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Critical statistical education: a teaching-learning experience in the MBA of an Economics course[1]

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ABSTRACT

Statistics is in our personal, professional and academic life, appearing in the curriculum of most undergraduate courses. The high workload of Statistics gives the Economics courses a quantitative bias, but not a critical one. The objective of this work is to report a pedagogical proposal for Statistics guided by the perspective of Critical Statistics Education as a teaching-learning methodology. Specifically, a teaching experience is reported in an MBA course in the Economics area, which took place virtually. In this context, we show some possibilities for building, in higher education, an integrative and critical statistical learning that values citizenship. The dialogical challenge posed by remote teaching has been overcome. It was possible to establish a non-hierarchical relationship, in which professor and students acted as accomplices in critical teaching, aimed at a better understanding of Statistics in the context of economic problems, but also for society in general.

KEYWORDS: Statistics Education; Critical Education; Economy.

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La educación estadística crítica: una experiencia de enseñanza-aprendizaje en el MBA de una carrera de Economía

RESUMEN

La estadística está presente en nuestra vida personal, profesional y académica, apareciendo en los más variados cursos de educación superior. La alta carga de trabajo de Estadística da a los cursos de Economía un sesgo cuantitativo, pero no crítico. El objetivo de este trabajo es relatar una propuesta pedagógica para la Estadística guiada por la Educación Estadística Crítica como metodología de enseñanza-aprendizaje. Específicamente, se relata una experiencia en un curso de MBA, que se llevó a cabo de manera virtual. Así mostramos algunas posibilidades para construir un aprendizaje estadístico integrador y crítico que valorice la ciudadanía. El reto dialógico que plantea la enseñanza a distancia ha sido superado. Fue posible establecer una relación no jerárquica, con profesor y alumnos actuando como cómplices de una enseñanza crítica, encaminada a una mejor comprensión de la Estadística en el contexto de los problemas económicos, pero también para la sociedad en general.

PALABRAS CLAVE: Educación Estadística; Educación Crítica; Economía.

Educação estatística crítica: uma experiência de ensino-aprendizagem no MBA de um curso de Economia

RESUMO

A Estatística está presente em nossa vida pessoal, profissional e acadêmica, aparecendo no currículo dos mais variados cursos superiores. A elevada carga horária de Estatística presente nas graduações em Economia, confere a esses cursos um viés quantitativo, mas pouco crítico. Objetiva-se neste trabalho relatar uma proposta pedagógica de Estatística pautada pela perspectiva da Educação Estatística Crítica como metodologia de ensino-aprendizagem. Em específico, relata-se uma experiência de ensino em um curso de MBA da área de Economia, o qual ocorreu de forma virtual. Nesse contexto, mostramos algumas possibilidades de construção, no ensino superior, de uma aprendizagem estatística integradora, crítica e que valoriza a cidadania. O desafio dialógico dado pelo ensino remoto restou superado. Foi possível

estabelecer uma relação desierarquizada, na qual docente e estudantes atuaram como cúmplices de um ensino crítico, direcionado para uma melhor compreensão da Estatística no âmbito dos problemas econômicos, mas também para a sociedade, em geral.

PALAVRAS-CHAVE: Educação Estatística; Educação Crítica; Economia.

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Opening the debate

Batanero (2001, p. 7) states in her book that it is indisputable that "the 20th century was the century of Statistics, which came to be considered one of the fundamental methodological sciences and the basis of the experimental scientific method". Along these lines, it is not an exaggeration to consider the current century as the age of data. Most of decision-making – whether by families, governments or companies – is based on data analysis. Everything is measured nowadays; from the perceived experience in a particular restaurant, to the probability of a candidate winning an election or the effectiveness of a vaccine. As a consequence (or cause) of this process, data is produced and available on an unprecedented scale.

As an apparent reflection of this scenario in the educational sphere, Statistics gains global relevance in curriculum at all levels and types of education, especially in Higher Education (Campos, Wodewotzki and Jacobini, 2011). Therefore, it is currently rare to find an undergraduate course that does not have at least one discipline related to some statistical content.

In the context of national higher education, according to Maciel (2023), the Economics course has the second largest number of statistical curricular components, surpassed only by the Bachelor's degree in Statistics itself. Furthermore, according to the National Curricular Guidelines (DCN) of the Undergraduate Course in Economics (Brasil, 2007), the pedagogical

project of these courses encompasses "(...) more advanced study topics in mathematics, statistics and econometrics , in order to develop analytical capacity, critical vision and effective communication both oral and written". (Brasil, 2007, p. 3).

In parallel with the greater penetration of Statistics in the educational sphere, its teaching practices are beginning to be (re)thought, with new perspectives being proposed for teaching and learning content. In this aspect, a movement begins with a view to escaping skills from memorizing formulas and mathematical algorithms. Thus, the student is guided towards the understanding, interpretation and critical reproduction of statistical applications on data.

Along these lines, Campos (2007) proposes Critical Statistical Education (CEE) as an obvious possibility for promoting critical and reflective skills in (higher education) classrooms. Generally speaking, this perspective is based on a symbiotic approach between Critical Education – Freire (1965, 1966 and 2014) and Critical Mathematics Education – Skovsmose (1994, 2001, 2011 and 2014). With this, Campos (2016) maintains that the combination of these elements makes the development of critical competence emerge in the student, a catalyst for critical and reflective citizenship.

However, in Higher Education, despite the large presence of Statistics in undergraduate courses, official actions towards new educational proposals are still timid. A possible reflection - or origin - of this is that most national research related to Statistical Education is more focused on Basic Education. Additionally, according to Maciel (2023), investigations in the context of Higher Education are (almost) always focused on courses that have historically, the highest number of enrollments, that is Pedagogy, Degree in Mathematics and Business Administration. Beyond that, the educational reality experienced by postgraduate students is almost completely neglected.

Given the presented context, the objective of this work is to report a teaching-learning proposal for Statistics based on the EEC perspective. Specifically, it is an analysis of a teaching experience in an MBA course in the field of Economics, in the year 2022. The aim is to present and discuss possibilities for building, in higher education, an integrative and critical learning towards the development of citizenship.

Importance of Statistics for economic science: contexts and learning

The leading role of Statistics in the study of economic problems dates back even before the treatment of Economics as a science. It is originated in antiquity, motivated by problems of population counting and tax collection. In fact, the very origin of the word Statistics is often attributed to an economist, Gottfried Achenwall (1719-1772), who interpreted it as having a close relationship to the State.

Along with computational advances, experienced since the middle of the 20th century, and the consequent increase in data production/dissemination, the synergy between Economic Science and Statistics increases. According to Maciel (2023, p. 49), "without hyperbole, it is close to impossible to study, currently, any economic phenomenon without the support of some statistical tool".

Because of this, undergraduate Economics courses around the world are typically immersed in curricula with great quantitative appeal. In Brazil, it is no different. As already reported in this work, national courses have one of the largest workloads related to quantitative areas, notably Mathematics and Statistics. As for Statistics, it is not uncommon for students to experience it, from the basic training cycle (first and second academic semesters), until the final years of the course.

In this sense, according to the DCN, the following subjects are mandatory components of Economics courses: Introduction to Statistics (or Statistics 1); Statistics 2; Statistics Applied to Economics; and Econometrics.

Typically, each of these subjects have a workload of 60 hours. They cover content related to Descriptive Analysis, Probability and Statistical Inference, with an emphasis on Linear Regression and Time Series Models.

Regarding investigations into the statistical teaching-learning process in Economics courses, Maciel (2023) states that one of the seminal works on the subject - Sowey (1983) - already raised problems in this process, in the context of North American courses. According to the aforementioned author, knowledge was not retained, beyond assessments during the course. There was a lack of effort from the teacher to demonstrate the usefulness of Statistics and also greater clarity of the contents exposed in the textbooks.

Almost 40 years after Sowey's (1983) initial notes, the scenario appears not to have undergone profound changes. There is a lack of context and a lot of mathematics. So much that for Arkes (2020), statistical content in Economics courses in the United States is still taught with exaggerated theoretical rigor, as if students were defending a doctoral thesis. However just a few will do it, in fact. Along these lines, based on Arkes (2020, p. 24), “high-level mathematics (calculus and linear algebra) and demonstrative proofs are unnecessary and steal time for the teacher to advance towards the most important thing: concepts”.

In the case of Brazil, studies on the learning process experienced by Economics students yet are rare. However, in a recent research effort, Maciel (2023) showed, based on the data from the National Student Performance Exam (ENADE) in 2018, that student performance, in Statistics issues, is considered low: barely reaches 50% of the grade. Regarding the characteristics of the teaching process, still based on Maciel (2023), it was clear that most of the Exam participants perceived teaching practices that reproduce, in a certain way, the problems reported by Sowey (1983) and Arkes (2020) for the North American case.

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Critical statistical education: foundations and perspectives

According to Skovsmose (2014), the objectivity and neutrality of science has been one of the great modernity's narratives. In particular, it celebrates the natural sciences as a demonstration of the ideal scientific format. In this sense, Mathematics developed a status of special rationality, and has been considered sublime or even divine. Thus, the author asserts that the notion of criticism grew and multiplied along with these and other great narratives of modernity. As this narrative grew, it started to challenge others. Anyway, criticism is not independent of these narratives and, like others, its concept has been challenged. In other words, Skovsmose (2011) states that criticism needs to be criticized.

This idea from Skovsmose's work already gives us a dimension of his thoughts about criticality, which demands reflections, deployments and... criticism! Our study of Skovsmose's work leads us to observe criticism as arising from various ideas, such as empowerment and democracy. Regarding the term empowerment, Skovsmose (2011) indicates that we should consider three notions related to Mathematics that are linked to it: i) classical - linked to intellectuality - and which highlights Mathematics as the only way to reach and understand the divine work; ii) pragmatic (and individual), related to applied mathematics, emerging from the industrial revolution; and iii) socio-political, with Paulo Freire, which brings us the idea of awareness and emancipation, and which expanded beyond the idea of critical citizenship (Skovsmose, 1994).

Critical citizenship, according to Skovsmose (2014), occurs when mathematical language allows the student to better understand (and become aware of) the problems of his/her world, from the most particular sense to the most global and generalized. It is mainly this idea that underlies the concept of empowerment described by the author. Thus, according to Skovsmose (2014, p. 16), "if mathematics education were a closed process without social significance, critical mathematics education would not have much to worry

about". Thus, such empowerment constitutes the basis of critical competence: "the idea is to make Mathematics as a language of power, accessible for critical discourse" (Skovsmose, 2014, p. 151).

The concept of criticism brought by Skovsmose (1994, 2001, 2011, 2014) is broadly linked to several other issues, in addition to empowerment, among which we can mention technology, democracy and reflective knowledge. Along this path, Skovsmose (op. cit.) conceives the classroom as a microsociety and adapts the broader idea we have about democracy to the pedagogical environment. As pointed out by Skovsmose (2014, p. 167), "a democracy must make room for critical citizenship, which is the effective performance of a critical competence".

The ideas of Skovsmose (1994, 2001), together with the work of Freire (1965, 1969, 1970) and Giroux (1997), motivated Campos (2007, 2016) to develop a theoretical framework for what he called Critical Theory of Statistical Education, which later became Critical Statistical Education.

> [...] we understand that before being Statistics teachers, we are teachers. And as such, assuming a reflective and self-critical stance, we place the objectives of Critical Education alongside the objectives of Statistics Education, without hierarchizing them, but assuming a communion in both, because even if one thing does not stand out over the other, neither harms it (Campos, 2007, p. 108).

According to the Campos (op. cit.), a Statistical Education that aims to be critical, must seek, among other things, to promote judgments about the validity of ideas and conclusions, encourage criticality and favor Freirian dialogue, based on democracy; conceived in an active and critical method. It is about an education based on problematizing content, presenting it to students as relevant and challenging.

Thus, Campos (2007, p. 97) asserts that this entire educational process results in "students' reflection-action about their world/reality, activating their awareness, based on the generating themes". And further: "only by developing a permanently critical attitude will men be able to overcome an attitude of accommodation" (Freire, 1970, p. 6)

Thereby, the EEC perspective follows a didactic approach opposed to traditional teaching, infected with neutrality, and supposed transparency. For EEC, teaching must place students in the position of actively critical citizens in the face of social inequalities and injustices. Thus, the role of transformative intellectuals placed by Giroux (1997) for educators and educational researchers stands out, as they are meant to perform both social and political function in the classroom.

Based on this, Campos (2007, p. 101) argues that EEC must be able to strengthen students "with the skills and knowledge necessary to recognize injustices and be critical actors [...] of a world free from oppression and exploration". Along this path, Statistics professors – as transformative intellectuals - "undertake a socially transformative practice in opposition to the exercise of mysterious intelligence or specialized knowledge under the appearance of political neutrality".

Finally, according to Campos (2007, p. 99), EEC must be understood from one main objective: "giving the student voice, helping them to critically read the world, making them an active and engaged citizen". In short, the idea is to provide for the student the opportunity of (p. 213) "a problematized, critical and reflective education, allowing the critical insertion of the student into the reality in which he/her lives", with the aim of allowing a better understanding of the world in which the student not only observes, but participates and intervenes, when necessary.

About the course report: EEC as a teaching-learning methodology

In this section, we take the EEC pillars already discussed to support and present an experience of teaching Statistics in a postgraduate Economics class. The discipline was taught in the second semester of 2022, in five consecutive meetings of three hours each, totaling a workload of fifteen hours. The class had nine students, from different areas of knowledge; however, half of the students came from business courses (administration, accounting, or economics).

The course program was divided into three parts. Part 1, named "Opening the debate" – and which will be analyzed in this article – contained the following topics: i) what is Statistics for you?; ii) Statistical thinking; iii) Defenses against misuse of Statistics; iv) Model x Reality; v) the three worlds of Statistics: data, estimators, and parameters; and vi) How to organize a database.

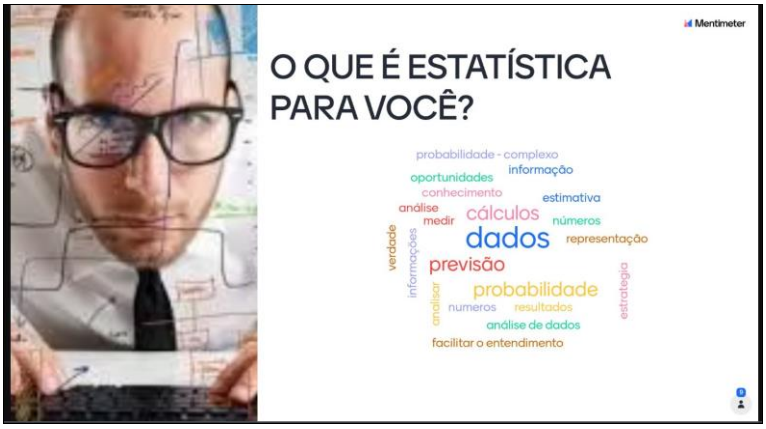
That said, the first obstacles were already present in the teaching method of the subject itself. Due to the limitations imposed by the COVID-19 Pandemic, classes were taught virtually through a web conferencing platform. Novelty, both for teachers and students. Therefore, the dialogical process – so fundamental to the critical educational perspective – was, curiously, harmed by technological intermediation. Many did not want to be seen or heard. Effortless! How to overcome this problem?

This initial passivity was already assumed and, much of it, can be attributed to the possible students' negative attitudinal aspects over Statistics, as a result of their past undergraduate experiences. Regarding this, Cordani (2001, p. 19-20) already stated, at the beginning of the 21st century: "what we see, largely in university courses, is a generalized aversion among students for the discipline of Statistics, (...) which has a high failure rate". More than 20 years later, the reality highlighted by the author still seems to have not undergone significant changes.

The approach to this problem – closely related to the beliefs and attitudes of each student – represented the initial discussion of the discipline. To this end, we chose to use the technological resource of the "word cloud". Using the Mentimeter application, students were invited to answer, from their computers, the following question: What is Statistics for you? Answers should be provided in three words.

Thus, the software anonymously gathered information from all students, generating a word cloud (Figure 1). In this sense, the size of the words within the cloud is directly related to the frequencies that which word appeared in the responses. It was then noted that most students perceived Statistics based on three main words: i) data; ii) forecast; and iii) calculations.

FIGURE 1: Word cloud result: what is statistics for you



Source: The authors, based on student responses, output from Mentimeter

From this moment on, a discussion was developed about the results pointed out by the cloud. Each person was invited to present themselves, explaining the relationship between the results of the formed cloud and their respective previous statistical learning experiences. Although the word "calculation" was not the most frequent, attention was drawn to the emphasis given by everyone on the mathematical appeal of their teachers when teaching statistical content. Two students (from the Economics course) even reported a history of two or more failures in Statistics. Speeches full of

anxiety, fear, and feelings of incapacity, due to the apparent mathematical complexity of the content. The challenge was set!

Despite EEC's efforts to guide teaching work towards critical competence, statistical content is typically still seen (taught) as extensions of mathematics. Thus, teachers persist with the overlay of the mathematical aspect, to the detriment of a conceptual, critical, and contextualized approach. Error! Statistics is not mathematics. Regarding this, Batanero (2001) clarifies that the nature of Statistics is different, as there are philosophical controversies about basic statistical concepts, such as probability, randomness, independence, or hypothesis testing, but we cannot talk about controversial algebra or geometry.

Still according to the aforementioned author, most statistical concepts are simple, from a mathematical point of view; however, there are numerous difficulties linked to the interpretation of these concepts and their application in practical situations. This impasse is not technical in nature, as there is a satisfactory level of axiomatic foundation in Statistics. Thus, the philosophical problems not resolved by axiomatization refer, according to (Batanero, 2001, p. 19), "to the possibilities of applying statistical concepts and interpreting them in different circumstances".

In view of this, the present teaching experience aimed at undoing students' mathematized beliefs regarding Statistics. To this end, it was stated that the classes' conduction would be guided by a conceptual perspective, with the aim of enabling them to take a critical and reflective stance towards statistical content, and not to develop mathematical calculation skills. The materialization of this was made in the presentation of the objectives of the discipline, which were: 1) Understanding the importance of Statistics, as well as its limitations. 2) Foundation of Statistical Thinking. 3) Discuss the conceptual domain of the main basic statistical tools, from a double point of view (producer and consumer of information). 4) Application of statistical models for business decision making.

After this initial moment, the professor provoked a debate about two aspects linked to the context of the current COVID-19 Pandemic: i) explosion in the number of pharmacies opened; and ii) intensification of global trade in medicines. In this, a comparative image was shown between two pharmacies, at different historical moments. (Figure 2). The figure on the left represented the beginning of the first European pharmacies, around the 16th century; on the right, a typical 21st century pharmacy.

FIGURE 2: Comparison between pharmacies from different eras

Source: Made by the authors, based on www.google.com.br

Students were invited to reflect on whether Statistics would play any role in this change of scenery observed in the images. Initially, the responses were positioned in the business direction: Statistics as a tool for market analysis, consumer trends, marketing, choosing the most suitable locations for opening branches. Later, after a period of provocation made by the teacher, a student (from a health field) highlighted the scientific role of Statistics, by contributing, through his methods, to the emergence of an ever-increasing number of medicines, for various purposes. The happy teacher, with an effusive voice, confirmed: - Statistics saves lives! Surprised, but confident in what they had just discovered, everyone agreed.

In fact, the consolidation of so-called Statistical Inference, combined with technological development in the last decades of the last century, made

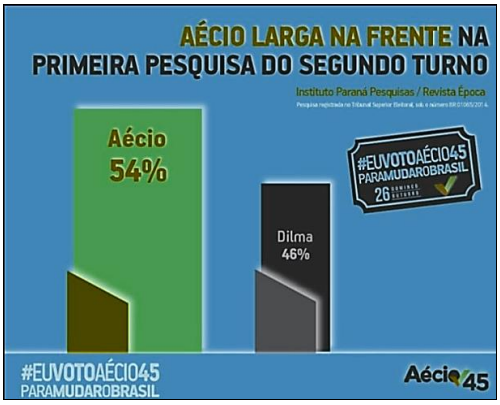
statistical knowledge indispensable in several sciences. So much that, according to Campos (2007, p. 21), "Statistics is not limited to science or research. It is in our society, in politics, in sport, in the media, in lotteries, in leisure and in education."

However, despite – or as a consequence – of this importance, the misuse of results arising from the use of statistical methods is not uncommon. The motivations for this are numerous: (dis)simulating, distorting, directing, or omitting, are the most common examples. They can occur in various scenarios, such as political debates, scientific research, commercial advertisements, sales of financial products, among others. Facing this, Maciel (2023, p. 25) warns: "the information, despite being embalmed by graphs, tables and p-values, can convey a false idea of scientificity, impartiality or even veracity".

In this regard, the students were confronted by the image of a graph prepared by the Electoral Committee of the former candidate for president of Brazil, Aécio Neves, in 2014 (Figure 3). There was a debate about the manipulation strategies used in the image, especially the disproportionality use of graphic scale, absence of axes and omission of grid lines; all combined to enhance the advantage of the candidate. Such manipulative strategies, according to Santos and Branches (2019, p. 206), "make it impossible to create systematic comparison parameters between the two columns, "forcing" the reader to believe in the visual information brought by the graph".

Gal (2002) highlights the importance of the citizen's inquisitive stance and critical sense when faced with any type of statistical information, even though this is not always a trivial task. The theorist warns: "message creators can have different objectives in terms of the assumed facts, images, or conclusions that they aim to create or instill in the reader's mind (GAL, 2002, p. 7). Hence, the need for this type of discussion in the classroom, which was strategically presented to the students along with teaching about graphics.

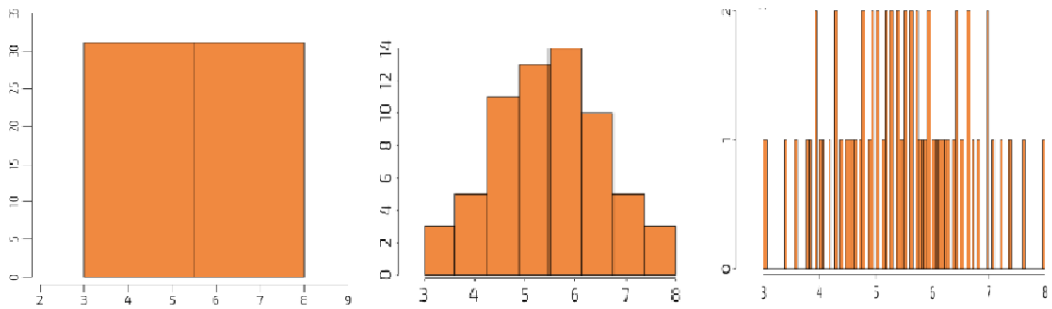
FIGURE 3: Voting intention survey for the position of President of the Republic – Brazil, 2014



Source: Santos e Branches (2019).

By the way, at this stage, we focused on the influence of the type of variable analyzed (quantitative or qualitative) on the choice of the most appropriate graph. Pie charts, columns and bars were presented. Finally, attention was paid to the histogram, placing it as the "king of graphs", as its use allows us to visualize important aspects regarding the data distribution. At this point, an opportunity was created to present some initial concepts about central tendency measures (mean, median and mode) and the level of data variability; topics that would still be covered in greater depth in the second part the course. The importance of the number of intervals chosen for the histogram was therefore highlighted, as a restricted or excessive number of classes could distort the analysis (Figure 4).

Figure 4: Comparison of histograms from the same data set, depending on the number of intervals

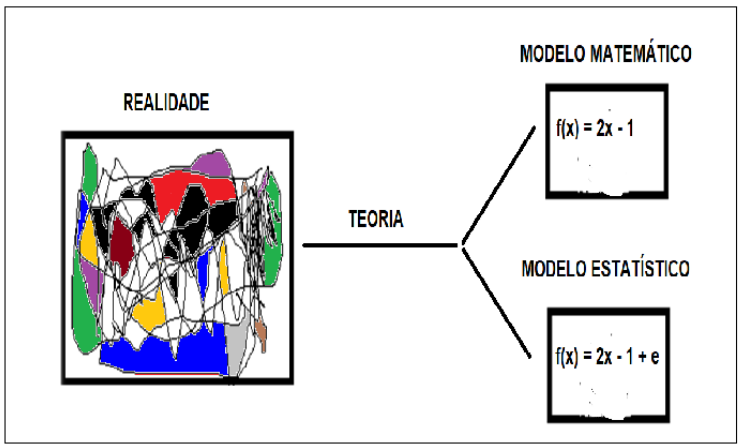


Source: made by the authors

Before delving into the statistical contents, we have chosen for a discussion on the differentiation between a mathematical model versus a statistical model, in addition to the importance of a solid theory for the construction of these models. In fact, theory appears as the epistemological bridge between reality (complex, abstract) and the quantitative model (simple, concrete). Thus, in the mathematical case, according to Maciel (2023), models obtained through algebraic functions, such as y=2x+1, can fully explain the relationship between the variables. The relation among them is exact, deterministic; exhausted by mathematical form.

In the statistical model, there is no exact relationship between the variables, since most of these variables are collected under a sampling process. Therefore, for each value of x, there is a set of possible values for the dependent variable (y), represented by a probability distribution. In this way, the statistical model is hostage to random error, a result of the variability inherent in sample collection. Thus, in statistical terms, the relationship between the variables is stochastic, mediated by the so-called random error ("e"), which brings together all the information about Y not included in the model. All of this was taught to students through the creation of a representative scheme (Figure 5).

FIGURE 5: Reality, theory, and model



Source: made by the authors.

Yet confined to the theme of models, the teacher discussed beliefs in the infallibility of results obtained using Statistics, especially in the field of Economics. It was even stated at the time that the word cloud obtained previously (Figure 1) had the word "truth"; a clear stance of accreditation in exact, infallible statistics. Possibly, much of this position may be a consequence of the excessive mathematical approach to statistical content in undergraduate courses, already discussed previously. In the case of Economics courses, calculations and predictions about Gross Domestic Product (GDP), inflation, exchange rate, are taught and communicated as something accurate, about which there is no room for the probabilistic perspective of such results.

According to Maciel (2023), criticisms regarding this are commonplace and permeate the history of teaching statistics in Economics courses. In 1939, the father of modern macroeconomics, Keynes (1939, p. 155) described the use of statistics in Economics as "an alchemy, an attempt to transform the base metal of imprecise data into the pure gold of a true parameter estimate". Epistemic illusion! Valavanis (1959), corroborating Lord Keynes, conceives the use of Statistics in economic models as

> (...) a strangely balanced French recipe, explaining exactly how many times the sauce should be mixed, how many pinches of pepper should be included and how many milliseconds the pasta should be cooked at exactly 245ºC temperature. But when the statistical cook turns to the raw material, he cannot find cactus fruit seeds, so he substitutes orange segments; where the recipe calls for cornstarch, he uses wheat; and he replaces olive oil with corn oil, turtle eggs with ping-pong balls and, for the 1883 vintage Chalifougnac, a can of turpentine (Valavanis, 1959, p. 83).

Against this, the professor warned postgraduate students: - most estimative of economic indicators result from sample surveys, therefore, they will always be subject to margins of error. In this way, the phenomenon measured and/or estimated may not represent the fateful reality. In addiction: the margin of error itself can present an error! The teacher continued, paraphrasing George Box - a famous British statistician from the 20th century: - In Statistics, there is no model that is 100% correct, there is a model that is more useful or less useless!

Thus, to illustrate the discussion, a curious cartoon was presented (Figure 6), in which a questionable situation appeared: which model would explain the mysterious sound heard by a child in his dark room? Would it come from the physical process of thermal expansion and cooling of bodies, or would it come from some ghost? They will never know, said the cartoon ghost surreptitiously. On this occasion, the professor contextualized: - As well as the true production of wealth in a country (GDP), or the true average value of the inflation rate over the last year, will never be known.

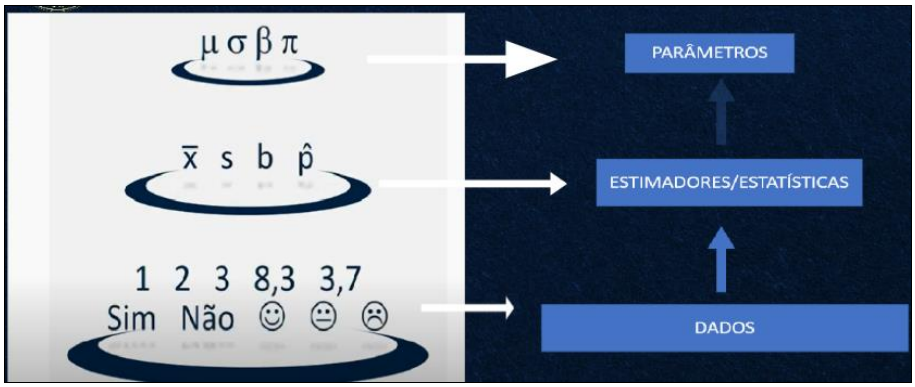
FIGURE 6: Cartoon used in class

Source: https://www.humorcomciencia.com/tirinhas/bate-na-madeira/.

Along with this discussion, the professor pointed out that this unknown world of Statistics is full by parameters, for which, in many cases, are impossible to achieve. What is done is an approximated inferential exercise, by obtaining estimators (samples), which can be: i)

average; ii) proportion; iii) variance; iv) standard deviation, among others. Such estimators, explained the professor, are the link between the sample data and the inaccessible parameter (Figure 7). Hence, the main objective of Inferential Statistics arises: to reduce the darkness between the sample data and the (real) value of the parameter pursued.

FIGURE 7: Parameters, estimators and data



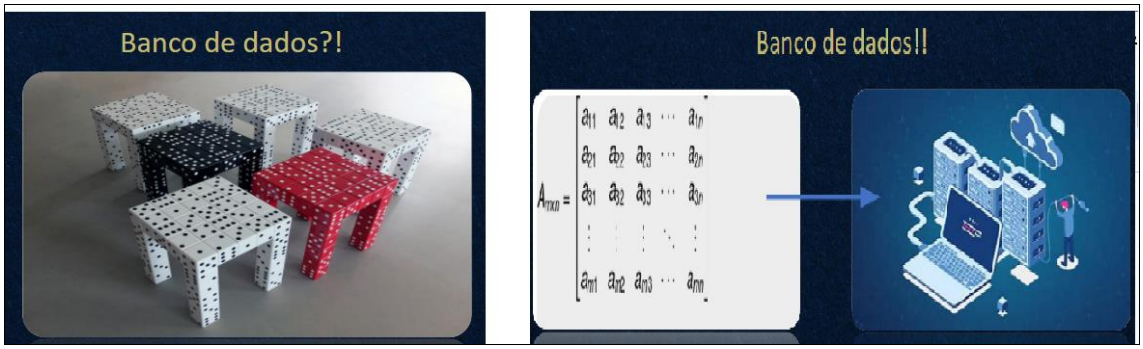
Source: made by the authors.

Next, some practical considerations were made about the organization of data on the computer. Students were instructed to see the database as matrices, in which the lines represent the unit of analysis (individuals, companies, countries, etc.) and each column indicates a certain type of characteristic investigated, that is, they are the variables. Some economic database manipulation exercises were carried out with the support of Codap[4] software.

On this occasion, the teacher stimulated a debate on the very notion of a database, through the display of an image (Figure 8). In that picture there was, side by side, a database – in the denotative sense – and a database, in the statistical sense. Suddenly, a relaxed atmosphere took over the virtual environment… Everyone learned: databases, never again!

[4] CODAP is an open source data analysis application, developed especially for the educational context. Available at: https://codap.concord.org/.

FIGURE 8: Database



Source: made by the authors

At that time, after three days of meetings, many discussions and discoveries, Part 1 of the course was accomplished. The supposed dialogical challenge, posed at the beginning, due to remote teaching, was overcome. It was possible to establish an intense, lively, de-hierarchical relationship. Teachers and students, active and activated, accomplices in critical teaching, aimed at a better understanding of the Statistics' usefulness and traps, not only in the context of economic problems, but also for society in general.

Conclusion

With the support of technological development, Statistics has been gaining prominence in most study fields, and it is not an exaggeration to confuse it with scientific practice itself. In this context, the important epistemological role of Statistics for economic science was highlighted, which ends up generating, in academic terms, undergraduate courses with great quantitative appeal, but little critical. In this subject, it was possible to verify a curious paradox: despite the importance of Statistics in the initial training of economists, its teaching practices are still little discussed in Brazil, especially in postgraduate studies.

The motivation for this article was born from the observation that it is necessary to (re)think statistical teaching, from several aspects, among which resizing the time spent in the classroom with

mathematical operational aspects, aiming efforts towards a critical and politically contextualized approach. In general terms, these are the precepts put forward by Critical Statistical Education (EEC), proposed by Campos (2007).

That said, this work aimed to report a teaching-learning experience in Statistics in an MBA class from an Economics course, in the year 2022. This experience was based on the theoretical perspective guided by the EEC. Thus, we show teaching work developed with - and for - students, based on the problematization of statistical teaching, on working with contextualized real data/facts, on stimulating debate and dialogue, on de-hierarchizing the (virtual) classroom and on promotion of critical capacity and critical knowledge; the pillars of teaching work proposed by EEC.

In this way, through the presentation of a teaching experience in a (virtual) classroom, we have shown that it is possible to combine the theoretical educational precepts from EEC with the reality experienced in a remote Statistics discipline, taught in an MBA Economics course, in which the majority of students were not economists. All of these aspects worked against the pedagogical success of the discipline, especially the fact that it was conducted virtually, due to COVID-19.

However, such obstacles did not prevent the search, in the classroom, for student citizenship training, prioritizing the development of skills that go beyond formal knowledge of statistical content: questioning ability, criticality and reflective stance; aspects consistent with the needs of a society that is increasingly producing and disseminating data.

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