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Analysis of Covid-19's Impact on the US Rental Market

Wanting Xi
Ethan Bai
Xuezhou Wen

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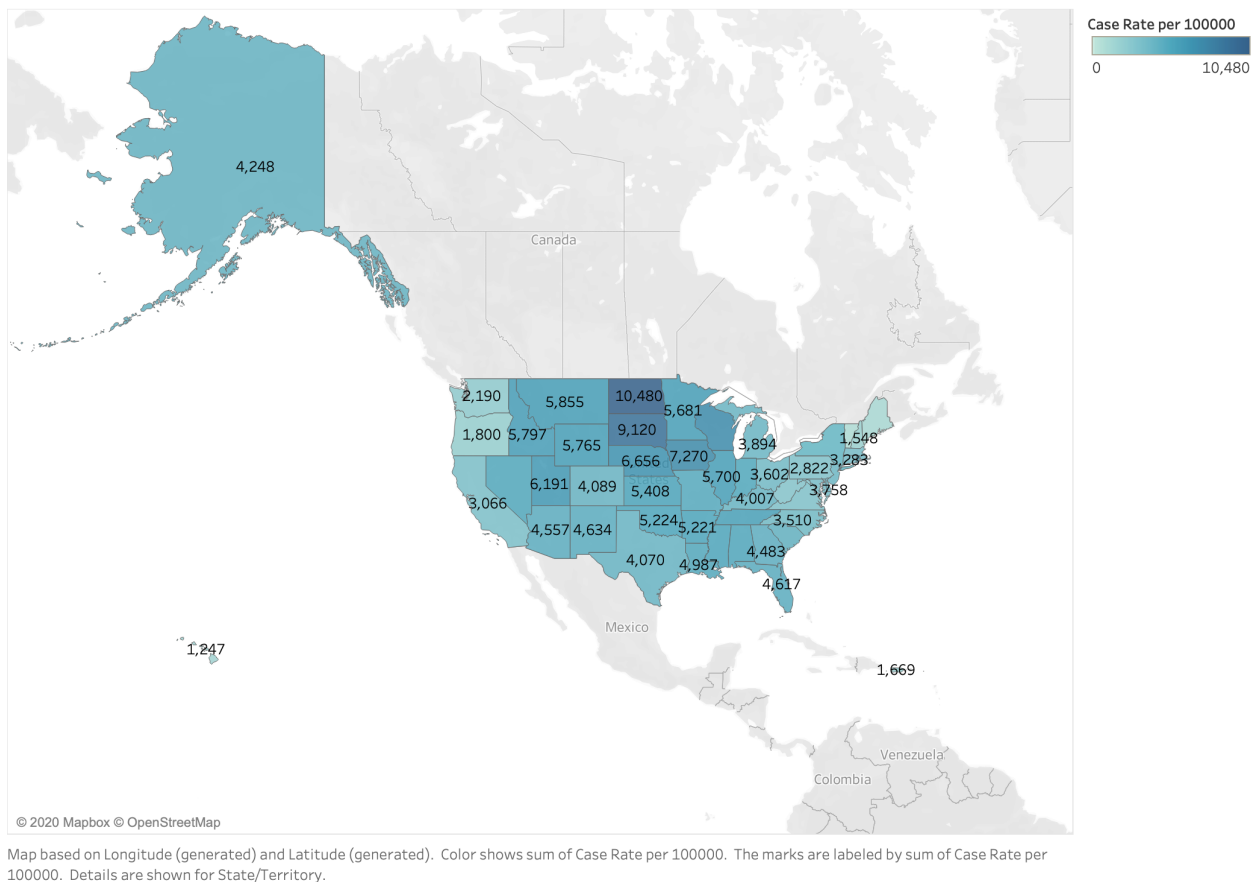
Abstract

From January 2020, Covid-19 has influenced many industries, like healthcare, travel industry, and etc. Our group focuses on the analysis of the influence towards the rental market. After reading some papers published, we think Covid-19 has negatively influenced the rental price. Based on our analysis on the Zillow dataset, Huduser.gov dataset and Covid-19 dataset, we proved our hypothesis that Covid-19 causes the rent decrease of about $\frac{1}{3}$ number of counties in the United States. And for the State level, the average rental price in NY has been influenced most. But the rental price has been slowly revived as the control of Covid-19. In addition, the rent prediction by counties is also useful which can help people who wants to rent certain types apartment.

Keywords: MapReduce, Rental Market, Covid-19's influence

I. Introduction

Case Rate per 100,000 Analysis



In January 2020, an unknown virus was detected in Wuhan City, Hubei Province, China and it was spreading fastly from person-to-person. Until December 4, 2020, there were a total of 14,462,527 cases in the United States and caused 280,135 deaths(CDC, 2020).

This project is mainly about analyzing how Covid-19 changed the rental prices in various states in the U.S. First, we will collect data of rental prices from a number of past months in several states. And then, we will use MapReduce to clean and profile the data collected, and we will analyze which states' rental price was influenced most because of covid-19. Finally use machine learning models to analyze the data and make predictions of the future price in the one month.

II. Motivation

In March, 2020, the universities in the U.S. decided to close the campus and turned to the online studying mode since the fast spread of coronavirus. Most students went back to their hometown and stopped the lease agreement with their apartment in order to avoid getting infected. And also, staff from companies decided to work from home. As a result, much less houses and apartments were leased due to the dropping demand. Therefore, we are very interested in how Covid-19 have impacted the house/apartment rental industry, which may help the rental companies to better prepare for and remedy their business loss from this kind of emergency event.

III. Related Work

Many scholars were also interested in this topic and published their findings. Scholars Sara and Samira research about the Covid-19's influence on the trading of short-term rental spaces using Airbnb data as an example (Dolnicar 2020). They think covid-19 can be thought of as an economic super-shock and listed the influence of some historical events, like earthquakes, hurricanes and even terrorist attacks . For example, the Iraq war and SARA led to a drop of economic growth to 3.2%(IMF, 2003), the global financial crisis in 2009 to -1.3%(IMF, 2009). According to the analysis, the Covid-19 is expected to lead to the growth to -3%(IMF, 2020). It is a huge bad influence to every industry compared to the other historical events than we know.

So how about the influence towards the rental industry? Duobis did the research about the travel restrictions made by the countries and found there were a 96% drop in Airbnb bookings. Because of the social distance requirement. Less people are willing to travel to other places to keep

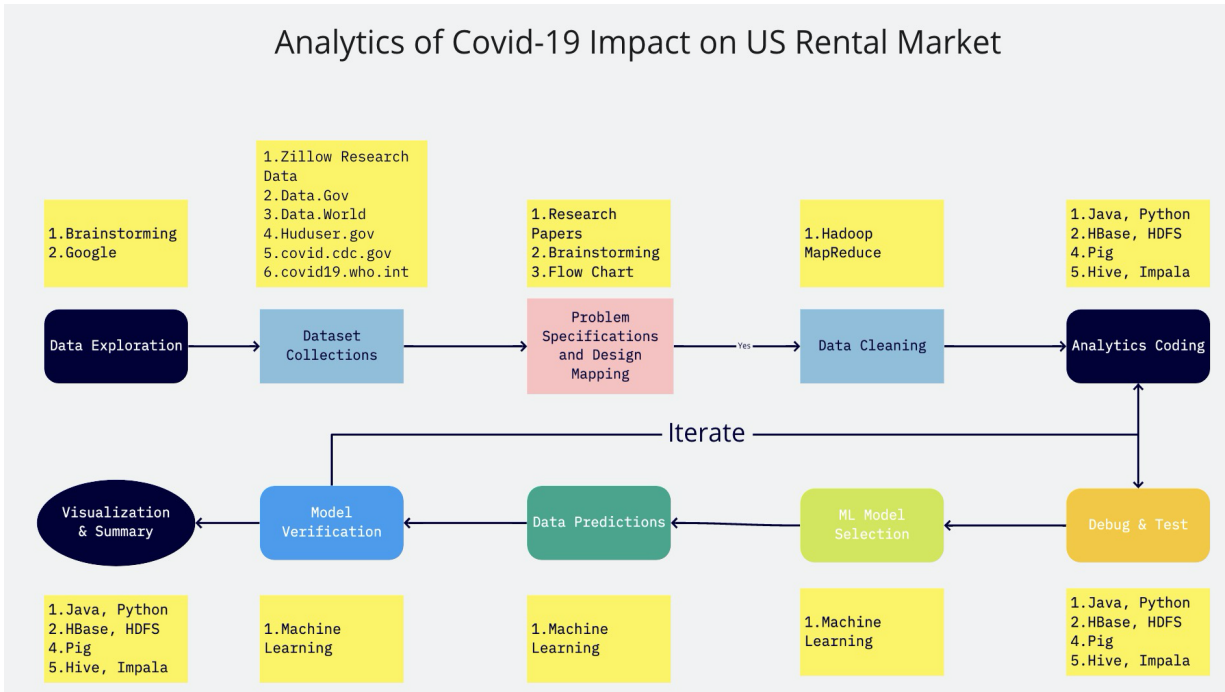
healthy, so this also results in the low economic growth of the rental market.

Not only Airbnb, the regular hotel industry was also almost the hardest hit(Vik Krishnan, 2020). And now the hotels are facing a high vacancy situation. In May, luxury hotels' occupancy are lower than 15%, economy hotels' occupancy are lower than 40%. And the investors are pessimistic and distinguished towards the hotel market.

So what is the impact on the renters? Kneebone and Murray have done one finding named "Estimating Covid-19's Next Term Impact on Renters" on April 24, and they said, lots of renters are facing income losses, thus they are unable to pay their rent(Kneebone 2020). The National Multifamily Housing Council(NMHC) also exposed these findings, and they said 86.8% of Apartment Households paid Rent as of October 13, and this was 2.4% lower than the data before, which means there are 271,000 households decreasing the rent.

Based on the research, we will analyze the Covid-19 impact in the rental market in different states, different months, and different rental types. We hope our findings will help others gain a good insight towards the real situation of the current market.

IV. Design and Implementation



First of all, we have several interesting ideas, like to analyze the political hot keywords in the past 30 years and analyze the political keywords next year. But after analysing this topic, we thought it is hard to predict since the political environment changes every day and there are always some unpredictable things happening. After brainstorming, we choose the topic about analyzing the Covid-19's influence towards the US rental market.

The key step is to find the dataset. There are some official websites related to this topic which can help us to easily collect this data. Our key dataset is the zillow data, which contain the information about the rental price from 2014 to 2020. Also, data.gov, and data.world help us to collect rental related data. WHO and CDC provide us some covid related dataset, which give us an overview about the spread speed of coronavirus. Hudster.gov helps us to analyze the rental price of different rental types and then we can predict the rental price of the coming month.

After collecting all the dataset that we will use, we started our project management stage. We draw the flowchart and decide the timeline to complete this project using Excel. Then we begin our first step about dealing with our data.

The first step is to use MapReduce and pig to do the data cleaning. And then we use MapReduce and Hive to analyze the data. To better understand the spread of Covid-19, we also use the data visualization tool - Tableau to draw the heat map. Finally, we use machine learning to build the Least Square Regression Line Model to predict the rental price of the coming fiscal year.

After analyzing our result, we summarize what we have done and think about our future works, like how our findings can help the rental companies to avoid the big loss.

V. Datasets

A. Zillow Dataset

For the rental data from Zillow(<https://www.zillow.com/research/data/>), we focus on analyzing the impact of covid-19 to major US cities. We have gathered data from 2014 to October 2020. The first step is to use pig to do the data cleaning, for example, we need to delete the header and the useless columns. And we use MapReduce to analyze the Covid-19 influence towards the rental prices.

B. Huduser.gov Dataset

For the Huduser.gov Dataset (<https://www.huduser.gov/portal/datasets/50per.html#2020>), we use the 50 percentile Fair Market Rent (FMR) data from Huduser to analyze the Covid19's impact on the gross rent of counties around the United States.

Firstly, we profile the FMR dataset and Covid number dataset respectively and join them by counties. Secondly, we use the Least Square Regression Line Model to predict the 2022 fiscal year's FMR based on the FMR of 2018 to 2021 fiscal year. Thirdly, we calculate the FMR change between FY (fiscal year) 2019 and FY 2020, FY 2020 and FY 2021 of each county, and compare them with the Covid infection number of them, so that we can observe which county's FMR change is covariant to its Covid infection number. Finally, we use Hive to sort out the top 100 counties that have the highest infection number and see how the Covid affected their FMRs.

C. Covid-19 Related Dataset

There are several Covid-19 related dataset that we have used. The first one is the New York Times Covid-19 dataset(<https://github.com/nytimes/covid-19-data>). In this dataset we use MapReduce to find the top counties that have the most cases. The second dataset is from WHO (<https://covid19.who.int/>). WHO has made the dashboard already that gives users a good sense about the fast spread of coronavirus. There are 13,563,731 confirmed cases and 268,482 deaths until December 3, 2020. Covid-19 continues to spread all over the United States which reverses economic growth. The third dataset is from CDC (<https://www.cdc.gov/coronavirus/2019-nCoV/index.html>) which gives us information about the number of cases in different states.

VI. Results

There are three hypotheses we made before our analysis:

1. Covid-19 negatively affects the rental prices in the market.
2. Less than half of the counties' rental prices have been negatively affected by the Covid-19.
3. The rental price is slowly ramping up.

We want to use our data to prove our hypothesis. Through the analysis of the combination of two dataset: Huduser.gov Dataset and the New York Times Covid-19 dataset, we obtained 3 results:

The first result is the statistical relationship between Covid-19 infection number and the 50 percentile FMR of each county. There are 3 integer be used as labels, where '1' represents the Covid number and the FMR of a county has a contravariant relationship, which means the rent tends to go up as the Covid increases, '0' represents no obvious statistical relationship, '-1' means the rent tends to go down as the Covid number increases, which can indicate that the rent price is negatively impacted by the Covid-19. The result file, evaluate1.txt, is attached along with this paper. And as a summary, we calculated the total number of counties that were negatively affected by the Covid: [1244, 1281, 1174, 1267, 1292], corresponding to the room type of apartment with 0,1,2,3,4 bedrooms, which means there were 1244 counties whose 0-bedroom apartment were negatively affected by Covid-19. As we know, there are 3143 counties in the total US, so less than half counties have been influenced.

The second result is the prediction on each county's FMR in FY 2022 using the data from FY 2018 to FY 2021 and LSRL (Least Square Regression Line) model. The result is stored inside the file predict-2.txt, where the rightmost 5 numbers of each row represent the predicted FMR of 5 types of apartments of each county.

The third result is counties with their average rental price change sorted by their numbers of infections decently, stored inside the file covid_top_100_eva.txt, where the infection number and average rental price change is stored in the rightmost two columns. In addition, we also sorted the same table by the order of average rental price change ascend, stored in the file counties_sort_by_change.txt, so that we can observe the

top 100 counties that experienced the largest average rental price drop. The top 3 counties are Fairfield in CT, Walton in GA, and Petersburg Borough in AK.

And also, the Zillow analysis result is corresponding to the previous analysis. Zillow records monthly rental prices across the US, and we have captured rental data ranging from January 2014 through October 2020. The analysis on Zillow focuses on understanding how covid-19 is impacting the US rental market on a city and monthly level.

Throughout the analytics by Apache Pig, we were able to observe the below findings. Firstly, there were 5 major states (NY, CA, WI, OH, FL) in the US experiencing rental decreases, but we didn't find a linear relationship on the number of Covid cases and rental price decrease. For example, Illinois and Texas are both ranked top 5 on number of covid infections, but we didn't observe any rental price decreases in these two states. New York and California are two of the states firstly reporting covid-19 cases, and they experience rental price drop largely due to the workforce working remotely or moving out of the high cost-of-living states.

Secondly, New York City had an average of 17% rental price decrease in 2020. This is due to renters moving out of Manhattan and the demand has dramatically decreased. Also, the City of Madison had a high 9% average price decrease, and this is because the University of Wisconsin Madison is operating in hybrid mode resulting in students and faculties leaving the campus.

Lastly, we observed that rental prices are slowly ramping up with the hope of vaccine development. Across the US, rental prices had their largest

decrease in 2020 in February and March, but the prices are varying in less than 10% for other months. Based on this, we predict that rental prices will resume to normal levels slowly in 2021 and 2022.

Based on our analysis, the hypothesis that we made before have been proved.

VII. Future work

If we have more time, we will think about expanding our analysis into different areas. For example, what is the Covid-19's impact towards the healthcare industry? How about the travel industry? Not only the market in the United States, how about our counties? And more importantly, how to analyze our result from a managerial perspective. For example, how do our findings help the business? And based on our findings, what could the manager do?

VIII. Conclusion

Covid-19 negatively impacted the rental market. But the influence is not as big as we had expected. For the state level, New York's rental price has the biggest decrease. For the county level, Fairfield in CT, Walton in GA and Petersburg Borough in AK decreased most. And less than half the counties have been influenced by Covid-19. And people who want to rent one house in a certain county can have a reference towards our prediction results.

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