



ARTICLE

Bibliometric analysis of scientific articles on jurimetry published in Brazil

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ABSTRACT

Judicial delays have been the subject of debate in the Brazilian academic community. Among the solutions discussed, jurimetrics has gained ground in seeking quantitative standards in court decisions. However, despite the relevance of this methodology, in Brazil, few researches have been conducted towards its dissemination. Therefore, the present study employs bibliometric techniques on national scientific production, articles, related to the term "jurimetry", from 2002 to 2019, made available on the Google Scholar search tool, presenting an information panel on the characteristics found in these publications. The results show that in the period surveyed, the number of publications on the subject showed an average annual growth of 18.92%; the collaboration index indicates that there are, on average, 2.32 authors per article, some of which stand out for the number of publications, including Daniel F. N. Menezes (four) and Filipe J. Zabala (three) and, in turn, the most cited authors are Lee Loevinger (eleven citations), Filipe J. Zabala and Fabiano F. Silveira (both with six citations); the magazine that has published the most on the subject is the Revista da Faculdade de Direito of the Federal University of Minas Gerais, with a single magazine publishing four articles, seven magazines publishing two articles and 66 magazines publishing a single article; and finally, as for the keywords associated with the term, the words "adoption", "civil procedure", "invalid act", "illegal act", "partial dissolution", and "successive incidence" stand out, suggesting Civil Law as an area of law more aligned to the use of jurimetry.

KEYWORDS

Legal scientific production. Empirical legal studies. Bibliometric Indicators.

Análise bibliométrica dos artigos científicos de jurimetria publicados no Brasil

RESUMO

A morosidade judicial tem sido tema de debates na comunidade acadêmica brasileira. Entre as soluções discutidas, a jurimetria tem ganhado espaço ao buscar por padrões quantitativos nas decisões judiciais. Porém, em que pese a relevância desta metodologia, no Brasil, poucas pesquisas têm sido conduzidas no sentido de sua disseminação. Assim sendo, o presente estudo emprega técnicas de bibliometria sobre a produção científica nacional, artigos, relacionada ao termo "jurimetria", de 2002 até 2019, disponibilizada na ferramenta de pesquisa do Google Acadêmico, apresentando um painel informativo sobre as características encontradas nestas publicações. Os resultados mostram que no período pesquisado, o número de publicações sobre o tema apresentou um crescimento médio anual de 18,92%; o índice de colaboração indica que existem, em média, 2,32 autores por artigo, sendo que alguns se destacam pelo número de publicações, entre eles, Daniel F. N. Menezes (quatro) e Filipe J. Zabala (três) e, por sua vez, os autores mais citados são Lee Loevinger (onze citações), Filipe J. Zabala e Fabiano F. Silveira (ambos com seis citações); já a revista que mais tem publicado sobre o tema é a Revista da Faculdade de Direito

da Universidade Federal de Minas Gerais, sendo que uma única revista publicou quatro artigos, sete revistas dois artigos e 66 revistas um único artigo e, finalmente; quanto às palavras-chaves associadas ao termo, destacam-se as palavras: “adoção”, “processo civil”, “ato inválido”, “ato ilícito”, “dissolução parcial”, e, “incidência sucessiva”, sugerindo o Direito Civil como uma área do direito mais alinhada ao uso da jurimetria.

PALAVRAS-CHAVE

Produção científica jurídica. Estudos jurídicos empíricos. Indicadores bibliométricos.



JITA: BB. Bibliometric methods.

1 INTRODUCTION

Judicial slowness significantly affects the efficiency of the Brazilian judiciary (BRITTO, LACERDA e KARNINKE, 2018; GARGANO e NADER, 2018; VENTURINI, SOUZA e BIANCHI, 2018). This situation “became part of the daily discussion of the academic community, which was forced to seek solutions to this problem that generates great social dissatisfaction” (BASSI and SCHUMAK, 2018, p. 720). In this scenario, jurimetry is inserted as an approach with real potential to, at least, suggest directions capable of optimizing the reasonable time for the solution of legal disputes (COUTO and OLIVEIRA, 2016). This approach, according to Menezes and Barros (2017), is capable of verifying the impact of law enforcement on society, allowing to evaluate the effectiveness of public policies and judicial decisions, showing itself, therefore, innovative in relation to the classic paradigm of scientific knowledge.

Although there is a growing interest in the study of jurimetry in Brazil, there are few relevant scientific works (ZABALA and SILVEIRA, 2014). In this same sense, for Menezes and Barros (2017, p. 80) “undeniable is the value of jurimetry, a methodology that has not been explored yet, to assess the real social impact of the standard when applied to the specific case”.

Therefore, given the importance of the theme, this study seeks to contribute to mitigate the scarcity of studies and contribute to this area by answering the following research problem: what are the characteristics of the scientific publications of jurimetry in Portuguese found in the research tool of the Google Scholar, until August 2019? It is a bibliometric, exploratory study that forms a scenario based on the authors with the largest number of publications involving the term "jurimetry", magazines with a higher incidence of the term, more associated keywords and the most cited articles.

This article, in addition to this introduction, is organized in four more sections: the theoretical framework presents the concept of jurimetry, the main studies in the area and the most used bibliometric laws; the methodological procedures provide the definition of the analysis corpus, variables to be analyzed and analytical procedures used; the fourth section is the presentation and analysis of the results and, finally; in the final considerations the conclusions of the study, its limitations and suggestions for future research are presented.

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2 THEORETICAL REFERENCE

This section presents the basic concepts used in the present study, not with the intention of exhausting such matters, but rather to lead to their understanding.

2.1 Jurimetry: conceptual aspects and applications

Although there is divergence in the literature regarding the origin of the association of statistical analysis with the study of Law, there is a consensus that this use is very old (ANDRADE, 2018; MACHADO, 2017; NUNES, 2016). According to Hald (2003), the term was found in the thesis *Dissertatio inauguralis mathematico-juridica* (BERNOULLI, 2012), defended by Nicolou I Bernoulli in 1709. For Rangel (2014), it was with the publication of the book *The path of the law*, by United States Supreme Court judge Oliver Wendell Holmes Jr. who became famous for the use of statistics in law, with the phrase “For the rational study of the law the blackletter man may be the man of the present, but the man of the future is the man of statistics and the master of economics ”(HOLMES JR, 1897, p. 457).

According to Couto and Oliveira (2016), the term “jurimetry”, a neologism created by the American lawyer Lee Loevinger, was used for the first time with the publication of the article *Jurimetrics: the next step forward* (LOEVINGER, 1971), in a context in which the application of analytical methods can bring progress and legal certainty. In the United States there are several law schools and associations that have research centers in jurimetry, having as references the Society for Empirical Legal Studies and the *Journal of Empirical Legal Studies* (MACHADO, 2017). In Brazil, according to Nunes (2016), this term began to be disseminated in 1973, with lectures by Italian professor Mario Losano. Since then, in Brazil, studies have emerged that started to address the term “jurimetry”: in 2002, the doctoral thesis of Fernando Antônio de Vasconcelos (2002) under the title: “Responsibility of the provider for damages done on the Internet” and José Augusto Delgado's (2002) article, “The computer law”; in 2003, the doctoral thesis by Alexandre Freire Pimentel (2003), “Principiologia juscibernética. Telematic process. A new general theory of process and civil procedural law ”and the master's dissertation by Ulysses Alves de Levy Machado (2003), “The convergence between the privilege of exploring intellectual creation and the elaboration of a right of virtual space with its consequences about the public domain. ” In 2006, the master's dissertation by Maria Paula Costa Bertran under the title: “Economic analysis as a guiding criterion for judicial decision: applications and limits, study based on the case of review of leasing contracts with exchange parity” (BERTRAN, 2006). In the United States there are several law schools and associations that have research centers in jurimetry, having as references the Society for Empirical Legal Studies and the *Journal of Empirical Legal Studies* (MACHADO, 2017).

For Loevinger (1963), jurimetry involves the use of quantitative analysis, the application of communication and information theory to laws, the use of mathematical logic in law, the retrieval of legal data by electronic and mechanical means and the formulation of calculations aiming at legal predictability . This concept is corroborated by Zabala and Silveira (2014, p. 75-76), where for whom, “the definitions of Jurimetry vary from author to author, passing through topics such as Statistics, Computing, Linguistics, Human Behavior and Science, more generally”.

Nunes (2016, p. 115-116) describes the term jurimetry as to its object and methodology, characterizing it as the “investigation of the functioning of the legal order”, whose methodology is to use “statistics to reestablish an element of causality and investigate the multiple factors (social, economic, geographical, ethical, etc.) that influence the behavior of legal agents ”. For Couto and Oliveira (2016, p. 779), jurimetry,

seeks to describe the concrete interests of the legal agents, their conflicts and the solutions given by the judges, with the aim of helping the Law to better understand the citizens' desires and offer subsidies to the authorities for the production of laws more in line with social reality, as well as how to function as a fundamental tool for the development of more just legal institutions, capable of assimilating the living nature of law and providing society with swift and pacifying jurisdictional protection, or, alternatively, pointing out the most appropriate non-jurisdictional means of dispute settlement for each case (mediation, arbitration, etc.).

In this sense, for Andrade (2018, p. 687),

Jurimetry provides a systematic perspective of the factors that influence or that play a role in decision making by the magistrate, as it helps to define, based on quantitative elements, standards of legal behavior.

For Menezes and Barros (2017, p. 56) “there are countless advantages resulting from the application of the proper methodology of jurimetry in all public spheres”. The main advantages would be

the implementation of policies of transparency, inspection, efficiency, cost reduction, data collection in real time and, mainly, analysis of social reality, which would allow the evaluation of the effectiveness of public policies, judicial decisions and current laws when analyzing the corresponding impacts on society.

Couto and Oliveira (2016) present as a positive aspect of the use of statistical techniques, the aid in the identification of problems and the direction of strategies for solving the difficulties of knowledge management. The disadvantages include the difficulty in obtaining data, conservatism and the plastering of the Judiciary. In addition, according to Menezes and Barros (2017, p. 57), the following challenges must be faced:

- a) the difficulty in understanding the statistical language by the lawyer (who, as a rule, is not familiar with it);
- b) the interdisciplinarity to be observed in order to carry out this study;
- c) the change in habit represented by the replacement of merely bibliographic research by empiricism;
- d) the control of uncertainties that is characteristic of statistics is not for the law.

Although the difficulty in understanding statistical language was listed, Machado (2017) reports the existence of the myth that the use of jurimetry is done through extremely sophisticated methods and with the use of cutting-edge mathematics and computational resources, limiting its application to only doctors in Exact Sciences. For these authors, a jurimetric work is any study with an object belonging to the legal world, which has the presence of data collected empirically and whose analysis is based on some statistical concept. In addition, it should be noted that the choice of the statistical method to be used does not occur randomly, but according to what is intended to be identified with the research, always maintaining care to preserve the representativeness of the population in cases of generalization of the results. As an example of some methods used, there is the case study, descriptive statistics and/or correlations, causality regressions and other infinity of theories, techniques and empirical models.

However, Couto and Oliveira (2016) warn that care should be taken in the direct use of mathematical tools, since the incessant search for procedural speed could result in a massive and unsatisfactory judicial provision for the judicial system. This is because jurimetry would have the function of diagnosing problems and suggesting measures for knowledge management.

Machado (2017) presents some themes studied with the use of jurimetry, being the effects of: (a) ideology in judicial decisions; (b) gender in judicial decisions; (c) composition and voting on panels and peer effects; (d) external pressure from the media or popular opinion on court decisions. “In addition to gender, there are other factors that affect judicial decisions, related to minority groups such as race, ethnicity, religious group and social formation, among others” (MACHADO, 2017, p. 262). A summary of the authors studying these themes is presented in Chart 1:

Chart 1. Studies related to jurimetry

Theme	Authors	Study object
Ideology	Pritchett (1968)	Analyzes the North American Supreme Court trials in order to identify patterns arising from ideological differences.

	Epstein, Landes and Posner (2013)	Argues that the impacts of political ideology have been growing over time.
	Arida, Bacha and Lara-Resende (2005)	Point to the existence of an alleged pro-debtor bias by the Brazilian judiciary.
	Yeung and Azevedo (2015)	Analyzes the studies of Arida, Bacha and Lara-Resende (2005) in approximately 1,700 decisions of the STJ (Supreme Court of Justice).
Gender	Peresie (2005)	Shows that the gender of judges is a significant determinant in the decisions of appellate courts in the United States, in cases of disputes over sexual harassment and discrimination.
	Farhang and Wawro (2004)	According to these authors, judges tend to significantly influence their male colleagues.
	Boyd, Epstein and Martin (2010)	Found significant gender impact in sex discrimination litigation.
	King and Greening (2007)	Analized the decisions of the International Criminal Court in cases of sexual violence in the former Yugoslavia.
	Poncezk and Grezzana (2012)	Analyzed more than 90 thousand labor conflicts in the Superior Labor Court: in general, they do not find evidence of gender impact in the decisions of that court.
Composition and voting on panels, and peer effect	Epstein, Landes and Posner (2013)	Tested the occurrence of the effect of the composition of the panel, that is, votes decided unanimously or by majority.
	Smyth (2005)	Dissent pattern in the Australian Supreme Court for almost a hundred years.
Media and popular opinion	Epstein and Kobyłka (1992)	According to these authors, most judicial decisions reflect public opinion.

	Casillas, Enns and Wohlfarth (2011)	They find significant influence of public opinion on the decisions of the United States Supreme Court.
	Giles, Blackstone and Vining Jr (2008)	They say there is clear evidence of causality in the vote of the ministers.
	Epstein and Martin (2010)	They find evidence that the Supreme Court's decisions are, to some degree, in line with public opinion.
	Lopes and Azevedo (2018)	Comparing the impacts of pressure from the Executive Branch (especially from the Presidency of the Republic) on the decisions of the Supreme Court of Justice and the Supreme Federal Court.

Source: adapted from Machado (2017).

Machado (2017) also suggests some themes that should be studied in Brazil: contractual relations; labor justice; criminal justice; and, gender impacts.

It is verified, therefore, that the use of statistical methods applied to Legal Science, defined here as jurimetry, can bring benefits, not only to the judiciary and those who use the Brazilian justice, but to the whole of society, since it will provide a greater procedural speed, as well as contribute to greater assertiveness in judicial decisions.

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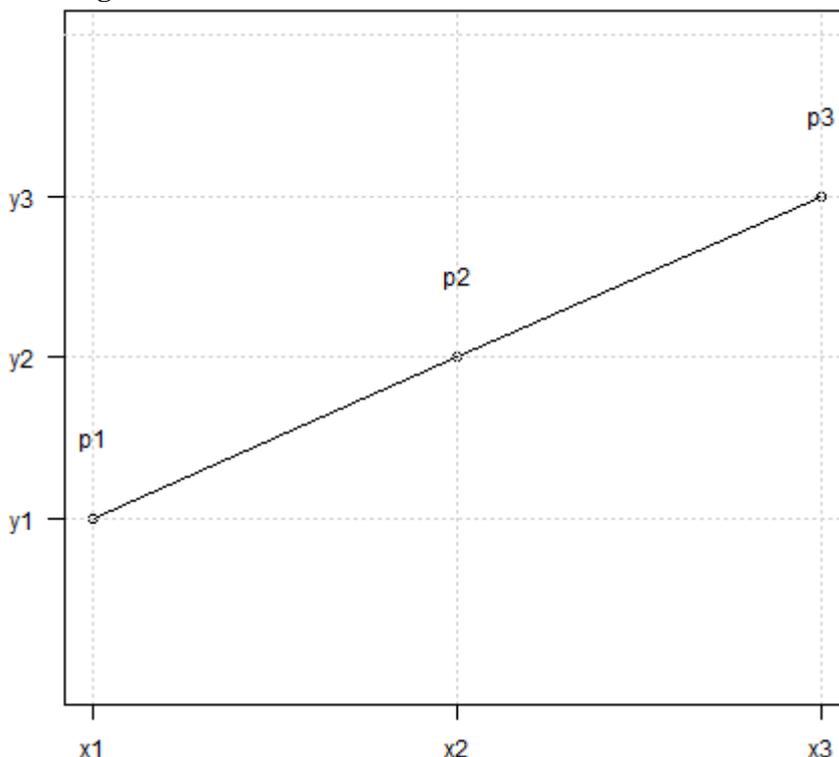
2.2 *Bibliometrics: concepts and laws*

According to Silva, Hayashi and Hayashi (2011) the origin of the term bibliometrics has sometimes been attributed to Paul Otlet in his work *Traité de Documentation: Le Livre Sur Le Livre, Theorie et Pratique* (1934) and, sometimes, to Alan Pritchard, in his book *Statistical Bibliography or Bibliometrics?* (1969). However, a distinction must be made between the concepts presented by the authors. Whereas, for Otlet (1934) bibliometrics is inserted in bibliography, for Pritchard (1969) bibliometrics has its equivalence to bibliographic statistics, defining it as a more appropriate term when making statistics from scientific publications. For Santos (2015, p. 5) “the word bibliometrics comes from the fusion of the suffix 'metria' and 'bibliography', 'information', 'science' and 'library', being respectively analogous or close to their nature, objectives and applications”. According to Alvarado (2002, p. 90), it is a “set of research methodologies in the field of Information Sciences that takes advantage of quantitative data analysis, to explore the framework of a scientific area”. In any case, it is a consolidated concept that revolves around the application of statistical methods on bibliographic content (SILVA, HAYASHI and HAYASHI, 2011; YOSHIDA, 2010; CHUEKE and AMATUCCI, 2015).

According to Alvarado (2002), Araújo (2006) and Santos (2015), there are three classic laws in bibliometry: Bradford's Law (1934) that studies the productivity of journals; Lotka's Law (1926) that works with the authors' scientific productivity; and the laws of Zipf (2012) that analyze the frequency of occurrences of words.

Bradford's Law, also called the Dispersion Law, “allows, by measuring the productivity of magazines, to establish the nucleus and areas of dispersion on a given subject in the same set of magazines” (VANTI, 2002, p. 153), as shown in Figure 1:

Figure 1. Bradford’s Law



Source: adapted from Vanti (2002).

Bradford's Law indicates that there are a small number of journals, which are "closely related to the subject and a larger core of closely related journals, with the number of journals in each zone increasing, while productivity decreasing" (ARAÚJO, 2006, p. 14). Therefore, it is suggested that “as new written subjects appear, they will be subject to a small filtering by related journals, when accepted. As a result, these journals attract more and more articles, in the course of the development of the area” (SILVA, et al., 2012, p. 3).

Lotka's Law or Inverse Squares Law (LOTKA, 1926) aims to describe the profile of the authors' scientific productions, the majority of which few authors produce much and many authors produce little. Moretti and Campanario (2009, p. 70) summarize it as follows: “the number of authors who make 'n' publications on a given scientific area is approximately 1/n² of those who make a single publication, the proportion of which is approximately 60% of the set of authors”. Lotka's Law presented some reformulations, among which, the replacement of the Inverse Square Method by the Generalized Inverse Power model (PAO, 1985; NICHOLLS, 1986), as demonstrated by Cândido, et al., (2018), in the Equation (1):

$$\gamma_x = cx^{-n} \tag{1}$$

Where:

- γ_x = probability of an author contributing x publications on a subject;
- x = number of publications on a given subject found in a given period of time;
- c = theoretical percentage of the authors who contributed with only one article, in the studied period of time (Lotka coefficient);

n = slope of Lotka's Law.

In such a way that c is obtained by the Equation (2):

$$c = \frac{1}{\sum_{x=1}^{P-1} \frac{1}{x^n} + \frac{1}{(n-1)P^{n-1}} + \frac{1}{2P^n} + \frac{n}{24(P-1)^{n+1}}} \quad (2)$$

Where:

x = number of publications by author;

n = slope of Lotka's Law;

P = observed number of pairs.

And, in turn, n is calculated according to Equation (3):

$$n = \frac{N \sum \log x \log y - \sum \log x \sum \log y}{N \sum \log x^2 - (\sum \log x)^2} \quad (3)$$

Where:

N = number of data pairs (publications by author X authors);

x = number of publications by author;

y = number of authors in relation to the number of publications;

The third classic law of bibliometrics is the Zipf Law, which, according to Araújo (2006, p. 16) “describes the relationship between words in a given text that is large enough and the serial order of these words (word count in large samples)”. According to Booth (1967) it is a law originally proposed by Estoup (2018) in 1916 and popularized by Zipf (2012) in 1949, whose equation (4) is shown below:

$$c = rf \quad (4)$$

Where:

c = constant value for any word in a particular text (Zipf constant);

r = position of the word in a decreasing list ordered by frequency;

f = number of occurrences of the word.

This law indicates that “the product of the serial order (r) of a word (given by the frequency of occurrence in decreasing order) by its frequency of occurrence (f) was [is] approximately constant” (GUEDES, 1994, p. 318). From there, Zipf (2012) identified that in any text, low-frequency words have, basically, the same frequency. Booth (1967) interprets it according to Equation (5):

$$\frac{I_1}{I_n} = \frac{n(n+1)}{2} \quad (5)$$

Where:

I_1 = number of words with frequency 1;

I_n = number of words with frequency n ;

n = number of occurrences of a given word.

At this point William Goffman “concluded that there is a transition point between high and low frequency words and that the words contained in this space would have a high semantic content, that is, words that give meaning to the text” (MELLO, 2017, p. 87). This conclusion, published by Pao (1978), became known as Point of Transition, indicating the “neighborhood where [...] the words with the highest semantic content should be included”, according to

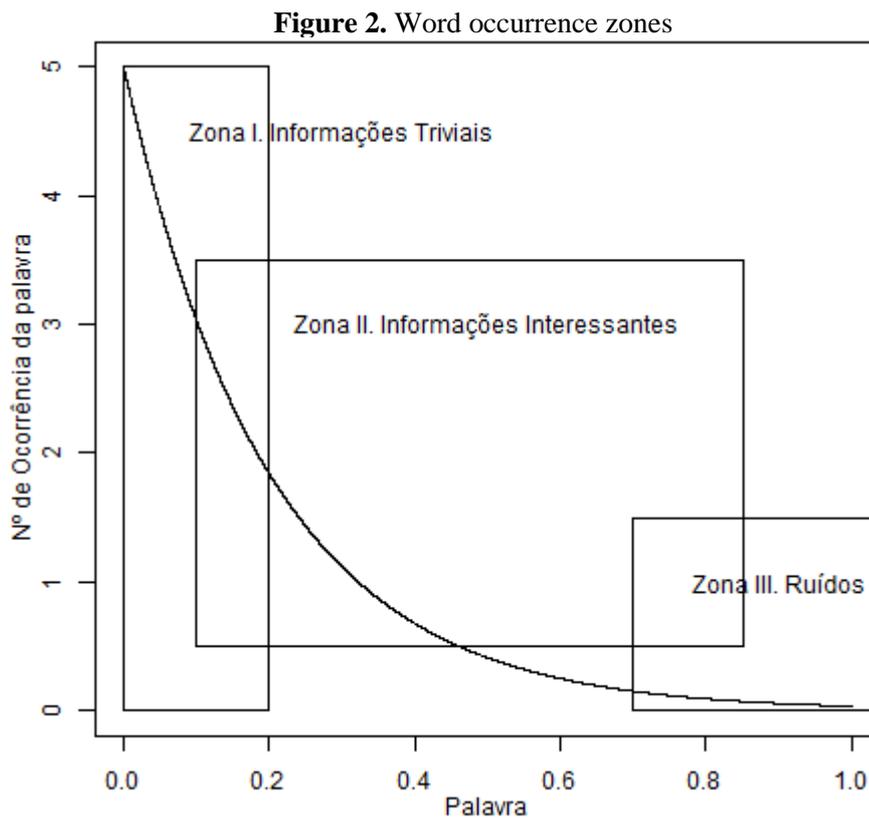
$$n = \frac{-1 + \sqrt{1 + 8I_1}}{2} \tag{6}$$

Where:

n = Goffman's Transition Point, known as T;

I_1 = number of words with frequency 1.

From the combination of Zipf's laws and Goffman's Transition Point it is possible to establish, graphically, where the transition from low to high frequency words occurs, highlighting the words that form the trivial, interesting and simply noisy information sets , as shown in Figure 2:



Source: adapted from Quoniam, *et al.* (2001).

Evidently, bibliometrics is not limited to these laws (FONSECA, 1986; CALLON, COURTIAL and PENAN, 1995; GINGRAS, 2016). That said, considering the importance of bibliographic references in scientific works (MORAES, FURTADO and TOMAÉL, 2015), we tried to verify how the citations and references of each of the works are related, through analysis of citations.

“The Analysis of Citations is based on the premise that researchers conceive their work from previous works and demonstrate this by citing previous works in their texts and in an ordered and standardized list of references” (MORAES, FURTADO and TOMAÉL, 2015 , p. 186). Its objective is “to measure the impact and visibility of certain authors within a scientific community” (VANZ and CAREGNATO, 2003, p. 251). To meet this objective, Hirsch (2005) and Garfield (1956) proposed tools to assess the quality of publications and measure the researcher's productivity and impact. Eugene Garfield (1956) proposed the Impact Factor (FI): a tool for evaluating the quality of publications, efficient in evaluating the quality of a journal. For calculating the Impact Factor for a given year “the number of citations received in that year by the articles published by the journal in the previous two years is taken into account, divided by the number of articles published by the journal in the same period” (THOMAZ, ASSAD and MOREIRA, 2011, p. 90).

Jorge E. Hirsch (2005) proposed the H Index, an indicator responsible for measuring the researcher's productivity and impact, relating the number of publications to the number of citations. “The H index of a given author will be the number of the numerical sequence of works whose number of citations is equal to or greater than the rank of the sequence” (THOMAZ, ASSAD and MOREIRA, 2011, p. 92), as shown in the example Figure 3:

Figure 3. Example of calculating the H index

Author “x” articles	Number of citations
A	20
B	3
C	5
D	10
E	7

Order →

Author “x” articles	Order	Number of citations
A	1	20
D	2	10
E	3	7
C	4	5
B	5	3

Source: the authors (2019)

It is important to stress that the laws presented here are not without criticism: for authors like M. Carl Drott and Manfred Bonitz, the theoretical support for Bradford's Law is lacking (BORGES, 2002); C. Oppenheimer and Paul Travis Nicholls, on the other hand, point to weaknesses in the Lotka Law, associated with the estimation parameters (ALVARADO, 2002); as for Zipf's Law, scholars like Pintadosi (2014), Manin (2008) and Aitchison, Corradi and Latham (2016) warn of the synonymic pitfalls that can affect their results. On the other hand, there are works using text mining, social network analysis and geoanalysis in bibliometric exploration (FAVARETTO and FRANCISCO, 2017); operational research techniques, such as linear programming and decision trees (BORGES, 2002); theoretical probability distributions and normalization methods applied to the number of citations, percentile-based approaches (MINGERS and LEYDESDORFF, 2015) and even; qualitative approaches such as meta-synthesis (OLIVEIRA, LIMA and MORAIS, 2016).

4 METHODOLOGICAL PROCEDURES

Using the categorization proposed by Silva and Menezes (2005), the present research is classified as basic as to its nature, considering that it aims to study the characteristics of the production of articles referring to jurimetry in Brazil; as quantitative in terms of approaching the problem, as it aims to measure publications and their specificities; as exploratory in relation to the objectives for explaining how the subject in question has been studied in the country; and

from the point of view of technical procedures, such as bibliography, since the study is developed through published articles and found in the Google Scholar search tool.

The Google Scholar research tool was defined as a source for the composition of the analysis corpus, having as its time frame the period from the date of publication of the first article on this basis, until August 12, 2019 (inclusive). The choice of this tool is due to the fact that Google Scholar contains all publications present in the Capes Periodicals database. In addition, Google Scholar has projected itself as one of the main scientific search tools (FALAGAS, et al., 2008), since its results are as good as that of other scientific research bases (HARZING and ALAKANGAS, 2016).

The analyzed records were obtained from the search for the term “jurimetry”, plus the filters: (1) search anywhere in the document and, (2) exclusion of patents and citations. The search returned 270 publications, of which, from this total, repeated publications were removed, as well as texts in English and Spanish. All records that were not scientific articles were also excluded. Finally, a total of 84 articles were found. From these articles, the variables to be analyzed were extracted, presented in Chart 2:

Chart 2. Analysis variables

Variable	Nature	What is to be analyzed
Title	Categorical	Expected values of the number of scientific articles published in Brazil, with the term “jurimetry” in the title.
Author	Categorical	Expected values of authors and co-authorships per article; numbers of articles by a single author and more than one author; most referenced articles; collaboration index (average number of authors present in the publication in relation to the number of publications in the analyzed literature,
Journals	Categorical	Journals that publish more on “jurimetry”.
Publication year	Numerical	Distribution of the number of publications over the years.
Keywords	Categorical	Keywords that represent the most frequent information on the theme “jurimetry”.
References	Categorical	Most referenced publications.

Source: the authors (2019).

The variables presented in Chart 2 were submitted to the analysis protocol shown in Chart 3:

Chart 3. Analysis protocol

Stage	Procedures	Goals
1	Descriptive statistics: frequencies, averages, standard deviations, minimum and maximum.	Describe the data set.
2	Lotka's law.	Find the scientific productivity of the authors.

3	Bradford's law.	Identify the productivity zones of magazines.
4	Zipf Laws and Goffman's Transition Point.	Identify the most relevant keywords.
5	Analysis of citations using the H index.	Identify the most cited authors.

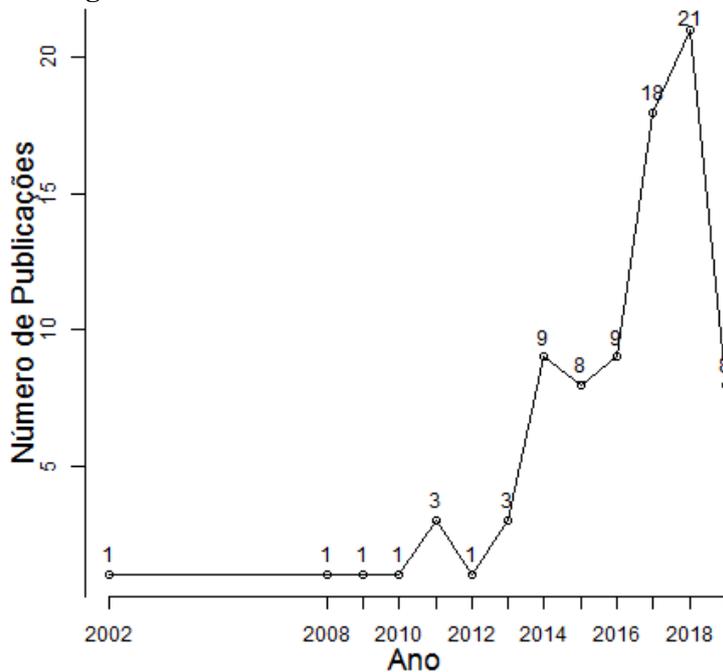
Fonte: os autores (2019).

Data analysis was performed using software R version 3.5.1, using the bibliometrics package (ARIA and CUCCURULLO, 2017). The reference data of the 84 articles were saved in the BibTex format, exported to the xlsx format and tabulated in the Microsoft Excel 2010 software.

4 PRESENTATION AND ANALYSIS OF RESULTS

In the 84 articles analyzed, it was found that the first work was published in 2002 - it is the article “The computer law” by José Augusto Delgado. After this registration, there was a six-year time lag until the next publication in 2008. From that date on, in all years there were publications related to the researched theme, as shown in Figure 4:

Figure 4. Publication numbers from 2002 to 2019



Source: research data (2019).

It is possible to note, therefore, a clear increase in the number of publications, mainly from 2013 onwards. Analyzing the entire period, there was an average annual growth of 18.92%.

Table 1 shows the descriptive statistics associated with the numbers of articles and authors:

Table 1. Articles and authorship

Variables	Average	Standard desviation	Minimum	Maximum
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Articles by author	0,58	0,59	1	4
Authors by article	1,70	1,19	1	9
Co-authorship by article	1,85	1,55	0	8

Source: research data (2019).

It is observed that the majority of articles (75.72%) have more than one author, increasing the statistics of average co-authorship and average number of authors per article to almost two. In general, the collaboration index reached 2.32, which means that there are an average of 2.32 authors collaborating per article. It was also registered 36 articles with only one author and 109 articles with more than one author.

In turn, Chart 4 presents the authors who produced more than one article in the studied period:

Chart 4. Authors present in more than one article

Autor	Título	Ano
Daniel Francisco Nagao Menezes	Brief analysis on jurimetry, the challenges for its implementation and the corresponding advantages	2017
	Effectiveness of the right to education in the Jurisprudence of the Court of Justice of the State of São Paulo in the light of Jurimetry	2017
	Metropolitan Region of Campinas: GDP X Labor Proceedings - Jurimetric Analysis.	2014
	Jurimetry: Analysis of the ineffectiveness of the judiciary in consumer protection	2014
Filipe Jaeger Zabala	Free software applied research in mathematics and statistics learning	2018
	Automatic evaluation and correction in RStudio free software	2016
	Jurimetry: statistics applied to Law	2014
Grazielly Alessandra Baggenstoss	Legal hermeneutics in Brazilian higher courts: Sample survey of court decisions	2014
	The judicial decision in guarantor constitutionalism	2013
Mônica Bonetti Couto	Justice and knowledge management: the contribution of jurimetry to the administration of justice	2016
	Utilitarian ethics and qualitative empirical research in law	2015
Simone Pereira de Oliveira	Justice and knowledge management: the contribution of jurimetry to the administration of justice	2016
	Utilitarian ethics and qualitative empirical research in law	2015
Alexandre Rocha Almeida de Moraes	A new model of criminal activity for the Brazilian Public Ministry: agencies and jurimetry laboratory	2018
	New prospects for criminal activity by the Public Ministry in the social control of crime	2017
Thaís Jacintho Muller	Free software applied research in mathematics and statistics learning	2018
	Automatic evaluation and correction in RStudio free software	2016
Márcia Carla Pereira Ribeiro	Legal and economic mechanisms for technology transfer: a case study	2017
	The "Lemons Model" applied to the contract under the legal regime of transfer of business establishment: an economic analysis of Law	2015
Marcelo Guedes Nunes	Judicial recovery in the state of São Paulo - 2nd phase of the insolvency observatory	2019
	Decision reforms in criminal law chambers in São Paulo	2015

Source: research data (2019).

That is, of the 84 articles analyzed, 63 of them were written by authors who did not produce other articles available on the studied base. In order to describe the frequency of publication of the authors, the Lotka coefficient was calculated, whose result of 3.77 indicates that the number of authors who write two articles would be equal to 0.073 (1 / 23.77) of the number of authors who wrote only one article.

Having identified the authors with the highest number of productions under this research, the journals with the highest incidence of published articles were investigated. The results are shown in Table 2:

Table 2. Journals with more than one article

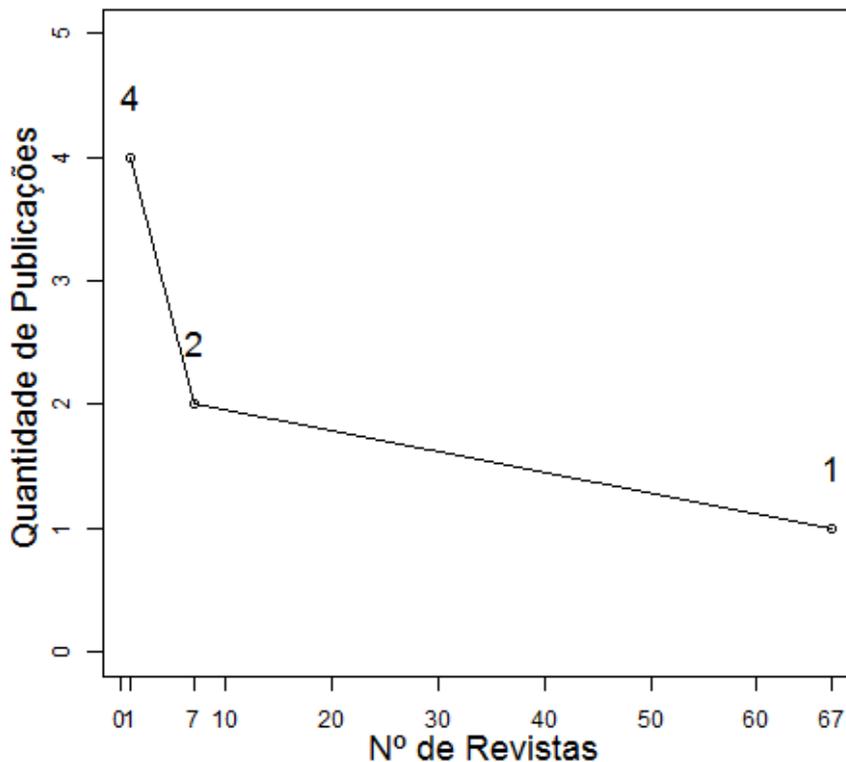
Journal name	Number of publications
Journal of Law School of Federal University of Minas Gerais	4
Brazilian Journal of Empirical Legal Studies	2

Law UNIFACS – Virtual Debate	2
Prensas de la Universidad de Zaragoza	2
Law and Freedom Journal	2
Online Courts Review	2
Legal Journal of the Higher School of the Public Ministry of São Paulo	2
Legal Opinion Journal	2

Source: research data (2019).

According to Bradford's Law, it appears that one magazine presents four articles, seven magazines two articles and 56 magazines a single article. Therefore, it is corroborated that many journals produce little about the investigated area, as shown in Figure 5:

Figure 5. Number of journals by number of publications



Source: research data (2019).

Regarding the keywords, Table 3 presents a quantitative summary of the occurrences found:

Table 3. Keywords

Frequency of keywords	Amount of keywords	Keywords
21	1	Jurimetry
5	3	Law; statistic; artificial intelligence
3	2	Adoption; civil Procedure
2	16	Logical analysis; invalid act and illegal act; civil procedure code; Judicial decision; human rights; partial dissolution; successive incidence; interdisciplinarity; public ministry; slowness; validity plan; judicial power; natural language processing; RStudio; safety; Federal Court of Justice
1	253	...

Source: research data (2019).

Except for the word “jurimetry” (precisely the term used in the search), the terms “adoption” and “civil process” stand out, showing the areas of law with more applications of jurimetry. Soon after, the words "law" and "statistics", present in five articles, show the very definition of jurimetry (statistics applied to law). In addition to these, also in the same position regarding the number of occurrences, the use of "artificial intelligence" stands out, indicating the application of computer systems capable of acting in a similar way to human, in the field of Law.

Excluding the word “jurimetry” and applying the 1st Zipf’s Law to the other keywords, ordered in descending order according to the frequency of occurrence, the values shown in Table 4 are obtained:

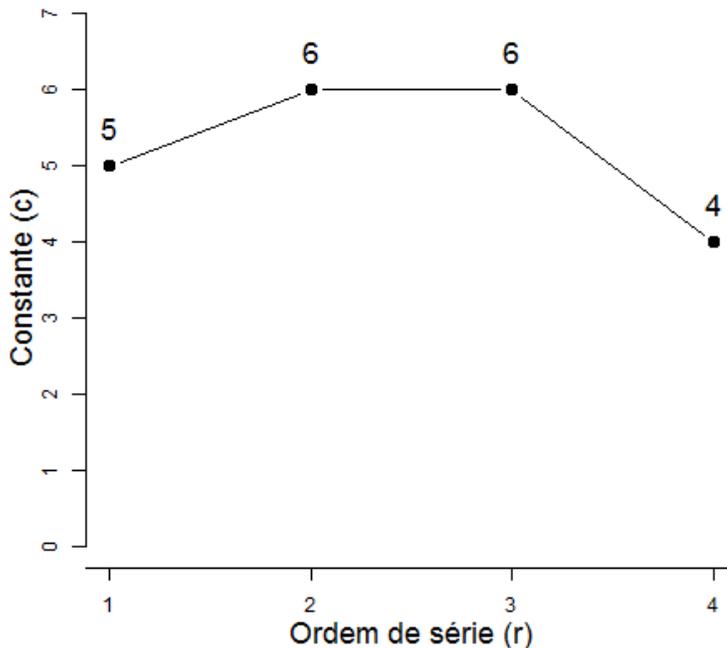
Table 4. 1ª Zipf Law

Amount of keywords	Serial order (r)	Frequency (f)	Zipf constant
3	1	5	5
2	2	3	6
16	3	2	6
253	4	1	4

Source: research data (2019).

When plotting the Zipf constants in relation to the series orders, found in Table 4, Figure 6 is obtained:

Figure 6. Keyword occurrence zones



Source: research data (2019).

It can be observed that the transition point between the high and low frequency words is the one that has the Zipf constant equal to six, given that the words: jurimetry; law; statistic; Artificial intelligence are considered as trivial information (Zone I, as proposed by Zipf) and words with Zipf constant equal to four are considered noise (Zone III). Thus, in order to identify the word that separates the trivial information zone from the noise zone, the Goffman Transition Point (T) was calculated, which, when returning a value of T equal to 22, indicates that the 22nd keyword is the one that displays this transition, as shown in Table 5:

Table 5. Keywords for Goffman's Transition Point

Word occurrence zones	Words	Order
Zone I. Trivial Information	Jurimetry	-
Zone II. Interesting Information	Law	1
	Statistics	2
	Artificial Inteligence	3
	Adoption	4
	Civil process	5
	Logical analysis	6
	Invalid and unlawful act	7
	Civil Procedure Code	8
	Judicial decision	9
	Human rights	10
	Partial dissolution	11
	Successive incidence	12
	Interdisciplinarity	13
	Public ministry	14
	Slowness	15
	Validity plan	16
	Judicial power	17
	Natural language processing	18
	Rstudio	19
	Safety	20
	Federal Supreme Court	21
	Brazilian Association of Lawtechs and Legaltechs	22
Zona III. Ruídos	Access justice; Institutional reception; Judgment; Actio nata; Public administration; Judicial administrators; Brazilian adoption; Consensual adoption; Adoption intuitu personae; Affection; Agency; Infiltrated agent Analysis of methods; Economic analysis; Economic analysis of law; Empirical analysis of judicial decisions; Jurisprudential analysis; Latent semantic analysis Anchoring; Computer application; Active learning; Calculation of assets; Legal arguments; Art 1 085 of the civil code; Activism; Intangible commercial identity assets; Intangible assets and intellectual property; Criminal performance and efficiency; Conciliation hearing; Autonomy; Heritage autonomy; Performance evaluation; Judicial evaluation; Bankruptcy Law; Electronic bases of judgments; Environmental good; Big data; Biogas; Methodological DIY; National CNA adoption register; Adoption campaigns; Carf; Science of law; Movie theater; Civil Law; General contractual clauses; E-commerce; Common Law; Communication; Contests; Conflict between partners; Positive conflict; Mass conflicts; Conflicts between domain name on the internet and trademarks; Advisers; Consequentialism; Constitutionality; Constitutionalism; Administrative litigation; Mass litigation; Contradictory; Contracts; Controversies; Cooperation; Corruption; Child and teenager; Organized crime; Watch out; Open data; Moral damage; Repetitive demand; Derivatives; Expropriation; Judicial performance; Social differences; Human dignity; Alternative law; Civil right; Commercial law; Brazilian commercial law; Comparative law; Criminal law; Child and youth law; Family law; Consumer law; Education law; Electronic law; International right; Private right; Civil procedural law; Social law; Corporate law; Fundamental rights, Economy; Behavioral economics; Economic effects; Effectiveness; Effectiveness of private law; Judicial efficiency; Procedural efficiency; Empiria; Empirical legal research; Legal education; Entity shielding; Barriers and obstacles; Voluntary delivery; Epistemology; Democratic state; Regulatory status; State-owned; Legal statistics; Empirical legal studies; Extrajudicial exclusion of a minority partner; Exercise of citizenship; Liability; Bankruptcy; Family; Biological or origin family; Substitute family; Philosophy; Framing; Gamefication; Justice management; Ghost in the shell; Open government; State government; Habeas corpus; Legal hermeneutics; Heterogeneity of calculations; Homo economicus; Impact of the judicial decision; Inertia; Information; Asymmetric information; Legal informatics; Insolvency Law; Artificial intelligence and law; Cognitive intelligence; Functional interdependence; Public interest; Internationalization; Internet; Interoperability; Interpretation; Natural judge; Judge; Brazilian judges; Legal; Jurismometry; Lawtechs; Learning with free software; Lee loevinger; Legality; Information access law; Freedom of initiative; Usual litigants;	

Repetitive litigation; Inductive logic; Class struggle; Markdown; Basic math; Analysis matrices; Mediation; Mercosur; Mcda c methodology; Motivation; Virtual world; Bank loan; Business and contracts; Protection level; New civil procedure code; Online dispute resolution; Ontologies; Law operators; Optimism; Owner shielding; Pan principiologismo; Legal personality; Research applied in law; Case law research; Empirical research; Qualitative empirical research; Virtual research; Methodological pluralism; General power of caution; Criminal and dogmatic criminal policy; Judicial policy; Public policy; Positivism; Legal practice; Judicial precedent; Binding precedents; Criminal prevention; Principle of efficiency; Principles; Privacy; Private; Collective process; Electronic process; Electronic judicial process; Court lawsuits; Labor lawsuits; Attorney; Employment protection program; Thinking the Law project; Judicial leadership; Protection of private investment; Distinctive protection of companies; Legal protection of private investment commercial code; Intellectual property protection; Public; R Studio; Strong rationality; Pattern Recognition; Business recovery; Reduction of working hours; Wage reduction; Decision reform; Family reintegration; Consumer relationship; Relationship between genders; Legal relations; General repercussion; Research in education; Limited liability; Responsiveness; Scientific methodology; Selection; Adverse selection; Public sector; Shiny; Symbolism of codes; Multiport system; System R; Systems based on legal knowledge; Information society; Commercial companies; Social technologies; Telephony; Theory of legal guarantee; Vital testament; Corporate types; Decision making; Topical; Technology transfer

Source: research data (2019).

Finally, following the analysis protocol, the behavior of the citations was analyzed, in order to identify which works and/or authors are being used when working with the referred theme. The publications that were most cited in the analyzed articles are shown in Table 6:

Table 6. Most cited publications

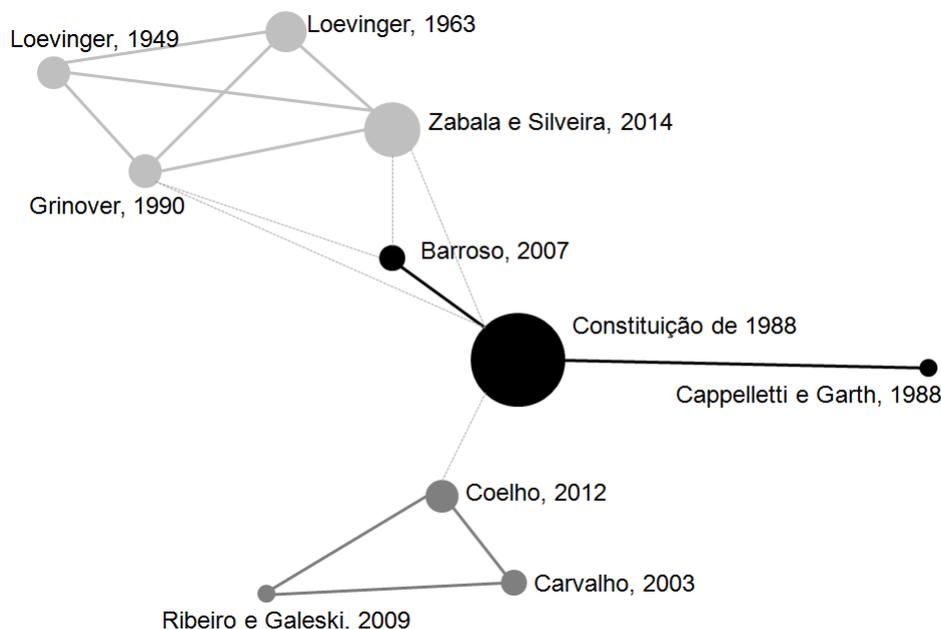
Autor	Título	Ano	Frequência
Lee Loevinger	Jurimetrics: The Methodology of Legal Inquiry	1963	7
Filipe Jaeger Zabala e Fabiano Feijó Silveira	Jurimetry: statistics applied to Law	2014	6
Lee Loevinger	Jurimetrics – The Next Step Forward	1949	4
Marcelo Guedes Nunes	Jurimetry applied to corporate law - a statistical study of the dissolution of society in Brazil	2012	4
Marcelo Guedes Nunes	Jurimetry: how statistics can reinvent Law	2016	4
Mauro Cappelletti Bryant Garth	Access to justice	1988	3
Fábio Ulhoa Coelho	Commercial Law Course: Business Law	2012	3
Marcos Bernardes de Mello	Legal Fact Theory - plan of existence	2003	3
Márcia Milena Pivatto Serra	How to use elements of descriptive statistics in jurimetry	2013	3

Source: research data (2019).

Lee Loevinger's works, found in the research, caused this author to be cited more frequently, including, also, the fact of being considered the precursor of the term under study (GARGANO and NADER, 2018; LUVIZOTTO and GARCIA, 2020).

Given the most cited publications, the H Index was calculated, an indicator responsible for measuring the researcher's productivity and impact, relating the number of publications by an author to the number of citations. For the case analyzed, an H index of 4 was reached, that is, at least four of the most cited authors have four or more citations. Analyzing the co-citations, we can see the relationship shown in Figure 7:

Figure 7. Co-citations network



Source: research data (2019).

Figure 7 shows the relationship presented by each author to other individuals, with a predominance of the 1988 Constitution of the Federative Republic of Brazil.

It is important to analyze the results found in the light of other studies. In this sense, corroborating with the laws of Bradford (1934) and Lotka (1926), the findings point to a concentration, in terms of authors and magazines, that act on this theme. In other words, even though there was an average increase of publications, from 2002 to August 2019, of 18.92%, there are few authors and magazines publishing about jurimetry - which corroborates with previous studies, which emphasize it is a recent theme and still little explored in Brazil (MENEZES and BARROS, 2017; ZABALA and SILVEIRA, 2014; YEUNG, 2017).

As for what has been published, from the classification of keywords proposed by Zipf (2012), it is possible to identify recurrently addressed themes. If, on the one hand, the keywords identified as “Interesting information” have broad meanings (for example, “Law”, “Judicial decision”, “Slowness”) when, from them, a search is carried out with the so-called “Noises”, we obtain a more precise scenario about the published studies:

- The themes associated with Family Law stand out, since from the term "Adoption", in the "Interesting information", it is possible to trace "Noises" of similar semantic meaning, namely: "right of childhood and youth"; “Family law”; “Brazilian adoption”; “Consensual adoption”; “Adoption intuitu personae”; "affection"; “National adoption register (CNA)”; “Adoption campaigns”; "child and teenager"; “Voluntary delivery”; "family"; “Biological or original family”; “Substitute family”; “Family reintegration”.
- Likewise, taking the interesting information “Partial dissolution”, it is possible to trace, along with the “Noises”, the terms “commercial law”; “Brazilian commercial law”; “Corporate law”; “Partial dissolution”; “Minority partner extrajudicial exclusion”; “Conflict between partners”; “Positive conflict”; “Mass conflicts”; "bankruptcy"; “Distinctive protection for companies”; “Legal protection of private investment”; “Commercial code”; “Business recovery”; “Corporate types”; “Transfers from business establishments”; “Bank loan”;

“Business and contract”.

- It is also possible to notice the presence of studies concerned with the decisions themselves (albeit in a smaller number), since from the term “Judicial decision” (“Interesting information”), the “Noises” are registered with the keywords “empirical analysis of judicial decisions”; “Jurisprudential analysis”; “Judicial performance”; “Judicial efficiency”; “Procedural efficiency”; “Impact of the judicial decision”.

Yeung (2017) states that, although in Brazil, jurimetry is at an early stage in terms of scientific communications, this topic could be of great value when associated with issues such as contractual relations, especially involving debts and banks; labor justice; criminal justice; and, gender impacts on court decisions. In this sense, the placement of Yeung (2017) seems to have been considered in a significant part of the published articles.

The presence of Lee Loevinger as the most frequently cited author is not surprising, as he was one of the precursors to the study of jurimetry (COUTO and OLIVEIRA, 2016; BISPO and GONÇALVES, 2019; DUARTE and NUNES, 2020).

Finally, with regard to the analysis of citations and co-citations, the highlight goes to the 1988 Constitution itself, given the importance of the Magna Carta in relation to legal studies. In addition, there is a high frequency of citation in the works of Lee Loevinger, the first person to use the term jurimetry (NUNES, 2016).

5 FINAL CONSIDERATIONS

At the end of this study, it is important to state the main results found. In this sense, between 2002 and August 2019, 84 scientific articles published in Brazil can be found under the theme of jurimetry, showing an average annual growth of 18.92%. Of the published articles, there are almost two authors per work, with 36 published alone out of a total of 143 authors. Two authors stood out: Daniel Francisco N. Menezes and Filipe J. Zabala, the first with four and the second with three publications. The Journal of the Faculty of Law of the Federal University of Minas Gerais was the journal with the most publications on the subject. Words related to statistics, judiciary and civil law (Adoption; Civil procedure; Invalid act and illegal act; Civil procedure code; Partial dissolution; Successive incidence) were classified as areas of interest, according to the Zipf Law, which suggests Civil Law as an area of law more aligned to the use of jurimetry. Lee Loevinger was the most cited author in the works, due to being considered the precursor of the term under study. Brazilian authors like Filipe J. Zabala, Fabiano F. Silveira and Marcelo G. Nunes also stood out.

As a limitation, this work explored only the Google Scholar search tool, since other academic research bases such as Scientific Electronic Library Online and Web of Science, for example, did not present scientific articles with the term “jurimetry”, though only in Portuguese. It is important to recognize that other sources such as the Virtual Library Network presented articles present in the research carried out via Google Scholar. Therefore, studies carried out on the basis of theses and dissertations are suggested, which, in a way, present more contemporary research. In addition, specific bases dealing with Law, such as the Brazilian Law Bibliography (BBD) maintained by the Federal Senate, must be taken into account in future research.

In addition, the study was limited to an exclusively descriptive aspect. It is necessary to deepen in the context of citations, since, according to Thomaz, Assad and Moreira (2011, p. 90),

The number of publications, citations and the average of citations per published work, taken in isolation, are traditional bibliometric indexes that have deficiencies, as they do not portray the combined information of published works with the respective citations.

The opportunity for comparative bibliometric studies, mainly associated with the analysis of citations, between Brazilian and foreign scientific production is also seen. In this sense, methods such as text mining can provide a broader understanding of the studies.

Anyway, the criticism regarding the exclusive use of bibliometric indicators, coming from researchers such as Ioannidis, et al., (2017), Hicks, et al., (2015) and Stephan, Veugelers and Wang (2017), do not disqualify applications in a context in which scenarios are established that can shed light on a body of knowledge - of relevant utility in the development of new studies.

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