the presence of subjectivity to the decision-making process. Therefore, there is a risk of including parameters intangible and difficult to measure, which is why in research topics it is usually use a qualitative estimate that is generally descriptive and does not offer a measure accurate risk and its uncertainty. You can appreciate the possibility offered by the neutrosophic theory to carry out the quantification of the risks that affect the decision-making process that is exposed to uncertainty due to diverse opinions and largely of the experts in the area, managing to adjust the results within the procedure used to state a possible solution to the issue of alimony.

The right to education is often violated due to the effectiveness of the application of current legal regulations. In Ecuador, there is a need to design a reform proposal, which introduces the suspension of alimony after 24 years. The Government must encourage and indicate to the governing bodies in the legal field the revision of the current legislation. It is necessary to protect students of legal age, whose parents when they turn 21 suspend their alimony regardless of whether they pursue a university career. Propose reforms on alimony and aid programs for university students over 21 years of age, backed by a difficult economic situation and still pursuing higher education and have an unfavorable economic situation. The method applied seeks to promote alternatives to improve the educational situation in Ecuador. The need to extend alimony up to 24 years of age is formulated so that all young people have the right not only to education and a university career but also to a job and a decent life.

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