



# Neutrosophic statistics applied to the analysis of socially responsible participation in the community

Johana Cristina Sierra Morán<sup>1</sup>, Jenny Fernanda Enríquez Chuga<sup>2</sup>, Wilmer Medardo Arias Collaguazo<sup>3</sup> and Carlos Wilman Maldonado Gudiño<sup>4</sup>

<sup>1</sup> Professor, Universidad Regional Autónoma de los Andes, Ecuador, E-mail: ui.johanasierra@uninades.edu.ec

<sup>2</sup> Professor, Universidad Regional Autónoma de los Andes, Ecuador, E-mail: ui.jennyenriquez@uniandes.edu.ec

<sup>3</sup> Professor, Universidad Regional Autónoma de los Andes, Ecuador, E-mail: ui.wilmerarias@uniandes.edu.ec,

<sup>4</sup> Professor, Universidad Regional Autónoma de los Andes, Ecuador, E-mail: ui.carlosmaldonado@uniandes.edu.ec

**Abstract.** Previous research points to the importance of the active and socially responsible participation of companies as members of the society to contribute to their economic and social development, i.e., a step beyond philanthropy. In this sense, this study aims to analyze the role played by the different organizations in the business sector of Imbabura in Ecuador, and its relationship with the community where they operate. The analysis was based on the different areas suggested within the ISO 26000 standards, such as education, culture, job creation, among others. The qualitative-quantitative approach was used, with descriptive scope. The survey and the interview were used as data collection techniques for which the respective instruments were designed and applied to different companies in the sector. The results of the instruments are quantified using neutrosophic statistics, which is useful for the quantitative analysis of citizens' participation in various activities developed in the community. According to the present study, the participation of the companies within the community is not significant and therefore, it is required to foment the responsibility of them in the social development and integration. Concepts like sustainability should be included in the company strategies, when trust and commitment want to be generated from communities in which companies develop their activities.

**Keywords:** Social capital, Participatory development, Social integration, Community participation, Neutrosophic statistics.

## 1 Introduction

According to [1], Social Responsibility refers to the fact that company's activities have an impact on society and therefore, they must be responsible for their actions and the consequences they bring with them. However, some of the questions that arise in the research of [2] cited in [3] are: (1) How to establish the limits between contributing to solving social problems such as unemployment, poverty, environmental pollution and sacrificing the economic benefits of companies? (2) How feasible is it for a company, not to increase the prices of its products and services to avoid falling into speculation or inflation, but at the same time to continue obtaining financial results that allow it to continue functioning?

Consequently, one could also ask: Do companies consider Socially Responsible as an investment or as an expense? In the case of being cataloged as an investment, what do companies seek? It can be said that they seek to achieve long-term benefits such as the recognition of society for their actions by contributing to the reduction of poverty and consequently obtaining an increase in their market value?, see [4]. Another objective benefit could be to wish clients' recognition, so that later they respond with loyalty when keep of buying their products and services. Or, on the contrary, it is considered an expense mainly because the benefits are subjective, i.e., they are not tangible and are difficult to quantify. In this case, we can ask ourselves whether corporate social responsibility practices obey a solidarity conscience that goes beyond ethics, philanthropy, and what the law

requires to be complied with and that seeks to strengthen the world economy and environmental protection.

Going a little deeper about who should be responsible for applying such practices, if the companies or the people who work in the companies, we find two positions, on the one hand, the companies, in this case would be considered as active members of society, with the same rights and obligations, that is, as one more citizen according to [5]. On the other hand, if we take into account the main objective pursued by shareholders and owners of companies to maximize their profits [6], those called upon to have a socially responsible attitude would be the people who work in the companies.

In this sense, it is important that shareholders have socially responsible intentions since it is their money that is being used to carry out such social responsibility practices and that those who make decisions within companies, that is to say, the directors, also have this sense of responsibility since they are the executer. In this case, it would be the owners and those who work in the companies, the accountable to carry out socially responsible entrepreneurial actions [6] with it are favored and benefit all members of the organization, including the top management, middle and fundamental, the operational part of a company, as long as everything is committed, thereby generating a great sustainable impact, economic, and especially cultural [7].

Likewise, active participation of companies and community development called by ISO 26000 requires companies to work more closely with the communities in which they operate. In other words, it implies for companies not only the fact that they are aware of the impact of their activities on the environment as a spectator, but rather as a member who participates in the debates and proposes solutions to the different social and environmental problems that surround the community seeking for a better quality of life for all its members.

Some of the suggestions referred in ISO 26000 are: companies are called to actively participate in community decisions on unsatisfied social needs, even delegating a representative for their fulfillment. It also points out that companies should be involved in actions that promote education and culture, as well as job creation and skills development among their inhabitants. That they should contribute to the development and access to technology for social purposes and the generation of wealth.

An organization's contribution to community development can help to promote higher levels of well-being within the community. Such development is understood as the improvement of the quality of life of a population. Community development is not a linear process; rather, it is a long-term process, in which different and conflicting interests will be present. Historical and cultural characteristics make each community unique and influence the possibilities for its future. Community development is therefore the result of social, political, economic and cultural characteristics and depends on the characteristics of the social forces involved. Stakeholders in the community may have different interests, even conflicting interests. Shared responsibility is required to promote the well-being of the community as a common goal.

Key community development issues to which an organization can contribute include job creation through expansion and diversification of economic activities and technological development. It can also contribute with social investments [8] in generating wealth and income in the local economic development initiatives; expanding education and skills development programmes; promoting and preserving culture and the arts; and providing or promoting community health services. Community development could include institutional strengthening of the community, its collective groups and forums, cultural, social and environmental programs and local networks involving multiple institutions, because to build a professional statistical system capable of responding with quality and timeliness to the statistical information needs of each productive organization, promotes the achievement of business development goals, forming a necessity that expresses competitiveness and credibility [9].

Usually, community development is advanced when the social forces of the community strive to promote public participation, and pursue equal rights and decent living standards for all citizens, without discrimination. It is an internal community process that takes into account existing relationships and overcomes barriers to the enjoyment of rights. Community development is reinforced through socially responsible behavior.

Consequently, the objective of this study is to establish whether socially responsible practices towards the community are related to the active participation of the business sector in different areas such as education, culture, job creation among others suggested by ISO 26000 standards.

The use of Neutrosophy was proposed by Florentin Smarandache [10] for the treatment of neutrality, it is a branch of philosophy that studies the origin, nature and scope of neutrality. This has formed the basis for a series of mathematical theories that generalize classical and fuzzy theories such as neutrosophic sets and neutrosophic logic as referred in [10]. The original definition of truth value in neutrosophic logic is shown in [11].

Based on the theoretical analysis carried out, the use of neutrosophic statistics is required for the analysis of socially responsible participation in the community. Neutrosophic statistics are useful because they describe

the statistical calculation for several different samples, each of the same size. The use of single-valued neutrosophic sets [12] (SVNS) was proposed, which through them it is possible to use linguistic terms [10], in order to obtain a greater interpretability of the results obtained with this type of data.

With the use of classical statistics we know the data, formed by clear numbers, in neutrosophic statistics the data have some indeterminacy, 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 [13, 14, 15, 16].

Additionally, in neutrosophic statistics, the sample size may not be known exactly (for example, the sample size may be between 90 and 100), this may happen 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 partially belong to the population of interest, while partially do not belong). 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.

## 2 Neutrosophy theory and Neutrosophic Statistics

This section is devoted to expose the basic concepts of Neutrosophic sets and Neutrosophic Statistics.

**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:

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

With regard to Neutrosophic Statistics, 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 appartenance of its members or because of the indeterminacy of this subset as a whole.

**Example 1** Some examples of neutrosophic data are the following sets:  $\{4, [2, 6], [7, 8], 10, 23, [20, 23]\}$  and  $\{5, [4, 7], \{1, 2, 6\}, (65, 70), (4, 5)\}$ . See that some data are imprecise like  $[7, 8]$  and  $\{1, 2, 6\}$ , because the exact datum is not known. In the framework of a neutrosophic sample, we can also have an imprecise sample size, where the sample size can be stated in 90, 91, ..., 100.

After proposing the instruments to obtain the results of the present study, neutrosophic statistics are used for the analysis of socially responsible participation in the community. The neutrosophic statistic is appropriate for this analysis since results are obtained that require interpretability. In that sense, Neutrosophy is used in these studies.

In Neutrosophic Statistics it is important to calculate using 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 [17]:

1.  $I_1 \leq I_2$  if and only if  $a \leq c$  and  $b \leq d$ .
2.  $I_1 + I_2 = [a+c, b+d]$ .
3.  $I_1 - I_2 = [a-d, b-c]$ .
4.  $I_1 \cdot I_2 = [\min(ac, ad, bc, bd), \max(ac, ad, bc, bd)]$ .
5.  $1/I_1 = [1/b, 1/a]$ , always that  $0 \notin I_1$ .
6.  $I_1/I_2 = I_1 \cdot (1/I_2)$ .
7.  $\sqrt{I_1} = [\sqrt{a}, \sqrt{b}]$ , if and only if  $a \geq 0$ .
8.  $I_1^n = \underbrace{I_1 \cdot I_1 \cdot \dots \cdot I_1}_{n \text{ times}}, n \in \mathbb{N}$ .

**Definition 3** A *Neutrosophic Normal Distribution* is a normal distribution of the random variable  $X$ , where

either the median  $\mu$  or the variance  $\sigma^2$  (standard deviation  $\sigma$ ) 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 if at least one value which describe 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** A neutrosophic hypotheses can be the following:

$$\left\{ \begin{array}{l} NH_0: \mu \in [0, 1] \\ NH_a: \mu > 1 \end{array} \right\} \left\{ \begin{array}{l} NH_0: \mu \in [0, 1] \\ NH_a: \mu < 1 \end{array} \right\} \text{ or } \left\{ \begin{array}{l} NH_0: \mu \in [0, 1] \\ NH_a: \mu \notin [0, 1] \end{array} \right\}$$

There exists two neutrosophic type of errors, they are:

1. A *Neutrosophic Type I Error*, is the error of rejecting  $NH_0$  when  $NH_0$  is true.
2. A *Neutrosophic Type II Error*, is the error of not rejecting  $NH_0$  when  $NH_0$  is false.

A *Neutrosophic Level of Significance*  $\alpha$  can be a set, in this framework  $\alpha = [0.01, 0.05]$  can be defined.

**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** Limits of the *Neutrosophic Confidence Interval for the Population Mean*  $\mu$  is calculated by the following formula:

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

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

Other distributions are defined as usual, e.g.,  $\chi^2 = \sum_{i=1}^k Z_i^2$ , see [18, 19], where every  $Z_i$  are normal random variables, equally distributed with mean 0 and variance 1. Moreover, the hypothesis test can be naturally extended to neutrosophic hypothesis test. Also, test of normality, can be applied, taking into account the new definitions, e.g., Shapiro-Wilk normality test.

Linguistic terms can be associated to SVNN according to Table 1, defined in [20].

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

### 3 Results

For this study, the most appropriate research approach for testing a hypothesis is quantitative, and the type of scope defined is exploratory. The techniques used for data collection are based on measuring the number of companies that integrate active participation and community development as part of their social responsibility practices, and the number of managers and workers who expressed through a survey their perception of execution.

#### a. Sampling procedures

In order to prepare the Imbabura business projection table, the United Nations International Standard Industrial Classification (ISIC) and the business directory database for the years 2014, 2015, 2016 have been taken into account, a study conducted by the National Institute of Statistics and Censuses of Ecuador (INEC according to the abbreviation in Spanish), which presents 39,867 companies by 2014, 44,887 companies by

2015 and 49,985 companies by 2016, historical data that allowed forecasting through formula in Equation 2, the projection for 2017 and 2018:

$$M = C(1 + i)^{n-1} \quad (2)$$

Where:

$i$  = Projection percentage

$M$  = last element (49,985)

$C$  = first element (39,867)

$n$  = Historical period taken into account for the projection (3 years)

Year	Number of companies
2014	39,867
2015	44,887
2016	49,985

**Table 2:** Number of companies determined in the INEC. Source Directory of REDATAM-ECLAC Companies (2016)

$$49,985 = 39,867 (1 + i)^{3-1}$$

$$i_{2018} = \sqrt[3]{\frac{49,985}{39,867}} - 1$$

$$i_{2018} = 0.1138$$

The result of 0.1138 is equivalent to 11.38% for 2017 and 2018 multiplied by the last historical series of INEC (49,985 companies) resulting in 55,469 companies projected for 2017 and 62,479 companies for 2018. This information was organized by economic sectors for better identification and application of measurement instruments.

Let us remark that the population of enterprises in 2018 was forecasted from the population in 2016, calculated by a census. Census results are not completely accurate, because during the polls many changes can occur. Evidently the forecasted result is even less accurate. Thus, we can estimate the population size in the interval from 49,985 to 62,479 because there exists certain indeterminacy. For simplicity we take  $N = 62,479$ .

Code	Economic activity	2014	2015	2016	Projection		
					Rate	2017	2018
A	Agriculture, livestock, forestry and fishing	3,627	4,244	4,687	0.1368	5,328	6,057
B	Mining and quarrying	45	41	44	-0.0112	44	43
C	Manufacturing Industries	4,191	4,930	5,377	0.1327	6,090	6,899
D	Electricity, gas, steam and air conditioning supply	8	9	13	0.2748	17	21
E	Water distribution; sewerage, waste and sanitation	31	33	42	0.1640	49	57
F	Construction	1,568	1,858	2,049	0.1431	2,342	2,678
G	Trade, automotive repair and motorcycles	13,090	16,004	17,326	0.1505	19,933	22,933
H	Transport and storage	4,686	5,062	5,350	0.0685	5,716	6,108
I	Accommodation and meal service activities	3,333	3,724	4,157	0.1168	4,643	5,185
J	Information and communication	358	297	307	-0.0740	284	263
K	Financial and insurance activities	57	59	60	0.0260	62	63
L	Real estate activities	597	736	826	0.1763	972	1,143
M	Professional, scientific and technical activities	1,261	1,913	2,045	0.2735	2,604	3,316
N	Administrative and support services activities	1,025	833	880	-0.0734	815	756
O	Public administration and defense, social security	120	130	128	0.0328	132	137
P	Education	470	521	804	0.3079	1,052	1,375
Q	Human health care and social assistance activities	580	651	689	0.0899	751	818
R	Arts, Entertainment and Recreation	363	473	534	0.2129	648	786

S	Other service activities	4,457	3,369	4,138	-0.0365	3,987	3,842
	Total	39,867	44,887	49,456	0.1138	55,469	62,479

**Table 3:** Projection of the companies' classification in Imbabura. Source: Directory of companies, REDATAM-ECLAC (2016)

**b. Procedure for the selection of participants**

Once the information was consolidated, the cadastral database was classified by primary units (cantons), secondary units (uniform international industrial classifier version 4.0), and final units (companies), a number selected according to the projected size of the primary units.

We also took into consideration those businesses that were active at the time of the investigation, so we eliminated from the study those companies that, at the time of verifying telephones, addresses did not coincide with the databases provided by the municipal cadastres.

Based on the results of the business projection for the province of Imbabura calculated in Table 2, we have an estimate of 62,479 companies for the year 2018, which served as the universe for the study. Subsequently, the sample size was calculated using the following statistical formula:

$$n = \frac{P.Q.N}{(N-1)\left[\frac{E^2}{K^2}\right] + P.Q} \quad (3)$$

Where:

n= sample size

N= population size (62,479 enterprises)

P= probability that the event will occur (0.5) or 50%

Q= probability that the event will not occur (0.5) or 50%.

E= 0.05 or 5%. Maximum error allowed.

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

$$n = \frac{62,479 \times 0.5 \times 0.5}{\left[(62,479 - 1)\left(\frac{0.05^2}{1.96^2}\right)\right] + (0.5 \times 0.5)}, n = 381.92 \cong 382 \text{ inquiries}$$

For the present research, the concepts of Corporate Social Responsibility embodied in the ISO 26000 standard were taken as a reference, considering the variables in Table 4.

Variable	Dimension	Type	Scale	Question
Active Participation and Community Development	Active Participation In The Community	Quantitative	Nominal	Consultation of community representative groups to determine priorities for social investment and community development activities.
		Quantitative	Nominal	Delegate a representative to participate in local association meetings as far as possible and appropriate, with the aim of contributing to the public good and community development objectives.
	Education and culture	Quantitative	Nominal	Promotes and supports education and/or culture at all levels, engaging in actions that improve the quality of and access to education, promoting local and cultural knowledge.
	Social investment	Quantitative	Nominal	Takes into account the promotion of community development when planning social investment projects.
Quantitative		Nominal	Avoids actions that perpetuate the community's dependence on the organization's philanthropic activities, continued presence or support.	

**Table 4:** Operative variables

**c. Procedure for collecting information**

Once the sample size was calculated, multiple stages probabilistic sampling was chosen, with a random selection of primary units (cantons), secondary units (parishes) and final units (persons).

In the first stage, the sample calculated by main activity was divided according to ISIC. It was then distributed by cantons, parishes, and neighborhoods in proportion to the cadastre of each canton.

In the second stage, a simple sample of the businesses identified in the parishes of each of the six cantons that make up the province of Imbabura was selected.

In the next stage, according to the sectors selected, the number of companies established in the distribution table of the sample was applied through a random procedure, counting each umpteenth time, if the sector warranted it. In case of rejection, inexistence or inaccuracy of the addresses of the companies, or other impediments to carry out the survey, the selected company was replaced, following the random procedure of each umpteenth time.

Finally, the fourth stage consisted in applying the survey to the final units. The companies surveyed were selected according to their proximity to the business sectors at random in both the urban and rural sectors, through an appropriate allocation table for each canton. A filter was applied to the chosen respondent to find out if they live in the sector, otherwise the survey was completed.

#### d. Procedure for the validation of the research instrument.

The validity of the content was carried out through the judgment of experts, applying the Delphi method, carrying it out in three phases: a) selection and construction of the instruments to be evaluated; b) selection of the experts, applying a coefficient of competence of the expert and; c) validation of the instrument. The consultation was carried out to five experts with Master's degree in Administration and Business, three of them reached a qualification of 0.8875 over 1 on the performance in the values of the competence coefficient to study, analyze, give valid and reliable criteria on the elaborated work.

In this section, the results obtained are presented and explained as evidence of exploratory work carried out through a descriptive analysis of the active participation and development of the community as part of its social responsibility practices, in contrast to execution.

The first step was to verify the existence of active participation and community development of the units of study in each of the cantons of the province. We verified that the companies have integrated in their planning and as part of their business philosophy, concepts that have to do with their social responsibility.

The second step was to establish the workers and managers' perception about how much they know about the active participation and development whether it was implemented with respect to the principles of corporate social responsibility.

The results obtained from the cantons under study present a lack of knowledge on the part of workers and managers about the active participation and development of the community as part of their practices of social responsibility, with high negative percentages (83%), with the exception of the business sector of the canton Cotacachi and Pimampiro, who answered affirmatively (76%) to know on the active participation and development of the community as part of their practices of social responsibility, however their strategies are focused more on care for the environment, which can be explained by the mining boom.

In the third stage, it was determined how many companies were executing what they had determined about corporate social responsibility.

Based on the obtained results, (23), when evaluating the number of companies that execute the determined about corporate social responsibility, in the cantons of the province, where it has been verified that these companies have integrated in their planning and as part of their corporate philosophy, concepts that have to do with their social responsibility, in particular because they know the importance they have in socially responsible participation in the community.

The procedure used to assess every company performance is the following:

1. Every expert select one linguistic term from Table 1 to assess company performance for every one of the companies. Their equivalent SVNNS are used for calculation.
2. For each company (index j), the mean of its five experts' evaluation (index i) is calculated, using the formula  $E_j = \left( \frac{\sum_{i=1}^5 T_{ij}}{5}, \frac{\sum_{i=1}^5 I_{ij}}{5}, \frac{\sum_{i=1}^5 F_{ij}}{5} \right)$ ,  $j = 1, 2, \dots, 382$ . Then,  $E_j$  is the new neutrosophic assessment for company j.

3. The Shapiro-Wilk normality test is applied to the set of truth values for every  $E_j$ , which is a useful test that contributes to prove that the data obtained, adjust to a Normal distribution. The result was that the normality hypothesis is not rejected with  $p = 0.27462$ .
4. We consider the following Neutrosophic Hypothesis problem:  
 $NH_0: \mu_T \in [0, 0.5)$   
 $NH_a: \mu_T > 0.5$ , where  $\mu_T$  is the sample mean of the truth value for every  $E_j$ , i.e., we calculate if it is statically significant that the assessment of every company is under Average, according to Table 1.

We obtained do not reject the neutrosophic null hypothesis with a maximum  $p = 0.5949$ . Therefore, the result is that the assessment is less than Average.

From what can be seen, that the business sector is not executing the programmed activities in relation to what was planned in social responsibility.

These results can be explained from different theories that provide various points of view such as the instrumental theory that refers to the study of social activities that allow to fulfill the purpose of creating entrepreneurial wealth, which implies that companies will develop socially responsible actions if they are linked for obtaining higher levels of profitability for both owners and shareholders [21].

According to [2], philanthropic contributions must be made by shareholders, owners or employees, as an independent decision to the company. The author stresses that business organizations have been created exclusively to generate profits and obtain maximum profitability for shareholders, following an ethic that respects the laws and regulations that regulate the economic activities of companies.

Friedman in [2] also states that socially responsible activities are works of charity, while for business owners it is an unfair and costly burden that they should not assume and which further deprives them of the freedom and capacity to decide for themselves, as to what to do with their utilities and to whom to allocate them. It even mentions that contributing through the payment of taxes already constitutes fulfilling the development of the community and that the administration of such funds is the responsibility of the central government.

On the other hand, it can be explained by Williamson's Theory of Transaction Costs (1975), which states that the primary purpose of the economic institutions of capitalism is to economize transaction costs; which from the outset proposes a challenge to be studied from the perspective of law, economics and organization, if one considers that these -the economic institutions of capitalism-, have not occupied a place of relevance in social science research, perhaps because of their inherent complexity, or perhaps because of the lack of agreement regarding the main purposes of economic organization [22].

Companies do not actively participate in the community because of the consequences of the Agency Theory explained in [23], where he states that, according to the company, agency theory is a kind of legal artifice that serves as a nexus to a series of contractual interactions called agency relationships. The agency relationship is one in which the owners of the capital (principal) and the directors (agents) interact, in an explicit or implicit contract by which they commit themselves to carry out a business activity. According to [24], in effect, the company is conceived as a team whose members act to satisfy their own interests, but who are aware that their future depends on the survival capacity of their team in the process of concurrence with other organizational work teams that would allow a greater production with a minimum expenditure of human effort and the technical and economic resources committed [25]. Therefore, it is likely that shareholders have socially responsible intentions, but that managers do not apply them with the objective of maximizing company profits.

#### 4 Conclusions

It was evident that the activities of a company affect the environment in which they operate, the degree will depend on the type of industry, however, it is important that they are responsible for their actions and actively participate in the search for solutions together with the community.

It is necessary that companies materialize the theory in active participation and community development, which is framed with socially responsible responsibility and which is not well accepted among the entrepreneurs of the province for now.

It should be considered that there is a requirement for greater commitment on the part of entrepreneurs to integrate concepts of sustainability in their strategies, which will allow them to generate trust and commitment with the communities in which they develop their commercial activities.

On the other hand, it requires consideration of social responsibility that incorporates sociological aspects that are related to the social and economic dynamics of a sector and responds to cultural, educational and emotional trends. It is important to establish that entrepreneurs respond to social dynamics by developing



strategies as contingents in response to these factors.

The social investment is conditioned to factors of capacity and resources reason why the entrepreneurs from Imbabura, prefer to elaborate strategies to respond contingently to factors that can be imposed by the social tendency, or cultural of the moment in which the citizenship lives.

In order to demonstrate the significance of the active participation of companies in the community, a study was carried out in the six groups (cantons), which have different characteristics, for which neutrosophic statistics were used, on the basis of which it was detected that the active participation of companies in the community is not positive due to the fact that entrepreneurs do not see economic opportunities based on theories such as risk and appropriation through which they consider that investing in the community does not generate any economic value.

## References

- [1] Sabogal, J. (2008). *Approach and questions to the concept of Corporate Social Responsibility*. Journal of the Faculty of Economic Sciences, 16 (1), 179-195.
- [2] Friedman, M. (2007). The social responsibility of business is to increase its profits. In *Corporate ethics and corporate governance* (pp. 173-178). Berlin, Heidelberg: Springer.
- [3] Bour, E. (2012). *Social Responsibility of the Company analysis of the concept*. Economic Studies, 29 (1), 1-30. Consulted from <http://bibliotecadigital.uns.edu.ar/pdf/ee/v29n59/v29n59a02.pdf>
- [4] Davis, K. (1960). *Can business afford to ignore social responsibilities?*. California management review, 2(3), 70-76.
- [5] Carroll, A. B. (1994). *Social issues in management research: experts' views, analysis, and commentary*. Business & Society, 33(1), 5-29.
- [6] Friedman, M. (1970). *A Friedman doctrine: The social responsibility of business is to increase its profits*. The New York Times Magazine, 13(1970), 32-33.
- [7] Ramos Carpio, J. P., Villacrés Álvarez, A. E., Ocampo Ulloa, W. L., and Pazmiño Romero, D. A. (2018). *Quality: Consciousness of continuous improvement in the company*. Contemporary Dilemmas Magazine: Education, Politics and Values. ISSN: 2007-7890, 1-15.
- [8] Sajardo, A., and Ribas, M. (2014). *The social investment of companies: corporate volunteering in Spain* (La inversión social de las empresas: el voluntariado corporativo en España)(In Spanish). CIRIEC-España Revista de Economía Pública Social y Cooperativa.
- [9] Estupiñán Ricardo, J., and Batista Hernandez, N. (2018). *Business management and postmodernity*. Bruxelles, Belgium: Pons Publishing House.
- [10] Smarandache, F. (2005). *Unifying Field in Logics: Neutrosophic Logic. Neutrosophy, Neutrosophic Set, Neutrosophic Probability: Neutrosophic Logic. Neutrosophy, Neutrosophic Set, Neutrosophic Probability*: Infinite Study.
- [11] Smarandache, F. (1999). A unifying field in Logics: Neutrosophic Logic. In *Philosophy* (pp. 1-141). American Research Press.
- [12] Wang, H., Smarandache, F., Zhang, Y. Q., and Sunderraman, R. (2005). *Interval Neutrosophic Sets and Logic: Theory and Applications in Computing: Theory and Applications in Computing*: Hexis.
- [13] Guo, Q., Wang, H., He, Y., Deng, Y., and Smarandache, F. (2017). *An Evidence Fusion Method with Importance Discounting Factors based on Neutrosophic Probability Analysis in DSMT Framework*. Neutrosophic Sets and Systems, 17, 64-73.
- [14] Smarandache, F. (2014). *Introduction to Neutrosophic Statistics*. Craiova: Sitech and Education Publishing.
- [15] Smarandache, F. (2017) *PCR5 and Neutrosophic Probability in Target Identification (revisited)*. Neutrosophic Sets and Systems, 16, 76-79.
- [16] Yuhua, F. (2015). *Examples of Neutrosophic Probability in Physics*. Neutrosophic Sets and Systems, 7, 32-33.
- [17] Moore, R. E. (1979) *Methods and Applications of Interval Analysis*, Siam, Philadelphia.
- [18] Alhabib, R., Ranna, M. M., Farah, H., and Salama, A. A. (2018). *Some Neutrosophic Probability Distributions*. Neutrosophic Sets and Systems, 22, 30-38.
- [19] Patro, S. K., and Smarandache, F. (2016) *The Neutrosophic Statistical Distribution, More Problems, More Solutions*. Neutrosophic Sets and Systems, 12, 73-79.
- [20] Sahin, R., and Yigider, M. (2016). *A Multi-Criteria Neutrosophic Group Decision Making Method Based TOPSIS for Supplier Selection*. Applied Mathematics and Information Sciences, 10 (5), 1-10.
- [21] Carroll, A. B. (1979). *A three-dimensional conceptual model of corporate performance*. Academy of management review, 4(4), 497-505.
- [22] Jones, T. M., Felps, W., and Bigley, G. A. (2007). *Ethical theory and stakeholder-related decisions: The role of stakeholder culture*. Academy of Management Review, 32(1), 137-155.
- [23] Eisenhardt, K. M. (1989). *Agency theory: An assessment and review*. Academy of management review, 14(1), 57-74.
- [24] Marin, D. (2012). *Theory of agency and transaction costs: a theoretical observation of its postulates* (Teoría de agencia y costos de transacción: una observación teórica de sus postulados) (In Spanish). Revista Mutis, 2(1), 61-81.
- [25] Torres, T. M., Buitrago, M. T., Vélez, P. G., Sánchez, J. H. P., and Ramos, J. A. V. (2013). *The theory of the agency. The case of a private university in the city of Manizales* (La teoría de la agencia. El caso de una universidad privada en

la ciudad de Manizales)(In Spanish). *Equidad y Desarrollo*, 2013, 53-76.

Received: January 25, 2019.

Accepted: May 10, 2019