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# Study of the Situation of Venezuelan Emigrants in Ecuador based on NeutroAlgebra

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**Abstract**. Venezuelan migration to neighboring countries in the area is a phenomenon that has been growing in recent years. Ecuador is one of the main countries where migrants who leave Venezuela have gone to reside.They initially arrived in the country as a transit to reach other countries, however, over time many of them decided to settle in Ecuador permanently. Venezuelan migration in our country presents certain characteristics, such as the youth of those who arrive, the high educational level, and the motivation for economic improvement that prompted them to emigrate at first and in a second wave for family reunification. This research aims to apply a survey to know more precisely the economic, social, labor, and humanitarian situation of this sector of migration in the country. We selected a model that uses NeutroAlgebra and is generated by the PROSPECTOR function. PROSPECTOR function is the well-known function used in the classic medical expert system MYCIN, while NeutroAlgebra is an algebra that has at least one NeutroOperation or one NeutroAxiom, where some cases are indeterminate. This model has previously been used in the evaluation of medical care of migrants in Chile. However, unlike the model we are inspired on, here input data are linguistic terms associated with Single-Valued Neutrosophic Numbers, which allows respondents to express more reliably what they want to say.

**Keywords:** migration, single-valued triangular neutrosophic number, PROSPECTOR function, NeutroFunction, NeutroAlgebra

## 1 Introduction

Until September 2019, approximately 4.3 million people left Venezuela. Eighty percent emigrated to Latin America, and the main recipient countries have been Colombia, Peru, and Ecuador [1]. At the beginning of the Venezuelan exodus, Ecuador was characterized as a transit country to Peru or other countries of the Southern Cone such as Chile and Argentina. However, between 2015 and September 2019, almost 400,000 Venezuelans decided to settle in Ecuador.

To deal with thesecircumstances, the Government of Ecuador asked the World Bank to analyze the situation to make informed policy decisions that allow compliance with the constitutional duty to guarantee human mobility, health, and education services. Accordingly, the World Bank worked together with six United Nations agencies, the Survey of People in Human Mobility and Host Communities in Ecuador (in Spanish EPEC). In addition, qualitative information was collected through focus groups. Based on the survey, the focus groups, and the analysis of administrative data from different sectors, a report was prepared on the situation of the Venezuelan population in Ecuador.

Venezuelans in mobility are, on average, 26 years old, 3 less than the average age of Ecuadorians in host communities. These migrants are also younger than those of other nationalities: just over a third of migrants of other nationalities are between 19 and 35. In addition, the majority of the Venezuelan population in the country has a secondary education, and the Ecuadorian host population has a predominantly level of primary education. Similarly, the proportion of the population with third-level education is higher for migrants, particularly for women.

Until July 2019, more than 80% of those who entered the country registered their entry through an official way, but 54% of those who reside are in an irregular situation. Among Venezuelans who arrived in 2016, 9 out of 10 had a valid ID document. However, the situation of those who arrived later was much more precarious. Among migrants who arrived in 2017, 2018, and 2019, 44 percent, 63 percent, and 45 percent did not have regular status, respectively. More than half of whom did not register their entry did not have a valid ID card, passport, or Andean letter. A large proportion of migrants did not register their entry because: they did not meet the immigration requirements, they did so because of irregular points, they were sick, or because of the lack of authorization from the parents of minor children. More than 80 percent of Venezuelans on the move report having a passport that expires between 2019 and 2020. This shows the possibility that a large part of this population will pass through an irregular migratory status in the coming years if they do not have the information or sufficient resources to carry out the regularization procedures in Ecuador. Given this reality, in July 2019, decree 826 was issued that recognizes the validity of the passport up to five years after its expiration date.

The flow of migrants is expected to increase in the region because a contraction in the Venezuelan economy occurred in 2019 and because of family reunification. For example, in Peru, one-third of the total flow of migrants are children, suggesting that family reunification is an important motivation. In the case of Ecuador, more than half of Venezuelans chose their destination city motivated by their family, and about 40 percent plan to bring their relatives within the next two years.

Venezuela is going through a deep crisis, whose impacts resemble a country's conditions at war and cause a massive exodus. Thus, Venezuelan economic contraction in the last five years is comparable to that of Sierra Leone in 1991 and Rwanda in 1994. In addition, the Venezuelan migration is similar to the refugee crises experienced in other countries such as Syria, Afghanistan, Somalia, and South Sudan. In the first wave of migration, Venezuela's economic situation and insecurity were the main reasons for leaving the country. Between 2016 and 2017, most were expelled because of the economic situation, and about a third left because of insecurity. It is also observed that 32% of men arrived first to look for work. In the second wave of migration, family reunification was the main reason for emigration. For those who migrated between 2018 and 2019, family reunification began to be an important reason to leave Venezuela. Mainly women, children, and adolescents (41%) were part of this second migratory movement.

The authors of this research decided to survey Venezuelan emigrants in the country to know their social, economic, humanitarian, and labor conditions. We consider that, beyond the information that the application of a classical statistical test could provide, we need a mathematical tool where respondents could express qualitatively, preferably using a linguistic scale, their opinion on the different aspects of their lives that we were interested in studying. Additionally, the used model should allow us to decide why it is important to take into account the aggregation operator used to perform this study.

We determined to use the model that appeared in [2], which is a method based on NeutroAlgebra theory. However, in this paper, we make some modifications, where instead of respondents proposing an assessment based on a scale of -10 to 10, we use a linguistic scale that allows them to express more reliably what they want to say. For this purpose, the original method is adapted to these new features. In other words, the objective of this article is to determine the situation of Venezuelan migrants through the use of the evaluative model appeared in [2], utilizing input data based on a scale of linguistic terms. A NeutroAlgebra is an algebra that has at least one NeutroOperation or one NeutroAxiom (axiom that is true for some elements, indeterminate for other elements, and false for the other elements), [2-12]. The linguistic scale is associated with Single-Valued Neutrosophic Numbers.

This article has the following structure:Section 2 contains the main concepts used in this research. Section 3 contains the adaptation of the model used in [2] adapted to the input data of the survey that was conducted and also the results of the study. The last section shows the conclusions.

## 2 Preliminaries

This section summarizes the main theories and concepts used to do this study. Subsection 2.1 contains the concept of single-valued triangular neutrosophic numbers, whereas subsection 2.2 contains NeutroAlgebra and PROSPECTOR function [13].

### 2.1 Single-valued triangular neutrosophic number

**Definition 1** [14]: The *Neutrosophic set* N is characterized by three membership functions, which are the truth-membership function $T_A$, indeterminacy-membership function $I_A$,and falsity-membership function $F_A$, where U is the Universe of Discourse and $\forall x \in U$, $T_A(x), I_A(x), F_A(x) \subseteq ]^-0, 1^+[$, and $^-0 \leq \inf T_A(x) + \inf I_A(x) + \inf F_A(x) \leq \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \leq 3^+$.

See that according to Definition 1, $T_A(x), I_A(x), F_A(x)$ are real standard or non-standard subsets of $]^-0, 1^+[$ and hence, $T_A(x), I_A(x), F_A(x)$ can be subintervals of $[0, 1]$.

**Definition 2** ([14]): The *Single-Valued Neutrosophic Set* (SVNS) N over U is $A = \{< x;\ T_A(x), I_A(x), F_A(x) >: x \in U\}$, where $T_A: U \rightarrow [0, 1]$, $I_A: U \rightarrow [0, 1]$, and $F_A: U \rightarrow [0, 1]$, $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

The *Single-Valued NeutrosophicNumber* (SVNN) is symbolized by$N = (t, i, f)$, such that $0 \leq t, i, f \leq 1$ and $0 \leq t + i + f \leq 3$.

**Definition 3** [14-16]:The *single-valued triangular neutrosophic number* $\tilde{a} = \langle(a_1, a_2. a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle$, is a neutrosophic set on $\mathbb{R}$, whose truth, indeterminacy and falsity membership functions are defined as follows, respectively:

$$T_{\tilde{a}}(x) = \begin{cases} \alpha_{\tilde{a}\left(\frac{x-a_1}{a_2-a_1}\right)}, & a_1 \le x \le a_2 \\ \alpha_{\tilde{a},} & x = a_2 \\ \alpha_{\tilde{a}\left(\frac{a_3-x}{a_3-a_2}\right)}, & a_2 < x \le a_3 \\ 0, & \text{otherwise} \end{cases} \tag{1}$$

$$I_{\tilde{a}}(x) = \begin{cases} \dfrac{\left(a_2 - x + \beta_{\tilde{a}}(x - a_1)\right)}{a_2 - a_1}, & a_1 \le x \le a_2 \\ \beta_{\tilde{a}}\,, & x = a_2 \\ \dfrac{\left(x - a_2 + \beta_{\tilde{a}}(a_3 - x)\right)}{a_3 - a_2}, & a_2 < x \le a_3 \\ 1, & \text{otherwise} \end{cases} \tag{2}$$

$$F_{\tilde{a}}(x) = \begin{cases} \dfrac{\left(a_2 - x + \gamma_{\tilde{a}}(x - a_1)\right)}{a_2 - a_1}, & a_1 \le x \le a_2 \\ \gamma_{\tilde{a}}\,, & x = a_2 \\ \dfrac{\left(x - a_2 + \gamma_{\tilde{a}}(a_3 - x)\right)}{a_3 - a_2}, & a_2 < x \le a_3 \\ 1, & \text{otherwise} \end{cases} \tag{3}$$

Where $\alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \in [0, 1]$, $a_1, a_2, a_3 \in \mathbb{R}$and $a_1 \le a_2 \le a_3$.

**Definition 4** ([14-16]): Given $\tilde{a} = \langle(a_1, a_2, a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle$ and $\tilde{b} = \langle(b_1, b_2, b_3); \alpha_{\tilde{b}}, \beta_{\tilde{b}}, \gamma_{\tilde{b}}\rangle$ two single-valued triangular neutrosophic numbers and λ any non-null number in the real line. Then, the following operations are defined:

1. Addition: $\tilde{a} + \tilde{b} = \langle(a_1 + b_1, a_2 + b_2, a_3 + b_3); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle$
2. Subtraction: $\tilde{a} - \tilde{b} = \langle(a_1 - b_3, a_2 - b_2, a_3 - b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle$
3. Inversion: $\tilde{a}^{-1} = \langle(a_3{}^{-1}, a_2{}^{-1}, a_1{}^{-1}); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle$, where $a_1, a_2, a_3 \neq 0$.
4. Multiplication by a scalar number:
$$\lambda\tilde{a} = \begin{cases} \langle(\lambda a_1, \lambda a_2, \lambda a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle, & \lambda > 0 \\ \langle(\lambda a_3, \lambda a_2, \lambda a_1); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle, & \lambda < 0 \end{cases}$$
5. Division of two triangular neutrosophic numbers:
$$\frac{\tilde{a}}{\tilde{b}} = \begin{cases} \left\langle\left(\frac{a_1}{b_3}, \frac{a_2}{b_2}, \frac{a_3}{b_1}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\right\rangle, a_3 > 0 \; and b_3 > 0 \\ \left\langle\left(\frac{a_3}{b_3}, \frac{a_2}{b_2}, \frac{a_1}{b_1}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\right\rangle, a_3 < 0 \; and b_3 > 0 \\ \left\langle\left(\frac{a_3}{b_1}, \frac{a_2}{b_2}, \frac{a_1}{b_3}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\right\rangle, a_3 < 0 \; and b_3 < 0 \end{cases}$$
6. Multiplication of two triangular neutrosophic numbers:
$$\tilde{a}\tilde{b} = \begin{cases} \langle(a_1 b_1, a_2 b_2, a_3 b_3); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle, & a_3 > 0 \; and b_3 > 0 \\ \langle(a_1 b_3, a_2 b_2, a_3 b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle, & a_3 < 0 \; and b_3 > 0 \\ \langle(a_3 b_3, a_2 b_2, a_1 b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle, & a_3 < 0 \; and b_3 < 0 \end{cases}$$

Where, $\wedge$ is a t-norm and $\vee$ is a t-conorm, [17].

Let $\tilde{a} = \langle(a_1, a_2, a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle$ be a single-valued triangular neutrosophic number, then,

$$S(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} - \gamma_{\tilde{a}}) \tag{4}$$

$$\mathbf{A}(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} + \gamma_{\tilde{a}}) \tag{5}$$

They are called the score and accuracy degrees of ã, respectively.

Let $\{\tilde{A}_1, \tilde{A}_2, \cdots, \tilde{A}_n\}$ be a set of n SVTNNs, where $\tilde{A}_j = \langle(a_j, b_j, c_j); \alpha_{\tilde{a}_j}, \beta_{\tilde{a}_j}, \gamma_{\tilde{a}_j}\rangle$ (j = 1, 2, …, n), then the *weightedmean of the SVTNNs* is calculated with the following Equation:

$$\widetilde{A} = \sum_{j=1}^{n} \lambda_j \widetilde{A}_j \tag{6}$$

Where $\lambda_j$ is the weight of $A_j$, $\lambda_j \in [0, 1]$ and $\sum_{j=1}^{n} \lambda_j = 1$.

### 2.2 NeutroAlgebra and PROSPECTOR combination function

**Definition 5** ([3, 4]): Let X be a given nonempty space (or simply set) included into a universe of discourse U. Let <A> be an item (concept, attribute, idea, proposition, theory, etc.) defined on the set X. Then, through the process of neutrosophication, we split the set X into three regions [two opposite ones <A> and <antiA>, and one neutral (indeterminate) <neutroA> between them], regions which may or may not be disjoint – depending on the application, but they are exhaustive (their union equals the whole space).

A *NeutroAlgebra* is an algebra with at least one *NeutroOperation* or one *NeutroAxiom* (axiom that is true for some elements, indeterminate for other elements, and false for other elements).

The NeutroAlgebra is a generalization of *Partial Algebra*, an algebra with at least one *Partial Operation*, while all its Axioms are true (classical axioms).

**Definition 6** ([3, 4]): A function f: X → Y is called a *Partial Function* if it is well-defined for some elements in X, and undefined for all the other elements in X. Therefore, there exist some elements $a \in X$ such that $f(a) \in Y$ (well-defined), and for all other element $b \in X$ we have $f(b)$ is undefined.

**Definition 7** ([3, 4]): A function f: X → Y is called a *NeutroFunction* if it has elements in X for which the function is well-defined {degree of truth (T)}, elements in X for which the function is indeterminate {degree of indeterminacy (I)}, and elements in X for which the function is outer-defined {degree of falsehood (F)}, where $T, I, F \in [0,1]$, with $(T, I, F) \neq (1, 0, 0)$ that represents the (Total) Function, and $(T, I, F) \neq (0, 0, 1)$ that represents the AntiFunction.

**Classification of Functions**

i) (Classical) Function, which is a function well-defined for all the elements in its domain of definition.

ii) NeutroFunction, which is a function partially well-defined, partially indeterminate, and partially outer-defined on its domain of definition.

iii) AntiFunction, which is a function outer-defined for all the elements in its domain of definition.

**Definition 8** ([3, 4]): A (classical) *Algebraic Structure* (or Algebra) is a nonempty set *A* endowed with some (totally well-defined) operations (functions) on *A*, and satisfying some (classical) axioms (totally true) - according to the Universal Algebra.

**Definition 9** ([3, 4]): A (classical) *Partial Algebra* is an algebra defined on a nonempty set *PA* that is endowed with some partial operations (or partial functions: partially well-defined and partially undefined). While the axioms (laws) defined on a Partial Algebra are all totally (100%) true.

**Definition 10** ([3, 4]): A *NeutroAxiom* (or *Neutrosophic Axiom*) defined on a nonempty set is an axiom that is true for some set of elements {degree of truth (T)}, indeterminate for another set of elements {degree of indeterminacy (I)}, or false for the other set of elements {degree of falsehood (F)}, where $T, I, F \in [0,1]$, with $(T, I, F) \neq (1, 0, 0)$ that represents the (classical) Axiom, and $(T, I, F) \neq (0, 0, 1)$ that represents the AntiAxiom.

**Classification of Algebras**

i) A (classical) *Algebra* is a nonempty set *CA* that is endowed with total operations (or total functions, i.e. true for all set elements) and (classical) Axioms (also true for all set elements).

ii) A *NeutroAlgebra* (or *NeutroAlgebraic Structure*) is a nonempty set *NA* that is endowed with: at least one *NeutroOperation* (or *NeutroFunction*), or one *NeutroAxiom* that is referred to the set (partial-, neutro-, or total-) operations.

iii) An *AntiAlgebra* (or *AntiAlgebraic Structure*) is a nonempty set *AA* that is endowed with at least one *AntiOperation* (or *AntiFunction*) or at least one *AntiAxiom*.

Additionally, the PROSPECTOR combination function is defined in the PROSPECTOR expert system in the following way; it is a mapping from $[-1, 1]^2$ into $[-1, 1]$ with formula, [18-20]:

$$P(x, y) = \frac{x+y}{1+xy} \tag{7}$$

This function is a uninorm with neutral element 0, thus it fulfills commutativity, associativity, and monotonicity, see the different types of uninorms in [19-25], which include those defined for offsets [26-28]. $P(-1,1)$ and $P(1, -1)$ are undefined.

### 3 Results

First of all, we use a scale of linguistic terms for respondents to evaluate their opinions about what we want to study, this scale and its corresponding single-valued triangular neutrosophic number is summarized in the table below:

| **Linguistic term** | **SVTNN** |
|---|---|
| Very low (VL) | $\langle(0,0,1); 0.00, 1.00, 1.00\rangle$ |
| Medium-low (ML) | $\langle(0, 1, 3); 0.17, 0.85, 0.83\rangle$ |
| Low (L) | $\langle(1, 3,5); 0.33, 0.75, 0.67\rangle$ |
| Medium(M) | $\langle(3, 5,7); 0.50, 0.50, 0.50\rangle$ |
| High (H) | $\langle(5, 7,9); 0.67, 0.25, 0.33\rangle$ |
| Medium-high (MH) | $\langle(7, 9, 10); 0.83, 0.15, 0.17\rangle$ |
| Very high (VH) | $\langle(9,10, 10); 1.00, 0.00, 0.00\rangle$ |

**Table 1:** Scale of linguistic terms and neutrosophic triangular scale associated with them. Source: [29].

Let us note that the elements in Table 1 correspond to the agreement (positive) evaluations of the respondents. The disagreement scale is calculated based on the same elements such that its SVTNN is multiplied by the scalar $\lambda = -1$. For example, the term “very low agree” on the fulfillment of a certain criterion is associated with the SVTN $\langle(0,0, 1); 0.00, 1.00, 1.00\rangle$, whereas “very low disagree” is calculated as $(-1)\langle(0,0, 1); 0.00, 1.00, 1.00\rangle = \langle(-1,0,0); 0.00, 1.00, 1.00\rangle$.

On the other hand, for the aggregation of the survey values, the operator generated by the PROSPECTOR combination function [2] is used, which corresponds to Tables 2 and 3.

| $x \odot y$ | **-1** | **-0.9** | **-0.8** | **-0.7** | **-0.6** | **-0.5** | **-0.4** | **-0.3** | **-0.2** | **-0.1** | **0** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **-1** | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| **-0.9** | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -0.9 | -0.9 | -0.9 | -0.9 |
| **-0.8** | -1 | -1 | -1 | -1 | -0.9 | -0.9 | -0.9 | -0.9 | -0.9 | -0.8 | -0.8 |
| **-0.7** | -1 | -1 | -1 | -0.9 | -0.9 | -0.9 | -0.9 | -0.8 | -0.8 | -0.7 | -0.7 |
| **-0.6** | -1 | -1 | -0.9 | -0.9 | -0.9 | -0.8 | -0.8 | -0.8 | -0.7 | -0.7 | -0.6 |
| **-0.5** | -1 | -1 | -0.9 | -0.9 | -0.8 | -0.8 | -0.8 | -0.7 | -0.6 | -0.6 | -0.5 |
| **-0.4** | -1 | -1 | -0.9 | -0.9 | -0.8 | -0.8 | -0.7 | -0.6 | -0.6 | -0.5 | -0.4 |
| **-0.3** | -1 | -0.9 | -0.9 | -0.8 | -0.8 | -0.7 | -0.6 | -0.6 | -0.5 | -0.4 | -0.3 |
| **-0.2** | -1 | -0.9 | -0.9 | -0.8 | -0.7 | -0.6 | -0.6 | -0.5 | -0.4 | -0.3 | -0.2 |
| **-0.1** | -1 | -0.9 | -0.8 | -0.7 | -0.7 | -0.6 | -0.5 | -0.4 | -0.3 | -0.2 | -0.1 |
| **undef.** | -1 | -0.9 | -0.8 | -0.7 | -0.6 | -0.5 | -0.4 | -0.3 | -0.2 | -0.1 | 0 |
| **0** | -1 | -0.9 | -0.8 | -0.7 | -0.6 | -0.5 | -0.4 | -0.3 | -0.2 | -0.1 | 0 |
| **0.1** | -1 | -0.9 | -0.8 | -0.6 | -0.5 | -0.4 | -0.3 | -0.2 | -0.1 | 0 | 0.1 |
| **0.2** | -1 | -0.9 | -0.7 | -0.6 | -0.5 | -0.3 | -0.2 | -0.1 | 0 | 0.1 | 0.2 |
| **0.3** | -1 | -0.8 | -0.7 | -0.5 | -0.4 | -0.2 | -0.1 | 0 | 0.1 | 0.2 | 0.3 |
| **0.4** | -1 | -0.8 | -0.6 | -0.4 | -0.3 | -0.1 | 0 | 0.1 | 0.2 | 0.3 | 0.4 |
| **0.5** | -1 | -0.7 | -0.5 | -0.3 | -0.1 | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 |
| **0.6** | -1 | -0.7 | -0.4 | -0.2 | 0 | 0.1 | 0.3 | 0.4 | 0.5 | 0.5 | 0.6 |
| **0.7** | -1 | -0.5 | -0.2 | 0 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.6 | 0.7 |
| **0.8** | -1 | -0.4 | 0 | 0.2 | 0.4 | 0.5 | 0.6 | 0.7 | 0.7 | 0.8 | 0.8 |
| **0.9** | -1 | 0 | 0.4 | 0.5 | 0.7 | 0.7 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 |
| **1** | undef. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Table 2:** Cayley table of $\odot$.

| $x \odot y$ | **undef.** | **0.1** | **0.2** | **0.3** | **0.4** | **0.5** | **0.6** | **0.7** | **0.8** | **0.9** | **1** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **-1** | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | undef. |
| **-0.9** | -0.9 | -0.9 | -0.9 | -0.8 | -0.8 | -0.7 | -0.7 | -0.5 | -0.4 | 0 | 1 |
| **-0.8** | -0.8 | -0.8 | -0.7 | -0.7 | -0.6 | -0.5 | -0.4 | -0.2 | 0 | 0.4 | 1 |
| **-0.7** | -0.7 | -0.6 | -0.6 | -0.5 | -0.4 | -0.3 | -0.2 | 0 | 0.2 | 0.5 | 1 |
| **-0.6** | -0.6 | -0.5 | -0.5 | -0.4 | -0.3 | -0.1 | 0 | 0.2 | 0.4 | 0.7 | 1 |
| **-0.5** | -0.5 | -0.4 | -0.3 | -0.2 | -0.1 | 0 | 0.1 | 0.3 | 0.5 | 0.7 | 1 |
| **-0.4** | -0.4 | -0.3 | -0.2 | -0.1 | 0 | 0.1 | 0.3 | 0.4 | 0.6 | 0.8 | 1 |
| **-0.3** | -0.3 | -0.2 | -0.1 | 0 | 0.1 | 0.2 | 0.4 | 0.5 | 0.7 | 0.8 | 1 |
| **-0.2** | -0.2 | -0.1 | 0 | 0.1 | 0.2 | 0.3 | 0.5 | 0.6 | 0.7 | 0.9 | 1 |
| **-0.1** | -0.1 | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.8 | 0.9 | 1 |
| **undef.** | undef. | undef. | undef. | undef. | undef. | undef. | undef. | undef. | undef. | undef. | undef. |
| **0** | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0.1** | undef. | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.7 | 0.8 | 0.9 | 1 |
| **0.2** | undef. | 0.3 | 0.4 | 0.5 | 0.6 | 0.6 | 0.7 | 0.8 | 0.9 | 0.9 | 1 |
| **0.3** | undef. | 0.4 | 0.5 | 0.6 | 0.6 | 0.7 | 0.8 | 0.8 | 0.9 | 0.9 | 1 |
| **0.4** | undef. | 0.5 | 0.6 | 0.6 | 0.7 | 0.8 | 0.8 | 0.9 | 0.9 | 1 | 1 |
| **0.5** | undef. | 0.6 | 0.6 | 0.7 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 1 | 1 |
| **0.6** | undef. | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 1 | 1 |
| **0.7** | undef. | 0.7 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 1 | 1 | 1 |
| **0.8** | undef. | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1 | 1 | 1 | 1 |
| **0.9** | undef. | 0.9 | 0.9 | 0.9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **1** | undef. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Table 3:** Cayley table of $\odot$ (Continuation).

See that $\odot$ is not always associative, e.g. let $a = -0.9$, $b = 0.8$, $c = undefined$, then this implies $a \odot (b \odot c) = a$ and $(a \odot b) \odot c = -0.4 \neq a$. Let us note that we always choose the "worst" option, where negative is worst than "undefined" and "undefined " is worst than "positive". We have also some other properties that are not hard to prove. They are that $\odot$ is an internal function, it is commutative, and every element has an inverse. If x<0, then both e = 0 and e = "undefined" are the neutral elements, whereas, e = 0 is also the neutral value for x≥0.

A group of 384 Venezuelan emigrants in Ecuador were asked a series of questions to assess various criteria. The five criteria to evaluate (denoted by $C_1$, $C_2$, $C_3$, $C_4$, $C_5$) and the questions that were asked are detailed below, [1]:

**C1. Integration into the labor market**

1.1. Because of their economic status, Venezuelan migrants often work under less favorable conditions.
1.2. Young and less skilled Ecuadorian workers are affected by migration.
1.3. Venezuelan workers do not have access to jobs commensurate with their level of preparation.

**C2. Schooling**

2.1. Despite free access, many school-age Venezuelan migrants do not attend the education system.
2.2. The main informal barriers migrants face in accessing education are the lack of quotas and documentation.
2.3. The main barrier to the permanence of all students is the payment requested by educational centers.
2.4. Other barriers to access to education include discrimination and xenophobia.

**C3. Health system**

3.1. The migrant population has a more favorable state of health than the host population.
3.2. Free access to health services does not guarantee that the majority of the needed population will have access to a public or private facility.
3.3. Migration status is an impediment to access health services for migrants who attend more public establishments.
3.4. Migrants are dissatisfied with health services.
3.5. Migrants and host populations face different difficulties.

**C4. Social risks**

4.1. A significant proportion of foster and migrant households are affected by one or more of the following risks: poverty, chronic malnutrition, child labor, or adolescent pregnancy.
4.2. Migrants cannot benefit from financial transfers.
4.3. The Venezuelan population in mobility also benefited from school feeding, uniforms, and text programs. However, coverage is much lower for migrants in care services and even less in transfers than their Ecuadorian peers are.

**C5. Discrimination**

5.1. Discrimination is a problem that affects both, the Venezuelan population and Ecuadorians in the host communities.
5.2. Discrimination permeates all areas of society.
5.3. Most Ecuadorians believe that Venezuelan migrants have a negative impact on the economy and are a bad influence on the culture of society.
5.4. Although the crimes decreased in the last five years, Ecuadorians' perception of insecurity rose and is attributed to the arrival of migrants, as in other countries in the region.

The method that will be followed to evaluate Venezuelan migrants' situation in Ecuador is the following:

1. The survey is conducted based on the linguistic scale explained above. See Table 1 and the explanation.
2. Variables $x_{ijk}$ are designated according to SVTNN associated with the linguistic scale, which is the opinion of the i-th surveyed (i=1,2,..., 384), on the j-th aspect to be evaluated (j = 1, 2,..., $j_k$) within the k-th criterion (k=1,2,..., 5).

3. For every i (i=1,2,...,384) and every k (k=1,2,...,5) it is calculated $\bar{x}_{ik} = \sum_{j=1}^{j_k} \lambda_j x_{ijk}$, where $\lambda_j = \frac{1}{j_k}$. That is, $\bar{x}_{ik}$ is the arithmetic mean of the SVTNN using formula 6, of each respondent for all aspects of each criterion.
4. Convert $\bar{x}_{ik}$ to crisp values by applying the accuracy degree formula 5, such that $\bar{y}_{ik} = \mathbf{A}(\bar{x}_{ik})$.
5. The values of $\bar{y}_{ik}$ are rescaled to $\bar{\bar{y}}_{ik} = \frac{\bar{y}_{ik}}{10}$ if $-10 \leq \bar{y}_{ik} \leq 10$, while $\bar{\bar{y}}_{ik} = -1$ or $1$, if $\bar{y}_{ik} < -10$ or $> 10$.
6. The results are aggregated for all respondents, as follows:
   6.1. If < 20% of respondents satisfy that their opinions are extreme, i.e. $\bar{\bar{y}}_{ik} = -1$ or $1$, then the following formula applies:
   $\tilde{y}_k = \odot_{i=1}^{n} \frac{\text{round}(\bar{\bar{y}}_{ik}*10)}{10}$. Where n is the number of respondents with non-extreme opinions, i.e. $\bar{\bar{y}}_{ik} \neq -1$ or $1$.
   Where round is the rounding function and $\odot$ is the NeutroOperator defined in Tables 2 and 3.
   6.2. If > 10% of opinion pairs of respondents about criterion k are of the type $(-1, 1)$ it is considered that there are contradictions between the results of the k-th aspect and the results are considered undefined, so this will need further analysis.
   6.3. If > 20% of respondents have extreme opinions of the same type, either -1 or 1, and do not fall in the case above, then $\tilde{y}_k = -1$ or $1$ is considered, depending on the prevailing opinion.

According to the study, the result was summarized in Table 4.

| Aspect to assess | Result |
|---|---|
| Integration into the labor market | 1 |
| Schooling | 1 |
| Health system | -0.6 |
| Social risks | -0.7 |
| Discrimination | 1 |

**Table 4:** Results of the poll aggregated per criteria.

The results shown in Table 4 are interpreted as evidence of an unfavorable situation for Venezuelan migration in Ecuador in terms of integration in the labor market, schooling, and discrimination by the Ecuadorian population. In terms of health care and social risks, the results are more favorable.

## Conclusion

The political, economic, and social situation in Venezuela has produced a migratory flow to neighboring countries, including Ecuador. As a result, migrants from this country needed special attention from the Ecuadorian authorities and citizens. This paper studied the situation of Venezuelan migrants who arrived in Ecuador in the last few years. To achieve this objective, 384 Venezuelans living in Ecuador were surveyed regarding five fundamental criteria of their lives: integration into the local labor market, their children's attendance at educational institutions, access to health, the social risks they may be subjected to within the new host society, and finally the discrimination they suffer. The mathematical tools used were the single-valued triangular neutrosophic number associated with a linguistic assessment scale. The use of linguistic scales allows the respondent to express more precisely what they think. For aggregation, a combination of the arithmetic means is used to evaluate the personal opinion, together with a NeutroOperator generated by the PROSPECTOR function to aggregate the collective opinion. The result is that there exists an unfavorable situation in terms of the labor market, schooling, and discrimination, while it is more favorable in terms of the health system and social risks. Measures should therefore be taken to improve the overall situation, particularly in the first three mentioned areas. Let us note that when we explicitely include the term "undefined" and we consider that if x>0, y<0, then $y \prec \text{"undefined"} \sim 0 \prec x$, we obtain a non-associative Algebra, however this criteria have been proved to be accepted by experts for evaluating.

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