



Research trend on the use of historical approaches for the teaching of Statistics in Brazil

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ABSTRACT:

The objective of this work was to systematically analyze the literature in Brazil, through scientific articles, theses from stricto sensu postgraduate courses and books, which used historical approaches to the teaching of Statistics. The databases searched were: the Brazilian Digital Library of Theses, Catalog of Theses and Google Scholar, based on the keyword system, History of Statistics as the first option (and) Teaching; History of Statistics (and) Teaching of Statistics; History of Statistics (and) Statistical Education; historical approaches (and) Teaching of Statistics. Twelve studies were considered as results, in the period from 2012 to 2019, and the IRaMuTeQ software was used for multidimensional analysis from the organization in texts (corpus), each one being defined as a "text segment". Each text was prepared considering what was emphasized in the research, the methodology or methodological approach used, the context in which it was developed and the types of study and areas involved and the main results and conclusions. In addition, data analysis was organized, based on the identification for each text, of the following variables of interest: Type of publication (pubType); Year of publication of the text (yearPub); Teaching Cycle to which the work was destined (cycleTeaching); Public to which the work is intended (publicTeaching); Work focus (workFocus); and Brazilian region where the work was developed (PubRegion). In the maximum tree generated in IRaMuTeQ about the set of abstracts, it is evident that there is a concern in research with the student's profile and its relationship with experiential knowledge, with daily life, with its relationship with the world of work and, contributing to the formation of citizens aware of the development of statistical science. However, the study indicates that research on the use of historical approaches in the teaching of statistics is still incipient, highlighting the need for further research in the Brazilian context.

KEYWORDS: Historical Approaches, Statistical Teaching, Scientific Publications, Systematic Literature Review

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I. INTRODUCTION

When employing historical assumptions, we consider it essential to understand which events, mechanisms and facts converged to produce certain knowledge, as well as to relate the social needs that drove such discoveries.

We assume that history has great cultural and social value that should be worked on in the classroom, as it allows students to show that the contents are not a static and ready field of knowledge, but that it is constantly changing according to the needs of each people and each region throughout history.

It is considered in [1], that concepts approached in connection with its history constitute vehicles of cultural, sociological and anthropological information of great formative value.

Thus, such an approach could help the student to understand what motivated a particular society in the elaboration of certain knowledge and how formality is gaining space, not to complicate or select individuals, but to facilitate the understanding of phenomena more and more. widespread.

The author [2] states that it is in the historical development of mathematics that one can perceive the different formalizations of the same concept. And, in this sense, history would assist in learning the concept and in different ways of "formalizing it".

In [3] considers that when included in the curriculum theme, the history of mathematics clarifies and deepens the understanding of mathematical ideas, showing its connection with culture and, thus helping students to understand the concepts of mathematics as a human action.

For [4] in the search to understand the historical reality in the investigative activity, the student will be building for himself mathematical information contained in the investigated reality. He also points out that, by applying the historical context in his classes, the teacher can provide students with a source of new discoveries in relation to mathematical principles that can sometimes arise in response to existing social problems.

Thus, these considerations reinforce the idea that, when introduced into the historical context, teaching will better contribute to the understanding and critical formation of the student on a certain subject/content within the mathematical context.

In [5], the Common Curricular National Base for the final years of Elementary School, it is indicated that it is necessary to consider that, for the learning of a certain concept or procedure, it is essential to have a meaningful context for students, not necessarily of everyday life, but also from other areas of knowledge and the history of mathematics itself.

This history can appear in the math class to help students understand the historical and social construction of the concepts. This historical construction can show the teacher and, even for the students, the needs that people and groups have had throughout history, and how mathematics has been used to explore or explain these needs.

Thus, we consider that the History of Mathematics can be a valuable didactic resource, with a view to the development of mathematical concepts and knowledge, encompassing the assumptions of Statistics, rescuing the cultural, social and political history of societies and their peoples.

Therefore, we question whether the national bibliographic production has advanced in relation to the use of historical approaches in the teaching of statistics, seeking to identify the teaching procedures adopted with the perspective of proposing a set of strategies to reverse the challenges posed in the process of teaching statistics in the context of Brazilian schools, as well as the target audience and the school modality attended by students. Therefore, this research aimed to systematically analyze the national literature that used historical approaches in the teaching of statistics

II. MATERIAL AND METHODS

This is a Systematic Literature Review (SLR). SLR is a form of secondary study using a well-defined methodology to identify, analyze and interpret all evidence related to a research question [6]. To complement the systematic mapping with the RSL technique, which is characterized by offering a wide review of preliminary studies on a specific topic, in order to identify the evidence available to the use of historical approaches in the teaching of statistics in Brazil.

2.1 Sample

The consultation was carried out online in the databases, specifically in that order: (1) Brazilian Digital Library of Theses (BDTD); (2) Catalog of Theses from the Coordination for the Improvement of Higher Education Personnel - CAPES; (3) Google Scholar. The keywords were used in conjunction with the term: History of Statistics as the first option (and) Teaching; History of Statistics (and) Teaching of Statistics; History of Statistics (and) Statistical Education; historical approaches (and) Teaching of Statistics.

The criterion adopted to compose the corpus was: (a) articles published in scientific journals and scientific events published in Brazil; (b) theses published in Brazil; (c) Book published in Brazil; who investigated or answered questions regarding the use of historical approaches in the teaching of statistics.

After returning from studies with the search through the keyword system, the title and summary of each work was read. The inclusion criterion adopted was linguistic, that is, texts in Portuguese that mentioned in the title or summary the theme of the use of historical approaches in the teaching of statistics.

Exclusion criteria were studies that did not correspond to the theme mentioned in the inclusion criterion, as well as those repeated, already identified in the search in another database and published in another language. Finally, the full texts considered as results were read.

2.2 Study collection procedure

The study was carried out under the guidelines proposed by [6] to perform an RSL, comprising three phases: planning, process and reporting of results. In the planning phase, a protocol was developed for the literature review, which establishes the interaction that researchers should have, the procedure for conducting the review is defined, the research questions are formulated, as well as the search strategies, search criteria. inclusion and exclusion, data collection and analysis. In the second phase, the process focused on the execution of the review protocol. Finally, in the third phase, the results report, a final report was prepared.

In BDTD, five works were recovered, four of which were discarded for referring to the history of statistics in graduate programs, institutions of higher education and federation unit in Brazil or even the use of the use of historical-critical pedagogy. In the CAPES Catalog, 41 papers were identified, all of which were excluded because they were related to the same aspects identified in the BDTD, among other aspects, except the work already selected. In Google Scholar 312 works were recovered, of which 11 (eleven) of them met the inclusion criterion (use of historical approaches in the teaching of statistics) or were eliminated due to the exclusion criteria (use of historical approaches in the teaching of mathematics or the presentation of the history of statistics without focusing on pedagogical approaches, etc.). Figure 2 shows the collection flow.

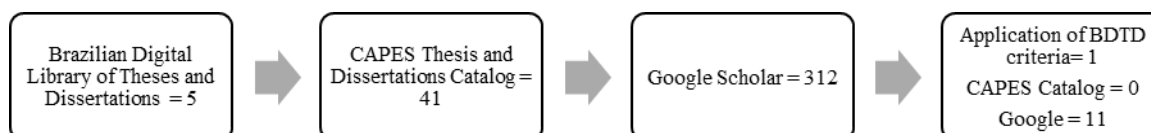


Figure 2. Flow of data collection and number of studies retrieved in each base.

Therefore, this search returned 12 results and all titles, abstracts and the text were read to identify proposals using historical approaches to the teaching of Statistics (chart 1).

2.3 Data analysis

The studies were categorized in order to answer the research questions, to highlight: How has research using historical approaches contributed to the teaching of statistics in Brazil?

The analysis of the data obtained by searching for articles (scientific journals and scientific events) and Brazilian theses and books, in the database bases (Brazilian Digital Library of Theses (BDTD); CAPES Thesis Catalog; Google academic) was lexical, through a Descending Hierarchical Classification (DHC).

For this purpose, the software IRaMuTeQ (Interface R for Multidimensional Text and Questionnaire Analysis) was used, used with the objective of improving the research work, as it uses the optimization of the organization process and the more specific delimitation of the selected texts, which allows the survey of the constituent elements of socially shared representations, which highlight traces of mental worlds through lexical worlds that he outlined and, later, inferred to the content analysis technique [7].

The IRaMuTeQ program works with Initial Context Unit (ICU) that can be structured in different ways depending on the character of the data collected. When working with the selected works, each text must compose an ICU. The set of ICU comprised the corpus of analysis that the program divides into text segments, which are the Elementary Context Unit (ECU).

The ICUs were asked specific questions (SQ), which collect, organize and present relevant information on the development of research aimed at the use of historical approaches in the teaching of statistics, in Brazil, which are: SQ1: What was emphasized? SQ2: What is the methodology or methodological approach used? SQ3: What is the context in which it is developed? SQ4: What are the types of studies and the areas involved? SQ5: What are the main results and conclusions?

Then, we performed a DHC in order to give rise to lexical classes characterized by the vocabulary and by segments of texts that share the same vocabulary [8]. In this sense, the different classes that emerge from the corpus of the text represent the space of meaning of the narrated words and may suggest elements belonging to the studies on how historical approaches are carried out in the teaching of Statistics in Brazil.

Chart 1: Identification of the texts selected when searching the databases.

Text	Year of publication	Type of publication	Educational Institution/ Federation Unit	Text title	Focus of work	Teaching cycle	Public for which the work is intended
1	2012	Scientific event article	Pontifical Catholic University of Campinas - São Paulo - Brazil	Portraying the evolution of statistics through images contained in commemorative postage stamps	Teaching Statistics	Higher education	Students and teachers
2	2012	Scientific event article	Pontifical Catholic University of Campinas - São Paulo - Brazil	History of statistics in images contained on postage stamps.	Teaching Statistics	High School	Students and teachers
3	2013	Scientific event article	Federal Technological University of Paraná - Curitiba - Paraná - Brazil	History of mathematics: a strategy for teaching statistics and probability in the school context	Teaching Statistics and Probability	Elementary School (final years)	Students and teachers

4	2013	Scientific event article	Federal University of Triângulo Mineiro - Uberaba - Minas Gerais - Brazil	The history of statistics interfering in the teaching-learning process of mathematics in high school	Teaching Statistics	High School	Students
5	2015	Scientific journal article	Federal Technological University of Paraná - Curitiba - Paraná - Brazil	History of mathematics: a contextualized strategy for teaching statistics and probability in the early years of elementary school.	Teaching Statistics and Probability	Elementary School (early years)	Students
6	2015	Scientific journal article	Federal University of Rio Grande do Norte - Natal - Rio Grande do Norte - Brazil	Galton linear regression: historical activities for affine function and basic statistics using spreadsheets.	Teaching Statistics	High School	Students
7	2015	Masters dissertation	Federal University of Rio Grande do Norte - Natal - Rio Grande do Norte - Brazil	From least squares to linear regression: historical activities on the affine function and statistics using spreadsheets.	Teaching Statistics	High School	Students
8	2017	Scientific event article	State University of Minas Gerais - Divinópolis - Minas Gerais - Brazil	Presenting statistics and probability in higher education with a historical focus.	Teaching Statistics and Probability	Higher education	Students
9	2017	Scientific journal article	Leonardo Da Vinci University Center - Indaial - Santa Catarina - Brazil	Historical implementation of mathematics: contextualizing statistics in percentage and average teaching.	Teaching Statistics	Elementary School	Teachers
10	2017	Scientific journal article	Federal University of ABC - Santo André - São Paulo - Brazil	Pedagogical potentialities of the history of mathematics for teaching statistics in basic education.	Teaching Statistics	Elementary School	Students
11	2018	Scientific journal article	Pontifical Catholic University of Campinas - São Paulo - Brazil	Some considerations about the history and applications of statistics through philately.	Teaching Statistics	High School	Students and teachers
12	2019	Book chapter	Federal Institute of Education, Science and Technology of Paraíba - Paraíba - Brazil	An analysis of the history of statistics and complex numbers covered in high school textbooks.	Teaching Statistics	High School	Students

III. RESULTS

The set of each of the selected works was organized in a single text (corpus), each one being defined by the IRaMuTeQ program as a “text segment”. The corpus is organized by command lines called "asterisk lines", in which the identification numbers of the text are informed, followed by some indispensable variables for the accomplishment of the textual analysis. In this research, the variables were coded as follows:

- (1) Text: text_01 and so on until text_12;
- (2) Type of publication: pubType_01, theses; pubType_02, articles published in scientific journals; pubType_03, articles published in scientific events; pubType_03, book chapter.
- (3) Year of publication of the text: yearPub_01, published in 2012; yearPub_02, published in 2013; yearPub_03, published in 2015; yearPub_04, published in 2017; yearPub_05, published in 2018; yearPub_06, published in 2019.
- (4) Teaching cycle to which the work was destined: cycleTeaching_01, Elementary School; cycleTeaching_02, High School; cycleTeaching_03, Higher Education.
- (5) Audience for which the work is intended: publicTeaching_01, student; publicTeaching_02, teacher; publicTeaching_03, student and teacher.
- (6) Focus of the work: workFocus_01, teaching statistics; workFocus_02, teaching statistics and probability.

- (7) Brazilian region where the work was developed: PubRegion_01, Northeast region; PubRegion_02, Southeast region; PubRegion_03, South region.

Describing the Brazilian educational system [9], indicates that it is divided into educational systems of the Union, the States, the Federal District and the Municipalities. The Federal Constitution of 1988 [10], with Constitutional Amendment no. 14, 1996 and the Law of Directives and Bases of National Education (LDB), instituted by law no. 9394, of 1996 [11], are the larger laws that regulate the current Brazilian educational system.

The current structure of the regular educational system comprises basic education, formed by early childhood education, elementary education and high school; and higher education. We describe below how [9] indicates how these cycles work:

1. Basic Education: Early childhood education, the first stage of basic education, is offered in daycare centers, for children up to 3 years old and in preschools, for children aged 4 to 6 years. Elementary education, with a minimum duration of eight years, is mandatory and free in public schools, and it is up to the Government to guarantee its offer for everyone, including those who did not have access to it at their own age. High school, the final stage of basic education, has a minimum duration of three years and meets the general education of the student, which may include general preparation programs for work and, optionally, professional qualification.
2. Higher Education: Covers undergraduate courses in different professional areas, open to candidates who have completed high school or equivalent and have been classified in selection processes. Postgraduate education is also part of this level of education, which includes master's and doctoral programs and specialization courses.

In [12], it is reported that the Brazilian regions correspond to the divisions of the national territory based on criteria, such as natural, social, cultural and economic aspects. The body responsible for the regionalization of Brazil is the Brazilian Institute of Geography and Statistics (IBGE), which currently divides the country into five regions: 1. North; 2. Northeast; 3. Midwest; 4. Southeast; 5. South. Considering the regions that presented publication of some work selected for this work, we indicate according to [12], its main characteristics:

1. Northeast Region - Covers nine states and corresponds to almost 18% of the Brazilian territory, being the second most populous region in Brazil, with tourism as one of the most prevalent activities in the Northeastern economy, in addition to extractivism and agriculture;
2. Southeast Region - Covers four states and corresponds to approximately one tenth of the national territory. It has the highest population density in the country, with approximately 92 inhabitants per km². It is one of the regions that most attract migrants looking for better opportunities and quality of life. It has the largest Brazilian Gross Domestic Product – GDP, corresponding to 55.2% of the national GDP. The economy is based on the industrial, financial and commercial sector, with emphasis on the automobile, steel and oil industries.
3. South Region - It covers three states and is the one with the most differences between the other regions of the country, due, especially to its colonization, made mainly by Germans and Italians. The demographic density is about 47 inhabitants per km², presenting the best social indicators. The economy is based on plant extraction and agriculture, with the creation of pigs and grape production, having the second largest national GDP.

In addition, the texts that make up the textual corpus were configured as defined in the IRaMuTeQ tutorial [8], mainly regarding accentuation, use of special characters and formatting. The procedure for organizing the command lines, for inserting scientific productions, can be observed in the example of the fragment of the first text (analyzed in Portuguese and here freely translated into English):

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**** *text_01 *pubType_02 *yearPub_01 *cycleTeaching_03 *publicTeaching_03 *workFocus_01 * PubRegion_02
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The evolution of Statistics through a historical process relating the social, political and economic conditions of its times, was used as support material for the images contained in several postage stamps issued by different countries. Aspects of the academic production of some scientists who contributed to the evolution of statistical thought were analyzed. The research proposes that it is possible to use the history of statistics, through the images contained in commemorative postage stamps in university courses. The initiative and the results of this research reveal that philately can be a powerful tool for scientific dissemination, especially for the classic themes of science. Both the History of Mathematics and the History of Statistics are presented as areas of knowledge that benefit a more meaningful and contextualized pedagogical work, which may awaken in the student an interest in learning when he interacts with the discoveries made in the past by scientists. In addition, it can be noted that many of the discoveries were made at a certain time in human history and under conditions that are not always favorable for such intellectual endeavors. This type of procedure, when adopted by the teacher, makes it possible to

understand the various steps that are necessary to arrive at a scientific result. The National Curriculum Parameters for Secondary Education (PCNEM) emphasize the need for a broad training of students, in which Statistics occupies a prominent place. Thus, as the History of Mathematics contributes to the learning of mathematical content, since it allows us to understand the origin of the ideas that shaped our culture, the History of Statistics allows us to observe the human aspects involved in its development. Therefore, the History of Statistics makes it possible to analyze the people of the past who created the principles of this science, in addition to studying the circumstances in which the discoveries were achieved, showing that it is an important instrument for teaching and learning in several areas and Statistics itself. In the case of activities involving the History of Statistics through the material presented here, a suggestion for its use in teaching practice is illustrated. Through a diagram, the objective is to show that teachers and students can use the History of Statistics depicted on postage stamps and, in parallel, make the intersection with the History of Mathematics. The visual aspects contained in the postage stamps can arouse the student's curiosity and interest and, as a consequence, expand his knowledge. Through this philatelic material it is possible to instigate the student to discover the origin of a certain statistical content, making learning not only significant, but also motivating. In addition, the postage stamps can provide some questions and discussions about the evolution of Statistics present in the images and relate it to other areas of knowledge. Because it is an attractive and easy-to-use material, it can be used as an additional option for teaching and learning and, therefore, assist teachers who wish to encourage their students to appreciate, analyze and study images portraying personalities in history of Statistics.

Thus, we use Reinert's method that proposes a descending hierarchical classification according to the method described by [13]. It aims to obtain classes of text segments (TS) that, at the same time, present vocabulary similar to each other and vocabulary different from the ST of other classes.

We emphasize that the choice to use one or the other analysis technique depends on the characteristics of the problem and the objectives of the research [14]. In this sense, the researcher's theoretical-methodological framework, plus the support of lexicometric analysis software, can give greater reliability to the inferences made in qualitative research [15] and [16].

Therefore, the study presented here describes and discusses the characteristics of the use of IRaMuTeQ in the analysis of data from scientific works focused on the use of historical approaches in the teaching of statistics published between 2012 and 2020.

So, this analysis is based on lexical proximity and the idea that words used in a similar context are associated with the same lexical world and are part of specific mental worlds or systems of representation. In this analysis, the text segments are classified according to their respective vocabulary and the set of terms is partitioned according to the frequency of the word roots. The system seeks to obtain classes formed by words that are significantly associated with that class (significance starts with the chi-square test - χ^2).

According to [17] it is one of the most important analyzes of IRaMuTeQ, because the software uses the correlation logic, starting from segmentations of the textual corpus, together with the list of reduced forms and the dictionary (in this case in Portuguese) made available in the same to present a hierarchical class scheme. In this way, the text is processed so that vocabulary classes can be identified, making it possible to infer which ideas the textual corpus wishes to convey, that is, the analysis is made from a statistical logic processed by computer and applied in a lexical way.

Starting the study, the first analysis option that IRaMuTeQ makes available is related to the statistical data of the textual corpus (figure 1), providing the number of texts and text segments, occurrences, average frequency of words, as well as the total frequency of each form and its grammatical classification.

```
+++++
|iR|a|M|u|T|e|Q| - Fri Jan 22 19:43:19 2021
+++++
Number of texts: 12
Number of text segments: 73
Number of forms: 1412
Number of occurrences: 6173
Number of mottos: 986
Number of active forms: 895
Number of supplementary forms: 64
Number of active shapes with frequency >= 3: 315
Average shapes by segment: 84.561644
Number of clusters: 6
63 segments classified on 73 (86.30%)
#####
time: 0h 0m 43s
```

Figure 1: Result of Classification by the Reinert Method: textual statistics.

The result of the analysis of textual statistics, brings information that summarizes the textual corpus as follows:

- a) Number of texts: Number of texts (records) contained in the body. In this case, for example, the corpus has 12 texts (described in table 1), corresponding to the paragraphs indicating the specific questions (SQ), which, in the case of this work, collect, organize and present relevant information on the development of research focused on the use of historical approaches in the teaching of statistics in Brazil;
- b) Text segments: The software divided the text into 73 text segments;
- c) Number of active and supplementary forms: Words considered active (adjectives, nouns, verbs and adverbs) and supplementary (articles and pronouns). Articles and prepositions were eliminated;
- d) Number of occurrences: Total number of words contained in the corpus;
- e) Number of mottos: It differs from the number of forms, since the mottos are the lemmatized forms, that is, the process, effectively, of deflecting a word to determine its motto (the inflections are called lexemes).
- f) Average shapes by segment: Number of occurrences divided by the number of texts.
- g) Number of classified segments: In the present case, 86.3% of the segments were classified due to the choice of the word categories in the preferences menu (first menu presented in this analysis), as well as the choice of how to select the text segments;
- h) Number of clusters: number of classes determined by the analysis.

It is important to note that analyzes of the DHC type, to be useful for the classification of any textual material, require a minimum retention of 75% of the text segments, when an analysis is below this value, it is not considered an adequate analysis, as it offers only a partial classification [8]. In this sense, the textual corpus used for the analysis of the present study is considered representative and useful, since the use was 86.30%.

The interpretation of DHC results is supported by the hypothesis that the use of similar lexical forms is linked to common representations or concepts [18]. For this reason, the Reinert method is often used in order to identify themes underlying a set of texts.

Thus, in the DHC tab of the IRaMuTeQ results, it is possible to access the dendrogram (Figure 2), which shows the partitions that were made in the corpus until the final six classes were reached. The dendrogram is read from left to right.

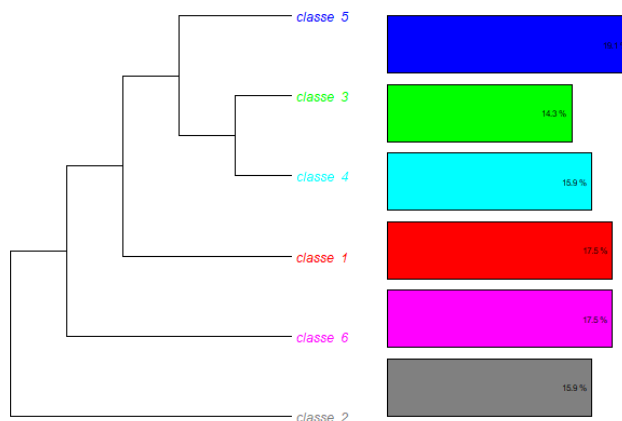


Figure 2: Result of Classification by the Reinert Method: Dendrogram.

Thus, in the result of the Classification by the Reinert Method: Dendrogram, figure 2, at first, the corpus "Body" was divided (1st partition or iteration) into two subcorpus, separating class 2 from the rest of the material which represents 15.9% of the textual corpus.

In a second moment, the major subcorpus was divided, giving rise to class 6, which contains 17.5% of the textual corpus (2nd partition or iteration). In a third moment there is a partition giving rise to class 1 which contains 17.5%. In the fourth moment, class 5 (19.1% of the textual corpus) can be observed and, finally, in the fifth and last moment there is a partition giving rise to classes 3 and 4 with, respectively, 14.3% and 15.9%. DHC, therefore, generated six classes that proved to be stable, that is, composed of units of text segments with similar vocabulary.

Thus, the six classes contain the active forms or organized words that presented more frequency, in decreasing order, and that were significant to represent each of the subcorpus through the chi-square association test generated in the reports of IRaMuTeQ, that is, the greater adherence of them in the class and between

classes and which can be seen in the filogram, which is one more result of the Classification by the Reinert Method (figure 3), in Portuguese.

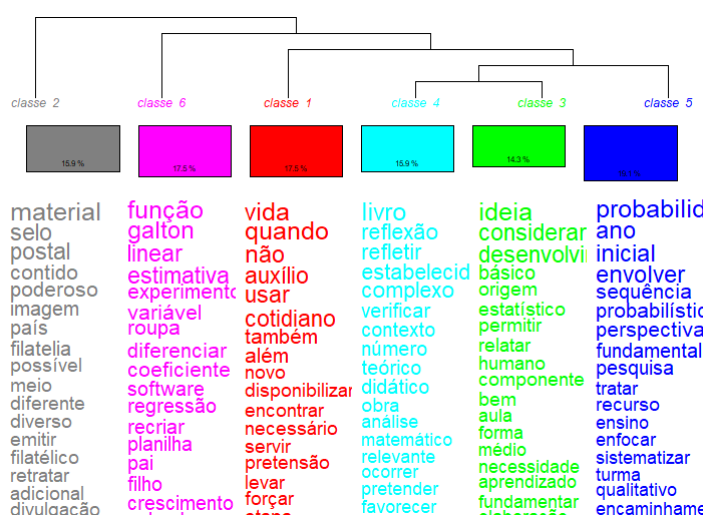


Figure 3: Result of Classification by the Reinert Method: Filogram.

Taking the filogram shown in figure 3, we call the six classes and describe them as follows:

1. Using the history of philately in Brazil and other countries as a historical approach to teaching statistics (Class 2): The active forms with the highest chi-square values of this class reveal the methodological option of the researches carried out by the qualitative approach and the procedures methodological and instruments that were used by the researchers: use of philatelic material as an instrument for teaching statistics and a powerful tool to present the image of Brazil and other countries;
2. Use of the history of Galton's linear regression and the method of linear least squares for the study of basic statistics, using electronic spreadsheets, in Secondary Education in Brazil (Class 6): This class, strongly articulated with class 2, presents another historical aspect that can be used for the teaching of statistics, that is, in the historical contexts of Adrien-Marie Legendre (1752-1833), his creation of the Least Squares Method in 1805 and Francis Galton (1822-1911) and his experiments that led to Linear Regression in 1875;
3. Use of everyday situations to associate historical facts with current situations contributing to the understanding of the world and the teaching of statistics (Class 1): the words of this class with higher chi-square values refer to the understanding of everyday life as a necessary element to teaching and learning process of statistics;
4. Teaching of Statistics associated with the teaching of Probability through historical approaches and discussing the history of mathematics as a pedagogical methodology (Class 5): This class is strongly articulated with classes 3 and 4, pointing to the use of teaching sequence to involve students in situations where they have to research, becoming fundamental to teaching statistics. Hence the predominance in this class of words: probability, involve, sequence, fundamental, research, resource, teaching, systematize, class.
5. Associate the teaching of Statistics with other mathematics teaching content and evaluate how historical approaches can be used (Class 4): There is reflection on pedagogical practices in the focus of Mathematics Education, linked to the History of Mathematics, as a resource didactic for Teaching Statistics and Probability in the school context. There is a predominance of words, among others: reflection, context, theoretical, didactic, analysis, mathematical, relevant.
6. Presentation of pedagogical potentialities for teaching statistics for Basic Education (Class 3): Supported by bibliographic research on the History of Statistics, activities were developed for the use in Basic Education classrooms of basic statistical concepts such as population, sample, average, fashion and median, among others; seeking to reproduce facts constituting the historical development of statistical contents such as the elaboration and analysis of graphs and tables and basic concepts that underlie this area of knowledge, so that, from these activities, it is possible for students to grasp the studied statistical contents.

In addition to the dendrogram, these results interface also makes it possible to identify the lexical content of each of the classes (figures 2 and 3) and a factorial representation of the DHC.

As an example of analyzes that support the lexical analysis (in Portuguese), figure 4 presents, for Class 2, the data related to its content: 1. n. (number ordering the words in the table); 2. eff. st (number of text segments that contain the word in the class); 3. eff. total (number of text segments in the corpus that contains, at least once, the word cited); 4. percentage (percentage of occurrence of the word in the text segments in this class, in relation to its occurrence in the corpus); 5. χ^2 (association of the word with the class); 6. Type (grammatical class in which the word was identified in the shape dictionary); 7. Form (identify the word); 8. p (identifies the level of significance of the word's association with the class).

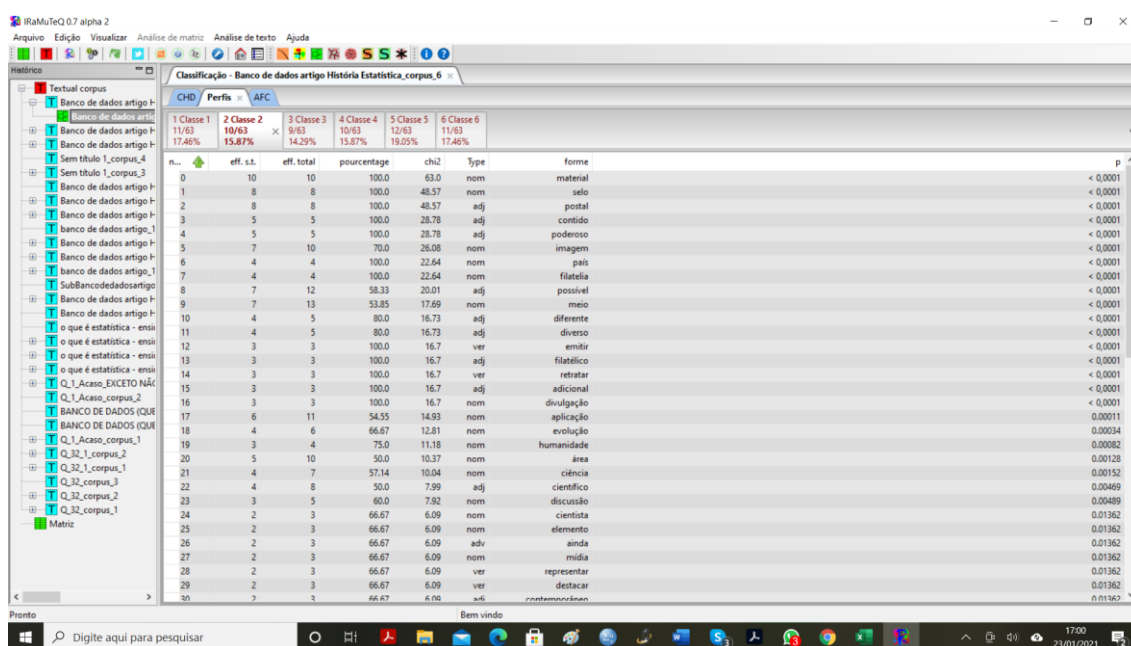


Figure 4: Result of Classification by the Reinert Method: Class 2 profiles.

The results obtained with the Reinert (DHC) method can also be represented in a factorial plan constructed by the Factorial Correspondence Analysis (FCA). Specifically, when used in the Reinert method, the FAC relates linguistic forms and context variables with the resulting classes of DHC [19].

Considering the FCA, it was possible to associate the textual corpus between words, considering the frequency of word incidence and classes, representing them in the Cartesian plane. Thus, it is possible to visualize the contextualization of the typical vocabulary of each class, making it possible to identify which classes complement and concentrate the corpus, and which distance themselves from the center and show a certain specificity (Figure 5).

It is observed that the words of the classes are presented in a centralized segment that expands to peripheral points. However, there are several words that go beyond the other quadrants, presenting significant union between the classes.

The words in classes 1, 3, 4 and 5 are closer and named, respectively, as “Use of everyday situations to associate historical facts with current situations contributing to the understanding of the world and the teaching of statistics”, “Presentation of pedagogical potentialities to the teaching of statistics for Basic Education”, “Associate the teaching of Statistics with other contents of the teaching of mathematics and evaluate how historical approaches can be used” and “Teaching of Statistics associated with the teaching of Probability through historical approaches and discussing the history of mathematics as a pedagogical methodology”.

In this subcorpus, it is observed that there is a concern to indicate how historical approaches as a strategy for teaching statistics and that can be used as teaching methodology from elementary to higher education, however, with the application of pedagogical activities in the classroom from an initial theoretical discussion.

The text 3, [20], present a reflexive approach with regard to theoretical discussions on the History of Mathematics, as a didactic resource for the teaching of Statistics and Probability, addressing issues relevant to the teaching of mathematics, focusing on the historical perspective, turning to Statistical and Probabilistic Education. They consider that the weightings point out relevant aspects in favor of reflection and analysis, based on the considerations and relationships established from the theoretical support.

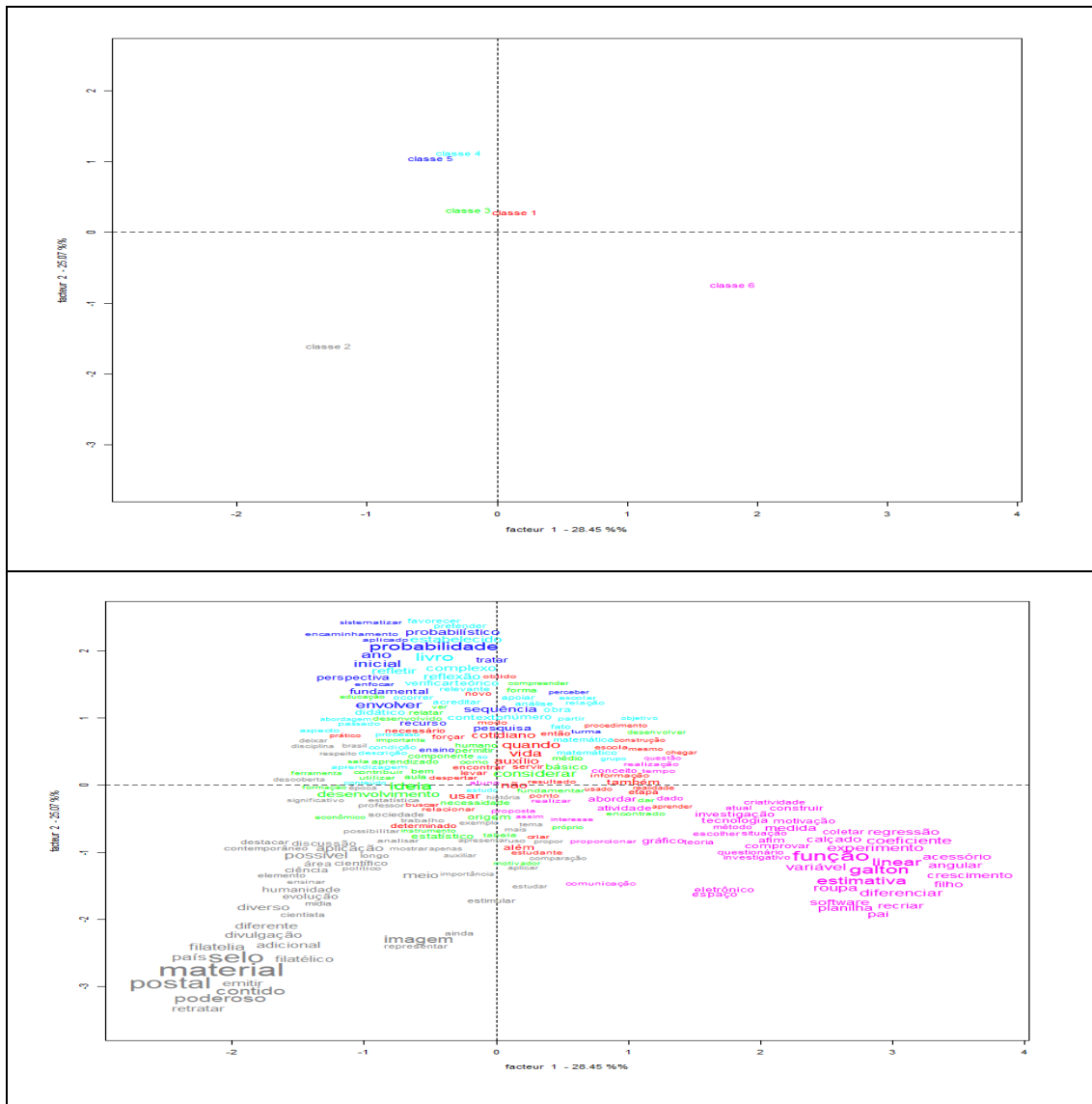


Figure 5: Result of Classification by the Reinert Method: FCA.

The same authors, [21], text 5, analyze the contributions that a Teaching Sequence can bring to the teaching of Statistics and Probability in the early years of elementary school, using contextualization involving the History of Mathematics as a didactic resource. A Teaching Sequence directed to the basic contents of Statistics and Probability was worked out with a group of students from the 4th year of elementary school in a school in the municipal education system of Curitiba, Paraná, Brazil. The methodology used in the research is applied, descriptive, and the results were analyzed from a qualitative perspective. These were issues relevant to the teaching of mathematics, focusing on the historical perspective, aimed at statistical and probabilistic education. They conclude that a contextualized Teaching Sequence is configured as a productive pedagogical resource to enable the teaching and learning processes of the contents that involve Statistics and Probability for the initial years of elementary school.

In [22], text 4, it is reported the elaboration of a didactic sequence that works the use of the History of Mathematics as a resource for the teaching of Statistics, being based on bibliographic research on the History of Statistics, which begins with reports obtained on the use of Statistics since ancient times, where governments used it to collect data from the population to collect taxes and even to force young people to do military service. The study is contemporary, where it appears that the objectives of statistical research remain practically the same, for tax collection, analysis of problems in society, among others. With the elaboration of the didactic sequence and, in the future, its application, it is intended to show that knowledge develops from needs, helping to understand the importance of learning such contents for living and acting in society.

In addition to the study by [22], the text 10, brought in [23], indicates that the activities built and presented in the text were intended to present to the students' knowledge how they were carried out the advances

in Statistics throughout the history of mankind, seeking that they are able to perceive through texts and proposed activities, the progress of this area, so present in our daily lives. They consider that, to show how Statistics can influence citizens' opinion formation, it is essential that the student builds his knowledge through the information made available to him. With the help of the History of Statistics in the teaching-learning process, it is expected, then, that in addition to learning new content, students will also be able to analyze and criticize the results obtained and the information made available in their daily lives and in their lives, so that what is learned at school is not an end in itself, but that collaborates for the construction of citizenship and active participation in society.

In text 8 by [24] is presented difficulties with students from most of the higher education courses that require Statistics, particularly in Civil Engineering and Environmental and Sanitary Engineering courses and bring a teaching proposal based on in the investigation of the history of Statistics, giving a greater focus on its evolution over time, introducing a historical approach in statistics classes, so that the student can understand that scientific knowledge is not a "closed package" to be delivered or a prescription to be followed that would encourage the non-alienation of your teaching. Thus, through activities in the classroom, the efficiency of inserting the history of statistics was verified as a way of contextualizing the content, relating knowledge to everyday life and then contextualizing it in scientific language, creating a bridge between prior knowledge and acquired knowledge.

In the text 9 by [25] is contextualized the history of mathematics, as well as the teaching of Statistics, focusing on the percentage and average of the data, presenting the history of the development of Statistics as a science, using it to improve classroom learning. An emphasis is given to the historical importance of mathematics, adding to the evolution of mathematical subjects in education linked to statistics. In the proposed activities, they indicate the history of the percentage and its applicability in the classroom, showing the great importance it has, being the best known and easiest statistical tool, as it allows the presentation of data in graphical mode. The data mean complements this concept, because in addition to presenting the data, it also presents the central tendency.

Finally, text 12 by [26], addressed the history of mathematics to enable new approaches related to teaching and learning in order to verify the presence of the historical context of statistics and the complex numbers present in six books high school didactics in Brazil and edited at different times, to identify the presence of the history of this content in these works reflecting on how much these works value the history of mathematics as a useful tool in learning. Through the analysis of the works, some differences were noticed in relation to the history of mathematics covered in statistics and in complex numbers by the textbook authors in relation to the criteria adopted in this work as a way to motivate students to be interested in these themes, emphasizing that the content of statistics is covered by only two of the works and that it can be explained by difficulties in accessing a more detailed bibliography on statistics.

In opposition are the words of class 2 (Using the history of philately in Brazil and other countries as a historical approach to the teaching of statistics) that appear in the graphical representation in a more isolated way from the other classes.

It is interesting to highlight that in this class there are three texts (1, 2 and 11) by the same authors and with the same focus, that is, the use of the evolution of Statistics through a historical process relating the social, political and economic conditions of their times, having as support material the images contained in several postage stamps issued by several countries, including Brazil.

Thus, in [27] text 1, the history of statistics is considered, with the premise of analyzing the people of the past who created the principles of statistical science, in addition to studying the circumstances in which discoveries were made, showing that it is an important instrument for teaching and learning in several areas and Statistics itself. In the case of activities involving the history of statistics, a suggestion for its use in teaching practice is illustrated. It is considered that the visual aspects contained in the postage stamps can arouse the student's curiosity and interest and, as a consequence, expand his knowledge. It is assumed that through philatelic material it is possible to instigate the student to discover the origin of a certain statistical content, making learning not only significant, but also motivating. In addition, the postage stamps can provide some questions and discussions about the evolution of Statistics present in the images and relate it to other areas of knowledge. Because it is an easy-to-use material, it can be used as an additional option for teaching and learning and, therefore, assist teachers who wish to encourage their students to appreciate, analyze and study images portraying personalities from the History of Statistics.

Still in 2012, [28], text 2, starting from the work previously indicated, and considering that the National Curriculum Parameters for Secondary Education in Brazil point to the need for the historical-social contextualization of knowledge, this implies considering the contribution of the History of Sciences, the History of Statistics can contribute to the learning of statistical content, as it allows us to understand the origin of the ideas that shaped our culture. In addition, it is possible to verify under what circumstances these ideas occurred,

showing to be an important instrument for teaching in the different areas of Statistics itself and other sciences that use it as a tool.

The same authors [29], in 2018, text 11, feature 89 stamps selected that involving the theme of interest (Statistics) during the period from 1920 to 2014 issued by several countries, including Brazil, which had some relation to Mathematics and Statistics. Of this total, 45 prints were selected to meet the objectives of this research, that is, the sample was restricted to those stamps containing only the statistical connotation. It is considered that the existing content in the images printed on the prints, often makes it possible to carry out a different and motivating approach to the analysis of historical content, portraying the evolution of statistics over time and its links and uses in the scope of other sciences, as is the case of Geography, Physics, Chemistry and Mathematics itself. It is concluded, through this work, that Statistics has been disseminated through philately, characterizing in the issues of various postage stamps from different countries some elements of the history and evolution of the applications of this science.

Still showing more isolated words in the graphical representation, we identified the Class 6 that we call "Use of the history of Galton linear regression and the method of linear least squares for the study of basic statistics, through electronic spreadsheets, in High School in Brazil".

In the same way as Class 2, there are two texts that are the result of research by the same authors as [30], who built activities based on the History of Mathematics, carried out through Mathematical Investigation and Information Technologies and Communication, to approach and contextualize concepts of Affine Function and Basic Statistics in High School. An anthropometric study based on Francis Galton (1822-1911) was carried out to prove that his eugenic theory gave rise not only to mathematical and statistical concepts, but also created the method of digital recognition and is closely linked to the standardization of measurement measures. clothes, shoes and accessories. According to the authors, there was interest and motivation from students when measuring their colleagues and themselves and, in addition, the groups formed in the activity went beyond the requested research, to find out why the relationship between the size of clothes in number (or range of numbers) and in letters. Therefore, the attitude of some students, in researching on the internet, images of the measurement instruments used by Galton, also proved the motivation that the history of the statistician's work caused in most students.

In [31], activities based on the History of Mathematics were built, carried out through Mathematical Investigation and Information and Communication Technologies to address, in a contextualized way, the concepts of Affine Function and Statistics in High School. Therefore, it is based on the historical context of Adrien-Marie Legendre (1752-1833), his creation of the Least Squares Method (1805); Francis Galton (1822-1911) and his experiments that led to Linear Regression (1875). As a result, and conclusion of the study, we identified points that can be improved by the teacher who uses it in his classes, which are listed in detail in tips that can be used by the teacher at the end of each activity. It is considered that the work can contribute to the teaching of Related Functions and Basic Statistics in order to make the teaching and learning process of these concepts more motivating, interesting, contextualized and humanized.

The results obtained with the Reinert (DHC) method by the FCA, also bring relations with the context variables associated with the resulting classes of the DHC (figure 6). We recall that the variables used were: Type of publication (pubType); Year of publication of the text (yearPub); Teaching Cycle to which the work was destined (cycleTeaching); Public to which the work is intended (publicTeaching); Work focus (workFocus); and Brazilian region where the work was developed (PubRegion).

Considering Figure 6, we will present which variables used to identify each text are significantly associated with each of the classes generated by DHC.

In Class 2 "Using the history of philately in Brazil and other countries as a historical approach to teaching statistics", formed by the works [27], [28] and [29], it is identified that: 1. It was carried out in the Southeast region of Brazil; 2. It is aimed at students and teachers, mainly from Higher Education; 3. Based mainly on production published in scientific events; 4. Focused on teaching statistics; 5. Started in 2012.

In Class 6 "Using the history of Galton's linear regression and the method of linear least squares for the study of basic statistics, using electronic spreadsheets, in High School in Brazil", formed by the works [30] and [31], it is identified that: 1. It was carried out in the Northeast region of Brazil; 2. It is aimed at high school; 3. Based on a Master's dissertation; 4. Focused on teaching statistics; 5. Held in 2015.

The Class 1 "Use of everyday situations to associate historical facts with current situations contributing to the understanding of the world and the teaching of statistics", formed by the works [24] and [25] is mainly focused on work related to mathematics teachers.

Considering Class 5 "Teaching Statistics associated with the teaching of Probability through historical approaches and discussing the history of mathematics as a pedagogical methodology" ([21] and [22]), we have the following identification: 1. It was held in the southern region of Brazil; 2. It is aimed at students; 3. Focused on teaching statistics and probability.

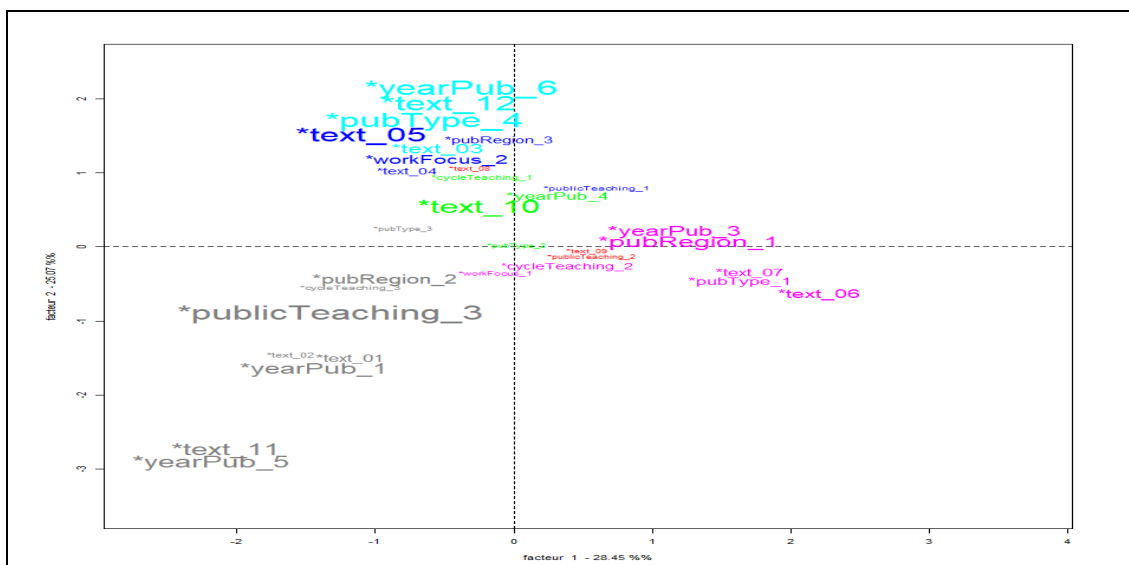


Figure 6: Result of Classification by the Reinert Method: FCA, associated with the highlighted variables.

For Class 4, associating the teaching of Statistics with other mathematics teaching content and assessing how historical approaches can be used [20] and [26], is identified mainly by the chapter of a book produced in 2019. Finally, Class 3 “Presentation of pedagogical potentialities in the teaching of statistics for Basic Education” [23], is identified for being directed to elementary education and being a scientific article published in 2017.

IV. CONCLUSION

In this text, we present an analysis of scientific productions in the Brazilian context on the use of historical approaches, related to the teaching of statistics. The inventoried works offer important elements to understand the history of knowledge production and to highlight the contributions and gaps in this area of research, and at the same time enable this field to be further explored by researchers.

During the period from 2012 to 2019, 12 studies were found focused on the use of historical approaches in the teaching of statistics. Among the main results obtained in our research was to report a Systematic Literature Review (SLR) in order to provide an overview of the development of research in relation to this theme, in Brazil.

Data analysis was organized based on the identification of the following variables of interest: Type of publication (pubType); Year of publication of the text (yearPub); Teaching Cycle to which the work was destined (cycleTeaching); Public to which the work is intended (publicTeaching); Work focus (workFocus); and Brazilian region where the work was developed (PubRegion).

In addition, these variables were associated with the following specific questions (SE), which guided the collection, organization and presentation of relevant information on the development of research aimed at the use of historical approaches in the teaching of statistics, in Brazil, namely: SE1: What was emphasized? SE2: What is the methodology or methodological approach used? SE3: What is the context in which it is developed? SE4: What are the types of studies and the areas involved? SE5: What are the main results and conclusions?

The set of works analyzed reveal some important aspects:

1. The research carried out in the period 2012-2019 is concentrated in the Southeast, Northeast and South regions, with no investigation in the other Brazilian regions (North and Center-West);
2. Most of the research is aimed at students, lacking work more geared towards teachers;
3. Only one of the works was developed in a postgraduate program and specifically the production of a Master's dissertation, indicating the need for more research to be developed using historical approaches in the teaching of statistics with a more in-depth theoretical discussion;
4. Research on the use of historical approaches in the teaching of statistics is still incipient, considering that was inserted in the Brazilian curricular structure, mainly in Basic Education with the National Curriculum Parameters - PCN, from 1997 (1st and 2nd cycles) and 1998 (3rd and 4th cycles), in the content block called “Information Treatment”, and in High School, from 1999 and 2002, in the axis called “Data Analysis”;

5. In the maximum tree generated in IRaMuTeQ about the set of abstracts, it is evident that there is a concern in research with the student's profile and its relationship with experiential knowledge, with daily life, with its relationship with the world of work and, contributing to training citizens aware of the development of statistical science;
6. There is a need to conduct more research addressing the use of historical approaches aimed at teaching statistics in the Brazilian context.

Finally, we indicate that, although research in Brazil in relation to the use of historical approaches in the teaching of statistics is still incipient, the works selected for these studies show that Statistics can influence the formation of citizens' opinions, being essential that knowledge is built through the information available. Thus, it is important to know how Statistics was built and that from the needs and situations that have arisen throughout history, it is realized that this knowledge has been built over the years.

It is still perceived in the works the recognition that statistical information is always available to society through the media and, based on this assumption, it is considered that students already have some knowledge on the subject and, therefore, the search for knowledge history of this content can assist them in the construction of a new critical and autonomous knowledge through the provision of new knowledge.

With the help of the History of Statistics in the teaching-learning process, it is believed, then, that in addition to learning new content, from the development of the ability to analyze and criticize the results obtained and the information available in their daily lives and in their day-to-day experiences, so that learning at school is not an end in itself, but can contribute to the construction of citizenship and active participation in society.

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