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Indeterminate Likert Scale for the Analysis of the Incidence of the Organic Administrative Code in the current Ecuadorian Legislation

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Abstract. In this investigation, we make use of the indeterminate Likert scale to analyze the results of a survey applied to legal professionals in the province of Tulcán, Ecuador, on the incidence of the Administrative Organic Code in the current legal system. With the use of this scale, we sought the possibility that the surveyed professionals would express their degree of acceptance, indetermination, and non-acceptance of this code. The results we obtained showed positive levels of acceptance, especially among public employees of the Decentralized Autonomous Governments, but also significant values of indetermination or neutrality.

Keywords: Triple Refined Indeterminate Neutrosophic Sets, Likert scale, satisfaction index.

1 Introduction

The entry into force of the Organic Administrative Code (OAC), a regulatory body from which The State has the power to organize itself. Therefore, its analysis involves making observations and clarifications with the highest standards of application of investigative methods and techniques [1].

This Code regulates the exercise of the administrative function of the agencies that make up the public sector. Individuals are entitled to the right to good public administration, which is specified in the application of the Constitution, the International Instruments, the Law and this Code. Individuals shall comply, without the need for any additional requirement, with the provisions of the Constitution, the Laws and the Legal Order in general and the decisions adopted by the competent authority. The Legislative Function approved this body of regulations in June 20, 2017 in the official Registry Number R.O. 31, Second Supplement [2, 3].

The problem of legal analysis of the OAC and its impact on the current Ecuadorian legal system is described fundamentally in terms of the changes that this new legal body makes within the legal framework. In a block of constitutionality, as well as the formal adaptation that has been made upon the basic guarantees of due process. A neo-constitutional trend, the limitation of state power that historically had not been addressed, since administrative law as such presents facultative attributions of the state that historically had not been admitted as such within the processes and procedures [4, 5].

In order to process the results, we proposed to use an indeterminate Likert scale based on Neutrosophy instead of a classic Likert scale[6].

A typical Likert scale survey does not allow its respondents to simply select from “yes/no”; it provides specific choices that are degrees of “agreeing” or “disagreeing”. The most basic Likert scaling format is a 5-column answer, with choices like: strongly disagree, disagree, neither agree nor disagree (do not know), agree and strongly agree. The neutral option is generally opted by the person who is unsure. That is why typical Likert scale has a limitation, since it is numerical and only offers a single option with 100% of certainty.

Indeterminate Likert scale is based on Neutrosophy, [4, 5]. Neutrosophy is the branch of philosophy that studies all related to neutralities, due to the lack of information, contradictory information, paradoxical and imprecise information, among others[7-9]. Indeterminate Likert scale will eradicate the need to go with the dominant choice

or a forced option which cannot always be true if it is varying from the other option only be a small or a shade of difference [10-12].

The experts exact feelings/thinking/options cannot be captured very realistically by Likert scale, but certainly indeterminate Likert scale based on Triple Refined Indeterminate Neutrosophic Sets (TRINS) can do this very accurately [4, 5].

Here, the indeterminacy concept is divided into three: indeterminacy leaning towards truth membership, indeterminacy membership and indeterminacy leaning towards false membership. This division helps increasing the accuracy and precision of the indeterminacy and to fit in the Likert's scale.

2 Materials and methods

This section contains the main concepts related to Neutrosophy [13-15] that we use in this paper, especially Triple Refined Indeterminate Neutrosophic Sets.

Let X be a space of points (objects) with basic elements in X represented by x . A single-valued neutrosophic set (SVNS) A in X is characterized by truth $T_A(x)$, indeterminacy $I_A(x)$, and falsehood $F_A(x)$ membership functions. For each point x in X , there are $T_A(x), I_A(x), F_A(x) \in [0,1]$

and $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$. A is denoted by $A = \{ \langle x, T_A(x), I_A(x), F_A(x) \rangle \mid x \in X \}$.

The refined neutrosophic logic is defined by [16, 17]:

Definition 1 The truth T is divided into several types of truths: T_1, T_2, \dots, T_p , and I into various indeterminacies: I_1, I_2, \dots, I_r , and F into various falsities: F_1, F_2, \dots, F_s , where all $p, r, s \geq 1$ are integers, and $p + r + s = n$.

Definition 2 [16, 17]: A triple refined indeterminate neutrosophic set (TRINS) A in X as given above is characterized by positive $P_A(x)$, indeterminacy $I_A(x)$, negative $N_A(x)$, positive indeterminacy $I_{PA}(x)$ and negative indeterminacy $I_{NA}(x)$ membership functions. Each has a weight $w_m \in [0,5]$ associated with it. For each $x \in X$, there are:

$$P_A(x), I_{PA}(x), I_A(x), I_{NA}(x), N_A(x) \in [0,1]$$

$$w_P^m(P_A(x)), w_{IP}^m(I_{PA}(x)), w_I^m(I_A(x)), w_{IN}^m(I_{NA}(x)), w_N^m(N_A(x)) \in [0,5]$$

And

$$0 \leq P_A(x) + I_{PA}(x) + I_A(x) + I_{NA}(x) + N_A(x) \leq 5$$

Therefore, a TRINS A can be represented by:

$$A = \{ \langle x, P_A(x), I_{PA}(x), I_A(x), I_{NA}(x), N_A(x) \rangle \mid x \in X \}$$

In a TRINS-based Likert scale, there can be a separate option for indecision, since equal amount of agreement and disagreement can be represented in degree of weak agreement and degree of weak disagreement, individually.

Definition 3 [16, 17]: The intersection of two TRINSs A and B is a TRINS C , denoted as $C = A \cap B$, whose truth membership, indeterminacy leaning toward truth membership, indeterminacy membership, indeterminacy leaning toward falsehood membership and falsehood membership functions are associated to A and B :

1. $T_C(x) = \min(T_A(x), T_B(x))$,
2. $I_{TC}(x) = \min(I_{TA}(x), I_{TB}(x))$,
3. $I_C(x) = \min(I_A(x), I_B(x))$,
4. $I_{FC}(x) = \min(I_{FA}(x), I_{FB}(x))$,
5. $F_C(x) = \max(F_A(x), F_B(x))$.

Definition 4 [16, 17]: The generalized Triple Refined Indeterminate Neutrosophic weight is defined as:

$$w(A) = \sum_{i=1}^n \{ w_T(T_A(x_i)) + w_{IT}(I_{TA}(x_i)) + w_I(I_A(x_i)) + w_{IF}(I_{FA}(x_i)) + w_F(F_A(x_i)) \}$$

Where, $w_T, w_{IT}, w_I, w_{IF}, w_F$ denote the weights of every membership.

3 Survey design and processing of information

The survey for the analysis of the incidence of the Administrative Organic Code [18, 19] in the Ecuadorian legislation in force was applied to 75 professionals, who are public employees of the Decentralized Autonomous Governments of Tulcan or free practice lawyers of the same city, who were asked about their degree of acceptance of the Administrative Organic Code [20].

The questionnaire we applied was designed so that, in each statement, the respondent would reflect the degree to which Strongly disagree (1), Disagree (2), Neither agree or disagree (3), Agree (4) and Strongly agree (5) with the proposal, rating each state on a scale of 1 to 10. The applied questionnaire is shown in Table 1.

Statement	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
1. The structure of the current Organic Administrative Code is correct.					
2. The current Administrative Organic Code presents an efficient formulation of criteria.					
3. The current Administrative Organic Code has obtained a strong advance for the dynamism of the administrative regulations.					
4. The current Administrative Organic Code efficiently protects the rights of the citizens of Ecuador					

Table 1. Applied questionnaire.

Once the results were obtained, the TRINS [21]matrix was constructed for each respondent by taking each rating per statement as an indeterminate Likert scale with (1) negative membership, (2) indeterminacy leaning toward negative membership, (3) indeterminate membership, (4) indeterminacy leaning toward positive membership, and (5) positive membership. Thus, for each respondent, we obtained his or her degree of acceptance of the statements, and the answers to Statement 1, Statement 2, Statement 3, and Statement 4 in the form of TRINS, denoted as G_1, G_2, G_3 and G_4 , respectively.

The total approval rate GT of the respondent was then calculated through this expression:

$$GT = G_1 \cap G_2 \cap G_3 \cap G_4$$

To obtain a unique crisp value, the generalized Triple Refined Indeterminate Neutrosophic weight was calculated with:

$$w(GT) = w_T(T_A(GT)) + w_{I_T}(I_{T_A}(GT)) + w_I(I_A(GT)) + w_{I_F}(I_{F_A}(GT)) + w_F(F_A(GT))$$

Where, $w_T, w_{I_T}, w_I, w_{I_F}, w_F$ denote the weights of every membership.

In order to sort the total approval ratings in terms of highest and lowest acceptance, the weights assumed for each membership were:

$$w_T = 5, w_{I_T} = 4, w_I = 3, w_{I_F} = 2, w_F = 1$$

Thus, those with the highest values will be the ones with the highest acceptance index over the Organic Administrative Code. For a better understanding, the acceptance index was calculated by: $AI = \frac{w_T}{5}$ and the following scale was used:

- If $AI > 1$ the respondent is Strongly agree with the OAC.
- If $0,75 < AI \leq 1$ the respondent is Agree with the OAC.
- If $0,5 < AI \leq 0,75$ the respondent is Neither agree or disagree with the OAC.
- If $0,25 < AI \leq 0,5$ the respondent is Disagree with the OAC.
- If $AI \leq 0,25$ the respondent is Strongly disagree with the OAC.

Finally, we made a statistical analysis of the results.

4 Results

With the application of the survey and the processing of the information described above for each respondent, the results shown in Table 2 were obtained.

N	GT TRINS	W(GT)	AI	N	GT TRINS	W(GT)	AI
1	(0.3, 0.2, 0, 0.1, 0.8)	3,3	0,66	38	(0.6, 0, 0, 0, 0.3)	3,3	0,66
2	(0.7, 0.3, 0, 0, 0.2)	4,9	0,98	39	(0.7, 0, 0, 0, 0)	3,5	0,7
3	(0, 0.1, 0.1, 0.1, 0.6)	1,5	0,3	40	(0.8, 0, 0, 0, 0)	4	0,8
4	(0.8, 0, 0, 0, 0.4)	4,4	0,88	41	(0.7, 0, 0, 0, 0.5)	4	0,8
5	(0.8, 0, 0, 0, 0.2)	4,2	0,84	42	(0.8, 0, 0, 0, 0.3)	4,3	0,86
6	(0.7, 0.1, 0, 0.1, 0.3)	4,4	0,88	43	(0.6, 0.2, 0, 0, 0.5)	4,3	0,86

7	(0.1, 0.3, 0.3, 0.3, 0.8)	4	0,8	44	(0.7, 0.1, 0, 0, 0.3)	4,2	0,84
8	(0.6, 0, 0, 0, 0.2)	3,2	0,64	45	(0.7, 0.3, 0, 0, 0.2)	4,9	0,98
9	(0.7, 0, 0, 0, 0.3)	3,8	0,76	46	(0.8, 0.1, 0, 0, 0.5)	4,9	0,98
10	(0.9, 0, 0, 0, 0)	4,5	0,9	47	(0.7, 0, 0, 0, 0.5)	4	0,8
11	(0.7, 0.2, 0, 0.1, 0.2)	4,7	0,94	48	(0.2, 0.3, 0.4, 0.3, 0.8)	4,8	0,96
12	(0.8, 0.1, 0, 0, 0.2)	4,6	0,92	49	(0.8, 0.1, 0, 0, 0.3)	4,7	0,94
13	(0.5, 0.4, 0.1, 0.1, 0.7)	5,3	1,06	50	(0.8, 0.1, 0, 0, 0.2)	4,6	0,92
14	(0.6, 0, 0, 0, 0.3)	3,3	0,66	51	(0.7, 0.1, 0, 0, 0.2)	4,1	0,82
15	(0.7, 0.1, 0, 0, 0.3)	4,2	0,84	52	(0.6, 0, 0, 0, 0.3)	3,3	0,66
16	(0.7, 0, 0, 0, 0)	3,5	0,7	53	(0.4, 0.1, 0.2, 0, 0.8)	3,8	0,76
17	(0.7, 0, 0, 0, 0.3)	3,8	0,76	54	(0.7, 0.1, 0, 0, 0.3)	4,2	0,84
18	(0.7, 0, 0, 0, 0.5)	4	0,8	55	(0.7, 0, 0, 0, 0.2)	3,7	0,74
19	(0.3, 0.1, 0, 0.1, 0.8)	2,9	0,58	56	(0.7, 0.2, 0, 0, 0.2)	4,5	0,9
20	(0.6, 0, 0, 0, 0.3)	3,3	0,66	57	(0.6, 0, 0, 0, 0.3)	3,3	0,66
21	(0.8, 0, 0, 0, 0.2)	4,2	0,84	58	(0.7, 0, 0, 0, 0.4)	3,9	0,78
22	(0.7, 0.2, 0.1, 0, 0.5)	5,1	1,02	59	(0.2, 0.3, 0, 0.2, 0.7)	3,3	0,66
23	(0.7, 0, 0, 0, 0.5)	4	0,8	60	(0.7, 0.1, 0.1, 0, 0.2)	4,4	0,88
24	(0.1, 0.3, 0.5, 0.5, 0.7)	4,9	0,98	61	(0.8, 0.3, 0, 0, 0.5)	5,7	1,14
25	(0.7, 0.2, 0, 0, 0.4)	4,7	0,94	62	(0.7, 0, 0, 0, 0.4)	3,9	0,78
26	(0, 0.1, 0.1, 0.1, 0.8)	1,7	0,34	63	(0.6, 0, 0, 0, 0.2)	3,2	0,64
27	(0.8, 0.1, 0.1, 0.2, 0.4)	5,5	1,1	64	(0.7, 0, 0, 0, 0.2)	3,7	0,74
28	(0.1, 0.2, 0.1, 0.1, 0.6)	2,4	0,48	65	(0.4, 0.6, 0.3, 0.4, 0.8)	6,9	1,38
29	(0.6, 0.2, 0, 0, 0.4)	4,2	0,84	66	(0.1, 0.2, 0.1, 0.2, 0.8)	2,8	0,56
30	(0.7, 0.2, 0, 0, 0.3)	4,6	0,92	67	(0.2, 0.4, 0.1, 0, 0.7)	3,6	0,72
31	(0.7, 0.1, 0, 0, 0.2)	4,1	0,82	68	(0.6, 0.1, 0, 0, 0.5)	3,9	0,78
32	(0.7, 0.1, 0, 0, 0.4)	4,3	0,86	69	(0.7, 0.2, 0, 0, 0.2)	4,5	0,9
33	(0.8, 0, 0, 0, 0.5)	4,5	0,9	70	(0.4, 0.3, 0, 0.2, 0.7)	4,3	0,86
34	(0.6, 0.2, 0, 0, 0.2)	4	0,8	71	(0.8, 0, 0, 0, 0.2)	4,2	0,84
35	(0.7, 0, 0, 0, 0)	3,5	0,7	72	(0.2, 0.3, 0, 0.3, 0.7)	3,5	0,7
36	(0.7, 0, 0, 0, 0.4)	3,9	0,78	73	(0.7, 0, 0, 0, 0.2)	3,7	0,74
37	(0.8, 0, 0, 0, 0.4)	4,4	0,88	74	(0.1, 0.3, 0.2, 0.3, 0.7)	3,6	0,72
38	(0.8, 0, 0, 0, 0.4)	4,4	0,88	75	(0.6, 0, 0, 0, 0.3)	3,3	0,66

Table 2: Total approval rate in TRINS form, generalized TRIN weight and the acceptance index obtained by respondent

Regarding the interpretation of these values, we may see in Figure 1 that the highest values correspond to the acceptance of the current OAC, although the number of respondents who do not have a certain position on this is significant.

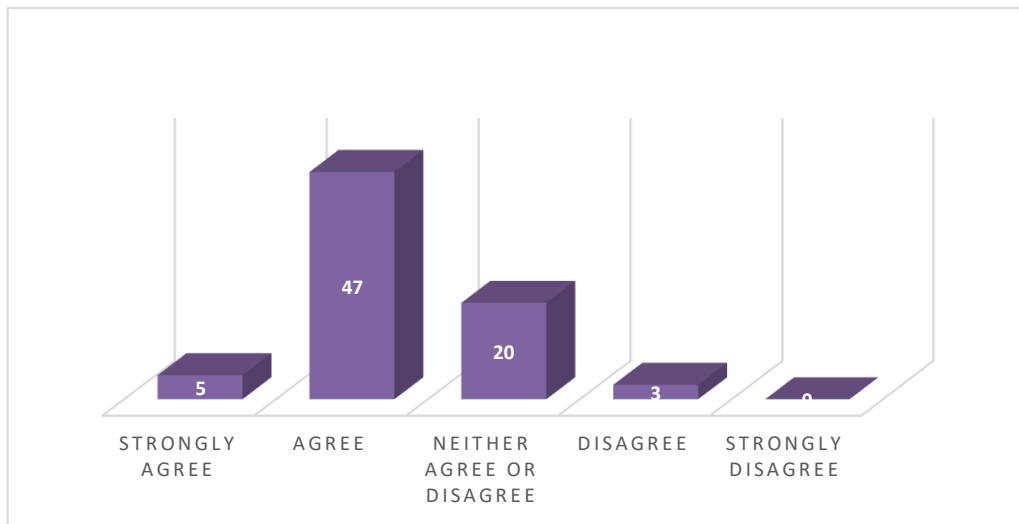


Figure 1. Figure 1. Level of satisfaction of respondents with the current OAC according to the AI.

When analyzing the information obtained through the hierarchical clustering algorithm, with Ward link and Euclidean distance, and the help of the program Orange3.26, two groups can be clearly identified, as shown in figure 2.

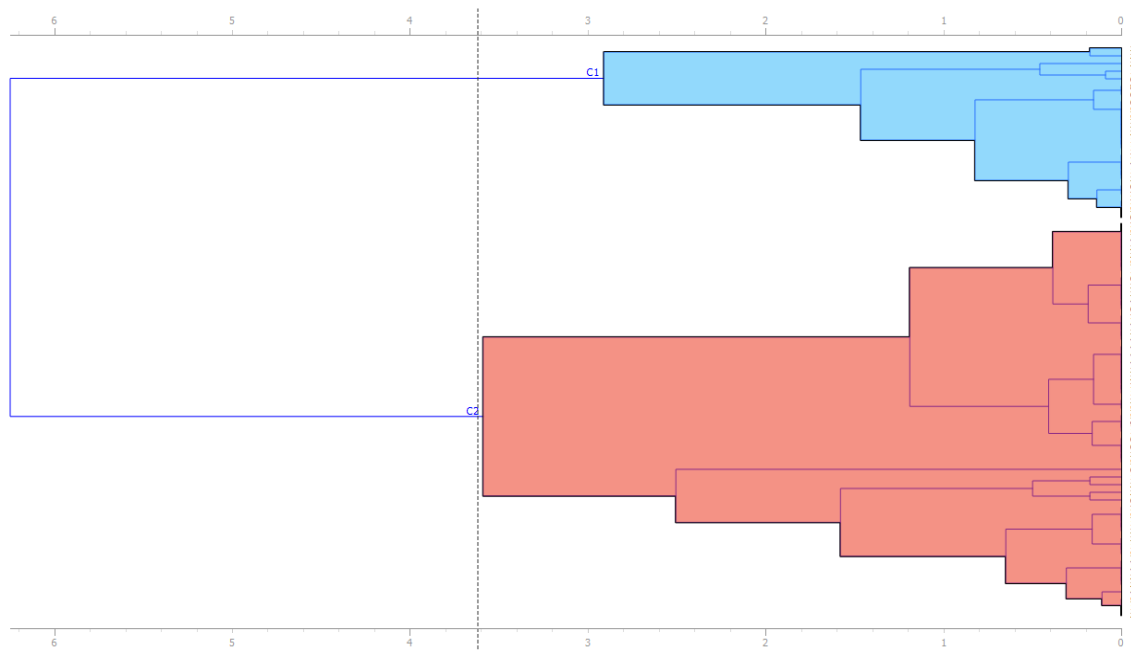


Figure 2. Clusters formed by a hierarchical clustering algorithm

The first group, with a majority of 52 respondents, is satisfied with the current OAC. Fifty percent are public employees of the Decentralized Autonomous Governments of Tulcán and 50% are self-employed lawyers. 47 of them agree and 5 strongly agree.

The second group consists of only 23 respondents. 20 of them do not agree or disagree and 3 disagree. Sixty-five percent are free exercise lawyers and 35% are public employees of the Decentralized Autonomous Governments of Tulcán.

In terms of the position of those surveyed according to their profession, there is greater rejection of the OAC by lawyers, since 100% of those who were dissatisfied are lawyers and in addition, 29.27% of the total number of lawyers show indetermination when it comes to qualifying them. Only 2.44% of the lawyers strongly agree with the OAC.

On the other hand, public employees show a higher rate of satisfaction in general, with 64.7% and 11.76% agreeing and strongly agreeing, respectively. 23.5% neither agree nor disagree with the OAC.

This last appreciation can be reinforced by observing in figure 3 the range of the satisfaction index and the medians of each group of professionals surveyed.

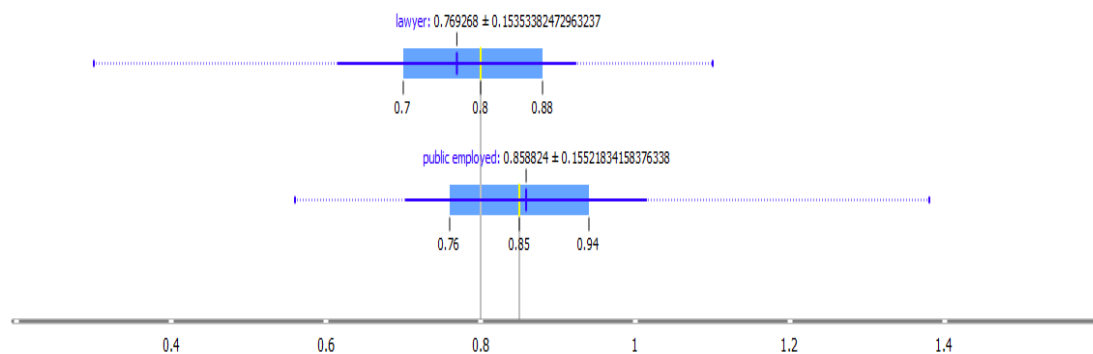


Figure 3. Box plot of AI by profession

In summary, according to the satisfaction index found in the study sample, a positive evaluation can be inferred with respect to the OAC by specialists in the subject in Ecuador.

Conclusions

With the use of the Indeterminate or Neutrosophic Likert Scale, the level of acceptance that the current Organic Administrative Code has among professionals in Ecuador, who are specialists in the subject, could be appreciated with greater rigor. The use of TRINS ensured that mixed feelings were captured in the evaluations. According to the results, the professionals surveyed are most satisfied with the current OAC. Although there is a significant percentage whose position is undetermined or neutral. No significant values of dissatisfaction were obtained. The professionals with the greatest dissatisfaction with this standard were the self-employed lawyers. It can be said that the current OAC has a positive, although not absolute, level of acceptance, from which it can be inferred that it still needs to be improved.

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