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**COVID-19 Impact on Consumer Online
Habits on Food Services**

Evidence from Portugal and Cyprus' restaurants

Beatriz Esteves Feliz

Dissertation presented as partial requirement for
obtaining the Master's degree in Information
Management, with a specialisation in Marketing
Intelligence

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

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by

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Advisor: Nuno Miguel da Conceição António

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DEDICATION

This dissertation is dedicated to my parents, who invested in me and my education, and encouraged me to strive for excellence.

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ABSTRACT

Food is essential for survival, and it is also one of the biggest industries, that has been growing at an astounding speed. The sector had to adapt to digital changes, and some changes occurred to the consumers as well. As technological use and innovations have evolved, alongside the dine-in concept, takeaway and delivery have gained significance.

Moreover, not only has the COVID-19 pandemic accelerated an unprecedented disruption of commerce in several industry sectors, but also is said to have stimulated the growing demand for takeaway and delivery services.

This study focused on digital adoption in food ordering services by examining the evolution of consumers' food habits, by means of analysing sales data registered, before and during the pandemic, obtained from Portuguese and Cypriot restaurants that offer both dine-in and delivery/takeaway services. It also investigated the significance of Coronavirus impact on delivery and takeaway orders, using the data previously mentioned and empirical sales data about stringency measures taken by the governments.

The report fills a research gap by analysing objective data about consumers' everyday consumption data, in two different countries. On the whole, a new perspective of research is developed, proving valuable insights regarding the evolution of consumer behaviour.

Keywords: dine-in; takeaway; food delivery; consumer behaviour; COVID-19; sales record

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LIST OF ABBREVIATIONS AND ACRONYMS

C1	Cyprus-1 (Restaurant 1 from Cyprus)
C2	Cyprus-2 (Restaurant 2 from Cyprus)
C3	Cyprus-2 (Restaurant 3 from Cyprus)
C4	Cyprus-2 (Restaurant 4 from Cyprus)
P1	Portugal-1 (Restaurant 1 from Portugal)
P2	Portugal-2 (Restaurant 2 from Portugal)
SI	Stringency Index

1. INTRODUCTION

Food is essential for survival, by furnishing the necessary energy to organisms (Merriam-Webster, n.d.). From another perspective, it is also one of the biggest industries, that has been growing at an astounding speed, and the sector has made lifestyle changes with it (Murray, 2007).

On the other hand, the proliferation of smartphones and several mobile devices, with access to the internet has also created an unmatched opportunity for e-commerce and, mostly, m-commerce, i.e. any transaction with monetary value done through mobile handheld devices (Clarke III, 2008). Thus, mobile services have been developed and implemented in different industries.

In particular, food delivery services have been gaining significance and generating more revenue (Zhao & Bacao, 2020). This study focuses primarily on two food services: takeaway and delivery. Accordingly to Merriam-Webster Dictionary and Cambridge Dictionary, takeaway refers to a meal prepared and bought at the shop but taken somewhere else from its place, while delivery is when goods are brought to the customer's house or to any place where they want them. Food delivery services have changed consumer behaviour so much, that using these services has become routine (Chai & Yat, 2019).

Moreover, the COVID-19 pandemic outbreak has forced many businesses to close, leading to an unprecedented disruption of commerce in most industry sectors (Donthu & Gustafsson, 2020). Additionally, the COVID-19 pandemic imposed substantial lifestyle changes, making consumers change their habits and the motivations behind them (Laguna et al., 2020).

This study lines up to identify habits on consuming food, dining in and ordering (referring to both delivery and takeaway services), before and during the Coronavirus pandemic, through restaurants' sales data analysis.

1.1. Background and problem identification

The COVID-19 pandemic brought not only health consequences but also economic ones. As it relies on human interaction and gatherings, the food service industry is found to be highly vulnerable to epidemic crises (Albuquerque et al., 2022), so its survival depends on the ability to adapt to the circumstances, in particular to the restrictions imposed by the governments to fight the pandemic.

Gössling et al., 2020 predicted, at the beginning of the pandemic, that restaurants would face problems recovering from the measures taken by the government, including businesses' mandatory closure and social distancing. However, the same study recognizes takeaway as an operational alternative.

Hence, Coronavirus propelled, in a rough way, an unprecedented disruption of commerce in most industry sectors (Donthu & Gustafsson, 2020), and, consequently, of buying habits (Sheth, 2020). The consumer by being unable to go to the store, the store has to come to the consumer (Sheth, 2020). Some examples of that are the food industry's digital adoption, and, consequently, the rapidly growing use of food delivery applications and websites on mobile devices, and takeaway services, in which despite having to go pick up the meal, the customer still does not use the restaurant dining space nor has to prepare his meal.

1.2. Study importance

Studies focused on the consumers' cultural influence on their online purchase behaviour have been developed. According to Slyke et al., 2010, culture has an impact on consumers' intentions to purchase goods or services online.

Moreover, nowadays, the world lives with uncertainty due to the COVID-19 pandemic, which influences consumer behaviour and existing habits (Sheth, 2020). Therefore, with the pandemic and an uncertain future, businesses are expected to prioritize and optimize spending (Donthu & Gustafsson, 2020).

As the COVID-19 outbreak presents a unique opportunity to study how markets are created and how they disappear within a very limited time span (Donthu & Gustafsson, 2020), this study aimed to explore both solutions: dine-in and delivery/takeaway, as the food businesses must use an omnichannel strategy to remain competitive in such situation.

To understand the consumer behaviour evolution on online consumption, considering the impact of COVID-19, empirical data were analysed. The data was obtained from Portuguese and Cypriot restaurants with food delivery services (delivery, takeaway or both), considering the periods: prior and during to the pandemic.

The findings in this study help better inform restaurants managers, in particular the marketing team, about its businesses and, mostly, the consumers' food consumption and habits, and consequently, provide useful guidelines about how to respond to market changes and how to improve their services, as in an ambiguous time, making the right decisions is crucial. By comparing empirical sales data with stringency measures taken by the governments to mitigate COVID-19 spread, the present research also investigated the significance of Coronavirus impact on delivery and takeaway orders, i.e. determine, statistically, whether or not pandemics affected the demand for food services, apart from dining out.

1.3. Study objectives

This study had the following objectives:

- (1) Understand the evolution (before and during the Coronavirus pandemic) of food consumption, in particular:
 - a. Discover the preferred mealtime, day of the week and seasons through sales volume, for each restaurant and country;
 - b. Compare orders' volume with periods with enforced stringency measures taken by governments to tackle down COVID-19 pandemic;
 - c. Verify whether or not the Coronavirus pandemic (more specifically, the governments' restrictions) had a significant impact on food services.

- (2) Identify differences and similarities between Portuguese and Cypriot consumers, taking into consideration the findings from objective 1.

The first objective provided valuable insights about consumer behaviour and how easily (or difficult) it can be changed. The expected results were optimistic about the increase in consumers' online consumption. The second objective provided strength to the research as it analysed not only one culture but two.

2. LITERATURE REVIEW

2.1. Culture and its impact on purchase intentions

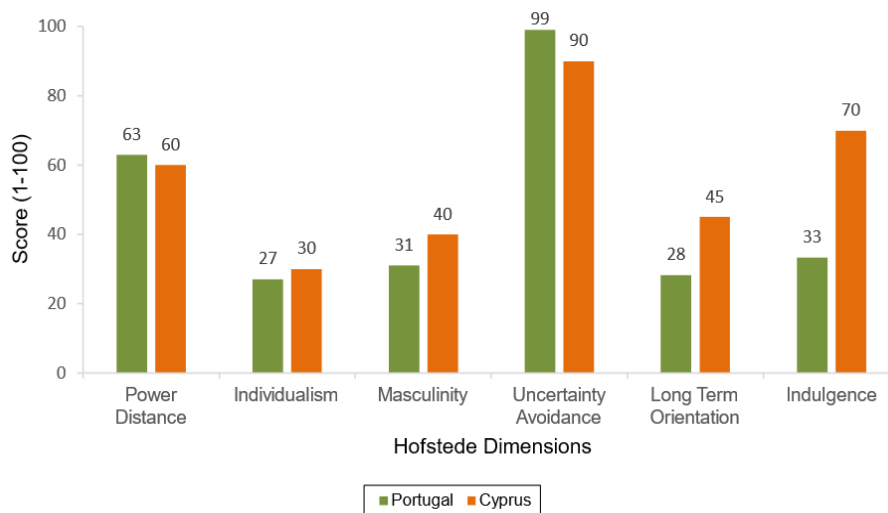
Previous studies, based on Hofstede’s conceptualization of national culture, affirm that culture has a significant impact on intentions to purchase goods or services online (Slyke et al., 2010). Hofstede’s conceptualization of national culture has been the subject of considerable criticism. However, it remains in wide use in current cross-cultural studies. In this research, it is a starting point to come close to or separate the two cultures.

Hofstede’s cultural dimensions theory consists of six dimensions:

- (1) Power Distance Index (PDI);
- (2) Individualism versus Collectivism (IDV);
- (3) Masculinity versus Femininity (MAS);
- (4) Uncertainty Avoidance Index (UAI);
- (5) Long Term Orientation versus Short Term Normative Orientation (LTO);
- (6) Indulgence versus Restraint (IVR).

In the following bar chart (Figure 1), it can be seen the six dimensions’ score differences for Portugal and Cyprus.

Figure 1. Hofstede’s cultural dimensions score for Cyprus and Portugal



Note. Cyprus scores, except for the sixth, are not validated and are educated guesses, provided by Gen Jan Hofstede (*Hofstede’s Globe – Geert Hofstede B.V, n.d.*).

Portugal and Cyprus score very similarly in most of the dimensions. Thus, both countries accept hierarchical distance (PDI), have collectivist (IDV) and consensual (MAS) cultures, and value working hard, precision, punctuality and security (UAI).

On other hand, due to a low score in Long Term Orientation, Portuguese people are focused on achieving quick results and show less propensity to save for the future, while Cypriots score average on this dimension, calculating they have a 50% normative 50% pragmatic culture. In order to understand the national culture's influence on product diffusion, a study by (Dwyer et al., 2005) suggest that short-term-oriented countries promote faster adoption of new product innovations while long-term-oriented ones are more prudent toward abrupt changes and are focused on saving. Yet, the scores difference between the two countries is not that substantial.

The dimension that separates the two countries is the IVR, where Portugal is more Restraint, and Cyprus is an Indulgent country. Hence, Portuguese people have a propensity for pessimism and do give much importance to leisure time, while Cypriots are more optimistic and act on their impulses to enjoy life, making them spend money as they wish.

Overall, Portugal and Cyprus do not show considerable cultural differences between them, so it is estimated that the Coronavirus pandemic impact on food services was similar in the two countries.

2.2. Behavioural intention towards delivery services, during the COVID-19 pandemic

As consumers adapt to house arrest for a prolonged period of time, they are likely to adopt newer technologies that facilitate work, study and consumption more conveniently. Embracing digital technology is likely to modify existing habits (Sheth, 2020).

Research, through online questionnaires to consumers of different cultures and from different countries, has been made to determine which factors determine behaviour intention of using OFD services. Some of those focused on those reasons, particularly during the COVID-19 outbreak. Among them are: firstly as the most mentioned, hedonic motivation (Prasetyo et al.,

2021); (Zhao & Bacao, 2020); (Yeo et al., 2017), task-technology fit (Muangmee et al., 2021); (Zhao & Bacao, 2020), trust (Zhao & Bacao, 2020), safety (Al Amin et al., 2021); (Muangmee et al., 2021), performance expectancy (Muangmee et al., 2021); (Zhao & Bacao, 2020), social influence (Muangmee et al., 2021); (Zhao & Bacao, 2020) and effort expectancy (Muangmee et al., 2021).

Previously, it was mentioned that Cyprus is a more indulgent culture, which is related to hedonism. Combining these findings, it is anticipated that Cypriots are more likely to consume OFD than Portuguese people.

Results obtained, from previous literature, also indicate that consumers recognize the benefits of food delivery services. One of those benefits, for instance, is the contactless function, which affects consumer intention to online order continuingly, especially in a pandemic context (Zhao & Bacao, 2020).

2.3. COVID-19 pandemic impact on online shopping

On the matter of whether COVID-19 influences or not consumer behaviour in online shopping, some research has already been made.

In Jordanian, online shopping using a website or application has become an increasingly important base for many consumers, influenced by the pandemic (Hashem, 2020). That is confirmed in Vietnam, within the book business, it was found that situational influences (in which the COVID-19 outbreak can be included) have a positive and significant impact on consumer behaviour and intention to buy through online channels (Nguyen et al., 2020).

However, according to Hand et al., 2009, related to online grocery shopping, the adoption decision caused by a situational factor is easily reversed when the initial trigger disappears and the situation changes back to what it was. Can it be the case with the delivery and takeaway adoption?

Additionally, in Portugal, through a questionnaire, it was inferred that consumers use more food delivery apps since when started to deal with the COVID-19 pandemic situation, and are also aware of their utilitarian value (Albuquerque et al., 2022).

2.4. Food consumption

To what concerns food, Eger et al., 2021 concluded that consumers, during the pandemic crises, have become more focused on basic needs than self-fulfilment ones. In contrast, questionnaire results showed that, with the lockdown, a significant change in the frequency of shopping happened: Spanish people start to go grocery shopping weekly, whereas, before the pandemic situation, it was more usual to go twice per week (Laguna et al., 2020). Therefore, consumers are more centred on their basic needs – which includes food – but going grocery shopping less often, it can be assumed consumers are buying groceries in more quantities to last longer and/or are getting food from other sources than supermarkets.

Lastly, when the lockdown started, Portuguese restaurants were proactive with concern about hygiene regulations, to offer better service and protection to customers. The sector was also concerned about maintaining jobs and assure business survival (Madeira et al., 2021). This emphasizes the need of adapting the business to the situation, where delivery and takeaway options appear to be an optimal solution – and that is why luxury hotel restaurants in China start to offer ordering and home delivery services (Yang et al., 2021).

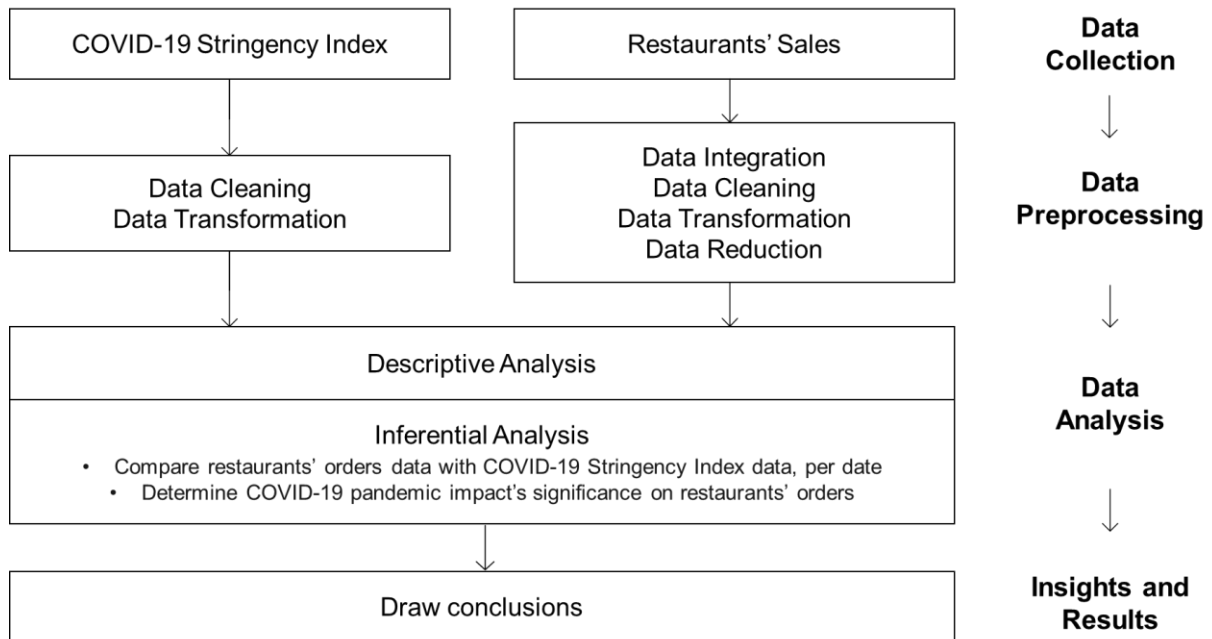
Literature states that COVID-19 had a significant influence on consumer behaviour, but it also asserts that further empirical research is required. This research fills the aforementioned gap by analysing restaurants' sales data during the COVID-19 pandemic, which has not been done before.

3. METHODOLOGY

3.1. Research model

Below, in Figure 2, is the proposed research model for the study.

Figure 2. Research model



Note. Restaurants' orders data refers to delivery and takeaway services, i.e. excluding the dine-in sales volume.

The research followed four main steps: data collection, data preprocessing, data analysis and lastly, getting insights and results. COVID-19 Stringency Index (SI) and Restaurants' Sales, identified in the first stage in Figure 2, refer to the two types of data that were exploited to conduct the research.

3.2. Methods

The proposed approach is data-driven, as the study focused on data and extracting patterns and facts from it, comparing the habits of consumers during the time, taking into consideration the stringency of measures taken by the governments of the two countries of the study – Portugal and Cyprus.

As observed in Figure 2, in the Data Collection phase, two main sources of data were considered:

(1) COVID-19 Stringency Index (SI)

- a. Obtained from the Oxford COVID-19 Government Response Tracker (OxCGRT) data (Hale et al., 2021) that provides the SI, from 0 to 100 (100 = strictest), for more than 180 countries, for each day, since January 1, 2020. This information is based on 23 indicators of government response to tackle the COVID-19 pandemic. These indicators are divided into containment and closure policies, economic policies, health system policies and vaccine policies. Researchers and decision-makers may find insights, with this data, to recognize the effects of governments' responses to COVID-19 across different populations and contexts (Hale et al., 2021).
- b. The complete dataset provides the calculated SI, for each country (identified by name or code) and for each day. Portugal and Cyprus' SI were compared with restaurants' orders volume and were also subject to statistical tests to verify whether or not the Coronavirus pandemic (more specifically, the governments' restrictions) had a significant impact on food services.

(2) Restaurants' Sales

- a. Requested and obtained from Portuguese and Cypriot restaurants, around September 2021. Although 8 restaurants provided their sales information for this study, only 6 were valid (as the remaining 2 did not provide clear evidence about the service type of each sale – dine-in, delivery or takeaway). Thus, 4 Cypriot and 2 Portuguese restaurants were the objects of study. One of the businesses provided its sales data since January 2019, and the others provided since January 2018, which enables an unbiased analysis of their business, before even imagining there could be a global pandemic happening a couple of years later.

- b. For the confidentiality of each restaurant to be preserved, restaurants were identified with a combination of a letter and a number: a C, for Cypriot restaurants, or P, for Portuguese, followed by a number. As a result, the 6 restaurants are, henceforth, referred to as C1, C2, C3, C4, P1 and P2.
- c. The datasets of the first five restaurants are similar among them, providing such information as *DocNumber*, the products and quantity that make it up, the exact date and time of the transaction (*InvoiceDateHour*) and the service type, i.e. dine-in or delivery/takeaway. The last information mentioned is obtained through a boolean variable (*IsDelivery*) where 0 corresponds to Dine-in, and 1 matches to Delivery/Takeaway, therefore it was not possible to differentiate between delivery and takeaway. So forth, sales identified with *IsDelivery* = 1 were considered and will be identified henceforth as “Orders”. This separation and denomination enabled the differentiation between dine-in and order (i.e. not having the meal in the restaurants' facilities) to better draw outcomes. Although some restaurants provided that information, revenue was not addressed in this study.
- d. The dataset of the remaining restaurant (P2) only provided information about the total of documents per day, i.e. the total sales volume per day, without any information about the time. P2 registers its sales divided into 3 services: dine-in, takeaway and delivery. However, to address the restaurants on the same ground level, the takeaway and delivery sales volume was combined.
- e. Through these data, information on preferred months, weekdays or mealtime were obtained, as well as the comparison between the dine-in and orders volume, for each restaurant considering the same period.

Data preprocessing and analysis were completed with Python, using Jupyter Notebook. Pandas (The pandas development team, 2022) (McKinney, 2010), NumPy (Harris et al., 2020), Matplotlib (Hunter, 2007), Seaborn (Waskom, 2021) and Plotly (Plotly Technologies Inc., 2015) libraries were useful to manipulate data and visualize findings, within the scope of descriptive

analysis. For the inferential analysis – to determine the COVID-19 pandemic impact on restaurants' orders – Scipy library (Virtanen et al., 2020) was used. As it cannot be assumed normality in orders data, Kruskal-Wallis H-test was used to determine statistically significant differences between the median of the groups – between restaurants' orders sales and COVID-19 SI of the respective country.

January 2020 to August 2021 was the analysed period to compare both data obtained from the two sources, detailed above, as it is the common period among the two.

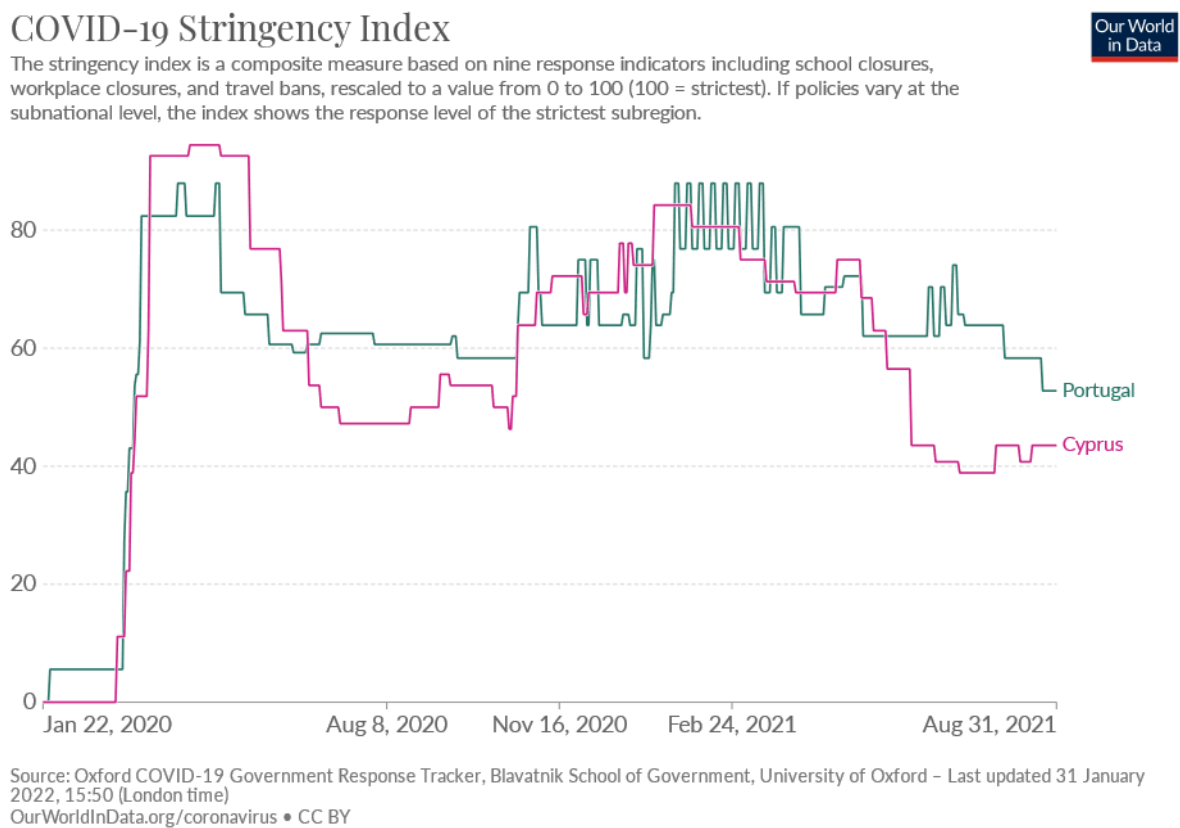
4. RESULTS AND DISCUSSION

4.1. COVID-19 Stringency Index

As mentioned in the previous chapter, the study and data of Hale et al., 2021 were used to address COVID-19’s stringency impact on each country.

Figure 3 shows the rigidity evolution of the Portuguese and Cypriot government measures to reduce the spread of COVID-19, where 100 equals the strictest measures.

Figure 3. Evolution of Portugal and Cyprus’ COVID-19 SI, from January 2020 to August 2021

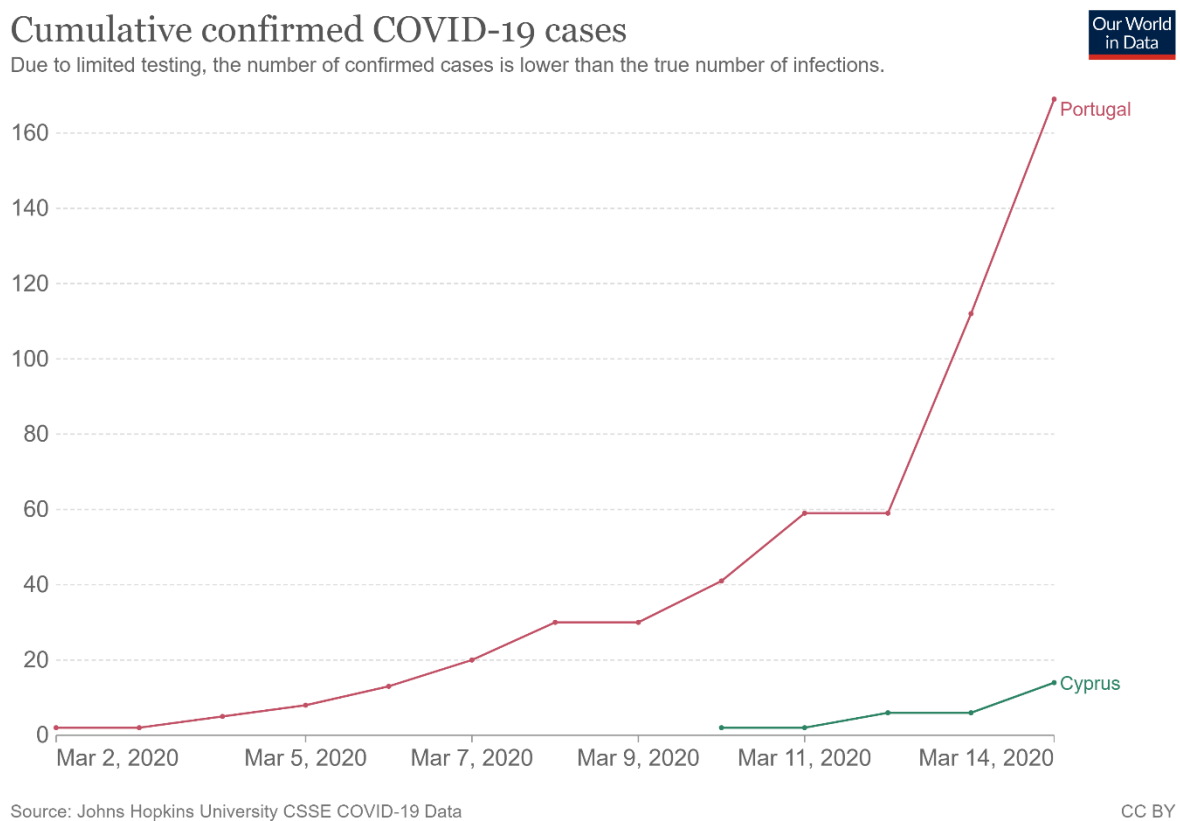


Note. Oxford COVID-19 Government Response Tracker, Blavatnik School of Government, University of Oxford.

According to Dong et al., 2020, and as can be seen in Figure 4, Portugal confirmed its first two cases on March 2, 2020, while in Cyprus the first two cases of COVID-19 were recorded on March 10, 2022. Not much later, the governments started to take action and that is when the index starts to increase for both countries (Figure 3). Portugal had an estimated SI above 80 between March 19th and May 3rd, and Cyprus scored the same SI interval (80-100) between

March 24th and May 20th. These first months correspond to the beginning of the pandemic in Europe when the measures taken by the governments were more intense. In the summer of 2020, life starts to seem more normal, with fewer restrictions; but later, another wave has felt at the beginning of 2021 (January, February and March).

Figure 4. The first cumulative confirmed COVID-19 cases, in Portugal and Cyprus



Note. COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University.

4.2. Restaurant’s descriptive analysis

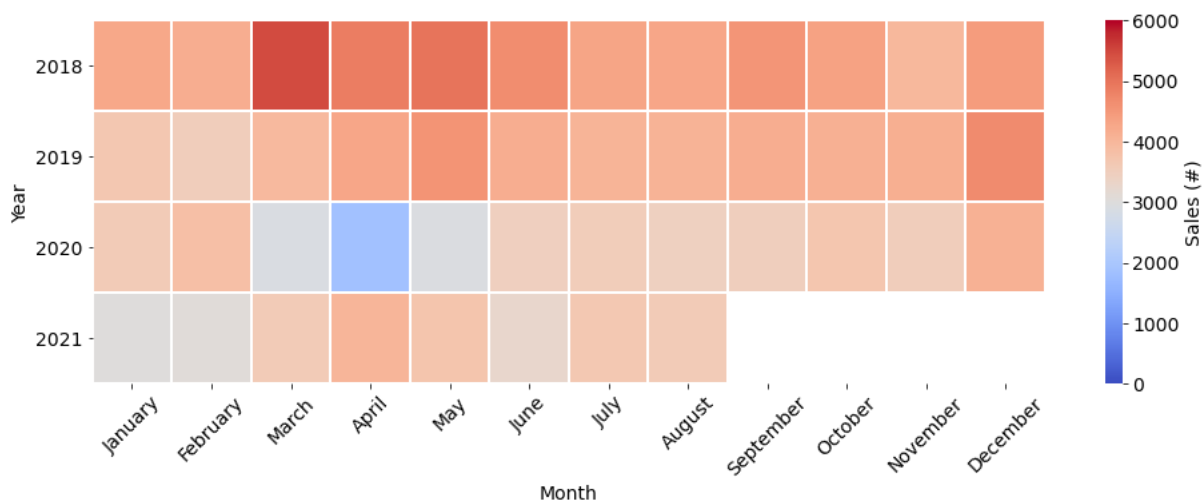
For each restaurant, it was created an overall report to be familiar with and better understand the businesses’ reality.

4.2.1. C1

C1 serves traditional Greek/Cypriot food. Its sales were analysed from January 2018 to August 2021. The restaurant serves dine-in meals and offers takeaway and food delivery services since 2018, at least.

Through the heatmap visualization (Figure 5), it was possible to infer the year(s) and month(s) with more and less affluence and orders: 2018 was the year when C1 had more clients, both dine-in and orders services. In March 2020, followed by April and May 2020, it suffered from an accentuated decrease in sales volume. Although it recovered a little bit the rest of the year, 2021 started badly. Starting in March 2021, it started to recover, similar to what happened in 2020.

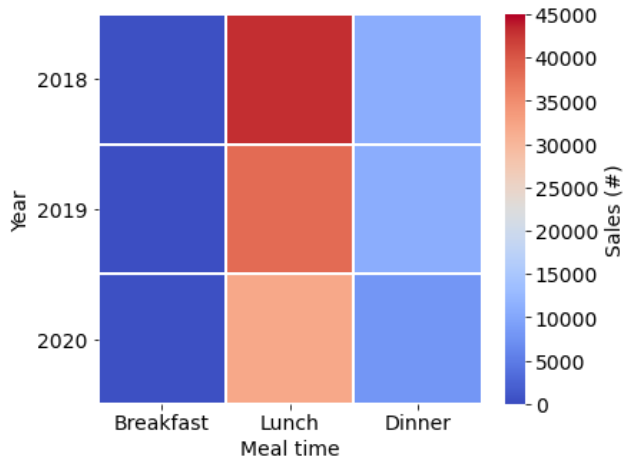
Figure 5. C1's # of sales, distributed per year and month



Figures 6 and 7, it is provided an overview of the sales volume per year and mealtime or day of the week, respectively. In addition, Figure 8 shows visually the dine-in and the orders sales volume for each year. For these three Figures, the analysed years were 2018, 2019 and 2020; as 2021 was not considered, since the available sales data only belong to the dates from January to August. Considering the year 2021 in these three maps would not reflect a balanced analysis when compared to the other years.

C1 serves mostly lunches, and it has usually more sales on Saturdays, followed by Sundays. Although the number of sales has been decreasing over the years, Figure 8 indicates the percentage of orders has been increasing.

Figure 6. C1's # of sales, distributed per year and mealtime



Note. Breakfast until 11 a.m., Lunch from 11 a.m. to 6 p.m. and lastly, Dinner after 6 p.m.

Figure 7. C1's # of sales, distributed per year and day of the week

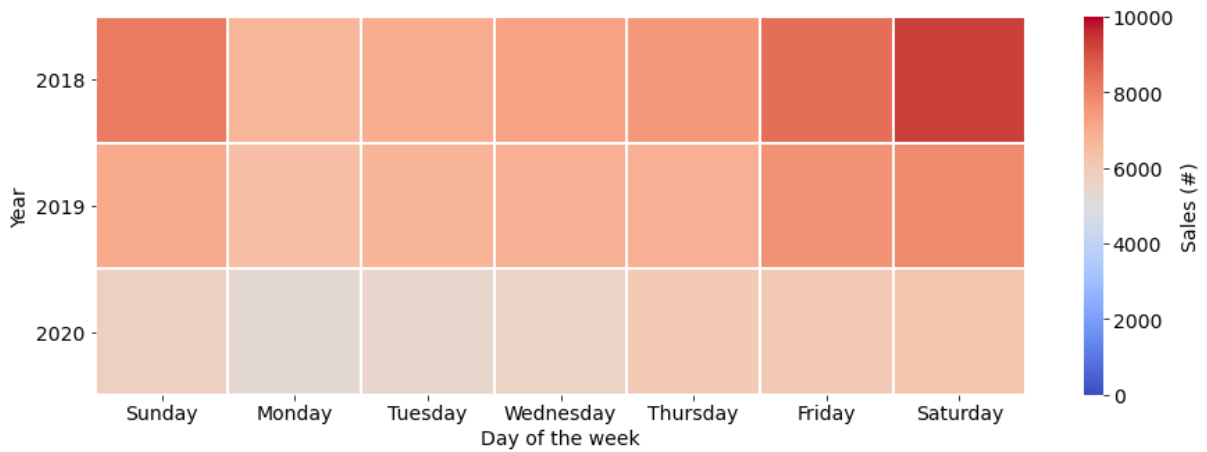


Figure 8. C1's # of sales per year, Dine-in VS Orders

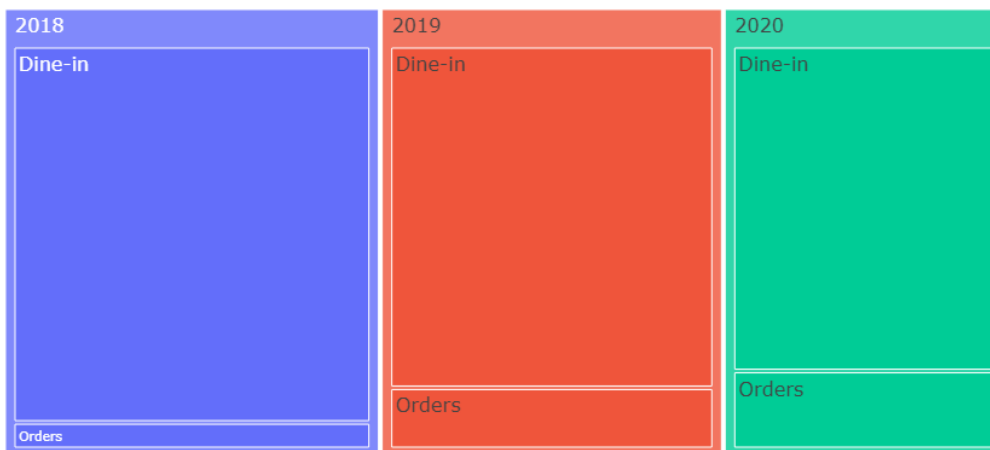
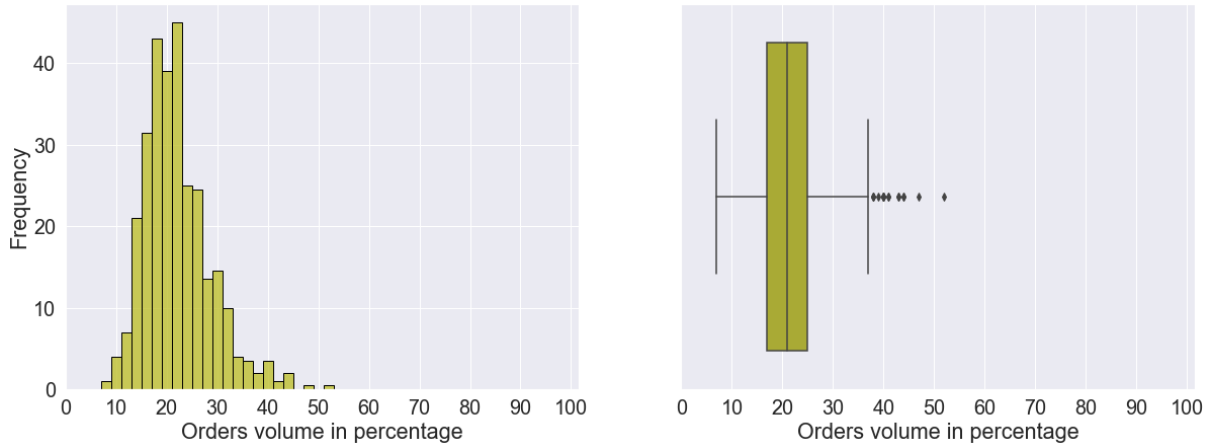


Figure 9 refers only to the orders' percentage volume distribution from January 2020 to August 2021. These charts were designed to visually acknowledge the orders' percentage volume distribution of C1. Thereby, considering the total sales per day, the average orders volume sums up to around 20%, which may it be higher on exceptional days (outliers).

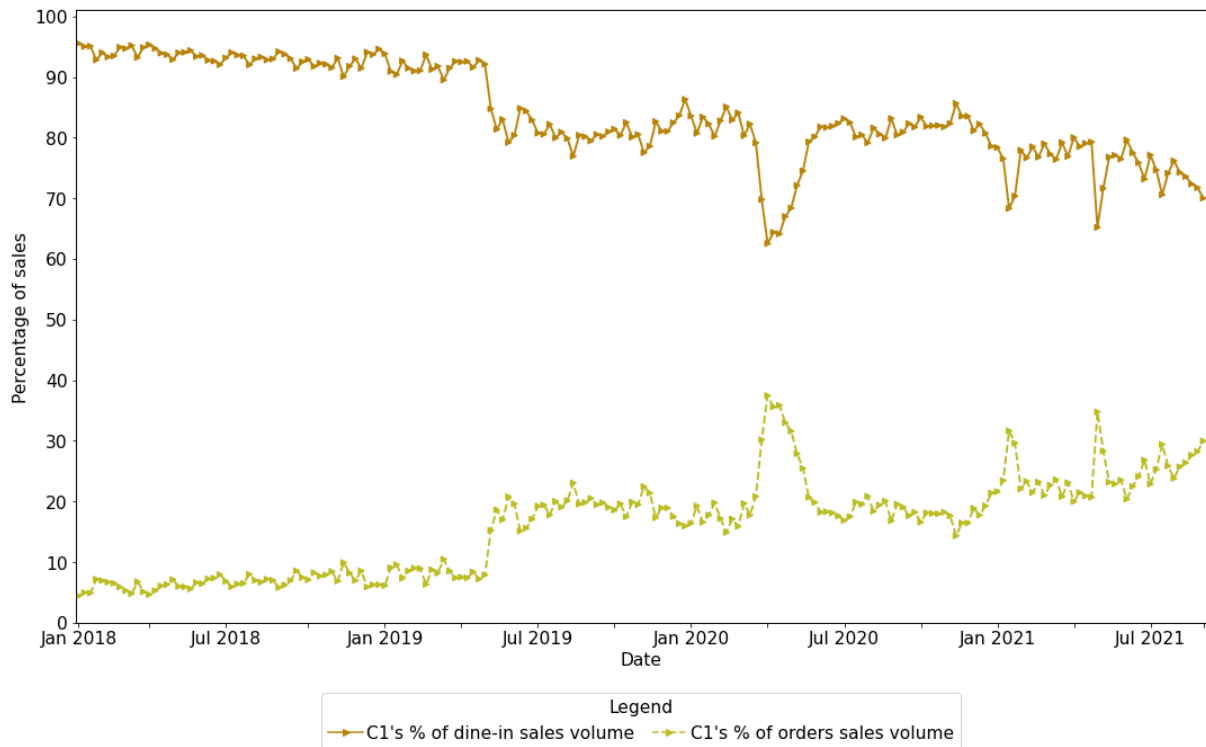
Figure 9. Histogram (left) and Boxplot (right) representing C1's % of Orders volume, from January 2020 to August 2021



Note. These charts are considering the restaurant's distribution of orders in percentage, from January 2020 to August 2021.

Additionally, Figure 10 provides insight into the distribution of total sales into the two types of service: dine-in and orders. Orders sales percentage have been increasing essentially since the second trimester of 2019, and three peaks have been registered since then: around April 2020, January 2021 and between April and July 2021.

Figure 10. C1’s sales distribution, considering the weekly mean percentage of Dine-in and Orders, from January 2018 to August 2021



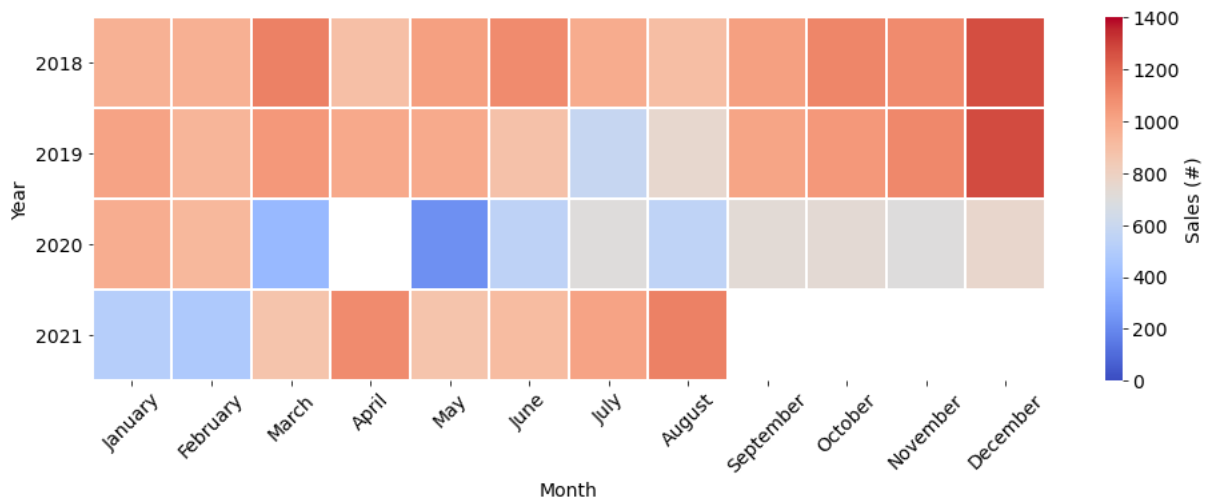
4.2.2. C2

C2 is a buffet restaurant for dine-in meals. Starting around March and April 2021, it also started to offer takeaway and delivery services, through its website. According to Figure 15, in May 2020, C2 registered some order sales. However, it presents to be an isolated situation, for which there is no explanation, nor can it be proved to be an error.

C2’s sales data were analysed from January 2018 to August 2021.

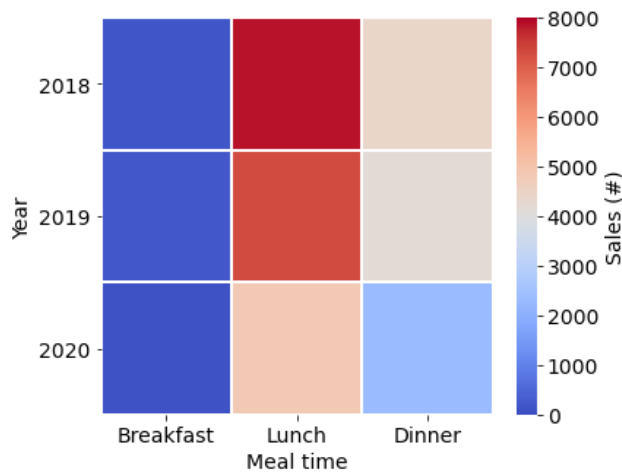
Through Figure 11, it was possible to conclude the restaurant used to have huge affluence in December, but that trend ended in 2020, as, except for January and February, 2020 was a very weak year compared to the homologous periods. Moreover, the heatmap even indicates that in April 2020, C2 was closed as it did not record any sales. Starting in March 2021, it seems to be recovering its usual sales volume – and in some months, obtaining the best results in four years.

Figure 11. C2's # of sales, distributed per year and month



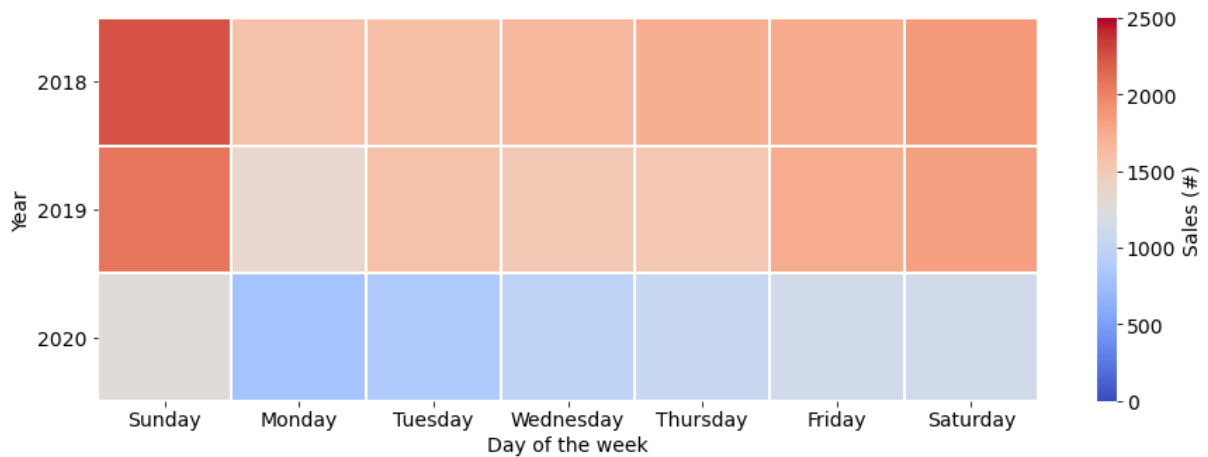
Figures 12 and 13 provide a general idea of C2's customers' preferred mealtime and day of the week, respectively. C2 serves mostly lunches and has higher agitation on Sundays.

Figure 12. C2's # of sales, distributed per year and mealtime



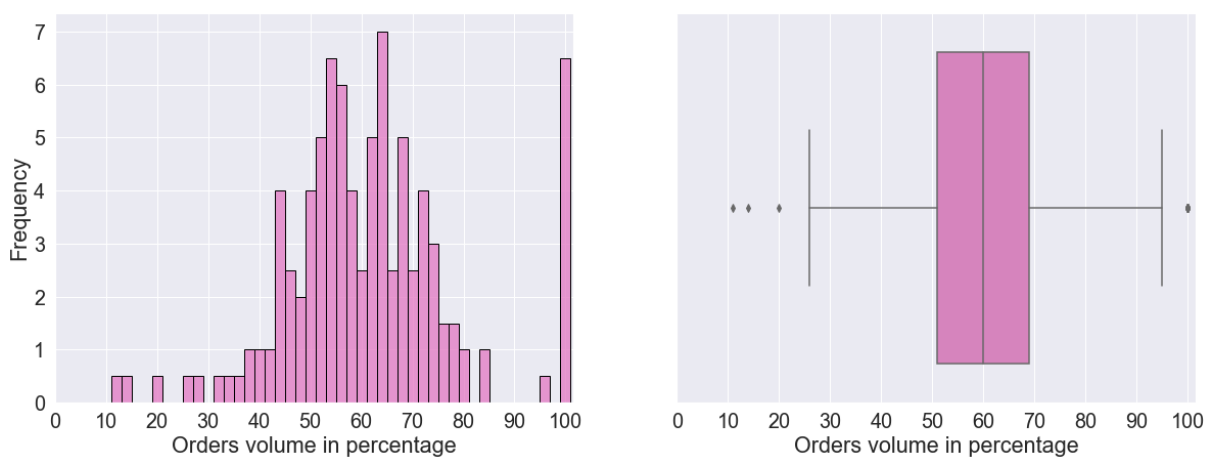
Note. Breakfast until 11 a.m., Lunch from 11 a.m. to 6 p.m. and lastly, Dinner after 6 p.m.

Figure 13. C2's # of sales, distributed per year and day of the week



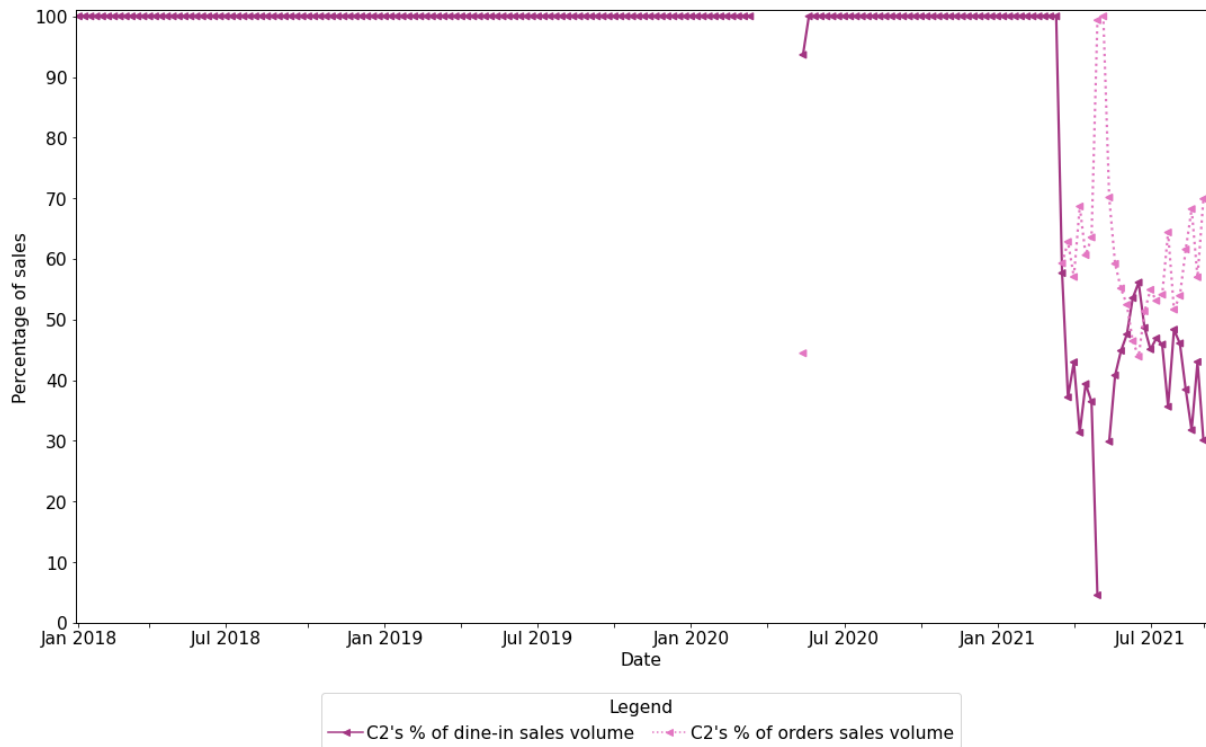
As Figure 14 refers to the orders' percentage volume distribution, it is possible to infer that the average orders volume, from January 2020 to August 2021, is around 60%. Charts also suggest there were some days with very few orders, but others that C2 only invoiced with orders. Through Figure 15 it is possible to confirm these insights, as it enlightens that C2 started to sell outward around March and April 2021, with great affluence.

Figure 14. Histogram (left) and Boxplot (right) representing C2's % of Orders volume, from January 2020 to August 2021



Note. These charts are considering the restaurant's distribution of orders in percentage, from January 2020 to August 2021.

Figure 15. C2's sales distribution, considering the weekly mean percentage of Dine-in and Orders, from January 2018 to August 2021

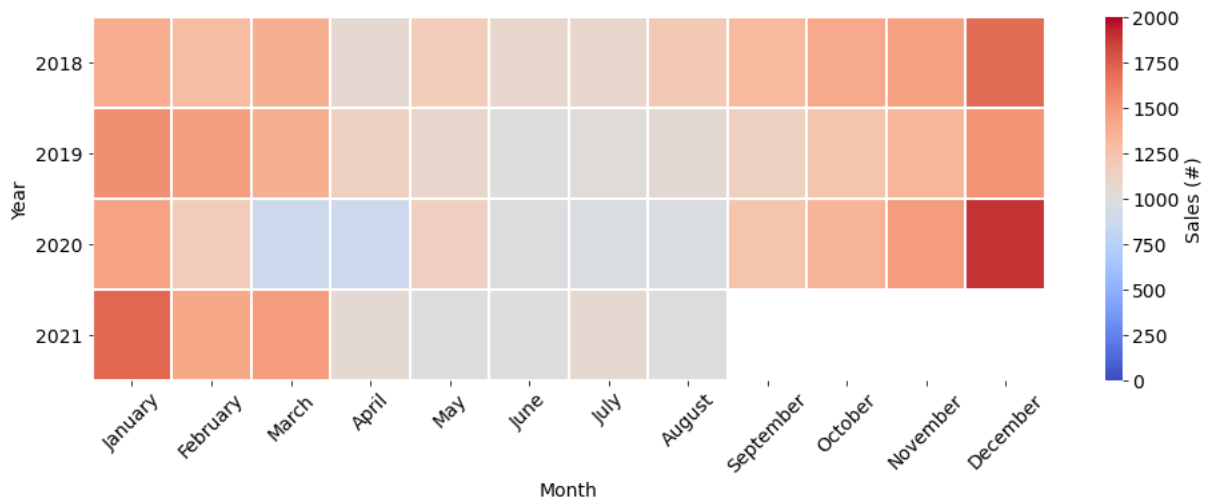


4.2.3. C3

C3 serves Chinese food, and its sales were analysed for this study considering the period between January 2018 and August 2021. C3 has been providing the two services (dine-in and delivery/takeaway) for a while. Unlike the previous restaurants mentioned, C3 has been collecting more than half of its profits from delivery and takeaway services. The restaurant has a strong online presence, due to its website where it is possible to place an order.

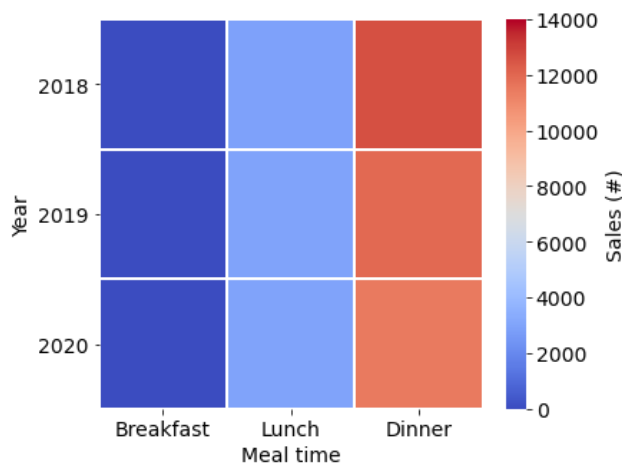
Figure 16 indicates that, although its ordering services, the sales decreased when COVID-19 emerged in Europe, i.e. in March and April 2020. The heatmap also suggests that C3 tends to have more sales in the coldest months, corresponding to the Autumn and Winter seasons. Furthermore, December 2021 was the top sales month, confirming the previous insight.

Figure 16. C3's # of sales, distributed per year and month



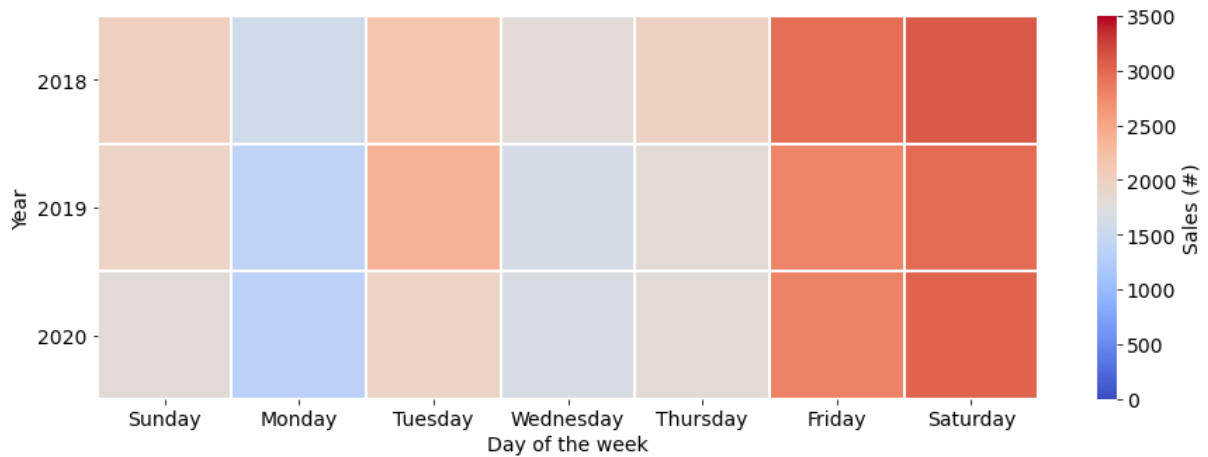
As for the favourite mealtime and day of the week of C3's customers, Figure 17 demonstrates that dinner is, by far, the time of the day with more sales, and Figure 18 points that Saturday and Friday are the days with more invoices, while Monday is the least consumers' preferred day respectively.

Figure 17. C3's # of sales, distributed per year and mealtime



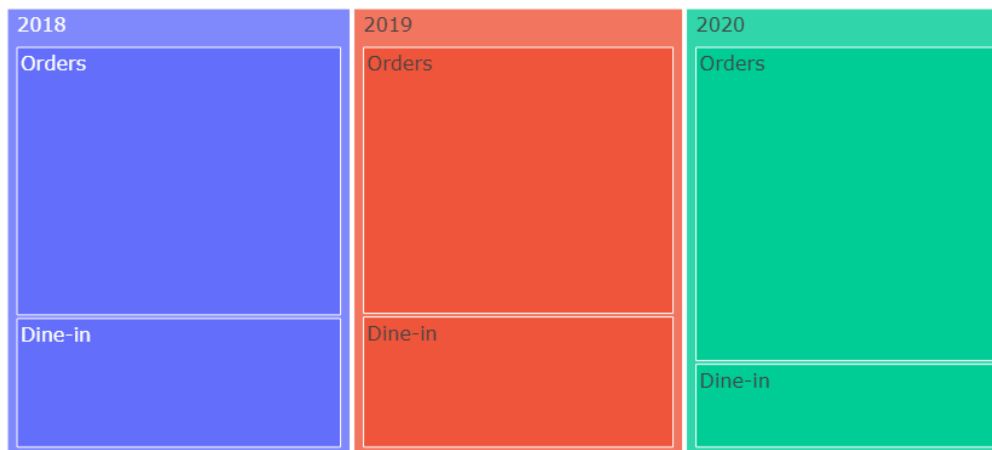
Note. Breakfast until 11 a.m., Lunch from 11 a.m. to 6 p.m. and lastly, Dinner after 6 p.m.

Figure 18. C3's # of sales, distributed per year and day of the week



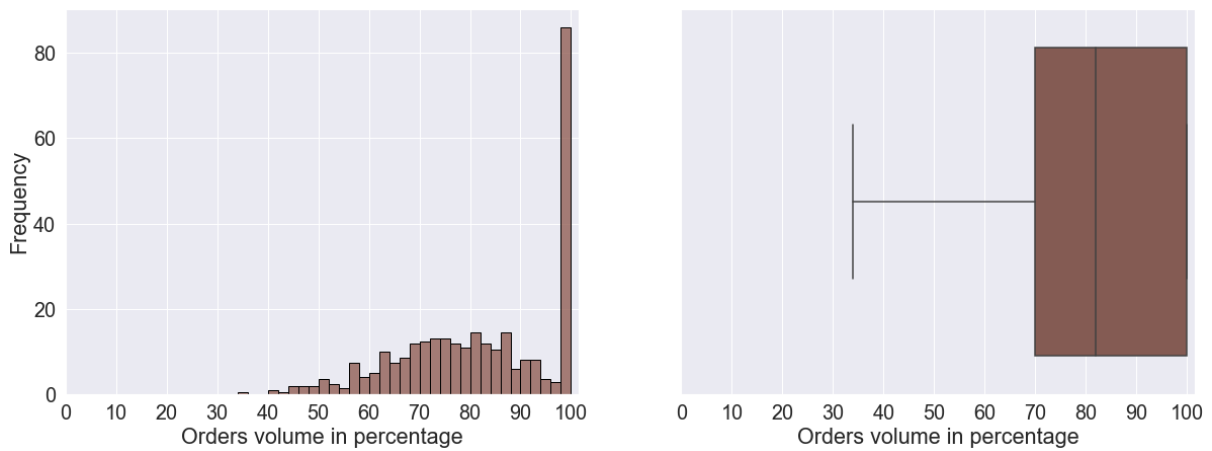
In addition, Figure 19 presents visually the dine-in and the orders' sales volume for each year. Among the three years, although 2018 was the one with the higher volume of sales, the difference is almost unnoticeable. Additionally, orders sales have been increasing, replacing dine-in sales.

Figure 19. C3's # of sales per year, Dine-in VS Orders



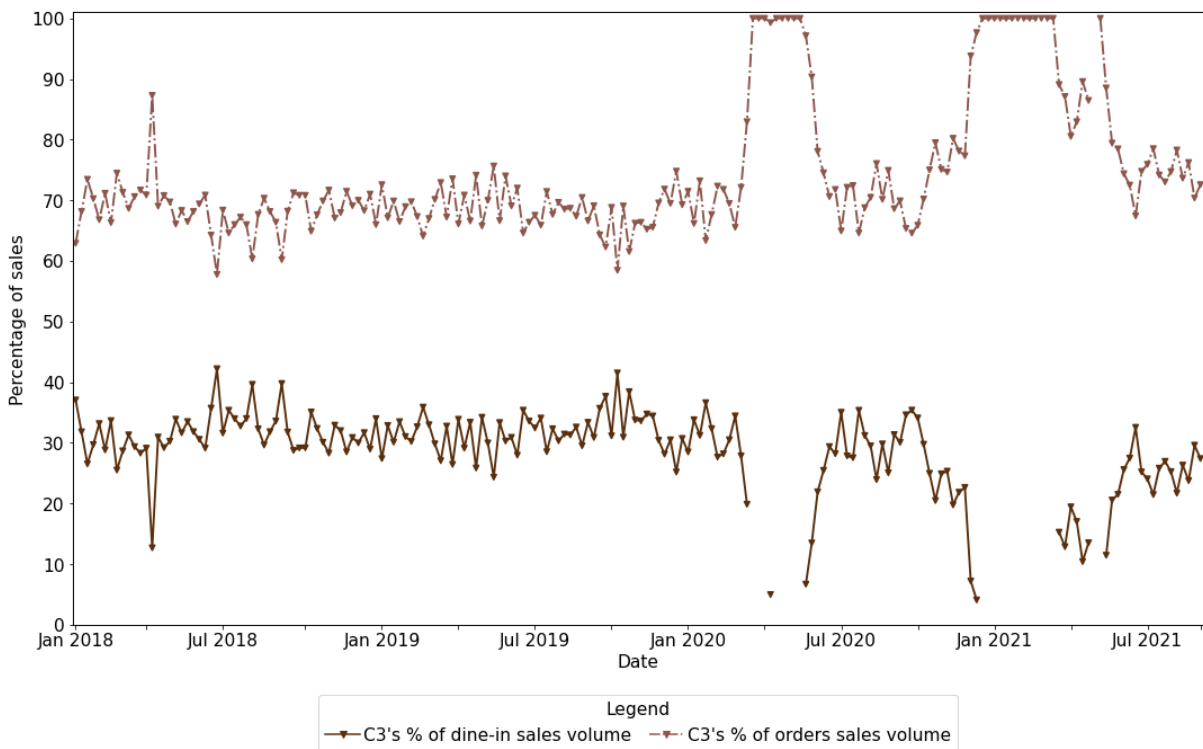
When looking at the orders' percentage volume distribution from January 2020 to August 2021, in Figure 20, it is visible a left-skewed distribution, where although the mean value is around 80%, the mode is 100%. These conclusions are confirmed in Figure 21: C3 has been gaining its profits mostly from orders, and that trend is been increasing.

Figure 20. Histogram (left) and Boxplot (right) representing C3's % of Orders volume, from January 2020 to August 2021



Note. These charts are considering the restaurant's distribution of orders in percentage, from January 2020 to August 2021.

Figure 21. C3's sales distribution, considering the weekly mean percentage of Dine-in and Orders, from January 2018 to August 2021



4.2.4. C4

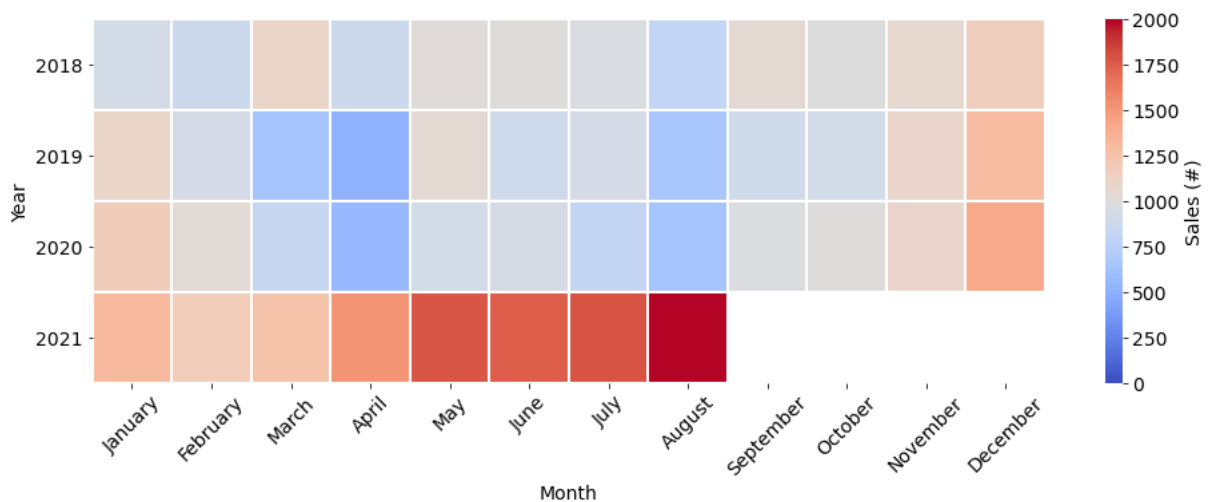
C4 is a pizzeria. Contrary to other Cypriot restaurants, as indicated in Figure 27, C4 only started to serve food at its facilities around July 2020. Before that, the business was dedicated to orders sales – focused on takeaway and delivery services, investing in its own delivery drivers.

Similar to C2, but switching the services, C4 registered dine-in sales on April 2019, but as it is an isolated situation and there is no explanation for it, it is difficult to infer its veracity and was considered to draw any conclusions.

C4’s sales data were analysed from January 2018 to August 2021.

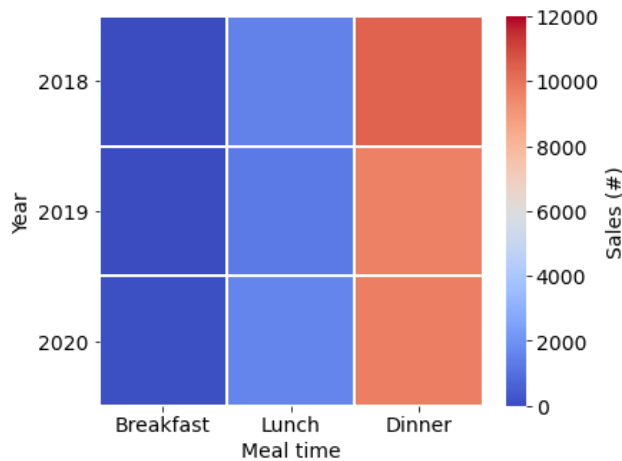
C4’s number of sales, distributed per year and month, in Figure 22, indicates that 2021, at least until August, was a very good year, as it had been increasing its volume, which can also represent an increase in profit. As in the previous three years, C4’s sales were higher at the end of the year. However, any month starting in April 2021 got better results than any other month in 2018, 2019 and 2019.

Figure 22. C4’s # of sales, distributed per year and month



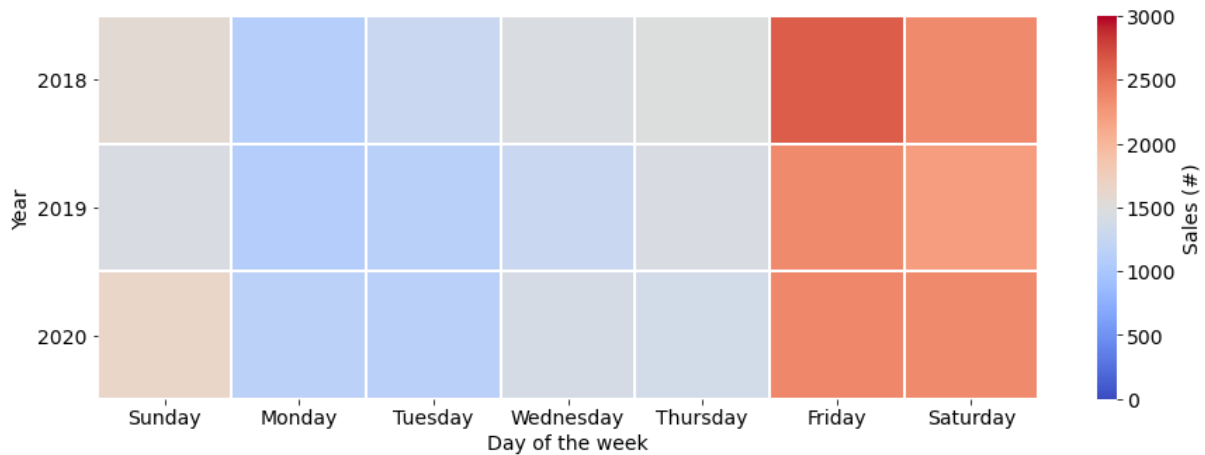
Figures 23 and 24 demonstrate the preferred mealtime and day of the week, respectively, for customers to eat C4’s pizzas. For the analysed three years (2018, 2019 and 2020), dinner on Fridays and Saturdays appears to be, considerably, the most popular period.

Figure 23. C4’s # of sales, distributed per year and mealtime



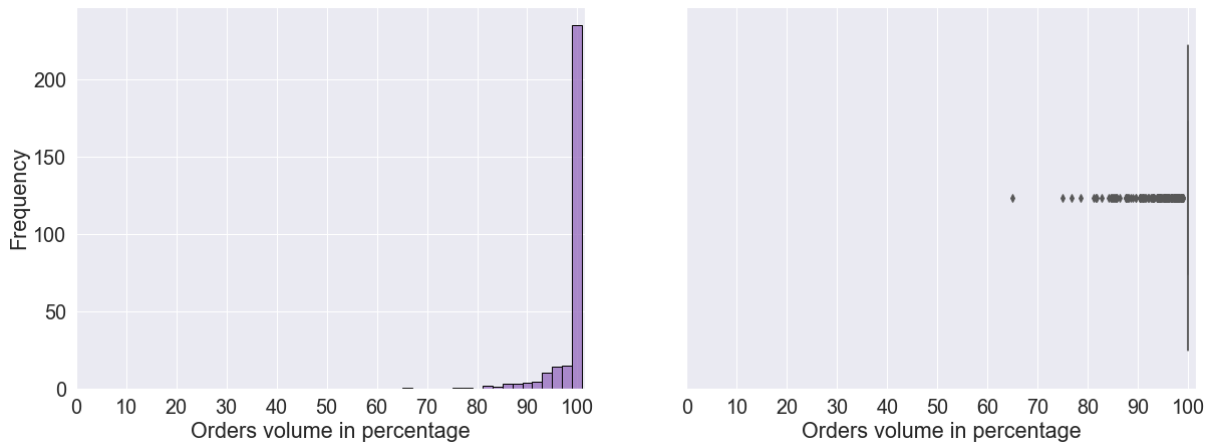
Note. Breakfast until 11 a.m., Lunch from 11 a.m. to 6 p.m. and lastly, Dinner after 6 p.m.

Figure 24. C4’s # of sales, distributed per year and day of the week



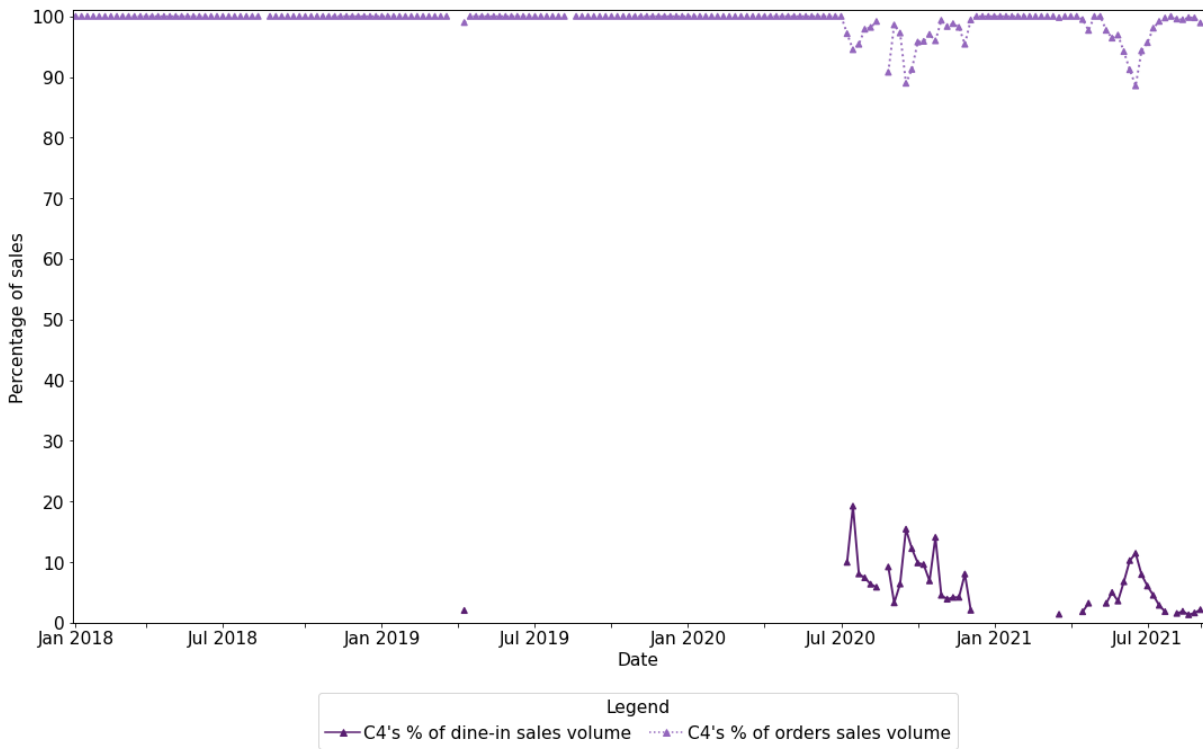
As Figure 25 shows the orders’ percentage volume distribution from January 2020 to August 2021, Figure 26 compares the volume distribution of both types of services during the period between January 2018 and August 2021. Figure 25 shows an accentuated negatively skewed distribution, where mean, median and mode are very close to one another, which is considered in Figure 26, where it is possible to verify that C4 gains are mainly from orders.

Figure 25. Histogram (left) and Boxplot (right) representing C4's % of Orders volume, from January 2020 to August 2021



Note. These charts are considering the restaurant's distribution of orders in percentage, from January 2020 to August 2021.

Figure 26. C4's sales distribution, considering the weekly mean percentage of Dine-in and Orders, from January 2018 to August 2021

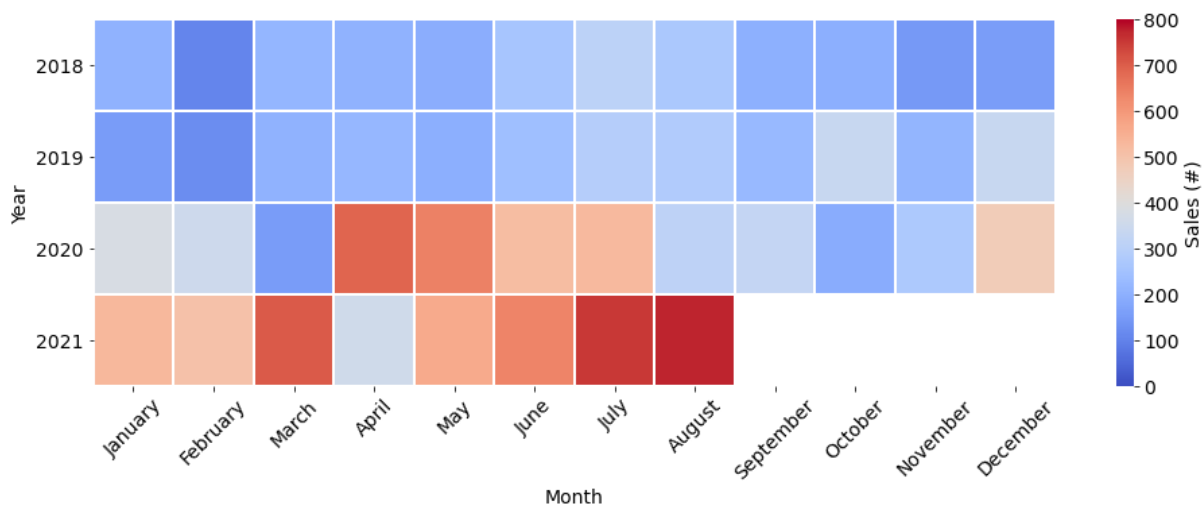


4.2.5. P1

P1 serves Japanese food, with a highlight on sushi. Its sales were analysed for this study considering the period between January 2018 and August 2021. The restaurant serves dine-in meals, but also offers takeaway and food delivery services since 2018, at least.

Looking at the following charts provides a better understanding of P1’s business. Figure 27 points out that the number of invoices did not exceed 400 per month, but it started to grow significantly in April 2020, adding about 50% extra to its average sales amount per month. April 2020 was not an isolated case, as the following three months were not bad either, despite being less than April. In August 2020 the usual values for 2018 and 2019 start to emerge again. Except for April 2021, when P1 struggled again; between December 2020 and August 2021, P1 thrived again.

Figure 27. P1's # of sales, distributed per year and month

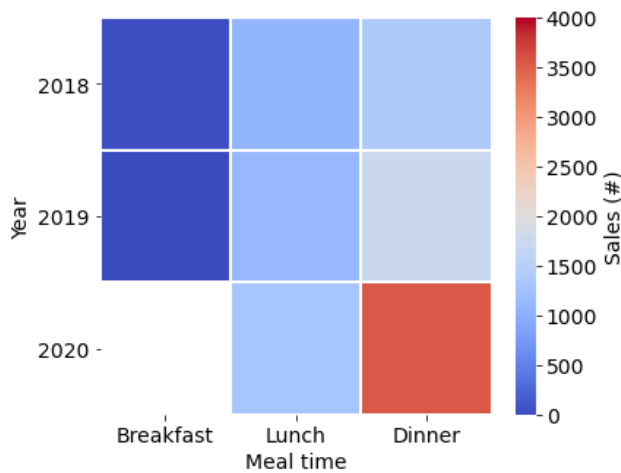


Figures 28 and 29 present a broad idea of the P1’s customers’ favourite mealtime and day of the week, respectively.

It is possible to conclude that P1, due to its cuisine being more adequate for lunch and dinner, is rarely sought for breakfast. Although the differences recorded in sales between the two times of the day were small, in 2018 and 2019, dinner was the period when P1’s was most wanted. That trend was accentuated in 2020, as more than half of its invoices were around dinner time.

In addition, P1's recorded just a few invoices on Sunday in 2018, but none in 2019 and 2020 for the same day, which may indicate that the restaurant started to close on that day of the week. As for the customers' favourite weekday to eat sushi from P1, according to the restaurant's sales data, is Friday.

Figure 28. P1's # of sales, distributed per year and mealtime



Note. Breakfast until 11 a.m., Lunch from 11 a.m. to 6 p.m. and lastly, Dinner after 6 p.m.

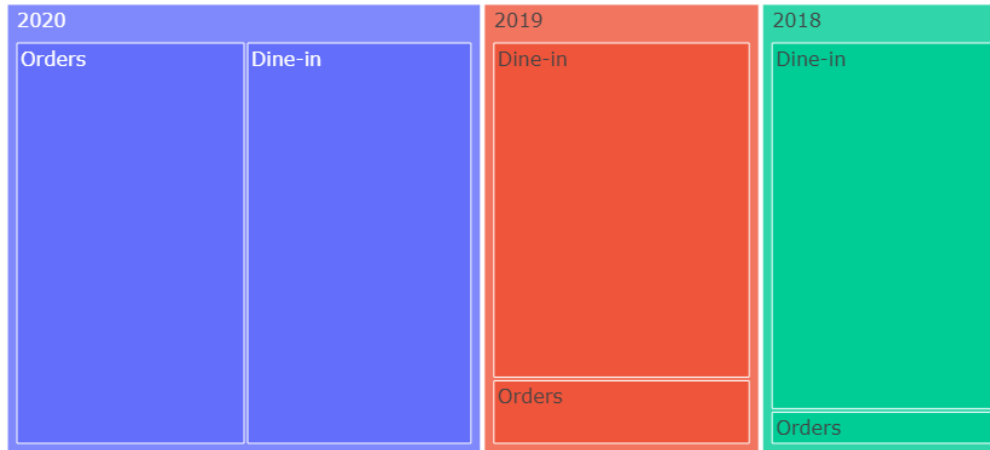
Figure 29. P1's # of sales, distributed per year and day of the week



Furthermore, the following treemap confirms what was observed in Figure 27: P1's business grow significantly in 2020 – according to Figure 30, the total number of sales in 2020 was almost the same as the sum of total sales of both years 2018 and 2019.

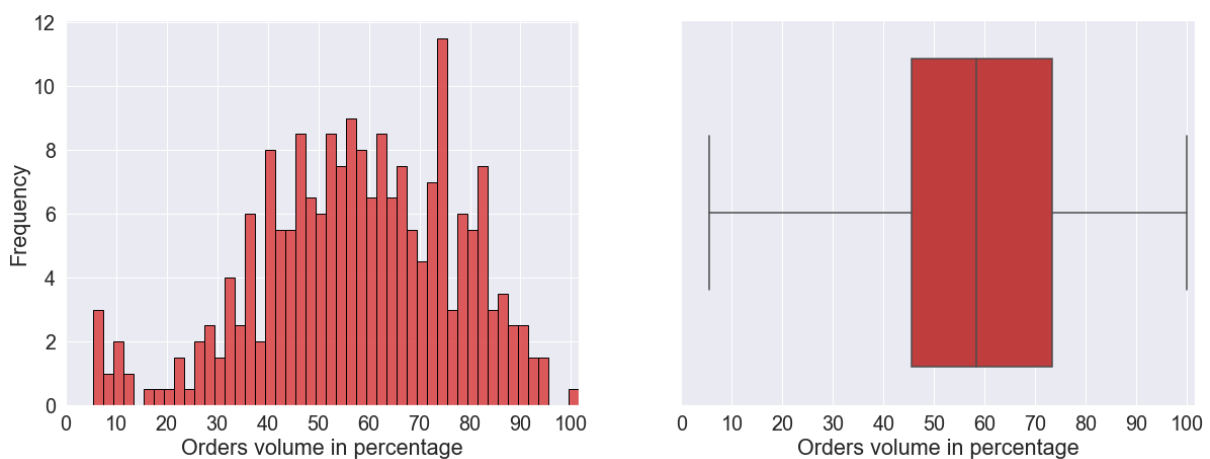
In addition to that, Figure 30 also provides a visual representation of how much orders service has been growing: from a small part of the total sales, in 2018, to half, in 2020.

Figure 30. P1's # of sales per year, Dine-in VS Orders



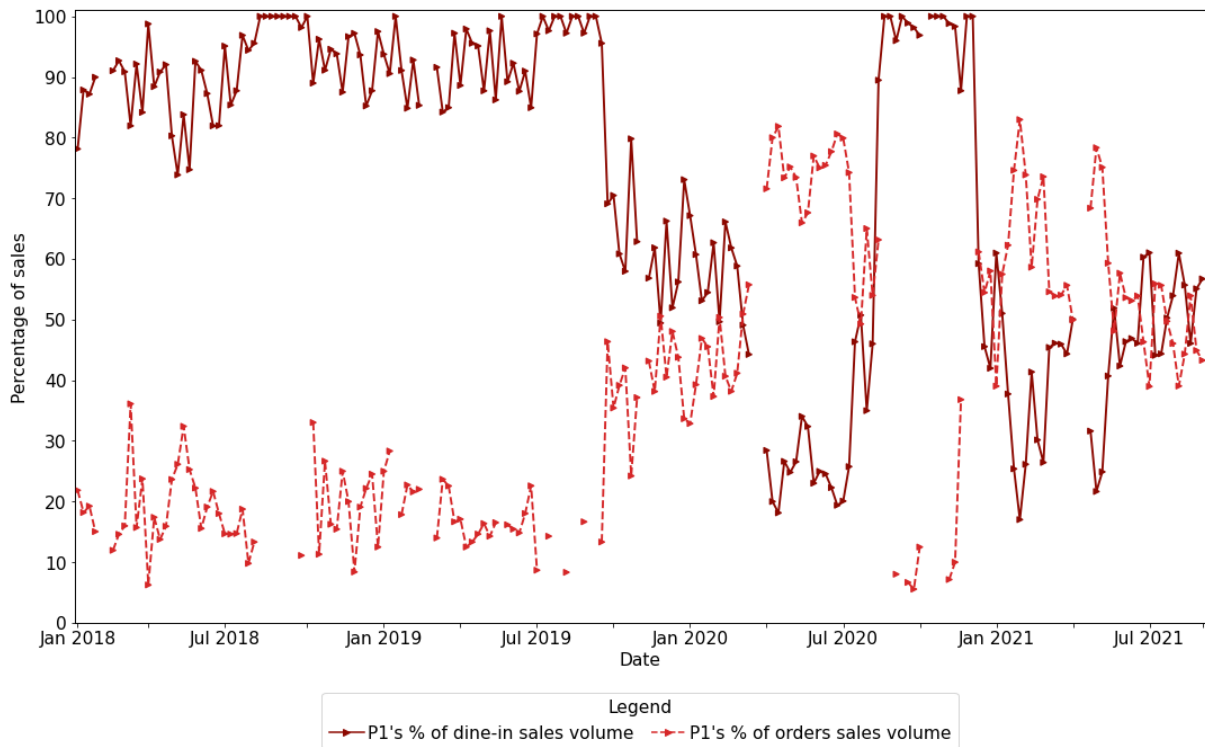
Lastly, Figure 31 shows the orders' percentage volume distribution from January 2020 to August 2021. These charts show that, during the analysed period, delivery and takeaway counted for, on average, 60% of the total sales. However, the contribution of the orders' service is not very consistent, as suggested by the whisker wider length of the boxplot, and that is noticeable in Figure 32 too. In the last trimester of 2019, orders service started to be more requested, and since 2020 both services have been relatively balanced.

Figure 31. Histogram (left) and Boxplot (right) representing P1's % of Orders volume, from January 2020 to August 2021



Note. These charts are considering the restaurant's distribution of orders in percentage, from January 2020 to August 2021.

Figure 32. P1's sales distribution, considering the weekly mean percentage of Dine-in and Orders, from January 2018 to August 2021



4.2.6. P2

P2 sells Italian food, having two businesses in one: a pizzeria and an ice cream shop. Beyond being possible to visit and enjoy its physical spaces, it is also possible to place an order for P2 through some of the available mobile delivery apps and also through its website.

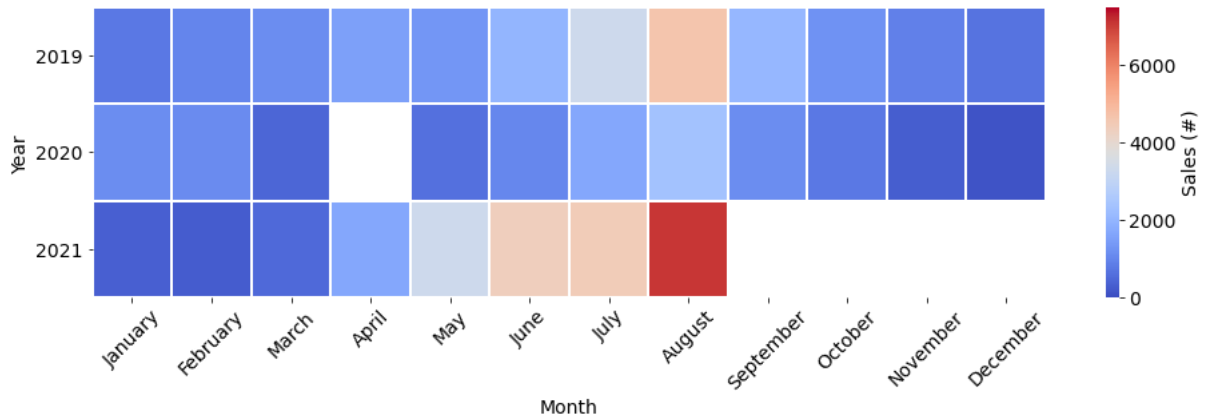
Contrarily to the other 5 restaurants, P2 has only provided sales data from 2019. Thus, its sales were analysed considering the period between January 2019 and August 2021.

The heatmap, in Figure 33, shows that P2's food is more requested in the summer, with a focal point in August, which can be related to its ice creams. Although August 2020 was the month in that year with the higher number of sales invoices, 2020 was not a very good year for P2's business.

In addition, April 2020 did not register any sales. Moreover, although the end of 2020 and beginning of 2021 suggested that P2 has struggled more than usual when compared to the

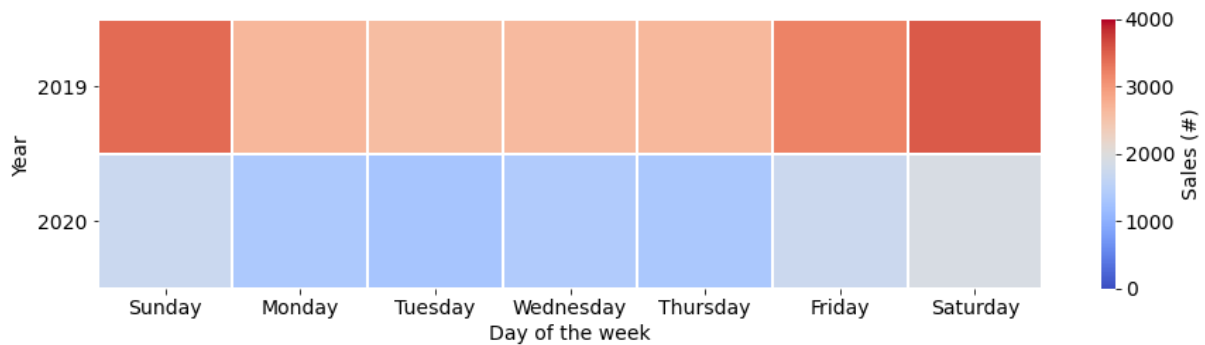
homologous period, Figure 33 also indicates that in the summer of 2021 (June, July and August), the business has been prospering.

Figure 33. P2's # of sales, distributed per year and month



Furthermore, it was not possible to get insights about the time of the day P2 usually records more invoices, as the invoice hour data was not provided. However, it was possible to infer the weekdays with more affluence. As previously mentioned, 2020 was not a very good year, but the preferences of its consumers who continued or started to visit or order from P2 remained the same. P2 usually get a higher amount of invoices on Saturday, Sunday and Friday, from that order.

Figure 34. P2's # of sales, distributed per year and day of the week



As for how much orders and dine-in contributes to the sales volume in a year, Figure 35 gives a clear understanding of, despite the number of total sales decreased, orders invoices started to gain strength in percentage in 2020 when contrasted to the dine-in ones.

Figure 35. P2's # of sales per year, Dine-in VS Orders

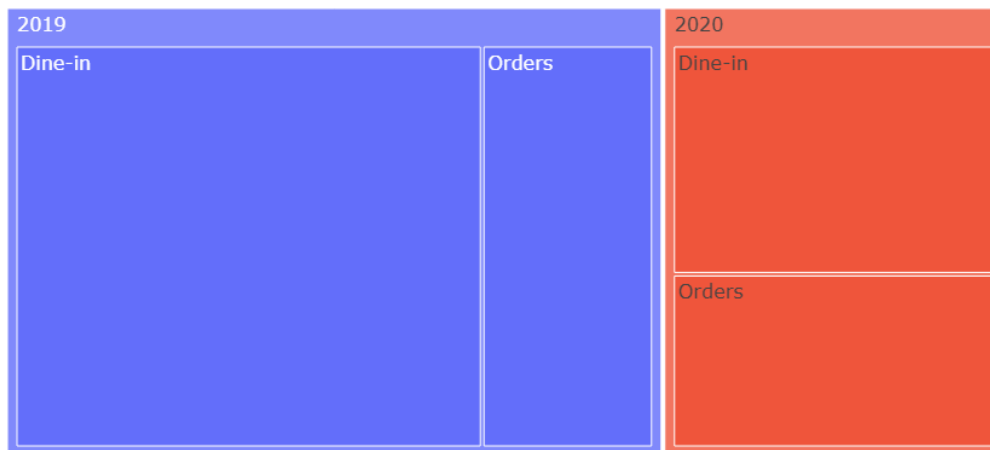
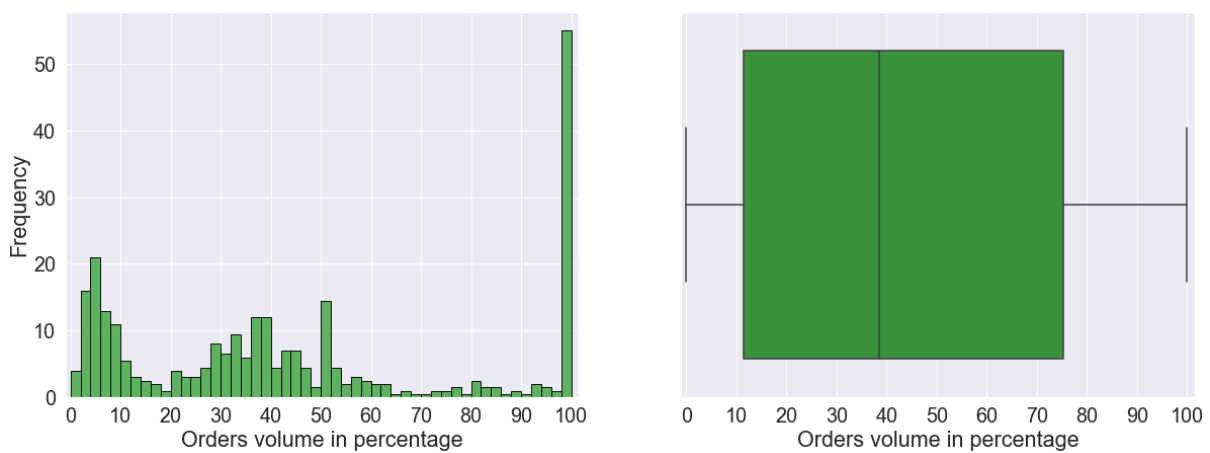


Figure 36 shows the orders' percentage volume distribution from January 2020 to August 2021, in a histogram and a boxplot. These charts illustrate that, during the analysed period, orders service counted for, on average, 40% of the total sales. On the other hand, its contribution to the orders sales amount is quite irregular. That fact comes from the observation of the boxplot, in Figure 36, which indicates more variable data due to its wider ranges (whisker length and also box size).

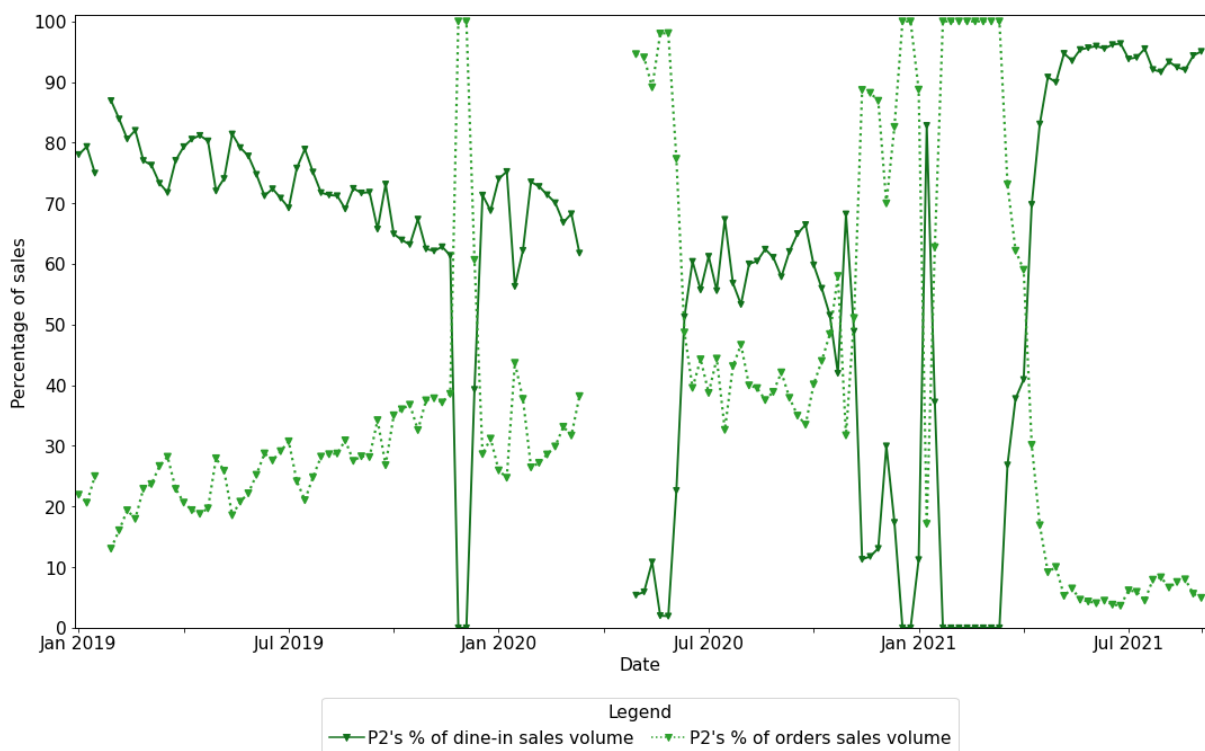
Figure 36. Histogram (left) and Boxplot (right) representing P2's % of Orders volume, from January 2020 to August 2021



Note. These charts are considering the restaurant's distribution of orders in percentage, from January 2020 to August 2021.

Finally, Figure 37 shows, in percentage, the contribution of each one of the two available services: dine-in and orders. As stated before, delivery and takeaway services started to be more wanted at the end of 2019, extending until the end of the first quarter of 2021, having its ups and downs during that period. The line chart also demonstrates that the percentage of orders sale volume decreased dramatically, getting to lower values (in percentage terms) than in 2019.

Figure 37. P2's sales distribution, considering the weekly mean percentage of Dine-in and Orders, from January 2019 to August 2021



4.3. Inferential analysis

4.3.1. Comparison between SI and restaurants' percentage of orders volume

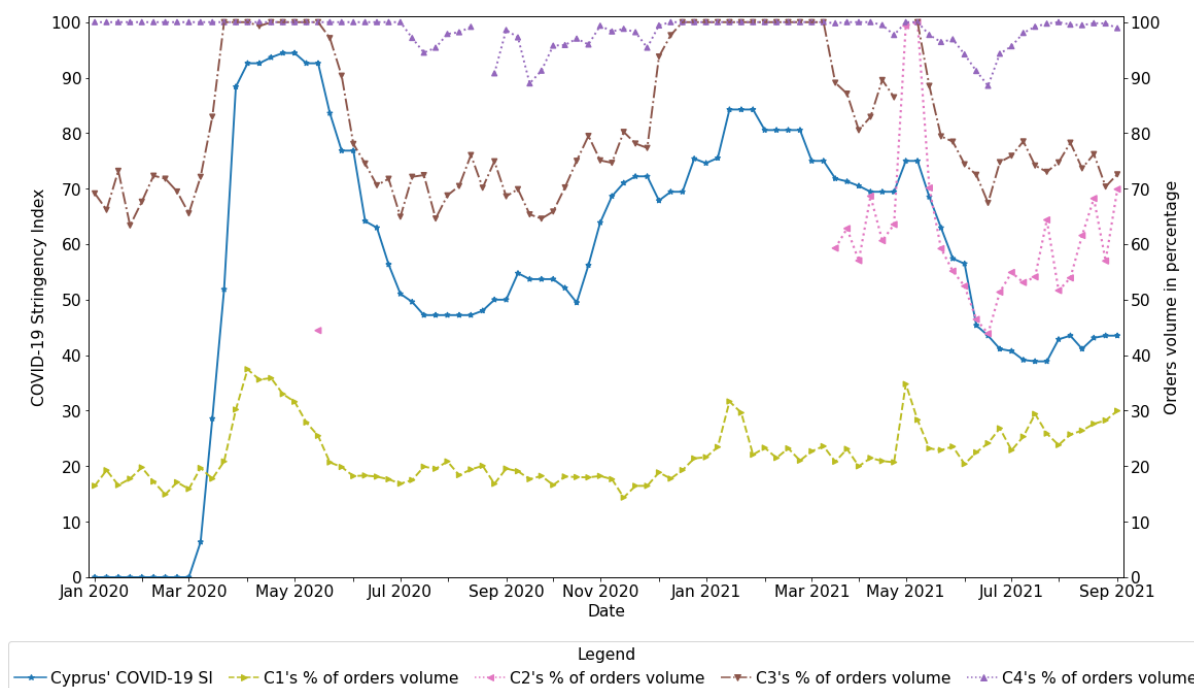
To address the impact of COVID-19, and the associated governments' measures to prevent its spread, on restaurants' businesses, Figures 38, 39, 40 and 41 were designed for better visual inference.

Figures 38 and 39 exhibit Cyprus’ panorama and its four restaurants.

In the line chart, in Figure 38, we can observe that, despite being in different volumes, C1 and C3 increased the volume percentage of their orders when the stringency measures increased. Although C4 was already strong in delivery/takeaway, when some of the restrictions were lifted (and COVID-19 SI decreased), its orders volume in percentage slightly decreased as well, meaning customers restart to have meals in C4’s facilities. These three positive correlations between each one of the three restaurants and COVID-19 are confirmed in Figure 39.

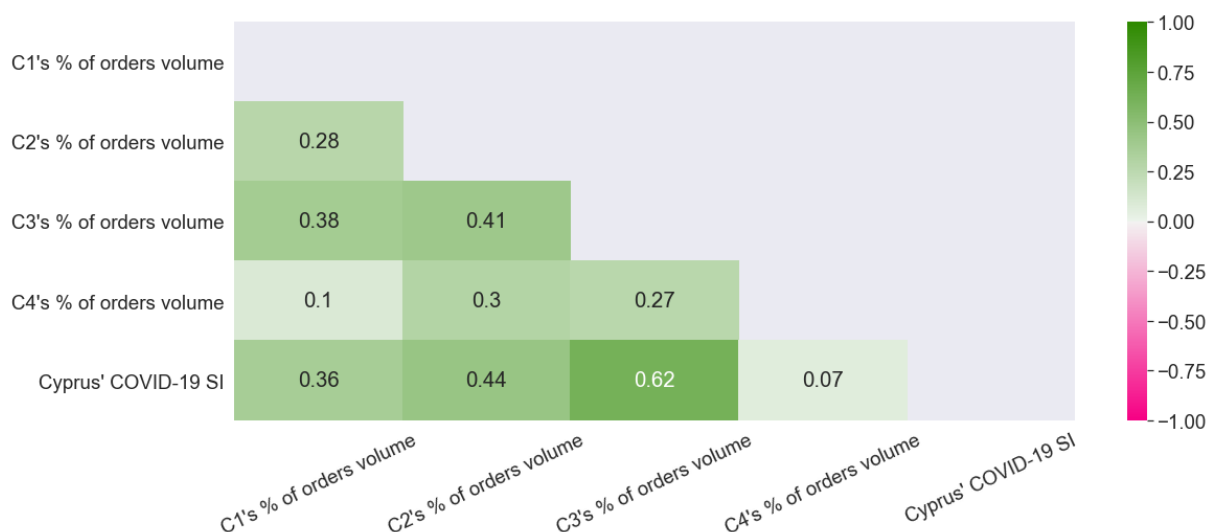
On other hand, as stated previously, C2 started to invest in the delivery/takeaway business model only in March 2021, so this analysis was restricted to five months. Although the short time span, two specific correlations can be drawn: one, around May 2021, C2 got a high peak in its orders’ volume when the SI increases marginally; and another one, in mid-June 2021, when the orders’ invoices decreased at the same time the SI did.

Figure 38. Evolution from January 2020 to August 2021 of Cyprus’ COVID-19 SI compared with the orders volume in % for each restaurant



Note. To better visualisation, the data was resampled by average per week.

Figure 39. Diagonal correlation heatmap for Cyprus’ restaurants and COVID-19 SI



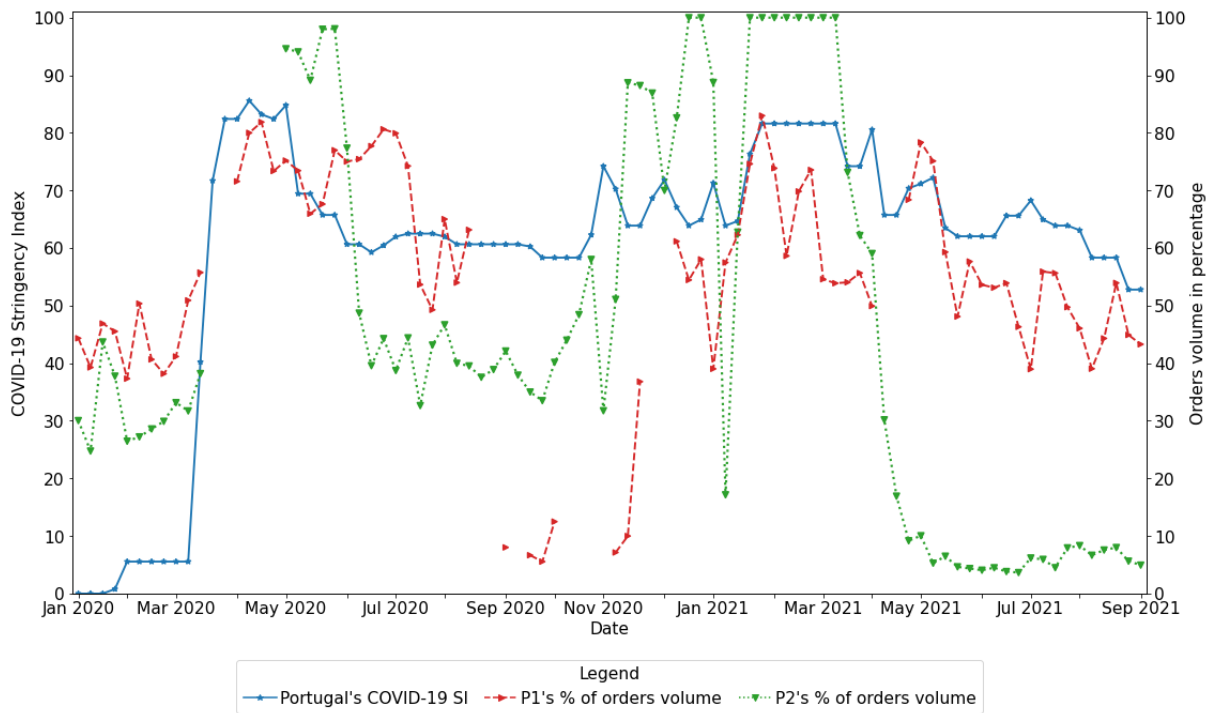
Figures 40 and 41 are about Portugal’s panorama and its two restaurants.

Unlike Figure 38, Figure 40 shows more gaps – some dots do not connect with others, suggesting P1 and P2 interrupted their services more often (as they did not register any invoices in those periods). That is, mainly, the case for P1, which makes it more difficult to deduce any impact that COVID-19 may or may not have had on its business. Accordingly, Figure 41 displays a low correlation between P1 and Portugal’s COVID-19 SI.

One of those interruptions in its services happened not much later after the first cases of COVID-19 appeared, corresponding to the exact time as the SI increased, i.e. the Portuguese government took actions to mitigate the pandemic spread. One of those actions was the closure of restaurants.

Moreover, there are some periods where P2’s percentage of orders volume increased when the SI increased. However, there is also some unconformity: P2’s orders volume appears to be quite unstable as, in some weeks, it recorded a very high volume of orders (in percentage terms), but in the following week, a very low. Additionally, in Mid-April 2021, its orders volume decreased drastically, for which there were no provided explanations. COVID-19 does not look as if it is the principal reason, since the SI decreased around that same time, but not that much. The diagonal correlation heatmap, in Figure 41, confirms that the correlation between both is low.

Figure 40. Evolution from January 2020 to August 2021 of Portugal's COVID-19 SI compared with the orders volume in % for each restaurant



Note. To better visualisation, the data was resampled by average per week.

Figure 41. Diagonal correlation heatmap for Portugal's restaurants and COVID-19 SI



Considering the initial assumption that Cypriot consumers were more likely to consume more delivery and takeaway food than Portuguese ones, Figures 38 and 40 were considered to give not enough information to conclude anything. On one hand, the Portuguese restaurants analysed were only two, showing an irregular demand for ordering services. And on the other hand, each Cypriot restaurant has a different percentage of orders sales volume.

4.3.2. Statistical inference of distributions

To determine if restaurants' percentage of orders volume and COVID-19 SI have a similar distribution, Kruskal-Wallis H-test was used. This statistical test determines if the medians are equal across the samples (H_0). Kruskal-Wallis is the non-parametric test equivalent of the one-way ANOVA, meaning it does not assume normally distributed data.

Rejecting the H_0 (null hypothesis) means that at least one group has a different median, i.e. it provides sufficient evidence to conclude that at least one group has a different distribution. To reject the H_0 , in this study, it was considered the p-value must be less than 0.0001 ($P < .0001$); if the p-value is greater than or equal to 0.0001, it fails to reject the H_0 , meaning that exists sufficient evidence to say there is a statistically significant difference between the groups' distribution.

As table 1 presents the summary of the tests done, on Cypriot restaurants', table 2 is dedicated to the Portuguese ones. The samples used were the percentage of orders volume from January 2020 to August 2021, comparing them among restaurants. It also used the COVID-19 SI of the corresponding country, in the same period.

Table 1. Results of the Kruskal-Wallis H-tests about the Cypriot restaurants

#	Groups	Kruskal-Wallis H Statistic	p-value
0	C1, C2, C3 and C4	1565.594694	0.000000e+00
1	C1, C2 and C3	1041.574259	6.683799e-227
2	C1, C2 and C4	1143.865371	4.100065e-249
3	C1, C3 and C4	1408.865823	1.161315e-306
4	C2, C3 and C4	642.041890	3.822743e-140
5	C1 and C2	365.433188	1.847342e-81
6	C1 and C3	891.688267	6.290728e-196
7	C1 and C4	947.125545	3.390034e-208
8	C2 and C3	163.892372	1.596885e-37

9	C2 and C4	431.944648	6.132503e-96
10	C3 and C4	421.482927	1.160569e-93
11	C1 and Cyprus' COVID-19 SI	526.654939	1.509001e-116
12	C2 and Cyprus' COVID-19 SI	0.599348	4.388268e-01
13	C3 and Cyprus' COVID-19 SI	330.878955	6.185155e-74
14	C4 and Cyprus' COVID-19 SI	928.370185	6.677113e-204

Table 2. Results of the Kruskal-Wallis H-tests about the Portuguese restaurants

#	Groups	Kruskal-Wallis H Statistic	p-value
15	P1 and P2	61.295506	4.912001e-15
16	P1 and Portugal's COVID-19 SI	13.440344	2.462705e-04
17	P2 and Portugal's COVID-19 SI	87.370808	8.996864e-21

On one hand, tests #0 to #10, and also test #15 were conducted to answer the question: does COVID-19 impact restaurants' percentage of orders? Namely, to determine whether or not there is a statistically significant difference between the median percentage of orders from different restaurants.

Since the p-value, for each one of the performed tests, with different restaurants' combinations, was less than 0.0001, H_0 could be rejected. Therefore, there is sufficient evidence to conclude that the pandemic situation led to statistically significant differences in restaurants' percentage of orders volume.

On other hand, tests #11, #12, #13, #14, #16 and #17 used two samples each: the restaurant's percentage of orders volume and the corresponding calculated SI.

For the two tests #12 and #16, H_0 could not be rejected. These results imply that the median of one sample is different from the other; in other words, there is no sufficient evidence for significant differences between C2's percentage of orders volume and Cyprus' COVID-19 SI, nor between P1's percentage of orders volume and Portugal's COVID-19 SI.

Lastly, since the p-values for tests #11, #13, #14 and #17 were less than 0.0001, the H_0 for each one of them was rejected. This means that exists significant differences between the median of the restaurant's percentage orders volume and the stringency index.

5. CONCLUSIONS

The study offers useful implications for managers seeking optimization. Restaurant managers can use the descriptive analysis approach to identify the customers' preferred mealtime, weekday or year's seasons, which helps adjust resources and marketing efforts, and prioritize tasks. In addition to that, the same methodology can be applied to other industries and businesses that are looking for insights into consumer behaviour, to keep up with the market and behaviour changes, and improve their results.

Furthermore, through the data analysed, the work provides speculations that adding delivery and/or takeaway services to the restaurants' business models was crucial for their survival during a rough time, such as a pandemic. Although the orders volume tends to decrease with the mitigation of government restrictions imposed, this service is still searched for by consumers, representing an additional source of revenue.

Taking into account the culture of Portugal and Cyprus, and the measures and restrictions adopted by the governments, both countries seemed to have fought the pandemic very similarly, and for this reason, it was not possible to infer cultural conclusions and impacts.

Lastly, the findings imply that, although there is a small positive correlation between the restaurants' orders (both delivery and takeaway), due to the performed statistical tests, it was concluded that the pandemic situation led to statistically significant differences among restaurants' orders sales volume. All things considered, there is no proof that the Coronavirus outbreak triggered the same impact on different restaurants.

6. LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Despite the contribution of this work by addressing two different countries, their cultural dimensions score was found to be very similar, and the analysis detailed in this report could not indicate differences between Portuguese and Cypriot consumer habits. In addition, there are much more different cultures, regions and countries, that might react differently, to which the same model could be applied.

Another limitation, due to confidentiality, is the fact that restaurants/cafes, from which the data was collected, may not be a good representation of the delivery and takeaway services in both countries, resulting in bad characterization.

Furthermore, it was also not possible to differentiate between delivery and takeaway, which can be a new approach to develop in future research.

Lastly, after-pandemic habits are yet to be discovered. It would be relevant to do the same work for later periods without any COVID-19 restrictions related, to fully answer the subject of the COVID-19 pandemic's impact on consumer food ordering habits in long term.

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