THE ROLE OF JURIMETRICS AND PREDICTIVE ANALYSIS IN JUDICIAL DECISION-MAKING: A CURRENT PANORAMA

RWRSILANY SILVA
FACULDADE DE ECONOMIA, ADMINISTRAÇÃO E CONTABILIDADE DA UNIVERSIDADE DE SÃO PAULO - FEA

CLEICE DE PONTES BERNARDO
FUNDAÇÃO UNIVERSIDADE FEDERAL DE RONDÔNIA (UNIR)

ADRIANA BACKX NORONHA VIANA
FACULDADE DE ECONOMIA, ADMINISTRAÇÃO E CONTABILIDADE DA UNIVERSIDADE DE SÃO PAULO - FEA

ROGERIO PEREIRA DOS SANTOS
UNIVERSIDADE LUSÓFONA DE HUMANIDADES E TECNOLOGIAS

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1. INTRODUCTION

According to a survey in Statistics Data Platform, the volume of available digital data has increased significantly in recent years, growing from 2 zettabytes to 50 zettabytes in a decade, and this volume is expected to quintuple by 2025 (SEE, 2021). Law, as a science of human knowledge, cannot be absent from this impact of technology, and there is a consensus that the Brazilian Judiciary needs to modernize to improve the services delivered to society (BARBOSA; PAMPLONA, 2017). In this perspective, in the world of Big Data, techniques such as Jurimetry and Predictive Analysis, which are related to artificial intelligence, allow precise analyzes of future scenarios within the scope of Justice. Jurimetry is a science that seeks to understand legal processes and facts through statistical models, helping the Law better understand citizens' desires and produce fairer laws (LOEVINGER, 1949; OLIVEIRA, 2017). Predictive Analysis, on the other hand, uses data from the past to predict future events, allowing prospecting increasingly accurate scenarios. Combined with machine learning, predictive analytics can quickly identify changing trends and provide accurate forecasts, a fundamental tool for developing fairer legal institutions (SIEGEL, 2017).

The low efficiency of the administration of Justice is a problem that generates difficulties in accessing judicial services and a disproportion between the efforts of the population and the benefits achieved. The Judiciary's expansion and the processes' slowness magnify these problems. In addition, data from the National Council of Justice - CNJ (2021) indicate about 77 million cases in progress and a congestion rate of 68.5%, which shows the need for technological resources, especially Artificial Intelligence (AI), to optimize procedures and reduce costs. However, it is essential to highlight that the CNJ has edited norms to standardize and provide security to using technology in the judicial scope, establishing National Goals to improve judicial performance. In this way, several institutional initiatives are being developed to implement AI tools, including systems in the Superior Labor Court and the Regional Labor Courts. In this sense, the importance of surveying studies in the current scenario on the applications of perimetry and predictive analysis in the judiciary ecosystem is highlighted. Given this, the following question arises: How are perimetry and predictive data analysis used to assist in judicial decision-making? Considering the importance of AI for law, this work aimed to understand the role of perimetry and predictive data analysis in supporting legal decision-making. As for the methodological aspects, it is a literature review using the Parsifal platform under the quantitative approach, deductive method, and bibliographic research procedure. The articles were obtained through searches in sources of national and international papers, using keywords, on the website of (I) CAPES journals, and on the databases (II) Scopus, (III) Web of Science, (IV) ScienceDirect and (V) IEEE Xplore Digital Library. A string of court decisions was used, returning 513 article titles, of which 40 met the selection criteria.

The research in question offers significant contributions both for legal professionals and for society as a whole. Law professionals will benefit from receiving subsidies to analyze and reflect on the challenges that need to be overcome to adapt to new changes. On the other hand, society will have access to valuable information, such as forecasts on the number of lawsuits filed in the Brazilian judicial system, establishing a correlation between the demand for cases and the macroeconomic environment. In addition, society will act to consolidate the new paradigm that promotes data-based decision-making, allowing the legal sector and the judicial system to reduce risks, manage compliance and achieve successful results for its clients, citizens, partners, and interested parties.

In short, applying perimetry and predictive analysis can help judges on several fronts,

such as predicting the interpretation of law articles, estimating procedural deadlines, and predicting penalties. These techniques can also help judges make informed decisions, identify patterns and trends, and improve the service offered by the judiciary. Consequently, predictive analytics has become essential for modernizing the justice system and improving its services. In addition, the research addressed the decision-making theory with the application of perimetry in judicial decisions. She guided researchers by proposing a research agenda. She presented a framework that demonstrated the interconnection between the following categories of analysis: detection of trends and sources of legal data, prediction of judicial decisions, benefits for the magistrate's performance, technologies and society, and ethical considerations. This broad and interdisciplinary approach allowed a more comprehensive understanding of the subject and contributed to advancing the perimetry field.

Therefore, this research brought significant implications for decision-making in the legal area, offered direction for future research, and presented a framework that showed the interaction between different categories of analysis.

2. THEORETICAL REFERENCE

The contributions of theorists on decision-making, judicial decisions, Predictive Analysis, and Jurimetry follow, resorting to seminal and contemporary authors whose works stand out in studying such themes.

2.1 Decision-making and limited decision-making

Decision-making is a process that involves obtaining relevant information about the variables present in a given context. Through this process, people make value judgments, express their preferences, and make consistent choices (RIBEIRO, 2014). Herbert Simon (1957) already argued that, due to cognitive and resource limitations, human decisions generally seek satisfactory rather than optimized solutions.

Mintzberg (1976) describes the decision-making process as a dynamic set of actions that begins with identifying an initial stimulus and culminates in the commitment to follow through. On the other hand, Bazerman (2015) expands this view by considering commitment as a previously selected course of action, which goes beyond the path outlined by the rational decision-making process model. Robbins, Judge, and Sobral (2010) state that decision-making occurs in response to a problem when there is a discrepancy between the current state of affairs and the desired state. Decision-making and limited decision-making.

Bazerman (2015) states that the rational decision-making process involves six distinct steps. The first step is a clear definition of the problem in question. Next, you need to identify the relevant criteria and weigh their importance. In the fourth stage, viable alternatives for action are generated. The fifth step consists of evaluating each option according to established standards, which is often the most challenging part of the decision-making process, requiring forecasting future events and systematic analysis of the potential consequences of each option. Finally, in the sixth and final step, we seek to identify the ideal solution, combining the weighted rankings of the criteria for each option and selecting the one with the highest weighted sum.

2.2 Judicial decisions and the insertion of artificial intelligence

The judicial decision is a distinct process that requires the action of a judge (MONTEIRO, 2007). Several personal and contextual characteristics of the judges influence these decisions. According to Dworkin (2014), it is essential to emphasize the relevance of judges' decisions and their basis in principles. In cases where there are no clear answers, judges use their discretion. The reasons for findings play a crucial role in this context (TOVAR, 2018).

Authority emanates from judicial decisions (OST, 1993), and several sources influence the judge's interpretive process. Judicial decisions reflect social interactions and the judge's convictions (CLAYTON, 1999; DIREITO, 2001). Although artificial intelligence is used, it is essential to highlight that it does not replace judges (OLIVEIRA; COSTA, 2018). Furthermore, this technology faces challenges related to accountability and data protection (Bill 21/20). In addition, the transparency and independence of judges are essential considerations in this context (CNJ, 2021). These issues have been debated, including discussions about using statistical data in France.

2.3 Concept and applicability of predictive analytics

Predictive Analytics uses statistical, data modeling, data mining, artificial intelligence, and machine learning techniques to make predictions from the analysis of current and historical data (SIEGEL, 2017). This analysis is applied to big data, allowing to explore large volumes of complex and heterogeneous data (KITCHIN; MCARDLE, 2016). Predictive Analytics uses statistical strategies, such as machine learning and regression, to identify patterns and infer algorithms, which are evaluated and improved based on data (SATHISHKUMAR et al., 2020). This analysis has gained relevance due to computational advancement and enables proactive organizational decisions (SIEGEL, 2017).

In addition to Predictive Analysis, other data mining techniques are used, such as genetic algorithms, clustering, association, and classification rules (LIAO; CHU; HSIAO, 2012). Predictive Analytics has applications across healthcare, education, supply chain management, transportation, and agriculture. In the legal market, predictive analytics predicts court decisions based on past data (SIEGEL, 2017).

Given the above, Table 1 presents the definitions of the main terms presented in this topic.

Table 1 – main definitions of the terms presented

We have in English	Definitions
Artificial intelligence	It is a multidisciplinary science that seeks to develop and apply computational techniques that simulate human behavior in specific activities. The study of computations makes it possible to perceive, reason, and act.
Data science	It uses statistical methods to analyze and interpret large amounts of data with different formats, generated from various sources and at different speeds.
Predictive analytics	They are used to make predictions about trends and behavior patterns. It uses various techniques extracted from statistics, data modeling, data mining, artificial intelligence, and machine learning to analyze data and make predictions.
legaltechs	The term represents the union between statistics, computational methods, and legal theory in law.
Machine learning	It is a subfield of artificial intelligence that aims to solve more complex problems, of which progra to gain such broad knowledge. It is used to discover hidden patterns in data by applying some of it classification, association, or grouping in machine training.
Big data	It is the term in Information Technology (IT) that deals with large sets of data that need to be proc
Data mining	A set of tools and techniques forms it through learning or classification algorithms based on neu statistics. These can explore a collection of data, extracting or helping to show patterns in this dat discovering knowledge.
Decision Tree	Decision trees are trained on data for classification and regression problems. They are usually fast and accurate and are a big favorite in machine learning. Examples are "Random Forest," which is a blended learning method used, among other tasks, for classification, and "Classification and Regression Tree (CART)."

Clustering	Clustering methods are typically organized by modeling approaches such as centroid-based and hierarchical. All forms are concerned with using the inherent structures of the data better to manage the data into groups of maximum commonality.
Artificial Neural Network	They are models inspired by biological neural networks' structure and function. They are a pattern-matching class commonly used for regression and classification problems. However, they are a vast subfield comprising hundreds of algorithms and variations for various issues. Examples of methods are "Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNNs)."
Deep Learning	These methods are a modern update of Artificial Neural Networks and are concerned with building much larger and more complex neural networks.
Linear Regression	The highly interpretable standard method for modeling the past relationship between independent input variables and dependent output variables (which can have an infinite number of values) helps predict future values of output variables.
Association Rule Learning	Association rule learning methods extract rules that best explain the observed relationships between variables in the data.
Support Vector Machines (SVM)"	They are supervised learning models with associated algorithms that analyze the data used to make linear and non-linear classifications. Therefore, they can be used to classify the predictive analysis problem.
Natural Language Processing	The model allows computers to understand natural language like humans. Whether the language is spoken or written, natural language processing uses artificial intelligence to take input from the real world, process it, and understand it in a way that a computer can understand.

Prepared by the author, based on the studies selected in this review

In health, predictive analytics in big data helps predict the spread of diseases, hospital readmissions, and the identification of appropriate treatments (WANG, 2016; TSUMOTO; HIRANO, 2015). In education, sensors and management systems generate data and support decisions (The Center for Digital Education, 2015). Supply chain management benefits from predictive analytics by improving customer relationships, understanding customer satisfaction, and predicting supplier relationships (ACCENTURE, 2014; TAN et al., 2015). In transportation, predictive analytics based on big data is used to predict and control traffic, observe travel demand, and reduce passenger waiting times (SHI; ABDEL-ATY; TOOLE, 2015). In agriculture, sensors are applied to analyze the effectiveness of seeds and fertilizers, improve operations and predict environmental impacts (STUBBS, 2016).

Despite the advantages of Predictive Analytics, there are limitations, such as errors in data labeling, scarcity of massive datasets, lack of explainability of algorithms, and bias in data (CHUI; MANYIKA; MIREMADI, 2018). Despite correction proposals, such as reinforcement learning and transfer learning techniques, there are still no clear solutions to deal with bias in the data.

2.4 Predictive analytics in jurimetry

Jurimetry, also known as Legal Analysis, is a science that uses statistical models to understand facts and legal processes. Its objective is to apply statistical data and symbolic logic to law, taking into account the specificity of the subject and social interests (LEVINGER, 1949). Jurimetry combines statistics, computational methods, and legal theory to solve legal problems and predict procedural outcomes (BARROS et al., 2018). The use of jurimetrics has recently intensified with the emergence of legal and law techs, which apply predictive analytics and data security technologies to provide legal services (RUBIN, 2014; EBRAHIM, 2018). Jurimetry can help identify good administrative practices, reduce judicial delays, and provide a technical basis for judges and lawyers (OLIVEIRA, 2017).

3. METHODOLOGICAL PROCEDURES

3.1 search ranking

This work aims to understand the role of jurimetry and predictive data analysis in supporting legal decision-making. For this, the categorization proposed by Creswell (2010) describes its research nature. From the perspective of approaching the problem, this research is classified as qualitative. As for the method used, it is a deductive approach. The research is based on a bibliographic review regarding the technical procedures used. This review was conducted by analyzing published articles selected from reliable sources, such as the Journal Portal of the Coordination for the Improvement of Higher Education Personnel (CAPES) and the databases: Scopus, Science Direct, Web of Science, and IEEE Digital Library.

3.2 Stages of the literature review

The preparation of this Literature Review (RL) followed the protocol established by Kitchenham and Charters (2007), which outlines three main phases: planning, conducting, and producing the report, as illustrated in Figure 1.

Figure 1 - Stages of the literature review
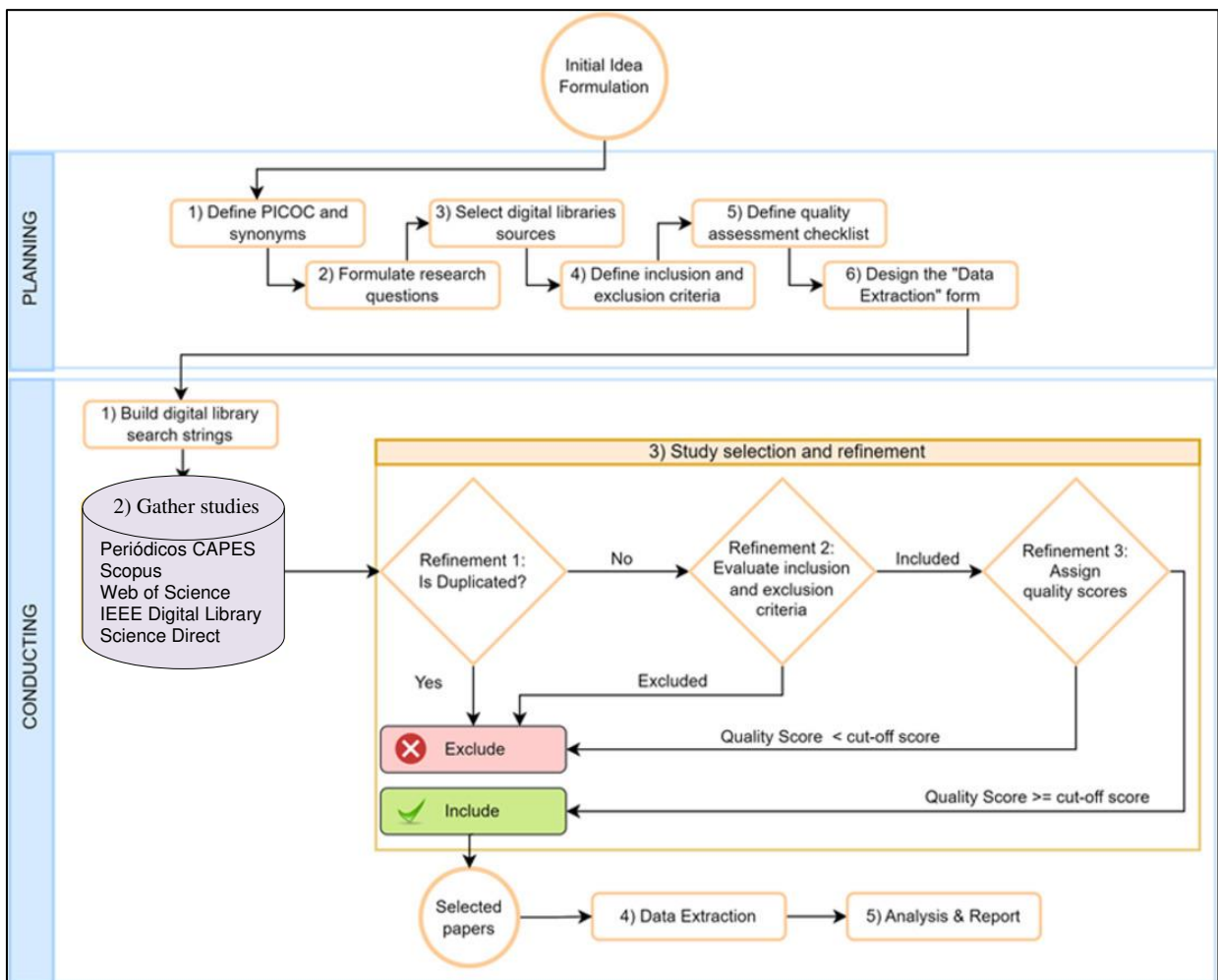
Source: Systematic review steps adapted from Carrera-Rivera et al. (2022) and Kitchenham and Charters (2007)

3.2.3 selection criteria

The selection of articles followed established criteria. Initially, the titles and abstracts for selection were read. In case of conflicting articles, they were marked for further review. After reading all titles and abstracts, the relevance of each article was reassessed. The inclusion criteria (CI) were: to address jurimetry or predictive analysis in court decisions, to be published between 2011 and 2021, and to be complete and written in Portuguese or English. Exclusion criteria (EC) were: out-of-scope studies, predictive models not applied to judicial decisions, gray literature, languages other than Portuguese or English, full text not available online, and publication outside the period from 2011 to 2021.

In Step 1, studies were retrieved using the search above string from digital databases. The databases returned 511 articles downloaded, registered, and organized with the Parsifal tool. Additionally, two additional articles were manually included to address relevant concepts. Of the 513 initial results, 462 were not duplicates (step 2). Then, 386 studies were excluded based on the described exclusion criteria. When data were insufficient, articles were temporarily accepted for further review. At the end of the third stage, 75 articles remained in the selection process. After reading and analyzing the full texts, 40 relevant articles were obtained (step 4). At this stage, the articles were excluded according to the previously mentioned exclusion criteria. It is essential to highlight that several studies were excluded from this literature review because they addressed topics outside the scope or did not involve judicial decisions in the context of predictive models. Therefore, only works that proposed applying predictive models in judicial decisions were selected. Figure 2 shows the flow of the article selection process.

Figure 2 - Process flow for conducting this review
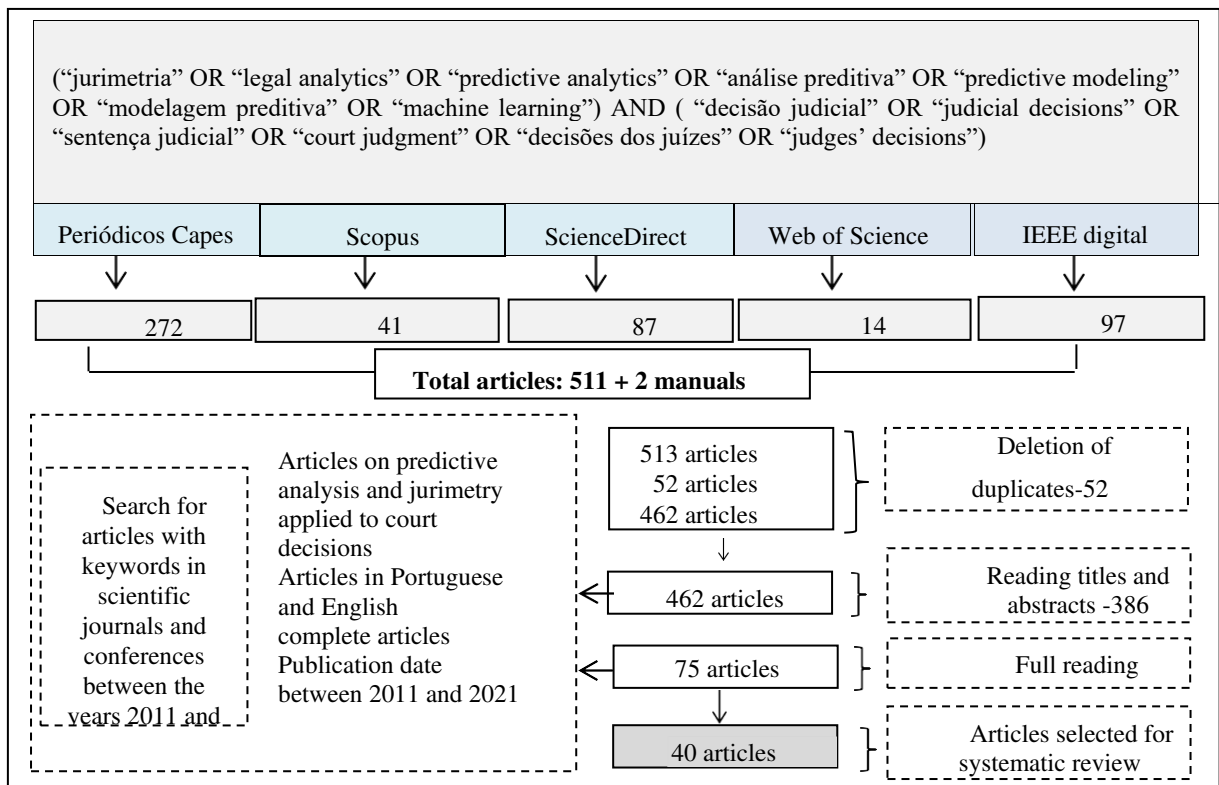
Source: prepared by the author based on Kitchenham and Charters (2007).

3.2.5 Data Extraction, Coding and Data Analysis

After completing the sampling of articles, the review was conducted using the thematic analysis methodology. The pre-analysis stage began with the "floating" reading of the selected articles to become familiar with their content. Data were extracted from selected articles and entered into the Atlas.ti software, where relevant text segments (citations) were marked for coding. During the process, the most prevalent information related to the subject of the study was considered. The software allowed for locating the codes in the texts, reviewing the coding criteria, and observing the relationships between the identified codes. In the synthesis stage, the themes were associated with the codes, providing standards to describe, organize and interpret aspects of the research theme. With the codifications identified, the following categories of analysis were elaborated: detection of trends and sources of legal data, review of judicial decision, benefits for the magistrate's performance, technologies and ethical considerations of society, providing a comprehensive view of the benefits and applications of the jurimetry and predictive data analysis to court decisions.

3.2.4 quality assessment

The quality of the selected articles was evaluated by answering the ten quality questions (QQ) listed below in Chart 2. According to the answers, The score given to each one was as follows: yes = 1 point; partially = 0.5 points; and not = zero scores. Only one researcher performed the quality analysis. The quality of the selected studies was assessed based on ten criteria, obtaining a positive score for credibility, completeness, and relevance.

Table 2 – Quality issue

Questão	Quality assessment issues
(QQ1)	Is the purpose of the research clearly described?
(QQ2)	Does the article deal with judicial decisions?
(QQ3)	Are the research methodology and technique clearly described?
(QQ4)	Does the article address the limitations of the study?
(QQ5)	Does the article indicate future research?
(QQ6)	Does the article identify laws and regulations aimed at artificial intelligence in legal decisions?
(QQ7)	Does the article indicate the advantages and disadvantages of predictive models?
(QQ8)	Is there discussion about the results of the study?
(QQ9)	Does the study significantly increase knowledge about the application of predictive analysis or jurimetry to judicial decisions?
(QQ10)	The study was cited by authors (less than 2 =0.0, 5 to 7 = 0.5 point, above 8 citations = 1.0 point)

Source: prepared by the authors.

4 RESULTS

Based on 40 selected studies published between 2011 and 2021, this systematic review addresses the results related to predictive analysis and jurimetry applied to judicial decisions, answering the two specified research questions.

4.1 How are jurimetry and predictive data analysis being used to assist in judicial decision-making?

Jurimetry and predictive analytics are used in the legal field to analyze data and predict future outcomes. These approaches assist magistrates in making informed decisions by identifying patterns and trends in court data. In addition, they can help identify biases and discrepancies in decisions, promoting fairness and impartiality. However, there are limitations, such as data availability and quality, the need to consider the legal context and the importance

of addressing ethical and privacy issues. Jurimetry and predictive analytics should be support tools, not substitutes for legal analysis.

In this sense, Chart 3 was created to express and present the results of this research. It systematizes the relevant categories: detection of trends and sources of legal data, judicial decision prediction, benefits for the magistrate's performance, technologies and society, and ethical considerations. The framework provides a comprehensive overview of the benefits and applications of jurimetrics and predictive data analytics in court decisions.

Table 3 - Summary of categories

	Analysis category	context unit	recording unit	Reference
Application of Jurimetry and predictive analysis to court decisions	Trend Detection and Legal Data Sources	Legal data analysis platform.	Records of court decisions and case descriptions Clauses and articles of laws court records Categorization of trials according to verdict Challenge in the implementation of a jurimetric system Broad and informed view of the legal field	Park et al. (2021) Medvedeva, wieling, vols, (2021) Armonas Colombo, Buck e Miana Bezerra (2017)
	Judicial Decision Forecast	specific court case or a set of cases	Other predictions of court decisions Forecast of article of law sentence prediction Penalty period forecast Prediction of Judgments by Sentiment Analysis Anticipation of privacy violation decisions Prediction of proportionality in algorithmic sentences recurrence forecast Justice System	Li et. al (2019); Pillai e Chandran (2018 Vols e Wielin (2020) Katz, Bommarito e Blackman (2017); Petrova, Armour e Lukasiewicz (2020); Medvedeva, wieling, vols, (2021); Yao et. al (2021) Chen et al. (2019) Liu e Chen (2018), Parke e Chai (2021 Chiao (2018 Zolbanin et. al., (2019) Aletras et al. (2016); YAO (2021).
	Benefits for the magistrate	Judicial environment	Sentence prediction and alignment Agility in obtaining information More informed decision making Automation of legal services Objective basis Selection of strategies Preliminary decisions by Judge IA Identification of profiles of defendants	Barros et al. (2018) Park et al. (2021; Freitas e Barddal (2019) Barros et al. (2018); Fagan (2020) PARK *et al.,* 2021 Park et al. (2021)
	Technologies and Society	Technological advances in the judicial system	Procedural publicity and transparency Decreased procedural delays software and programs Predictive analytics in criminal cases. Machine Learning	Guimarães (2019) Barros et al. (2018); Freitas e Barddal (2019) Dal Pont et al. (2021); Iftikhar et al. (2019); Završnik (2019); Yao et. al (2021)

Analysis category	context unit	recording unit	Reference
			Roseli et al. (2021) Nunes (2016)
Ethical Considerations	Reflection on the intersection between technology, ethics and justice	data protection cognitive bias Awareness of Arbitrariness and Bias in Algorithmic Decisions Criticism of the Use of algorithms in judicial contexts Search for Equity and Justice in Decisions Fuzzy Probability and the Legal Process	Souza Britto, Erzinger e Barddal (2020); Fagan (2020) Greene et. al (2020) Morison e Harkens (2019). Brennan-Marquez e Henderson (2019) Battelli (2021) Sabahi e Akbarzadeh (2014); Guimarães (2019

Fonte: Elaborado pelos autores baseado nos dados da pesquisa

a) Trend Detection and Legal Data Sources

Spotting trends and properly using legal data sources play a crucial role in predictive analytics and a comprehensive understanding of the legal field. These historical records help judges identify defendants' profiles, patterns, and legal predictions (PARK et al., 2021). However, the implementation of legal systems faces technical and non-technical challenges, such as the heterogeneity of judicial systems and the interpretation of laws related to open data (ARMONAS COLOMBO et al., 2017). In addition, clauses and articles of law provide a solid basis for decision-making and judgments, while court records are essential sources of data for analysis and legal research (PARK et al., 2021).

However, obstacles must be overcome in effectively extracting information from judicial decisions. With small samples, the results cannot be generalized (BARROS et al., 2018; LIU; CHEN, 2018; ZOLBANIN et al., 2019; GREENE et al., 2020; RINCÓN-RIVEROS et al., 2021). Furthermore, applying these models is limited to specific areas of law (LIU; CHEN, 2018). Selecting international scientific articles with the term "jurimetry" can also be challenging (MAIA; BEZERRA, 2020). Therefore, it is necessary to analyze different types of data from various sources (ALETRAS et al., 2016; IFTIKHAR; JAFFRY; UL; MALIK, 2019; MAKHLOUF; ZHIOUA; PALAMIDESSI, 2021; ROSELI et al., 2021).

Furthermore, it is relevant to deal with linguistic variation in writing styles between courts and jurisdictions for the extraction and quality of results (PETROVA; ARMOUR; LUKASIEWICZ, 2020; PARK et al., 2021). It is also suggested to include studies in theses and dissertations bases, as well as in specific Law bases, such as the Brazilian Law Bibliography (BBD) maintained by the Federal Senate, for more contemporary research (MAIA; BEZERRA, 2020).

b) Judicial Decision Forecast

Several record units are used in this context, such as prediction of articles of law, prediction of sentences, prediction of penalty term, prediction of judgments by sentiment analysis, prediction of decisions on violation of privacy, prediction of proportionality in algorithmic sentences, prediction of recidivism and the justice system.

Studies such as those by Aletras et al. (2016) and Medvedeva, Vols, and Wielin (2020) analyzed cases judged by the European Court of Human Rights (ECHR). They highlighted the importance of systems for predicting intelligent judicial decisions to assist magistrates, lawyers, and citizens. Katz, Bommarito, and Blackman (2017) developed a predictive model for the voting behavior of the United States Supreme Court, achieving significant results. Pillai and Chandran (2018), Verdict Prediction for Indian Courts Petrova, Armor, and Lukasiewicz (2020)

addressed the extraction of outcomes from everyday law court decisions in the US, enabling outcome prediction and advanced legal analysis. Using sentiment analysis, Liu and Chen (2018) proposed an advanced method to predict judgments based on historical criminal precedents. Chiao (2018) emphasized the importance of proportionality in judicial decisions and proposed an algorithm to predict proportionality in algorithmic sentences.

Medvedeva, Wieling, and Vols (2021) categorized the judgments according to the verdict, allowing the identification of patterns and predictions. Park and Chai (2021) proposed an artificial intelligence model to predict judgments related to privacy violations. Li et al. (2019) used the NLP algorithm to predict decisions in divorce cases. Zolbanin et al. (2019) developed a decision support system to predict recidivism in drug courts. Iftikhar et al. (2019) analyzed criminal court decisions of the High Court of Lahore, obtaining promising results. Chen et al. (2019) applied a deep learning model to predict decisions related to sentence, prosecution, and legal provisions.

As a suggestion for studies, they recommended the application of new technology for predictive purposes and other concrete cases for the prediction of judicial decisions, using the machine learning method combined with a classifier to improve the prediction of the performance of the tools (KATZ; BOMMARITO; BLACKMAN, 2017; GUIMARÃES, 2019; MEDVEDEVA; VOLS; WIELIN, 2020; CAO; ASH; CHEN, 2020; PARK; CHAI, 2021); determining what are the barriers to the implementation of jurimetric systems (ARMONAS COLOMBO; BUCK; MIANA BEZERRA, 2017).

c)Benefits for the magistrate

Jurimetry and predictive analysis offer several benefits for the magistrate's performance, such as prediction and sentence alignment. Based on data analysis and advanced algorithms, these techniques allow predicting trends and case outcomes, helping judges to make more informed decisions. In addition, the agility in obtaining information and the automation of legal services provide greater efficiency in analyzing processes, allowing the magistrate to have an objective basis when issuing his sentences. The identification of profiles of defendants through jurimetry also contributes to a better understanding of the cases, facilitating the selection of adequate strategies. In addition, the possibility of using artificial intelligence for preliminary decisions by the judge streamlines the judicial process. All these benefits, provided by jurimetry, promote the magistrate's more effective and grounded performance in exercising his functions.

Barros et al. (2018) mention software that allows law firms to obtain information quickly and exploratory, directing their efforts toward more effective legal strategies. This approach can also assist judges by considering legal grounds and relevant social factors. Through a systematic review, Park et al. (2021) identified data sources used in predictive legal analyses, such as court decision records and case descriptions. These historical records assist magistrates in identifying profiles of defendants and associated legal information. Judicial decision data is essential for legal technology research based on data analysis.

Finally, Fagan (2020) highlights the transformative potential of analyzing large datasets in legal practice, enabling choice of words, selection of strategies, legislative elaboration, and judgments. Data analysis techniques allow the automation or semi-automation of legal services. In addition, artificial intelligence-based judicial decision support systems, such as AI judges, offer sentencing recommendations in pending cases, improving decision-making procedures.

As for the indication of future research, the authors proposed research on predictive analysis that aims to contribute to the alignment of the sentence in judicial cases with ontologies and legal hermeneutics (SABAHI; AKBARZADEH, 2014; HOMMERDING; HARTMANN, 2021; DAL PONT et al., 2021)

d) Technologies and Society

The Technologies and Society analysis category promotes transparency and efficiency in the legal system through registries. Studies demonstrate the effectiveness of machine learning methods in predicting court decisions, achieving high precision (ROSELI et al., 2021; YANG et al., 2020). Tools such as Jurimetría, Tyrant Analytics, and vLex Analytics contribute to improving the legal system (FREITAS; BARDDAL, 2019).

In the criminal context, the use of AI allows the identification of rules associated with maintaining preventive detention (DAL PONT et al., 2021) and the prediction of recidivism in drug courts (ZOLBANIN et al., 2019). Applying deep learning models also helps predict decisions related to penalties, charges, and legal provisions (CHEN et al., 2019; IFTIKHAR et al., 2019). These approaches highlight how software and predictive analytics, including machine learning, can improve procedural publicity, reduce delays, and provide insights for more informed judicial decision-making.

Finally, CHEN et al., 2019 suggested studying more dimensions to build judicial decision-making models based on deep learning to make more assertive and effective decisions.

e) Ethical Considerations

Controversial aspects that require reflection on important legal values, such as fundamental rights, privacy, processing of personal data and legislation (such as the General Data Protection Regulation - GDPR and the General Data Protection Law - LGPD), biases and discriminatory decision-making, the authors raised questions mainly about the application of predictive analysis in criminal court decisions (FREITAS; BARDDAL, 2019; ZAVRŠNIK, 2019; DE SOUZA BRITTO et al. 2020).

It is necessary to consider the judges' cognitive bias and awareness of arbitrariness and bias in algorithmic decisions (DE SOUZA BRITTO et al., 2020). Critically evaluating the use of algorithms in criminal cases is essential due to the associated risks and insecurities (MORISON; HARKENS, 2019). Considering fuzzy probability, seeking equity and justice in decisions is essential (SABAHI; AKBARZADEH, 2014). It is necessary to deal with the inconsistencies of human judges and those arising from algorithms, including designers, implementers, data aggregation, storage, schema processing, and model selection by data scientists (GREENE et al., 2020). Addressing the biases in the analysis critically and transparently is essential (GUIMARÃES, 2019). It is necessary to seek a balance between the use of algorithms, ethical awareness, and the protection of individual rights in the legal system.

Freitas and Barddal (2019) recommended researching in more detail regarding theoretical and practical information on when and how to use predictive analysis, respecting fundamental rights, privacy, non-discriminatory treatment of personal data, and how to create a good relationship between computer science and law.

5. DISCUSSION OF THE RESULTS
5.1 Implications of the Theory of Rational Decision Making

The theory of rational decision-making seeks to understand logical and objective decisions, considering all available information. Predictive analysis and perimetry help in the context of judicial decisions, providing tools and additional information for informed and reasoned decision-making. By applying the rational decision-making theory, these approaches provide an objective and systematic assessment of relevant criteria, minimizing biases and contributing to the efficiency of the justice system. In addition, they offer valuable insights to legal professionals, complementing their expertise and contributing to a fairer decision-making process. In view of this, the relationship between predictive analysis techniques and jurimetry with the decision-making stages is illustrated in Chart 4.

Table 4 - The convergence between the decision-making process and support for judicial decisions

Phases of the decision-making process (BAZERMAN, 2015)	Decision-making and judicial decisions	Support of predictive analysis and jurimetry to court decisions
Phase 1) Clearly define the problem	Identification of the legal issue	Support the accurate identification of legal issues by analyzing historical data, patterns, and trends, providing a clear understanding of the justice system's challenges. In addition, applied to judicial decisions, these techniques help identify the problems and challenges judges face, predicting sentences, penalty periods, and collections.
Level 2) Identify relevant criteria	Relevant data collection	Support the provision of relevant information on legal, social, and human criteria in judicial decision-making using data such as decision records, cases, and legal codes. These approaches help to understand past criteria and allow considering factors such as legal precedents, social issues, profiles of defendants, and dispute resolution strategies, facilitating the extraction of practical knowledge for judicial decision-making.
Phase 3) Consider criteria	Data analysis and interpretation	Support for assigning weights to relevant criteria based on historical data and statistical analysis, enabling an objective and reasoned assessment of available options. These approaches apply machine learning and data processing techniques to identify patterns and relationships between legal variables, such as articles of law and profiles of defendants, facilitating the interpretation of data and understanding of different scenarios in the legal context.
Phase 4) Generate alternatives	Generating insights and forecasts	Support for identifying possible solutions and strategies in similar cases, assisting judges in decision-making. Additionally, these approaches generate insights and predictions about court outcomes, judge behavior, and the likelihood of recidivism, helping legal system professionals make more informed decisions. Based on statistical models and algorithms trained on historical data, these techniques assess the probability of success of each identified alternative.
Phase 5) Evaluate alternatives	Decision making support	Support for evaluating and predicting the results and consequences of alternatives considering relevant criteria, such as legal, social, and human aspects. Judges can use these approaches and jurimetric metrics to analyze and choose the best alternative, helping to make more informed judicial decisions. In addition, decision support systems based on artificial intelligence can offer preliminary recommendations, streamlining the judicial decision process.
Phase 6) Identify the ideal solution	Evaluation and review of decisions	Support optimal solution identification using weighted rankings and weights assigned to relevant criteria. Judges can apply these approaches to find the solution that maximizes the desired results regarding judicial system efficiency. In addition, predictive analysis and jurimetry also contribute to the evaluation and review of court decisions, verifying the accuracy of forecasts and identifying opportunities for improvement in decision-making procedures. It is important to emphasize that these approaches provide additional support but do not replace the role of the judge or lawyer in decision-making.

Fonte: Elaborado pelos autores

In summary, the organized structure of decision-making steps, which follow a linear and prescriptive sequence of actions, plays a crucial role in rational decision-making. Each phase has a specific function, contributing to the conclusion of a progressive cycle that culminates in

selecting the ideal alternative. In the context of judicial decisions, judges adopt an approach based on logic, the application of laws, and the interpretation of legal norms. When reviewing cases and litigation, they seek to impartially assess the evidence presented, examine the parties' arguments, and apply the legal rules relevant to the case at hand. Rational decision-making in the judicial sphere aims to ensure objectivity, consistency, and justice in decisions, promoting stability and trust in the legal system. By basing their decisions on rational criteria, judges seek to ensure equal treatment, protection of the parties' rights, and preservation of fundamental principles of justice.

Figure 3 - Implications of the Theory of Decision Making in the judicial decision
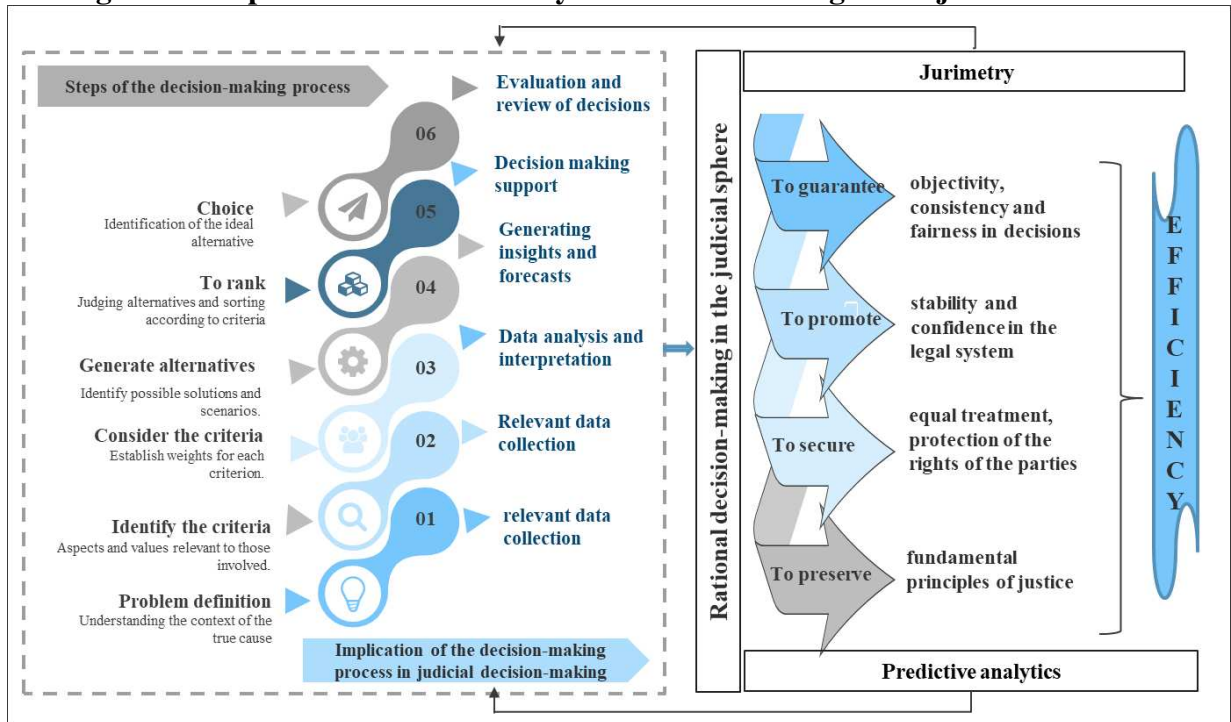
Source: prepared by the authors

Finally, predictive analysis and jurimetry can provide support and foundation for each of the phases of the limited decision-making theory, helping judges analyze cases, understand the relevant criteria, and identify the most appropriate solution. , based on data and evidence.

5.2 Framework proposal and research agenda

This study proposes a framework that presents the role of jurimetry and predictive analysis in the justice system, as illustrated in Figure 4.

In the first level of this framework, the techniques of jurimetry, predictive analysis, and the theory of the decision-making process are addressed, all of which are related to judicial decision-making. Applying these techniques takes us to the second level, which involves detecting trends and sources of legal data and predicting court decisions. Through these applications, it is possible to obtain more accurate forecasts and identify trends in the legal system.

At the third level of the framework, we find the results of these techniques, which include benefits for the magistrate's performance, implications for society, and ethical considerations. These results represent the added value that applying these techniques provides to justice system users. Regarding the benefits for the magistrate's performance, improvements in efficiency, systematization of decisions, and greater agility in the judicial process stand out.

On the other hand, we have benefits for society and the technologies involved in this context. Citizens perceive these benefits as justice system users and include greater transparency and legal certainty. Applying these techniques allows for a more accurate and grounded analysis, contributing to a more efficient and reliable justice system.

However, these results must be appropriately regulated, parameterized, and improved through ethical considerations. Ethics is crucial in applying jurimetry and predictive analysis techniques, ensuring fairness, impartiality, and justice in judicial decisions. It is necessary to ensure that forecasts and analyses are carried out ethically, considering data protection, minimizing cognitive biases, and pursuing a transparent and fair legal process.

Figure 4 - Framework - the role of jurimetry and predictive analysis in the justice system
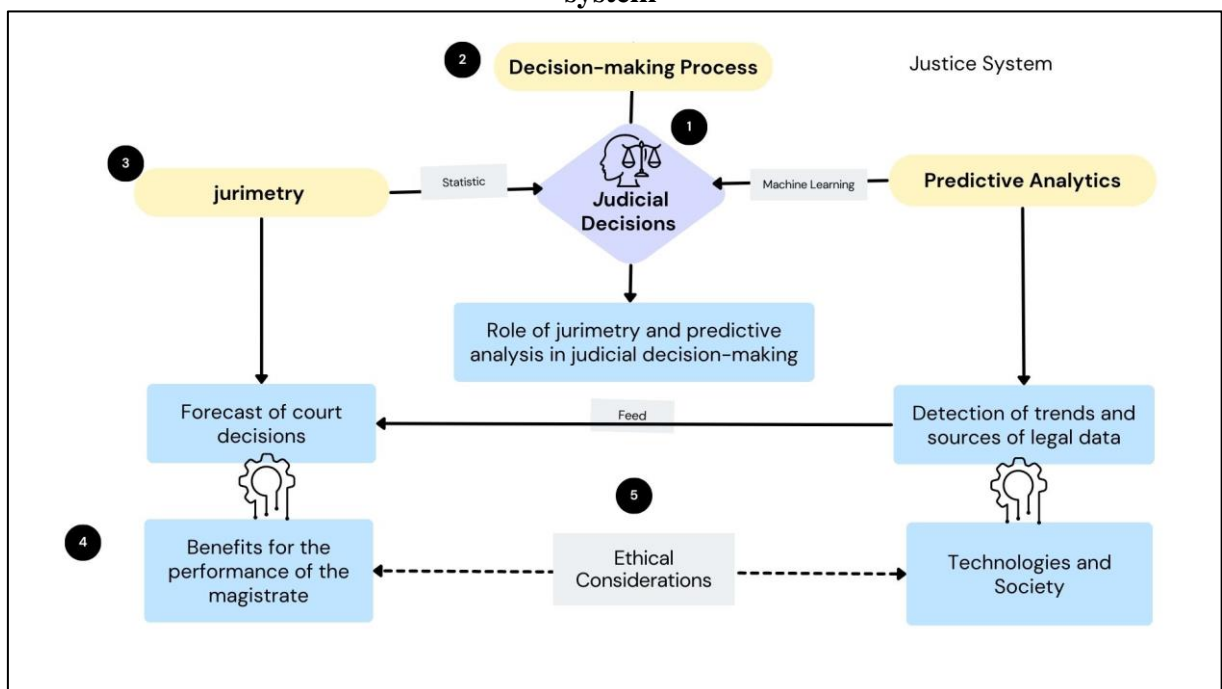
Source: Prepared by the authors

Thus, the relationship between jurimetry, predictive analysis, and judicial decisions is intrinsically linked to the search for a more efficient, transparent, and fair justice system. Applying these techniques can bring significant benefits to the performance of the magistrate and society as a whole, as long as strict ethical considerations and duly regulations accompany them.

Continuing with the objectives of this research, in this systematic review of the literature, directions for future research on jurimetry and predictive analysis applied to the legal context were identified. Within each category analyzed in the previous section, it was possible to observe that the literature lacks a deeper analysis of each of the presented categories. In this sense, Table 5 lists some research questions the researchers pointed out in the articles comprising the bibliographic portfolio related to the topic above.

Table 5 - Research Agenda - Some suggestions for research questions listed in the bibliographic portfolio studies

	research questions
future schedule	How does the alignment of the sentence in judicial cases to ontologies or legal hermeneutics contribute to the consistency and coherence of judicial decisions?
	How can applying new technology combined with machine learning improve prediction in court cases?
	What are the main barriers to the implementation of jurimetric systems, and how can these barriers be identified?
	What theoretical and practical information is relevant for the use of predictive analytics with respect to fundamental rights?
	How to deal with linguistic variation in writing styles to deepen the quality of extracting results in predictive analytics?
	What are the reasons for the scarcity of studies on predictive analysis and jurimetry in labor court decisions?
	What are the bases of theses and dissertations and the specific Law bases that contain relevant information for future research on predictive analysis and jurimetry, and how can these sources enrich knowledge in this area?
	What are the main challenges and opportunities in building models of judicial decision-making based on deep learning, and how can these models be effectively integrated into the legal context?
	What types of data are collected and from what sources are they obtained in predictive analytics and jurimetry, and how does using these different types of data contribute to a more accurate assessment of court cases?

Fonte; elaborado pelos autores baseados no portfólio bibliográfico

Based on the mapping carried out on the theme of analysis focused on in this review and with the suggestions for research questions briefly presented in this section, these can help researchers to outline future research on jurimetry and predictive analysis applied to the legal context, thus deepening, the development of studies in this area.

6. CONCLUSION

The organizational scenario undergoes constant changes resulting from various forces, such as political, economic, social, and environmental, which go beyond previously insurmountable borders. In this context, databases play a crucial role for managers and judges, providing solid information that reduces possible technical errors in legal processes. This work aimed to understand the role of jurimetry and predictive data analysis in legal decision-making.

The results revealed that jurimetry and predictive analysis help the magistrate in several areas, allowing the prediction of the interpretation of articles of law, the anticipation of collections to reduce procedural delays, the prediction of sentences and deadlines, the quick identification of relevant information, making decisions based on legal grounds and social considerations, identifying profiles of defendants, selecting dispute resolution strategies, recommending sentences by an AI judge, accurately predicting court decisions, verifying of fuzzy probability for decision making, the use of tools that promote equity and justice, the prediction of proportionality in sentences, the categorization of judgments, the prediction of decisions in specific cases, the review of appeals in the Federal Supreme Court, the prediction of recidivism in drug courts, the determination of decisions based on the description of the facts of a crime and the identification of biases in judicial decisions.

By relating predictive analysis and jurimetry with the phases of limited decision-making theory, it is observed how these approaches provide support and information to judges from problem definition to the identification of the ideal solution. The research also proposed a research agenda and presented a framework that interconnects different categories of analysis, such as trends and sources of legal data, prediction of judicial decisions, benefits for the

magistrate, technology, and society, and ethical considerations. This broad approach contributed to a broader understanding of the subject and the advancement of jurimetry.

However, some limitations must be recognized, such as excluding articles written in languages other than Spanish and the non-consideration of gray literature. For future work, it is recommended to analyze the application of jurimetry and predictive analysis in different areas of law to carry out a comprehensive comparison. This will allow identifying how predictive analysis has been used to assist judges and lawyers, providing a basis and efficiency in the decision-making process. In short, this work is an interim contribution to academic studies and represents the predictive analytics literature in law, being open to challenge and a basis for future research.

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