Open For Business: Analyzing Venetian Storefronts

Analysis of big data in order to aid local business in Venice

Venice Project Center

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Abstract

Like doctors diagnosing ailments, Venice's shops act as indicators for underlying trends occurring throughout the city. Over the past 50 years, Venice's population has seen a large increase in tourists and a sharp decline in lifelong residents. To draw meaningful conclusions about the trends caused by this demographic shift, data about business in Venice must be collected. The goal of this project is to collect data about the type, number, and location of stores in Venice, and to add this data to the VPC's database. The website that displays this data will also be updated with a modern look. The data will then be visualized using the website and analyzed to show how demographic shifts may be correlated to changes in Venice's retail landscape.

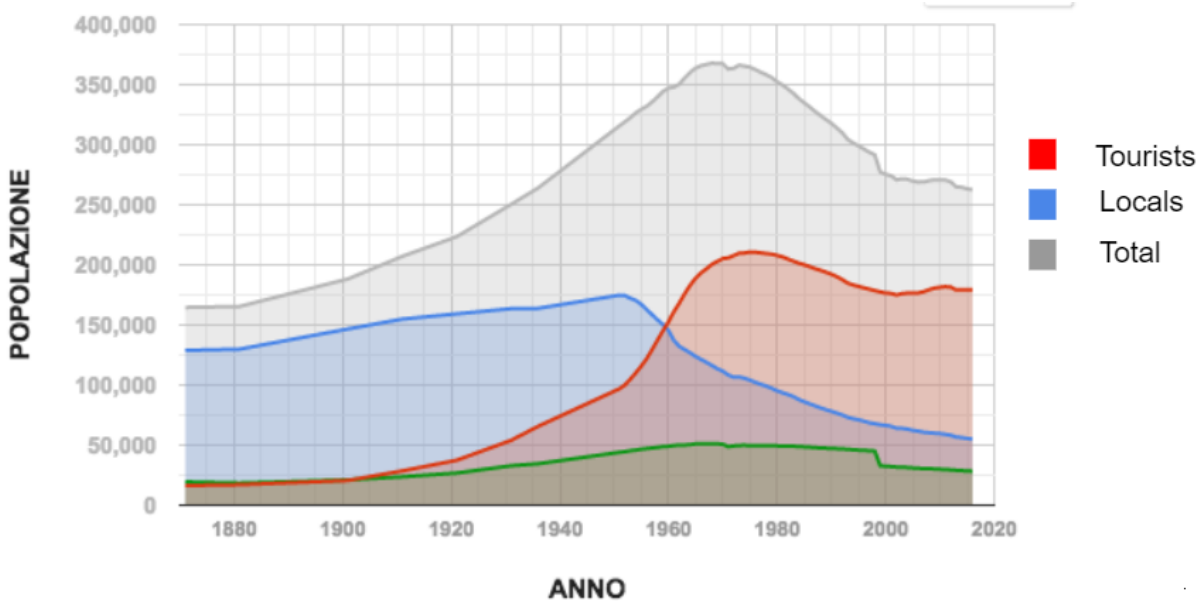
Executive Summary

The economy of the historic city of Venice has gone through many changes throughout this time. In order to understand and see the economic health and trends of this historic area, WPI and the Venice Project Center set up an ongoing project to collect retail data and catalogue the economic landscape of Venice.

Since 2004, the Venice Project Center has had multiple teams collect data in different districts, or *sestieri*. This year, in 2018, marks the eighth team to do so, continuing to give a picture of the evolving storefronts. The objectives of the 2018 team are:

1. To collect data on types of retail in Venice accordance with standards used by previous teams.
2. To improve on the current web-based data visualization tool used by the center.
3. To analyze the changes and patterns in the retail sector over time and identify economic trends.

The retail sector is the reflection of the demographics of an area as businesses will often target the people that frequent that location. Since the 1970s, the local population of Venice has declined consistently; the population has fallen by one third since 1981.



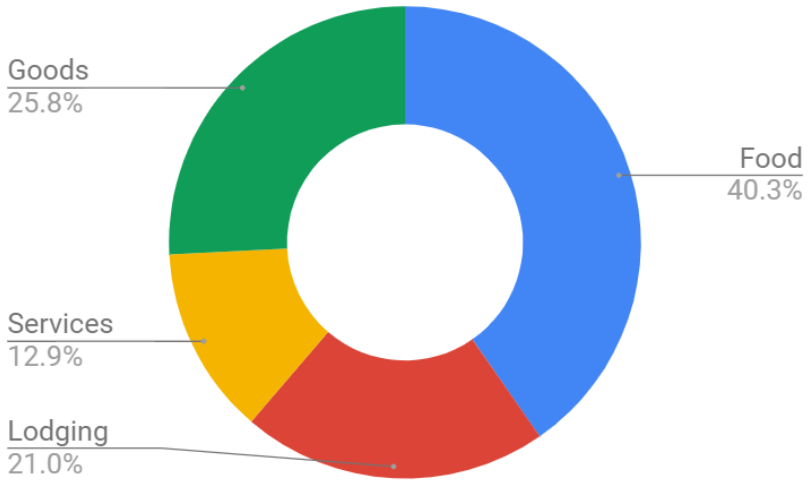
As this decline happens, the city is also aging: as the average age of a Venetian has risen from 40.6 years to 48.3 years from 1971 to 2001. On the other hand, tourism has risen constantly over time, making it the major part of Venice's economy. Since 1987, Venice has exceeded the recommended number of 15,000 residential tourists (i.e. tourists staying for at least one night) and 10,000 'day-trippers', totaling a 25,000 per day capacity. This information is crucial for the team to consider while analyzing the economic trends of Venice.

The 2018 shops team chose the island of Giudecca and the *sestiere* of Cannaregio as the main focus of data collection. In the past 7 shops projects, the VPC has never done data collection in the island of Giudecca, so the 2018 team chose to create a baseline of retail sector activity that future teams could use for analysis. Also, since there is past data on Cannaregio to serve as a baseline, the 2018 team decided to collect new data that could be compared to identify economic trends.

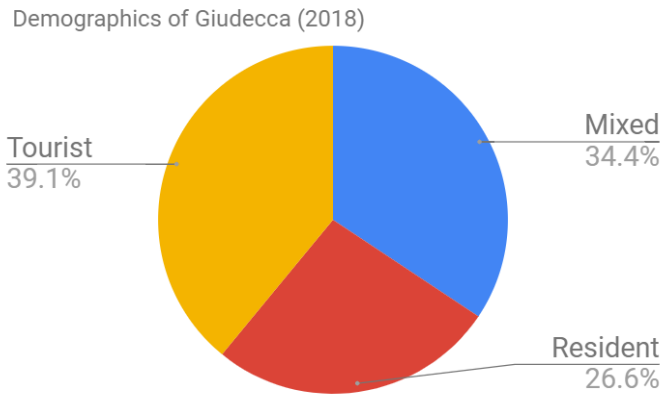
This project is mainly based on data collection, web-tool improvement, and data analysis. Firstly, the team will focus on collecting data on Venice' retail as well as cleaning up past data. Previous teams stored their datasets in the City Knowledge Database, where all data collected by past Venice Project Center teams is stored.

In data collection this year, the team collected the following information of shops: shop names, addresses, districts, corporate ownership, ethnicity of ownership, years of opening and closing, and the modified NACE code. The team used paper and pen to do data collection, as well as photographs of the storefronts found.

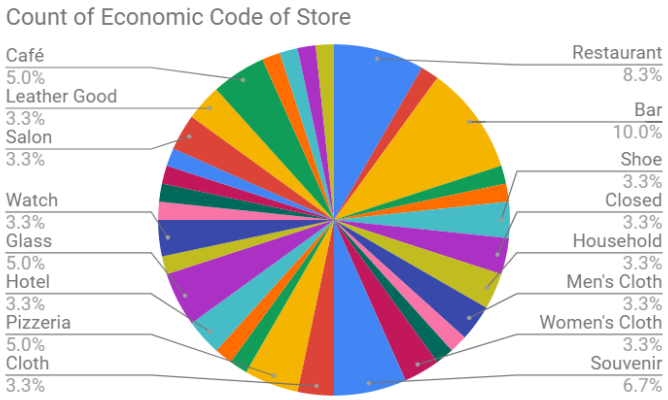
The majority of stores on Giudecca are food-based retail (40.3%). In addition, 21% of stores are lodging-based retail, 12.9% are service-based retail, and 25.8% are goods-based retail.



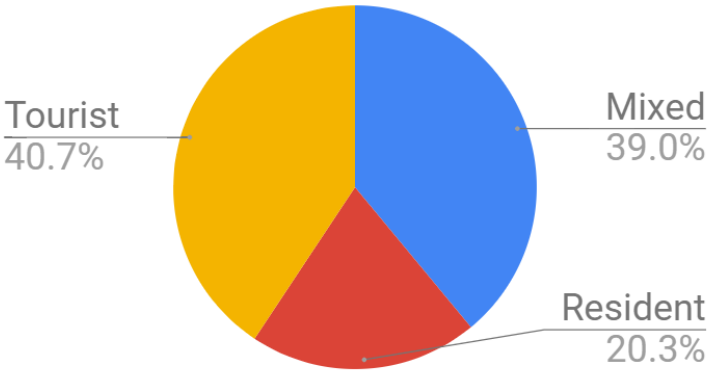
In a similar way, the team was able to observe the target demographics that each store attempted to market toward. 39.1% of stores on Giudecca seemed to market toward tourists, whereas 26% of stores seemed to cater to residents. 34.4% were classified as "Mixed" , which means that a store had no obvious target market in either direction.



The team also made a pie chart for the data collected from Cannaregio. The top classification for the Cannaregio *sestiere* are bar (10%), restaurant (8.6%), and souvenir stores (6.7%).



The group also collected data on the target market of stores in Cannaregio. The majority, 40.7%, were found to be stores targeting tourists. These consist of stores such as large chains, souvenir stores, take out restaurants, and some bars.



The team also finalized the design for the new website. First, the team updated the look of the website to adhere to the new color scheme and design patterns of the other Venice Project Center websites. Next, the team added a search bar that users can search certain types of store by keyword. Also, the dataset can be filtered with through many different criteria and displayed on the map. In addition, census data can be overlaid in a heatmap style fashion with the menu on the top left of the screen.

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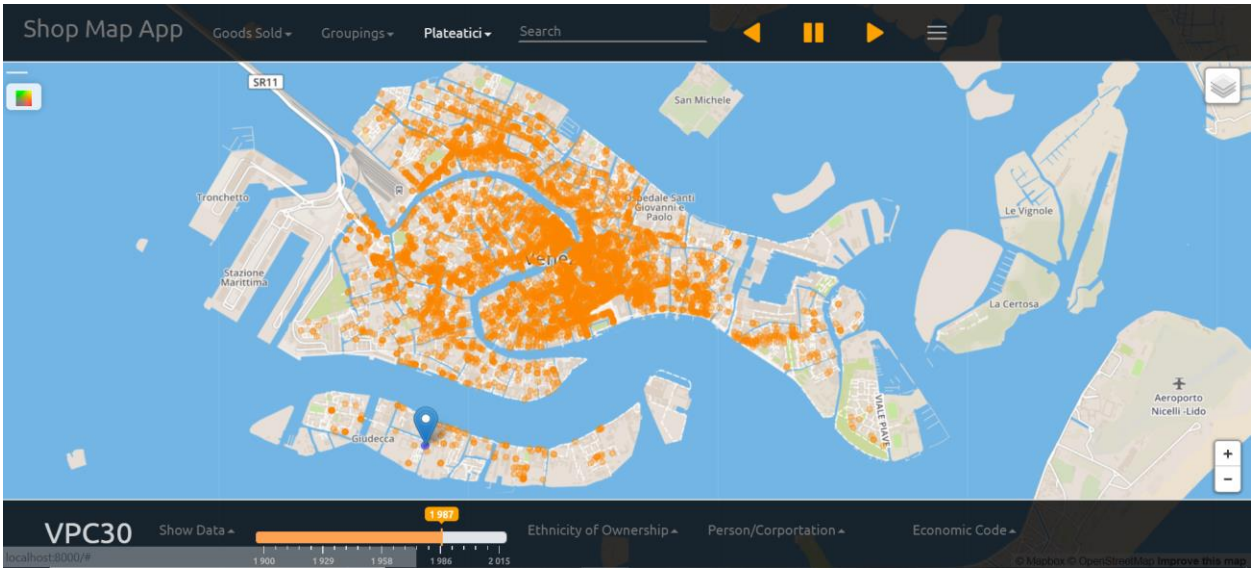

In conclusion, since there's not enough data from Giudecca, the team could not draw any conclusions about the data. For Cannaregio, the economy saw a slight increase in the ratio of active stores to inactive stores compared to past years, while the food-based activities saw a slight increase and good-based retail saw a contrasting decline. Considering all collected data as a whole set, the number of active and inactive storefronts both decreased compared to the historical data. Also, there's slight decrease in restaurants and souvenir shops.

For future teams, our team has recommendations about the web-application, database and data collection method. For the web-application, our team suggests the future team can either work on the 2015's website or build up a new web-app using the react framework created this year. For the database, our team recommends that the future teams sort the chamber of commerce data in the same structure as VPC data. This would increase website loading speed. For the data collection method, our team highly recommends the future team works on the CK input app as a large part of their project- it has many bugs that need to be fixed and need much more functionality in order to be useful. If the team finds out that the CK app is unusable, they should start to do data collection using photo or pen and paper as soon as possible.

Table of Contents

List of Figures

List of Tables

Authorship

This paper was authored by Joe Bartone, Yibin Chen, Stephanie Racca, and Keith Scales.

Joe Bartone worked on the Executive Summary, Abstract, Introduction, 2.1 - Venetian Residential Demographics, 3.2 - Improving on the Current Data Visualization Tool, 4.1-Overview of Collected Data, 5.2-Recommendations on the State of the Current Web-Application, and refurbishing the old VPC website.

Yibin Chen worked on the Executive Summary, Background Introduction, 2.4 - Venetian Food Industry, 5.4 - Recommendations on Retail Database, 5.5 - Future points of analysis, and the Acknowledgements.

Stephanie Racca was the team editor, and worked on 2.3 - The Classification of Retail Business, 3.3 - Analyzing and Identifying Factors Affecting the Retail Sector, 4.3-Analyzing the Collected Data, 5.1 - Conclusions on the Results of the Data, 5.3 - Recommendations on the Retail Database, 5.4- Recommendations on Retail Data Collection, 5.5- Future Points of Analysis, 5.6-Overall Conclusions, Appendixes B through H, all numbers and calculations of past and present data that were stated in the paper and in graphs, as well as creating all original designs for the application and creating the new React website and new retail database.

Keith Scales worked on 2.2 - Venetian Tourism, 3.1-Collecting Data on Venice Retail, and Appendix A.

The entire team worked together in collection in the field, with Keith Scales and Yibin Chen primarily taking the lead. The entire team contributed to the upkeep of the team website, including weekly blogs and vocabulary review.

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1.0 Introduction

Data about retail over time can reveal shifts in the dominant industries of a region. Due to the historical and cultural importance of the city, Venice sees about 90,000 tourists per day (Martin et al., 2014). The retail sector has changed to reflect this; in 2012, 67% of stores surveyed in the Veneto region were found to be "tourist" shops (Schulman et al., 2012). This large proportion of tourist shops provide historical Venice with a source of income where traditional sources, like manufacturing, prove too costly due to the region's island landscape (Kingston 2009).

Since 2004, students from WPI have aided the Venice Project Center in collecting data on retail businesses in Venice. These teams collect data to provide a continuous picture of Venice's evolving storefronts. When a project team from 2012 surveyed 5 *sestieri,* they found that "...there are a total of 2764 tourist stores, 864 resident stores, and 486 mixed stores in the five districts covered," (Schulman, Olm, Chen, & Bruso, 2012, p. 11). Although these snapshots are helpful, data becomes valuable when compared over time. This way, the VPC can see broad shifts in active stores, inactive stores, and conversions- and through this, assess larger trends in the economy of the Veneto region.

Past projects, despite providing a wealth of useful retail data, left room for improvements for future teams. As of 2018, the VPC has yet to collect retail data from the island of Giudecca, and the web-application created by the 2015 team can be updated to have a sleeker modern look and feel. In addition, the VPC method of classifying store types has limitless potential for expansion to more specifically identify types of stores. The CK database used by previous shops teams also contains many data inconsistencies and problems that could be smoothed out for future teams.

In 2018, our team will continue the tradition of collecting data about store types in the city of Venice. The team will also improve upon the 2015 data visualization web application (i.e. http://shops.veniceprojectcenter.org/), and add new, more specific classifications to the data collection process. Our team will also comb through previously collected data in order to identify and correct inconsistencies in the quality or structure of data points. Through this, the team will create visuals to help the VPC to better understand the shifts in Venice's industry, and set up future teams to collect a finer grain of consistently structured shops data.

2.0 Background

Venice has always been considered a major city in Europe. Located in the gulf of the Mediterranean, the city became a trading hub due to its prime location, and still remains a historic locale in Europe today. Approximately 80,000 tourists visit per day, reflecting this influx in the retail industry (Martin, La Manna, D'Ambrosio, & Blanco, 2014). From 1999 to 2008, the number of tourist shops in Venice rose from 191 to 1516, an increase of 793% (Carrera, 2008). In addition to tourism-based retail, the Venetian economy contains many facets, including an industrial focus on hotels and accommodations, food service, and food retail. This chapter provides an overarching view of the Venetian economy, as well as the logistics of repurposing unused storefronts.

2.1 Venetian Residential Demographics

The retail sector acts as a reflection of the current demographic state of Venice. Businesses cater to the demographic of people within the area in which they are located in order to prosper. In this way, businesses are at the mercy of the changing needs of the consumers. Some adapt to suit the changing needs of the general public in order to remain successful. Because of the direct correlation, understanding the change in Venice's consumer needs will aid in creating a basis for expectations for changes in the retail sector.

2.1.1 Post Industrial Venice

Giudecca, an island in Venice, used to be an industrial center. Since the industrial booms caused by WWII, the decline of manufacturing in Venice and increasing tourism numbers have spurred economic shifts that promote tourism in the local economy. This, at first, proved to be a sound direction for Venice's economy, but has recently has proven unsustainable and detrimental to residential life. Tourists have "...cut into a space in which Venetians used to live" (Kington 2009)

In addition, the 1970's marked a major shift in Venice's population. In the decade prior, Venice's population was growing at a rate of 0.64% per year, as shown in Figure 2.1. Since then, the population has been declining at an average rate of approximately 0.74% per year, with the population of the Veneto region decreasing to approximately 261,000 by 2010 (Venice, 2015).

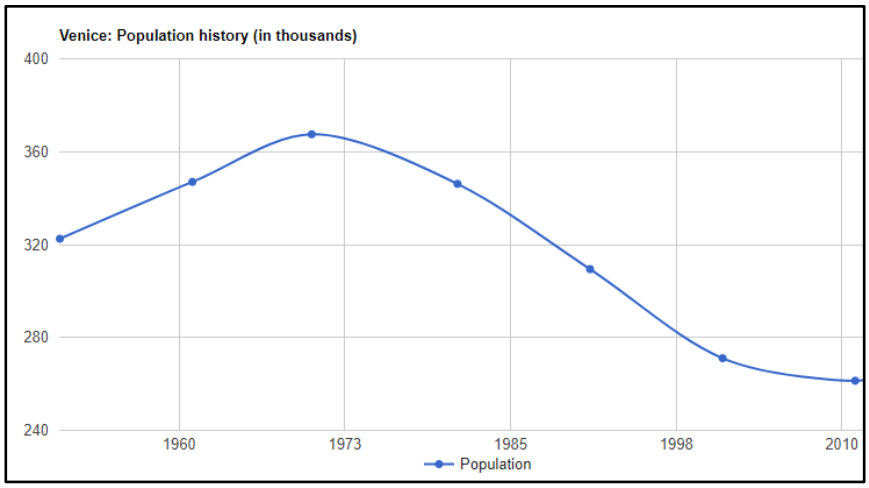


Figure 2.1 Population history graph (Venice, 2015)

This phenomenon of steady decline is even worse in the historic lagoon district of Venice, where the "...population of the lagoon [the historic city, the Lido, Pellestrina and the islands] has fallen by more than a third [since 1981]," (Demographics, 2016).

2.1.2 Aging Population

Venice's population is shifting in other ways as well – the city's residents are aging. According to the European Statistics Group (2010), the average age in Venice has risen from 40.6 years to 48.3 years from 1971 to 2001. Incidentally, this is higher than both Italy's average age and the overall average age of the EU (Eurostat, 2010). This trend is exaggerated in the historic district of the city, with 24% of the district's residents being aged over 60. This is significantly higher than the proportion of seniors in Venice as a whole (16.9%) (Demographics, 2016).

The greying of Venice's population is accelerated by the departure of the city's youth. The proportion of those aged 0 to 13 in Venice plummeted from 16% in 1971 to 9.1% in 2010 (Comune de Venezia, 2010), which can in part be attributed to the lack of meaningful work for young people; the city of Venice had a 2.2% hiring rate of university graduates in 2009, compared to the massive 37% hiring rate of unskilled workers (Angeloni, 2013). In the context of the project, this growing amount of unskilled work in the retail sector could be demographic shifts worth exploring with storefront data.

2.2 Venetian Tourism

Over time, Venice has begun to feature tourism as a major part of its economy. This transformation has in turn had a large impact on the rest of its economy; and in regards to retail, the types of store that line the streets . Data collected by previous project center teams show an increase in retail catering to tourists (e.g. hotels, hostels, money transfer, exchange, souvenirs, etc.) from 2004 to 2009.

2.2.1 The Rise of Tourism in Venice

Tourism in Venice is so rampant that the city's "carrying capacity" has been surpassed. Carrying capacity, as defined by World Tourism Industry, is the "maximum number of people that may visit a tourist destination at the same time, without causing distress to the physical, economic, and socio-cultural environment, while still maintaining an acceptable level of visitor satisfaction," (Massiani & Santoro, 2012). Since 1987, Venice has exceeded the recommended number of 15,000 residential tourists (i.e. tourists staying for at least one night) and 10,000 'day-trippers', totaling a 25,000 per day capacity. This recommendation is far less than the current average of 80,000 tourists per day, causing concern for Venice's health (Martin et al., 2014).

The tourism business in Italy brings in over 161 billion euros annually, making up over 10 percent of the GDP (Biagi, 2015); with 2 billion of those euros being contributed by tourism in Venice (Martin et al., 2014). Naturally, due to the lucrative opportunity being presented in Venice, the majority of stores on the island have adapted to accommodate visitors to the island. It is theorized often that when a person travels, spending increases and more 'non-essential' items are bought – a lucrative opportunity for local business-owners (World Tourism Organization, 2014).

Of the over 4000 stores recorded by the 2012 Venice team, over 2700 were deemed "tourist" store (Schulman et al., 2012). Tourist stores were defined as shops that sell souvenirs, glass, masks, trinkets, and other goods that local Venetians would not be apt to purchase.

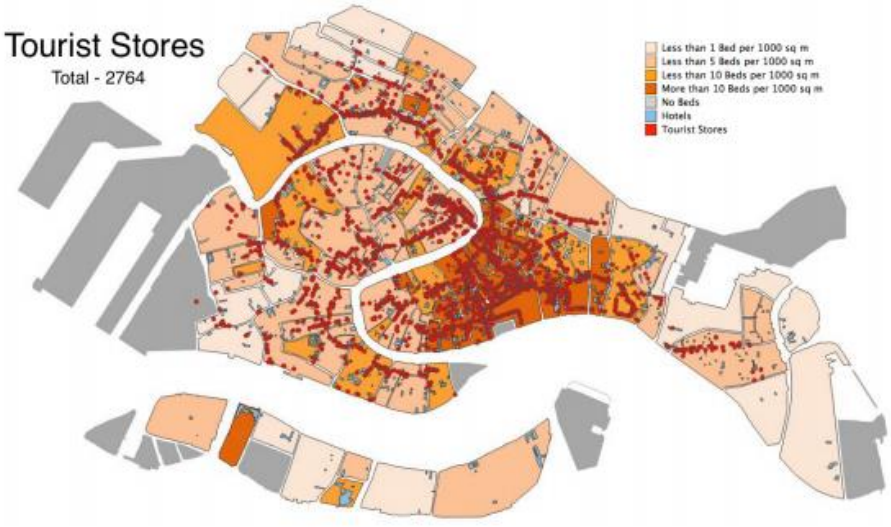


Figure 2.2 The Location of tourist stores in relation to accommodations (Schulman et. al, 2012)

Tourism retail has increased in places where tourists frequent; with the numbers and locations of stores correlating with the number of tourist beds in the area. In Figure 2.2, a visualization of this data shows that tourist stores cluster around areas where tourists are living, a natural reaction to the industry at hand. In the middle right in the image above, dark orange sections have very high densities of tourist stores; in other words, tourist stores appear in large numbers in areas with high densities of tourist beds.

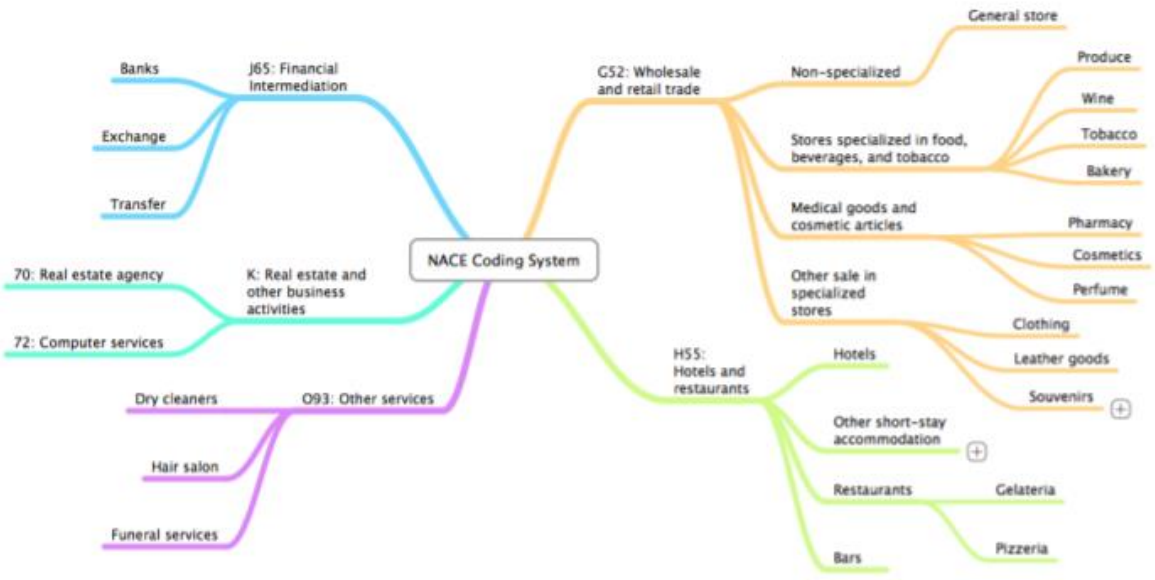
2.3 The Classification of Retail Businesses

Like any city, the retail sector of Venice is incredibly nuanced. In years past, WPI students have found clothing, souvenirs, restaurants and hotels to have the largest number of stores in Venice; despite that, there are many other types to account for (LaRovere et al., 2015). Without a standardized way to classify every type of business in Venice, data collected would be messy, unorganized, and unhelpful. This section details the European standards for classifying retail businesses.

2.3.1 Nomenclature of Economic Activities (NACE) Standard

The Nomenclature of Economic Activities (NACE) is a European statistical classification based off of United Nation standards for categorizing economic activities (Rev, 2008). As a way to compare across international borders, NACE is mandatory across the European statistical system (What is a NACE code?, n.d.).

A four component code is given to each economic activity, with each part contributing to the overall comprehension of what this retail actually is. The code is broken down as follows into section, division, group, and class. For example, G is the category for wholesale and retail trade, whereas the division would be 52 if the economic activity was retail trade.



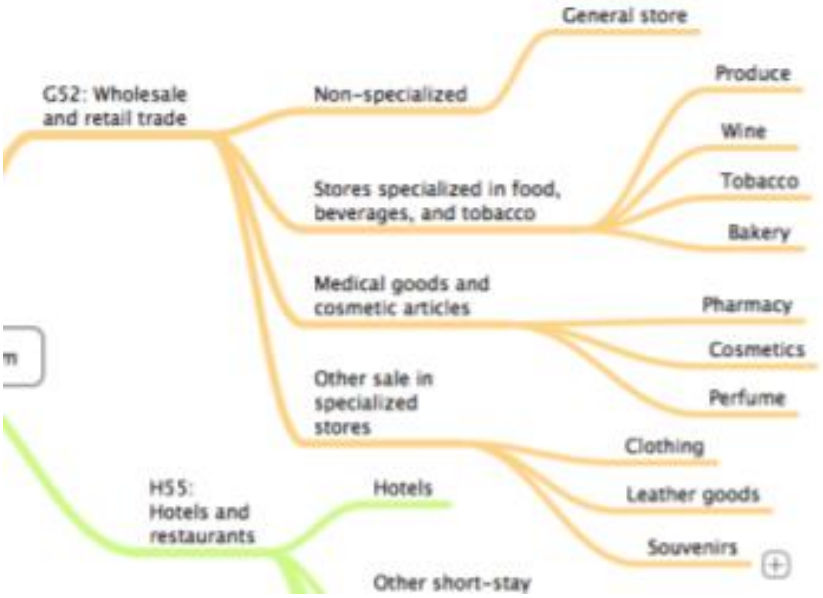


Figure 2.3 Diagrams of NACE Codes (Schulman et al., 2012)

The standard NACE coding does not define retail in a specific enough way to satisfy the needs of the VPC. So, the Venice Project Center has added extra numbers to NACE coding for the retail database. In Figure 2.3, an example of a leather shoe store is given. The NACE standard for a shoe store would be G52.43 (Rev, 2008), however that only tells the reader that it is a leather goods stores, meaning the uninformed would not be able to tell if it sells leather bags, leather shoes, etc. So, to differentiate it from the other classifications, the Venice Project Center classifies a leather shoe store as G52.43.1 (Schulman et.al., 2012). This modified NACE code is used as part of the data collection methods of Venetian stores.

2.4 Venetian Food Industry

When detailing the changing face of Venice's retail sector, it is impossible to avoid mentioning the food industry. For all intents and purposes, the VPC classifies all classifications of stores in the food industry under the umbrella of "retail" businesses.

In general, the food industry includes economic activity such as agriculture, food processing, food distribution, food service, and food retail. This includes businesses such as farms, grocers, and restaurants. According to a past project from Worcester Polytechnic Institute, "Venice has one food retail store for every 391 residents, while in comparison the nearby Mestre has one food store for every 624 residents," signifying a significantly larger number of food stores compared to other areas (LaRovere et al., 2015, p. 60). Due to various factors such as the lack of quick transportation to mainland areas, as well as the tightly-packed constitution of storefronts on the island, the plentiful nature of food retail makes sense.

2.4.1 The Rise of Supermarkets

Another ongoing food retail related trend in Venice is the replacement of locally-owned food stalls with large, centralized supermarkets. A website advising tourists staying in Italy reported that,

> "... supermarkets have sprung up in neighborhoods through Venice's historic center. Co-op, Conad, Despar, Prix, and Punto are just a few of the supermarkets that have branches around the city," (Imboden, n.d.).

In addition, "...in 1994, there were only 5 supermarkets located in the historic center of Venice, while today 24 are in existence…" (Demographics, 2016).

The issue is the fact that "these newer supermarkets have been appearing along commuting routes" and not in residential areas (Venipedia, 2016). Venice is a city where an aging population must walk to and from their homes to buy groceries, where 24% of the historic district's residents are senior citizens. (Demographics, 2016). Although walking to and from markets is a task that residents of Venice have had to do since its' founding, placement of recent supermarkets could better accommodate the residents of the city and make their lives easier.

3.0 Methodology

The goal of this project is to collect data for analysis of the changing retail landscape of Venice. By providing an up to date collection of data on the many facets of Venetian retail, as well as an engaging and unique visualization tool, this data can be used to identify current trends in Venice's economy.

The objectives of this project are as follows:

1. To collect data on types of retail in Venice in accordance with standards used by previous teams.
2. To improve the current web-based data visualization tool used by the center.
3. To analyze the changes and patterns in the retail sector over time as well as identify factors affecting the retail sector.

Data will be collected and analyzed over seven weeks, starting with an inventory of stores on the island of Giudecca. The team will compare this data to that currently withheld in the Venice Project Center database and analyze correlations with the data of past teams. To aid in analysis, the team will revitalize the current Venice Project Center's web-app with the end-goal of making it load-time quicker while simultaneously making it easier to use. The following sections detail the methods the project will use in order to accomplish the set objectives.

3.1 Collecting Data on Venice Retail

Collecting data on retail in Venice is crucial for future analysis of the city's economic changes. To date, there are approximately 4,000 data points within the center's database on Venetian retail, dating all the way back to 1900. Through multiple trials, past teams have created a standard in collecting when it comes to retail. Based on the data as well as the classification code of past projects, the team will add new data for further research.

3.1.1 Review of Previous Data

All previous data collected by the center is stored in a database. The previous teams broke down the data by *sestiere* and assured that they noted the economic activity of each shop. In the dataset, especially in that of Cannaregio, special attention was paid to restaurants, hotels, bars to mark the abundance of each of these establishments. The team will analyze the database, looking for particular patterns and will make note of the state, or prevalence of particular types of retail, particular number of inactive storefronts, etc., with the most recent data from 2015. The locations of hotels, restaurants and bars were also noted, as the team plans to focus on those in the data collection phase. This way, once data collection was complete, analysis of these classifications of stores were completed and test visuals created in an efficient manner.

The team conducted content analysis on specific areas that have also been analyzed by past teams, as well as the types of graphics they produced to display this data. As 3 years have

gone by since the last point of collection, the retail sector has had ample time to change, and the data collected by the 2018 team could show that it has..

3.1.2 Identification Standards

As previously noted, the Venice Project Center has utilized NACE coding standards in order to effectively display the types of retail collected. While these classifications can provide a general overview of the type of store recorded, they are not descriptive enough to allow for a perfect understanding of a store's inventory. For every type of store that the team encountered that was not provided an accurate NACE code (e.g., men's clothing) an extension to the code was added. Additional extensions to the code that have been added by the current team are women's, men's, and children's clothing; as well as food-based retail such as fast food, ethnic restaurant, and take-away food as shown in Table 3.1.

NACE Code	Title	Description
G 52.4.2.4	Women's Clothing	Retail sale of women's clothing
G 52.4.2.5	Men's Clothing	Retail sale of men's clothing
G 52.4.2.6	Children's Clothing	Retail sale of children's clothing
G 52.4.8.23	Mask	Retail sale of masks
G 52.4.8.24	Glass	Retail sale of glass items
H 55.3.0.4	Fast Food	Retail sale of fast food
H 55.3.0.5	Ethnic Restaurant	Retail sale of non-Italian food
H 55.3.0.6	Take-away food	Retail sale of take-away
I 63.4.0.1	Delivery	Delivery and mail services
K 74.9.0	Printing	Printing services
K 74.10.0	Study Agency	Agency for tutoring and other education services
O 92.7.1	Casino	Gambling and betting activities
O 93.0.6.1	Hospital	Medical Services
O 93.0.6.2	Veterinarian	Medical Services for animals

Table 3.1 Table of NACE codes added in 2018

The precision provided by the new extensions will provide the Venice Project Center with a more accuracy in the classification and analysis of retail stores, especially in regards to the issues that globalization brings (when taking into regard the rise of fast food or ethnic restaurants). Appendix A gives a full list of Venice Project Center NACE codes, including the ones the team created.

As part of the process, the Venice Project Center collects data on shop names, addresses, districts, corporate ownership, ethnicity of ownership, years of opening and inactive storefronts, and the modified NACE code, as shown in Figure 3.1. Appendix B shows all filterable options that the Venice Project Center provides in terms of data collection.

Name	Pizzeria A Tre Scaini
Adress	Calle Michelangelo 53C
Sestiere	Giudecca(Dorsoduro)
Economic Code (Name)	Pizzeria
Economic Activity (NACE)	H 55.3.0.3
Year Open	2018
Year Closed	N/A
Not Corporate Owned	Person
Group	Mixed
Outdoor Space	No

Figure 3.1 Typical data point collected

The team has agreed on continuing this standard, as it provides a clear understanding to not only the team in categorizing things, but also any reader who looks at the center's data. By keeping consistent with the current standard, the team's time spent on data collection will be much more efficient, as there will be no time wasted on changing the numerous data points to fit a new identification standard.

3.1.3 In-Field Data Collecting

To begin the data collection process, the team reviewed each member's data collection process. Data collected on the island of Giudecca was done by different combinations of teammates. This data was then compared to check for quality and consistency. The team later used these group combinations to collect data throughout Cannaregio.

To collect the data, the team employed multiple methods. First the team used the City Knowledge application, a web-application in which data is input through a template, complete with a picture, and then submitted at the location of the store, allowing for information about that certain geographical location to be recorded effectively. The team experienced difficulties with the consistency of the application and its ability to record data without errors, so other measures were taken. The team resorted to walking around the city and recording data using pen and paper, which posed some difficulty as there was often a lot of stopping in the middle of busy streets to record data. After recording one section of Cannaregio using this method, the team developed a more efficient method: taking pictures of the stores and their addresses, then going to a workspace to record the information as if we were live in front of the store. This method proved more efficient due to the lack of distractions and issues that live collection created.

The team divided the main lagoon area of Venice into their appropriate *sestiere*, and from there into smaller sub-sections based on the number of islands in that area. An example of a divided *sestiere* can be seen in Figure 3.2.

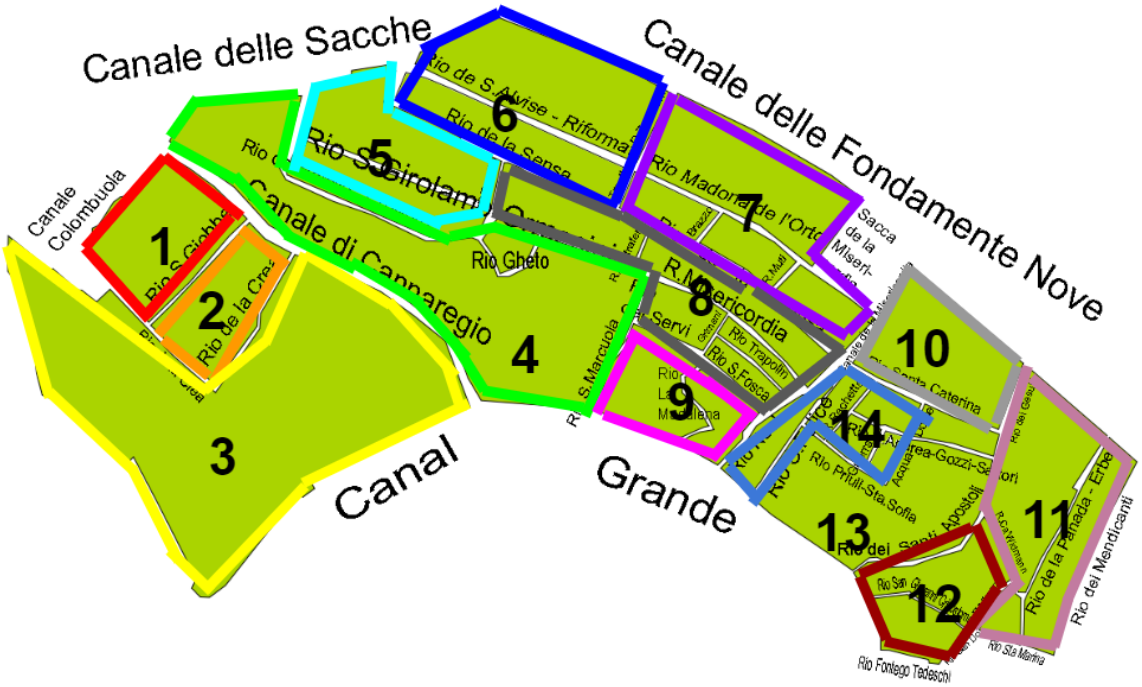


Figure 3.2 Data Collection Schedule for Cannaregio

To collect data, two teams of two walked down opposite sides of a selected street a took pictures of the retail stores present. Afterwards, the team took the photos to the selected workspace in order to complete the previously described method of recording.

3.2 Improving on Current Technical Tools

The data from past and present Venice Project Center teams is currently displayed on a website (Figure 3.3), where users can see data over a map of Venice, and display certain points based on the filters provided. On the 30th anniversary of the VPC, project websites are moving toward a standard color scheme and a sleek, modern look.

By 2018 standards, the visuals of the application look dated, and inconsistent with current VPC standards. By mostly focusing on front-end development (visible aspects), members of the team plan to refresh the application, using modern web-development methods such as Material Design; a method of web design created by Google, whose primary design principles are to use shadows, hard edges, to create suggestions of objects on screen. Most modern web-development use this as part of their design method, as it promotes clean and usable interfaces.

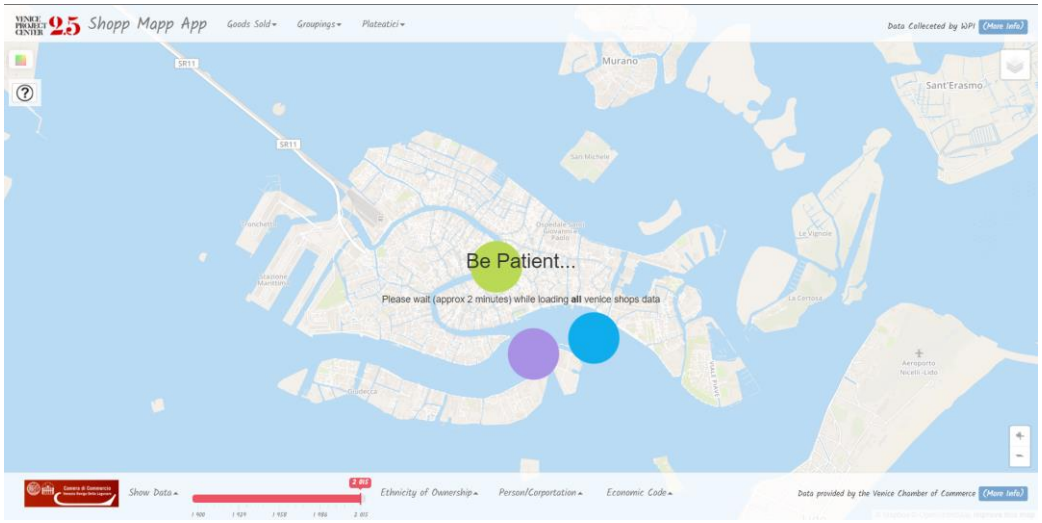


Figure 3.3 2015 VPC web-application, in it's loading state

3.2.1 Plans for Development

A crucial part of any tool is ease of use. The redesigns are not only to make the web-application look good, but improve input response, accessibility, and motion for a better user experience overall.

3.2.1.1 Building a New Website

The original application in 2015 was written in JavaScript. Although the application will still be programmed using JavaScript, the team originally decided to use the React.js library as a means of constructing the front-end. Created in 2013 by Facebook, it streamlines the front-end development process, and is easy to use; an added benefit when working with people of various programming levels.

The team spent time designing the website to have a more modern look and feel compared to the site from 2015. In addition, a new tab was implemented in order to display all stores currently displayed on the map. The pins for each store were also colored differently in order to display the target consumer market of each store, shown in Figure 3.4.

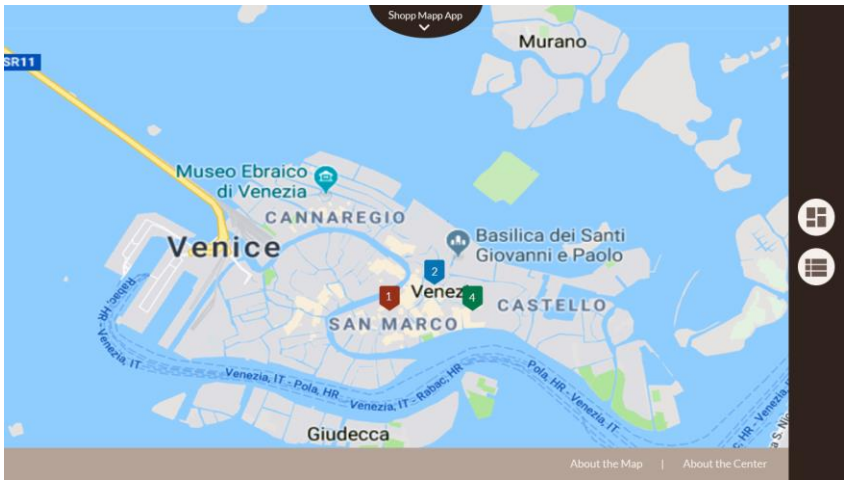


Figure 3.4 Preliminary designs of React website

Another improvement was the statistics tab, that would use the current year's data in order to create helpful visuals on the side of the map, created by the filtered options a user chooses, shown in Figure 3.5.

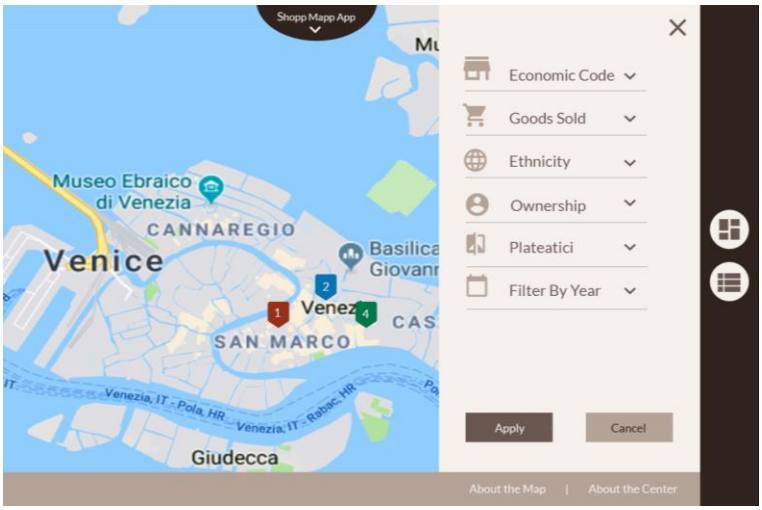


Figure 3.5 Filterable options, preliminary designs of React website

Unfortunately, due to early database setbacks, our team lacked the time necessary to completely launch a website from scratch while also collecting retail data, which led to a partial implementation of a React-based website, and a fully refurbished Javascript website.

3.2.1.2 Revitalizing the Shops Website

In realizing that the scope of a new website would prove too daunting for this project, the Computer Science oriented members of the team decided to shift their focus on overhauling the existing website through cosmetic revamps and added features. This was done using the original language of Javascript, as the team felt converting the code would be not be time-efficient when

coupled with data collection. The team updated the look of the website to adhere to the new color scheme and design patterns of the Venice Project Center websites.

3.2.2 Database Improvements

The backend work done on this project took the team in a surprising direction. Although we had planned to improve on the website's data retrieval algorithm, the team found that before this could be accomplished, the database must be made clean and consistent. To do so, the team created their own database in which students can view all shops data collected by the Venice Project Center. This was necessary, not only because the shops data encompasses a large portion of the CK database, but due to the structure of the database, it was difficult to traverse the back-end to get the historical data, as shown by its structure laid out in Appendix G.

This will allow students to view all data collected by the Venice Project Center, as well as implement the database in any future applications the center may make . To maximize efficiency, a specific branch system was created with a Firebase environment. First, data was divided into two categories: Chamber of Commerce data ("chamber") and Venice Project Center data ("shops"). From there, shops data was broken up by year of opening. After that, individual shops were pushed to their respective years of opening with all of their data included, as well as the primary address ID given to them within the CK database. This layered approach to database structuring allows for faster query times, and makes more sense for future teams to use than the full City Knowledge database (outlined in Appendix G). A full diagram of the structure of the newly created database can be found in Appendix F.

3.3 Analyzing and Identifying Factors Affecting the Retail Sector

The overall goal of this project is to provide the VPC with the data and tools needed to analyze the change of Venetian storefronts over time. One of the most important aspects of this project is to use these tools to visualize these changes. In order to do this, the web-application will be used in order to create meaningful visuals of the collected data that easily and accurately reflect the retail sector's change. These visualizations will consist of different types of stores plotted on the same map. In terms of analysis, regions of high densities of either store will be mapped off and compared to see if there is a trend in the placement of store types. Average distance between the two types of stores will be considered in the analysis of the visualization.

3.3.1 Primary Data to Target

One of the primary focuses of analysis is the amount and frequency of certain economic activities within the *sestieri* of Giudecca and Cannaregio. Using the NACE code classifications as a guide, the team will look at the number of certain types of stores that have been collected this year to get a better understanding of the predominant economic types in the area. Not only will the team use the NACE code as finer method of classification, those economic activities will be grouped into 'based' retail -food-based, lodging-based, service-based, goods-based, and other - to determine if there has been an increase in the broader types of retail (a table categorizing each group can be found in Appendix C), Specific analysis will be done on demographics that have had a historically high number of presence in Venice, such as restaurants, clothing, etc.

On top of that, the team will be looking at the number of active & inactive storefronts that have previously occurred. Using historical data from the Venice Project Center and the Chamber of Commerce, the team will determine the year in which stores were opened. The total number of stores opened in each year will be recorded and used for analysis. As for inactive storefronts, the team not only will catalogue any stores that look empty or abandoned as inactive as we do in-field data collection, using the addresses and coordinates collected, the team will cross-reference historical data to see if a store collected in the past has closed and re-opened as the store we saw in-field.

For each of these factors, not only will the data be looked at overall, historical and present data will be collected by *sestiere*, specifically Cannaregio and Giudecca, as it isn't necessarily accurate to compare a specific data set to an overarching one.

3.3.3 Determining Change

Using tried-and-true methods of visual analysis such as bar graphs, pie/donut charts, and line charts will be utilized by the team in our methods of analysis. The team will use our records on economic activity as a means of comparison, determining and increase in percentages of certain types of stores and the like. Since historical data tends to widely differ in amount collected as well as demographic-wise, possible averages of the data in a particular data set will be created.

As it isn't necessarily fair to draw conclusions from comparisons to data from the 1900s on, the team will mostly make our conclusions through comparisons to post-2000s data. Not only is it the most comparable due to the time period, it is also the most comparable as this project started in 2004, so data from prior to that may not always be the most accurate. On top of that, the Venetian Chamber of Commerce did not require shops to register with them until 1996, so data prior to that often turns out to be inaccurate or lacking crucial information.

The team's main factor in determining what is considered a change will be in the significance of an increase. Using basic statistics (i.e.. standard deviation) will determine if a type of economic activity, number of active storefronts, etc. is significant enough to warrant a change. Of course, the amount of data we have on a subject will be taken into account as well, and will be a determining factor in our confidence in a possible conclusion.

4.0 Results & Analysis

4.1 Overview of Collected Data

A primary goal of this project was to catalogue the island of Giudecca for the first time in the center's history to establish a baseline. After this was completed, the team moved to Cannaregio to continue to survey its storefronts. Although Cannaregio was not completed fully, enough data was collected for comparison and analysis with data from past IQP teams. In total, 261 data points were collected across Giudecca and Cannaregio. Of these 261 storefronts, 189 of them were active and 12 of them were inactive. This is a historical low number of inactive storefronts for the post-2000s era of Venice Project Center data collection.

4.1.1 Catalogue of Giudecca

Since Chamber of Commerce data for Giudecca is sparse, this year's collection acted as a baseline for future analysis and comparison. This year, there were 56 active storefronts recorded on Giudecca. This is because there was no data to compare this year's catalogue to, and so the year that most stores opened is unknown.

As seen in Figure 4.1, the majority of stores found on Giudecca are food-based retail (40.3%). In addition, 21% of stores are lodging-based retail, 12.9% are service-based retail, and 25.8% are goods-based retail. A more detailed breakdown of every store in Giudecca by NACE store classification can be seen below in Figure 4.2.

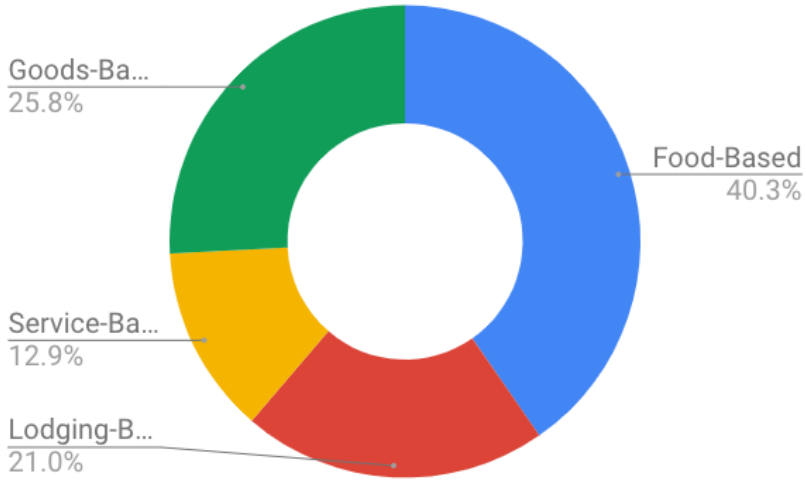


Figure 4.1 Breakdown of storefronts in Giudecca, 2018

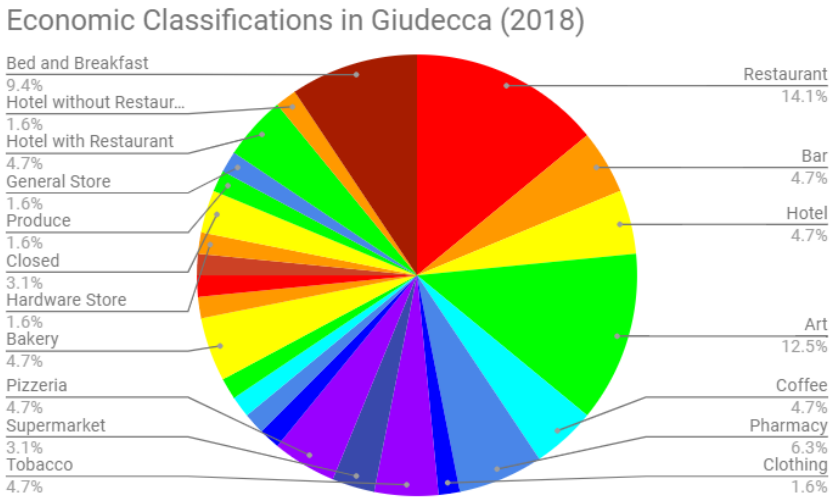


Figure 4.2 Detailed NACE breakdown in Giudecca 2018

By observing each storefront and performing some background research, the team was able to classify if each store operated as a chain or as a small business. It was found that 81.5% of stores on Giudecca were owned by people, and only 18.5% were corporate chains, seen in Figure 4.3.

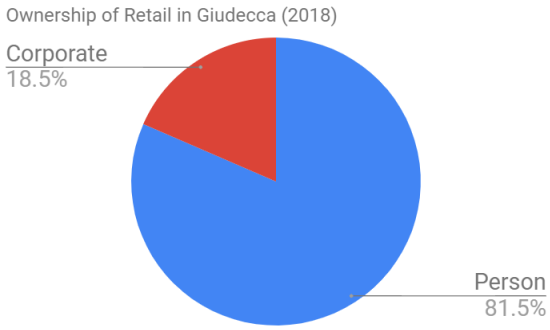


Figure 4.3 Ownership of retail stores in Giudecca, 2018

In a similar way, the team was able to observe the target demographic that each store attempted to market toward. 39.1% of stores on Giudecca seemed to market toward tourists, whereas 26% of stores seemed to cater to residents. 34.4% were classified as ‘Mixed’ (Figure 4.4), which means that a store had no obvious target market in either direction.

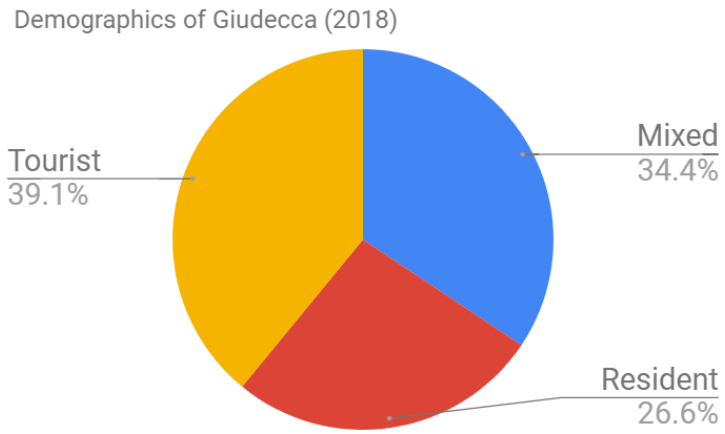


Figure 4.4 Target markets of Giudecca retail, 2018

Another piece of data that was observed was whether a business takes up outdoor space for seating. Only 25.8% of stores on Giudecca had outdoor space, where 74.2% did not (Figure 4.5).

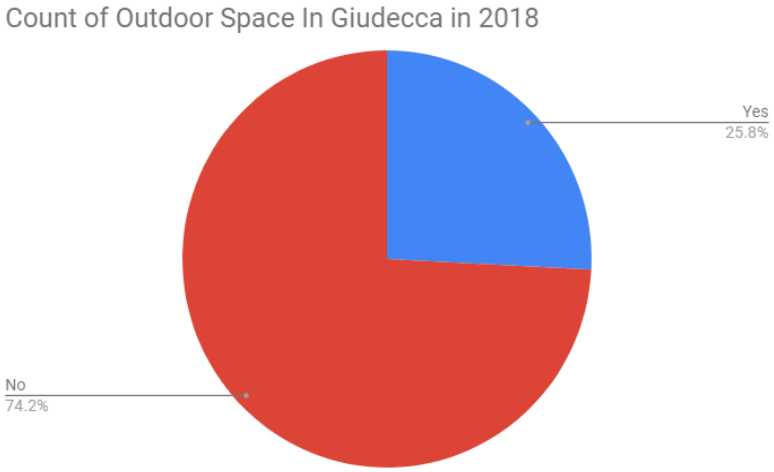


Figure 4.5 Proportion of stores with outdoor space in Giudecca 2018

4.1.2 Catalogue of Cannaregio

This year's data collection in Cannaregio served as a comparison to data collected in the past. Cannaregio was found to have a diverse array of different types of retail. This year, bars accounted for 10% of stores in Cannaregio. Other types of stores, such as restaurants and souvenir shops, accounted for large portions of retail in Cannaregio; 8.3% and 6.7% respectively (Figure 4.6).

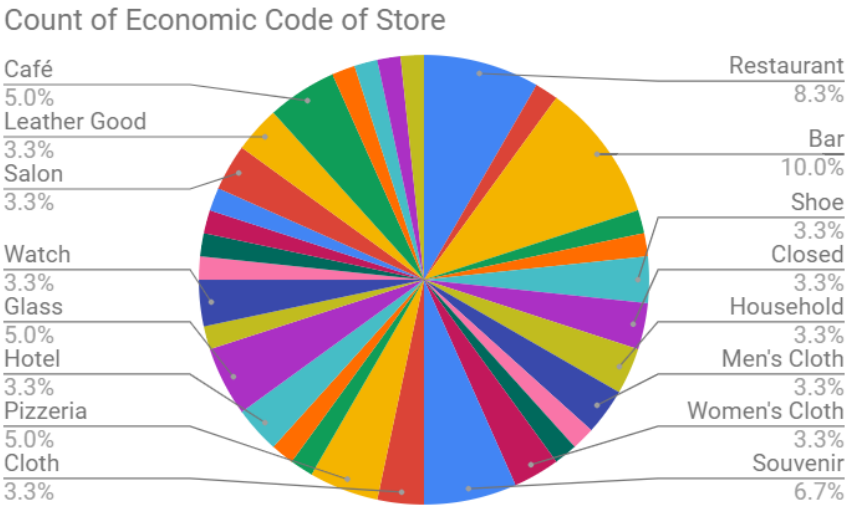


Figure 4.6 NACE codes in Cannaregio, 2018

As seen in Figure 4.7 below, shops that encroached on outdoor space were sparse, making up 13.8% of total stores.

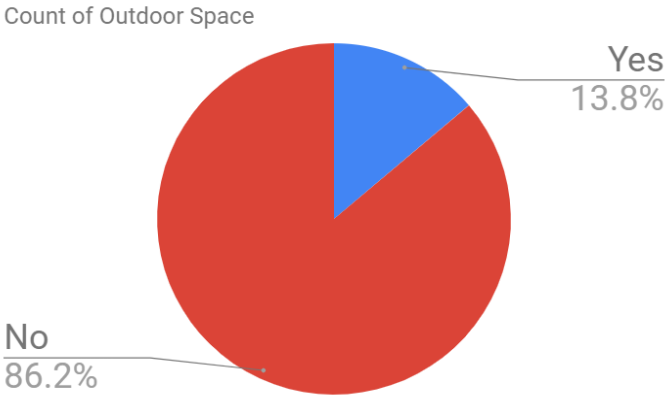


Figure 4.7 Shops with outdoor space in Cannaregio, 2018

In addition, about 58% of stores in Cannaregio were found to be small businesses, 23% were owned by corporations, and 16% were unclear as to who owned the business (Figure 4.8). This was determined by visually assessing the store, it's appearance, and if it belonged to a chain of businesses either in Venice, or globally.

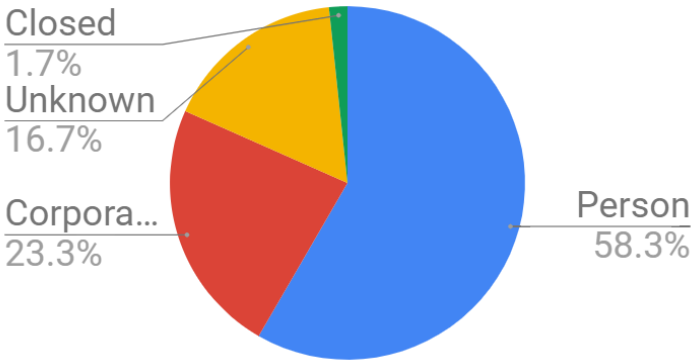


Figure 4.8 Ownership of Cannaregio stores, 2018

Finally, the group collected data on the target market of stores in Cannaregio. The majority of stores were found to be targeting tourists. These consist of stores such as large chains, souvenir stores, take out restaurants, and some bars. 39% of stores were found to have a mixed market, and 20.3% of stores were found to be residential stores (Figure 4.9).

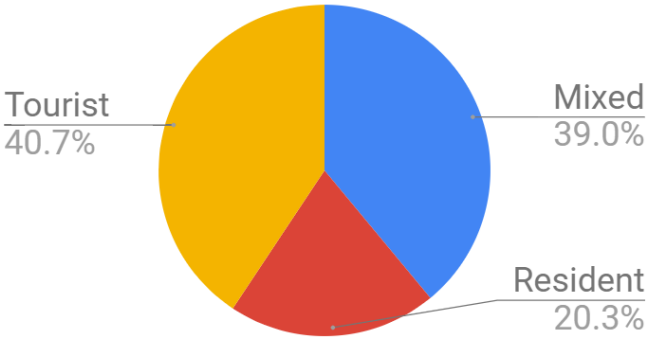


Figure 4.9 Target market of Cannaregio stores, 2018

4.2 Improvements on Current Data Visualization

The teams creation of data visualization tools can be broken up into two different sections: the improvements made to the web-application and the improvements made upon the back-end.

4.2.1 Improved Web-Application

After the partial implementation of the React-based website, as detailed in Section 3.2.1.1, the team switched to the refurbishment of the old one, as it was more time efficient. First, the team updated the look of the website to adhere to the new color scheme and design patterns of the Venice Project Center websites. The colors black, orange, white, and grey were utilized to do so. Next, the team added a search bar that retains the search terms in the URL of the website in case the user wants to save that specific search for later.

The website has the ability to switch between collected WPI data, and chamber of commerce data. Each data set can be filtered through many different criteria and displayed on the

map either with orange points or blue icons. In addition, census data can be overlaid in a heatmap style fashion with the menu on the top left of the screen, all shown in Figure 4.10.

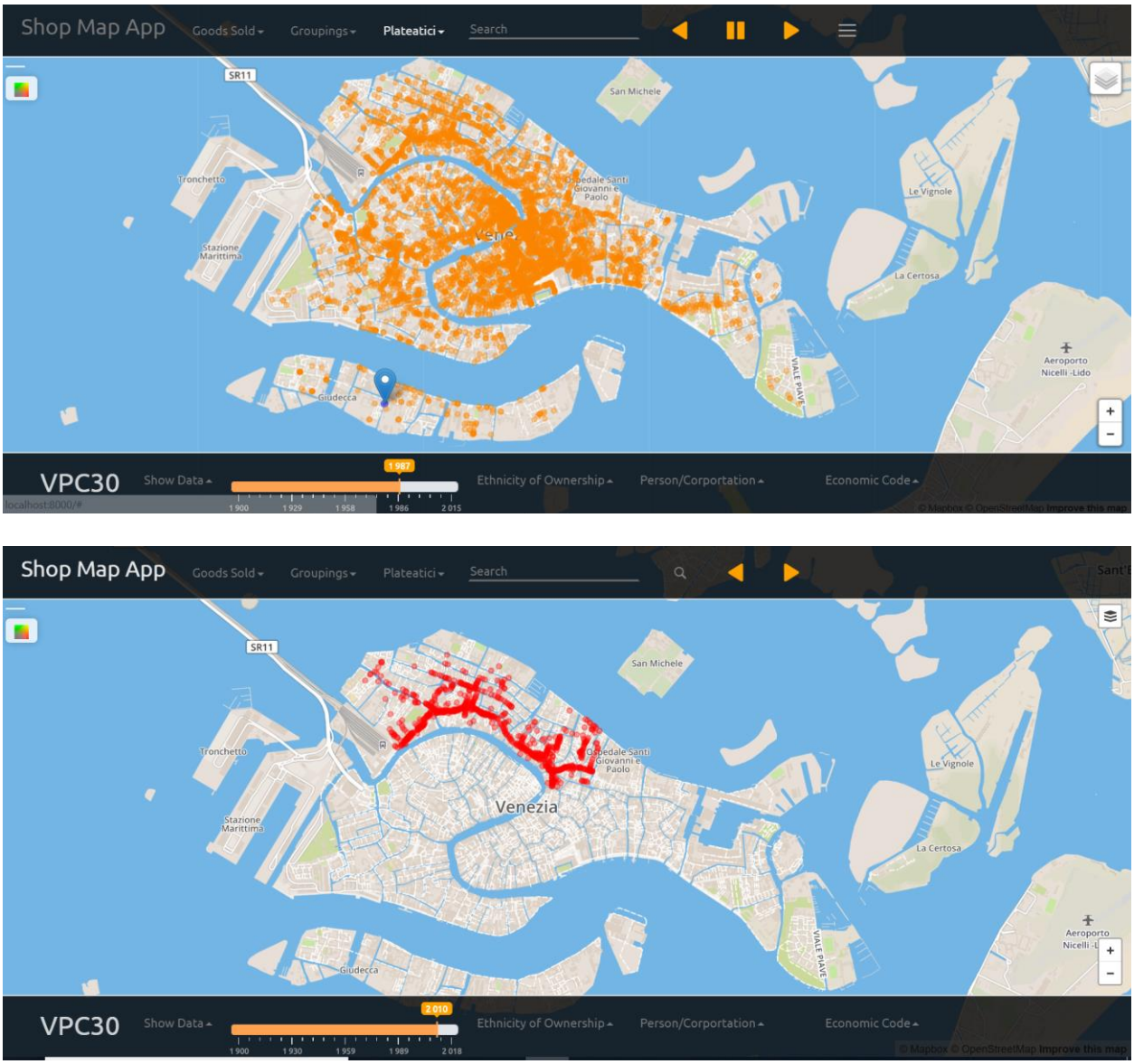


Figure 4.10 Final website design - Chamber of Commerce (above), VPC (below)

Prototype play, pause, and rewind buttons were also added with the intention of animating shop activity through the years. Experimentation with these buttons proved semi-successful- animations would play, albeit not smoothly, and would sometimes crash the website. This functionality was disabled for the time being, but the buttons were left in the user interface of the final website design.

Finally, a ‘you are here’ pin was added to show the user where they are on the map, and the VPC30 link was updated to point to the correct, new Venice Project Center website.

4.2.2 Improved Database for Shops Catalogue

Once the database was created and data from the past and present was put in, past data from teams often caused there to be inaccuracies in analysis. This was mainly due to inconsistencies in collection that were found. This is a natural issue, as with any project there comes the risk of human error, but there were a few major issues listed below that the team attempted to rectify.

The original data collected was separated into two groups: stores and store locations. This was done in an effort to make finding conversions of stores easier on future teams, as the could simply tag a specific ID to their store information so that ID could be queried to get all shops at that location. This would be effective if all store locations across all years were stored in one big group. However, the way it was done, each student team from each year kept two groups, one for stores, and one for store locations. So instead of having multiple years of information and one big group for locations, there are multiple groups for locations. Because of this, students often didn't check if locations were already logged by past teams, meaning addresses and the like were repeated. An example of this can be seen in Table 3.2. Not only does it defeat the purpose of keeping the locations separate, it causes issues; as this allows for discrepancies in latitude and longitude, causing issues with active stores remaining across years, but moving slightly on the map across years.

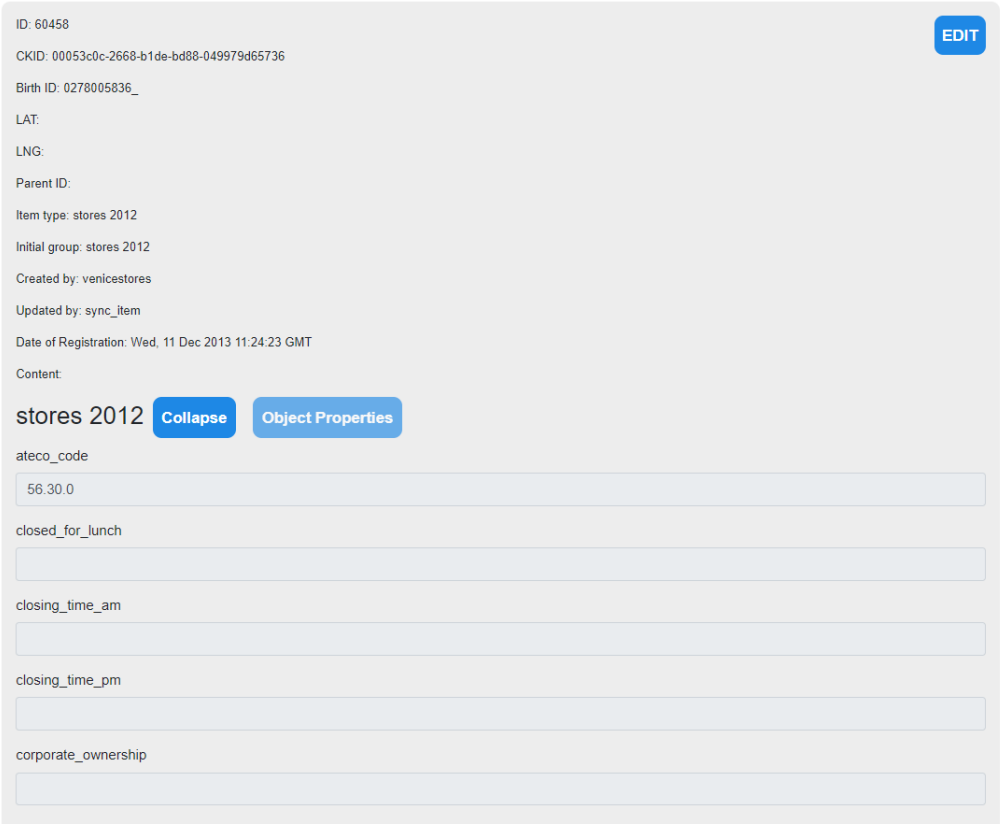
Point	Primary Address ID	Sestiere	Latitude	Longitude	Address	Year Collected
-LRi25J6Tql8OvRNmaDV	0278003844_	CN	45.44130609	12.33412905	Strada Nova 3844	2005
-LRM7qgkC-bqLnRWNND6	1600004952_	CN	45.44130609	12.33412905	Strada Nova 3844	2009

Table 4.1 Example of similar points found in "store locations 2005" and "store locations 2009"

On top of that there were three major issues encountered within the database while working with store information: blank data points, what was referred to as 'copy and paste' points, and formatting errors. Blank data points often showed up in groups of store information, where there would be a data point with no information and no matching store location, as shown in Appendix H. This was found quite often in the years 2005, 2009, and especially 2010; with 2010 having approximately fifty to a hundred blank data points. After reading their paper, it is

not entirely clear as to why this is the case, and the team chalked it up to user error in the data entry process.

In regards to ‘copy and paste’ points, the team realized this oddity during the creation of the database. During the transfer of historical data data into the new database, it became apparent that the data from 2004 and 2012 had an insane amount of data points compared to other years, around 2,000 to 4,000 points each, to be exact, compared to the average of about 500/year. Not only did this seem odd, the closer we looked, it seemed that both years had an extreme number of similar stores to previous years. Normally, a small amount of this is seen when working with each year, as stores don’t always necessarily move, or get re-recorded by the next team. However, it seemed like nearly all points were part of past data. In fact, when we summed up the amount of data from past years before those teams, that amount was almost nearly the exact same amount in each group, give or take a few hundred. When looking even closer at specific points, the group contained data points where the field “year_data_collected” did not in fact say 2012. An example of one such data point isis shown below in Figure 4.11, with the whole data point found in Appendix H.



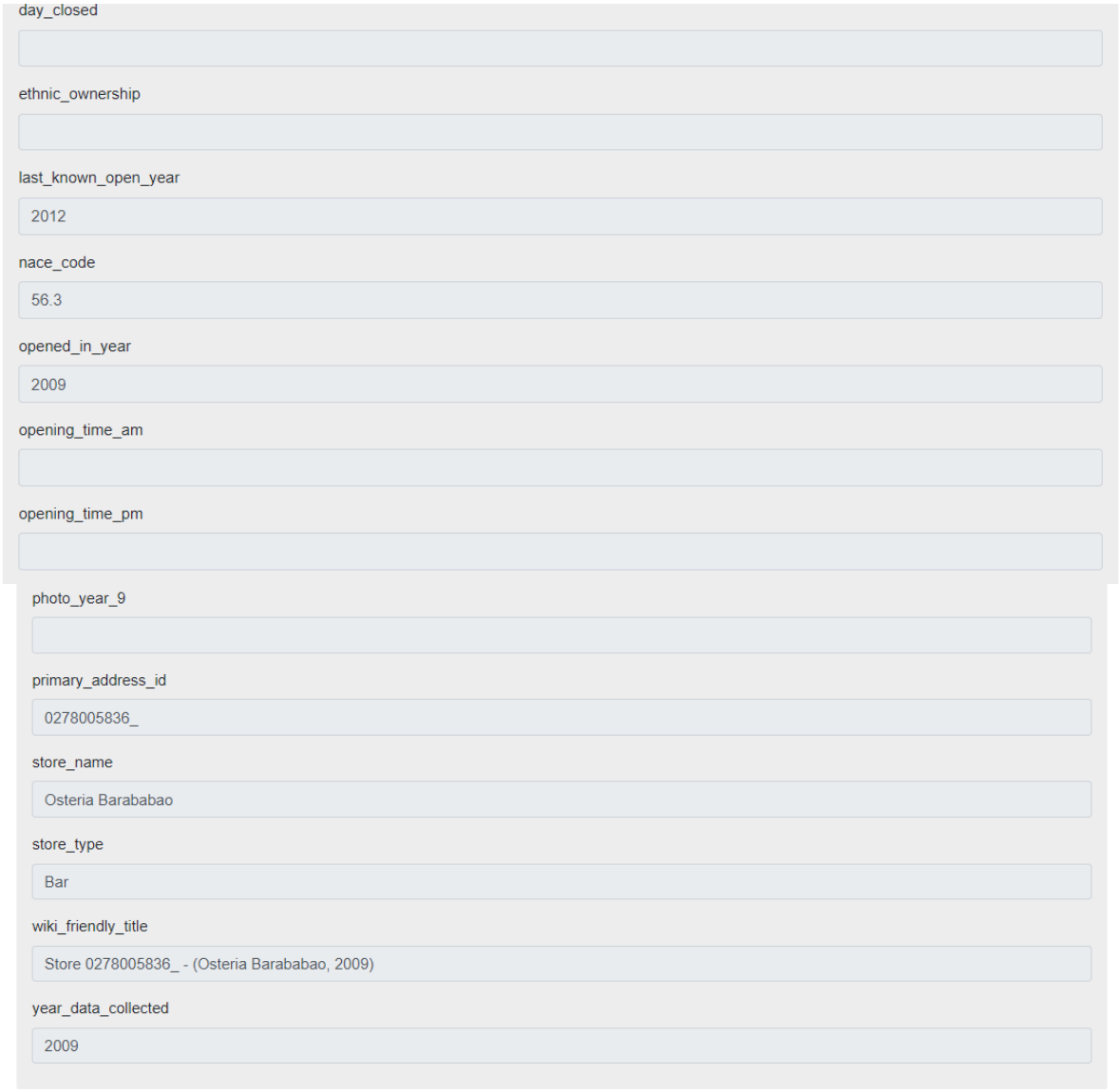


Figure 4.11 Copied data point, found in "stores 2012"

The team could only come to the conclusion that previous year's data was 'copy and pasted' into their group. At first the team believed it was for convenience of the past students, either for analysis or other purposes. But looking at the 2012 paper, as they claimed that it was through their data collection they found all the points. In fact, a direct quote from the 2012 paper stated:

> "Our team was able to cover Cannaregio, Dorsoduro, San Marco, San Polo, and Santa Croce in the amount of time we had for data collection. We cataloged a total of 4114 stores in these five sestieri. " (Bruso et. al., 2012).

Unfortunately, without showing the entire database up until 2012, it is pretty impossible to prove this beyond a shadow of doubt within the paper; so the team recommends any person interested further in this development either look through the City Knowledge Database themselves if given access. To combat this depressing development, the team tried to find as many similar data

points taken from past years within 2004 and 2012, and removed them when transferring those year's data into our new database.

Formatting errors were, fortunately, one of the easier issues to tackle. Certain data was labelled differently based on certain years. For example, the latitude of a location may be labelled "latitude" in one year's data, and "lat" in the next. On top of that, the 2005 team would often use a '\' if a store name was unknown, which not only renders a JSON file of that year's data unusable, it also breaks from other year's tradition of simply leaving the field blank. In an effort to rectify these issues, Python scripts were created that consume old data files from previous years and standardize them according to this year's data collection format, shown in Figure 4.12 below.

Figure 4.12 Data point from 2011 in current shop database

A script was also created to read from a standard form of excel sheet and directly convert it to a database- usable .json files, making moving data that was collected into the database much faster than adding points by hand.

4.3 Analyzing the Collected Data

As stated in the methodology, most of our comparisons and analysis were compared against historical data collected by the center and the Chamber of Commerce from the post-2000s.

Overall, historically high proportions of stores in Venice were found to be souvenir stores, restaurants, and clothing stores, as shown in Figure 4.13. This data is amassed and averaged from collected data sets from 2000-2015, and was used for comparison purposes.

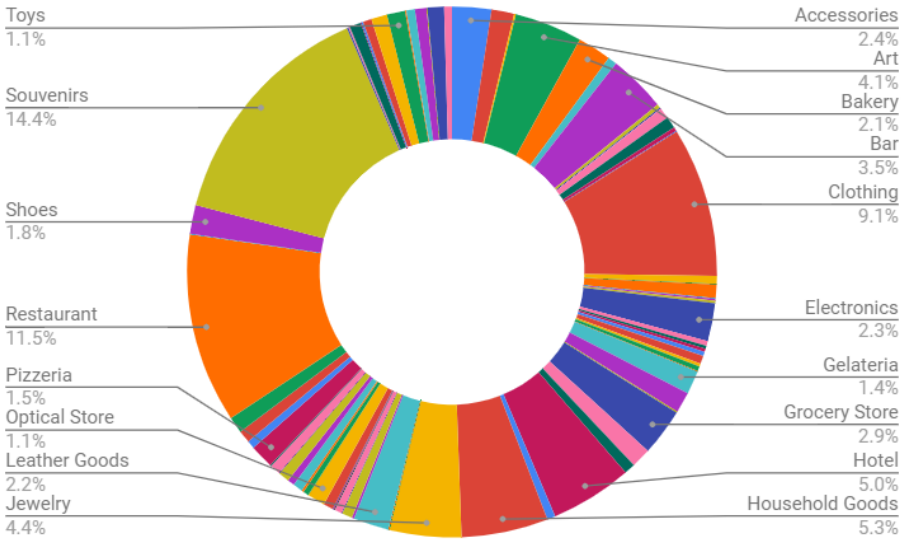


Figure 4.13 Summation of all economic activity collected, 2000-2015

In regards to grouped economic activity, Venice historically shows a tendency towards goods-based retail- historically, goods based retail made up 55.0% of total stores.(Figure 4.14).

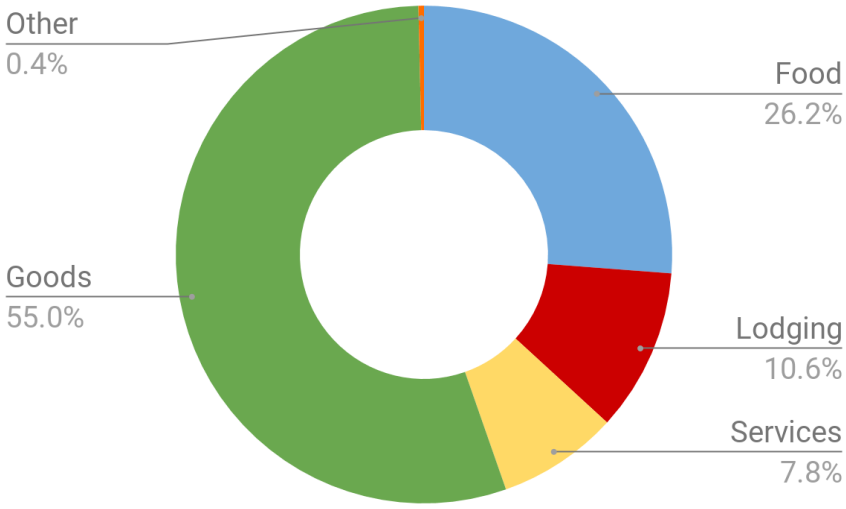


Figure 4.14 Grouped economic activity collected by the center, 2000-2015

4.3.1 Analysis of the Giudecca Data Set

Considering the fact that this is the first ever data set on Giudecca collected by the Venice Project Center itself, the team had to compare against Chamber of Commerce data. Like previously stated, this often proved difficult. There was only approximately 107 points spanning across 50 years. On top of that, chamber of commerce data only records the year a store was

registered and then subsequently closed; often the year of opening or closing was unknown, rendering those data points often useless (shown in Table 4.1).

Also, the NACE coding system that the Chamber of Commerce data uses reflects the current one in place by the European Union; the VPC still uses the old numbers of the NACE system, as it's basis, making conversions often difficult.

The team planned to use these numbers (year opened, year closed) in order to track store conversions on the island of Giudecca. As a result of not having this information, the team was unable to make meaningful historical comparisons between the 2018 Giudecca data and data from the past. However, as creating a baseline of Giudecca data was one of the team's primary objectives, this goal was still accomplished.

Category	**number of Data Points**
Year of Opening *Known*	75
Year of Opening *Unknown*	32
Year of Closing *Known*	65
Year of Closing *Unknown*	36
Opening & Closing *Known*	40
Opening & Closing *Unknown*	9

Table 4.2 Count of Year Opened/Closed Missing in Commerce Data, 1951-2015

4.3.1.1 Analysis of Giudecca Economic Classifications

This year established a baseline of shop data that will be used for comparison in future iterations of the shops project. Figure 4.19 details the general findings of the approximately 70 stores surveyed on the island. The majority- 40.3% of stores- were found to sell some kind of food. About 25% of them sold goods. 12.9% provided services, and 21% stores were lodging based establishments. A more detailed breakdown of the catalogued store types in Giudecca is shown in figure 4.15.

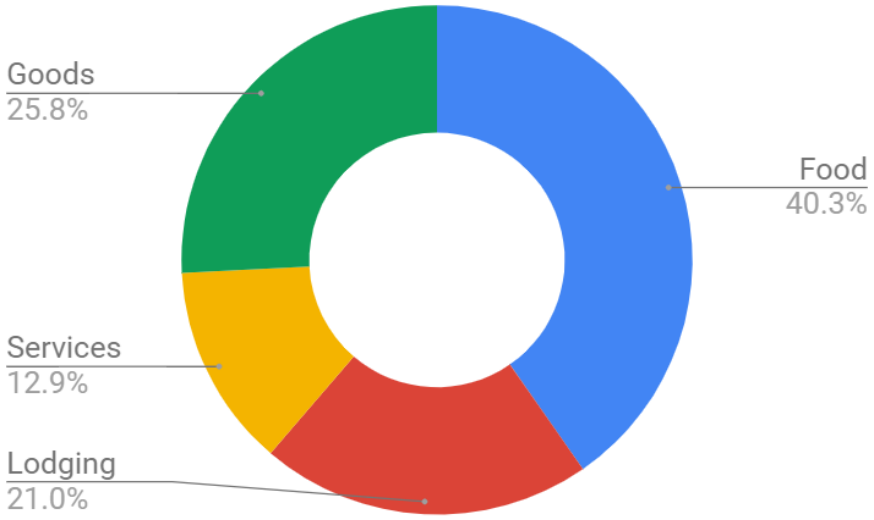


Figure 4.15 Grouped economic activity in Giudecca, 2018

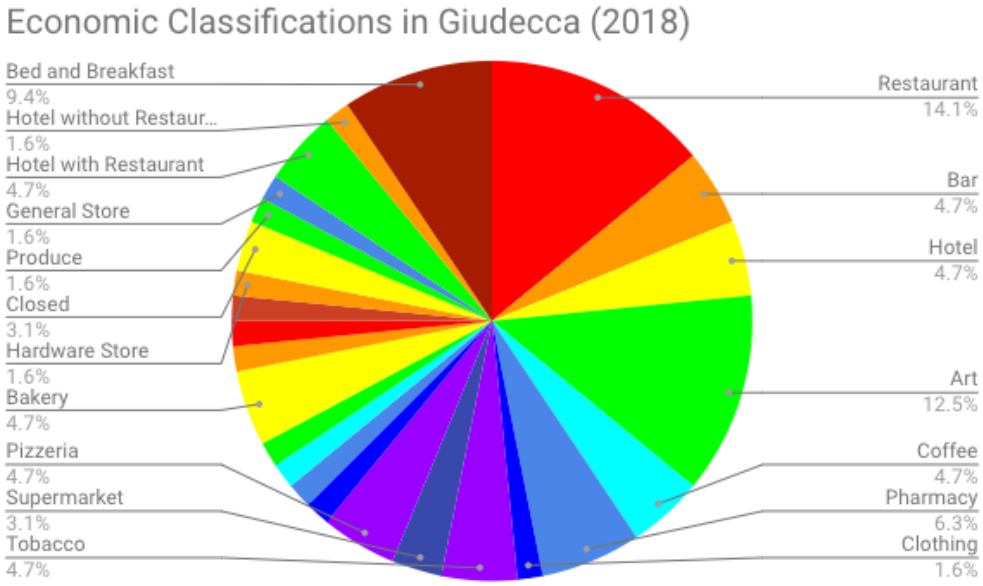


Figure 4.16 Store types in Giudecca, 2018

4.3.2 Analysis of the Cannaregio Data Set

As the team decided to start with comparison and analysis of Giudecca first, due to the unique complexities discovered when comparing against Chamber of Commerce data, we found it best to compare against previous Venice Project Center on shops found in Cannaregio. This way, it is possible to compare the two data sets, as the collection methods and recording is consistent with the methods used.

4.3.2.1 Analysis of Cannaregio Retail

Of the shops surveyed, the team found approximately 190 active storefronts and 9 inactive storefronts, as shown in Figure 4.17, where it is compared to historical data from the center.

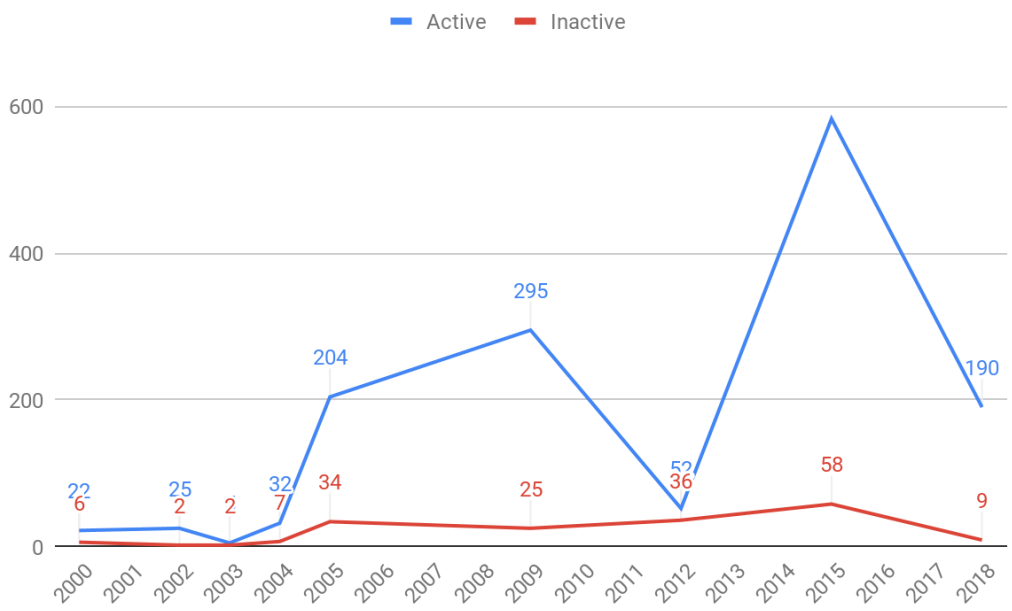


Figure 4.17 Active & inactive stores in Cannaregio, 2000-2018

Although it is not the highest number of active storefronts collected by the center in years past, it is still quite a good amount. Although the data set looks small in comparison to the number of active & inactive storefronts found in 2015, it is important to note the fact that the 2015 team had a fully functioning City Knowledge application to input their data with, making the process much faster than both the current team and past team's data collection method.

In fact, using statistical analysis as shown in Appendix F, it shows the Z-scores for 2015 active storefronts & inactive storefronts are approximately 2.24 and 1.84, respectively. Compared to the 2018 active & inactive storefronts Z-scores of 0.03 and -0.04, it shows that 2015 is probably an outlier in the data, and our amount of data is more consistent with the data collected by previous teams then theirs. It is also worth to note that the highest number of active and inactive storefronts in Cannaregio are all years where Cannaregio was a main area of focus in terms of data collection. In fact, the 2015 team focused *solely* on Cannaregio during their data collection.

4.3.2.2 Analysis of Cannaregio Economic Classifications

Due to the data presented previously, the team decided the best course of action was to not only compare the data on economic activities against data from 2000-2012, but also data from 2015 itself. Although it is definitely an outlier of some sort when compared to the number

of active & inactive storefronts in the Venice Project Center database, the specific percentages of economic classifications are still the most recent records the team had on Cannaregio, and the team felt it was of import to still compare as best as we could.

4.3.2.2.1 2000-2012 Comparisons

Looking at Figures 4.18 and Table 4.3, there seems to have been a consistency within the data. There are no increases or decreases in certain industries larger than 10%, which the team deemed to be the indication of potential change when looking at these types of graphs.

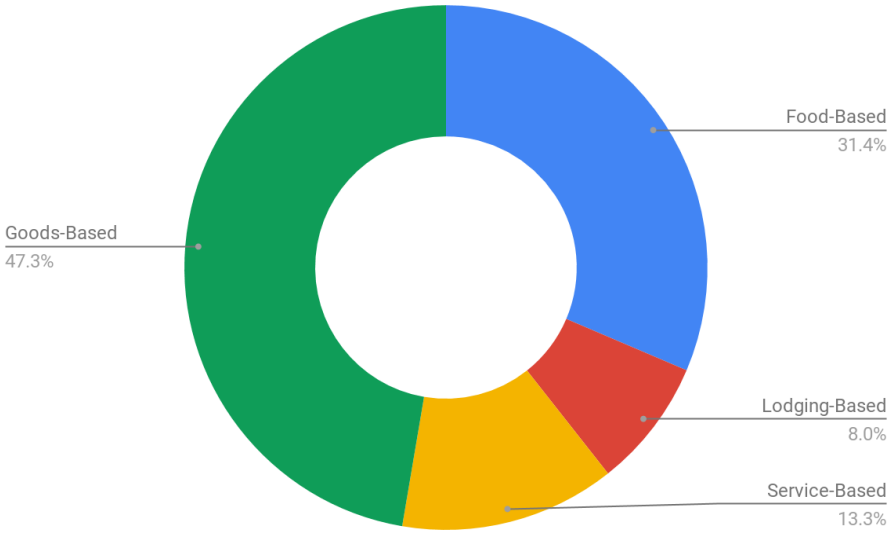


Figure 4.18 Economic groupings of all historical data in Cannaregio from 2000-2012

Grouping	**2000-2012**	**2018**	**Difference**
Food Based	31.4%	37.3%	+5.9%
Lodging Based	8.0%	5.9%	-2.1%
Service Based	13.3%	15.1%	+1.8%
Goods Based	47.3%	41.6%	-5.7%

Table 4.3 Differences between 2000-2012 data and 2018 data

However, if one looks at the average number of more specific economic activities opened per year (i.e. the mean number of an economic activity from 2000-2012), interesting information starts to show. If looking at the economic activities of Art, Bar, Clothing, Hotel, Household Goods, Jewelry, Restaurant, and Souvenirs one sees there have been significant decreases. The category of Souvenirs, a historically high category for the region and overall has decreased by

more than 12.37%, a significant degree. In a similar fashion, restaurants have increased by 10.25%, a number that although is not considered fully significant, is still worth investigating.

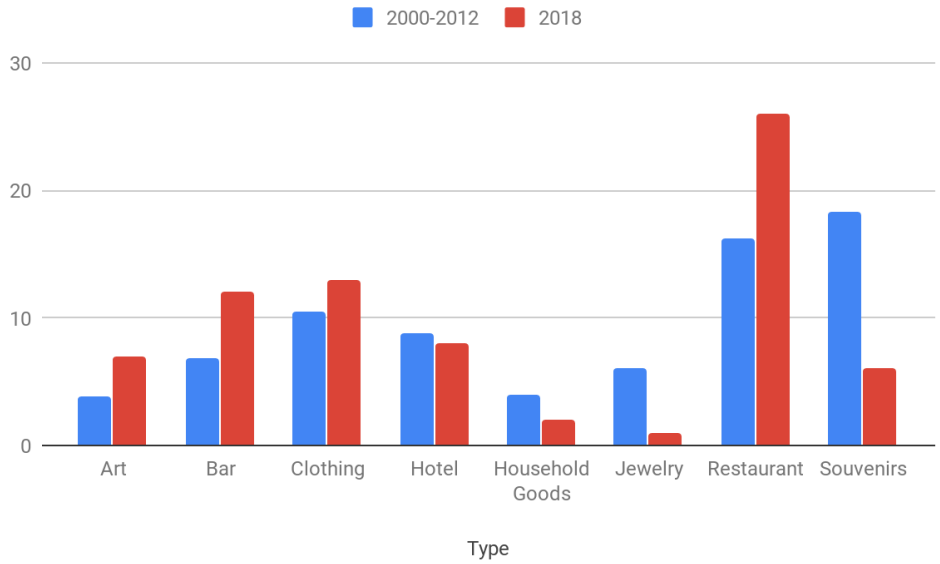


Figure 4.19 Bar chart of average number of economic activities compared to current data

To confirm these findings, statistical analysis was done across years in these categories to determine their Z-scores, and record any numbers that had a Z-score around 1.0 ± 0.2, as seen in Appendix F. After looking at the data carefully, the only Z-scores of note from the current year were of Art and of Restaurants, which were approximately 1.082 and 0.849, respectively. In fact, the Z-scores show that the number of art stores found in Cannaregio is comparable to the number opened in 2005 collected by the center.

4.3.2.2.1 2015 Comparisons

Comparing the groupings of 2015 and 2018 (shown in Figures 4.20 and Table 4.4), the data shows that there were no negative or positive changes greater than 10%, which was the teams minimum value of interesting change.

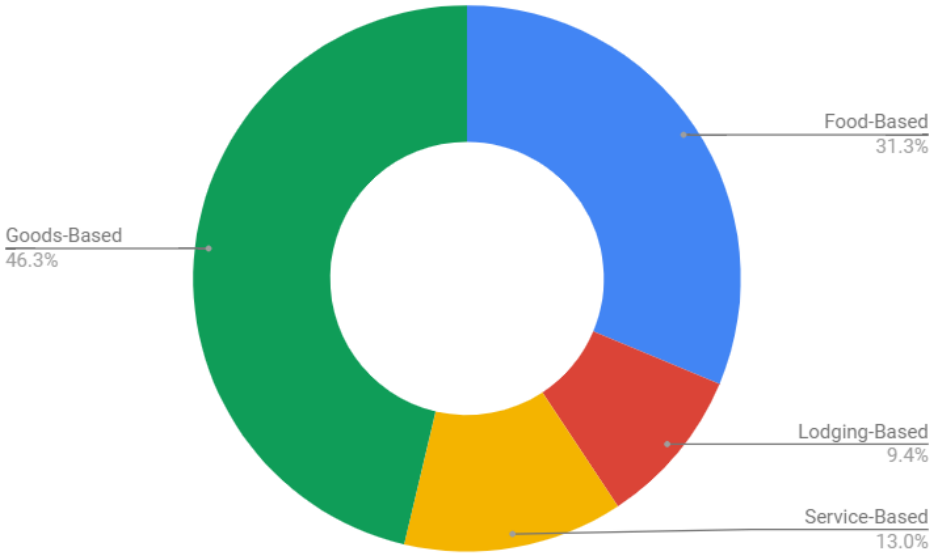


Figure 4.20 Economic groupings in Cannaregio, 2015

Grouping Type	**2015**	**2018**	**Difference**
Food Based	31.3%	37.3%	+6.0%
Lodging Based	9.4%	5.9%	-3.5%
Service Based	13.0%	15.1%	+2.1%
Goods Based	46.3%	41.6%	-4.7%

Table 4.4 Comparison of economic groupings, 2015 and 2018

Looking further into the matter shows that if one looks at the most popular categories between the two years, shows that the total amount of data collected in 2015 about each type of economic activity is higher than ours, as shown in Figure 4.21. However, it would be inaccurate to judge our data based on theirs as the sample size of active storefronts for 2015 and 2018 are different (523 in Cannaregio and 190 total points in Cannaregio, respectively).

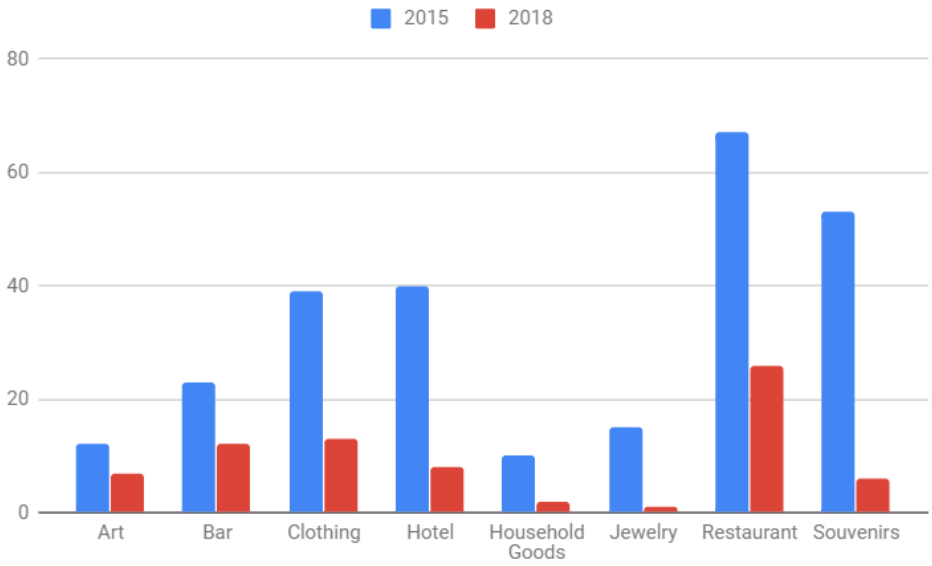


Figure 4.21 Number of shops in specific economic activities, 2015 and 2018

To give a proper analysis, the number of shop per economic activity was divided by the number of stores in Cannaregio found and multiplied by a hundred, to give the percentage in that activity in the year, shown in Figure 4.30.

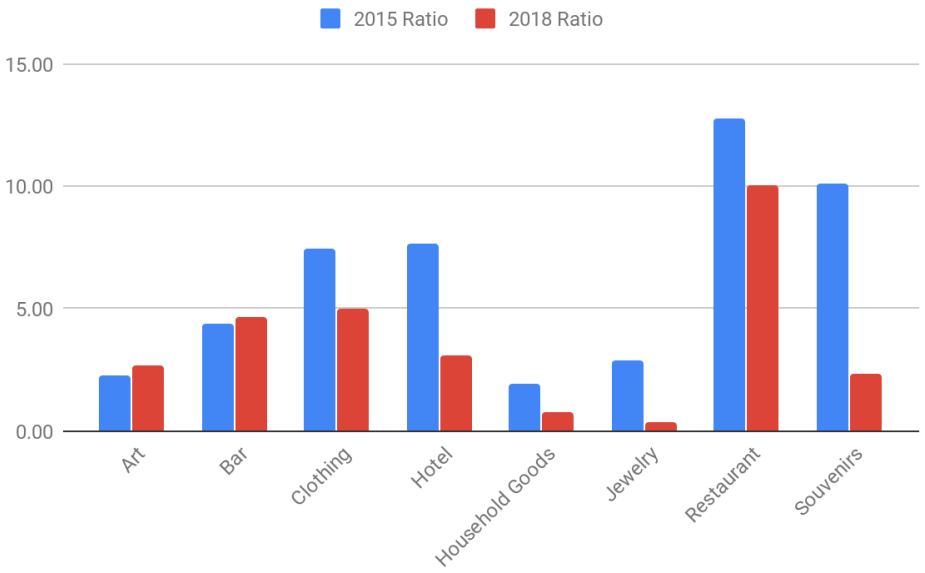


Figure 4.22 Percentages in popular economic activities, 2015 and 2018

From this information, one can see that the number of active storefronts in art stores and bars have remained relatively consistent. However, there has been a decrease in the number of souvenir shops, as well as in the number of hotels that have opened up recently, further detailed in Table 4.4.

Activity	**2015**	**2018**	**Difference**
Art	2.29%	3.74%	+1.45%
Bar	4.40%	6.31%	+1.91%
Clothing	7.46%	6.31%	-1.15%
Hotel	7.65%	4.72%	-2.93%
Household Goods	1.91%	3.74%	+1.83%
Restaurant	12.81%	13.70%	+0.89%

Table 4.5 Economic activity percentage ratios, 2015 and 2018

With that in mind, we found the ratio percentage of shops found by each team to be relatively consistent.

5.0 Conclusions & Recommendations

5.1 Conclusions on the Results of the Data

The current team has looked at all results from comparative analysis (detailed in Section 4.3), and come to three separate conclusions: one on the results in Giudecca, one on the results in Cannaregio, and one on the overall state of Venetian retail in 2018.

5.1.1 Conclusions on the Results in Giudecca

Due to the obvious lack of data on Giudecca, both in collection by WPI students and given to us by the Chamber of Commerce, the team has decided that although there may have been possible changes in Giudecca from the last time this project was done, there are too many unknown factors involved for us to make an accurate guess. The only statement the team can somewhat safely make is that the number of inactive storefronts in Giudecca is consistent with years past. We highly suggest another future project be done on the matter to further the Venice Project Center's understanding of the Giudecca economy, as well as a request to the Venice Chamber of Commerce for all information they have on shops opened in the area.

5.1.2 Conclusions on the Results in Cannaregio

In regards to the results in Cannaregio, there was of course two separate analysis done due to the extreme outlier data from the 2015 team.

When looking at the overall summation of data from 2000-2018, the data in Cannaregio is quite consistent. The active and inactive storefronts numbers are quite consistent with the active storefronts in years where Cannaregio was a main focus of collection. The team has come to the conclusion that in regards to overall economic growth, Cannaregio has had a slight increase, especially when looking at the ratios of active and inactive storefronts against the number of data points collected by the team from that year, detailed below in Table 5.1

Year	Active storefronts	Inactive storefronts	Ratio of Active storefronts	Ratio of Inactive storefronts
2000	22	6	78.57%	21.43%
2002	25	2	92.59%	7.41%
2003	5	2	71.43%	28.57%
2004	32	7	82.05%	17.95%
2005	204	34	85.71%	14.29%
2009	295	26	89.12%	7.85%
2012	52	36	59.09%	40.91%
2015	465	58	88.91%	11.09%
2018	190	9	95.47%	3.53%

Table 5.1 Ratios of active & inactive storefronts in Cannaregio, 2000-2018

As you can see, despite the high number of data points collected by the 2015 team, there was an approximate 6.56 percent increase in store active storefronts in Cannaregio from 2015 to 2018, as well as a 7.56 percent decrease in inactive stores. These ratios were determined by taking the number of active or inactive storefronts and dividing them by the total number storefronts that year to get the approximate ratio from the data set, which was determined to be more comparable. If one were to calculate the average ratio of active and inactive storefronts in Cannaregio per year, it is 82.55% and 16.90%, respectively; much less than our current percentages. So, it seems there has been quite a recent upturn in the number of active storefronts. Whether or not these numbers mean good or bad things, however, are unclear; as there is more than just the factor of economic prosperity when it comes to determining why stores are active where they are, and the team felt it was best to leave those answers to actual economists.

In regards to the number of particular types of economic activities, the team has concluded that there has been a slight increase in food-based activities in the past three years (Table 5.1). This could be due to all manner of reasons, but the team felt it was best not to past judgment as to whether or not it was affected by tourism, as food-based retail can be utilized and enjoy by locals and visitors alike.

It may be interesting to note if a rise in renting and leasing in Cannaregio, drop in demand, or simply all the storefronts in Cannaregio are being used could affect our data so the team recommends that future teams cross-reference the historical and current prices in leasing these buildings around the area to see if it could possibly be due to that.

5.1.3 Conclusions on Venetian Retail in 2018

Overall, our numbers show a decrease in the number of stores active in Venice and an increase in inactive storefronts compared to data from three years ago, as shown in Table 5.2.

Year	Active storefronts	Inactive storefronts	Ratio of Active storefronts	Ratio of Inactive storefronts
2000	51	0	100.00%	0.00%
2001	4	1	80.00%	20.00%
2002	25	3	89.29%	10.71%
2003	13	1	92.86%	7.14%
2004	656	80	89.13%	10.87%
2005	70	7	90.09%	9.91%
2009	569	86	86.87%	13.13%
2010	76	24	76%	24%
2011	397	199	66.61%	33.39%
2012	296	104	74%	26%
2015	465	58	88.91%	11.09%
2018	189	12	72.97%	27.03%

Table 5.2 Ratios of active and inactive storefronts in Venice, 2000-2018

From 2015 to 2018, there was a 15.94 percent decrease in active storefronts and a 15.94% increase in inactive storefronts. However, this also might be because of 2015 being an outlier, and only had data on the *sestiere* of Cannaregio. To check, the average percentage of active and inactive storefronts collected from 2000 to 2012 was calculated, and was found to be 84.4% and 15.52%, respectively. So even with that comparison, it still was a significant change. This could possibly indicate economic stagnation in the entire historic region as a whole, or it could quite possibly be due to other factors. The team recommends that future teams conduct a larger sample size of the area to get a better idea.

As for economic activity, the team has noticed a significant decrease in the number of restaurants and souvenir stores as a whole, as detailed below in Table 5.3.

	2000	2001	2002	2003	2004	2005	2009	2010	2011	2012	2015	2018
Art	3.92%		25.00%		5.57%	6.49%	1.68%	9.00%	1.68%	3.25%	2.49%	5.41%
Bar	1.96%		7.14%		2.31%	7.79%	2.60%	1.00%	2.18%	3.00%	4.78%	5.79%
Clothing	5.88%	40.00%		35.71%	8.29%	7.79%	8.55%	8.00%	4.70%	7.50%	8.60%	5.41%
Hotel	9.80%	20.00%	7.14%		1.09%	1.30%	6.72%		8.89%	3.25%	3.82%	5.79%
Household Goods	3.92%	20.00%	10.71%	7.14%	7.34%	5.19%	3.05%	5.00%	3.02%	2.75%	4.40%	0.77%
Jewelry	3.92%		3.57%		4.21%	1.30%	4.58%	4.00%	3.19%	2.75%	3.44%	0.39%
Restaurant	9.80%	20.00%	7.14%	7.14%	7.61%	5.19%	10.08%	13.00%	9.56%	6.25%	14.91%	9.75%
Souvenirs	11.76%		21.43%	7.14%	13.04%	5.19%	18.78%	7.00%	7.21%	11.00%	10.90%	2.32%

Table 5.3 Ratios of specific economic activities, 2000-2018

From 2015-2018 there was a 5.16% decrease in the number of restaurants and a 8.58% decrease in the number of souvenir stores. The team deems that the decrease in restaurants might be significant, however since it is only 5%, this may just be a temporary decrease and should be studied further. As for souvenir stores, when compared against the average ratio of souvenir stores from 2000-2012 (10.26%), that this is an all time low of souvenir stores active up all over Venice. The reasoning behind this information is unknown, but the team *highly* recommends it be studied further.

5.2 Recommendations on the State of the Current Web-Application

For further development of the web-application, the team suggests that teams in the future, teams either continue to update the website started by the 2015 shops team, or build a new website off of the react framework created this year by our team. Either way, teams could add broader filters to more generally see groupings of stores.

Unfortunately, the current website displays data in a way that is sometimes too fine to see clearly. If a team were to implement a filter that only showed food retail, or goods retail, or all lodging retail, it would give a more general picture of the store type distribution in Venice. If there was also a way to recolor the data points to show this split, it may be helpful in drawing conclusions about the state of retail in Venice.

In addition, if the team continues to update the current website, it would be beneficial to increase the loading times of the shops data. This can be achieved through changing the methods used to load all of the data into the app- this would also require the team to fragment the CK app database that the VPC uses. This restructuring would be a large undertaking, and has started with this year's team creating a separate database that can be used with the website.

5.2.1 Recommendations Based on Original Designs

The react framework created this year is a react-based website that is a great foundation for future teams to build off of. This base project had prototype support for in-app statistics, lists for all of the displayed stores, a search functionality, and colored each store according to some of its attributes, such as target market.

In addition, future teams could add a way to view each store as their information is displayed on screen. Including pictures in this fashion would require the confirmation of every image link in the CK database, since some of them point to google drive files that are no longer in use.

Last, future teams could add a toggle filter to switch between chamber of commerce data and WPI VPC collected data. This would avoid confusion and ensure that the data on the screen is being compared in a valid way.

5.2.2 Recommendations Based on Current Website

A feature added to the current VPC website is the play and rewind increment buttons. They were created with the intention of cycling through all data in order by year, but the way that the data is loaded into the map prevented this animation from looking smooth. So, figuring out a way to decrease load times enough to enhance this functionality would be a major improvement to the website.

Originally, the website was designed with two separate toolbars- one on the top to control the filtering of WPI data, and one on the bottom to control the chamber of commerce data. Consolidating these into one menu with a toggle switch to swap between the two data sets would be a large improvement to the website and would keep visualizations clear.

A hamburger menu would also be a welcome addition to the current website to keep the homepage looking as clean as possible for screenshots of the data. This would also allow the user to have the functionality necessary to visualize the data as they please, without cluttering the map.

5.3 Recommendations on the Retail Database

Our team created a separate database to house our 2018 collected data to increase loading speed on our prototype react website. This database structure should be adopted with the main website as well or continued with new data on the react site.

5.3.1 Improvements on Newly Created Database

In creating the newly created database, the team noticed many errors in the data collected by previous year's teams. Some teams failed to utilize the ID's of physical store locations. This defeated the purpose of the location dataset, and also led to many duplicate data points across the years. This made comparing the data across previous years difficult.

To deal with this, our team removed duplicates and kept the opening date as the earliest one found. We recommend that future teams take this into account and validate the past data for a second time. Year collected could also be stored as a list, with each year adding their year collected to this list to avoid duplicate data. This would also reduce the number of overall points, and therefore cut down on loading speed.

The original database kept store locations separate from the collected retail data. This makes it easy to spot when a storefront changes. Locations, however, were separated by year. They are supposed to be static locations, but had multiple copies of the same address throughout the years.

To combat this, future teams should continue the practice of separating the locations and collection branches of the database, but give each location a unique ID that can be used by collected points.

In addition, future teams can sort chamber of commerce data into branches by year opened, like the VPC database structure. This would also be helpful in cutting website load time. Translating identifiers into English and removing excess unnecessary data would also be beneficial.

5.4 Recommendations on Retail Data Collection

This project is mainly focused on retail data collection and web-app visualization. Since previous shops teams had data differed widely across from 2004 to 2015, as well as from multiple *sestieri*, the project has often been difficult to analyze. Based on the team's experience, we have a list of advice on data collection for future analysis.

5.4.1 The City Knowledge Input Application

The City Knowledge application was created in 2015 for data collection use, and updated prior to 2018 by the center. However, the current application created for use had bugs that rendered it inefficient, with points often not being created and thusly data being lost. We *highly* recommend future teams dealing with retail receive immediate access to the application during the PQP period, so they can use the preparatory term to test it and work with the center to remove all bugs.

If this not able to happen, the team should immediately start using pen and paper or another suitable method at the beginning of IQP, as the process of removing bugs from the CK application proved extremely time-consuming and ate up a lot of time during the IQP period that could have been used towards data collection. On a similar note, starting early in the IQP term may prove beneficial, as often weather conditions such as flooding, etc. prevented the team from going out to collect on a few days that were scheduled for collection. In regards towards manual data collection, the team recommends using a similar method to our usage of photography, as it was more efficient and suitable for poor weather conditions.

5.4.2 Possible Additions to the NACE Code System

The first VPC modified NACE system was set up in 2010, and the following shops teams have kept adding when appropriate, making the system vastly different. However, the European Union has since updated the NACE coding system to reflect changes in overall European activity. Future teams should considering updating the VPC system to reflect the changes mad,

as well as changing past data to reflect the new VPC modified system with the new EU codes. This will be extremely helpful, as Chamber of Commerce data uses the new system, and it was often time consuming to 'convert' their codes to match ours.

In regards to new extensions to add, the team recommends possible additions of construction or building, as there is a market for the service that is not currently a part of the system.

5.5 Future Points of Analysis

All *sestieri* have been covered by each shop teams in historical Venice. However, Giudecca had remained un-collected until our team, despite being a part of the *sestiere* of Desudoro. Teams in the future should definitely collect more data on that.

In addition to adding more data points of shops, future teams should consider collecting the locations of Airbnb's around Venice, and cross-referencing their location around supermarkets, as their quite possibly be a correlation there. A similar point of analysis should be the locations of restaurants around hotels as well. However, this absolutely should not be an addition to regular shop collection, the website, and fixing the CK application. Speaking from experience, the team found that to be too taxing and felt spread thin attempting to do all four things in one term. This type of work is must better suited for a separate project, where only hotels, bed & breakfasts, hostels, restaurants, bars, supermarkets, and Airbnb's are collected that particular year, instead of all shops.

5.6 Overall Conclusions

To conclude, the team was able to successfully create a baseline of data on the isle of Giudecca as well as continue the Venice Project Center's collection on Cannaregio. The team was able to create the base of a react web application for future teams to build off of, and renovated the current VPC shops website. In addition, the team cleaned up inconsistent data from previous years, and created tools to standardize data according to newly created database structure. Although we often had a lot of deterrents along the way, the team managed to do what it set out to do.

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Appendix A

** Those highlighted orange were additions made by the 2018 Shops Team*

http://ec.europa.eu/environment/emas/pdf/general/nacecodes_en.pdf						
Section	**L1**	**L2**	**L3**	**L4**	**Description**	
Z					**Closed stores**	
	0	0			Closed stores	Closed
G					**Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods**	
G	**52**				**Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods**	
G	52	1			Retail sale in non-specialized stores	
G	52	1	1		Retail sale in non-specialized stores with food, beverages or tobacco predominating	Grocery Store
G	52	1	2		Other retail sale in non-specialized stores	General Store
G	52	2			Retail sale of food, beverages and tobacco in specialized stores	
G	52	2	1		Retail sale of fruit and vegetables	Produce
G	52	2	2		Retail sale of meat and meat products	Butcher
G	52	2	3		Retail sale of fish, crustaceans and molluscs	Seafood
G	52	2	4		Retail sale of bread, cakes, flour confectionery and sugar confectionery	
G	52	2	4	1	Retail sale of bread, cakes, and flour confectionery	Bakery
G	52	2	4	2	Retail sale of sugar confections	Candy
G	52	2	5		Retail sale of alcoholic and other beverages	
G	52	2	5	1	Retail sale of alcoholic and other beverages	Liquor
	52	2	5	2	Retail sale of wine	Wine
G	52	2	6		Retail sale of tobacco products	Tobacco

G	52	2	7		Other retail sale of food, beverages and tobacco in specialized stores	
G	52	2	7	1	Retail sale of dairy and dairy products	Dairy
G		2	7	2	Retail sale of coffee and coffee products	Coffee
G	52	3			Retail sale of pharmaceutical and medical goods, cosmetic and toilet articles	
G	52	3	1		Dispensing chemists	Pharmacy
G	52	3	2		Retail sale of medical and orthopaedic goods	Medical Goods
G	52	3	3		Retail sale of cosmetic and toilet articles	Cosmetics
G	52	3	3	1	Retail sale of perfume	Perfume
G	52	4			Other retail sale of new goods in specialized stores	
G	52	4	1		Retail sale of textiles	Textiles
G	52	4	2		Retail sale of clothing	Clothing
G	52	4	2	1	Retail sale of luxury items	Luxury
G	52	4	2	2	Retail sale of undergarments	Undergarments
G	52	4	2	3	Retail sale of accessories	Accessories
G	52	4	2	4	Retail sale of women cloth	women cloth
G	52	4	2	5	Retail sale of men cloth	men cloth
G	52	4	2	6	Retail sale of children cloth	children cloth
G	52	4	3		Retail sale of footwear and leather goods	
G	52	4	3	1	Retail sale of footware	Shoes
G	52	4	3	2	Retail sale of leather goods	Leather Goods
G	52	4	3	3	Retail sale of gloves	Gloves
G	52	4	4		Retail sale of furniture, lighting equipment and household articles n.e.c.	
G	52	4	4	1	Retail sale of furniture	Furniture
G	52	4	4	2	Retail sale of household articles/decoration	Household Goods
G	52	4	4	3	Retail sale of lighting equipment	
G	52	4	4	4	Retail sale of assorted items	

G	52	4	5		Retail sale of electrical household appliances and radio and television goods	
G	52	4	5	1	Retail sale of radio and television goods	Radio and Television
G	52	4	5	2	Retail sale of computer and computer goods	Computer
G	52	4	5	3	Retail sale of electronics	Electronics
G	52	4	6		Retail sale of hardware, paints and glass	Hardware Store
G	52	4	7		Retail sale of books, newspapers and stationery	
G	52	4	7	1	Retail sale of books	Books
G	52	4	7	2	Retail sale of newspapers	Newspaper
G	52	4	7	3	Retail sale of stationery	Stationery
G	52	4	8		Other retail sale in specialized stores	Other Retail
G	52	4	8	1	Retail sale of animal care products	Pet Store
G	52	4	8	2	Retail sale of arts and crafts	Art
G	52	4	8	3	Retail sale of boat supplies	Boat Supplies
G	52	4	8	4	Retail sale of coins and stamps	Coins and Stamps
G	52	4	8	5	Retail sale of costumes	Costumes
G	52	4	8	6	Retail sale of eyewear and eyecare	Optical Store
G	52	4	8	7	Retail sale of fishing supplies	Fishing
G	52	4	8	8	Retail sale of frames	Frames
G	52	4	8	9	Retail sale of flowers	Florist
G	52	4	8	10	Retail sale of funeral goods	Funeral Goods
G	52	4	8	11	Retail sale of jewelry	Jewelry
G	52	4	8	12	Retail sale of knives	Knives
G	52	4	8	13	Retail sale of media	Entertainment
G	52	4	8	14	Retail sale of metal work	Metal Work
G	52	4	8	15	Retail sale of musical instruments	Musical Instruments
G	52	4	8	16	Retail sale of office supplies	Office Supplies

G	52	4	8	17	Retail sale of photographic goods	Photo Store
G	52	4	8	18	Retail sale of sporting goods	Sporting Goods
G	52	4	8	19	Retail sale of souvenirs	Souvenirs
G	52	4	8	20	Retail sale of toys	Toys
G	52	4	8	21	Retail sale wedding decorations and related goods	Wedding
G	52	4	8	22	Retail sale of wood work	Wood Work
G	52	4	8	23	Retail sale of mask	mask
G	52	4	8	24	Retail sale of glass	glass
G	52	5			Retail sale of second-hand goods in stores	
G	52	5	0		Retail sale of second-hand goods in stores	Pawn Shop
G	52	5	0	1	Antiques	Antiques
G	52	6			Retail sale not in stores	
G	52	6	1		Retail sale via mail order houses	
G	52	6	2		Retail sale via stalls and markets	
G	52	6	3		Other non-store retail sale	
G	52	7			Repair of personal and household goods	Repair
G	52	7	1		Repair of boots, shoes and other articles of leather	
G	52	7	2		Repair of electrical household goods	
G	52	7	3		Repair of watches, clocks and jewellery	
G	52	7	4		Repair n.e.c.	
H					**Hotels and restaurants**	
H	**55**				**Hotels and restaurants**	
H	55	1			Hotels	Hotel
H	55	1	1		Hotels and motels, with restaurant	Hotel with Restaurants
H	55	1	2		Hotels and motels, without restaurant	Hotel without

						Restaurants
H	55	2			Camping sites and other provision of short-stay accommodation	
H	55	2	1		Youth hostels and mountain refuges	Hostel
H	55	2	2		Camping sites, including caravan sites	
H	55	2	3		Other provision of lodgings n.e.c.	
H	55	2	3	1	Bed and breakfasts	Bed and Breakfasts
H	55	2	3	2	Renting of rooms of private homes and guest houses	Affitacamere
H	55	2	3	3	Apartment rental	Apartment Rental
H	55	3			Restaurants	
H	55	3	0			Restaurant
H	55	3	0	1	Italian restaurant	Italian restaurant
H	55	3	0	2	Gelateria	Gelateria
H	55	3	0	3	Pizzeria	Pizzeria
H	55	3	0	4	Fast food	Fast food
H	55	3	0	5	Ethnic restaurant	Ethnic restaurant
H	55	3	0	6	Take away food	take away food
H	55	4			Bars & Cafe	
H	55	4	0	1	Bars	Bars
H	55	4	0	2	Cafe	Cafe
H	55	5			Canteens and catering	
H	55	5	1		Canteens	
H	55	5	2		Catering	
I					**Transport, Storage and Communication**	

I	63				Supporting and auxiliary transport activities; activities of travel agencies	
I	63	1			Cargo handling and storage	
I	63	1	1		Cargo handling	
I	63	1	2		Storage and warehousing	
I	63	2			Other supporting transport activities	
I	63	2	1		Other supporting land transport activities	
I	63	2	2		Other supporting water transport activities	
I	63	2	3		Other supporting air transport activities	
I	63	3			Activities of travel agencies and tour operators; tourist assistance activities n.e.c.	
I	63	3	0		Activities of travel agencies and tour operators; tourist assistance activities n.e.c.	Travel Agency
I	63	4			Activities of other transport agencies	
I	63	4	0		Activities of other transport agencies	Transportation
I	63	4	0	1	Delivery and mail services	Delivery
J					**Financial intermediation**	
J	65				M	
J	65	1			Monetary intermediation	
J	65	1	1		Central banking	Bank
J	65	1	2		Other monetary intermediation	
J	65	1	2	1	Cash Exchange	Exchange
J	65	1	2	2	Money Transfer	Money Transfer
J	65	2			Other financial intermediation	
J	65	2	1		Financial leasing	
J	65	2	2		Other credit granting	
J	65	2	3		Other financial intermediation n.e.c.	
J	65					

J	66				Insurance and pension funding, except compulsory social security	
J	66	0			Insurance and pension funding, except compulsory social security	
J	66	0	1		Life insurance	
J	66	0	2		Pension funding	
J	66	0	3		Non-life insurance	
J	67				Activities auxiliary to financial intermediation	
J	67	1			Activities auxiliary to financial intermediation, except insurance and pension funding	
J	67	1	1		Administration of financial markets	
J	67	1	2		Security broking and fund management	
J	67	1	3		Activities auxiliary to financial intermediation n.e.c.	
J	67	2			Activities auxiliary to insurance and pension funding	
J	67	2	0		Activities auxiliary to insurance and pension funding	
K					**Real estate, renting and business activities**	
K	**70**				**Real estate activities**	
K	70	1			Real estate activities with own property	
K	70	1	1		Development and selling of real estate	
K	70	1	2		Buying and selling of own real estate	
K	70	2			Letting of own property	
K	70	2	0		Letting of own property	
K	70	3			Real estate activities on a fee or contract basis	
K	70	3	1		Real estate agencies	Real Estate
K	70	3	2		Management of real estate on a fee or contract basis	
K	**71**				**Renting of machinery and equipment without operator and of personal and household goods**	

K	71	1			Renting of automobiles	
K	71	1	0		Renting of automobiles	Car Rental
K	71	2			Renting of other transport equipment	
K	71	2	1		Renting of other land transport equipment	
K	71	2	2		Renting of water transport equipment	
K	71	2	3		Renting of air transport equipment	
K	71	3			Renting of other machinery and equipment	
K	71	3	1		Renting of agricultural machinery and equipment	
K	71	3	2		Renting of construction and civil engineering machinery and equipment	
K	71	3	3		Renting of office machinery and equipment, including computers	
K	71	3	4		Renting of other machinery and equipment n.e.c.	
K	71	4			Renting of personal and household goods n.e.c.	
K	71	4	0		Renting of personal and household goods n.e.c.	
K	71	4	0	1	Renting of personal goods only	
K	71	4	0	2	Renting of household goods only	
K	71	4	0	3	Renting of both personal and household goods	
K	**72**				**Computer and related activities**	
K	72	1			Hardware consultancy	
K	72	1	0		Hardware consultancy	
K	72	2			Software consultancy and supply	
K	72	2	0		Software consultancy and supply	
K	72	3			Data processing	
K	72	3	0		Data processing	
K	72	4			Database activities	
K	72	4	0		Database activities	
K	72	5			Maintenance and repair of office, accounting and computing machinery	

K	72	5	0		Maintenance and repair of office, accounting and computing machinery	Computer Services
K	72	6			Other computer related activities	
K	72	6	0		Other computer related activities	
K	**74**				**Other business activities**	
K	74	1			Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings	
K	74	1	1		Legal activities	
K	74	1	2		Accounting, book-keeping and auditing activities; tax consultancy	
K	74	1	3		Market research and public opinion polling	
K	74	1	4		Business and management consultancy activities	
K	74	1	5		Management activities of holding companies	
K	74	2			Architectural and engineering activities and related technical consultancy	
K	74	2	0		Architectural and engineering activities and related technical consultancy	
K	74	3			Technical testing and analysis	
K	74	3	0		Technical testing and analysis	
K	74	4			Advertising	
K	74	4	0		Advertising	
K	74	5			Labour recruitment and provision of personnel	
K	74	5	0		Labour recruitment and provision of personnel	
K	74	6			Investigation and security activities	
K	74	6	0		Investigation and security activities	
K	74	7			Industrial cleaning	
K	74	7	0		Industrial cleaning	
K	74	8			Miscellaneous business activities n.e.c.	

K	74	8	1		Photographic activities	Photographer
K	74	8	2		Packaging activities	
K	74	8	3		Secretarial and translation activities	
K	74	8	4		Other business activities n.e.c.	
K	74	8	5		Photocopy activities	Photocopy
K	74	8	6		Graphic design activities	Graphic Design
K	74	9	0		Printing services	Printing service
K	74	10	0		Study agency	study agency
O					**Other community, social and personal service activities**	
O	**92**				**Recreational, cultural and sporting activities**	
O	92	1			Motion picture and video activities	
O	92	1	1		Motion picture and video production	
O	92	1	2		Motion picture and video distribution	
O	92	1	3		Motion picture projection	
O	92	2			Radio and television activities	
O	92	2	0		Radio and television activities	
O	92	2	0	1	Radio activities	
O	92	2	0	2	Television activities	
O	92	3			Other entertainment activities	
O	92	3	1		Artistic and literary creation and interpretation	
O	92	3	1	1	Artistic creation and interpretation	
O	92	3	1	2	Literary creation and interpretation	
O	92	3	2		Operation of arts facilities	
O	92	3	3		Fair and amusement park activities	
O	92	3	4		Other entertainment activities n.e.c.	

O	92	4			News agency activities	
O	92	4	0		News agency activities	
O	92	5			Library, archives, museums and other cultural activities	
O	92	5	1		Library and archives activities	
O	92	5	2		Museums activities and preservation of historical sites and buildings	
O	92	5	2	1	Museums activities	
O	92	5	2	2	Preservation of historical sites and buildings activities	
O	92	5	3		Botanical and zoological gardens and nature reserves activities	
O	92	6			Sporting activities	
O	92	6	1		Operation of sports arenas and stadiums	
O	92	6	2		Other sporting activities	
O	92	7			Other recreational activities	
O	92	7	1		Gambling and betting activities	Casino
O	92	7	2		Other recreational activities n.e.c.	Recreational Activities
O	**93**				**Other service activities**	
O	93	0			Other service activities	
O	93	0	1		Washing and dry-cleaning of textile and fur products	
O	93	0	1	1	Dry-cleaners	Dry Cleaner
O	93	0	1	2	Laundrymat	Laundryma t
O	93	0	2		Hairdressing and other beauty treatment	
O	93	0	2	1	Hair Salon	Hair Salon
O	93	0	2	2	Nail Salon	Nail Salon
O	93	0	2	3	Spa	Spa
O	93	0	2	4	Masseuse	Masseuse
O	93	0	2	5	Tattoo and Piercing	Tattoo and Piercing

O	93	0	3		Funeral and related activities	Funeral Services
O	93	0	4		Physical well-being activities	Fitness
O	93	0	5		Other service activities n.e.c.	
O	93	0	5	1	Tailor	Tailor
O	93	0	6	1	Hospital/ doctor services	Hospital
O	93	0	6	2	Vet	Vet

Appendix B

Filters for WPI Data

Goods Sold (VPC NACE)	Groupings	Plateatici
Accessories Antiques Apartment Rental Art Bakery Bank Bar Bed and Breakfasts Boat Supplies Books Butcher Closed Clothing Coffee Cosmetics Dairy Dry Cleaner Electronics Entertainment Exchange Fitness Florist Funeral Goods Funeral Services Furniture Gelateria General Store Graphic Design Grocery Store Hair Salon Hardware store Hostel Hotel with Restaurants Hotel without Restaurants Household Goods Jewelry Knives	Tourist Retail Resident Retail Mixed Retail	Yes No

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Leather Goods Liquor Lodgings Masseuse Medical Goods Money Transfer Nail salon Newspaper Office supplies Optical Store Other Retail Perfume Pet Store Pharmacy Photo store Photocopy Photographer Pizzeria Produce Real Estate Repair Restaurant Seafood Shoes Souvenirs Spa Stationery Tailor Tattoo and Piercing Tobacco store Toys Transportation Travel Agency Undergarments Wine Wood work		

Filters for Chamber of Commerce Data

Person/Corporation	**Ethnicity**	**Economic Code (EU NACE)**
Person Corporation	Bangladesh Chinese Egyptian	Bar Bed & Breakfast Grocer

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	France United Kingdom United States Venetian	Hardware Hotel Supermarket Trinkets

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Appendix C

All NACE codes for the economic activities listed below can be found in Appendix C

Food-Based	Lodging-Based	Service-Based
Grocery Store General Store Produce Butcher Seafood Bakery Candy Liquor Wine Tobacco Dairy Coffee Restaurant Italian Restaurant Gelateria Pizzeria Fast Food Ethnic Restaurant Take Away Bars Cafe	Hostel Hotel Hotel with Restaurant Hotel without Restaurant Bed & Breakfast *Affitacamere* Apartment Rental	Pharmacy Florist Metal Work Wood Work Pawn Shop Repair Travel Agency Delivery Bank Exchange Money Transfer Real Estate Car Rental Computer Services Photographer Photocopy Graphic Design Printing Services Study Agency Casino Recreational Activities Dry Cleaner Laundromat Hair Salon Nail Salon Spa Masseuse Tattoo & Piercing Funeral Services Tailor Hospital Veterinarian

Goods-Based	Other
Medical Goods Cosmetics Perfume Textiles Clothing Luxury Undergarments Accessories Women's Clothing Men's Clothing Children's Clothing Shoes Leather Goods Gloves Furniture Household Goods Radio & Television Computer Electronics Hardware Store Books Newspaper Stationery Pet Store Art Boat supplies Coins & Stamps Costumes Optical Store Fishing Supplies Frames Funeral goods Jewelry Knives Entertainment Musical Instruments Office Supplies Photo Store Sporting Goods Souvenirs Toys Wedding Mask	Other Retail Unknown

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Glass Antiques Fitness	

Appendix D

Statistical Analysis of Historical and Current Data on Giudecca

Overall Analysis

Mean number of Active Storefronts: 2.89
Median number of Active Storefronts: 2
Standard Deviation of Active Storefronts: 8.10

Mean number of Inactive Storefronts: 1.48
Median number of Inactive Storefronts: 2.5
Standard Deviation of Inactive Storefronts: 1.94

	Active Storefronts		Inactive Storefronts	
	Value	Z-Score	Value	Z-Score
1951	1	-0.233	0	-0.763
1964	1	-0.233	0	-0.763
1978	1	-0.233	0	-0.763
1971	1	-0.233	0	-0.763
1974	2	-0.110	0	-0.763
1975	1	-0.233	0	-0.763
1976	1	-0.233	0	-0.763
1977	1	-0.233	0	-0.763
1978	1	-0.233	0	-0.763
1979	4	0.137	0	-0.763
1980	2	-0.110	0	-0.763
1981	2	-0.110	0	-0.763
1982	3	0.014	0	-0.763
1983	2	-0.110	0	-0.763
1984	4	0.137	0	-0.763
1985	3	0.014	0	-0.763
1986	3	0.014	1	-0.247
1988	1	-0.233	0	-0.763
1989	1	-0.233	0	-0.763
1990	2	-0.110	0	-0.763
1991	3	0.014	2	0.268
1992	1	-0.233	0	-0.763
1993	2	-0.110	1	-0.247

1994	0	-0.357	1	-0.247
1995	3	0.014	3	0.784
1996	4	0.137	1	-0.247
1997	1	-0.233	3	0.784
1998	4	0.137	8	3.361
1999	1	-0.233	5	1.814
2000	3	0.014	5	1.814
2001	2	-0.110	3	0.784
2002	1	-0.233	4	1.299
2003	0	-0.357	2	0.268
2004	0	-0.357	3	0.784
2005	3	0.014	0	-0.763
2006	0	-0.357	4	1.299
2007	1	-0.233	1	-0.247
2008	4	0.137	2	0.268
2009	0	-0.357	1	-0.247
2010	1	-0.233	2	0.268
2011	2	-0.110	3	0.784
2012	0	-0.357	4	1.299
2013	3	0.014	2	0.268
2014	0	-0.357	1	-0.247
2015	1	-0.233	0	-0.763
2018	56	6.557	6	2.330

2000-2018 Analysis

Mean number of Active Storefronts: 4.53
Median number of Active Storefronts: 1
Standard Deviation of Active Storefronts: 13.33

Mean number of Inactive Storefronts: 2.53
Median number of Inactive Storefronts: 2
Standard Deviation of Inactive Storefronts: 1.70

	Active Storefronts		**Inactive Storefronts**	
	Value	Z-Score	Value	Z-Score
2000	3	-0.115	5	1.453
2001	2	-0.190	3	0.276
2002	1	-0.265	4	0.865
2003	0	-0.340	2	-0.312
2004	0	-0.340	3	0.276

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2005	3	-0.115	0	-1.488
2006	0	-0.340	4	0.865
2007	1	-0.265	1	-0.900
2008	4	-0.040	2	-0.312
2009	0	-0.340	1	-0.900
2010	1	-0.265	2	-0.312
2011	2	-0.190	3	0.276
2012	0	-0.340	4	0.865
2013	3	-0.115	2	-0.312
2014	0	-0.340	1	-0.900
2015	1	-0.265	0	-1.488
2018	56	3.861	6	2.041

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Appendix E

Active & inactive storefronts

Mean of Active Storefronts: 156.44
Median of Active Storefronts: 52
Standard Deviation of Active Storefronts: 190.14

Mean of Inactive Storefronts: 21.0
Median of Inactive Storefronts: 9
Standard Deviation of Inactive Storefronts: 20.14

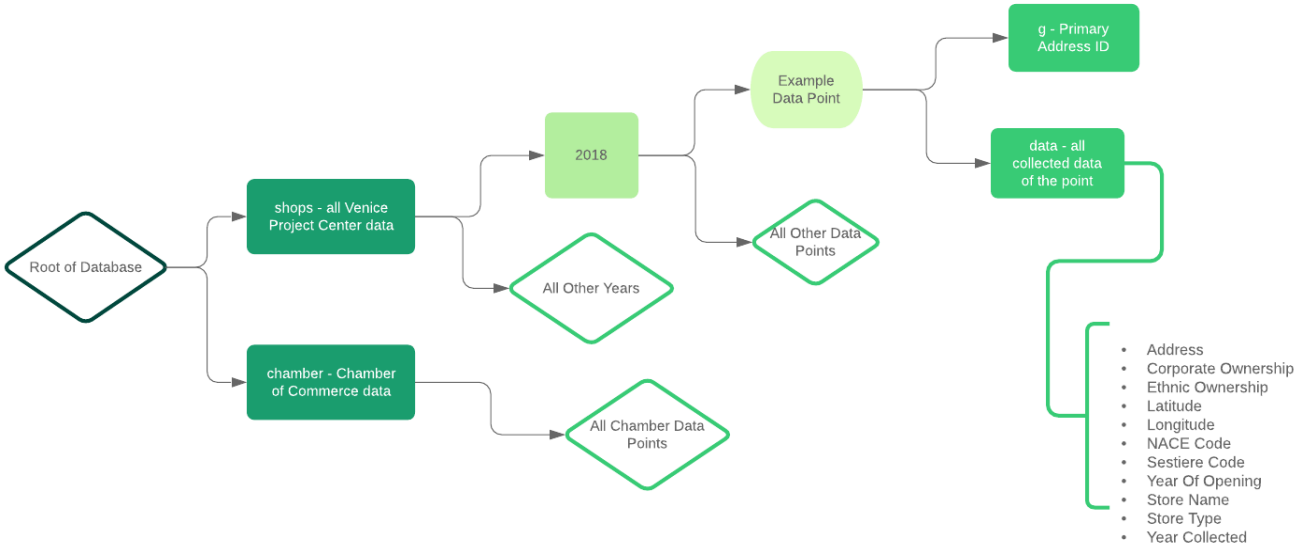
	Active Storefronts		Inactive Storefronts	
	Value	Z-Score	Value	Z-Score
2000	22	-0.7070579573	6	-0.7447864945
2001		-0.8227621752		-1.042701092
2002	25	-0.6912801094	2	-0.9433962264
2003	5	-0.7964657621	2	-0.9433962264
2004	32	-0.654465131	7	-0.6951340616
2005	204	0.2501314821	34	0.6454816286
2006		-0.8227621752		-1.042701092
2007		-0.8227621752		-1.042701092
2008		-0.8227621752		-1.042701092
2009	295	0.7287262017	35	0.6951340616
2010		-0.8227621752		-1.042701092
2011		-0.8227621752		-1.042701092
2012	52	-0.5492794783	36	0.7447864945
2013		-0.8227621752		-1.042701092
2014		-		-1.042701092

		0.8227621752		
2015	583	2.2433996	58	1.83714002
2016		-0.8227621752		-1.042701092
2017		-0.8227621752		-1.042701092
2018	190	0.1765015252	9	-0.5958291956

Economic Activity Analysis

	Art		Bar		Clothing		Hotel		Household Goods		Jewelry		Restaurants		Souvenirs	
	Value	Z Score	Value	Z Score	Value	Z Score	Value	Z Score	Value	Z Score	Value	Z Score	Value	Z Score	Value	Z Score
2000	1	-0.891		-1.151	1	-0.755	3	-0.404		-1.290	2	-0.455	2	-0.702	5	-0.4050
2002	2	-0.563	2	-0.884	1	-0.755	1	-0.703	1	-0.968	1	-0.615	2	-0.702	4	-0.4581
2003		-1.220		-1.151	1	-0.755		-0.852		-1.290		-0.774		-0.831	1	-0.6173
2004	2	-0.563	3	-0.750	4	-0.458	2	-0.554	5	0.323	1	-0.615	3	-0.637	3	-0.5111
2005	9	1.740	20	1.526	14	0.532	4	-0.255	7	0.968	13	1.296	11	-0.120	20	0.3912
2009	2	-0.563	6	-0.348	30	2.116	20	2.133	8	1.290	15	1.615	42	1.882	57	2.3551
2012	3	-0.234		-1.151	5	-0.359	2	-0.554	1	-0.968	1	-0.615	4	-0.572	5	-0.4050
2018	7	1.082	12	0.455	13	0.433	8	0.342	2	-0.645	1	-0.615	26	0.849	6	-0.3519
Mean	3.71		8.60		8.63		5.71		4.00		4.86		12.86		12.63	
Std Dev	3.04		7.47		10.10		6.70		3.10		6.28		15.48		18.84	

Appendix F

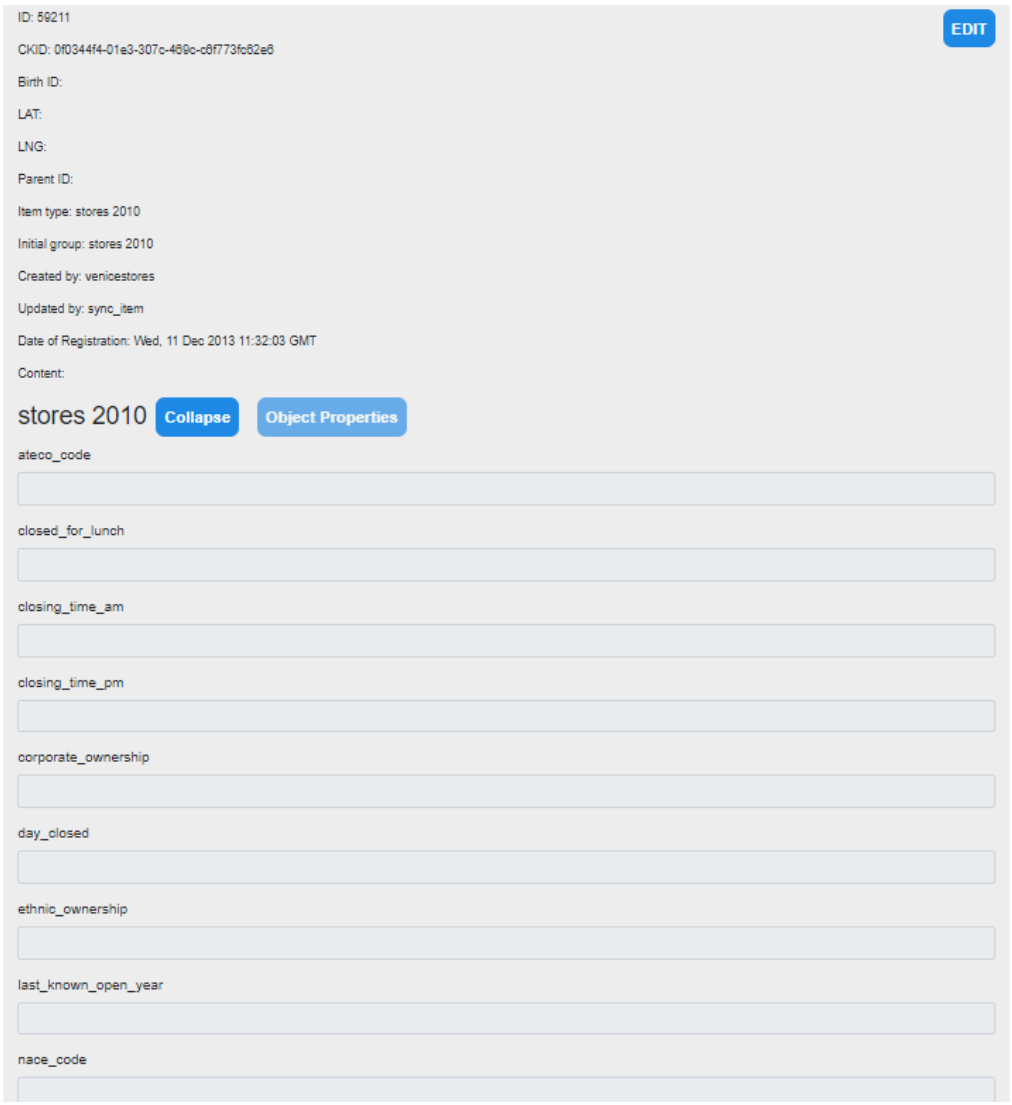

Root of Database
shops - all Venice Project Center data
chamber - Chamber of Commerce data
2018
All Other Years
Example Data Point
All Other Data Points
All Chamber Data Points
g - Primary Address ID
data - all collected data of the point
Address
Corporate Ownership
Ethnic Ownership
Latitude
Longitude
NACE Code
Sestiere Code
Year Of Opening
Store Name
Store Type
Year Collected

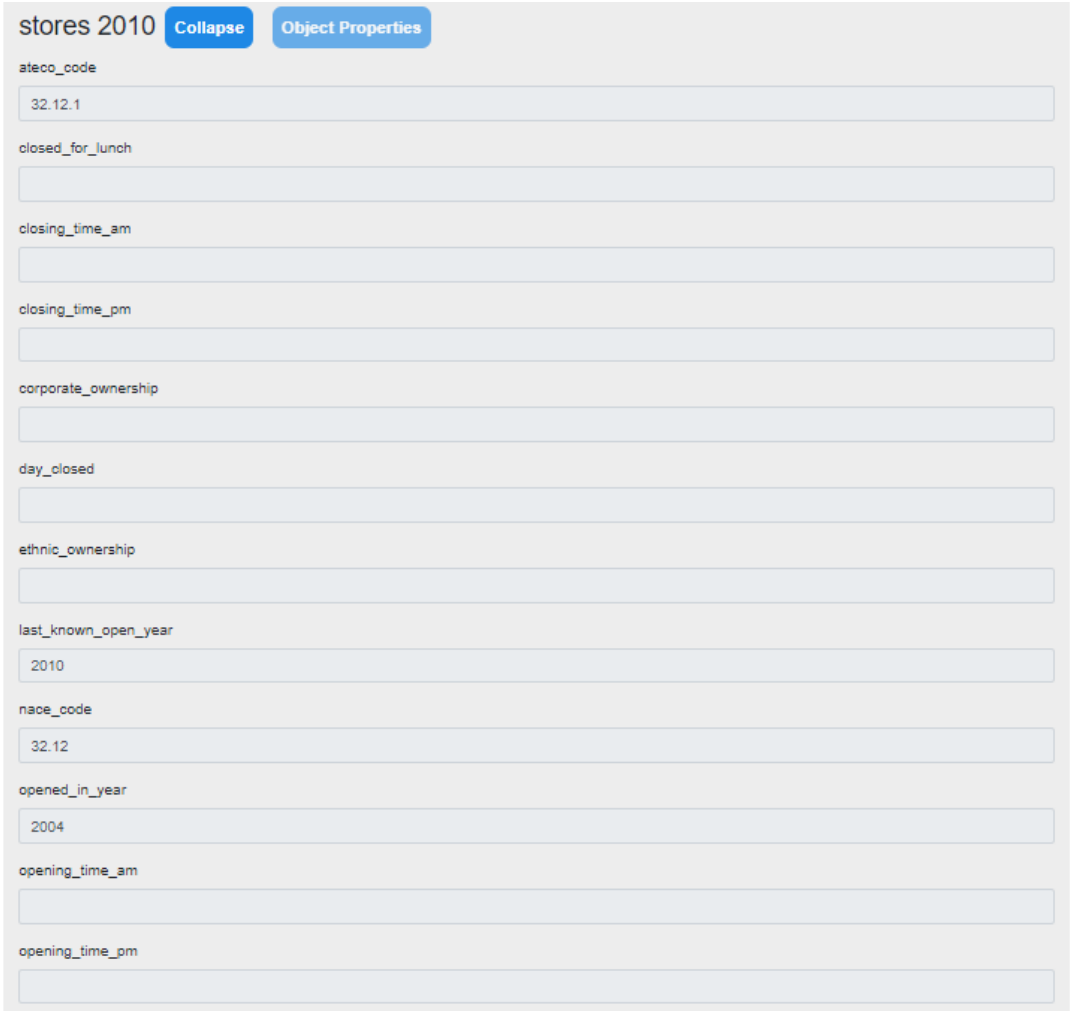
y

Appendix G

Appendix H

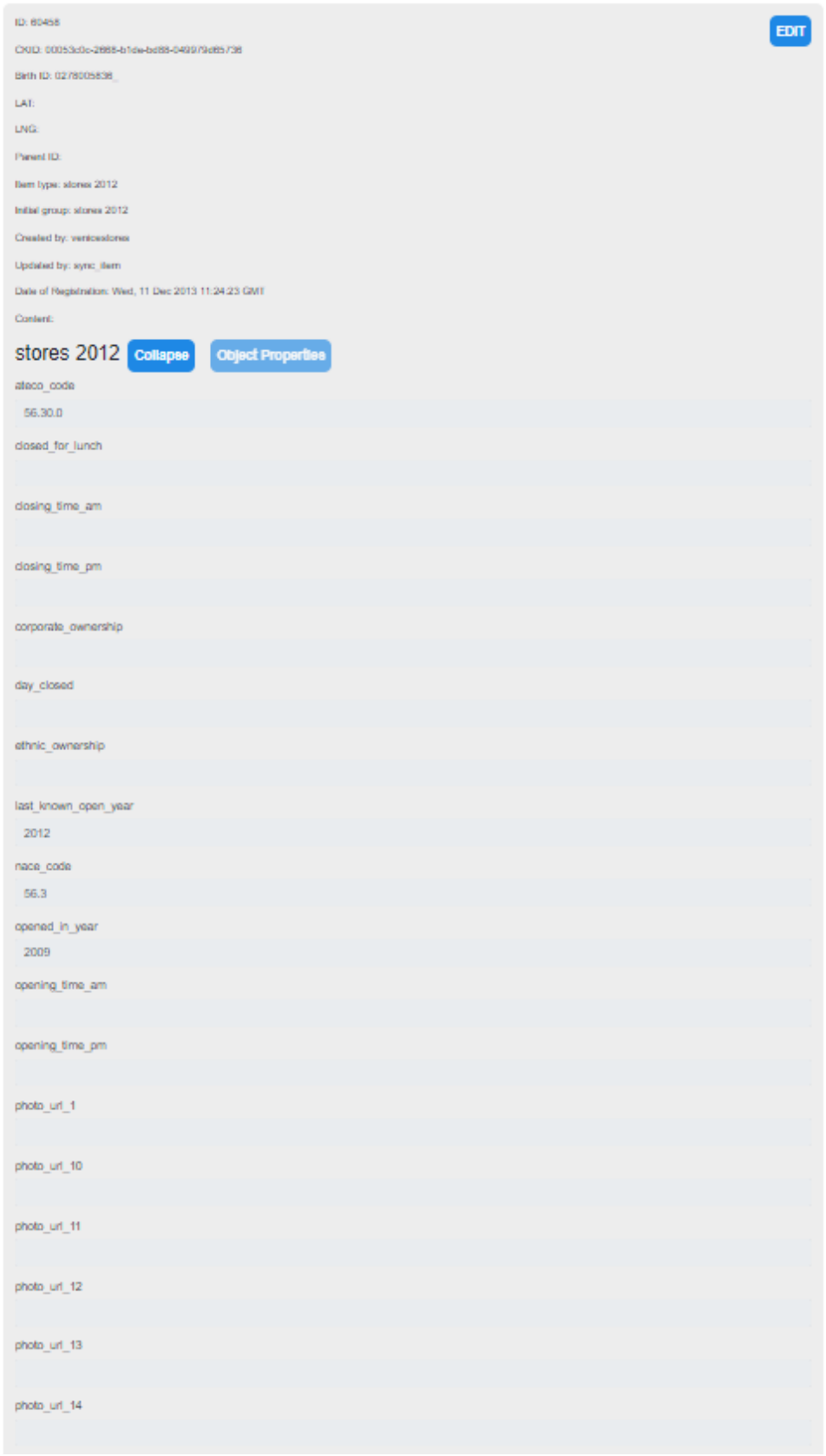
Blank Data Points





“Copy and Paste” Data Points

bb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CKID: 00053c0c-2888-b1de-bd88-0499f3d85738
Birth ID: 02/8005838_
LAT:
LNG:
Parent ID:
Item type: stores 2012
Initial group: stores 2012
Created by: venicestores
Updated by: sync_item
Date of Registration: Wed, 11 Dec 2013 11:24:23 GMT
Content:
stores 2012
Collapse
Object Properties
ateco_code
56.30.0
closed_for_lunch
closing_time_am
closing_time_pm
corporate_ownership
day_closed
ethnic_ownership
last_known_open_year
2012
naca_code
56.3
opened_in_year
2009
opening_time_am
opening_time_pm
photo_url_1
photo_url_10
photo_url_11
photo_url_12
photo_url_13
photo_url_14

cc

photo_url_14

photo_url_15

photo_url_2

photo_url_3

photo_url_4

photo_url_5

photo_url_6

photo_url_7

photo_url_8

photo_url_9

photo_year_1

photo_year_10

photo_year_11

photo_year_12

photo_year_13

photo_year_14

photo_year_15

photo_year_2

photo_year_3

photo_year_4

photo_year_5

photo_year_6

dd

photo_year_6

photo_year_7

photo_year_8

photo_year_9

primary_address_id

0278005836

store_name

Osteria Barababao

store_type

Bar

wiki_friendly_title

Store 0278005836 - (Osteria Barababao, 2009)

year_data_collected

2009

ee