BRAZILIAN COVID-19 DATA ANALYSIS (2020): CRITICS AND CONSIDERATIONS TO DEVELOP ARTIFICIAL INTELLIGENCE MODEL TO HELP ON DECISION-MAKING PROCESS FOR SOCIAL RIGHTS*

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ABSTRACT: This research aims to establish the first step to creating a suitable artificial intelligence model that could help the government decision-making process for Social Rights, considering the COVID-19 pandemic, with information gathered from 2020. Fundamental Rights are strictly connected with COVID-19: from the Individual Rights to the Social Rights. Indeed, this last matter deals with labor policies, social care policies, taxation policies, social security policies, health care policies, among others. Observing the economic scarcity, it is not an easy task to attend to all those Social Rights. This is the reason for developing an artificial intelligence tool: to optimize public spending and provide more rights to the population. To perform this objective, data-mining is essential and some will be pre-labeling during this study. During the journey, it will be analyzed and criticized some of Brazilian COVID-19 data and or methodologies. With this data, a polynomial regression for the independent variables can be created, as a pre-algorithm for the artificial intelligence and to better understand the variability of the data tendencies.

KEYWORDS: Social Rights; Fundamental Rights; COVID-19; Brazil; economics.

I. Introduction

Concerning Fundamental Rights, specifically about the protection of Social Rights, it is worth considering, with some degree of certainty, that abyssal social inequality and social misery are global preoccupations, regardless of the legal-economic model adopted by the State. Whether it is a more theoretical preoccupation or a more effective one, poverty and social misery are not desirable. With this in mind, the protection of Social Rights appears as a movement to oppose abyssal social inequality, into the Welfare State environment.
Brazilian 1988 Constitution is an important document to affirm such rights and guarantee social protection. According to it, the Brazilian State has a role to ensure these positive rights. However, there is a problem: considering also that economic scarcity; considering, the effectiveness and applicability of Fundamental Rights; how can the Brazilian government be more efficient on decision-making process over Social Rights, considering COVID-19 crises?

The purpose of the research is to present some fundaments of Artificial Intelligence (AI) to respond to this question. That is the reason for data-mining independent variables: in future research, an AI could help on the decision-making process in this crisis and similar ones. Considering this research is theoretical and practical, it is divided into proper fields: legal, economic theory and health have a more theoretical approach; statistics and economics have a more practical approach.

* This research is born from a full scholarship Post-Doctoral stage in "New Technologies and Law" at Mediterranea International Centre for Human Rights Research (MICHR), "Mediterranea" University of Reggio Calabria, Italy, as a partial condition to obtain the final certification. Eternal gratitude to MICHR and MICHR's Director, Prof. Dr. Angelo Viglianisi Ferraro, for enabling this research. Eternal gratitude to Prof. Zélia Luiza Pierdoná for every lesson over the last three years and for Wallace Correa de Oliveira Casaca, to the all-new thoughts upon statistics.

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II. Methodology

This research uses an inductive methodology for the statistics thesis formulation. For this, the data collected will be compared with the empirical evident phenomena. Besides, this paper uses deductive methodology with biography review for legal, public health, and economic thesis formulation, which should serve as a parameter for the statistical analysis. The general problem was already presented: how can the Brazilian government be more efficient in the decision-making process over Social Rights, considering the COVID-19 crises?

The statistic problem is: are Brazilian COVID-19 data accurate with the reality, considering well-seen (empiric) reality? Can medical literature and statistics help to establish well-fitting data?

The legal, public health, and economic problems are is the following considering more accurate data results: can government respond with better public policies against COVID-19? Can the government take better economic actions in efforts to maximize Welfare State public policies?

For the statistical analysis, this study intends to observe the following Brazilian data set features: I-COVID-19, considering new cases, deaths, in 2020 (official sources); II-population (deaths and births) from 2015 to 2020 (official sources); III- economy (GDP, taxes, unemployment) from 2015 to 2020 (official sources); IV- social isolation at 2020 (estimative). Those are the independent variables (or the discrete values) with continuous values.

The dependent variables with continuous values are: I- COVID-19 infected people; II-government spends with health care system; III- government spends with other well-fair state related with COVID-19. For those, will be used regression technics.

The dependent variable with classifiable value is: IV- government health and social public policies (curfew, quarantine, capability limitation…) measures that were taken in action. For this, will be used classification technic (labeling).

For the legal and economic analysis, this study intends to compare this data collected, with medical knowledge about COVID-19 and statistics, objecting to refine the data to establish fundaments for a well-fitting model with optimized strategies.

With this, the main objective of this study would be achieved: the first step to creating an artificial intelligence model through supervised learning methodology with the purpose to predict the real quantity of infected people (continuous values) and which public health public policies fits better in that scenario (labels).

III. Fundamental rights and artificial intelligence

It is possible to enunciate that Fundamental Rights [85] are a subjective right, with declaratory and or remedy nature, predicted in a constitutional normative level or equivalent, born from the necessity to protect people against the state (vertical relation), but nowadays applied horizontally for general relations in the society, with the main purpose to guarantee human dignity [86]. With this in mind, it is quite tangible the importance of this group of rights in legal order. Naturally, the same importance goes when artificial intelligence (AI) thematic is over the table. Fundamental Rights can relate to AI on, at least, two fronts.

[85] Human Rights develops a similar attribution if compared with Fundamental Rights. The main difference seems to be Human Rights are established on an international law basis, i.e. treaties and declarations.

[86] In this sense: (MÜLLER, 2000, p. 61-62) (ALEXY, 2008, p. 65) (FERRAJOLI, 2009, p. 19) among several authors.

The first front. Fundamental Rights as a legal (and ethical) guideline for programmers. In this sense, it must be highlighted the general idea of applying Fundamental Rights regularly over society's common relations. It means when programmers are dealing with data e.g., they must preserve intimacy, a Fundamental Right; if they are constructing an algorithm model, every care must be taken to ensure that prejudice or negative discrimination observed in the data do not infect the result. In short, here Fundamental Rights are a part of the developing AI methodology and logistics.

The second front. Now, Fundamental Rights are being quantified as data. How many violations; how much to spend; how many people; those generic questions intend to exemplify how this is being applied so far. As so, Fundamental Rights are an object of AI's purpose. Some premature, obvious, and important, conclusions so far: all programmers of AI must apply Fundamental Rights on its methodology and logistics (even if Fundamental Rights are not the object of the research).

Artificial intelligence is a program. Nothing more than this, despite all the fuzz about this matter. It can be classified into three different groups: GOFAI (HAUGELAND, 1985), machine learning (MITCHELL, 1997), and complete-AI (MONTALVO, 1983). As it is possible to realize, it is not something new, considering it is around since the mid-1980s. However, just recently it became more popular, especially considering machine learning use in big digital companies like Facebook or Google (WEINBERGER, 2021). The consumers' data is collected in these companies' platforms and is used, for instance, for a more appealing directed marketing, enforcing cognitive dissonance.

GOFAI stands for good old fashion artificial intelligence. This is a more traditional programming approach. It can be affirmed as a "kind of" false AI. It is based on "if-and-else" programming. On a tree of choices, each interaction represents a patch that will be followed: "if this" happens, the consequence is "that"; "if something else" happens, the consequence is "that other". This tree of choices is as big as it needs. And precisely for this reason, programming GOFAI is exhausting; any mistake can jeopardize all programming. Also, for very complex interactions, the program file would be massive for some computers to work with.

Machine learning presents itself as a programming tool that analyses statistics, from a given dataset with a programmed algorithm model. The species of machine learning are supervised, unsupervised and semi-supervised. In a supervised machine learning approach[87], the programmer labels data for the AI; it means the programmer sets and labels whose variables are independent (if they are part of the hypothesis question) and whose variables are dependent (if they are part of the hypothesis answer). Unsupervised machine learning, as it is self-evident, the programmer presents a dataset without labeling variables and allowing the AI to establish correlations between each entree, per se. In semi-supervised machine learning, the programmer establishes some labeling.

Finally, complete-AI. Today, there is no complete-AI. This would be a self-aware and self-conscientious machine, the human mind likewise. So far, GOFAI and machine learning "try" to answer the questions of their programmers. Complete-AI, likewise a human being, would be able to ask the questions and "try" to answer them. Nowadays, this is only object of science fiction (like Skynet in the Terminator movies franchise; HAL from Kubrick's 2001; the Architect and the Oracle from the Matrix movies franchise). However, it is quite interesting to project how these "beings" would be seen by society in general. In 2017, Saudi Arabia reckons citizenship for the bot Sophia (GITTLESON, 2017), a machine learning AI-based bot with facial expressions and human interactions

[87] This is the approach proposed in this study.

emulator (HANSON ROBOTICS, 2021). Can this "bein" receive the same Fundamental Rights as a human? The very same debate goes with anthropocentrism vs. biocentrism[88].

It is possible to comprehend that everything is connected with Fundamental Rights, at some level. As a matter of fact, this study is using Fundamental Rights as an ethical standard in its methodology and logistics, and also using Fundamental Rights as the objective of this research, in special, the Social Rights issues connected with COVID-19.

IV. Social rights applicability dilemma and covid-19 chaotic framework for state decision-making

Fundamental Rights were well established since the 18th Century, with liberalism acceptance in societies and states. Individual Rights have roots in liberalism, consisting, basically, in negative behavior from the state, inserted in a minimal state idea. Naturally, this absence of state behavior does not mean total absenteeism, as it is explained in the book The Cost of Right (SUNSTEIN e HOLMES, 1999). Anyhow, just Individual Rights shows some unjustifed discrepancies of treatment in society, considering every persons' access to economics. Mostly because of liberalism failures (DENEEN, 2018), the social doctrine emerges on the mid-ends of the 19th Century, with most acceptances as an equality promoter using regulatory normative. Aristotle mention:

For instance, it is thought that justice is equality, and so it is, though not for everybody but only for those who are equals; and it is thought that inequality is just, for so indeed it is, though not for everybody, but for those who are unequal " (ARISTOTLE, 1932, p. 211)

Social Rights are another species of Fundamental Rights. They begin to be fully accepted in social democratic states, at the beginning of the 20th Century, and on. It is well perceived that Individual Rights, precisely because they are not completely absentee, implies public spends to support them; and the same goes with Social Rights but in some greater proportion. This happens because when the state avokes a particular Fundamental Right for its own Constitution, it is expected this state implements and executes this particular right for the benefit of its people. The problem, thus, is financing all Social Rights. For each Social Right, every public policy generates a large impact on the finances of the state (PIERDONÁ, 2017, p. 164 e ss.) and, considering the scarcity of capital, many times these rights would not be applied. Even Alexy recognizes the complexity of Social Rights implementation, stating that it *is practically impossible to determine what is part of the constitutionally guaranteed existential minimum* (ALEXY, 2008, p. 427).

In Brazil, Social Rights are predicted at the Constitutional level, in article 6 and several others[89]. As mention by Aristotle, social justice is the very purpose of all Social Rights. For this, the solidarity principle is one of the fundaments of the social doctrine in which they emerge. It became even more evident its importance in the COVID-19 era, considering Social Rights regulates labor, health care, social aids, social security among several others, all sensitive matters in normal times, not even mentioning in pandemic times. As pointed by Ferraro, one of the many problems of Social Rights in this pandemic crisis is the limits of the solidarity principle considering the economic scarcity and comprehend how far can the judge goes interpreting it (FERRARO, 2021).

In this sense, COVID-19 deals with a great number of Fundamental Rights. Over Individual Rights, it deals for instance, with limits of freedom of movement, freedom of use or not health equipment, freedom of being subject to medical treatment, just to

[88] For more insights over anthropocentrism debate, consider reading (AVANCI, 2017).

[89] Article 6. Education, health, food, work, housing, transportation, leisure, security, social welfare, protection of motherhood and childhood, and assistance to the destitute, are social rights, as set forth by this Constitution. (BRASIL, 1988)

exemplify some. And over Social Rights, the same kind of debate appear at a different level: preventive health care policies; health care treatments policies; social aid policies; economic and labor policies; tax policies; and it could go on. This is a piece of evidence that decision-making on Social Rights is something quite complex.

To guarantee the achievability of this research, despite all self-evident complexity of COVID-19 and Social Rights, it is been highlighted three points for the discussion about decision-making. First. A strictly legal problem. Are Social Rights *self-executing provisions90* or *non-self-executing provisions*?[91] (COOLEY, 1927) (DODD, 1931) This is a delicate debate for Brazilians. Fundamental Rights, in general, are self-executing provisions. However, the massive cost of all Social Rights and economic scarcity make it unfeasible to self-execute them all at the same time. They must be feasible in the same proportion as economics allows, without letting states' bureaucracy and lack of efficiency be used as a scapegoat for its non-appliance (SEN, 2009, p. 310)[92]. Precisely thinking in a more efficient application of public spending, this research invites to use some of those pre-models to study AI that can analyze implementing Social Rights. That is the reason why this research adopts a regressive methodology.

The second point is up to scarcity itself. An economic and philosophical problem. No one can have everything all the time (HUME, 2004, p. 245). Even using public incomes more efficiently, it is unlikely the economic scarcity disappears. Paraphrasing Dworkin, Sunstein and Holmes say: "*taking rights seriously is taking scarcity seriously*" (SUNSTEIN e HOLMES, 1999, p. 93). Because of this, it is always interesting to revisit the *trolley problem* (FOOT, 1967), so implementing Social Rights would not be something mechanic and not automatic. This kind of problem cannot be resolved in a singularly utilitarian approach: Coase observed this phenomenon in "The Problem of Social Cost", in which he enunciates that, for every problem with reciprocate harm, society will look for the less expensive with mutual benefits answer. Although, he states a particularity in Welfare State:

There can be little doubt that the Welfare State is likely to bring an extension of that immunity from liability for damage, which economists have been in the habit of condemning (although they have tended to assume that this immunity was a sign of too little Government intervention in the economic system). (COASE, 1960)

The social doctrine will not necessarily take the cheaper outcome for some problem. Moreover, this must be considered in the Social Rights execution decision making-process. In this line, Sen enunciates money does not necessarily guarantee equality: *a disabled person may need expensive medical and transport equipment to achieve the same level of welfare* (SEN, 2000, p. 265). This goes directly with COVID-19 matters: how much costs a human life? AI programmers must observe that ethical dilemma during modeling.

In addition to the complex dilemma presented so far, there is a more practical one, the third and final observed point for the Social Rights decision-making process. A methodological problem. COVID-19 deals with a great number of data – big data – and

90 "*A constitutional provision is "self-executing" if the judiciary can enforce the provision without the aid of a legislative enactment*." (BLACK'S LAW DICTIONARY;, 2020); por via transversa, as normas *non-self-executing* dependem de suporte legislativo para constituírem provisão para o ato.

91 *"Non-mandatory provisions do not direct the legislature, impose a duty or obligation, or grant a right.56 These provisions are often statements of public policy, or sentiment. For example, "The people declare that Montana servicemen, servicewomen, and veterans may be given special considerations determined by the legislature" is a statement of public policy. These provisions universally fail the self-execution test. Thus, they have no more than moral force "* (WYATT-SHAW, 1994)

92 This matter is more profoundly analyzed in "Variable effectiveness of social rights and economic tensions" in Teoria Pós Positivista dos Direitos Fundamentais (AVANCI, 2021).

the mining process, as so, labeling process can be difficult per se. So, there is the complexity of the problems evolving Social Rights, here presented, and the data are complex itself. The Cynefin framework could help in this second case, presenting a methodology for the working flow:

The framework sorts the issues facing leaders into five contexts defined by the nature of the relationship between cause and effect. Four of these—simple, complicated, complex, and chaotic—require leaders to diagnose situations and to act in contextually appropriate ways. The fifth—disorder—applies when it is unclear which of the other four contexts is predominant. (SNOWDEN e BOONE, 2007).

On modeling AI, it is mandatory to establish labeling capable of observing the chaoticity or complexity of the dynamics of COVID-19 over society. Therefore, using this framework, AI could start from a neutral point - confused - to identify whether there is another framework that best suits reality and, thus, making possible the transformation to a predictable framework. Using the Cynefin framework proposed methodology, it is expected "*not only make better decisions but also avoid the problems that arise when*" a personal preferred management style causes mistakes (SNOWDEN e BOONE, 2007). This could help to deal with the apparent high entropy presented in the data of this research.

V. Critics and considerations upon COVID-19 data-mining

A. Justifying data set: evaluating the number of deaths data

Preliminarily, the best way to comprehend COVID-19 dissemination and, therefore, planning actions would be by knowing the number of COVID-19 cases. However, it must be observed that there are some major problems with government official data about new infections.

The first problem. The Brazilian Government was not able to buy COVID-19 tests in the early moments of the spread (March/2020). The first related case in Brazilian territory was diagnosed on Feb/26/2020 (BRASIL; MINISTÉRIO DA SAÚDE, s/d). At that moment, testing was very rare in Brazil, considering the global cost (over R$5,000 or about US$1,000 per test) and its scarcity (R7, 2020). From January to June, testing was far from massive and, therefore, it was not possible to conclude how many infected had COVID-19 (UN; WHO; PAHO, 2020).

The second problem. The poor reliability of the tests. There are three types of COVID-19 tests available: PCR/SWAB (molecular test); IgG/IgM/rapid test (antigen test); antibody/blood exam (serology test) (US; CDC, 2020). Molecular test and serology test reveals signs of better accuracy. However, rapid tests reveal low accuracy, considering, most of all, patience's insufficient presence of antigen in the bloodstream. In this sense, researchers concluded for an absence of general accuracy for the COVID-19 tests (SHMERLING, 2020).

The third problem. Asymptomatic infected persons. US CDC estimates that probably 40% are completely asymptomatic, but this number could reach 70%.

The percent of cases that are asymptomatic, i.e. never experience symptoms, remains uncertain. Longitudinal testing of individuals is required to accurately detect the absence of symptoms for the full period of infectiousness. Current peer-reviewed and preprint studies vary widely in follow-up times for re-testing, or do not include re-testing of cases. Additionally, studies vary in the definition of a symptomatic case, which makes it difficult to make direct comparisons between estimates. Furthermore, the percent of cases that are asymptomatic may vary by age, and the age groups reported in studies vary. Given these limitations, the range of estimates for Scenarios 1-4 is wide. The lower bound estimate approximates the lower 95% confidence interval bound estimated from: Byambasuren,

O., Cardona, M., Bell, K., Clark, J., McLaws, M. L., & Glasziou, P. (2020). Estimating the extent of true asymptomatic COVID-19 and its potential for community transmission: systematic review and meta-analysis. Available at SSRN 3586675. The upper bound estimate approximates the upper 95% confidence interval bound estimated from: Poletti, P., Tirani, M., Cereda, D., Trentini, F., Guzzetta, G., Sabatino, G., Marziano, V., Castrofino, A., Grosso, F., Del Castillo, G. and Piccarreta, R. (2020). Probability of symptoms and critical disease after SARS-CoV-2 infection. arXiv preprint arXiv:2006.08471. The best estimate is the midpoint of this range and aligns with estimates from: Oran DP, Topol EJ. Prevalence of Asymptomatic SARS-CoV-2 Infection: A Narrative Review [published online ahead of print, 2020 Jun 3]. Ann Intern Med. 2020; M20-3012. (US; CDC, 2020)

With this in mind, all the official government COVID-19 infected numbers seem to be underestimated. According to the Brazilian database, from Feb/26/2020 (9th epidemiologic week) to 02/Jan/2021 (53rd epidemiologic week), there were 194,949 officially registered COVID-19 causes of death, and 7,675,973 COVID-19 officially registered infected persons (BRASIL; MINISTÉRIO DA SAÚDE, 2020).

However, the Brazilian Transparency Site for Civil Registration (Portal Transparência Registro Civil) reveals 666,444 people died during 2020, with the following causes: COVID-19, indeterminate, others, respiratory insufficiency, pneumonia, septicemic, acute respiratory distress syndrome[93]. All those, according to this official source, could be quite connected with COVID-19 symptomatic (BRASIL; REGISTRO CIVIL, 2021). As a matter of fact, would it be possible to identify which persons died directly or indirectly from COVID-19? Statistics could answer this demand.

The problem goes further. Brazil presents itself as a very accurate civil registration data set. Since the early 2000s, every death and its cause (among other registrations like marriages, births etc.) are settled in a government data set. With this, it would possible to verify the data needed for this study, i.e., deaths caused by ICD-10 Chapter X (diseases of the respiratory system) from 2015 to 202094. Nevertheless, there are some major differences from a data set to another data set.

Table 1: Total of Brazilian deaths according Ministério da Saúde (MS), Portal Transparência Registro Civil (RC) and Instituto Brasileiro de Geografia e Estatística (IBGE) data sets, 2015-2020

	2015	2016	2017	2018	2019	2020
IBGE	1,244,558	1,288,856	1,292,297	1,298,579	1,331,983	n/a
RC	899,771	1,028,259	1,061,880	1,196,641	1,261,723	1,450,781
MS	1,264,175	1,309,774	1,312,663	1,316,719	1,349,802	n/a

source: (BRASIL; MINISTÉRIO DA SAÚDE, 2021) (BRASIL; INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2021) (BRASIL; REGISTRO CIVIL, 2021)

Considering the data from Minstério da Saúde, the average number of total deaths during 2015-2019 is about 1,31mi. Comparing it with Portal Transparência Registro Civil data set, there are profound disparities: this second source, also official, presents completely different numbers, though. From 2015-2019, the average number of total deaths would be 1,119mi. Finally, paralleling with the third data set, from Instituto Brasileiro de Geografia e Estatística IBGE, it reveals the average number of total deaths from 2015-2019 in the order of 1,29mi. It was not found any motif or explanation in these

[93] N.B.: the explanation of those terminologies in notes 14-20.
[94] The selected period would perform as a control reference, for the average purpose.

official sources that could justify this discrepancy in the data (in average, up to 19 thousand reaching 200 thousand per year per data set compared).

Continuing the analysis, now the objective is to identify deaths related with ICD-10 Chapter X. The sources are Ministério da Saúde and Portal Transparência Registro Civil, when available. Instituto Brasileiro de Geografia e Estatística (IBGE) does not have this information.

Table 2: Specific cause of Brazilian deaths Ministério da Saúde (MS) and Portal Transparência Registro Civil (RC) data sets, 2015-2020

	2015	2016	2017	2018	2019		2020	
	PNEUMONIA + SARS	PNEUMONIA + SARS	PNEUMONIA + SARS	PNEUMONIA + SARS	PNEUMONIA + SARS	COVID-19	PNEUMONIA + SARS	COVID-19
RC	n/a	n/a	n/a	n/a	227,955	1	198,764	196,228
MS	104,392	111,716	106,800	107,066	112,311	0	n/a	194,949

source: (BRASIL; MINISTÉRIO DA SAÚDE, 2021) (BRASIL; REGISTRO CIVIL, 2021)

Once again, if confronted with the numbers of those two data sets, huge differences are evident, especially in 2019. For each datum, the following was considered: for Ministério da Saúde numbers, it was used the sum of the ICD-10 J group [95] deaths; for the Registro Civil numbers, it was used the sum of pneumonia, respiratory failure, and SARS registered deaths[96] (probably a less technical approach given by the source). Apparently, for this reason, there is a difference comparing both data sets, even considering it was applied in both the same criteria to identity the causes of death. It is speculative, as far as there is no source that could clarify this. However, the probable reason for this divergence is a double-count of deaths in the case of two or more causes of deaths attributed to the same individual.

The preliminary conclusion is the absence of adequate data for an accurate analysis. However, in a completely speculative scenario, it will be used data set from Portal Transparência Registro Civil to verify the authenticity of the first and second problems described in this title. With this in mind, the number of deaths caused by respiratory diseases did not increase from 2019 to 2020, using singularly this data set:

[95] J06 Acute upper respiratory infections, J09-J18 Influenza and pneumonia, J22 Other acute lower respiratory infections; J39 Other diseases of upper respiratory tract, J80 Other respiratory diseases principally affecting the interstitium, J94 and J96 Other diseases of pleura, J98 Other diseases of the respiratory system

[96] N.B.: the explanation for those terminologies in notes 14-20.

Tabela 3: Causes of death 2019-2020 (Portal Transparência Registro Civil)

CAUSE	2019	2020	RATE 2019-2020
COVID-19 [97] Total	1	196,228	19622700,0%
Indeterminated [98] Total	6,993	9,739	39,3%
Respiratory Failure 99 Total	100,734	99,280	-1,4%
Others 100 Total	661,632	692,838	4,7%
Pneumonia 101 Total	226,451	182,446	-19,4%
Sepsis 102 Total	175,627	163,244	-7,1%
SARS 103 Total	1,498	16,606	1008,5%
Total	1,172,936	1,360,381	16,0%

Source: (BRASIL; REGISTRO CIVIL, 2021)

Despite the substantial increase of SARS cause of death, it can be seen a decrease in pneumonia cases or even in respiratory failure cases. This could indicate the population in general, with the flu vaccine, social distancing, and hygiene care were less susceptible to pneumonia and or other respiratory diseases. In this speculative scenario, it is possible to conclude that problems one and two related to infection numbers (COVID-19 under testing and the poor reliability of the tests) did not affect the results. Nevertheless, the third problem remains, i.e., asymptomatic COVID-19 infected persons.

Actually, the same approach – considering deaths numbers to review infected numbers - is used by Imperial College London's "back-calculate":

To estimate the total number of infections, we use detailed information collated from ongoing epidemics to "back-calculate" from the reported deaths. This includes information on the proportion of infections that require hospitalisation as well as distributions for the time from infection to onset of symptoms (i.e. the incubation period),

[97] According to https://transparencia.registrocivil.org.br/covid/dicionario_covid-19.pdf, COVID-19 stands for confirmed and or unconfirmed cases.

[98] According to https://transparencia.registrocivil.org.br/covid/dicionario_covid-19.pdf, indeterminate cause stands for: abnormalities in heartbeat; non-specific tachycardia; non-specific bradycardia; palpitations; other abnormalities and non-specific heartbeat; murmurs and other heart sounds; benign or innocent heart murmurs; heart murmur ne; other heart sounds; bleeding from the respiratory tract; epistaxis; bleeding from the throat; hemoptysis; hemorrhage from other locations of the down pathways; bleeding from the respiratory tract; cough; breathing abnormalities; dyspnea; stridor; panting; periodic breathing; hyperventilation; mouth breathing; other abnormalities and breathing ne; sore throat and chest; sore throat; chest pain when breathing; precordial pain; another chest pain; chest pain ne; other symptoms and signs related to the device; asphyxiation; pleurisy; respiratory failure; abnormal sputum; other symptoms and signs specified relative; fever of unknown and other origin; persistent fever; another specified fever; fever; headache; non-classified pain; acute pain; intractable chronic pain; another chronic pain; pain; non-classified seizures; febrile seizures; other seizures; non-classified shock; cardiogenic shock; hypovolemic shock; other forms of shock; shock; non-classified hemorrhage; abnormal findings of diagnostic tests; other sudden deaths of unknown cause; instant death; death that occurs less than 24 hours after the start; death without assistance; other ill-defined causes and mortality; death to be clarified; to clarify; undetermined death; indeterminate.

[99] According to https://transparencia.registrocivil.org.br/covid/dicionario_covid-19.pdf, Respiratory Failure stands for acute respiratory failure, associated with heart condition or hypoxemic.

[100] Other stants for every other cause.

[101] According to https://transparencia.registrocivil.org.br/covid/dicionario_covid-19.pdf, Pneumonia stands for any use of pneumonia isolated or associated.

[102] According to https://transparencia.registrocivil.org.br/covid/dicionario_covid-19.pdf, Sepsis stands for bacteremia, any kind of sepsis shock, any kind of infection, and any use of sepsis word

[103] According to https://transparencia.registrocivil.org.br/covid/dicionario_covid-19.pdf, SARS stands for any use of acute respiratory distress syndrome, respiratory infection, acute respiratory failure.

from onset of symptoms to hospitalisation, and from hospitalisation to outcome. A significant proportion of infections are likely to be either completely asymptomatic, or sufficiently mild as to not seek care. From our early analysis of data from China, we estimate this to be approximately 40-50% of all infections. Of those infections that are symptomatic and would seek care, the surveillance underway in each country is likely to pick up a fraction of these. In countries that are testing widely in the community, we would expect this fraction to be much higher than in countries that are focusing testing in hospitals. The difference in the estimated infections and reported cases should be interpreted with this in mind; however, the scale gives a sense of the likely potential for ongoing transmission in the community. (MRC CENTRE FOR GLOBAL INFECTIOUS DISEASE ANALYSIS; IMPERIAL COLLEGE LONDON, 2020)

A final data is interesting, concerning COVID-19 testing. Until Nov/2020, 28.6 million persons were tested, of which 6.5 million positive. The distributions of the testing according to three tests types are: SWAB 12.686 million; antigen 12.430 million; serology 8.015 million (BRASIL; INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2020).

B. Polynomial regression over COVID-19 deaths and infected

Presented the scenario observed in this study, using Ministério da Saúde data set, it is possible to recalculate the number of COVID-19 infected persons in Brazil due 2020. First, it is presented the data from Ministério da Saúde (official numbers - SUS) and the data from BRASIL.IO (unofficial numbers – IO). Next, the chart with this data, using just official numbers. Finally, the correspondent polynomial regression to the deaths and the infected, and its inflections points.

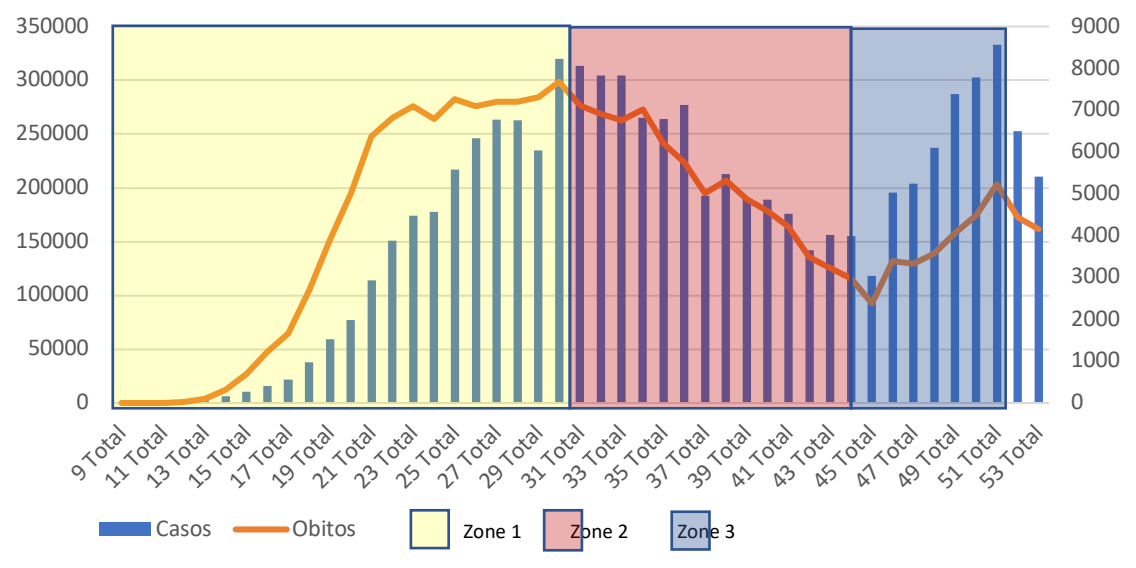
Table 4 COVID-19 New Cases; New Deaths; Brazil (Ministério da Saúde - SUS; Brasil.io – I/O) from 9th week (march/2020) to 53rd week (02/01/2021)

EPID. WEEK	NEW CASES (I/O)	NEW DEATHS (I/O)	NEW CASES (SUS)	NEW DEATHS (SUS)	NEW CASES + 40%. (SUS basis)	NEW CASES + 70% (SUS basis)
9	2	-	2	-	3	3
10	17	-	17	-	24	29
11	117	-	102	-	143	173
12	996	18	1,007	18	1,410	1,712
13	2,821	97	2,775	96	3,885	4,718
14	6,428	330	6,375	318	8,925	10,838
15	10,610	696	10,449	692	14,629	17,763
16	16,184	1,234	15,872	1,223	22,221	26,982
17	22,331	1,699	21,910	1,669	30,674	37,247
18	38,073	2,736	37,887	2,708	53,042	64,408
19	59,669	3,885	59,543	3,903	83,360	101,223
20	77,430	5,007	77,203	5,006	108,084	131,245
21	116,883	6,494	114,256	6,380	159,958	194,235
22	151,352	6,699	151,042	6,821	211,459	256,771
23	173,980	7,159	174,406	7,096	244,168	296,490
24	174,886	6,738	177,668	6,790	248,735	302,036
25	219,558	7,308	217,065	7,256	303,891	369,011
26	247,214	7,059	246,088	7,094	344,523	418,350
27	261,490	7,251	263,337	7,195	368,672	447,673

28	264,272	7,168	262,846	7,204	367,984	446,838
29	233,642	7,292	235,010	7,303	329,014	399,517
30	321,038	7,666	319,653	7,677	447,514	543,410
31	312,999	7,132	313,364	7,114	438,710	532,719
32	306,405	6,980	304,535	6,914	426,349	517,710
33	301,711	6,716	304,684	6,755	426,558	517,963
34	266,478	7,014	265,266	7,018	371,372	450,952
35	263,484	6,192	263,791	6,212	369,307	448,445
36	275,746	5,722	276,847	5,741	387,586	470,640
37	193,155	5,049	192,687	5,007	269,762	327,568
38	212,174	5,285	212,553	5,322	297,574	361,340
39	189,812	4,882	189,751	4,874	265,651	322,577
40	188,017	4,585	188,842	4,581	264,379	321,031
41	175,539	4,209	175,804	4,211	246,126	298,867
42	141,828	3,454	141,725	3,477	198,415	240,933
43	157,999	3,235	156,273	3,228	218,782	265,664
44	153,423	2,981	154,970	2,981	216,958	263,449
45	118,124	2,376	117,956	2,385	165,138	200,525
46	195,502	3,391	195,398	3,389	273,557	332,177
47	204,746	3,349	203,827	3,331	285,358	346,506
48	241,123	3,596	237,486	3,572	332,480	403,726
49	283,259	4,034	286,905	4,067	401,667	487,739
50	304,265	4,523	302,950	4,495	424,130	515,015
51	333,359	5,220	333,028	5,233	466,239	566,148
52	251,400	4,452	252,651	4,439	353,711	429,507
53	249,783	4,921	210,167	4,154	294,234	357,284
Total	7,719,324	195,834	7,675,973	194,949	10,746,362	13,049,154

Sources: (BRASIL.IO, 2021); (BRASIL; MINISTÉRIO DA SAÚDE, 2021)

Graphic 1 COVID-19 deaths and cases (Ministério da Saúde - SUS) from 9th week (march/2020) to 53th week (02/01/2021)



Source: (BRASIL; MINISTÉRIO DA SAÚDE, 2021)

The polynomial regression for COVID-19 cases (BRASIL; MINISTÉRIO DA SAÚDE, 2021) and its correlation coefficient:

$$y = -0.0123x^6 + 1.6136x^5 - 77.742x^4 + 1652.3x^3 - 14769x^2 + 54461x - 57130$$

$$R^2 = 0.9666$$

The differential equation for COVID-19 infection cases results on the following inflection points: 14.6 epidemiologic week; 29.4 epidemiologic week; 38.6 epidemiologic week.

And the polynomial regression for COVID-19 deaths (BRASIL; MINISTÉRIO DA SAÚDE, 2021) and its correlation coefficient:

$$y = -0.0023x^5 + 0.3118x^4 - 14.605x^3 + 269.01x^2 - 1354.4x - 1573.9$$

$R^2 = 0.9674$

The differential equation for COVID-19 deaths results on the following inflection points: 9.6 epidemiologic week; 27.4 epidemiologic week; 44.2 epidemiologic week.

Just from those inflection points, with more precision, it is possible to compare which public policies and population behavior could justify the changes in the tendency of the polynomial equation. Therefore, it is possible to fragment the chart in zones using the local maximum and local minimum points over the data and compare it with the two polynomial regressions inflection points.

Table 5 Ministério da Saúde deaths and infections data (min/max); death rate over the zone; polynomial regressions inflection points

DATE	ZONE'S END	MIN/MAX DEATH-INFECTED (EP WEEK)	INFLEX POINT CASES (EP WEEK)	INFLEX POINT DEATHS (EP WEEK)	DEATH RATE
mar/20		9	14.6	9.6	
jul/20	1	30	29.4	27.4	4,06%
nov/20	2	45	38.6	44.2	2,34%
dez/20	3	51	n/a	n/a	1,62%

Some conclusions so far. First. The difference in IO information (unofficial) compared with the Ministério da Saúde data set (official) is minor, therefore, it is possible to use the official source, despite a minimum margin of difference. Second. Applying the maximum and minimum predicted for asymptomatic cases, 40% to 70%, in the infected data set[104], the Brazilian total of infected persons in 2020 uprises from 7,675,973 to 10,746,362 or even 13,049,154. Third. With the inflection points, it is possible to realize, with more precision, which events could justify winds of changing (for better or for worse) from Apr/4/2020 (rising), from Jul/19/2020 (diminishing), and from Oct/31/2020 (rising).

C. Government countermeasures

Once observed the data so far, it is imperative to reckon some of the government countermeasures. The purpose of this is to understand which measures result more efficiently especially to guarantee social rights. First, the date of each Decree from all Brazilian federative unities. All the first-hand legal measures were imposed very soon when the pandemic reaches Brazil in March/2020.

[104] Scenarios described in the previous topic of this paper, using US CDC suggested numbers (US; CDC, 2020)

Table 6 COVID-19 countermeasures Decrees, by date

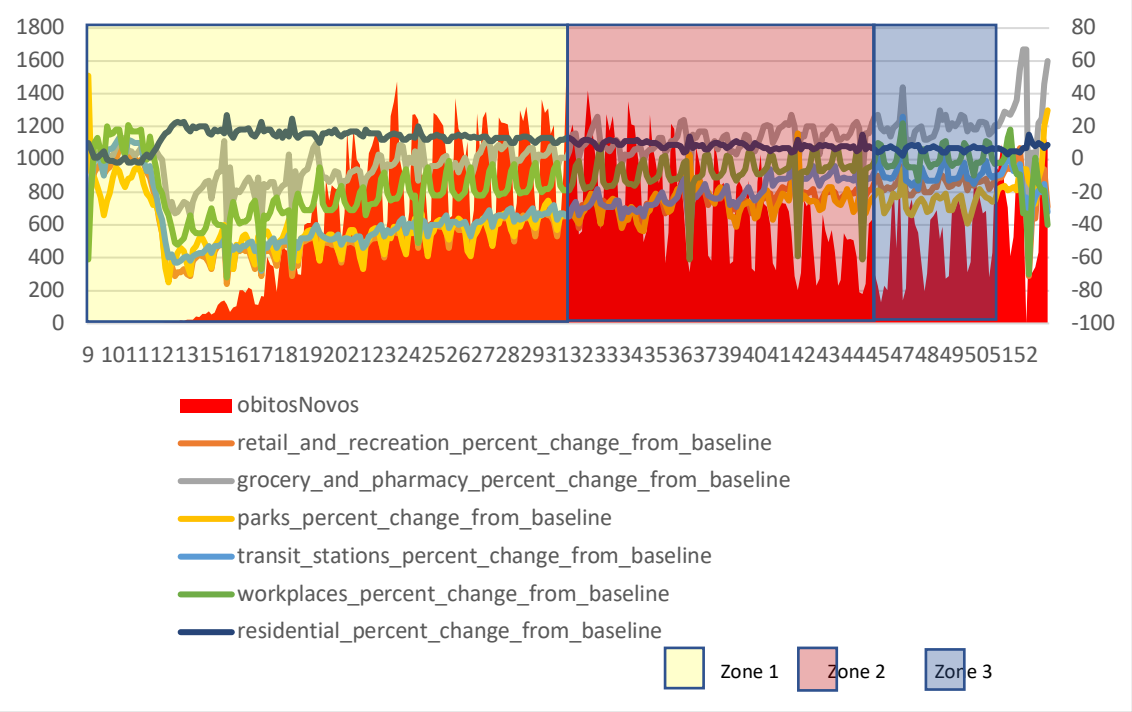
BRAZILIAN FEDERATIVE UNITY	EMERGENCY DECLARED	RETAIL AND SERVICES CLOSED	TRANSPORT RESTRICTED	SCHOOLS CLOSED
AC	20/03/2020	20/03/2020	20/03/2020	20/03/2020
AL	20/03/2020	21/03/2020	19/03/2020	23/03/2020
AM	16/03/2020	23/03/2020	23/03/2020	19/03/2020
AP	20/03/2020	23/03/2020	23/03/2020	17/03/2020
BA	19/03/2020	19/03/2020	20/03/2020	19/03/2020
CE	19/03/2020	19/03/2020	19/03/2020	19/03/2020
DF	28/02/2020	23/03/2020	18/03/2020	11/03/2020
ES	16/03/2020	20/03/2020	23/03/2020	17/03/2020
GO	13/03/2020	24/03/2020	24/03/2020	16/03/2020
MA	19/03/2020	23/03/2020	23/03/2020	17/03/2020
MG	12/03/2020	23/03/2020	23/03/2020	18/03/2020
MS	19/03/2020	19/03/2020	25/03/2020	24/03/2020
MT	23/03/2020	23/03/2020	18/03/2020	23/03/2020
PA	20/03/2020	20/03/2020	23/03/2020	17/03/2020
PB	21/03/2020	21/03/2020	19/03/2020	17/03/2020
PE	21/03/2020	14/03/2020	21/03/2020	18/03/2020
PI	19/03/2020	23/03/2020	23/03/2020	16/03/2020
PR	19/03/2020	23/03/2020	20/03/2020	18/03/2020
RJ	16/03/2020	20/03/2020	13/03/2020	20/03/2020
RN	20/03/2020	21/03/2020	21/03/2020	18/03/2020
RO	20/03/2020	21/03/2020		17/03/2020
RR	23/03/2020	23/03/2020	20/02/2020	20/03/2020
RS	19/03/2020	19/03/2020	20/03/2020	19/03/2020
SC	17/03/2020	18/03/2020	18/03/2020	19/03/2020
SE	16/03/2020	20/03/2020	20/03/2020	16/03/2020
SP	20/03/2020	22/03/2020	22/03/2020	21/03/2020
TO	21/03/2020	21/03/2020	21/03/2020	16/03/2020

Source: (MRC CENTRE FOR GLOBAL INFECTIOUS DISEASE ANALYSIS; IMPERIAL COLLEGE LONDON, 2020)

Even the following data is not an official source, Google did provide an analysis of people's transit through pandemics. For this data, Google uses as a reference the baseline, which consists in "*the median value from the 5-week period Jan 3 – Feb 6, 2020*" of the total of smartphones connected in Google accounts (GOOGLE, 2021). As so, the variation from this median is the numbers that appear in the chart.

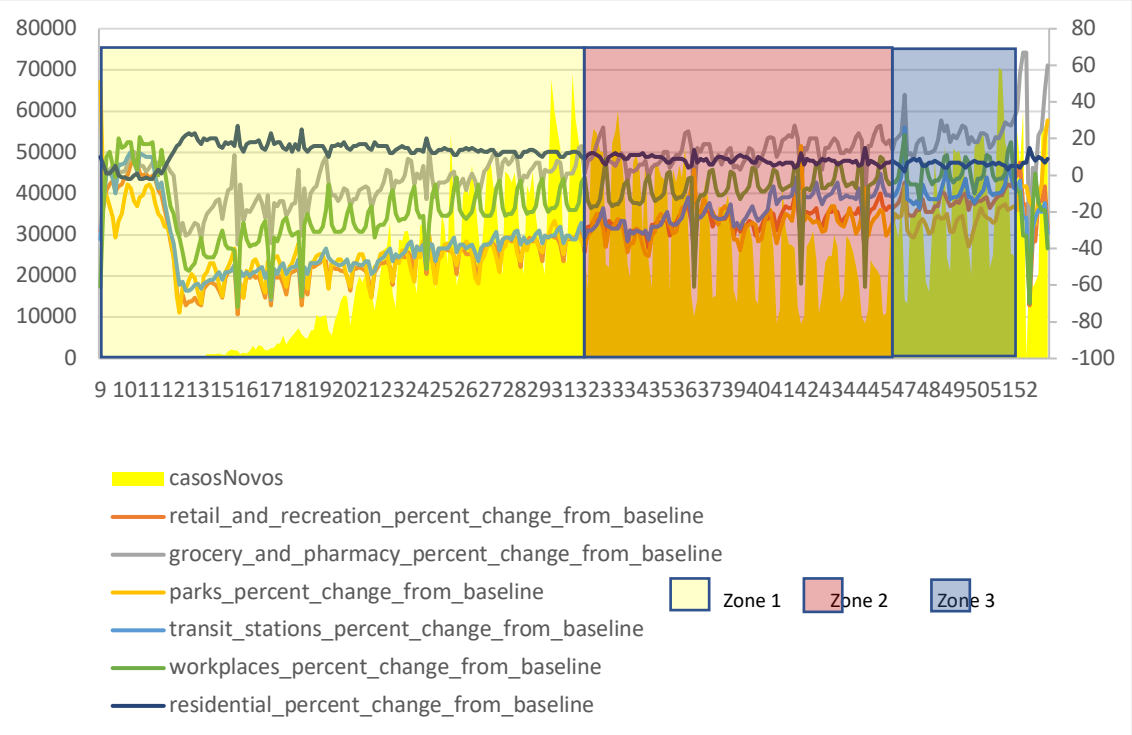
Google also divided into categorized places: grocery and pharmacy, parks, transit stations, workplaces, residential. With this, it is possible to observe into the next two charts how those governments' decree influents over day-to-day activities; the first chart compares to the number of COVID-19 deaths, considering the Ministério da Saúde data; the second one, compared to the number of COVID-19 infected.

Tabela 7 Google Comunity Mobility Report vs. Ministério da Saúde deaths data



Source: (GOOGLE, 2021); (BRASIL; MINISTÉRIO DA SAÚDE, 2020)

Tabela 8 Google Comunity Mobility Report vs. Ministério da Saúde deaths data



It is possible to observe over 12-21 of March/2020 (12th epidemiologic week) the drop of the mobility in general and the increase of home staying. Despite the progressive increase over Mar-Jul/2020, Aug/2020 was the first time home being was inferior to 20% percentage of the baseline. The most significant indicator is on the November 2020 holidays (November 2nd, Day of the Deaths, November 15th, Republic Proclamation, November 20th, Black Awareness Day). Brazilian population, at that time, was

significantly tired of social distancing and lockdowns (for some cities and or for states), and considering the moment of COVID-19 indicators downfall, it results in massive social disobedience of the states and municipalities decrees. The first consequence appear by the end of December, the 51st epidemiologic week, as can be noticed in the charts.

In parallel to the Decrees, the federal, states, municipalities, and federal district of the Brazilian government, all together, increases public spends from US$971 billion in 2019 to US$1.217 billion[105]. This was viable because of the emergency states, which allow approval of extraordinary measures in economics spending, the so-called "war budget". It is a constitutional amendment #106/2020, that establishes a proper regime for finances, public contracts, and taxes, flexing government responsibility for spending. It means most of all, the absence of attributing a financial source for new spending, to simplify public contracts executions and public procurements. As a direct result, it also permits the creation of a new social aid help, a new Keynesian economic support (KEYNES, 1992): the emergency aid intent to reduce poverty and keep a minimum of economics activated, especially for persons submitted to underemployment.

Emergency Aid is a financial benefit granted by the Federal Government to individual workers, individual microentrepreneurs (MEI), self-employed and unemployed, and aims to provide emergency protection during the period of facing the crisis caused by the Coronavirus pandemic - COVID 19. […]Citizens over the age of 18 can apply for the benefit, or mothers under 18, who meet all the following requirements: Those who are unemployed or work on the condition of: - Individual microentrepreneurs (MEI); - Individual Social Security Contributor (Previdência Social); - Informal worker. Those who belong to a family whose monthly income per person does not exceed half minimum wage (R$ 522,50), or whose total family income is up to 3 (three) minimum wages (R$ 3,135.00). […] Who is not entitled to the Aid? Those who have active formal employment; Those who belong to a family with an income greater than three minimum wages (R$ 3,135.00) or whose monthly income per person greater than half the minimum wage (R$ 522.50); Those who get Unemployment Insurance; Those who receive social security benefits, assistance, or benefit of transfer of federal income, with the exception of Bolsa Família; Those who received taxable income above the maximum limit of R$ 28,559.70 in 2018, according to an income tax return. (BRASIL; CAIXA ECONOMICA FEDERAL, 2021)

This financial aid reaches up to 67.9 million Brazilians, paying then, over five months, a total of R$288.7 billion (current Brazilian currency) or US$98.575 billion (2010 currency). For these criteria, Brazilians considered in the poverty line are those who perceive less than half of minimum wage, i.e. R$522.00 or US$173.00, month, values for 2020. The following tables can illustrate the unemployment increase, the public spending increases, the poverty decrease (precisely because of the financial emergency aid). Thus, it can be highlighted the downfall of gross domestic product (GDP) per capita.

[105] All the currency in this study same methodology of World Bank: US$ currency at 2010.

Table 9 Comparative over Brazilian poverty, unemployment, GDP per capita, and public spends

PERIOD	POPUL.	POVERTY	UNEMPLOYMENT	GDP PER CAPITA US$ 2010	PUBLIC SPENDS US$ 2010
2017	207660929	11,20%	13,1%	$11.021,72	$953.512.739.248,87
2018	2084949	11,10%	11,60%	$11.079,71	$968.910.467.794,16
2019	210147125	11%	10,50%	$11.121,74	$971.346.084.532,32
2020	211755692	7%	13,64%	$10.596,93	$1.217.272.868.678,28

Source: (BRASIL; INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2020); (BRASIL; PORTAL TRANSPARÊNCIA, 2021)

Table 10 Comparative over Brazilian unemployment, poverty, federal public spends, and the rate of federal public spends

PERIOD	UNEMPLOYMENT	POVERTY	TOTAL FEDERAL SPENDS US$ 2010	RATE FEDERAL SPENDS
Jan/Mar/2020	12,20%	11%	$115.823.149.798,72	21,17%
Apr/5/2020 - Jul/19/2020	13,30%	5,05%	$125.233.438.776,23	22,89%
Jul/20/2020 - Oct/31/2020	14,60%	4,60%	$192.801.502.074,01	35,24%
Nov/1/2020 - 03/01/2021	14,47%	7,90%	$113.197.022.642,21	20,69%
Total 2020	13,64%	7%	$547.109.824.273,59	100,00%

Source: (BRASIL; INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2020); (BRASIL; PORTAL TRANSPARÊNCIA, 2021)

Table 11 Comparative over Brazilian federal public spends per area.

PERIOD	TOTAL FEDERAL SPENDS US$ 2010	SOCIAL SECURITY	HEALTH	EDUCATION	SOCIAL CARE	LABOR	OTHERS
2017	$437.751.144.359,46	55.06%	9.06%	8.98%	7.33%	6.11%	13.46%
2018	$427.328.272.460,08	54.77%	9.42%	8.32%	7.48%	6.12%	13.90%
2019	$429.111.677.861,86	55.66%	9.50%	7.86%	7.72%	n/a	13.00%
2020	$547.109.824.273,59	43.89%	9.40%	5.50%	26.46%	4.74%	10.02%

Source: (BRASIL; PORTAL TRANSPARÊNCIA, 2021)

Finally, one of the main objectives of this study: how much did it cost? With this information, better decisions are supposed to be taken, to preserve the citizens' life and to spend more efficiently. This study will not be able to go further and establish a correlation coefficient, which is intended to be made in the future. For now, basic arithmetic: GDP loss and total COVID-19 public spends in Brazil. Further than R$789,844,438,170.85 or US$269,687,992,091.26, besides 195 thousand lives.

Table 12 General cost of COVID-19 for Brazil in 2020

PERIOD	NATURE	VALUE US$ 2010
2019	GDP	$ 2.347.237.948.499,32
2020	GDP	$ 2.243.959.478.765,35
2020	GDP losses (2019/2020)	$ 103.278.469.733,97
2020	COVID-19 federal expenses	$ 166.409.522.357,29
2020	Total cost of COVID-19	$ 269.687.992.091,26

Source: (BRASIL; PORTAL TRANSPARÊNCIA, 2021)

VI. Conclusions

This is preliminary research, so the conclusions are also preliminary[106], at least concerning statistic modeling. Concerning the theoretical approach, the conclusions are more evident.

- COVID-19 deals with Fundamental Rights at the Individual Rights level, and the Social Rights level. The second one, it concerns public health, social aid, labor and employment, taxation, and economics.
- Social Rights, as a species of Fundamental Rights, deals with a profound debate over its self-executing provisions nature (or not). Everything points that the Social Rights are self-executing provisions, until the economic limits of the state (observing every measure to optimize public spending).
- Choice over Social Rights cannot be taken lightly. It implies economic aspects, especially scarcity, social cost, and also philosophic aspects, as the evaluation and consequences of the choice.
- For those choices, it is also important to observe that not everything can be reduced to capital issues. There are many others important matters for the Welfare State, for instance, public policies on labor or accessibility, which not necessarily depend on just money to happen.
- For Social Rights and COVID-19 data in general, the Cynefin framework could optimize the line flow, ensuring less entropy.
- Brazil presents itself with a very confused groups of data spread in several and non-centralized datasets. Different official sources present different data for the same matters.
- This confused datasets scenario must be considered in modeling, because the data reveals, i.e., about 80 thousand to 200 thousand in numbers of deaths in general, and over SARS + pneumonia deaths over the last years.
- It would be highly recommended a centralized organ receive and manage all this data.
- Besides this data, COVID-19 also presents some particular difficulties for estimative, considering studies pointing a number from 40% to 70% of non-symptomatic infected persons. This could raise infected persons in Brazil during 2020, from about 7.675 million to 10-to-13 million persons infected, reflecting over COVID-19 dissemination.
- Polynomial regression reveals three period-zones for COVID-19 over Brazil's 2020 year. This allows a better view of the pandemics and their indicators.
- Polynomial regression also reveals inflection points, presenting important dates to be considered as a turning point into the development of the outbreak and the correspondent death rate.
- The countermeasures from the government, limiting social activities, and even establishing curfew could be measured by Google, and it was the probable cause of a complete non-disastrous situation, especially during Period Zone 1, from March to July 2020. Despite this, the death rate was about 4% of officially infected.
- With Google's Mobility Report, it can also be seen how a massive social interaction could result in a collapse of medical care. During Period Zone 3, during November Brazilian's holidays, social interaction escalates and this represents a significant increase in infections on December 20.

[106] It is intended to continue this research with the collaboration of two colleagues: Enir da Silva Fonseca, Ph.D. in Sciences and Mathematics, and Fernando Gonzales Tavares, Ph.D in Sciences and Mathematics.

- In addition to all social distancing decrees, the government also increases public spending by over US$166 billion (2010 currency), dedicating it mostly to health care and social financial aid, both Social Rights.
- Despite the Keynesian measures, Brazilian GDP shrinks more than 4%, over US$103 billion (2010 currency).
- In the year 2020, COVID-19 costs Brazil 195 thousand lives and US$269.7 billion (2010 currency), or R$789.8 billion (Brazilian current currency).

Now the answer for those questions, object of this research (presented on the methodology topic).

- COVID-19 Brazilian data is accurate considering death criteria (the difference observed from official sources to unofficial sources is minimum); however, general data, including the last few years are no accurate and must be observed with attention.
- Medical literature can help statistics, considering predictions over asymptomatic infected persons, so a more accurate model can be developed.
- The government can respond better to COVID-19 if it is well-known how many infected are disseminating the virus and impose more restrictive measures in these critical localities.
- The government can take better economic policies considering the same criteria described on the previous topic.

Finally, the general problematic question is solved: an AI tool could help with the decision-making process over COVID-19 matters. It could: predicting optimized measures on economics; observing and establish perimeters for optimal results, limiting as minimum as it could, restrictions; observing and implementing logistics over health, prevent unnecessary spending; preventing a gargantuan shrink of economics. This is feasible.

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