

## MACHINE LEARNING AND SENTIMENT ANALYSIS TO ASSESS THE EVOLUTION OF THE COVID-19 PANDEMIC AND THE IMPACTS ON TOURISM

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### Abstract

This article aims to analyze how the emotional, mental, and sentimental demands related with hospitality and hostility were developed during the pandemic of the COVID-19 in Brazil. As methodological procedures was applied sequential mixed methods research. Firstly, about 1,000 pieces of news were collected from two Brazilian websites to be able to manually classify them in the feelings of hospitality and hostility. We use a machine learning supervisor analysis following a sentiment analysis technique. Secondly, the data were used for training in eight machine learning algorithms, through supervised analysis, being chosen the logistic regression for the data classification, because it fits better to the data, reaching 72% of accuracy. The data collected in two years of the pandemic, thus approximately 221,000 news were then classified using the chosen algorithm, which allowed the generation of graphics and analysis through inferential statistics, through the evolution of feelings of hospitality and hostility. The results indicate that in situations such as the COVID-19 pandemic, people tend to behave hostilely, which leads to a lack of hospitality. The implications of this study are related to the ability to materialize, through the concepts of hospitality and hostility, the perception of visitors, guests, among other people, involved in the tourism sector. Therefore, the sentiment analysis from social media and news affected the tourism and hospitality industry.

**Keywords:** Artificial Intelligence; Hospitality in Tourism; Hostility in Tourism; Sentiment Analysis.

## APRENDIZADO DE MÁQUINA E ANÁLISE DE SENTIMENTOS PARA AVALIAR A EVOLUÇÃO DA PANDEMIA DE COVID-19 E OS IMPACTOS NO TURISMO

### Resumo

Este artigo tem como objetivo analisar como as demandas emocionais, mentais e sentimentais relacionadas à hospitalidade e hostilidade se desenvolveram durante a pandemia de COVID-19 no Brasil. Procedimentos metodológicos foram aplicados por meio de pesquisa sequencial de métodos mistos. Primeiramente, cerca de 1.000 notícias foram coletadas em dois sites brasileiros para serem classificadas manualmente nos sentimentos de hospitalidade e hostilidade. Foi utilizada uma análise de sentimento supervisionada de aprendizado de máquina. Em segundo lugar, os dados foram usados para o treinamento em oito algoritmos de aprendizado de máquina, por meio de análise supervisionada, sendo escolhida a regressão logística para a classificação dos dados, por se adequar melhor aos dados, alcançando 72% de precisão. Os dados coletados ao longo de dois anos da pandemia, aproximadamente 221.000 notícias, foram então classificados usando o algoritmo escolhido, o que permitiu a geração de gráficos e análises por meio de estatísticas inferenciais, mostrando a evolução dos sentimentos de hospitalidade e hostilidade. Os resultados indicam que em situações como a pandemia de COVID-19, as pessoas tendem a se comportar de maneira hostil, o que leva à falta de hospitalidade. As implicações deste estudo estão relacionadas à capacidade de materializar, por meio dos conceitos de hospitalidade e hostilidade, a percepção de visitantes, hóspedes e outras pessoas envolvidas no setor de turismo. Portanto, a análise de sentimentos provenientes de mídias sociais e notícias afetou a indústria do turismo e da hospitalidade.

**Palavras-chave:** Inteligência Artificial; Hospitalidade no Turismo; Hostilidade no Turismo; Análise de Sentimentos.

## APPRENTISSAGE AUTOMATIQUE ET ANALYSE DE SENTIMENTS POUR ÉVALUER L'ÉVOLUTION DE LA PANDÉMIE DE LA COVID-19 ET SES IMPACTS SUR LE TOURISME

### Resumé

Cet article vise à analyser comment les demandes émotionnelles, mentales et sentimentales liées à l'hospitalité et à l'hostilité se sont développées pendant la pandémie de la COVID-19 au Brésil. Des procédures méthodologiques ont été appliquées à travers une recherche séquentielle à méthodes mixtes. Tout d'abord, environ 1 000 articles ont été collectés sur deux sites web brésiliens pour être classifiés manuellement selon les sentiments d'hospitalité et d'hostilité. Nous avons utilisé une analyse de sentiment supervisée par apprentissage automatique. Ensuite, les données ont été utilisées pour entraîner huit algorithmes d'apprentissage automatique, à travers une analyse supervisée, la régression logistique ayant été choisie pour la classification des données, car elle correspond mieux aux données, atteignant 72% de précision. Les données collectées sur deux ans de pandémie, soit environ 221 000 articles, ont ensuite été classées en utilisant l'algorithme choisi, ce qui a permis de générer des graphiques et des analyses à l'aide de statistiques inférentielles, montrant l'évolution des sentiments d'hospitalité et d'hostilité. Les résultats indiquent que dans des situations telles que la pandémie de la COVID-19, les gens ont tendance à adopter un comportement hostile, ce qui conduit à un manque d'hospitalité. Les implications de cette étude sont liées à la capacité de matérialiser, à travers les concepts d'hospitalité et d'hostilité, la perception des visiteurs, des clients et d'autres personnes impliquées dans le secteur du tourisme. Ainsi, l'analyse de sentiments à partir des médias sociaux et des actualités a affecté l'industrie du tourisme et de l'hospitalité.

**Mots clés:** Intelligence Artificielle; Hospitalité dans le Tourisme; Hostilité dans le Tourisme; Analyse de Sentiments.



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## 1 INTRODUCTION

This study points to relevant issues in the daily life of human beings when dealing with their feelings that sometimes repercussion in aspects of hospitality and hostility (Camargo, 2021). Mendes, Fedrizzi and Sabbag (2022) indicated that hospitality is related to an interactional process of receiving, giving to a guest in order to make them feel welcomed. The authors continue to explain that hostility is a behavior that leads to conflicts, with hospitality dependent on the absence of hostility.

In this context, mental aspects, intangible internal factors are generated through their daily living as thoughts, perceptions, experiences (Ala-Harja et al., 2019; Wu & Cheng, 2020), and satisfaction (Chan et al., 2015). Therefore, the construction of spaces that promote a feeling of hospitality or hostility depends on artifacts, interactions, technology, among other elements (Oliveira et al., 2020; Lugosi, 2021).

This study is relevant because due to the dynamics of the society in the metropolis environment (Camargo, 2021; Mendes, Fedrizzi, & Sabbag, 2022), where the pace of life in these urban places, it is common to commute every day, taking hours to get to work or to educational institutions, or the use of different modes of transport to reach a specific destination, exhausting work routines, or prefer to consume fast food, for example. This context can cause a sensation of hospitality or hostility, as point out Lugosi (2021).

This dynamic interferes with human health and its environment and has recently generated consequences (PAHO, 2022). This dynamic is best evidenced when one observes the times that the World Health Organization – WHO has declared a Public Health Emergency of International Importance, as shown in Table 1 – Public Emergency Crises of International Importance.

**Table 1.** Public Emergency Crises of International Importance.

DATE	CRISIS
April 25 2009	Pandemic H1N1
May 05 2014	The international spread of poliovirus
August 08 2014	Ebola outbreak in West Africa
February 01 2016	Zika virus and increase in cases of microcephaly and other congenital malformations
May 18 2018	Ebola outbreak in the Democratic Republic of Congo

**Source:** Elaborated by the authors using data from Pan American Health Organization – PAHO (2022).

Table 1 – Public Emergency Crises of International Importance shows the many crises in the health sector that have had repercussions in various sectors PAHO (2022). The importance of the analyzes lies on the fact that during or after a public emergency crises the sentiment of animosity influences the intention to visit the place directly and indirectly, through a multidimensional construct formed by various causes, needing an investigation to ameliorate the sentiments of hospitality (AL-Sharuee et al., 2018; Campo & Alvarez, 2019; Luo et al., 2021).

The outbreak of Severe Acute Respiratory Syndrome – SARS – also known as the new Coronavirus, emerged in

the city of Wuhan, Hubei province, People's Republic of China, where the first cases were identified with the symptoms of atypical pneumonia; it was a new type (strain) of the virus, which spread to countries such as the United States, Brazil, South Korea, Spain, France, Italy and Iran (Kaushal & Srivastava, 2021; PAHO, 2022; Summan & Nandi, 2020), for example.

A few months after the first infections by COVID-19 were confirmed, according to data from the World Health Organization – WHO, there were 118 thousand cases in 114 countries with 4,291 deaths (UOL, 2020). In Brazil, due to the high number of deaths, the data on COVID-19 were removed from the government system (BBC News, 2020), which pointed out adverse reasons. Also, during April 2020, the public health system was pressured, with hospitals collapsing, due to overcrowding of Intensive Care Units – ICU (G1, 2020; Turrini et al., 2020).

From this fact, those responsible for the health sector and the authorities began to use different strategies such as blocking communities, social isolation and reducing the movement of people, the suspension of non-essential items sometimes due to the high cost, the search for activities associated with home office and home deliveries (Bartik et al., 2020; Bastos et al., 2021; Casco, 2020; Gursoy & Chi, 2020). In addition, this period also saw exponential growth in the online sales of products and services, thus changing the dynamics of people's lives.

Thus, it is demonstrated that crises and diseases in human beings covering the global environment are becoming increasingly frequent. These issues influence the mobility of people and their way of living and impact organisations' performance and stakeholders' performance, influencing the research in the field of social sciences (Chi et al., 2021). Therefore, the importance of this study is revealed when dealing with issues come to the fore in the field of sciences as the feelings of hospitality and hostility that are part of human nature, generated mainly in environments of uncertainty and crisis response as presented with the Covid-19 pandemic, during approximately two years. Mainly, the emotional demands and the physical and mental components are little researched in the hospitality sector (Li et al., 2020; Pienaar & Willemse, 2008; Pizam, 2020).

This study chose Brazil because it is the largest country in territorial size in Latin America, with about 214,407,347 inhabitants (IBGE, 2022) and has social complexities and disparities, regional and ethnic differences.

The hospitality and tourism sector are also considered to be vulnerable to times of crisis, such as earthquake attacks and natural disasters (Shapoval et al., 2021). During the pandemic crises almost half of direct employment in the hospitality industry disappeared almost overnight, causing a profound impact in the global economy raising the future uncertainty (Hugo, 2021). Thus, workers in this sector are also in this situation. By working on the core concepts of this research, it is understood that:

- Feelings of hospitality: they have the potential to analyse everyday practices of interaction in a variety of settings, which in turn presents the possibility of welcoming others at different levels, e.g., state and institutional (Lashley & Morrison, 2003; Lynch et al., 2011).

- Feelings of hostility: In the sphere of feelings, it comes to be known through negative issues and psychological disturbances reflected in daily attitudes (Ram, 2018).

Thus, based on what was discussed by Lashley and Morrison (2003), Lynch et al. (2011) and Ram (2018), this article aims to analyze how the emotional, mental, and sentimental demands related with hospitality and hostility were developed during the pandemic of the COVID-19 in Brazil. In this way, this study is justified by understanding that from the dissemination of the COVID-19 virus, it was observed that the practices in the daily life of society have changed. Thus, different perspectives are considered in the life of the human being.

## 2 THEORETICAL REVIEW

### 2.1 In the hospitality sector, in times of crisis and the COVID-19 pandemic

Sometimes traditionally centered on the offer of accommodation, food and beverages and entertainment, the context of hospitality has been advancing in its theorizations. Thus, when effecting a critical reflection of the progress of the journal *Hospitality & Society*, themes are identified in the form of conceptual contributions, which are divided into aspects of hospitality and hostility (Lynch et al., 2021), as pointed out in Table 2 – Conceptual contributions in the context of hospitality and hostility.

**Table 2.** Conceptual Contributions in the Context of Hospitality And Hostility.

HOSPITALITY	HOSTILITY
Migration and work	Hostility, violence and exploitation
Lifestyle	Hostily behaviour
Social hospitality	Unfriendliness or opposition
Hospitality, consumption, global citizenship, and ethics	Enmity showing itself in attacks or aggression
Hospitality careers and higher education	Antipathy
Historical studies	Aversion
Image and identity	
Space, design and food	
Hotel management and neo-liberalism	
Hospitality and technology	

Source: Table prepared by the authors based on Lynch et al. (2021).

Given the arguments demonstrated utilizing Chart 2 – Conceptual contributions in hospitality and hostility, insights emerge, and themes explored in studies in this field are pointed out. Thus, demonstrating a consolidation of studies in the context of hospitality, however, points out a vast field in hostility to be explored.

Within this context, presenting issues pertinent to organisations, one verifies that in the face of different lenses in the environment, companies have in their logic of supplying products and rendering services, determining factors associated with return on investment and profit. In this perspective, the problem exists when the company's sole

objective becomes the financial aspects.

Sometimes, this reality also occurs in organisations operating in the hospitality sector, which in its different facets also aim at economic aspects, for example:

- Hotels – on aspects related to the average daily rate, occupancy rate, revenue per available room;
- Restaurants – on the number of dishes sold and the prices charged;
- Travel Agencies and Tour Operators – Sale of travel packages for people who wish to travel for business or pleasure;
- In the health sector, the clinics – number of patients seen, amounts charged and received for assessment and rehabilitation.

This article was written during the COVID-19 pandemic, where the spread of this virus caused reflections in organisations; in this context, sometimes different situations are observed, for example, when considering the city/region or country that the person was, the number of daily deaths caused from infections and the level of transmission of the disease (Hur & Kim, 2020).

In hospitality or hostility, studies on the impact of pandemics come to be presented in distinct localities such as China (Kartari et al., 2021, Wang et al., 2021), the United States, Israel and Sweden (Shapoval et al., 2021). Nevertheless, it becomes interesting to note that the pandemic of COVID-19 has presented reflections in distinct fields of society, such as in people's food and household consumption patterns (Kartari et al., 2021).

In the area of economy and business, it has been observed that differences in the sphere of competitiveness of organisations have become more pronounced. These insights have also been demonstrated in the travel and hospitality sector, such as hotels and restaurants (Bartik et al., 2020; Gursoy & Chi, 2020; UNWTO, 2020), which deal with mobility, the art of gastronomy and hosting people.

Based on this context of services and interactions, the tourism/hospitality industry represents a job opportunity for people around the world, e.g., cruises, hotels, airlines and so on, which demands crew people, restaurants employees, and other job opportunities around the world (Casales-Garcia et al., 2021). However, during the last years tourism has gaining importance in the infrastructure of many countries, playing a major role in the development, which become a challenge with some financial constraints faced by the countries, mainly during the pandemic crises (Azmaiparashvili, 2021; Baranova et al., 2023). Regardless of the crises situation, Pillail (2021) affirmed that these crises also opened a series of opportunities and challenges for the tourism industry and countries which are dependent, because a lot of restrictions and control are raised to prevent the spread of pandemic crises.

According to their body mass index, age, and educational level, people had different food consumption patterns during the period when communities were blocked (Kartari et al., 2021). In addition, hospitality organisations have been used for other purposes in different parts of the world, affecting the destinations risks facts, but also aiding to improve the image of this industry, when, for example, a hotel donates their dependences to assist a group of people affected by Covid-19 (Sarıışık et al., 2021).

Thus, this study proposes H1: Based on the analysis of the news from the G1 and UOL communication channels and the notes of Ekinci et al. (2022), the population's feelings have changed during the research.

On June 23, 2020, it was noted that countless hotels closed due to low occupancy and security concerns. However, others used their facilities to accommodate doctors and nurses, and other professionals who were directly fighting the COVID-19 virus (CNN Travel, 2020).

For example, the Four Seasons New York developed partnerships to serve professionals from the New York State Nurses Association, and already the Midtown Manhattan building made 225 rooms available to serve these people; the Wyndham Hotel also served workers who were on the front line against this virus (CNN Travel, 2020). In Pennsylvania and New York accommodation facilities, this reality was observed. However, the organisations implemented various protocols to cater for healthcare professionals, including a single point of entry where each person's temperature was checked (CNN Travel, 2020).

Thus, it is observed that means were developed to ensure the safety of all stakeholders involved in this process, such as guests, suppliers of inputs to the means of accommodation and people who work in hotels. This reality has also occurred in other places worldwide, but it is also necessary to consider the existing barriers. For instance, where the activity's stakeholders want to help but at the same time have apprehension of being contaminated by the virus.

## 2.2 Sentiments of Hospitality and Hostility

This reality began to change when more effective measures were demonstrated to combat the consequences of infections of this virus in humans and the emergence of vaccines with proven effectiveness against its dissemination. In this context, in New York City, by March 27, 2021, about 30% of adults in the city have received at least one dose of the COVID-19 vaccine; however, when considering neighbourhoods, one verifies disparities in vaccination rates between regions of the city (The New York Times, 2021). Thus, it demonstrates insights associated with differences in access to the health sector within a city.

Due to the advance in vaccination and the return of activities in the tourism sector, hotel chains found new ways to operate in Asia. For instance, Radisson Hotel Group and Bensley Studio started to invest in domestic tourism. They observed that this new market was a highly profitable business (CNN Business, 2021), a business with the potential to serve the means of accommodation of these brands. This shows that the tourism and hospitality sector can recover from population vaccination (Ekinci et al., 2022).

Thus, this study proposes that H2: Given the analysis of the news of the communication channels researched, G1 and UOL, human interactions, as proposed by Lashley and Morrison (2003) and Lynch et al. (2011), come to develop positively from the vaccination of the population.

On January 31 2022, the number of cases of COVID-19 infection in the United States was found to be increasing again due to mutations of the virus (The New York Times, 2022). In addition, the Omicron variant is more infectious than the other existing strains of the virus.

These listed issues are sometimes focused on the business environment, which causes positive (hospitable) and negative (hostile) feelings. However, this provides researchers with numerous insights, which make a difference in daily relationships and have repercussions on external aspects in a tangible way through attitudes, gestures, acts of hospitality or hostility.

Sometimes these interferes with people involving the consumption of food and drinks (Ala-Harja et al., 2019), or the work environment in organisations. Nevertheless, when considering external factors such as service quality, it is established that it interferes with mental factors such as emotions (Ladhari, 2009).

When delving into the research carried out by Kartari et al. (2021), these questions point to aspects involving people's feelings and perceptions of different aspects of life, such as physical activity, fruit and legume consumption, healthy eating habits and perception of life.

Man's internal and external aspects influence his daily life, directly and indirectly. The external factors involve the environment, the consumption of products and services, social ties, and business. This article considers the internal issues, the aspects involving mentality, thoughts, and emotions, which, in turn, have repercussions in the form of feelings, perceptions and experiences.

The important thing is to understand that the compound of this comes to reflect in the daily life of society and organisations. Thus, the literature on feelings about hospitality and hostility multiplies when considering different perspectives, for example, the interrelation of these issues with tourism (Chan et al., 2015, Wu & Cheng, 2020).

Through this context, it is found that forced isolation to avoid COVID-19 contamination causes multifaceted effects, such as functional, emotional, and social loss, which ultimately drive experiential consumption (Lu et al., 2022). Thus, it is postulated that mental aspects and behaviour are directly related (Ladhari, 2009). In this way, it is observed that in the United States and other places of the world, among the compensatory consequences of isolation, there is a solid need to travel and consume products and services in the hospitality sector (Lu et al., 2022).

What is essential to understand is that this reality has reached distinct dimensions in society (Shapoval et al., 2021). The COVID-19 virus is highly contagious and can cause psychological aspects associated with depression and anxiety in different age groups (Wang et al., 2021). Furthermore, because it is a crisis in the health sector, the pandemic may cause unwanted and unexpected aspects in people, such as feelings of uncertainty and disbelief (Bastos et al., 2021).

Thus, this study proposes that H3: amidst the spread of the COVID-19 virus, relationships develop negative feelings and hostility, as Ram (2018) considered.

## 3 METHODOLOGY

The study was developed through a sequential mixed-methods study, beginning with a qualitative analysis, followed by qualitative research using machine learning and natural language analysis and a descriptive analysis using descriptive and inferential statistics, mainly because the

interest in big data and machine learning techniques are increasing in hospitality sector (Alfrjani et al., 2019; Amroun et al., 2022; Creswell & Clark, 2013, Zhang et al., 2020).

In the first phase, through a content analysis, the data were classified into feelings of hospitality and hostility. Then, the concepts obtained from the theoretical referential took the researchers to access the communication channels G1 and UOL and catalogue the news separated by day and time. Soon afterwards, to accomplish the analysis of this investigation through software.

It was searched to separate in a file about 1200 news, which served to be classified through the use of natural language analysis, employing eight algorithms of supervised classification: Support Vector Machine, Logistics Regression, Random Forests, Decision Tree, Gradient Boosting, KNN, Neural Network and Adaboost, in order to decide which was more adherent to the data (Hu et al., 2020; Jordan & Mitchell, 2015; Kubat, 2017; Kuncheva, 2014; Marsland, 2015).

It is worth noting that after training, the randomly selected news items were deleted from the original file, serving only for the classification regarding the feelings of hospitality and hostility and for training the algorithms through linguistics (tabilising language) and sentiment analysis (Ali et al., 2021; Bhowmik et al., 2022; Kiyavitskaya et al., 2009; Lashley & Morrison, 2003; Lynch et al., 2011; Ram, 2018, Tao et al., 2022).

In the third phase, the collected data were classified utilising the algorithm that presented the most outstanding adherence to the data. Then, tableau software could analyse it to generate graphs and apply inferential statistics, culminating in the data analysis presented in the next section.

Among the reasons for the choice of the communication channels, G1 and UOL refer to the fact that these communication channels have exhaustive visualisation and credibility in Brazil. This can be evidenced when it is verified that G1 is a news portal belonging to Globo Group. Its vehicles have structures to receive and process positive and negative information (G1, 2022). To demonstrate the relevance of this organisation, it is revealed that the Globo Group was elected as the dominant producer of digital content by the iBest Award (G1, 2021), where part of the votes in each category is held by popular vote.

UOL is the largest company of technology, content, services and means of payment, i.e., Internet products, and receives more than 114 million visitors per month (UOL, 2021). This site presents features for people such as technical assistance and digital security; chat channels; online courses and payments; e-mail and access to games; for companies, there is the availability of ads in this vehicle of communication; creation of websites and online shop; tips for business and credit card machines; in addition to applications and news (UOL, 2022).

The use of new technologies and the Internet involves multiple facets. This activity is observed through the increase of competitiveness and visibility, the improvement of local cooperation and the reduction of costs; thus, this activity is considered strategic (Buhalis, 2000) for the stakeholders existing in the locality, such as people and organisations, by balancing interests and distributing information to society.

## 4 RESULTS ANALYSIS

### 4.1 Locus and Object of study

For data analysis, data was first collected for the training of the machine learning algorithms, which are demonstrated by employing Table 3 – Data for training:

**Table 3.** Training data.

Sentiment	Encoding	Number of Examples
Hostility	1	920
Hospitality	0	681

**Source:** Prepared by the authors based on data from G1 and UOL (2021).

Based on Table 3 – Data for training, it is observed that 1601 news were collected from websites related to the Covid-19 pandemic, being later classified manually by a human supervisor; after this work, classified the news in Hostility: 920 and Hospitality 681.

The data were then tabulated and submitted for evaluation using the Python 3.7.6 software, in an Intel Core i5 computer, with 4Gb of memory to evaluate the performance of 8 supervised learning algorithms with the obtained data.

To this end, a python script was developed through the Jupyter Notebook platform, using the Spacy natural language analysis library, by lemmatising words, eliminating stopwords and creating a bow of words in Portuguese, which allowed the submission of data to the algorithms as mentioned earlier, as shown in Table 4 – Algorithms used for the evaluation of training data with the respective evaluation measures.

**Table 4.** Algorithms used for the evaluation of the training data with the respective evaluation measures.

Name	Accuracy	Precision	Recall	f1 Score
Support Vector Machine	0.618405	0.668162	0.672826	0.669343
Logistics Regression	0.653377	0.683827	0.740217	0.709971
Random Forests	0.647760	0.647478	0.853261	0.735665
Decision Trees	0.584635	0.627147	0.677174	0.650617
Gradient Boosting	0.625256	0.622241	0.884783	0.730419
KNN	0.570307	0.634965	0.606522	0.617433
Neural Network	0.625908	0.672256	0.681522	0.676061
AdaBoost	0.572209	0.619611	0.678261	0.636268

**Source:** Elaborated by the authors from research data (2021).

Table 4 – Algorithms used to evaluate the training data with their respective evaluation measures demonstrates the cross-analysis data of the machine learning algorithms' performance in order to allow the choice of the one that obtained the best indexes according to the demonstrated measures (Accuracy, Precision, Recall and f1 Score).

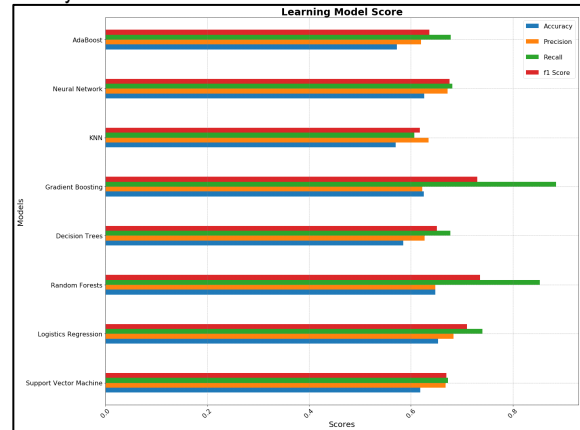
They demonstrate that the algorithm with the best performance if considering the four criteria is the linear regression, which was chosen for the generation of the model (pipe) for the data classification.

To better exposition, the data obtained in the research, Figure 1 – Performance of the machine learning algorithms with the training data by cross-validation was elaborated.

Figure 1 – Performance of machine learning algorithms with the training data by cross-validation demonstrates the learning curves of the eight algorithms to which the training data was subjected.

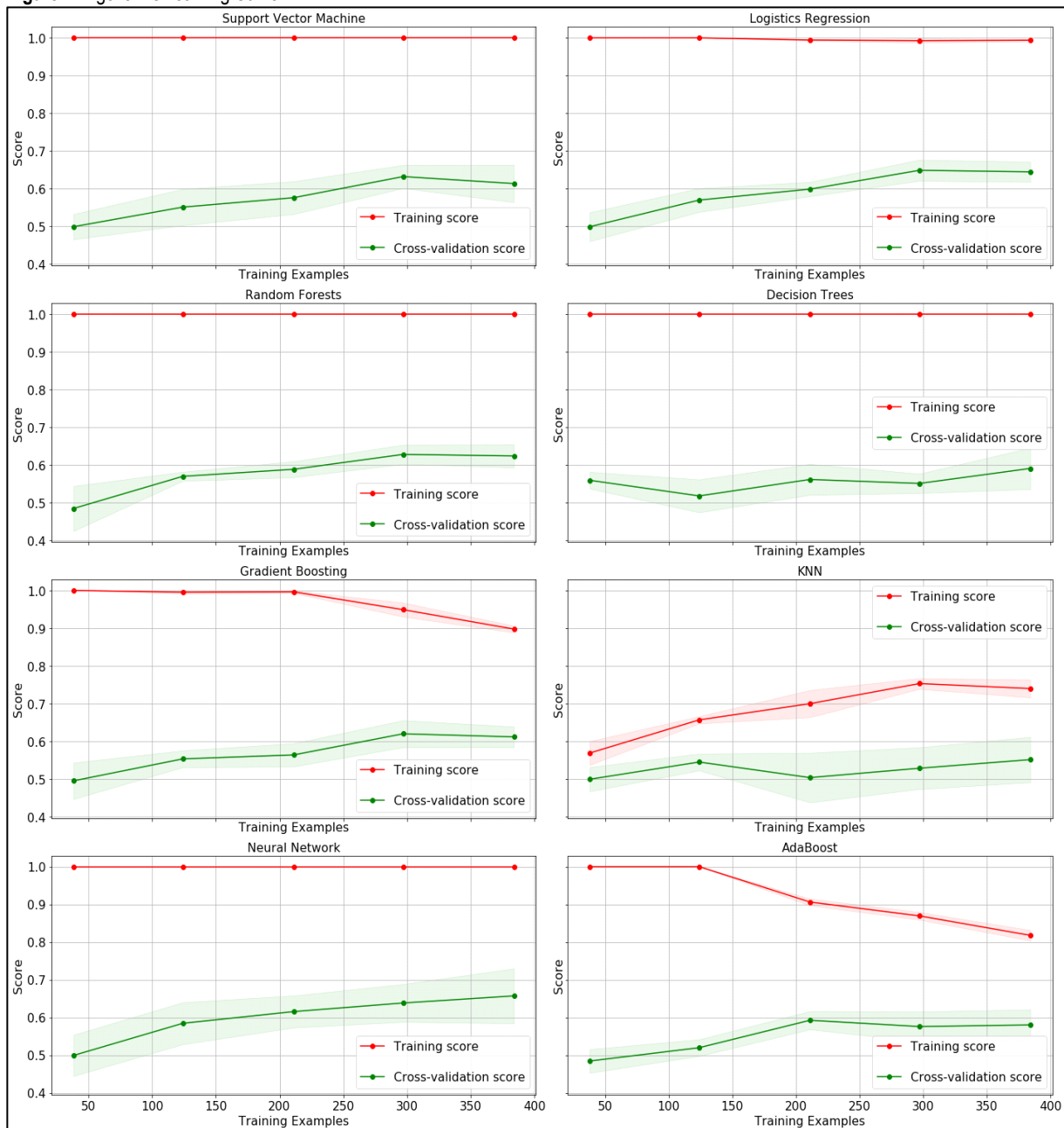
On the other hand, Figure 2 – Algorithm Learning Curve presents data used for training and validation of the software's research.

**Figure 1.** Performance of machine learning algorithms with training data by cross-validation.



**Source:** Elaborated with research data (2021).

**Figure 2.** Algorithms Learning Curve.



**Source:** Elaborated with research data (2021).

Through Figure 2 – Algorithm Learning Curve, it can be observed that the learning curve of the algorithm “Support Vector Machine”, regarding the training data, there is a constancy during the epochs. However, in the cross-validation process, the algorithm has a hit rate of 0.5, reaching a rate of 0.6 after 300 training examples, reaching a maximum of around 400 examples.

The logistic regression algorithm has an identical behaviour during the training process; however, during the cross-validation process, there is a slight difference starting from example 300, reaching its maximum value around 400 examples. The “Random Forest” algorithm has identical behaviour to the previous ones during training; however, during the cross-validation process, it reaches its peak during 210 examples, suffering a slight decrease after that, indicating that maybe fewer training examples bring a better result.

As far as the decision trees algorithm is concerned, the training has a behaviour similar to the previous ones, suffering a peak after 300 training examples and estabilizing after that, indicating that fewer training examples are necessary for the algorithm to perform better. As to the “Gradient Boosting” algorithm, the curve shows a decrease of around 210 examples during data training. The learning process goes through a growth process during the cross-validation process until it reaches its peak around epoch number 299.

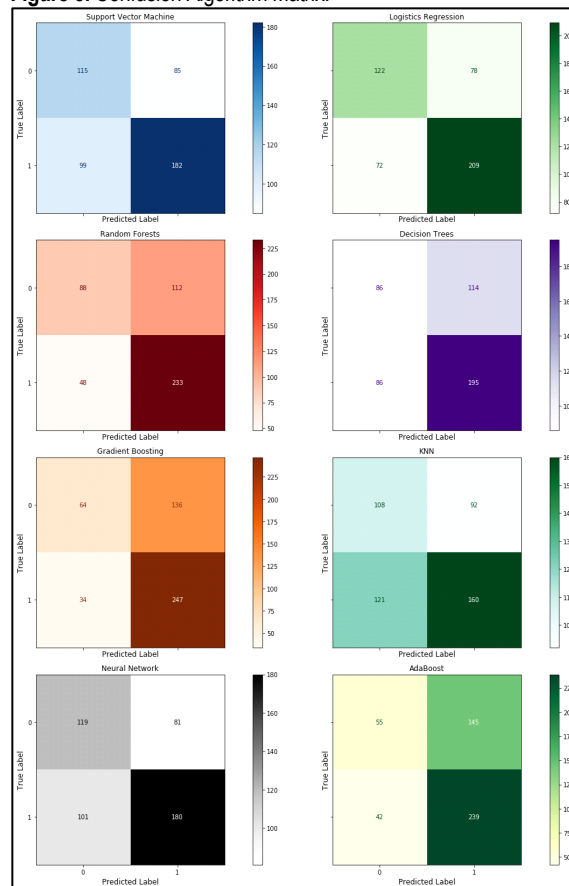
Regarding the “KNN” algorithm, during a specific rate of training examples, the learning reaches a rate of 0.7 in the beginning, suffering small increases during the passing of epochs, suffering a slight increase until reaching the peak around the number 400 training examples. The “Neural Network” algorithm, in its turn, has a behaviour during the training phase very similar to what was experienced by the initial algorithms, remaining stable during the training phase, besides having a very similar behaviour during cross-validation, starting with a learning rate of 0.5, reaching its peak around epoch number 400.

Finally, the “Adaboost” algorithm has a decreasing rate during the training period, reaching its minimum around the epoch number 400. The cross-validation starts with a rate of 0.5, keeping this way until epoch number 150, suffering a slight increase from then on until reaching its maximum around epoch number 400.

Figure 3— shows the confusion matrices, referring to the eight algorithms through which the training data were submitted. Based on the confusion matrix of the algorithm “Support Vector Machine”, it is observed that in the category “0”, the algorithm got 115 classifications right against 85 misclassifications. Regarding class 1, the algorithm classified 182 cases correctly against 99 misclassifications, indicating a greater predisposition to classify class 1 correctly.

The “Logistic Regression” algorithm correctly classified 122 answers in class 0 against 78 incorrectly classified. Concerning class 1, the algorithm classified 209 answers correctly against 72 incorrectly classified, maintaining the predisposition to classify the cases referring to class 1 correctly. Regarding the “Random Forest” algorithm, concerning class 0, the algorithm classified only 88 cases correctly against 112 classified correctly. Concerning class 1, the algorithm classified 247 cases correctly against only 34 classified incorrectly, further amplifying the tendency to classify correctly in class 1.

Figure 3. Confusion Algorithm Matrix.



Source: Elaborated with research data (2021).

Continuously, regarding the algorithm “Decision Tree”, there was a classification of 86 cases classified correctly against 114 classified incorrectly in class 0. In class 1, 160 cases were classified correctly against 120 classified incorrectly, concerning the “Gradient Boosting” algorithm, a hit rate of 64 against 136 in class 0. However, in class 1, there was a hit rate of 247 against 34 misclassified. The “KN” algorithm showed a hit rate of 108 against 92 in class 0 and 160 against 121 in class 1. The classification using the “Neural Networks” algorithm showed the following hit rates for classes: 0 => 119 and 1 => 180, against: 0 => 81 and 1 = 101 misclassifications. Finally, the “Adaboost” algorithm presented the following hit rates for the referred classes: 0=> 55 and 1=> 239, against 0=145 and 1=42, wrong classifications.

Based on the analysis of the figures, the algorithm automatically chose to perform the classification using the “Logistic Regression” algorithm, whose results are discussed in the next chapter.

#### 4.2 Discussion of the Data

When considering the news analysis in the communication vehicles UOL and G1 in 2019, 2020 and 2021, it was observed that 227,120 news were listed; these were catalogued, inserted into tables and performed the analysis employing software. These data generated multiple insights about the object of the study.

For example, in 2019, no news about COVID-19 was

registered in the communication vehicle UOL. However, in the G1 channel, three news items were registered; the period and subject dealt with are shown below. These data are exposed in Table 5— News about COVID-19 in the G1 communication vehicle in 2019.

**Table 5.** News About Covid-19.

DATE	THEME
March 25 2019	The importance of vaccination and protecting pets from diseases
June 10 2019	Diseases that Coronavirus can cause, such as Severe Acute Respiratory Syndrome
October 24 2019	Ebola outbreak in West Africa

Source: The G1 Media Outlet I (2019).

Facing Table 5- News about COVID-19 in the G1 media vehicle in 2019 demonstrates the date and topic of news associated with COVID-19. It is observed that only three news items were identified, even though infections in humans began in December 2019. Probably this is due to the

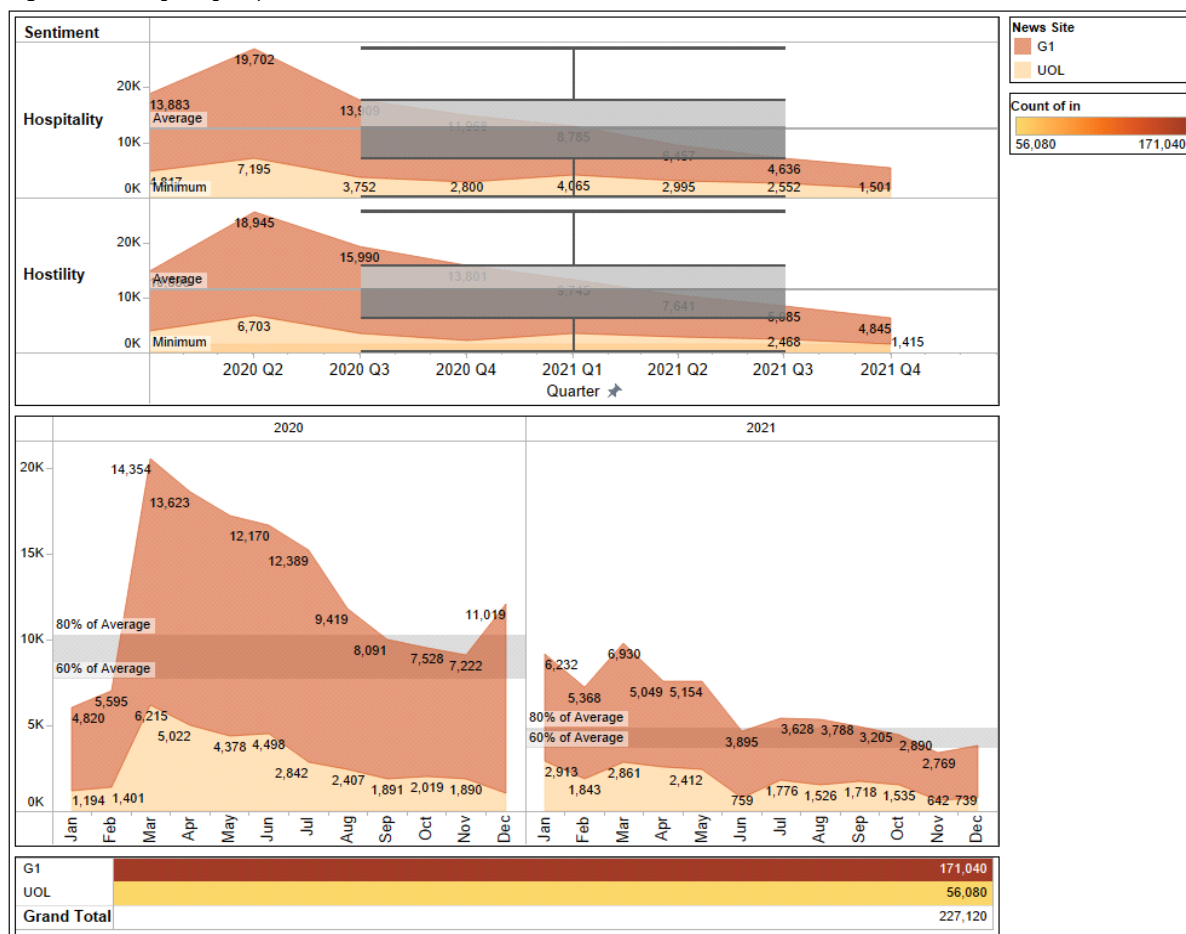
uncertainty at the time of what would be causing a particular disease.

There were positive news and informative and preventive aspects of this virus in dogs, cats, and people — for example, the importance of protection and vaccination of pets to avoid diseases. Alternatively, the diseases caused by the Coronavirus. Nevertheless, nothing was located dealing with serious diseases, people hospitalised, and deaths caused by coronavirus infection.

In December 2019, thanks to the academic community's efforts, it was possible to observe in the field of health the genetic sequencing of the Coronavirus through a partnership between researchers from the University of São Paulo— USP / Instituto Adolfo Lutz and Oxford University. The first tests capable of identifying contamination by this virus also emerged.

However, this scenario changed radically when it was discovered that this virus was causing illnesses in the population; thus, the number of news stories about Coronavirus and COVID-19 increased dramatically, as shown in figure 4.

**Figure 4.** News regarding the pandemic in the news sites researched.



Source: Elaborated with research data (2021).

In this context, it is also verified, as in the year 2020, in 2021, the number of posts made by the communication channel G1 was much higher than on UOL, possibly because one year had already passed since the coronavirus pandemic was declared.

Having trained the algorithm using the training data manually classified by a supervisor, we then proceeded to the data classification made from a spreadsheet containing data on news portals from January 01, 2020, to October 31, 2021, totalling 227,120 news items about Covid-19.

These data were then classified from the trained model



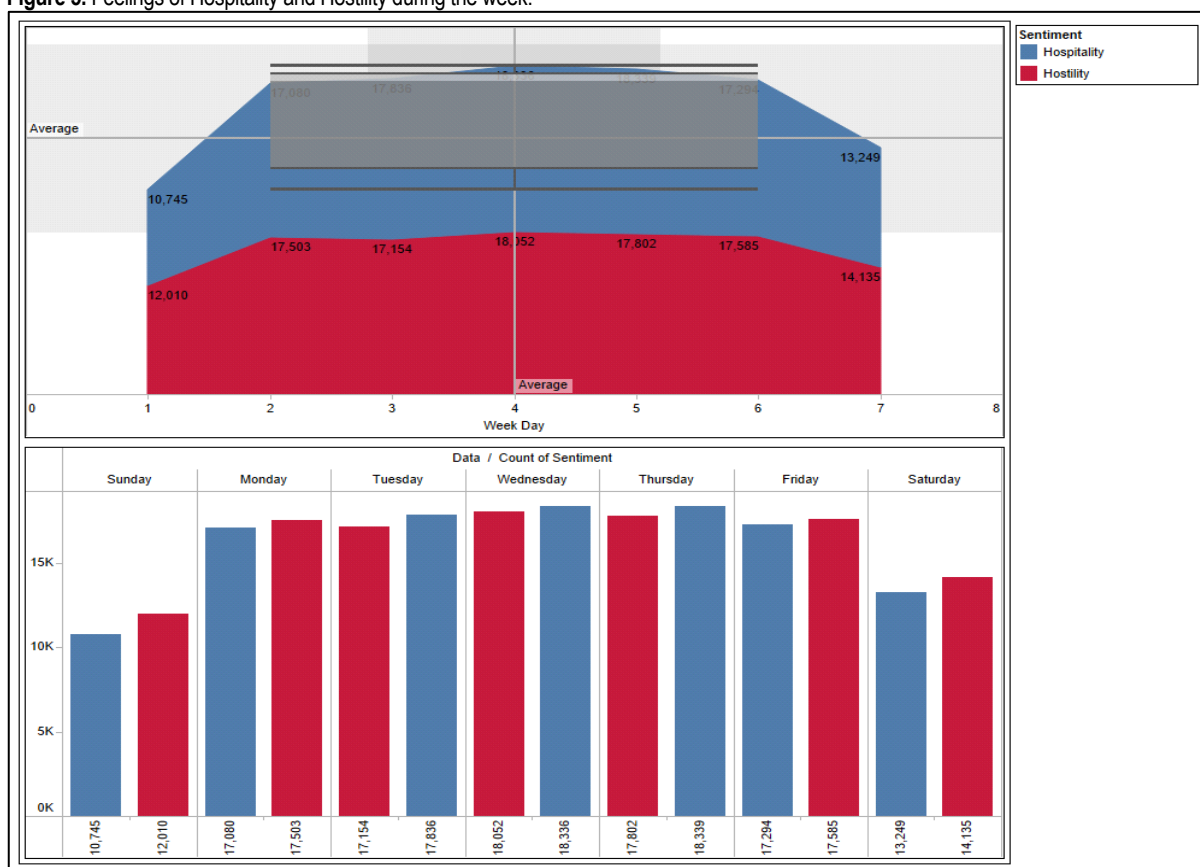
(pipe), which was generated using the training data previously catalogued, generating an Excel spreadsheet, which was used to generate the graphs using the Tableau software version 2021.4, in order to provide a temporal analysis of the data, seeking to understand the patterns of growth and decrease of feelings related to Hospitality and Hostility during the period analysed, thus seeking to correlate with events that occurred in the periods that most drew attention, in addition to seeking support in the literature review.

Figure 5— Feelings of Hospitality and Hostility throughout the week demonstrates the classification of feelings of hostility and hospitality and their respective counts by weekday, where 1=Sunday and 7=Saturday.

Figure 5— Feelings of Hospitality and Hostility during the week shows that both feelings of hostility and hospitality have a moderate upward trend, with a more significant increase as the week progresses for feelings of hostility, which peaks on Thursday (17.585), and then rises sharply on Friday, until Saturday.

The apex of the news occurred in the first half of 2020, where on March 11, 2020, in the face of 18,000 cases of infections in 114 countries, and 4,291 deaths worldwide, the director-general of the World Health Organization, Tedros Adhanom Ghebreyesus, declared the pandemic of COVID-19 as pointed out by UOL (2020).

**Figure 5.** Feelings of Hospitality and Hostility during the week.



**Source:** Elaborated with research data (2021).

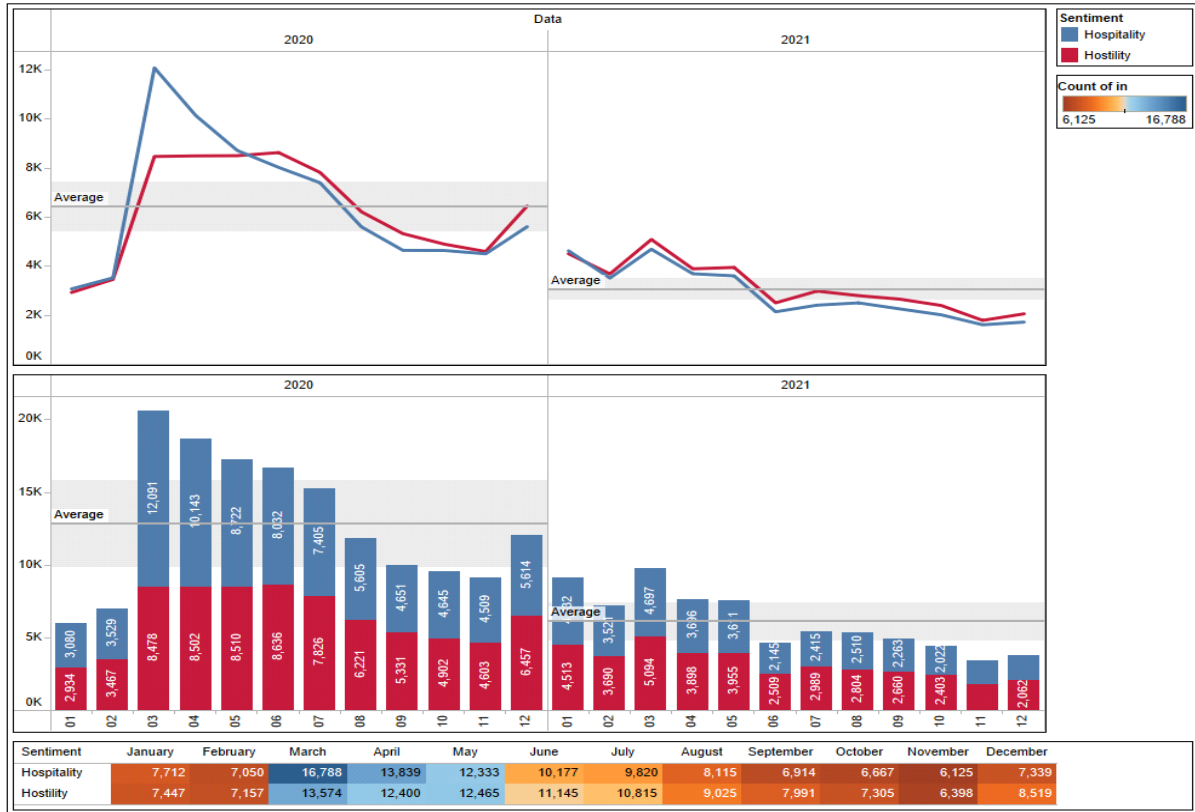
Issues pertinent to the spread of COVID-19 in Brazil became complex due to the populatio"s alarm over the issue. Thus, this issue escaped the health area and covered the political field, where the government removed the data on the number of deaths (BBC NEWS, 2020). Thus, the vaccine is used as a bargaining tool between countries. In the tourism and hospitality sector, there are initiatives from public administrators encouraging the populatio"s vaccination. A downward trend in the news is also observed, mainly by advancing vaccination and the awareness of those involved in adopting sanitary protocols, as exposed by CNN Travel (2020) and The New York Times (2021).

Still demonstrating the news evolution but considering these questions according to the month of the year, we demonstrate the Figure 6— Month by Month Data Analysis.

In the face of Figure 7— Month to Month Data Analysis,

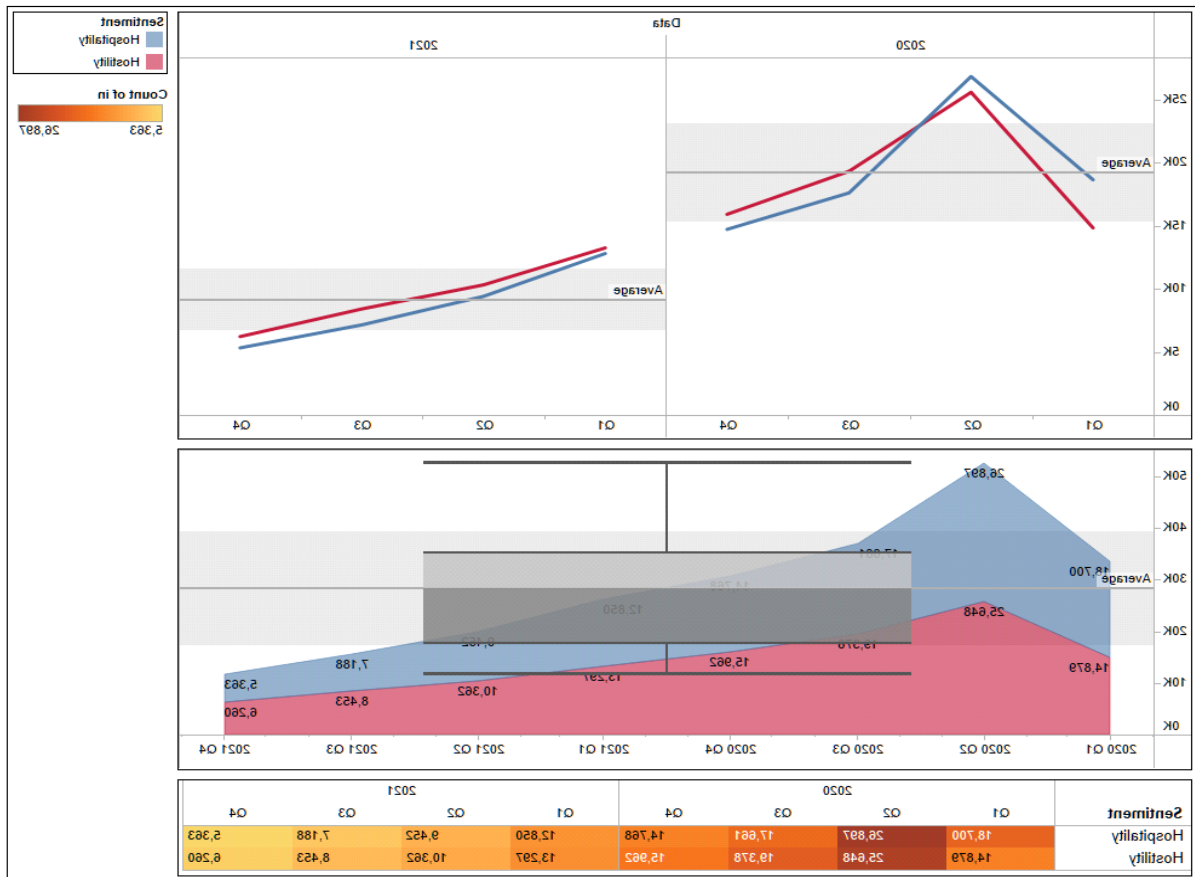
it is observed that until February 2020, the news relative to hospitality and hostility maintains themselves very close, keeping themselves around 3000 news items; this is since the cases are happening outside the country, concentrated mainly in Wuhan and Mainland China, and later in Europe, keeping themselves distant from our reality. However, around March, both the news related to hospitality and hostility suffered an expressive growth, being that hospitality reached a peak of 12,091 news items; this is due to verify that among the issues dealt with in the news of the year 2020, there are technical/informative notes on Coronavirus; the emergence and intensification of measures against the dissemination of the COVID-19 (Contingency Plan) as the avoidance of shaking hands, kissing the face, and the need to constantly clean hands; and the need of containment of people as a response to try to stop the dissemination of COVID-19, where public spaces such as Museums are closed for visitation.

Figure 6. Pandemic Covid-19 Data Evolution - Month by Month.



Source: Elaborated with research data (2021).

Figure 7. Evolution of Pandemic Sentiments per Quarter.



Source: Elaborated with research data (2021).

Nevertheless, also because in the year 2020, due to the population's alarm over the Coronavirus, Japan ran out of toilet paper to serve consumers; the first deaths from Coronavirus occurred, including among health professionals in Australia, Brazil, Qatar, Denmark, Ecuador, the United States, Estonia, France and Thailand; tests began with medicines to cure the virus; but also the appearance of false news about Coronavirus; the beginning of training for professionals to attend to suspected cases of contamination and the construction of hospitals to attend to those infected.

In education, the closure of educational institutions such as schools and universities were verified. In the economy, it was more evident the oscillations in the stock markets around the world through the news of increase or decrease in the number of deaths in countries; the impact on industrial production and the need to paralyse commerce; the lack of food and drinks in supermarkets around the world; and the lack of masks and Personal Protective Equipment in commerce.

In the tourism and hospitality sector, there was a drop in airline company profits; hotels closed or the use of accommodation to attend to the families of patients or doctors who were on the front line; in China, a hotel were used for people in quarantine collapsed; cruises were suspended; events in the cultural and political sphere were postponed, suspended or cancelled; and tourist activity began to worry residents for fear of contamination.

In 2021, it was evident that the oscillation in the number of deaths in the world increased in the number of restaurants and hotels that closed their doors due to lack of demand. However, one also begins to observe issues involving politics and international trade, such as blocking exports of the COVID-19 vaccine, for example, from the European Union to other countries outside the economic block; the emergence of online events; the beginning of vaccination of the American population. All these issues, to some extent, influenced the data.

We also realized that the social media and news affected the tourism and hospitality industry, mainly because people are insecure and because of this the government and the enterprises need to seek a solution, such as for example employee contract suspension, some flexibility of the laws and incentives for this sector, one of the most affected, which are vital for country development as pointed by Casales-Garcia et al. (2021), because this industry offer the opportunity to creates a lot of jobs and it is a challenge because the constraints faced by Brazil and other countries during the pandemic crises (Azmaiparashvili, 2021; Baranova et al., 2023).

Figure 7 shows the data on the pandemic by a quarter in order to assess how the pandemic evolved over the two years of the survey.

Through Figure 7, it is observed a tendency for the news to increase until around the second quarter of 2020, staying hospital ahead of hostility, a trend that inverts from the third quarter of 2020, mainly due to uncertainties generated by presidential and governmental actions regarding the policy of confrontation of the pandemic, generating political clashes.

However, also from the third quarter there is a downward trend in the number of news that remains constant until the last quarter of 2021, this movement is mainly due to the evolution of the vaccination of the population and also the reduction in the number of deaths over the periods, experiencing an increase mainly due to the emergence of virus variants and the uncertainty generated, as to the efficiency of vaccines concerning these new strains.

## 5 FINAL CONSIDERATIONS

This study demonstrated that in different parts of the planet, people had their rhythm of life. However, from the moment the COVID-19 virus started to interfere with human health, its dissemination affected people's daily lives, interactions, and food. Furthermore, it affected intangible aspects that are essential components for people.

Through the aim, which was analyze how the emotional, mental, and sentimental demands related with hospitality and hostility were developed during the pandemic of the COVID-19 in Brazil. It is highlighted that during the pandemic, the news classified by the research that involved aspects of hospitality and hostility oscillated, which confirms the hypothesis "H1— that the feelings changed along with the pandemic". At first, these issues were understood as news grouped in the hospitality environment, wherein in 2019, these issues dealt with informative aspects and prevention of diseases to pets.

Already in 2020, these issues are treated in the field of hostility due to the population's ignorance of what a pandemic would be. Sometimes, feelings were affected by the appearance of variants of COVID-19 that had not been known before, by the news of people who were infected twice, or by reports showing hospitals crowded and people who could not get medical attention.

Besides this, it was verified the disclosure of companies' bankruptcy, organisations that closed their doors due to lack of resources; it was also observed that governments of different locations sought to limit people's circulation to reduce the spread of the virus. Nevertheless, with the evolution of news and its analysis, it was observed that issues in the hospitality environment that gave the population more confidence occurred mainly through the adoption of health protocols and vaccination.

The general research objective is to analyse how the emotional, mental, and sentimental demands develop during the pandemic of the COVID-19 virus. As exposed by BBC News (2020), issues related to COVID-19 in Brazil migrated from the health field to the political field. These changes directly affected the tourism and hospitality industry, mainly because many trips have been cancelled due to border closures and isolation policies.

The apex of the news occurred in the first semester of 2020, of numerous aspects that effectively changed the routine of life of the population. However, from the appearance of vaccines, they have started to be used in political and monetary debates in Brazil and worldwide. Therefore, the news starts to present a downward trend after the immunisation of the population, which confirms

hypothesis H2 "it comes to develop positively after the vaccination of the population".

This aspect demanded a creative solution for tourism and hospitality industry, mainly because the risk perception is changed, and this companies need to invest in management solution, and also invested in their image as they supported the population and offer assistance to people affected by Covid-19 (Sarişik et al., 2021).

In this way, the oscillation in feelings during the COVID-19 pandemic is pointed out, where this research demonstrates the need for studies that contemplate the perspective of hospitality in adverse times and its implications, in which sometimes there is the feeling of threat to life itself, where factors of insecurity and risk emerge in human beings because of hostility.

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#### CRedit author statement.

Term	Definition	Author 1	A 2	A 3	A 4
Conceptualization	Ideas; formulation or evolution of overarching research goals and aims	x	X		x
Methodology	Development or design of methodology; creation of models	x	x	x	
Software	Programming, software development; designing computer programs; implementation of the computer code and supporting algorithms; testing of existing code components	x			x
Validation	Verification, whether as a part of the activity or separate, of the overall replication/ reproducibility of results/experiments and other research outputs	x	x		
Formal analysis	Application of statistical, mathematical, computational, or other formal techniques to analyze or synthesize study data	x	x	x	
Investigation	Conducting a research and investigation process, specifically performing the experiments, or data/evidence collection	x	x	x	
Resources	Provision of study materials, reagents, materials, patients, laboratory samples, animals, instrumentation, computing resources, or other analysis tools	x	x		
Data Curation	Management activities to annotate (produce metadata), scrub data and maintain research data (including software code, where it is necessary for interpreting the data itself) for initial use and later reuse	x	x		x
Writing - Original Draft	Preparation, creation and/or presentation of the published work, specifically writing the initial draft (including substantive translation)	x	x	x	x
Writing - Review & Editing	Preparation, creation and/or presentation of the published work by those from the original research group, specifically critical review, commentary or revision – including pre- or post-publication stages	x	x	x	x
Visualization	Preparation, creation and/or presentation of the published work, specifically visualization/ data presentation	x	x	x	x
Supervision	Oversight and leadership responsibility for the research activity planning and execution, including mentorship external to the core team	x	x	x	
Project administration	Management and coordination responsibility for the research activity planning and execution	x	x		
Funding acquisition	Acquisition of the financial support for the project leading to this publication	x	x	x	

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