



Neutrosophic statistics methods applied to demonstrate the extra-contractual liability of the state from the Administrative Organic Code

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Abstract. In the present work, a conceptualization was made on an exploratory model, which is explanatory of the requirements established by the General Organic Code of Processes, for the configuration of the extra-contractual liability of the State, emphasizing the qualified damage. Neutrosophic statistics are used to demonstrate the state's extra-contractual liability from the administrative organic code, deducing three main functions within the determination of liability, among which are the function of patrimonial reparation, the preventive function and the control function. The conclusion is that qualified damage is understood as that public burden unbalanced on an administered due to deficient state action, which leads to a patrimonial and moral reparation.

Keywords: Qualified damage, extra-contractual liability, public charges, legitimate interest, neutrosophic statistics.

1 Introduction

The non-contractual responsibility of the State is a system of meanings understood as a general principle of public law, a constitutional duty of the State in the exercise of any public function, a subjective public right of force, constitutional rank or value, a constitutional guarantee belonging to the individual or administered, a member of any democratic and judicial society, to demand through administrative or judicial channels the compensation of damages, material and moral, caused in their legal situation, subjective right and legitimate interest or current legal interest or in their movable or immovable property attributable to the normal or abnormal functioning of the entities and organs of the State [1].

The State is not liable for damages suffered by the contractor when these come from acts or facts that are beyond its actions or omissions, so the contracting public entity is not obliged to compensate all damages. The use of justified measures in the financial imbalance of the state contract has become so widespread that it has produced unfair and excessive situations for the State, which are contrary to the principles governing the state contract. The rigor has been reduced to define the unpredictable ones, accepting inflation and the variation of climatic conditions, and it is therefore suggested that the assumptions that make up the financial imbalance of the state contract be defined in legislation, particularly those linked to acts or facts committed by the state, see [2]. According to studies carried out in [3], individual and collective responsibility is derived from social progress, and the declaration of nature as a subject of law in Ecuador has become a new paradigm of South American legal sciences.

The Constitution of the Republic of Ecuador presents Ecuador as a Social State governed by the rule of law, which establishes as principles the protection of fundamental rights, respect for human dignity, work, solidarity and the prevalence of the general interest; in addition to promoting the realization of rights, such as food, housing, education, health, social security, among others. The interpretation of the meanings of the non-contractual responsibility of the State therefore has a field of eminently juridical character.

With regard to non-contractual liability for pecuniary or moral damages attributable to the State corresponds to one of the most important areas for Administrative Law, seen from a perspective it is the limit to the exercise of State power since its owners must act subject to the law; and, as a guarantee for administered citizens that their rights will be respected as long as the violation and damages caused by the State entails compensation.

The change of paradigm from the civil criterion to a constitutional one, regarding the extra-contractual liability of the state in Ecuador in effect as of July 7, 2018 through the Organic Administrative Code, raises the legal rank of sentences and normative bodies that have been previously applied unifying the criteria for these parameters, [4].

This study deals with the extra-contractual liability of the State, which, since its incorporation as an institution of this branch of Law, has been studied from different perspectives and points of view by various legislations. Although its study has not been taken to the daily arena, its importance does not diminish, [5]. It is an authentic factor of transformation, and therefore, depending on the proposed purpose, it will help to build a society with certain characteristics [6].

To speak of state responsibility implies getting involved in the relationship of the State with third parties, where one could witness in a certain way the irresponsibility through the essential obligations maintained by the State. Such as responsibly satisfying the collective needs of the social conglomerate, with a vision where the care of the public interest is above all its actions, for which a model is presented as an objective that involves the factors that intervene in the extra-contractual responsibility of the State from the Organic Administrative Code.

According to the previous analysis, the use of neutrosophic statistics is required to demonstrate the extra-contractual liability of the state from the administrative organic code. With the use of classical statistics, the data are known, formed by clear numbers. In the neutrosophic statistics the data have certain indetermination, the data can be ambiguous, vague, imprecise, incomplete, even unknown. Instead of sharp numbers used in classical statistics, sets (which approximate these sharp numbers respectively) are used in neutrosophic statistics [7].

In addition, the cited author refers that in neutrosophic statistics, the sample size may not be known exactly (for example, the sample size may be between 90 and 100); this may occur because, for example, the statistician is not sure what approximately they refer to, which are the individuals in the sample, whether or not they belong to the population of interest, or because the individuals in the sample only belong partially to the population of interest, while do not belong partially. Another approach would be to consider only partially the data provided by individuals in the sample whose membership in the population of interest is only partial.

This study makes use of neutrosophic hypotheses, where the distinction between the classical (statistical) hypothesis and the neutrosophic hypothesis according to [7], is that in the neutrosophic statistics the variables that describe the characteristics of the population are neutrosophic, have indeterminate values or several unknown values, or an inaccurate number of terms if the variable is discrete, or for values that we compare at least one of the characteristics of the population is neutrosophic, i.e., indeterminate or uncertain or of vague value.

Smarandache in [7] refers that, similarly to classical statistics, a Neutrosophic Null Hypothesis, denoted by NH_0 , is the assertion that it is initially assumed to be true. While the Alternative Neutrosophic Hypothesis, denoted by NH_a , is the other hypothesis. When testing NH_0 against NH_a , there are two possible conclusions: reject NH_0 (if the sample evidence clearly suggests NH_0 is false), or do not reject NH_0 (if the sample does not support the chain evidence against NH_0).

This paper is divided in a section of Materials and Methods, where some basic methods of neutrosophic theory and neutrosophic statistics are summarized. These methods are used to calculate the results in the section of Results and Discussions. The last section is devoted to conclude this paper.

2 Materials and Methods

A documentary review is applied to verify the role of the state in contractual responsibility. The working methodology focuses on an exploratory-explicative model, based on the extra-contractual responsibility of the State, by means of which strategies are applied for the compilation of primary sources, such as the compilation of literature and other key informants, as well as secondary sources such as existing statistical registers and other public and private thematic publications.

This type of model entails activities and tasks that make it possible to obtain and relate different types and levels of information that result in significant outcomes and are linked to the proposed objectives.

Likewise, the model is based on shared academic and transfer activities between the teacher in charge of the Project, students and intermediate organizations that participate directly and others that are added at the time of translating the objectives into activities.

In this sense, the importance and dynamics of the model applied is highlighted insofar as it proposes

strategies of joint, interrelated and interdisciplinary work between the different actors involved in this type of Project, whose dynamics extends beyond the University itself as an inherent attribute.

In the following some basic concepts of Neutrosophy theory are summarized.

The original definition of truth value in neutrosophic logic is shown in [8], where it is defined in Definitions 1 and 2.

Definition 1 Let X be a universe of discourse, a space of points (objects) and x denotes a generic element of X . A *neutrosophic set* A in X is characterized by a truth-membership function $T_A(x)$, an indeterminacy-membership function $I_A(x)$, and a falsity-membership function $F_A(x)$. Where, $T_A(x), I_A(x), F_A(x) \subseteq]0, 1+[$, i.e., they are real standard or nonstandard subsets of the interval $]0, 1+[$. These functions do not satisfy any restriction, that is to say, the following inequalities hold:

$$0 \leq \inf T_A(x) + \inf I_A(x) + \inf F_A(x) \leq \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \leq 3^+$$

Definition 2 Let X be a universe of discourse, a space of points (objects) and x denotes a generic element of X . A *Single Valued Neutrosophic Set* (SVNS) A in X is characterized by a truth-membership function $T_A(x)$, an indeterminacy-membership function $I_A(x)$, and a falsity-membership function $F_A(x)$. Where, $T_A(x), I_A(x), F_A(x): X \rightarrow]0, 1]$ such that: $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$. A *single valued neutrosophic number* (SVNN) is symbolized by $\langle T, I, F \rangle$ for convenience, where $T, I, F \in]0, 1]$ and $0 \leq T + I + F \leq 3$.

Therefore, $A = \{(x, T_A(x), I_A(x), F_A(x)): x \in X\}$ or more simply $A = \langle T_A(x), I_A(x), F_A(x) \rangle$, for every $x \in X$.

Given A and B two SVNSs, they satisfy the following relationships:

7. $A \subseteq B$ if and only if $T_A(x) \leq T_B(x)$, $I_A(x) \geq I_B(x)$ and $F_A(x) \geq F_B(x)$. Particularly, $A = B$ if and only if $A \subseteq B$ and $B \subseteq A$.

8. $A \cup B = \langle \max(T_A(x), T_B(x)), \min(I_A(x), I_B(x)), \min(F_A(x), F_B(x)) \rangle$, for every $x \in X$.

9. $A \cap B = \langle \min(T_A(x), T_B(x)), \max(I_A(x), I_B(x)), \max(F_A(x), F_B(x)) \rangle$, for every $x \in X$.

Some important concepts of Neutrosophic Statistics are the following:

A *neutrosophic population* is a population where the membership of the individuals is not well defined and a level of indeterminacy could exist.

A *neutrosophic sample* is a sample where indeterminacy is in some way present.

The origin of indeterminacy can be due to the partial appurtenance of its members or because of the indeterminacy of this subset as a whole.

Example 1 One example of neutrosophic data is following: $\{1, [1, 3], [2, 4], 3, 4, [3, 4), (1, 2], (0, 1), \{1, 2, 3\}\}$. See that some data are imprecise like $[1, 3]$ and $\{1, 2, 3\}$, because the exact datum is not known. In the framework of a neutrosophic sample, we can also have an imprecise sample size.

In Neutrosophic Statistics it is important to calculate with interval-valued operations, thus, in the following some of them are summarized. Let $I_1 = [a, b]$ and $I_2 = [c, d]$ be two real valued intervals, then, see [9]:

9. $I_1 \leq I_2$ if and only if $a \leq c$ and $b \leq d$.

10. $I_1 + I_2 = [a+c, b+d]$.

11. $I_1 - I_2 = [a-d, b-c]$.

12. $I_1 \cdot I_2 = [\min(ac, ad, bc, bd), \max(ac, ad, bc, bd)]$.

13. $1/I_1 = [1/b, 1/a]$, always that $0 \notin I_1$.

14. $I_1/I_2 = I_1 \cdot (1/I_2)$.

15. $\sqrt{I_1} = [\sqrt{a}, \sqrt{b}]$, if and only if $a \geq 0$.

16. $I_1^n = \underbrace{I_1 \cdot I_1 \cdot \dots \cdot I_1}_{n \text{ times}}$, $n \in \mathbb{N}$.

Definition 3 A *Neutrosophic Normal Distribution* is a normal distribution of the random variable X , where either the median μ or the variance σ^2 (standard deviation σ) or both of them are imprecise.

A *neutrosophic hypothesis* satisfies that the statistics of the variables used to describe the population characteristics are neutrosophic or at least one value which describes a population characteristic is neutrosophic.

The *Neutrosophic Null Hypothesis*, denoted by NH_0 , is the one which we have to prove it is true; also, the *Neutrosophic Alternative Hypothesis* is defined and denoted as NH_a .

Example 2 Neutrosophic hypotheses can be the following:

$$\left\{ \begin{array}{l} NH_0: \mu \in [1, 3] \\ NH_a: \mu > 3 \end{array} \right\} \left\{ \begin{array}{l} NH_0: \mu \in [1, 3] \\ NH_a: \mu < 3 \end{array} \right\} \text{ or } \left\{ \begin{array}{l} NH_0: \mu \in [1, 3] \\ NH_a: \mu \notin [1, 3] \end{array} \right\}$$

There exists two neutrosophic type of errors, they are:

3. A *Neutrosophic Type I Error*, is the error of rejecting NH_0 when NH_0 is true.

4. A *Neutrosophic Type II Error*, is the error of not rejecting NH_0 when NH_0 is false.

A *Neutrosophic Level of Significance* α can be a set, in this framework α can be defined like an interval.

Definition 4 A *Neutrosophic P-Value* p is the smallest level of significance such that NH_0 is rejected.

See that the Neutrosophic P-Value is not necessarily a crisp value.

Definition 5 The limits of the *Neutrosophic Confidence Interval for the Population Mean μ* is calculated with Equation 1.

$$\bar{x} \pm z_{\text{critical value}} \cdot \frac{\hat{S}}{\sqrt{n}} \tag{1}$$

Where n is the sample size, which can be an interval, α is the neutrosophic level of significance, \hat{S} is the sample standard deviation and \bar{x} is the sample mean.

Other distributions are defined as usual, see [10, 11, 12, 13]. Moreover, the hypothesis test can be naturally extended to neutrosophic hypothesis test. Also, a test of normality can be applied, taking into account the new definitions.

A formula to calculate the statistically representative sample size is given in Equation 2.

$$n = \frac{k^2 N p q}{e^2 (N-1) + k^2 p q} \tag{2}$$

Where:

n = sample size

N = population size.

p = probability that the event will occur (0.5).

q = probability that the event will not occur (0.5).

e = 0.05 or 5%. Maximum error accepted.

k = 1.96. For which the level of confidence is 95%.

Linguistic terms can be associated to SVNNs according to Table 1, defined in [14].

Linguistic Term	SVNN
Extremely good (EG)	(1,0,0)
Very very good (VVG)	(0.9, 0.1, 0.1)
Very good (VG)	(0.8,0.15,0.20)
Good(G)	(0.70,0.25,0.30)
Medium good (MDG)	(0.60,0.35,0.40)
Average(M)	(0.50,0.50,0.50)
Medium Bad (MDB)	(0.40,0.65,0.60)
Bad (B)	(0.30,0.75,0.70)
Very bad (VB)	(0.20,0.85,0.80)
Very very bad (VVB)	(0.10,0.90,0.90)
Extremely bad (EB)	(0,1,1)

Table 1: Linguistic terms and the associated SVNN

With the purpose of facilitating practical application to decision-making problems, the proposal was made for the use of single-value neutrosophic sets [8] (SVNS), through which it is possible to use linguistic terms [15], in order to obtain a greater interpretability of the results obtained with this type of data.

The SVNN in Table 1 can be ranked by using the scoring function defined in [16], see Equation 3.

$$s(M) = 2 + T - F - I \tag{3}$$

Where $M = (T, F, I)$ is a SVNN. Let us observe that $s: [0, 1]^3 \rightarrow [0, 3]$.

Thus, the proposed procedure is the following:

1. A poll is designed based on the interviewed' answers given in form of linguistic terms, like in Table 1. The closed question consists in: "How do you evaluate the application of the extra-contractual liability of the state from the administrative organic code in Ecuador?" where the possible answers are given in Table 1. The number of interviewed is calculated by using Equation 2. A random sample with this sample size is collected.
2. Each linguistic term of the sample is associated to a SVNN, according to Table 1.
3. The score function is evaluated for every one of the SVNNs of the step 2, using Equation 3.
4. The real-valued numbers obtained in step 3 are used like an equivalent sample.
5. A test of normality is applied to the new sample.
6. The following neutrosophic hypothesis problem is calculated, given that the sample distributes normally:
 - $NH_0: \mu \in [1.5, 3]$
 - $NH_a: \mu < 1.5$

That is to say, we have a null hypothesis which means that the population's opinion is at least an Average (M), whereas the alternative hypothesis means that it is less than Average or Bad.

Then, there exist two possible interpretations:

- 6.1. To non reject H_0 means that the population's opinion is qualified like at least Average.
- 6.2. To reject H_0 means that the population's opinion is qualified in the range from "Extremely bad" to "Medium bad".

3 Results and Discussions

The number of lawyers in Ecuador is estimated in approximately $N = 21,460$. Then, calculating with Equation 2, we have $n = 377.42 \approx 378$ is a significant sample size.

The question of the poll was asked to 378 lawyers randomly selected and interviewed personally or by cell phone.

The Kolmogorov-smirnov nonparametric test was applied to determine if the distribution of the sample is normal; however, the normality null hypothesis is rejected. Because of the sample size is much bigger than 30, the normality or quasi-normality was assumed.

The sample mean was $\bar{x} = 0.80675$ and the sample standard deviation was $\hat{s} = 0.47625$.

Then, $z = \frac{\bar{x} - \mu}{\left(\frac{\hat{s}}{\sqrt{n}}\right)} = \frac{[0.80675, 0.80675] - [1.5, 3]}{\left(\frac{0.47625}{\sqrt{378}}\right)} = [-89.534, -28.301]$. Thus, $z \ll -1.96$, i.e., NH_0 is rejected.

The sample mean is the closest to $s(0.3, 0.75, 0.7) = 0.85$, therefore the final result can be qualified like more or less "Bad".

In this context, after conducting the relevant analysis of the State's tort liability, there exists agreement with the authors' point of view [17, 18], which coincides with the affirmation of the obligation of the public administration to repair the damage caused to one of its administered, which was not in the legal duty to bear it. It is with the evolution of the theory of state liability that this type of obligation is also applicable under administrative law, which makes it possible to demand from the administration patrimonial liability through compensation for the damages it may cause to those administered [5].

Based on the foregoing, it is identified that the non-contractual liability of the Public Administration has three main functions, which contribute to the non-contractual liability of the state from the administrative organic code, these three functions are:

1. The Administration's patrimonial responsibility has as its primary function the reparation of damages to the administered, by reason of the administrative turn or traffic.
2. Preventive function, due to the fact that, together with other instruments such as criminal or disciplinary liability, the responsibility of the Administration serves to dissuade the public power and its officials, taking into account that in case of eventual damage, compensation must be sought [17].
3. Control function, which is directly related to the preventive function. This control function is exercised by the administrator by verifying the proper functioning of public services [18].

Within responsibility, the emphasis is also placed on public services within Administrative Law, as an obligation, that is, as a responsibility that the State has, with the national conglomerate [19]. In this sense, proactivity plays a fundamental role because it is a basic value in which it is incumbent upon them to guide and direct the destinies of certain activities, a futuristic and visionary construct [20].

4 Conclusions

It is demonstrated that the extra-contractual liability of the state is the proper guarantee of rights, whether for lack or deficient provision of public services or for actions or omissions in the exercise of public powers, the public servant is liable for violating the law, as well as for excess or defect in the performance of its activity. This means that in his (her) decisions he (she) cannot be reflected at his (her) whim or desire, but rather the realization of legal values. For which the Right through postulates and principles looks for justice and equality in a fair way, making reference to the ends that are the object of this Science.

On the other hand, emphasis is placed on Administrative Law, as the branch of law that seeks to frame the activity of the State within a legal order under the responsibility of which it guarantees and norm, this protects the coexistence of people and their goods, that is to say it provides security to its associates.

In the same way it is detected that it is the state that has sense and legitimate reason to be, before the deficient rendering of public services that cause damages, those that have the obligation to assume the reparation of the damage caused, by its officials in the exercise of the state activity. Therefore, it is concluded that the extra-contractual liability of the State is the limit to the exercise of state power that guarantees the rights of citizens against actions or omissions on the part of the State, thereby generating the obligation of the State to repair the injured citizen.

The extra-contractual liability demands the fulfillment of three requirements of which the configuration of the qualified damage understood as that unbalanced public burden on an administered one due to the deficient state action stands out, which leads to a patrimonial reparation and of being the moral case.

The neutrosophic statistical hypothesis was used to demonstrate the significance of the extra-contractual liability that the Public Administration possesses when making use of the three main functions, on the basis of which it was detected that an adequate action is necessary as regards the control function, which is directly related to the preventive function.

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