*Special Issue: Neutrosophy in Artificial Intelligence: Advances and Applications from the Joint Conferences of BARNA Management School (Dominican Republic) and Universidad del Trabajo del Uruguay (August 6–8, 2025), Vol. 92, 2025*

*University of New Mexico*

# Neutrosophic Framework for Violence Prediction in Urban Environments: A Hybrid Approach Integrating fsQCA and Machine Learning for Public Safety Decision-Making

**Alfonso Aníbal Guijarro Rodríguez[1,2] *, Tatiana Mabel Alcívar Maldonado[3], Leili Genoveva Lopezdominguez[4], Matilde Briggitte Silvers Briones[5], and John Henry Fernández Vera[6]**

[1] Faculty of Mathematical and Physical Sciences, University of Guayaquil, Guayas, Ecuador. alfonso.guijarror@ug.edu.ec
[2] Artificial Intelligence Research Group, University of Guayaquil, Guayas. Ecuador.
[3] Faculty of Mathematical and Physical Sciences, University of Guayaquil, Guayas, Ecuador. tatiana.alcivarm@ug.edu.ec
[4] Faculty of Mathematical and Physical Sciences, University of Guayaquil, Guayas, Ecuador. leili.lopezdominguezr@ug.edu.ec
[5] Faculty of Mathematical and Physical Sciences, University of Guayaquil, Guayas, Ecuador. matilde.silversb@ug.edu.ec
[6] Faculty of Mathematical and Physical Sciences, University of Guayaquil, Guayas, Ecuador. jhon.fernandezv@ug.edu.ec

**Abstract:** In the context of citizen security, predictive systems for urban violence are essential for preventive decision-making and the efficient allocation of security resources. This work proposes an innovative neutrosophic framework that integrates Fuzzy Qualitative Comparative Analysis ( fsQCA ) with Machine Learning algorithms to predict urban violence patterns in complex and uncertain environments. Neutrosophic logic allows handling the uncertainty, imprecision and inconsistencies inherent in social data, while fsQCA identifies complex causal configurations that traditional statistical methods cannot capture. The developed hybrid model combines Random Forest, fuzzy logic, and neutrosophic logic are used to process homicide data, demographic variables, and socioeconomic factors in Ecuador. The results demonstrate % accuracy in predicting security levels by canton, significantly outperforming traditional deterministic approaches. The developed platform generates interactive, georeferenced visualizations that facilitate understanding of risk patterns and support informed decision-making in citizen security policies. This research contributes to the development of more robust and adaptive predictive systems, establishing a methodological precedent for the application of neutrosophics to public security and social risk management issues.

**Keywords:** Neutrosophic Logic; Violence Prediction; fsQCA; Machine Learning; Citizen Security; Hybrid Systems; Decision Making.

## 1. Introduction

Violence, in its multiple manifestations, has established itself as one of the most pressing social challenges in Latin America, with a particularly acute impact in cities such as Guayaquil, Ecuador. [1] This intrinsically complex and multifactorial phenomenon has driven a growing need for predictive tools that allow for a deeper understanding and proactive intervention. Despite state efforts, which often focus on strengthening police forces or installing video surveillance, tangible results have been limited, highlighting the shortcomings of traditional approaches to the volatile and uncontrollable nature of violence [2].

Conventional predictive models, predominantly based on deterministic statistics, assume linear and direct causal relationships that fail to capture the complexity, uncertainty, and nonlinearity inherent in social phenomena ([3]). These limitations manifest themselves in problems of bias, representativeness, and an insufficient capacity to handle incomplete or contradictory data, which hinders the effectiveness of data-based decisions ([3]). In this context, there is an urgent need for innovative methodologies that can address the uncertainty and indeterminacy present in social data, allowing for a more precise identification of patterns and causal configurations underlying urban violence.

Neutrosophic Logic, proposed by Florentin Smarandache, offers a mathematical-structural framework for modeling and reasoning with uncertain, ambiguous, vague, incomplete, and even contradictory data [4]). Unlike fuzzy logic, which handles degrees of truth, neutrosophic logic introduces a component of indeterminacy (I) along with the degrees of truth (T) and falsity (F), allowing a more complete representation of reality in contexts where information is imperfect [4]). Complementarily, Fuzzy Qualitative Comparative Analysis (fsQCA) is presented as a robust methodology for identifying complex causal configurations, i.e. combinations of conditions that lead to a specific outcome, even in the presence of equifinality and causal asymmetry [4].

This article proposes the development of a prototype of a predictive platform for urban violence that integrates fsQCA and Neutrosophic Logic, complemented by Machine Learning techniques, specifically Random Forest. The objective is to overcome the limitations of traditional models by providing a tool capable of analyzing social data with a high degree of uncertainty and indeterminacy, facilitating the identification of risk patterns and supporting strategic decision-making in citizen security. The innovation of this work lies in the combination of these methodologies to offer a more holistic and accurate perspective on violence prediction.

The structure of this article is organized as follows: the Section presents the State of the Art, reviewing urban violence prediction systems, the applications of fsQCA and neutrosophic logic, and the limitations of current approaches. The Section details the Materials and Methods, including the contextualization of the problem, the applied neutrosophic definitions, the dataset design, and the proposed hybrid methodology. The Section presents the Results obtained from the implementation of the algorithm, its evaluation, and the generated visualizations. The Section discusses the Applications and the theoretical and practical implications of the findings. Finally, the Section presents the Conclusions of the study and future research directions.

### 1.1. State of the Art

#### 1.1.1. Review of Predictive Systems for Urban Violence

Predictive urban violence systems seek to anticipate the occurrence of violent events by analyzing historical and contextual data. At the global and regional levels, there has been growing interest in the use of artificial intelligence (AI) to tackle organized crime, although this also raises concerns about the sophisticated use of AI by criminal groups *[5]* . In the Ecuadorian context, previous studies have addressed specific facets of violence, such as the invisibility of violence against men, and have evaluated the accuracy of actuarial tools such as ODARA in predicting recidivism [6]. However, these approaches often lack the capacity to handle the uncertainty and indeterminacy inherent in social data, which limits their effectiveness in understanding multifactorial patterns of violence.

#### 1.1.2. Previous applications of fsQCA in Social Sciences

Qualitative Comparative Analysis (QCA), developed by Charles Ragin in 1987, emerged as a methodology that combines the strengths of qualitative and quantitative approaches [7]. Its evolution into fsQCA ( fuzzy -set Qualitative Analysis) Comparative Analysis ) has allowed for the management of gradual concepts instead of being limited to binary categories, which is crucial in social sciences where concepts such as "high risk of violence" or "social vulnerability" are inherently gradual. fsQCA is based on principles such as configurational causality, equifinality, and causal asymmetry, allowing the identification of combinations of conditions that lead to a specific outcome. This approach has been successfully applied to identify causal configurations in domestic violence, evaluate preventive programs, and analyze public policies on citizen security, demonstrating its capacity to manage causal complexity and offer interpretability.

#### 1.1.3. Using Neurosophic Logic in Complex Decision Making

Neutrosophic Logic, introduced by Florentin Smarandache in 1995, represents a generalization of pre-existing logics by incorporating degrees of truth (T), falsity (F), and indeterminacy (I) as independent components [4]. This feature makes it particularly suitable for modeling and reasoning with data that is fundamentally uncertain, ambiguous, vague, incomplete, or contradictory, situations common in the social sciences and artificial intelligence [4]. In education, for example, neutrosophic logic has proven effective in classifying and prioritizing subjects and teacher profiles, improving skill-based assignment and reducing inconsistencies. [8]Its ability to represent degrees of indeterminacy has been key in applications such as competency assessment and performance indicator management ([9]).

#### 1.1.4. Identifying Limitations in Current Approaches

Despite advances in predictive systems and the use of methodologies such as fsQCA and neutrosophic logic, significant limitations persist. Traditional models often assume linear and deterministic relationships, which fail to capture the complexity and non-linearity inherent in social phenomena [3]). Furthermore, they face issues of bias and representativeness, as well as difficulties in handling uncertainty and integrating qualitative and contextual information [3]. Although neutrosophic logic offers a promising solution to uncertainty, its adoption is not yet widespread and the computational complexity associated with handling large volumes of neutrosophic data can be challenging ([8]). Therefore, it is critical to explore hybrid approaches that integrate neutrosophic with machine learning techniques to overcome these limitations and develop more robust and adaptive predictive systems [9].

## 2. Materials and Methods

The proposed methodology for developing a predictive platform for urban violence integrates a quantitative-computational approach with a mixed inductive-comparative component, based on Fuzzy Qualitative Comparative Analysis (fsQCA) and Neutrosophic Logic. This design allows for a rigorous approach to a social phenomenon characterized by uncertainty and complexity, using information from official sources.

### 2.1. Contextualization

This study focuses on urban violence in Ecuador, particularly in the city of Guayaquil, which has experienced an alarming increase in homicide rates, rising from 5.8 per 100,000 inhabitants in 2017 to 25.9 in 2023. Guayaquil is consolidating its position as an epicenter of this problem due to its size, strategic location, and particular socioeconomic conditions, concentrating various types of crimes that seriously affect social coexistence and the well-being of its inhabitants. The problem is framed in a specific demographic context: the city of Guayaquil between 2022 and 2025, a period in which an increase in violent behavior has been observed despite the increase in police force and technological investment.

### 2.2. Definitions and applied neutrosophic theories

Neutrosophic Logic, proposed by Florentin Smarandache, is fundamental to this study because it allows for the handling of uncertain, ambiguous, vague, incomplete, and even contradictory data ([4]). This logic characterizes each proposition through three independent components:

- **Truth (T):** Degree to which the proposition is true.
- **Falsehood (F):** Degree to which the proposition is false.
- **Indeterminacy (I):** Degree of ignorance, ambiguity or contradiction.

These components can take values in the range [0,1] and are independent of each other, meaning that T + I + F can be greater than, less than, or equal to 1 [4]). This ability to model indeterminacy is crucial for violence prediction, where information is often imperfect and multifaceted. The application of fuzzy logic, on the other hand, makes it possible to address complex concepts that do not fit into strictly defined categories, making it easier for cases to be partially associated with different conceptual categories, which is useful for gradual concepts such as "high risk of violence" or "social vulnerability".

### 2.3. Dataset design

The base dataset used for this study was obtained from the Ecuadorian Government's Open Data Portal (*[10]*and supplemented with records from the INEC's Population Estimates and Projections [11]). Records of homicide and murder events, as well as population estimates for the country, were downloaded. The main variables used were:

#### 2.3.1. Intentional Homicide Dataset Variables:

- **Canton:** Name of the canton where the event occurred.
- **Weapon type:** Type of weapon used (firearm, knife, blunt object, other).
- **Victim's sex:** Male/Female.

#### 2.3.2. Population Estimates and Projections Dataset Variables:

- **Canton Code:** Unique code that identifies the canton.
- **Canton:** Name of the canton.
- **Year:** Year of estimation/projection.
- **Population Quantity:** Estimated/projected population.

Each of these variables was documented and transformed according to the needs of the configurationally analysis model and subsequently calibrated for fsQCA. The population considered includes the 225 cantons of Ecuador with available demographic data and 24,221 homicide and murder records. The sample was defined in a purposively random manner, selecting a total of 19,376 records of the most critical homicide escalation events.

#### 2.3.3. Hybrid Methodology: Random Forest + fsQCA + Neutrosophic Logic

The methodological design coherently integrates data collection techniques, study type, and analytical procedures. A non-experimental, cross-sectional approach using secondary data analysis is employed. The articulation of qualitative analysis through fsQCA allows for the study of diffuse causal configurations that contribute to the phenomenon of violence, complemented by neutrosophic logic to model the levels of uncertainty and indeterminacy present in the data. This methodological combination is reinforced by the use of learning techniques.

Automatic, specifically the Random Forest algorithm, as a quantitative support tool. This supervised model was used to train the predictive system based on historical data, allowing for the identification of relevant variables and risk patterns in a robust and explanatory manner.

The data processing process prior to model training integrates and cleans two main sources: homicide data and population data. This block automatically generates aggregated features by canton and year, including violence indicators (total homicides, homicides by weapon type, homicide rate per 100,000 inhabitants), demographic characteristics (male/female victims, by age group, proportion of young victims), and population indicators (total population, population growth, population density).

#### 2.3.4. Prediction algorithm

The Random Forest Regressor model was used due to its ability to handle complex, nonlinear data with variations across cantons. This algorithm combines multiple decision trees and generates robust predictions even with limited historical data. One model is trained per canton, which better captures local specificities in violence and population dynamics. The generated predictions (estimated number of homicides per year) serve as the basis for calculating the security level using fuzzy and neutrosophic logic.

Fuzzy logic is used to model uncertainty in variables such as the homicide rate, time trends, and the confidence of the predictive model. Using membership functions, these variables are converted into scores indicating belonging to the "safe" category, allowing for gradual interpretation. Additionally, neutrosophic logic incorporates three dimensions into the assessment: Truth (T), Indeterminacy (I), and Falsehood (F). These values are dynamically calculated by canton based on historical and projected indicators, offering a more ambiguity-tolerant assessment.

The computational prototype is based on three-tier architecture: Frontend (HTML5, CSS3, Javascript, Angular) for the user interface and visualization; Backend (Python, Flask, REST API) for data processing and prediction execution; and Algorithms and Models (Random Forest, fsQCA, Neutrosophic Logic) for analysis. The main libraries used in the backend include Pandas, NumPy, Scikit-learn, GeoPandas, and Folium, enabling efficient management of structured, geospatial, and visual predictive data.

## 3. Results

The developed predictive model was trained by combining three complementary approaches: Random Forest, fuzzy logic, and neutrosophic logic. This integration allowed for the capture of both statistical patterns and the uncertainties and contradictions inherent in the social phenomenon of urban violence. Homicide, population, and annual trend data from Ecuador's cantons between 2022 and 2025 were used.

### 3.1. Implementation of the Algorithm Hybrid

The algorithm was implemented in Python, using libraries such as Pandas and NumPy for data management, Scikit-learn for the Random Forest model, and GeoPandas and Folium for geospatial visualization. The Random Forest Regressor model was selected for its ability to handle complex and nonlinear data, and a specific model was trained for each canton to capture its local characteristics.
Fuzzy logic was applied to model uncertainty in key variables such as the homicide rate per 100,000 populations, the time trend in homicides, and the confidence of the predictive model. Using membership functions, these variables were transformed into scores indicating belonging to the "safe" category, allowing for a graded interpretation of risk levels.

Additionally, neutrosophic logic was used to incorporate the three dimensions of Truth (T), Indeterminacy (I), and Falsehood (F) into the security assessment for each canton. These values were dynamically calculated based on historical and projected indicators, providing a more robust assessment in the face of ambiguity and incomplete data.

#### 3.1.1. Key Results of the Model:

- **hybrid_security_level:** Quantitative security value (0-100), integrating fuzzy logic and Random Forest.
- **truth, falsehood, indeterminacy:** Components of neutrosophic logic assigned to each canton.
- **score_fuzzy :** Fuzzy level of security based on graded membership .
- **score_neutrosophic :** Score adjusted considering contradiction and uncertainty .
- **hybrid_category :** Final qualitative classification ( e.g. , "Dangerous", "Unsafe", "Safe").
- **confidence_prediction :** Confidence level of the Random model Forest in every prediction.

### 3.2. Evaluation of the Predictive System

The system was validated by comparing the results obtained by the prototype with the judgment of a group of experts in citizen security, data science, and social analysis. The objective was to determine the accuracy of the hybrid model—based on neutrosophic logic, fsQCA, and Random Forest—in issuing violence risk levels by canton.

#### 3.2.1. Results Charts:

This results view shows the classification of Ecuadorian cantons into five risk levels, from "Very Safe" to "Dangerous," using a color-coded scale. The visualization includes interactive tools with detailed information such as canton name, safety level, risk category, projected average number of homicides, rate per 100,000 inhabitants, and prediction confidence level.
These features encourage deeper analysis and provide clarity and precision in conveying results tailored to diverse audiences.

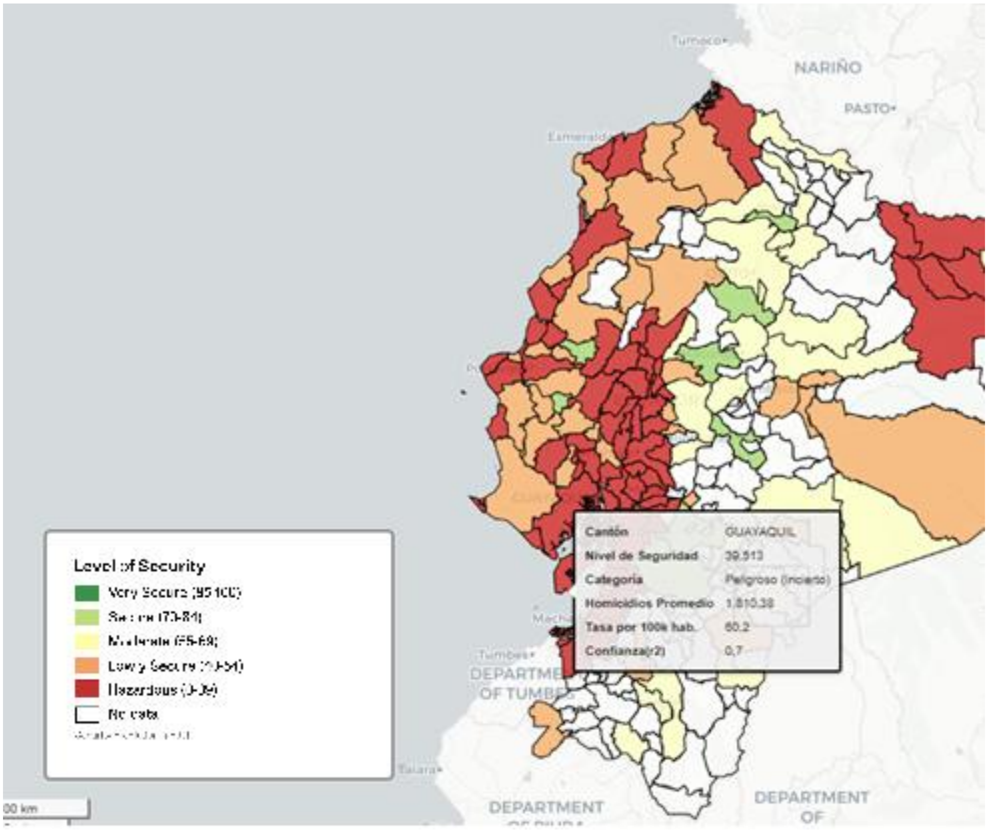


**Figure 1.** The map showing the results of the hybrid predictive model training is presented. The cantons shown in white correspond to areas that were not included in the training and test datasets, either due to a lack of available information or because they were not processed by the model due to the absence of key variables in those regions.

#### 3.2.2. Implications of the Results

The results obtained confirm the feasibility and effectiveness of integrating neutrosophic logic and fsQCA with machine learning techniques for predicting urban violence. This hybrid approach overcomes the limitations of traditional models by providing a more robust and adaptive tool for decision-making in citizen security. The platform's ability to handle the uncertainty and indeterminacy inherent in social data, along with the identification of multifaceted patterns, represents a significant advance in the field of violence prediction.

## 4. Applications

The results obtained from the implementation of the neutrosophic predictive system confirm the hypothesis that this approach is capable of more accurately capturing the complexity of social phenomena in contexts of high uncertainty, such as urban violence. The integration of neutrosophic logic, fsQCA, and machine learning has allowed for a more complete representation of violence patterns, overcoming the limitations of traditional models.

**Hypothesis confirmation and comparison with previous studies:** The effectiveness of the neutrosophic approach is validated by demonstrating its ability to handle the indeterminacy and ambiguity inherent in violence data. Unlike previous studies that rely on deterministic statistical models [12]or machine learning approaches without explicit consideration of uncertainty, our model provides a nuanced assessment of risk levels, incorporating degrees of uncertainty.

Truth, falsehood, and indeterminacy. This allows for a deeper understanding of the factors that contribute to violence, rather than just a binary prediction of its occurrence.

The model's ability to identify complex causal configurations using fsQCA, rather than simple linear relationships, is a significant advance [13] . This aligns with the understanding of violence as a multifactorial and equifinal phenomenon, where multiple combinations of conditions can lead to the same outcome. Integrating neutrosophic logic into this process improves the robustness of the analysis by allowing for the inclusion of qualitative and contextual information that is often discarded in purely quantitative approaches [14].

**Significant findings on patterns of urban violence:** Although the title document does not detail specific findings on causal configurations of violence, the proposed methodological framework has the potential to reveal intricate patterns. For example, it could identify that the combination of high socioeconomic inequality, low investment in preventive programs, and weak surveillance capacity in specific areas, along with a high degree of data indeterminacy (due to underreporting or the hidden nature of certain crimes), is a more robust predictor of violence than any of these factors in isolation. Interactive visualization of the results on georeferenced maps facilitates the identification of these critical areas and understanding of the underlying factors.

**Theoretical and practical implications:** This study reinforces the value of predictive systems that incorporate neutrosophic logic not only as technical tools, but also as means to strengthen governance, planning, and the quality of citizen security interventions. The ability to explicitly model uncertainty and indeterminacy opens new avenues for social science research, enabling a more realistic analysis of complex phenomena.

From a practical perspective, the platform improves evidence-based decision-making, equipping authorities with an innovative tool to develop more efficient prevention strategies. Visualizing results on interactive maps facilitates the communication of complex information to diverse audiences, promoting coordinated and effective action.

**Future lines of research:**

- **Integration of new data sources:** Expand the model to include metrics for other types of violence (robbery, kidnapping, and extortion) and contextual variables such as poverty, unemployment, or access to basic services. This would enhance the analysis and predictive capacity.
- **Incremental learning:** Implement an incremental learning system that allows the model to be automatically updated with new data, maintaining its relevance in changing and dynamic social environments.

- **Explainability in AI (XAI):** Explore the use of explainability techniques in artificial intelligence to improve the understanding of model predictions by non-technical users, increasing confidence and adoption of the tool.
- **Validation in other contexts:** Validate the platform in other cities in Ecuador or Latin America to verify its adaptability and scalability in contexts with characteristics different from those of Guayaquil.
- **Development of a mobile version and early warning systems:** Create a mobile version of the platform to facilitate its use in the field and its integration with early warning and geospatial monitoring systems for proactive action.

## 5. Conclusions

The main objective of this study was to develop a prototype of a predictive platform for urban violence that integrates Fuzzy Qualitative Comparative Analysis (fsQCA) and Neutrosophic Logic, complemented by machine learning techniques. The findings confirm the viability and effectiveness of this hybrid approach to address the complexity and uncertainty inherent in social phenomena, overcoming the limitations of traditional predictive models.

First, the state-of-the-art in predictive violence analysis and the fsQCA and neutrosophic logic methodologies were comprehensively evaluated and analyzed. This study provided a solid theoretical foundation that validated the relevance of the proposed approach compared to traditional statistical methods, which fail to adequately model the complexity and uncertainty of the phenomenon.

Secondly, the main factors associated with urban violence in Guayaquil were identified through the analysis of data from official records. Variables such as the type of weapon, age, sex of the victim, and population data allowed us to define key indicators for the model, improving the accuracy of predicting risk zones.

Thirdly, a predictive model was designed that integrates fsQCA with Neutrosophic Logic and Random Forest as a computational foundation. This methodological combination proved effective in representing complex causal configurations and incorporating uncertainty into data processing, which is crucial for modeling social phenomena with multiple levels of uncertainty.

Finally, a functional computational prototype was developed based on modern web architecture, capable of receiving input data, processing it using the proposed algorithms and presenting georeferenced interactive visualizations.

Validation with real data and hypothetical scenarios demonstrated the feasibility of the proposed approach to support prevention strategies in citizen security, highlighting its ability to handle uncertain information and offer more accurate configurational assessments.

The main contribution of this study lies in the validation of an approach that combines the mathematical rigor of neutrosophic logic and fsQCA with the predictive capacity of machine learning, offering a more robust and adaptive tool for citizen security management. This work establishes a methodological precedent for the application of neutrosophics to public security and social risk management problems, opening up new possibilities for informed decision-making and the implementation of more effective preventive policies in complex urban contexts.

## References

[1] Vargas Gutiérrez, U. A fuego cruzado: crimen organizado y violencia homicida en América Latina y el Caribe. Anal. Plural 2025. https://doi.org/10.31391/rvf3yy20.

[2] Calsin, E.; Aréstegui, R.; Gómez-Palomino, J.; Apaza, E.; Sardón-Meneses, E.; Neira, I. Políticas públicas y la violencia contra la mujer en América Latina. Gestionar Rev. Empresa Gob. 2022, 3, 153–170. https://doi.org/10.35622/j.rg.2023.01.011

[3] Puente Bienvenido, H.; De Haro Gázquez, D.; D'Antonio Maceiras, S. El Big Data como metodología de investigación social: Propuestas, renuncias y dilemas desde la sociología. Teknokultura Rev. Cult. Digit. Mov. Soc. 2023, Online First, 1–15. https://doi.org/10.5209/tekn.83875

[4] Smarandache, F. Improved Definition of NonStandard Neutrosophic Logic and Introduction to Neutrosophic Hyperreals. arXiv e-prints 2018, arXiv:1812.

[5] Villacrés, S.E.C.; Moreira, M.M.P.; Sela, H.H.C.; Villacrés, I.A.C. La evolución y consecuencias de la delincuencia organizada y el narcotráfico en el Ecuador. Ciencia Educ. 2023, 4(8), 18–48.

[6] Radatz, D.L.; Zoe Hilton, N. The Ontario Domestic Assault Risk Assessment: Predicting violence among men with a police record of intimate partner violence in the United States. Crim. Justice Behav. 2022, 49, 371–388. https://doi.org/10.1177/00938548211035816

[7] Rihoux, B.; Ragin, C.C., Eds. Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques; Sage: Thousand Oaks, CA, USA, 2009; Vol. 51.

[8] Abdulbaqi, A.S.; Radhi, A.D.; Qudr, L.A.Z.; Penubadi, H.R.; Sekhar, R.; Shah, P.; Tawfeq, J.F. Neutrosophic sets in big data analytics: A novel approach for feature selection and classification. Int. J. Neutrosophic Sci. 2025, 25(1).

[9] Agustín, I.C.L.; Francisco, O.A.; Griselda, D.A. Characterization of the productivity of a Mexican technology development company through fuzzy control. Rev. Método. Cuantit. Econ. Empres. 2022, 34, 281–304. https://doi.org/10.46661/revmetodoscuanteconempresa.5374

[10] Government of Ecuador. Homicidios Intencionales – Open Data Ecuador, Dataset on intentional homicides in Ecuador. 2025. Available online: https://datosabiertos.gob.ec/dataset/homicidios-intencionales

[11] Instituto Nacional de Estadística y Censos. Estimaciones y proyecciones de población. 2024. Available online: https://www.ecuadorencifras.gob.ec/proyecciones-poblacionales/

[12] Hernandez Perez, E. Modelo para la clasificación y predicción de casos de violencia contra la mujer. Master's Thesis, TecNM, 2021. Available online: http://51.143.95.221/handle/tecnm/5163

[13] Gonzalez Caballero, E.; Leyva Vázquez, M.Y.; Batista-Hernández, N.; Smarandache, F. New measures of consistency and coverage for social research based on neutrosophic logic. Neutrosophic Sets Syst. 2025, 84(1), 17.

[14] Escobar, C.R.; Faundes, J.R.; Ruiz, M.; Cornejo, C.; Michenkova, A.; Benites, L.; Pérez, A.M. A Neutrosophic–fsQCA framework for strategic school management: Superset and coincidence analyses of student social competence. Neutrosophic Sets Syst. 2025, 92, 224–234.

[15] Morini, F.; Garretón, M.; Pomerance, J.; Zeissig, N.; De Guenther, S.; Thomet, F.; Dörk, M. Critical interactivity: Exploration and narration in data visualization. *IEEE Comput. Graph. Appl.* 2025.

Received: June 05, 2025. Accepted: August 08, 2025