

Balancing the quantitative/qualitative divide:
A rhythmalytic review of Seattle's Black-Owned Restaurants' experience
during the COVID-19 pandemic (2020-2021)

Xiaoqi Bao

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Committee:

Bo Zhao

Michael Brown

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Xiaoqi Bao

University of Washington

Abstract

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Xiaoqi Bao

Chair of the Supervisory Committee:

Bo Zhao

Department of Geography

The unprecedented COVID-19 pandemic has prompted a surge in quantitative research aimed at comprehending its causes, progression, and spatial-temporal disparities. Nevertheless, there has been significant and ongoing critiques of quantitative approaches in geography since approximately 1970, with prolonged debates regarding the quantitative/qualitative divide lasting for decades. Echoing the appeals for non-binary mediations for this epistemological dichotomy, this Master's project proposes a new mixed-method approach, which applies rhythmanalysis, a traditionally qualitative analytical framework, on burgeoning big geospatial data. This new approach is comprised of four sequential steps, including 1) choosing the body, 2) identifying the rhythms, 3) measuring the rhythms, and 4) analyzing the polyrhythmia. To demonstrate its utility

and feasibility, I designed an empirical study to understand Seattle's Black-owned restaurants' experience during the pandemic (2020-2021). The case study proved the viability of the original method and generated a more situated understanding of Seattle's Black-owned restaurants' situation during the first two years of the pandemic. This project makes significant theoretical and practical contributions to the discipline and society by introducing a new methodological orientation for more humanistic geographic investigations. Lastly, it is worth noting that, part of the arguments of this thesis is built upon the paper that I co-authored and made significant contributions to in the empirical study and discussion. The paper titled "Black Businesses Matter: A Longitudinal Study of Black-Owned Restaurants in the COVID-19 Pandemic Using Geospatial Big Data" was published in 2022 in the *Annals of the American Association of Geographers*.

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1 Introduction

The COVID-19 pandemic has profoundly impacted human society since the end of 2019. Geographers, along with a plethora of researchers from various disciplines, have made significant contributions to understanding the pandemic from different aspects, such as the spread of the pandemic, social management, public behavior, and impacts of the pandemic (Xi et al., 2022). A recent systematic review of COVID-19 geographical research by Xi et al. (2022) revealed that most of the literature by geographers is in the areas of geographic information systems (GIS) and human geography, and that most of the methodologies are quantitative. While quantitative methods have been proven to have unique advantages in modern geography, they also received rather fierce criticism from critical geographers, which, at the same time, aligned with the general critiques of positivism. The debates on quantitative versus qualitative have been going on for decades since the start of the quantitative revolution in Geography. While some scholars hold firmly on either side, some have also called for a non-binary view of quantitative and qualitative methods (Kwan and Knigge, 2006; Lawson, 1995; Schuurman, 2000; Sheppard, 2000). Therefore, in recognition of the more inclusive methodology in alleviating the disagreements between the quantitative and the qualitative, I propose an innovative approach, which applies a traditionally qualitative framework to the burgeoning geospatial big data, to both address the ontological critiques in spatial research methods and to contribute to the COVID-19 geographic literature for better understanding of the pandemic.

Besides the pandemic, the year of 2020 was also an unprecedented year for the Black Lives Matter Movement - the scale of the protests for racial justice and civil rights made it possibly the largest in U.S. history (Buchanan et al., 2020). The murder of George Floyd, also an African American, by the Minneapolis police officer Derek Chauvin, sparked the national, if not

worldwide, increased demand list for racial justice (Westerman et al., 2020). Efforts across different disciplines show that racial inequity has been particularly exacerbated by the pandemic, unfortunately. Epidemiologists (Millett et al., 2020; Wiley et al., 2022) have revealed that the prevalence and morbidity issues are comparatively worse among African American populations. In the meantime, economists and social scientists also reached the conclusion that the pandemic has more severely challenged Black businesses through analyzing the results from a variety of economic and population data, such as the Current Population Survey, Small Business Credit Survey, and other customized surveys (Dua et al., 2020; Fairlie, 2020; Mills and Battisto, 2020; U.S. Federal Reserve Banks, 2021). It is clear that U.S. Black communities have been disproportionately impacted by the pandemic due to the entrenched systematic inequities in U.S. society (Dyer, 2020; Gray et al., 2020; Moore et al., 2020).

While not an African American, I am still part of the minority population in the U.S. Recognizing the distinctive demands between different race/ethnicity groups, I believe that any endeavor supporting minority communities would be invaluable in fostering unity within a divided society. As an early example, Ley and Cybriwsky (1974) two white urban geographers, ensured that the voice of Black communities would be heard by a broader audience through their groundbreaking work on racial tension and urban graffiti in Philadelphia. William Bunge, a radical quantitative geographer, also devoted his time and energy to issues of race and class in his later years (Bergmann and Morrill, 2018; Goodchild, 2008). As McKittrick (2006, xii) states, “Black matters are spatial matters.” Being a geographer who luckily has access to GIS resources, I wish to appropriately utilize my skills and critical thinking to join the collective cause of understanding the minority groups’ lived experiences and informing needed efforts in addressing social inequity with an innovative approach.

Under the dual influence of the unsettled quantitative/qualitative debate in geography and the unprecedented public health crisis that has been throughout my Master's study, this M.A. thesis aims at demonstrating the viability of rhythmanalysis with big geospatial data through the case study of Seattle Black-owned restaurants from 2020 to 2021. This novel combination of a traditionally qualitative method and burgeoning big quantitative data will be a progressive methodological attempt at bridging the quantitative/qualitative divide in a non-binary manner, signifying a more inclusive future of GIScience. At the same time, the empirical analysis through the method will also help shape a more situated and humanistic comprehension of the Black communities' experience during the pandemic. As a result, this project will make considerable contributions to both geographic research methodologies and spatial understandings of the pandemic-related racial inequities in the U.S.

2 Literature review

2.1 Geographical studies on the pandemic's differential impacts on Black communities/racial minorities

As the COVID-19 pandemic and its impacts have permeated almost all aspects of our lives, geographers have been active in understanding the pandemic since its beginning. Since early 2020, teams of geographers from different universities and organizations have worked actively and interdisciplinarily in creating and maintaining web maps that track the spread of the disease (Dong et al., 2020; Humanistic GIS Laboratory, 2020; The New York Times, 2020). As time passes, increasingly more geographical scholarships have attempted to understand the geographies of COVID-19 from various perspectives.

During the past two years, there has been an abundance of geographical research that utilizes different types of quantitative data and methods, thanks to the rapid growth of spatial data. The emerging trends of geospatial big data (Lee and Kang, 2015) and human dynamics (Shaw et al., 2016), fueled by the rapid development of location-based services, have led to an exponential growth of available human mobility data that document spatially explicit interactions among individuals and places, as well as advanced mobility analytical approaches that capture fine-grained visitation patterns. These fine-grained spatial data have enabled researchers to investigate the short- and long-term societal and economic effects of the COVID-19 pandemic and understand how social interactions and place connectivity have transformed during, under, and after the pandemic (Zhang et al., 2022). Numerous efforts have been made to harness the power of geospatial big data from various sources to understand the impact of the pandemic on human interactions and place visitations.

In the past five years, companies such as SafeGraph (<https://www.safegraph.com>), Cuebiq (<https://www.cuebiq.com>), and Foursquare (<https://foursquare.com>) started to offer place visitation patterns as part of the commercialized location intelligence. To protect privacy, such data are provided in aggregated forms and personally identifiable information has been removed. Such data have seeded a variety of investigations into the changing patterns of place visitation, especially during the pandemic. For example, Li et al. (2021) examined the effect of social distancing on changes in visits to urban POIs in sixteen cities in the United States and found disparate patterns across cities in terms of reduction in POI visitors. Kupfer et al. (2021) used mobility records released by SafeGraph to map and analyze the spatio-temporal patterns of visits to six national parks in the western United States. Wang et al. (2021) explored the temporal patterns of visits to healthcare POIs and examined how these patterns are associated with sociodemographic and spatial characteristics. Chalfin, Danagoulian, and Deza (2021) investigated the visits to bars and liquor stores in Detroit and further correlated the visits to alcohol outlets with domestic violence. Huang et al. (2021) revealed the socio-economic disparities in complying with stay-at-home orders during the pandemic. These studies benefited from the high representativeness and dense spatiotemporal granularity of cellphone-derived place visitation dynamics.

Compared to quantitative studies, geographical research that adopts qualitative data and methods is much scarcer. Manzo and Minello (2020) conducted online interviews to investigate the domestic rearrangements caused by the pandemic in Italy. Neely and Lopez (2022) conducted interviews with geography scholars within the U.S. and studied the differential impact of the pandemic on people of different genders, colors, and ages. Another group of geographers (Day et al., 2021) studied the impact of the pandemic on post-secondary teaching and learning

from six different institutions in the U.S., Canada, and Hong Kong by utilizing surveys of students. Scholars from other social science and health disciplines contribute a greater portion of qualitative studies on COVID-19. For instance, Aliyu et al. (2021) revealed the increased COVID-19 risks for Black patients in the U.S. by learning about their lived experiences through one-on-one interviews. Using content analysis of media articles, (Yang et al., 2022) investigated the anti-Asian racism and race-based stress during the pandemic.

In reality, the number of pandemic-related quantitative research, particularly from the discipline of geography, exceeds by far that of the studies using qualitative approaches. Nevertheless, qualitative research is still considered indispensable to pandemic-related studies, as the methods that focus more on lived experiences can inform more targeted and appropriate approaches to address the issues that appeared during the pandemic responses (Newman et al., 2021). Geographic scholars have been discussing the quantitative/qualitative divide for an extended time. The following sub-section serves as an overview of the academic debates.

2.2 History of the quantitative/qualitative dichotomy

The quantitative/qualitative discussion is a rather large topic in the development of geography as an academic discipline and it emerged after the quantitative revolution within the discipline. The quantitative revolution, which happened in the 1950s, marked a change from idiographic geography to nomothetic geography through the approach of spatial analysis (DeLyser et al., 2010; Gregory et al., 2009; Pickles, 1995). As described in *The Dictionary of Human Geography* (Gregory et al., 2009), young generations of quantitative geographers performed law-making analysis of spatial structures by embracing statistical methodologies that had prevailed in natural sciences. One of the most well-known examples is the first law of geography by Waldon Tobler (1970, p. 236) – “everything is related to everything else, but near

things are more related than distant things.” *Explanation in Geography*, an earlier textbook-level piece by David Harvey (1969), articulates the quantitative approaches in geography at the time and shows influences from positivism and empiricism.

Alongside the intellectual movements, the technological advancements in the second half of the twentieth century helped bear the concept of GIS, which was initially regarded merely as a tool for geographic investigations. The first formal appearance of “geographic information system” is the Canadian Geographic Information System (CGIS) developed by Roger Tomlinson and his team in the 1960s (Goodchild, 2018) for land use management. As computer technologies developed at a tremendous speed and became increasingly more efficient and affordable, Dobson published the famous article “Automated Geography” (1983) on *Professional Geographers*, which is a cheerful introduction to multiple GIS techniques, such as computer graphics and remote sensing, and how they could assist in more comprehensive spatial analysis. Despite the developments in quantitative techniques and technologies, there has been criticism of quantitative methods and GIS, as the latter was regarded as “an outgrowth of the ‘quantitative revolution’” (Pickles, 1995, p. 51). Part of the critiques revolved around epistemology. Crowe (1970), Harris (1971), and Sack (1972) expressed concerns that quantitative methods in geography led to spatial reductionism and were unable to capture the complexity of lived experiences. There could be problems with the data used by quantitative geographers and GIS users, as Taylor (1990) emphasized in an editorial comment that geographic information was not equal to geographic knowledge. Pickles, Taylor, and Johnston also wrote in the famous critiquing work of GIS, *Ground Truth* (Pickles, 1995), that the data used in spatial analysis were usually partial representation of the world and would thus lead to only partial, if not wrong, understandings of geographic phenomena.

The underlying politics and power implications with the quantitative and the subsequent development of GIS are also interrogated. Gould (1979) pointed out the profound masculism and Western centrism associated with the quantitative revolution - the pioneers and early promoters were all men from Western, First World countries, resulting in quantitative techniques and explanations that largely ignored the worldviews of certain groups, such as females and underdeveloped regions of the world. The same comment falls upon GIS, as initially GIS technologies were developed with primary support from governments and utilizations in the military domains (Gregory et al., 2009; Smith, 1992). Social geographers, including feminist geographers and queer geographers, indicated that much of the lived experience should not and can not be quantified into numeric data that are commonly used in spatial analysis, and some even detest quantitative approaches as the inherent masculinity and authoritativeness are against alternative worldviews at root (Brown, 1994; England, 1994; Kwan, 2002; Lawson, 1995).

Going beyond the epistemological and political concerns with the quantitative, human geographers also posed the grand ontological question of what we should study. Following the definition given by the renowned human geographer Yi-Fu Tuan - geography is “the study of the earth as the home of people” (1991, p.99), human geographers are more concerned with *place* than *space*. The former is attributed with significance, and the latter refers to any physical location on Earth (Gregory et al., 2009). Adding to this recognition, Buttimer (1976) explained the concept of “lifeworld” (p. 277), in which, instead of being objects moving across spaces in the objective world, humans experience the world in a proactive and subjective manner. Positivist quantitative and GIS means are usually incapable of supporting such humanistic investigations (Zhao, 2022).

Despite the criticism of the quantitative developments throughout most of the second half of the 20th century, quantitative geographers and the subsequent GIS scholars continued their work, deliberately ignoring the criticism, as many of them believed that the critics naively negated their efforts instead of communicating for improvements (Dixon and Jones, 1997; Gregory et al., 2009). Yet the discussions around GIS along with quantitative methods have become more inclusive and collaborative starting from the late 1990s, as identified by Schuurman (2000), Goodchild (2010; 2022), and Elwood (2022) in their review pieces. Instead of simply arguing the right and wrong of the quantitative, scholars began to scrutinize new constructs of research epistemologies and ontologies that would avoid the dualism between the quantitative and the qualitative. In 1993, Lawson provided an early example of incorporating quantitative methods into overall qualitative investigations of the gender divisions of work in Quito, Ecuador. Two years later, as a critical feminist geographer, she explicitly wrote that, this emphasis on the difference between quantitative and qualitative methods among geographers has obscured considerable overlap in the actual operations involved in both sets of techniques.” (1995, p. 451) At the end of Sui’s (1994) review article on GIS development, he reflected upon the positivist philosophies behind GIS along with its critiques and suggested the need for a change where “all the participants involved in this debate [of the quantitative] transcend themselves and work together for a harmonious synthesis of theory and technology.” (p. 272)

GIS scholars also began exploring ways to “rewire” GIS methodologies so that the limitations from the positivistic and political roots could be addressed. Weiner et al. (1995) were among the first to implement participatory GIS in their research of understanding apartheid in South Africa. Different from traditional top-down forms of GIS, where knowledge is produced by those in power, participatory GIS allows local communities to actively participate in

geographic knowledge production through a bottom-up manner, which changed the politics of knowledge production (Elwood, 2006; Weiner et al., 1995). As web technology developed at an unprecedented speed, in 2007, Michael Goodchild summarized the concept of volunteered geographic information (VGI). VGI shares the same merit as participatory GIS – it makes spatial knowledge generation and communication more decentralized and democratic. The most prominent instance nowadays would be OpenStreetMap. The concept of qualitative GIS has also been promoted, as it “integrates multiple forms of evidence or ways of knowing to explain how spatial knowledge, patterns, relationships, and interactions are produced, and with what sorts of social and political impacts.” (Elwood and Cope, 2009, p. 6). A notable example of qualitative GIS would be the method of “geo-narrative” by Kwan and Ding (2008), which combines GIS mapping and qualitative narrative materials such as text, audio, and video. Bergmann and Lally (2021) advocated for the term “geographical imagination system” (p. 26), which offered an idealistic possibility for radically re-thinking GIS. Meanwhile, influenced by humanistic geography, the more recent development of humanistic GIS by Bo Zhao (2022) established the theoretical foundation for bringing the focus of GIS back to the lived human experience of place.

2.3 Possibilities of new research methods on pandemic research

The pandemic posed significant difficulties on conducting traditional ethnographic work that requires in-person communications, such as interviews, especially during the initial phase. At the same time, the explosion of human mobility data facilitated numerous quantitative approaches. Albeit great progress has been made by utilizing quantitative data and methods to yield geographic understandings of the pandemic, there are still significant limitations inherent with the quantitative, positivistic methodologies. For instance, the quantitative data used for analysis are usually abstracted and decontextualized, which hinders a comprehensive

understanding of (spatial) phenomena (Schuurman and Leszczynski, 2006; Zhang et al., 2020; Zhao and Sui, 2017). Meanwhile, it is possible that there is a significant under-representativeness of certain populations (Zhang et al., 2022) when using popular “big-data” approaches. Therefore, with the previously mentioned considerations, a new approach is needed for a more comprehensive and humanistic understanding of people’s lived experiences during the pandemic.

Interestingly, DeLyser and Sui (2013) have suggested that Rhythmanalysis, a research method articulated by the French sociologist Henri Lefebvre (2004), has the potential to “cross the quantitative-qualitative chasm by connecting multiple scales, senses, and domains in geographic research.” (DeLyser and Sui, 2013, p. 299)

In his work *Rhythmanalysis: Space, Time, and Everyday Life*, Lefebvre defined “rhythm” as the following (2004, p. 15):

Everywhere where there is interaction between a place, a time and an expenditure of energy, there is rhythm. Therefore, [rhythm could be]:

- a) repetition (of movements, gestures, actions, situations, differences);
- b) interferences of linear processes and cyclical processes;
- c) birth, growth, peak, then decline and end

Lefebvre believed that rhythm exists in different forms. The different rhythms would resonate or collide, which leads to harmonies and disruptions. Specifically, Lefebvre defined three notions of rhythm interactions – “polyrhythmia,” “eurhythmia,” and “arrhythmia” (p. 16). Polyrhythmia refers to the co-existence of multiple rhythms. “Eurhythmia” refers to the constructive rhythms of each other and signals a healthy system. On the contrary, arrhythmia

means that there are conflicts between rhythms and thus indicates abnormalities and potential harm.

As Lefebvre's book only provides a vague description of rhythmanalysis as a method (Coletta and Kitchin, 2017; Lyon, 2018), it leaves opportunities for future scholars to explore ways of its creative application. A major contribution by Simpson (2012) operationalized rhythmanalysis by using time-lapse photography to understand everyday life through a qualitative, ethnographical approach. In their study, the time-lapse photos of a street magician in Bath, U.K. captured the rhythms of the crowd around the magician throughout the day. The performance of the street magician intervened into the polyrhythmia of the different pedestrians' social routines, as people walking by the performance either stopped for the show or continued walking. Meanwhile, eurhythmia was found between the elaborateness of the tricks played by the magician and the audience size. The visual details of the photos allowed the researchers to better examine the interactions among people, space, and time in a more situated and idiographic manner. An early quantitative approach of rhythmanalysis is Schwanen et al.'s (2011) study on the spatiotemporal inequalities in the nighttime economies of three Dutch cities. However, their work did not arrive at a deep integration of the rhythmanalysis in quantitative studies, as their analysis still focused on the regression models and "rhythm" was instead used as a synonym for "statistical pattern." Coletta and Kitchin's study (2017) on "algorhythmic governance" (p. 1) utilized the framework of rhythmanalysis and mixed-method approaches to better comprehend the socio-spatial impacts of "smart city" technologies in urban management. In their research, urban traffic flows were understood as rhythms and they inspected how the "smart-city" algorithms interact with the rhythms of urban traffic at different times of day and days of week (i.e., "algorhythmic governance"). In addition, they interviewed local transportation authority

personnel to further understand the algorithms' influence over the rhythms of traffic. Yet the emphasis of the study was still more on the broader level of city governance, with the major stakeholder being the government authorities instead of the local residents. While efforts from quantitative geographers on utilizing the traditionally qualitative framework, in this case, rhythmanalysis, are applaudable, the above two examples still show the strong idiographic and positivist heritage of quantitative methods. Therefore, in overall considerations of 1) better bridging the quantitative/qualitative gap in geographic scholarship, 2) the possibilities with rhythmanalysis, and 3) the potentials of human mobility big data, this thesis project aims at proposing an innovative and humanistic approach in human mobility analysis through the framework of rhythmanalysis. To illustrate the method, a case study analyzing the Black-owned restaurant patronage in Seattle during the pandemic period will be used.

3 Research Design

3.1 The rhythmanalytical framework

Rhythmanalysis could be understood as a research orientation that focus on the temporalities and spatialities of patterns (Lyon, 2018; Reid-Musson, 2019). This, by a happy coincidence, concur with the emphases of spatial analysis (Harvey, 1969). Although there seems to be compatibility at the theoretical level, the operationalization of rhythmanalysis with quantitative spatial data, as mentioned in the above paragraph, still remains challenging. Therefore, with the goal of devising an actionable methodology rhythmanalysis with quantitative data, I proposed a 4-step approach, including 1) choosing the body, 2) identifying the rhythms, 3) measuring the rhythms, and 4) analyzing the polyrhythmia. The “body” refers to the overarching subject in which all the rhythms exist. In other words, it could be understood as the research topic, or the research phenomena, because under this topic/phenomenon, there are various rhythms happening simultaneously and interacting with each other to shape the phenomenon that we can directly observe. After selecting the body, researchers need to identify the rhythms within. In positivist language, this step asks for *both* independent and dependent variables. Yet different from positivist thinking, there should be no strict causal relationship between the so-called “independent” and “dependent” variables, as the idea of polyrhythmia suggests that all the variables/rhythms could be mutually dependent each other (i.e., influenced by and influencing each other). The following step would be to measure the identified rhythms. Measure requires us to identify the key characteristics of rhythms, thus enabling the capturing of the rhythms (Lefebvre, 2004). In common words of data collection, measuring rhythms is to collect data that represent the characteristics of the identified rhythms. Lastly, the final step is to inspect the rhythms, and find and understand the polyrhythmia (i.e., the interactions among the rhythms)

through inspecting and analyzing the potential eurhythmia and arrhythmia (i.e., constructing and destructing patterns of the rhythms). Using the case study of Black-owned restaurants in Seattle during the pandemic, I clarify how each of the steps could be achieved in a less abstract fashion. Figure 1 provides an illustration of the steps along with the operationalizations in the case study.

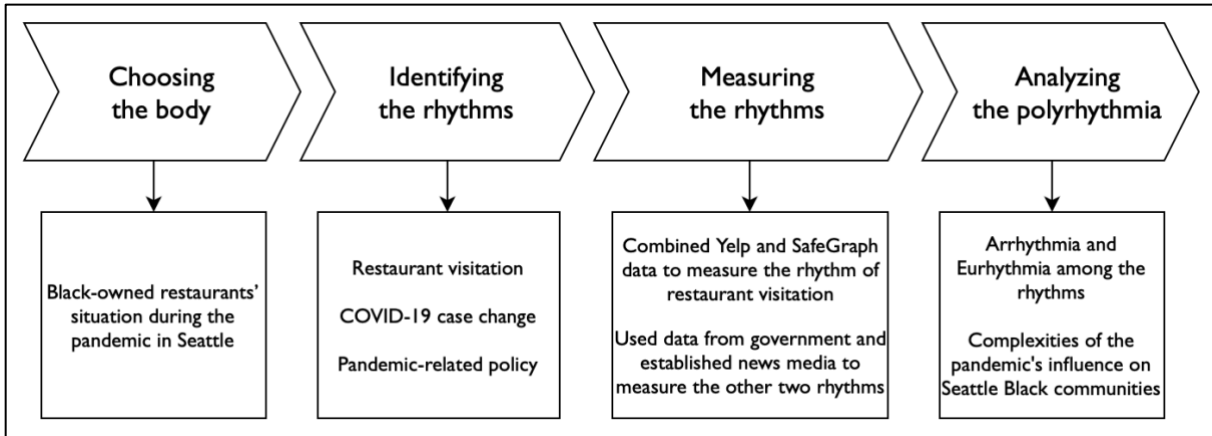


Figure 1. Proposed steps of rhythm analysis and their operationalizations in this case study

3.2 The case study of Black-owned restaurant visitation in Seattle during the pandemic

3.2.1 Choosing the body

The first step was relatively straightforward. Because the objective of the case study was to examine the Black-owned restaurants' situation during the pandemic in Seattle, the encompassing subject (i.e., the "body") for the rhythm analysis is the same (i.e., Seattle Black-owned restaurants' situation during the pandemic). This overarching "body" led us to consider the potential dynamics operating within, thereby helping us naturally transition to the next step - identifying the rhythms.

3.2.2 Identifying the rhythms

To identify the rhythms, in positivist language, I considered the “variables” related with the research topic - Black-owned restaurants’ situation during the pandemic in Seattle. I explored three “variables”- restaurant visitation, COVID-19 case change, and pandemic-related policy, among which there were potentially multiple interactions. For instance, customers might choose to continue or stop dining in restaurants as the prevalence of the virus changed. Meanwhile, public health policies at different times might also play roles in encouraging or discouraging restaurant patronage. However, as emphasized in rhythmanalysis, the relationship between the “variables” should not be assumed as one-way. Therefore, there should not be absolute “independent” or “dependent” variables in our case. In addition, from the temporal and spatial dimensions, these three “variables” all existed during the same time period (i.e., the pandemic time) in the same geographic area (i.e., Seattle, WA). Hence could there be measurements of these rhythms, which I will explain in the next sub-section. While it is important to acknowledge that there were probably more hidden rhythms that existed at the same time and space, these three rhythms would allow me to explore the polyrhythmia among them, thus well serving the purpose of this exploratory investigation.

3.2.3 Measuring the rhythms

Since measuring rhythms means collecting information/data that describes the rhythms, it requires researchers to identify key characteristics of the rhythms and consider what and how to gather information about such characteristics. As described previously, the three rhythms for this rhythmanalysis shared the same two characteristics – time and space. The specific time period used in my investigation is from 2020 to 2021, as the data collection phase for this thesis project was from early to mid-2022. The spatial coverage for all the rhythms is Seattle. With the

specified temporal and spatial scope, I present how I acquired the data that represent the three rhythms.

3.2.3.1 The rhythm of Black-owned restaurant visitation in Seattle

The data for the rhythm of (Black-owned) restaurant patronage comprised two datasets. I extracted the restaurant ownership information from Yelp. The restaurant visitation data was from SafeGraph. Then the two datasets were merged together, allowing me to derive the rhythm and sub-rhythms of Seattle restaurant visitations.

3.2.3.1.1 Black-owned restaurants on Yelp

Restaurant ownership information was a key challenge, as there was no publicly recognized data source for a list of Black-owned restaurants in Seattle. Gathering such information through fieldwork was unrealistic given the conditions of the thesis project. Fortunately, in June 2020, Yelp, a well-known crowd-sourced business review website in the U.S., introduced a searchable feature that allows owners to describe their business as “Black-owned” with just a few mouse clicks. For example, Figure 2 shows the first two items returned by a search for Black-owned restaurants in Seattle on Yelp. It is clear to see that the first result has the “Black-owned” label. Meanwhile, even when a restaurant does not have the self-identified “Black-owned” label, it would appear in the result when “Black-owned” was mentioned in its customer review. Figure 3 displays such a review that contributes to the identification of a searched Black-owned restaurant on Yelp. This feature of the “Black-owned” label is also a typical example for the concept of volunteered geographic information (Goodchild, 2007), as the valuable information is made available through individuals’ voluntary contribution of their knowledge of places. By utilizing the method of web scraping (Zhao, 2017), I collected the ownership information of the restaurants from Yelp. The Python-based web-

crawler allowed me to search on Yelp with the keyword “Black-owned Restaurants” in Seattle and then save the search results. Figure 4 illustrates the workflow of the crawler. The crawler collected restaurant information from every page of the search results and stored it in a SQLite database. The collected information included the name and address of the collected Black-owned restaurant. As a result, a total of 72 Black-owned restaurants were identified on Yelp in Seattle as of August 2022. With concerns of potential malicious exploitation of the racial information about the restaurants (Huang et al., 2022), I chose not to provide the full table of restaurant information publicly here.

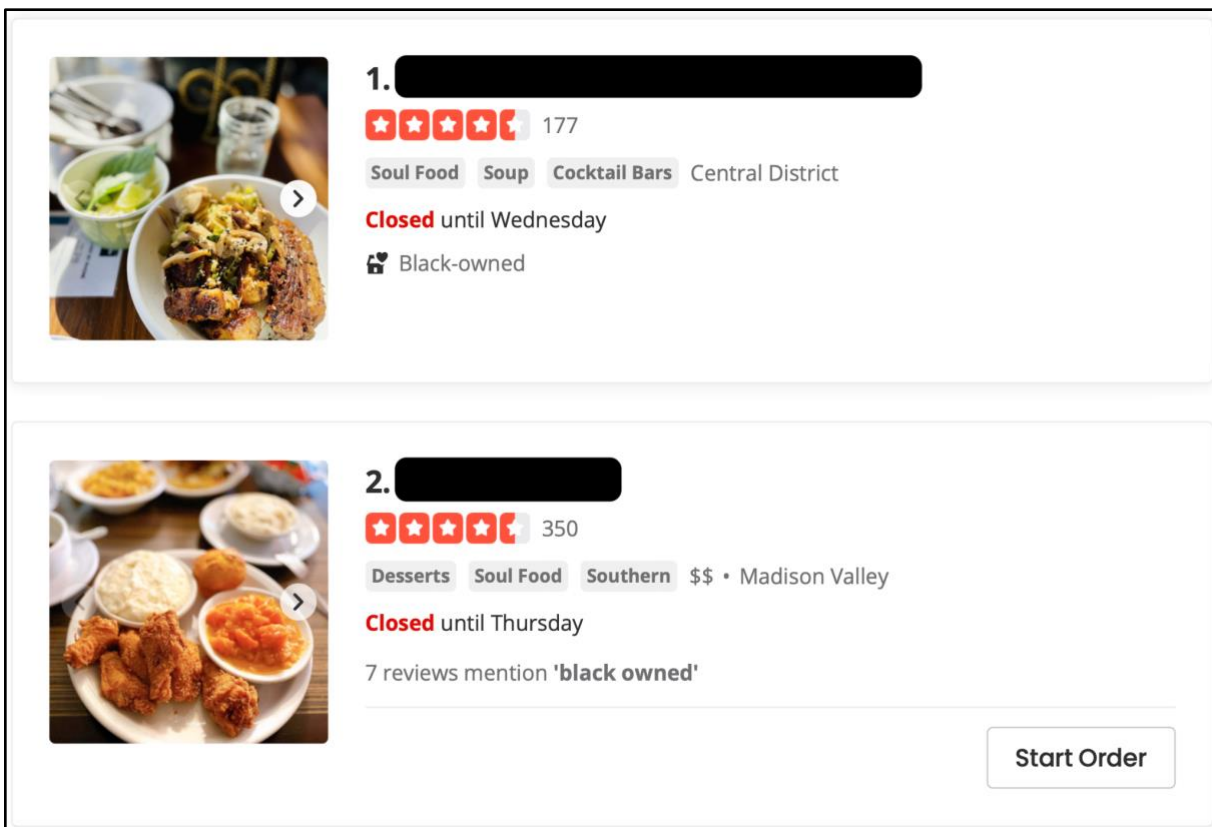


Figure 2. An example of two Black-owned restaurants listed on Yelp

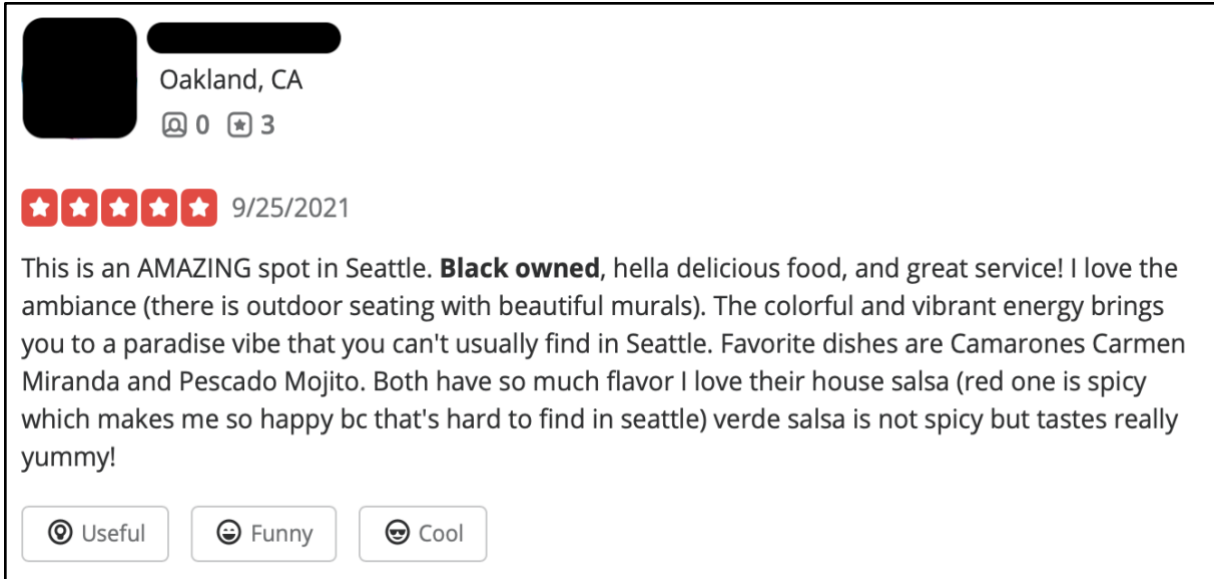


Figure 3. Yelp review that mentioned the black ownership of the restaurant

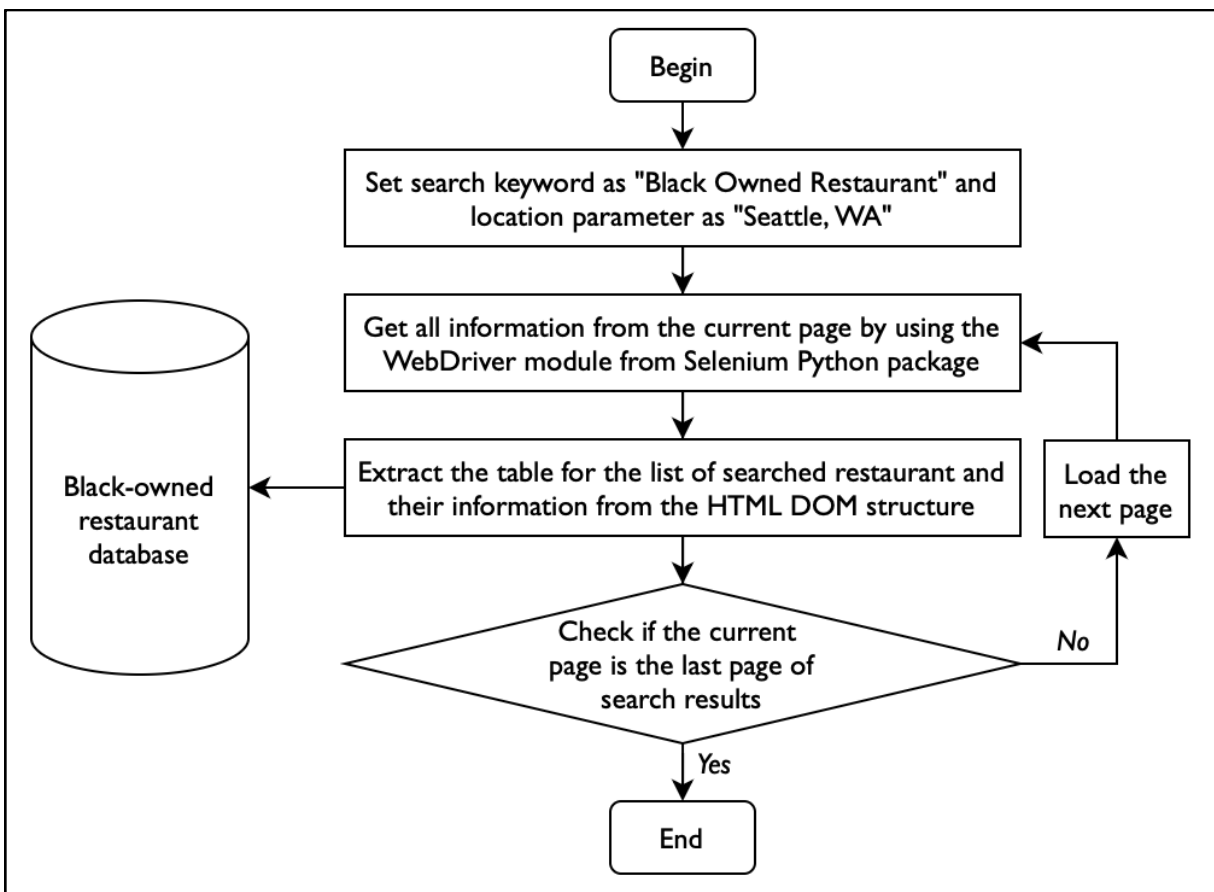


Figure 4. Python web crawler workflow

3.2.3.1.2 Restaurant visitation

Human mobility big data was vital in this rhythm analysis, as it provided the measure for the rhythm of restaurant visitation. The restaurant visitation records were acquired from SafeGraph, a company that collects visitation patterns of Points of Interest (POIs) using Global Positioning System (GPS) information from a total of 45 million mobile devices, which account for approximately 10 percent of all mobile devices in the U.S. (SafeGraph, 2019). POI-based data were useful because it allowed me to identify specific restaurants, differentiate them from other nearby restaurants, and match with the Yelp data. POIs in SafeGraph are classified according to the North American Industry Classification System (NAICS) code, a standard used by Federal statistical agencies to categorize business establishments for the purpose of collecting, analyzing, and publishing statistical data related to business and economy. I retrieved a total of 4,324 POIs with the code “722” (i.e., the category of “Food Services and Drinking Places”), in the city of Seattle. These retrieved SafeGraph POIs served as a POI pool, against which Yelp restaurants were later used to match and filter. For restaurant visitation records, I used the “Weekly Patterns” dataset that provides visitation information of the POIs (SafeGraph, 2021). The weekly data had the finest available temporal unit, allowing for a more detailed rhythm in terms of its temporality. Meanwhile, the data field “normalized_visits_by_state_scaling” was used for restaurant visitation, since it was described by SafeGraph as the best value, which was normalized based on state population, for population count estimation of POI visits (Huntington-Klein, 2022). The specific time period used for the case study was from January 6, 2020 (the first complete week of 2020) to December 27, 2021 (the last complete week of 2021).

3.2.3.1.3 Safegraph and yelp restaurant matching

In order to match the Black-owned restaurants from Yelp with the restaurant POI from SafeGraph, edit distance is used to match the restaurant name and address fields from both datasets. Edit distance evaluates the minimum number of character edits needed to convert one text to the other (Cohen et al., 2003; Levenshtein, 1966), and has been applied to fuzzy text and address matching in GIS research (Janowicz et al., 2008; Li et al., 2010; Ramani and Borrajo, 2023). To implement the concept, I used the Python library RapidFuzz (Bachmann, n.d.), which calculates edit-distance-based similarity score between two text values. In this study, a match between a Yelp restaurant and a SafeGraph restaurant is confirmed when both the names and the addresses have similarity scores that are no less than 90%. While there is not a universally “good” value for the calculated similarity score, I chose this value following the similar logic of the more tolerating p-value of 0.1, as the restaurants would be matched based on both name and address. To put this matching criterion in a less technical language, a match between a Yelp restaurant and a SafeGraph restaurant would only match if their names and addresses were 90% similar. Using this criterion, I acquired 28 matching Black-owned restaurants between the Yelp and SafeGraph datasets. In the rest of this paper, “Black-owned restaurants” will refer to those matched Black-owned restaurants from both the Yelp and SafeGraph databases and “Ownership-unidentified restaurants” will refer to all the other restaurants. Figure 5 is a map of the matched Black-owned restaurants in Seattle.

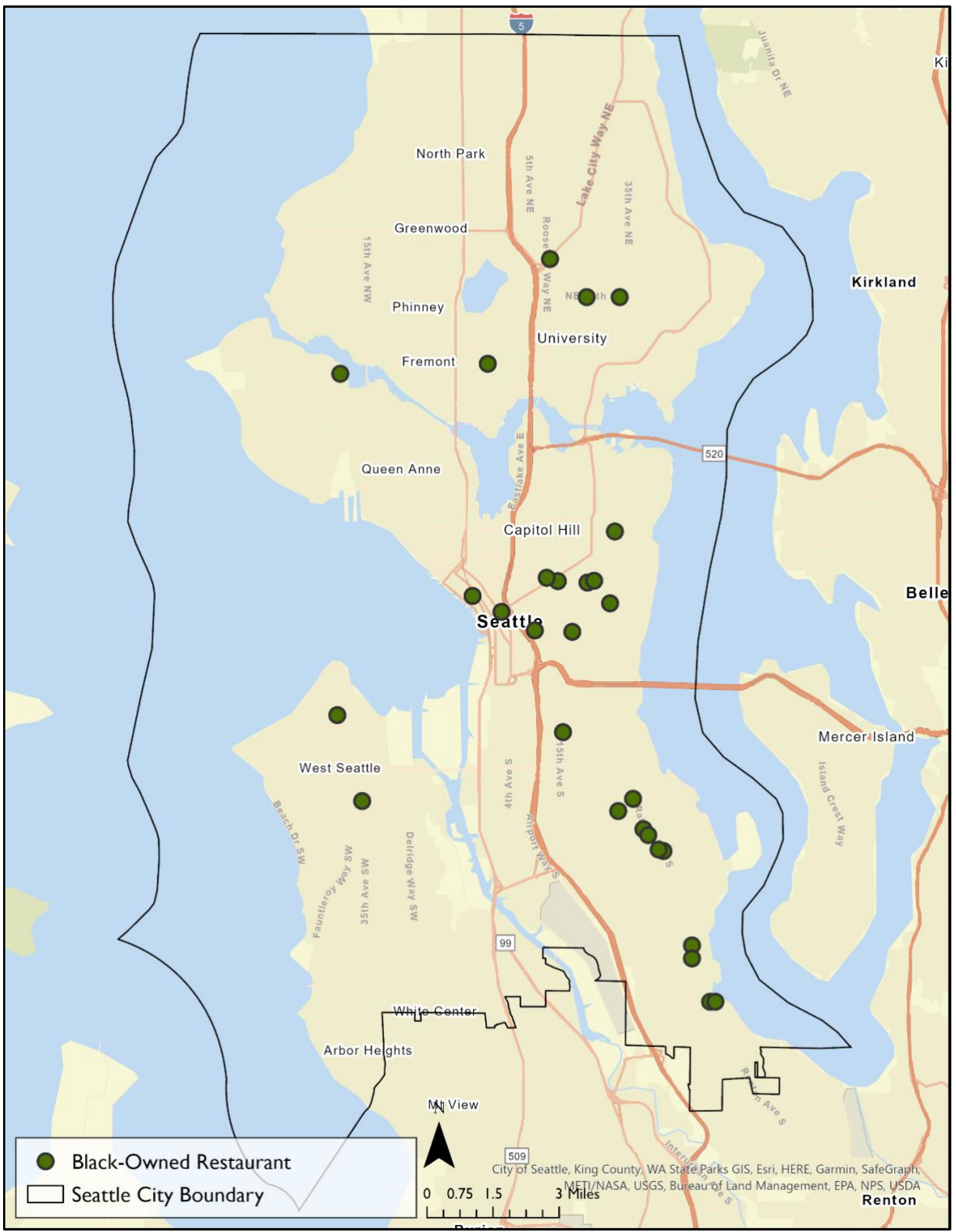


Figure 5. Map of matched Black-owned restaurants from both Yelp and Safegraph database

3.2.3.1.4 Data cleaning on restaurant visitation

Due to the sheer differences in the counts of the Black-owned restaurants and all the other types of restaurants, along with several significant outliers in the restaurant visitation records, additional data processing steps were conducted before the analysis. Because the total number of Black-owned restaurants was small, no further data cleaning was performed. For the other types of restaurants, I selected only those which are 0.5 miles (Euclidean distance) from the Black-owned restaurants for future comparison, following Tobler's first law of geography (Tobler, 1970). Figure 6 visualizes the ownership-unidentified restaurants within the 0.5-mile buffer zone of Black-owned restaurants. To minimize the influence of possible outliers, I removed the records with extreme visitation values based on the 1.5 interquartile range rule (Tukey, 1977). After all the data collecting, processing, and cleaning tasks, I acquired the measurements for the two (sub)rhythms of restaurant visitations in Seattle, including the one for the Black-owned and the other for other generic types of restaurants.

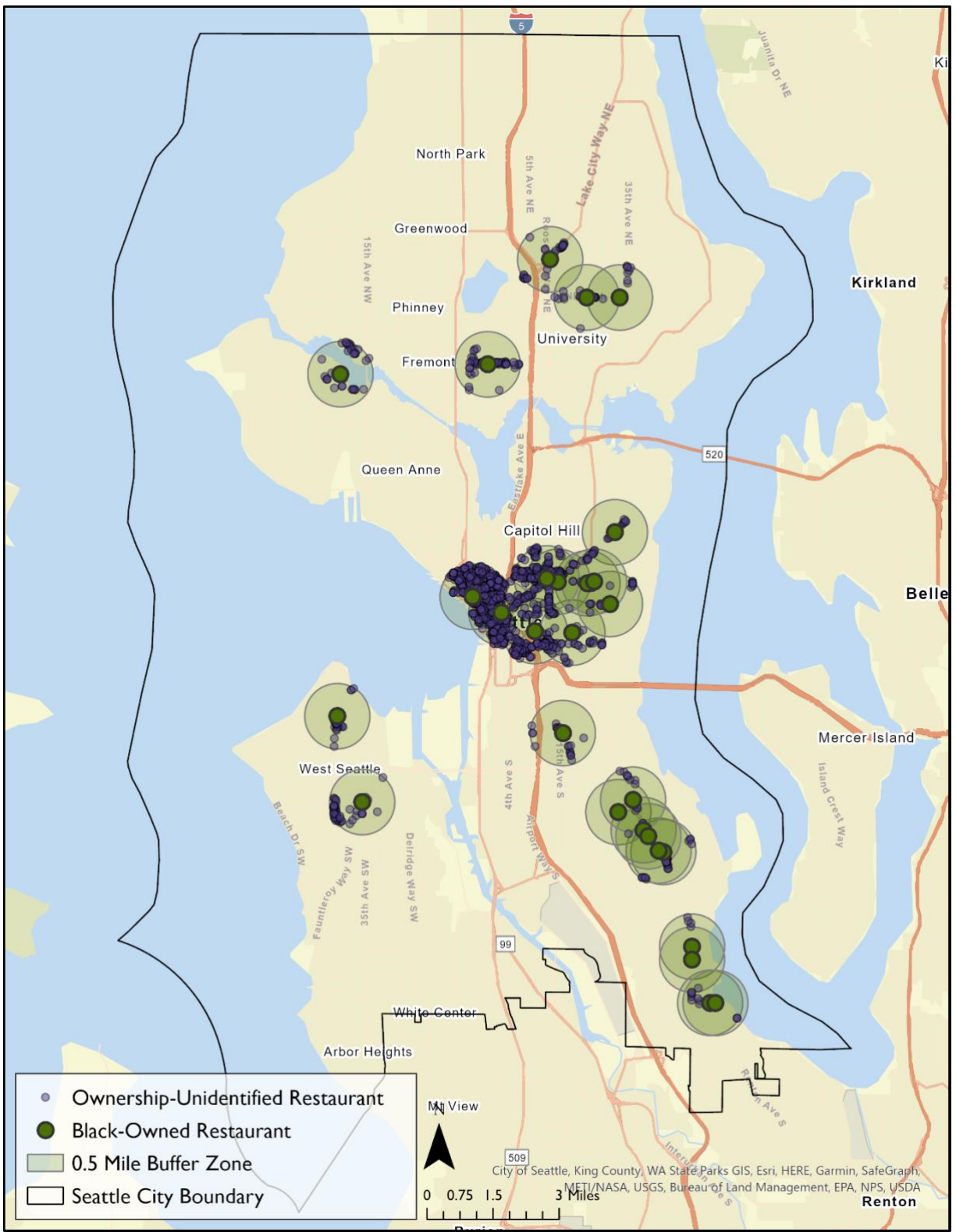


Figure 6. Map of ownership-identified restaurants within the 0.5-mile buffer zone of Black-owned restaurant

3.2.3.2 The rhythms of pandemic-related policy and COVID-19 case

Besides the restaurant visit rhythm, the other two essential rhythms, including the pandemic-related policies and COVID-19 case data, were acquired from both government and news agencies. The data for COVID-19 weekly new case count in Seattle was downloaded from Public Health – Seattle & King County (2020). The city-level weekly new cases were aggregated from the original census-tract level data through the time period of January 5, 2020 to December 25 2021. This measured the rhythm of COVID-19 cases during the study period. There was a one-day difference between the time span of the COVID-19 case data and the restaurant visitation data, because Sunday, instead of Monday, was used as the start of the week by the King County public health department in data recording. Given the temporal scope of two years and unit of one week, the influence of this one-day difference would be minimal for the analysis. For the policy rhythm, I acquired the policy-related data in Seattle from multiple sources, including King County’s Department of Community and Human Services (2021), Centers for Disease Control and Prevention (2022), and KIRO, a local news agency in Seattle (McNerthney 2020). The data were synthesized to include the start dates of pandemic response policies at different administrative levels that had impacts in Seattle. This collection of data from both government and established news agencies will serve as a reliable measurement for the rhythm of pandemic-related policy. With the three measured rhythms, the last task of rhythm analysis – analyzing the polyrhythmia – will be explained in the result section.

4 Result

4.1 The rhythm of restaurant patronage

To first inspect individual rhythms, Figure 7 presents the visualization of the rhythm of restaurant patronage in a traditional time-series graph. In general, the impact of the COVID-19 pandemic on restaurant patronage was notable, as weekly visits to both restaurant types experienced a sharp decline in March 2020. From February 24 to March 30, for the medians of restaurant visit counts, there were a 45% drop for the Black-owned restaurants and a 72% drop for the ownership-unidentified. Since then, even though there had been some fluctuations in visits to both types of restaurants, the medians of the visits never recovered to the pre-pandemic level. The rhythm of restaurant visits is mainly consistent with the human mobility pattern revealed in numerous mobility datasets (e.g., Huang et al., 2020; Kang et al., 2020). However, it is interesting to observe the differences between the sub-rhythm of the Black-owned restaurant visit and that of the ownership-unidentified, which suggest that Black-owned restaurants experienced less severe visitation loss from April 2020 to August 2020. In Figure 7, the solid green line lied above the solid blue line during the time period, with the weekly medians of the visitation patterns for the Black-owned restaurants being 25% higher than the ownership-unidentified on average. Yet, this trend began to be reversed in September 2020, as the sub-rhythm lines became entangled. Starting from around May 2021, the median visit to the ownership-unidentified restaurants surpassed that of the Black-owned and kept so until the end of the study period, with the ownership-unreported being 38% higher than the Black-owned on average.

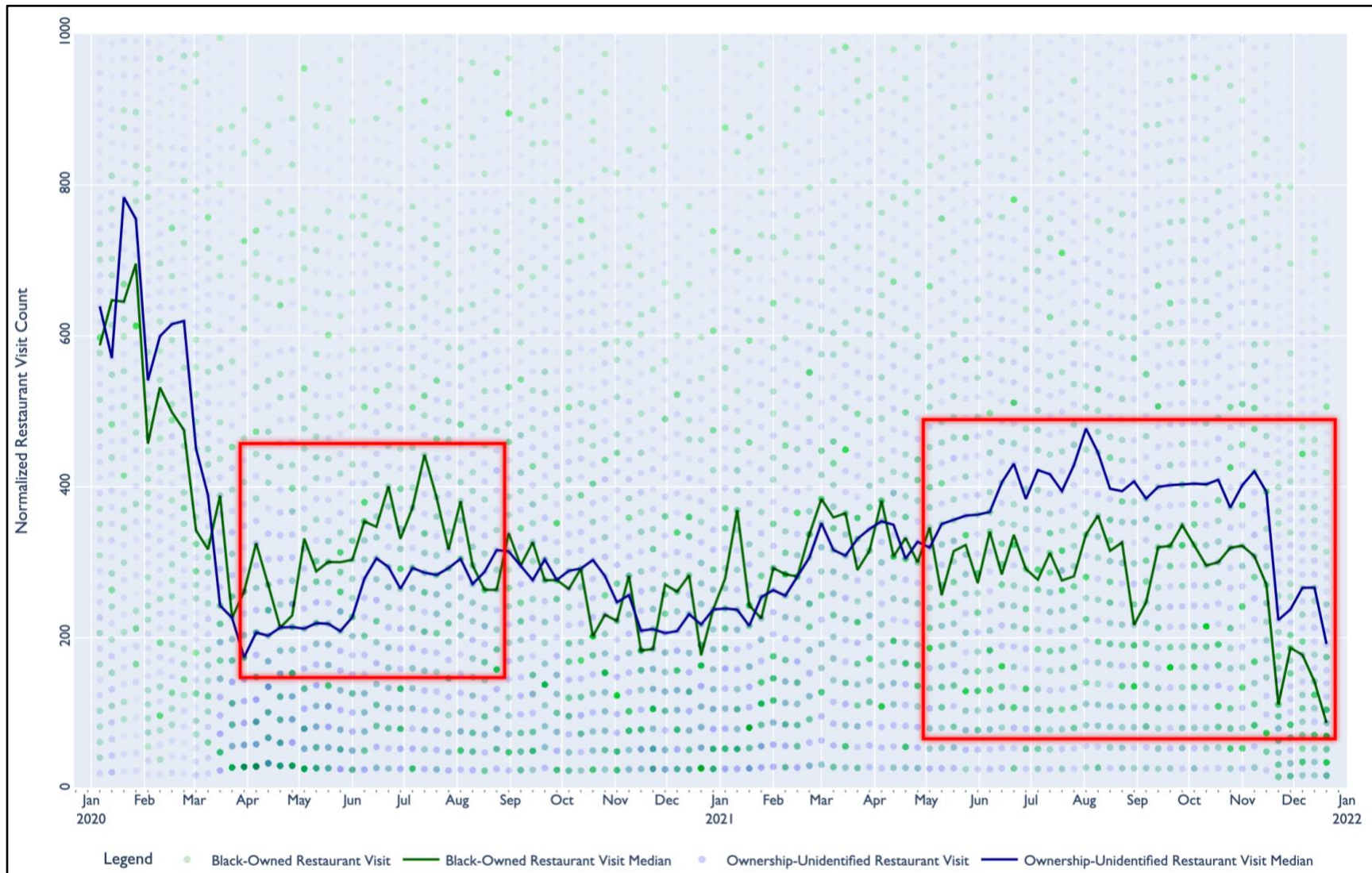


Figure 7. Time-series visualization of the rhythm of restaurant patronage (see the complete figure in Appendix A)

4.2 The rhythms of COVID-19 case change and pandemic-related policy

Besides the rhythm(s) of restaurant visitation, the other two rhythms are also visualized using similar time-series approaches. Figure 7 presents the rhythm of the weekly new COVID-19 cases in Seattle. Aside from the weekly new case changes, orange dots in the graph represented the times when the three most notable virus variants, Alpha (September 2020), Delta (October 2020), and Omicron (November 2021), were first recorded. From the rhythm graph, It is clear that there were fluctuations in the weekly new cases in the study period. Two of the three most notable spikes happened immediately after the first documentation of the Delta and Omicron variants, while the other local maximum point was in August 2021. Figure 7 displays the rhythm of the pandemic-related governmental responses, which include policies, CDC advisories, and vaccine approvals.

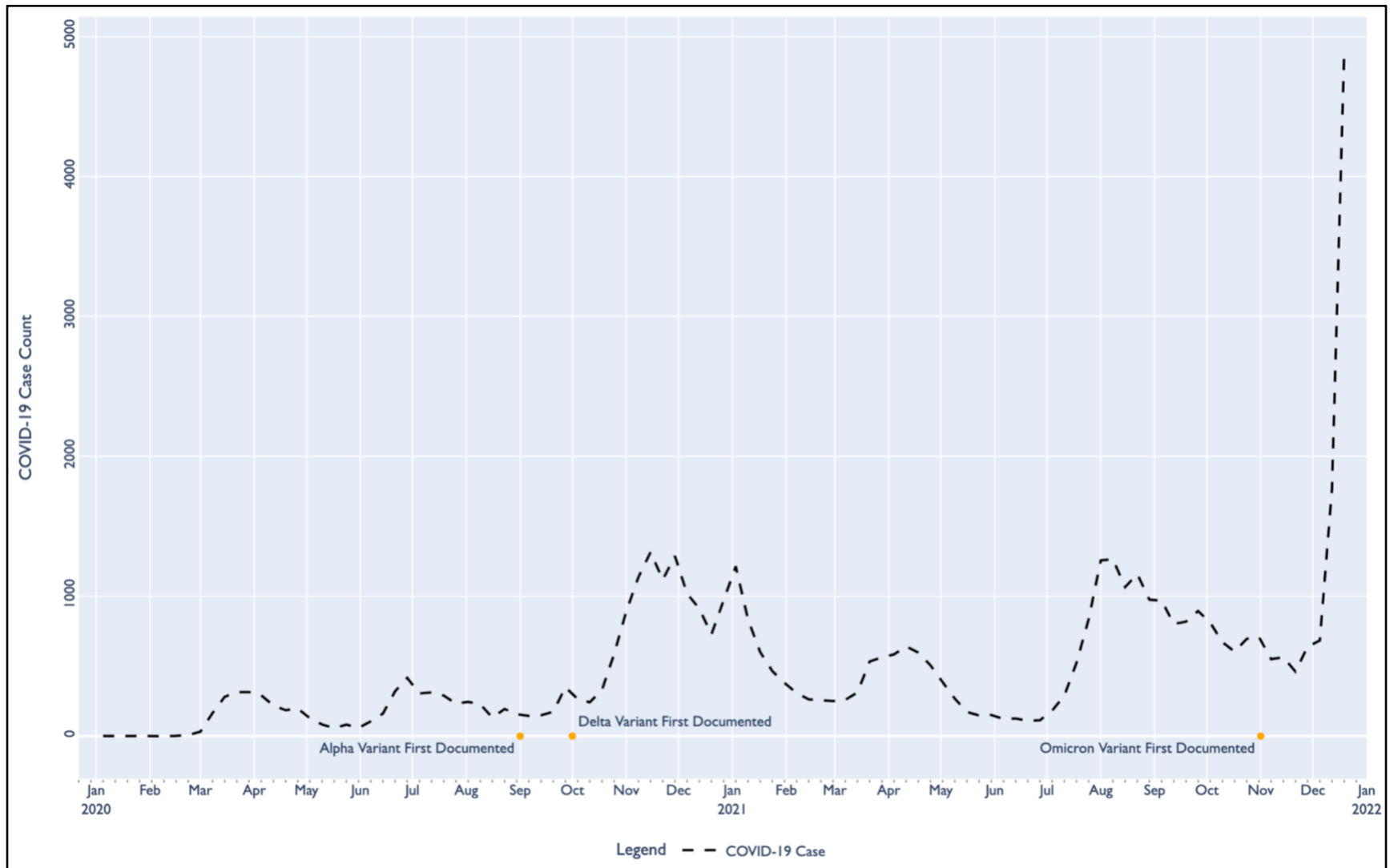


Figure 8. Time-series visualization of the rhythm of COVID-19 case

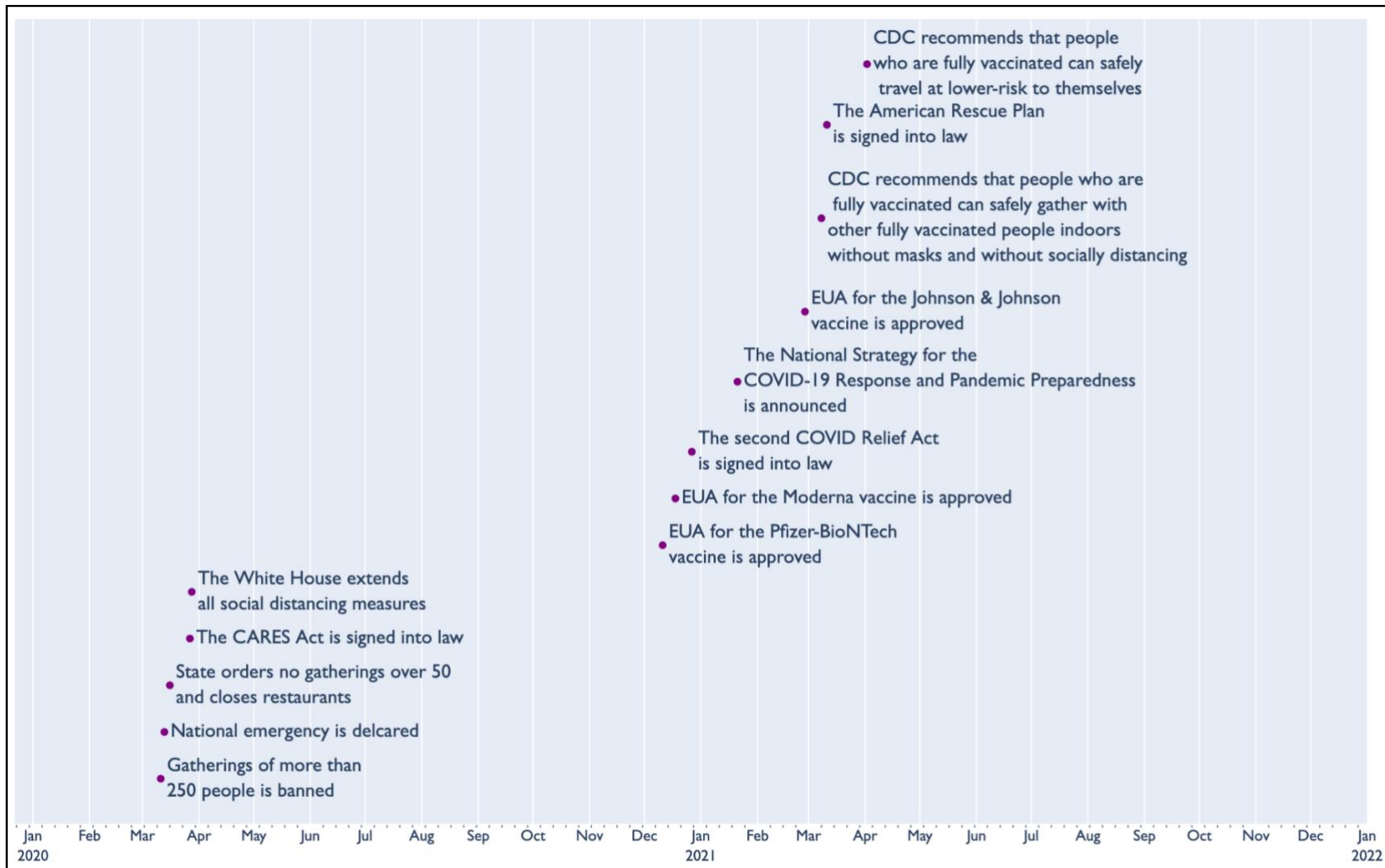


Figure 9. Time-series visualization of the rhythm of pandemic-related policy

4.3 Polyrhythmia, arrhythmia, and eurhythmia among the rhythms

While separate analyses on the three rhythms seemed unable to yield substantial findings, the guiding principle of rhythmanalysis – analyzing the polyrhythmia, or in other words, analyzing the co-existing rhythms as an organic composition – would lead us to reflect upon the potential arrhythmia and eurhythmia among the rhythms. Without any doubt, the three rhythms of restaurant visitation, pandemic policy, and the pandemic itself co-existed from 2020 to 2021 in Seattle, forming a polyrhythmia. For an easier visual identification of the interactions among the rhythms, Figure 10 was created by combining all three rhythms.

Albeit being a loaded graph, Figure 10 presented the visualization of the overall polyrhythmia. The sub-rhythms of overall restaurant patronage displayed a noteworthy arrhythmia starting from March 2020, the beginning of the pandemic. As mentioned previously, the sub-rhythm of Black-owned restaurant visitation and that of the other restaurants appeared to be conflicting with each other. Under the framework of rhythmanalysis, we, as researchers, are encouraged to consider the interconnections among this arrhythmia and other rhythms in order to understand the patterns in a more situated manner, since there could be other important contextual factors that may interact with the rhythm of restaurant visits.

When looking at the sub-rhythms of the restaurant visit and the rhythm of the pandemic-related policies, we can observe both arrhythmia and eurhythmia. The arrhythmia is between the sub-rhythm of the Black-owned restaurant visit and the rhythm of pandemic-related policies. Before March 2020, the line for the median value of the Black-owned restaurant visits is generally below that of the ownership-unidentified restaurant visits. As the pandemic started and multiple quarantine policies were implemented to mitigate the spread of the virus (Figure 10), an intuitive

expectation is that the visits to both types of restaurants would decline yet maintain the pattern that the visits to Black-owned restaurants would be lower than to the other restaurants.

However, the observed Black-owned restaurant visits became counter-intuitively higher than the visits to the ownership-unidentified restaurants during the period when the quarantine policies were most strictly implemented in the city, suggesting an arrhythmia between the two rhythms. On the contrary, the visits to ownership-unidentified restaurants appear to be in coordination with the policies. After the quarantine policies were announced in March 2020, the ownership-unidentified restaurants had fewer visits. Going into the re-opening period with the release of vaccines and more relief strategies being signed into effect, the visitation of the ownership-unidentified restaurants bounced back, again surpassing that of the Black-owned. This eurhythmia between the rhythm of ownership-unidentified restaurant visits and the policy rhythm makes the arrhythmia between the Black-owned restaurant visit and pandemic-related policies more notable, thus suggesting the need for appropriate explanations (i.e., what is causing these patterns) and understandings (i.e., what do these patterns mean) of Black communities' experiences during the pandemic.

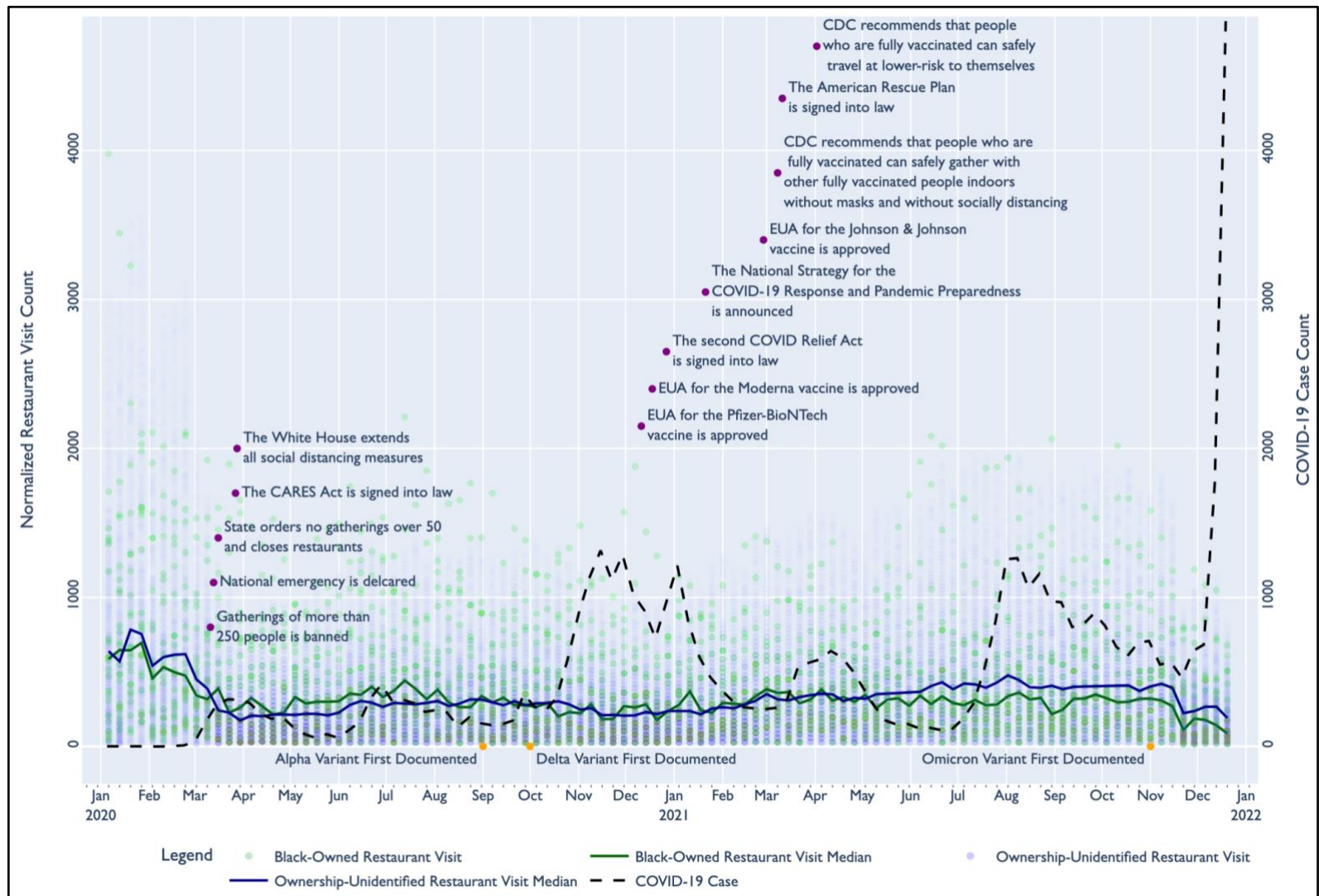


Figure 10. Time-series visualization of the polyrhythmia among the rhythms of restaurant patronage, COVID-19 case change, and pandemic-related policy

5 Discussion

5.1 Implications of the identified polyrhythmia from rhythmanalysis

By revealing the polyrhythmia, eurhythmia, and arrhythmia among the different rhythms, we arrived at a more contextual understanding of the Black-owned restaurants' experience during the pandemic period. The arrhythmia and eurhythmia among the restaurant visits and pandemic responses again revealed the systemic racism existing in U.S. society, calling for further investigations to better understand the interactions between the pandemic and existing social issues. There are many possible explanations for the result of the rhythmanalysis. One hypothesis could be that customers might become more reliant on the food provided by the opening Black-owned restaurants due to their own financial precarity at the initial stages of the pandemic. Another plausible explanation could be that the Black-owned restaurants may not have the financial capability to suspend business or switch to take-out only, as the restaurant owners and employees relied on the business to cover the basic living costs during the turbulent time. Such a "fight-to-lose-less" (Chen et al., 2022, p. 1) situation was also observed in the hospitality industry in Macao, China. At the same time, the existing systematic inequities and the lack of necessary protective measures and vaccines made those who were still working more vulnerable to the virus, which corresponded with the epidemiological findings of the pandemic (Millett et al., 2020; Wiley et al., 2022). It is important to note that these are only three possible, instead of conclusive, explanations of the polyrhythmia observed through rhythmanalysis. Further efforts, such as interviews and other fieldwork, should be made in order to appropriately understand the rhythms.

Based on the result of this rhythmanalysis, I argue that this project could serve as a springboard for more detailed and specified research for understanding the experience of Black

business owners during the pandemic. The revealed arrhythmia and eurhythmia indicate that the relief strategies were not equally effective for all catering businesses. Although previous studies have illustrated the importance of taking proactive measures, such as enacting plans creating a “rainy day fund” for times of crisis, to increase economic resilience (Madeira et al., 2020; Ntounis et al., 2021; Rose, 2004), systematic racism against Black populations may prevent them from adopting the same preventive measures as their White counterparts. The economic aid programs, such as the Coronavirus Aid, Relief, and Economic Security (CARES) Act by the Trump administration and the American Rescue Plan (ARP) by the Biden administration, primarily provides urgently needed financial loans and waivers to business owners so they can maintain operation. However, business owners must apply directly and may not be aware of such financial aid opportunities, which may prevent them from receiving essential funding. The study by Lichtenstein (2022) has provided evidence of the racial disadvantages for non-Hispanics to receive financial support from the CARES Act in the case of mortgage relief. Therefore, while it is evident that many Black restaurants have struggled to survive, governments should also take necessary and more targeted measures to protect these businesses, as the Black communities, who have been repressed by long-standing discrimination, are now being disproportionately harmed by the COVID-19 pandemic.

5.2 New possibilities with rhythm analysis and quantitative data

This study demonstrates that rhythm analysis is compatible with quantitative human mobility big data, thanks to the tremendous development of modern spatial technology. Rhythm analysis has been traditionally carried out by using qualitative approaches, such as field observation (Simpson, 2012), because only through qualitative observation would researchers be able to collect detailed information on the rhythms. However, as (geospatial) big data become increasingly popular, researchers can now collect more detailed data at a massive scale. For instance, the data for this study is made possible by the ubiquitousness of smartphones with Global Positioning System (GPS) chips. The fine-grained locational data allowed me to capture the rhythms of human mobility at different locations without going to the field for an extended period of time. The extensive spatial coverage of the data also enables other scholars to perform similar rhythm analyses in other locations. At the same time, the clever use of the volunteered geographic information for restaurant ownership utilized the democratized geographic knowledge from the local community.

Along with demonstrating the compatibility between the qualitative and the quantitative, this rhythm analysis presents a significant epistemological change in knowledge production through quantitative data. Quantitative geospatial methods and data have received criticism for a long time. One notable piece of criticism is that quantitative data is usually in a reduced form, deprived of necessary contexts. In this study, by using rhythm analysis to study Black-owned restaurants, I brought the crucial contexts of the human mobility data back to the center stage of the analysis, thereby deriving meaningful and previously hidden insights. In conventional quantitative studies, if the researchers realize the importance of data contexts, then connecting the “results” with possibly related contexts is usually part of the “discussion” section.

Meanwhile, it is also possible that some researchers are unaware of the context of the data, thereby excluding it from the study. Yet through rhythmanalysis, “context” becomes indispensable since the start of the research, as the rhythms to analyze are essentially the rhythms of the central topic and the related contexts. Therefore, rhythmanalysis becomes a powerful tool in the knowledge production process for bringing back the ignored contexts of quantitative data.

It is also important to indicate that in this paper, a large portion of the discussion of the “contexts” for analyzing Black-owned restaurants is placed in the “result” section, because in rhythmanalysis, the revealed rhythms and rhythmic interactions of the “contexts” are the direct results, instead of additional discussions. This also signifies a remarkable change in the ontology of quantitative data knowledge production. As contexts are important elements for understanding people’s lived experience of space, rhythmanalysis with new forms of geospatial data is also a humanistic innovation (Cresswell, 2023; Tuan, 1976; Zhao, 2022) in spatial research methodologies and a non-binary solution for addressing the quantitative/qualitative divide.

6 Limitations & Future Directions

As I worked on this exploring endeavor to bridge the dichotomy between the qualitative and the quantitative, I realized that there are still limitations in this newborn methodology upon which future research could be built. First, even though rhythmanalysis offers a contextualized data analysis, the human mobility data itself used in this case study was still collected in a decontextualized manner, as it was commercial data from SafeGraph, a private company. Secondly, the contextual elements in the rhythmanalysis (i.e., the rhythms included in the analysis) are still subjective to the researcher(s), since it is impossible, at least at the current stage, to include every possible context exhaustively. Thirdly, in the case study, statistical significance was not used when describing the relationships among the rhythms, which, from a positivistic view, could influence the reliability of the observation.

The limitations presented above also hint at the possible further development of this method, or perhaps all similar attempts in the future. The decontextualization of data requires first-hand data collectors and providers to include better metadata documentation. Data, by its ontology, is an abstract and decontextualized representation of a certain aspect of the world. Only with more comprehensive metadata, would data users have the opportunity to understand the related contextual information, thereby developing innovative and responsible ways to interact with the data. Another “issue” of such mix-method approaches that require additional discussion is that although many of the innovative mix-method approaches aiming at crossing the quantitative/qualitative divide gain from the advantages of both types of methods, they are also subject to the disadvantages from both sides. Instead of insisting on which is better and falling into the old dichotic trap again, scholars should be able to make flexible decisions to maximize the benefits. In partial response to the abovementioned point, there could be future

efforts in using the methodology proposed in this thesis to study the Black-owned restaurants in other cities, as those efforts would help validate and improve the combinative use of rhythm analysis and quantitative big data.

7 Conclusion

The COVID-19 pandemic has produced unprecedented impacts in human society and has received much attention from scholars of different disciplines. Most of the current geographic scholarship has been quantitative investigations. Yet there has been a history of critiques and debates on quantitative methods from human geographers since the 70s due to the deficiencies of positivism and empiricism. Therefore, as a GIS scholar, I proposed a mix-method methodological approach through combining the framework of rhythm analysis and human mobility big data derived from mobile phones. To operationalize the new method, I set up four steps for rhythm analysis - 1) choosing the body to analyze, 2) identifying the rhythms within the body, 3) acquiring the measurements of the rhythms, 4) analyzing the polyrhythmia among the rhythms. Under the influence of the COVID-19 pandemic and the worsened racial inequity issues during the same time period, I decided to adopt the case study of understanding the Black-owned restaurants' situation to illustrate the original method. The case study in Seattle demonstrates the capability of this innovative method in generating a more contextualized and nuanced understanding of the pandemic's influence on Black-owned restaurants. The rhythm analysis revealed the concerning trends of the Black-owned restaurant patronage and the potential ineffectiveness of the economic relief policies, calling for additional attention on the exacerbated racial inequities during the pandemic. Meanwhile, the method itself serves as an essential non-binary contribution to bridging the long-standing quantitative/qualitative divide. In the end, as a critical GIS scholar, I reflected upon three potential limitations of this project – decontextualized data sources, subjective rhythm selection, and lack of statistical significance. Yet no research method is perfect. The limitations of this project also hint at possible directions for a more humanistic advancement of GIScience. Responsible GIScientists should strive to

develop better (spatial) data practices with the importance of metadata in mind. Geographers from both the qualitative and the quantitative side should reconcile and cooperate upon new mix-method approaches to close the ontological gap that has been irritating the discipline for decades.

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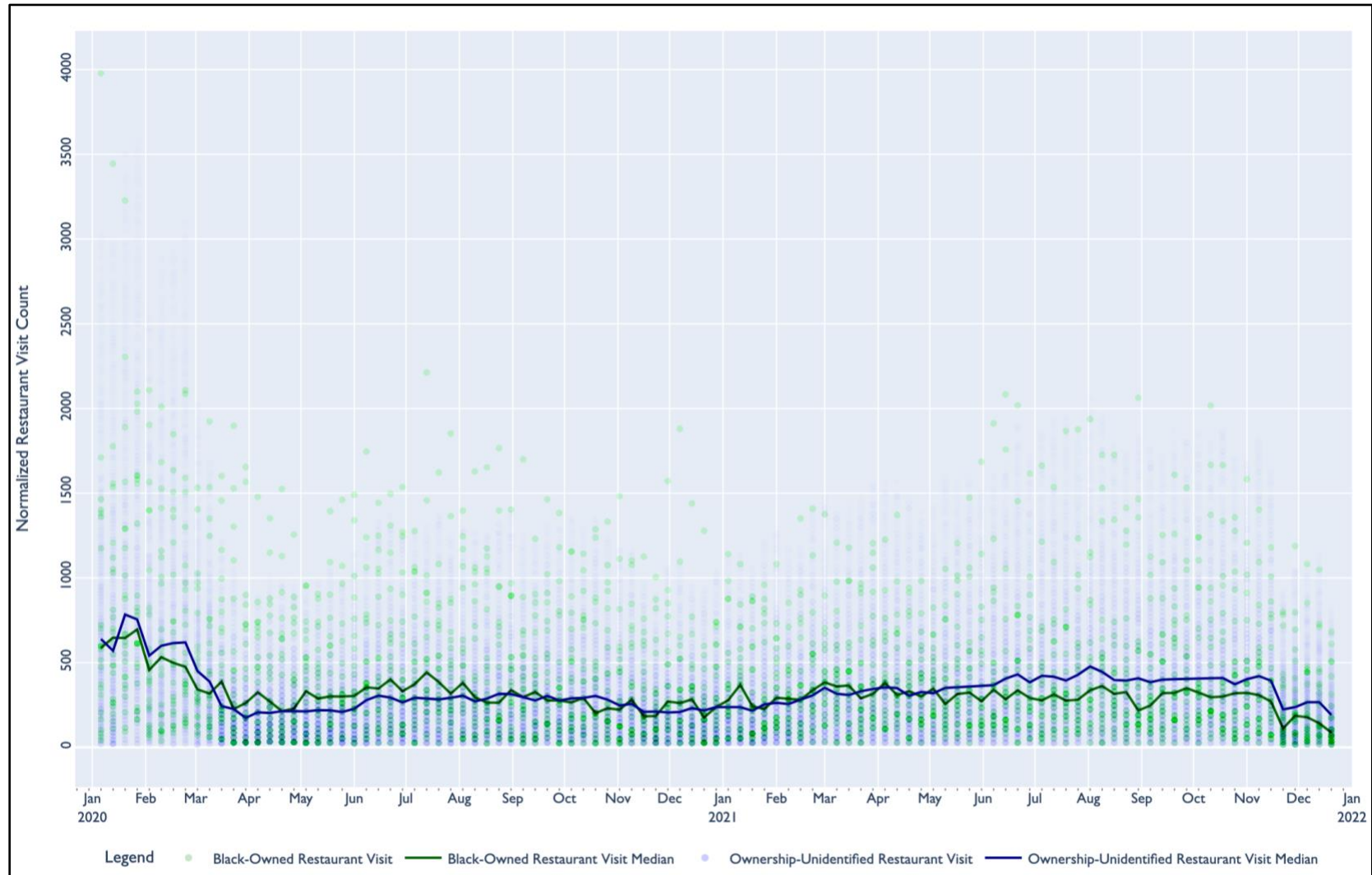
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Appendix A



Appendix A. Complete time-series visualization of the rhythm of restaurant patronage