HUMAN CENTERED DATA SCIENCE

PANDEMIC ANALYSIS FOR HAMILTON COUNTY, OHIO

An analysis of unemployment rate and Market Hotness Index

Table of Contents

Introduction

When covid hit US hard in March 2020, the economic downturn was quite evident that led to the closure of many businesses when strict quarantine protocols and mask mandates were in place. This impact was also reported in the US Census Bureau's economic surveys[3]. The economic impact could be seen across many sectors like retail, wholesale, and manufacturing. Many people lost jobs during this time, and others scrambled to make their needs met. But after the situation normalized, many companies resorted to working from home policy to keep their wheels running. I want to assess this economic impact by backtracking the unemployment rate in Hamilton county during the covid times. Although the initial shock of covid had put many people out of jobs but later, when things returned to normalcy, and new work policies were brought into place, the unemployment rate would also have ideally improved. I want to weigh the impact of covid on the unemployment rate in Hamilton county and understand if we can make our jobs resilient to such pandemics or any disaster by implementing innovative work policies.

Secondly, I want to assess the impact of covid on the housing market. An average person could only dream of owning a house in their lifetime. But during covid, many people took this as an opportunity to make their dreams come true by leveraging the plummeting mortgage rate. As an individual, I would expect people to have financial trouble investing in properties at a time when many people were losing jobs. According to a report by Vox[4], between Sep 2019 and Sep 2020, homeowners accumulated a collective $1 trillion in additional home equity. The S&P CoreLogic Case-Shiller National Home Price NSA Index, which tracks housing prices, reported that housing prices had risen by 9.5% in November 2020. While this was good news for many homeowners, many American dreamers were completely shut out of the housing market.

The primary reason for the market boom could be the demand and supply problem. While the demand increased due to low mortgage rates, the supply couldn't match the demand and hence the high housing prices. But still, if one does the math correctly, the decrease in mortgage rate compensates for the increase in housing prices. Through this analysis, I want to track the market sentiments in Hamilton county during the covid using the Market Hotness Score.

Background/Related Work

My research is focused on assessing the unemployment rate and the market hotness score during the pandemic. As claimed in many articles and papers, the unemployment rate increased at the time when the news of covid-19 broke in the USA, which led to a record number of temporary layoffs. Before this happened, the USA had witnessed the largest economic expansion in the first two months of 2020. However, the labor market began to recover in the late second quarter. While the unemployment rate began to improve, it was still worse than the previous year.

'Total employment, as measured by the CPS, rose by 8.6 million in the third quarter of 2020 and by 3.6 million in the fourth quarter. At the end of the year, total employment averaged 149.8 million, 8.8 million (or 5.5 percent) less than in the fourth quarter of 2019.'- US Bureau of Labor Statistics[1].

The housing market sentiments were also affected due to the pandemic. At the beginning of the pandemic, the housing market surely went through economic uncertainty. But as the market stabilized, the prices started to pick up. The record low mortgage rates along with the housing stock shortage, made the housing market extraordinarily hot. Recently, the Fed increased the interest rate to curb inflation which stabilized housing prices.

'The initial lull in home sales at the very start of the pandemic quickly turned into a white-hot sellers market with buyers offering over asking price and even waiving home inspections.' - Bankrate[2]

The claims made in several papers and articles are similar to the hypotheses I am proposing. Below are my research questions and hypotheses:

Research questions:

- How was the unemployment rate affected during covid 19, and were all economic sectors affected equally?
- How was the housing market sentiment of people during covid19 when many people were facing financial burdens, and what segment of people benefitted from this boom?

Hypothesis:

- While the overall unemployment rate in the USA increased, I expect Hamilton county to show similar trends in the unemployment rate.
- With the boom in the housing industry in the USA, the market hotness score will also increase in Hamilton county, Ohio.

Data Sources

I have used the data from St.Louis FRED database as my primary source. FRED stands for Federal Reserve Economic Database, which consists of hundreds of thousands of economic data time series, and it's free to use for non-commercial purposes. The Common analysis was around the trend of active confirmed cases of covid, and as the cases were increasing, more jobs were impacted, and this data would aid in answering my research question. The use of FRED data requires proper citation, and some data which is owned by a third party requires permission from the owners.

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- Unemployment time series of Hamilton county- This time series data is available from the year 1990 to 2022 and contains the monthly unemployment rate. This data will be used to answer my first research question.

  Link to data - https://fred.stlouisfed.org/series/OHHAMI1URN

- Market Hotness Index data of Hamilton county - This time series data is available from the year 2018 to 2022 and contains the Market Hotness Index, which is a score. This data will be used to answer my second research question. The MHI is defined by *realtor.com* as a score that reflects how the locals experience the fast-moving supply and rising demand. It breaks down the demand and supply dynamics to rank the counties and zip codes compared to the rest of the country. *'Realtor.com examines listing views by the market as an indicator of demand and median days on the market as an indicator of supply. '* The MHI may not necessarily indicate the rising and dropping of housing prices but could be used as a good proxy for it.

  Link to data - https://fred.stlouisfed.org/series/HOSCCOUNTY39061

My second data source is datausa.io. It uses the US government data, which is cleaned by their team and is made free to access for public use. With the rise in covid cases, the housing market boomed owing to the decrease in mortgage rates, and hence this data will help me to answer my second research question. The use of data is meant for informational and educational purposes, and the content on the website is copyrighted by GNU Affero General Public License v3.0 (GPLv3) license.

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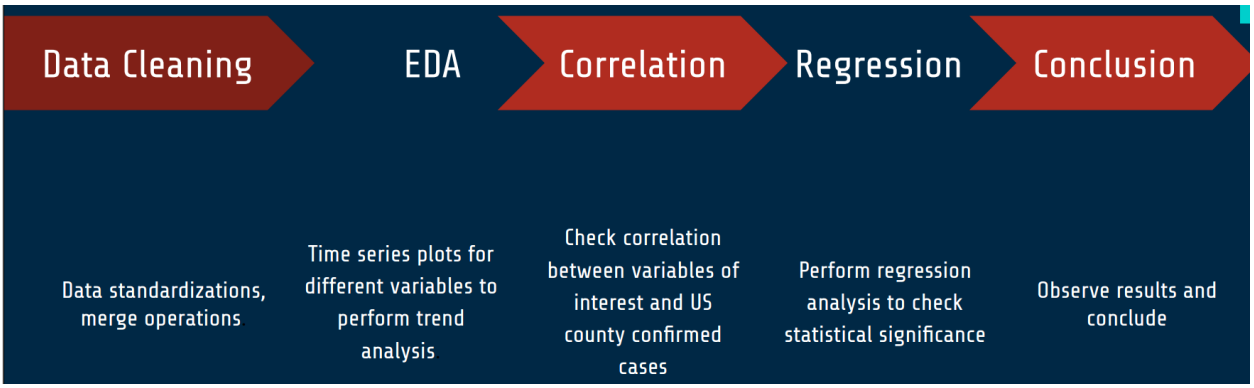
- Employment by different sectors - I am planning to use this data to answer my first research question. It will help to check if all the sectors were equally affected or if some sectors were more impacted than others in the covid leaving some people in a more

disadvantageous position than others. This is a monthly time series data indicating the number of employees in each super sector. This data is available for Cincinnati, which is the major metro around Hamilton, and I will use it as a proxy for Hamilton.

Link to data - https://datausa.io/profile/geo/cincinnati-oh/#housing

Methodology



1. **Data Cleaning:**

The 3 datasets discussed above for the extended analysis are on a monthly level, and the US daily confirmed cases data is also standardized to a monthly level for further merging and easier analysis.

2. **EDA**

After cleaning the data and ensuring the continuity of all the time series data, I first performed exploratory data analysis. The time series plots for the unemployment rate, hotness score for Hamilton county, and employee growth rate by different economic sectors are analyzed.

3. **Correlation**

The Pearson correlation between the unemployment rate and covid confirmed cases and the market hotness index and covid confirmed cases were checked to obtain a preliminary sense if my hypothesis is right or wrong. To validate the results further, I performed regression analysis keeping just one predictor at a time.

4. **Regression analysis**

I checked the relationship between the dependent (unemployment rate) and the independent variable (covid confirmed cases) through the beta coefficient. I also tested the significance of the independent variables from their associated p-value. A similar analysis was also performed with

the hotness score as the dependent variable and monthly confirmed cases as the independent variable.

Null Hypothesis: The beta coefficient is not significantly different from zero.

Alternative Hypothesis: The beta coefficient is significantly different from zero.

All the necessary assumptions were also tested before performing the regression analysis. Regression analysis was chosen in the analysis since I was trying to model the relationship between one or more variables. It aligned with my hypothesis, which was to understand if the covid induced recession drove the unemployment rate and the change in housing market sentiments.

Findings

During the common analysis, We observed the trends in rising covid cases (fig. 1) and how govt. Interventions like the mask mandate affected the number of covid cases. I found that the effects of mask mandate policies were not immediate, but with certain assumptions and theories, we could attribute the change in figures to the mask policy change. With more data, the conclusion could have been implied with more certainty.

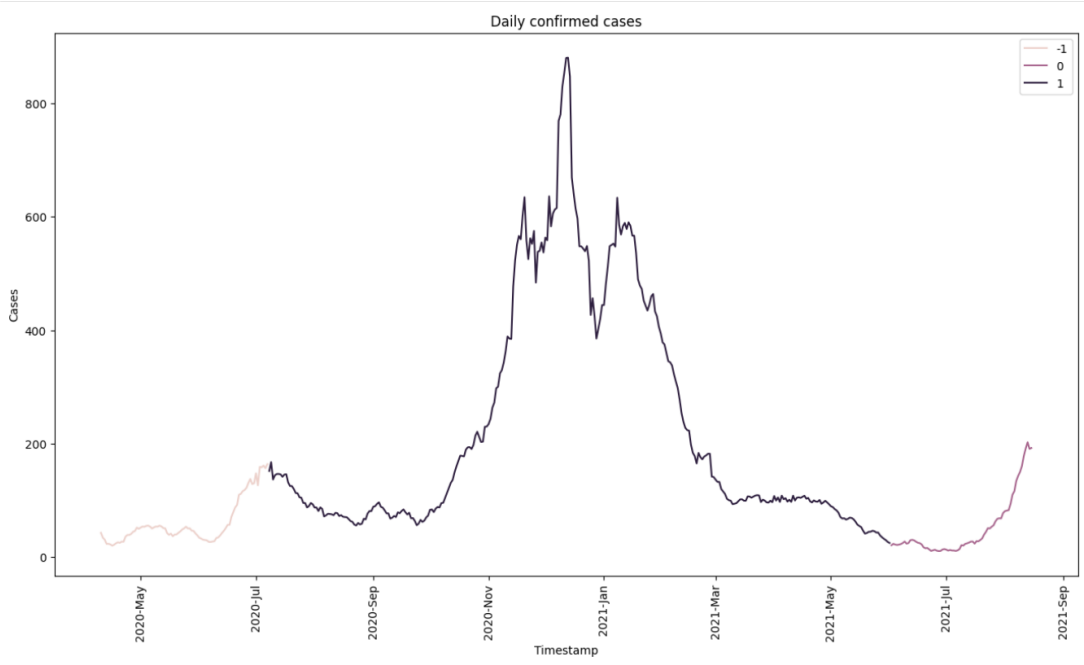


Fig. 1

We could see that as the mask policy changed to 'Yes'/1 (fig. 2), the infection rate started soaring. Although it seems counter-intuitive, this could be because the mask mandate policy was enforced as the cases started soaring. But later, the infection rate started decreasing which could be because of the continuation of the mask mandate and due to vaccinations coming around. The rising trend during the mask mandate could also be due to more testing and reported cases.

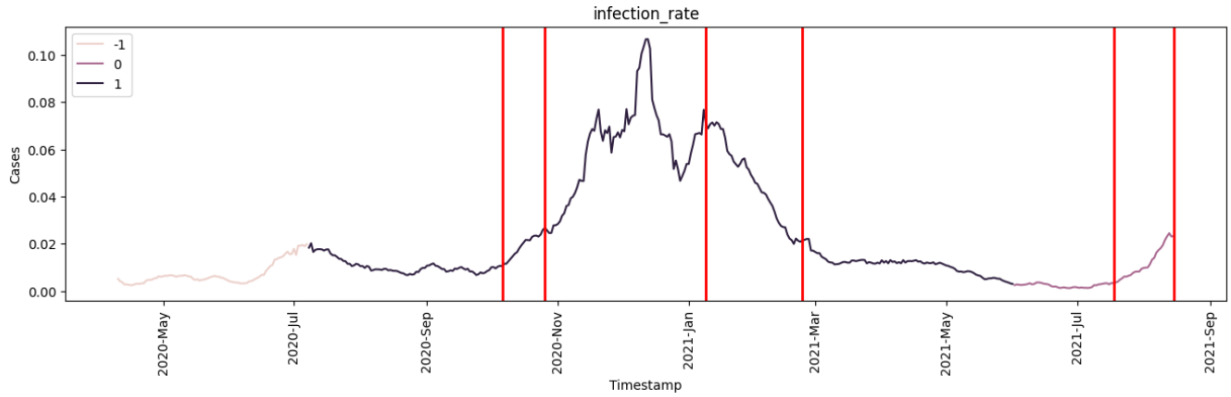


Fig. 2

In the extended analysis, we explored the relationship between the rising cases of covid and two variables of interest- Unemployment rate and Market Hotness Index.

During the start of covid in Mar 2020, the unemployment rate spiked (fig. 3) and during the peak of covid in Jan 2022 too, the unemployment rate started increasing again. But in other time periods during covid, the unemployment rate decreased after rising which could be due to various policies introduced by the government like covid relief funds and welfare schemes.

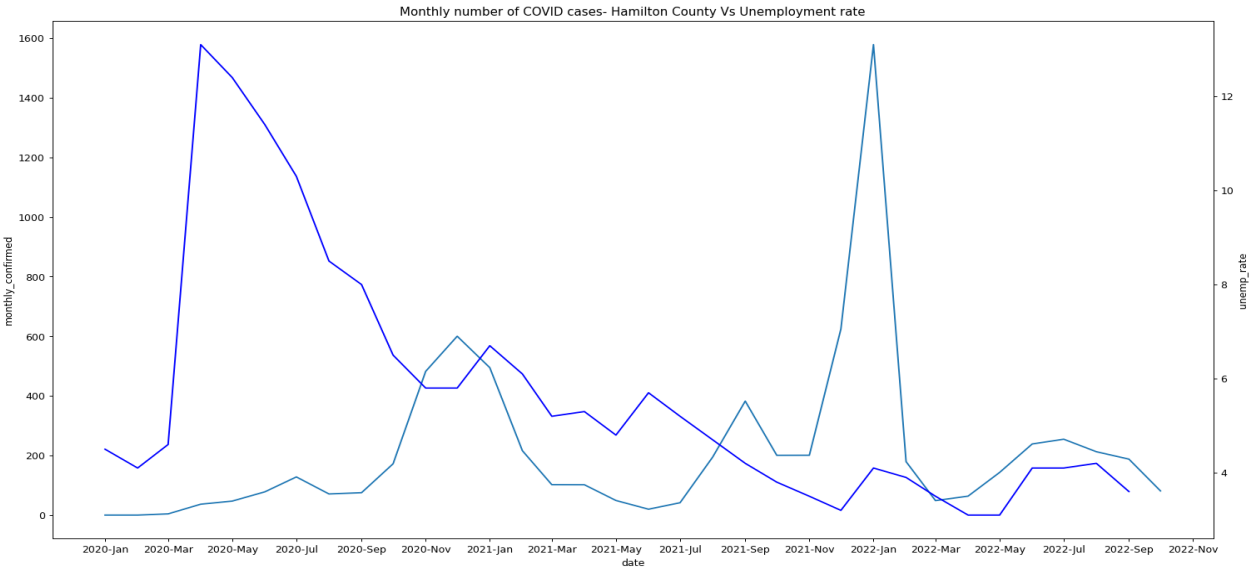


Fig. 3

In the below chart (fig. 4), I found that, until covid 19, the employment growth rate was almost constant across all sectors but after covid, some sectors were affected more than others - the leisure and hospitality sectors were impacted the most among all the sectors.

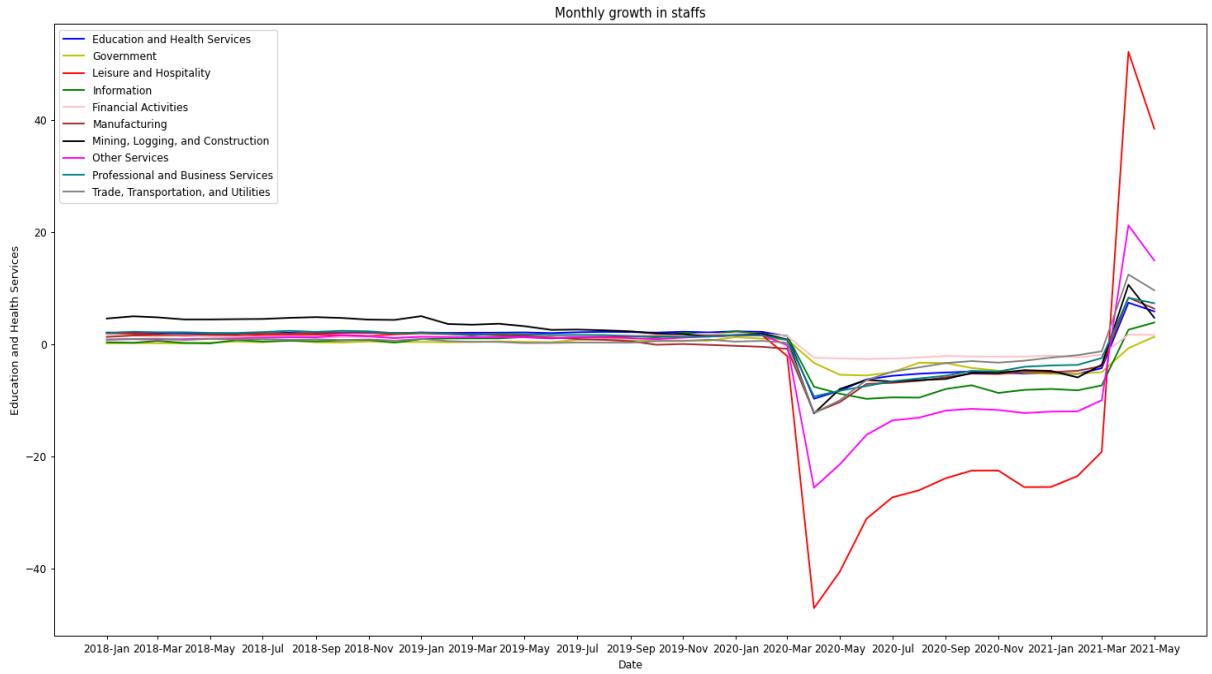


Fig. 4

Since the implementation of different policies like welfare schemes, vaccinations, mask mandates, covid relief schemes after the start of covid could impact the analysis, I restricted the analysis to just before and after the period of covid. This could show us the immediate impact of covid-19. The market hotness index decreased initially (fig.6) after the onset of covid in March 2020 which makes sense as there were lockdowns and other policies like mask mandates were in place. But then the score increased even when the cases increased after June 2021 similar to our initial theory and research. It kept increasing until Jan 2022 when the omicron variant was spreading rapidly and the cases were at an all-time peak.

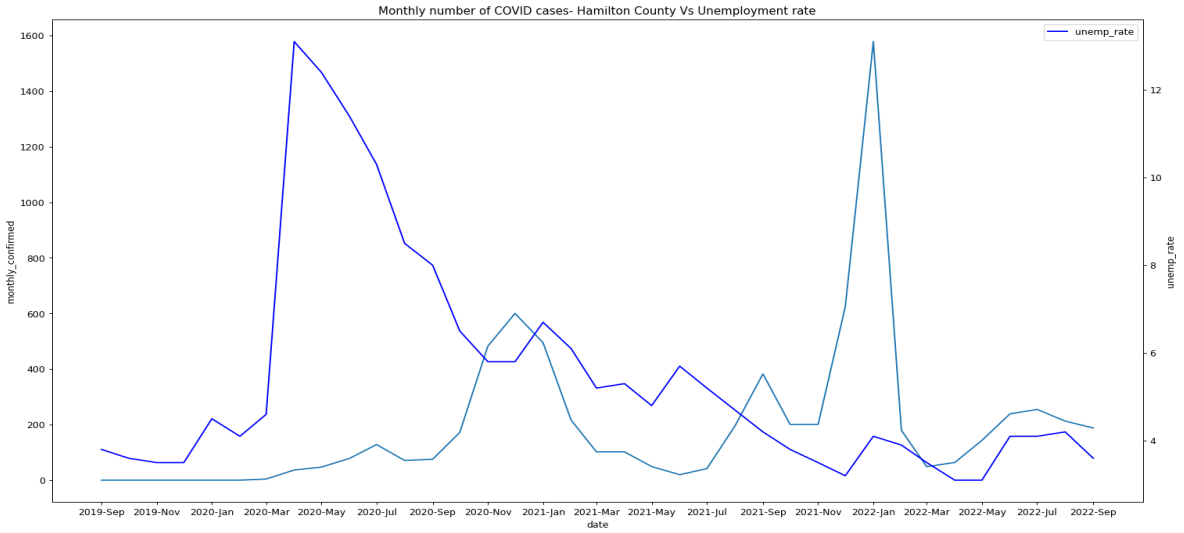


Fig. 5

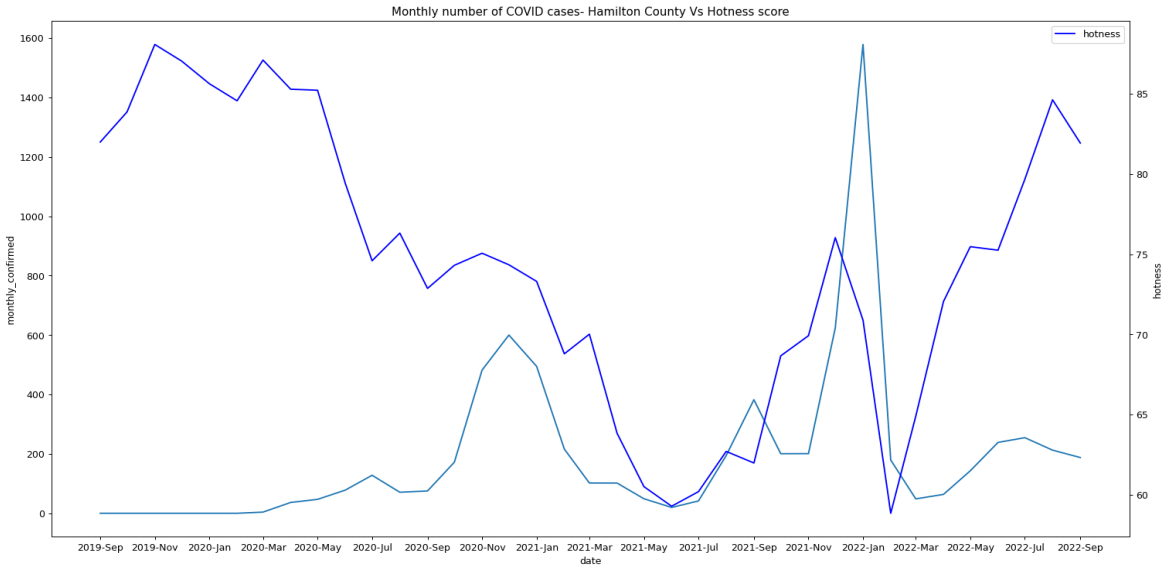


Fig. 6

Furthermore, there is no strong correlation between the unemployment rate and monthly confirmed cases or hotness score and monthly confirmed cases. The correlation is also negative for both variables which suggests that the increase in the number of covid cases led to a decrease in both the hotness score and the unemployment rate. But we know that there were lots of confounding variables in play which may lead to these opposing results to my initial theory. (fig 7).

- Pearsons correlation between the monthly number of covid cases and the unemployment rate was: -0.123

- Pearsons correlation between the monthly number of covid cases and hotness score was: -0.179

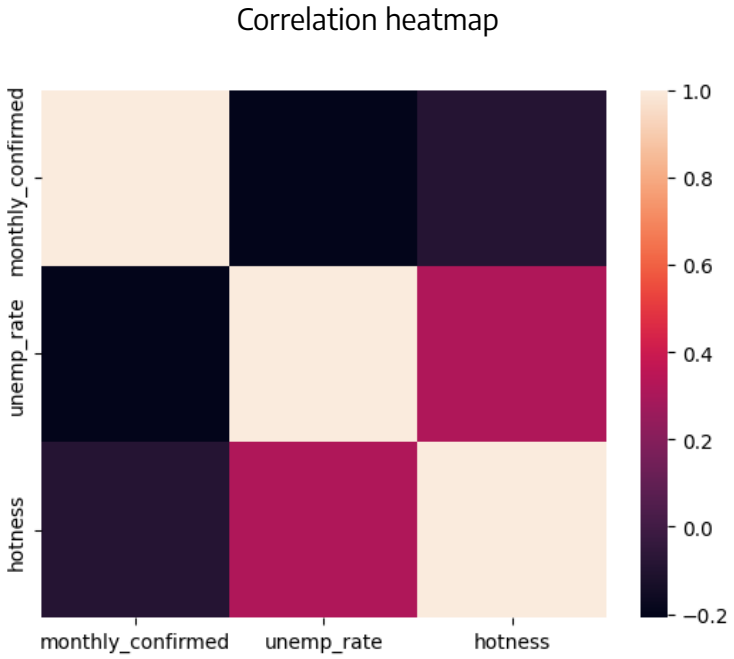


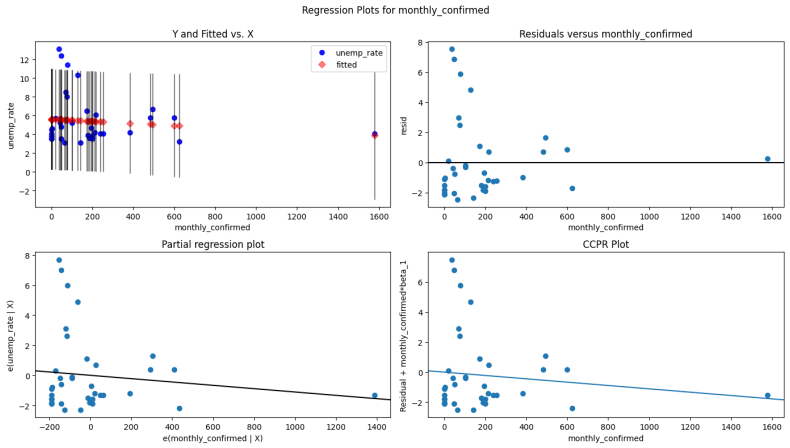
Fig. 7

For regression analysis, I used the OLS method to perform the statistical tests. The statsmodel package from python was used for the analysis. Below are the findings from the regression analysis.

Dependant variable- Unemployment rate

Independent variable- monthly confirmed cases

Here, the 'monthly_confirmed' variable is a statistically insignificant variable since the p-value is greater than .05. Hence, We cannot draw any inference about the unemployment rate from the coefficients.



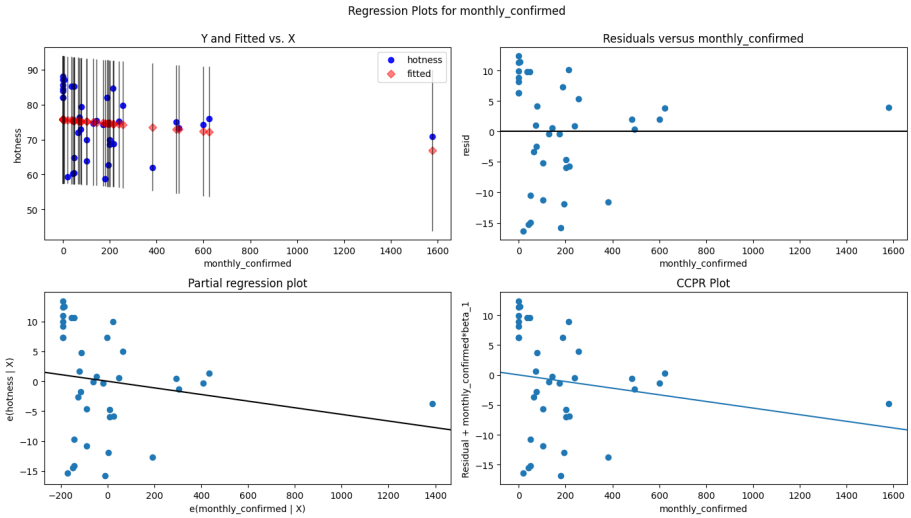
	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	5.6139	0.509	11.034	0.000	4.582	6.646
monthly_confirmed	-0.0011	0.001	-0.742	0.463	-0.004	0.002

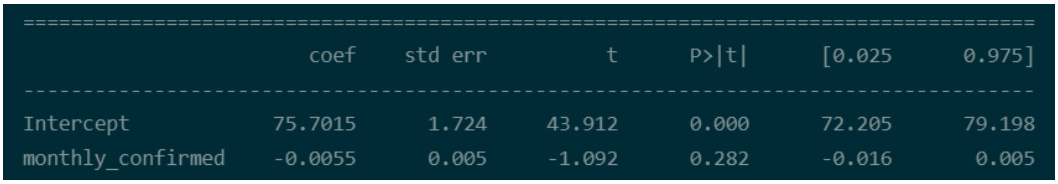
Fig. 7

Dependant variable- Hotness index

Independent variable- monthly confirmed cases

Similarly here as well the ‘monthly_confirmed’ variable is a statistically insignificant variable since the p-value is greater than .05.





	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	75.7015	1.724	43.912	0.000	72.205	79.198
monthly_confirmed	-0.0055	0.005	-1.092	0.282	-0.016	0.005

Fig. 8

Discussion/Implications

From the above analysis, we realized that the immediate impact of the covid-19 is quite visible. With the outbreak of covid-19, the unemployment rate dipped and the market hotness index plummeted as well. This observation lines up with the research in section 2, where we read about the immediate impact of covid-19 on the unemployment rate and the housing market.

However, we expected the unemployment rate to keep increasing with the increase in the number of cases. This is quite not what we observed in our analysis. The unemployment rate improved during the covid-19 period. This aligns with the article from US labor statistics[1] where it was mentioned that the unemployment rate started decreasing towards the end of the second quarter.

Also, as opposed to what was expected, the relationship between unemployment and hotness score with rising covid cases was not linear. From the Pearson correlation, we found a weak correlation between the variables. The nonlinear behavior could be because of many external factors like pharmaceutical and non-pharmaceutical interventions during covid-19.

It is clear the unemployment rate or the hotness score could not be modeled with just the confirmed cases data. Future work could build on this by using the data like vaccination rates, sanctioned covid relief funds, or new work policies data and with the addition of these new data, the dependent variables - market hotness index and the unemployment rate could be modeled.

Unemployment and the housing market are closely tied to humans as people need jobs in order to earn and survive. Many people lost jobs, and businesses were shut down while new jobs were also created. Also, owning a house is an American dream, and people were able to buy homes due to plummeting mortgage rates making many dreams come true. This analysis helped me to understand the extent to which an event like a pandemic could impact people's lives.

Limitations

The dataset for the employment growth rate was not available for Hamilton county. Hence, I used the data for Cincinnati county as a proxy in our analysis. The data used for extended analysis was available on a monthly level, while the data of US-confirmed cases was on a daily level. In order to perform the analysis, the US daily data was aggregated on a monthly level by taking the average.

Also, the impact of events like covid-19 is not always so immediate and people take time to react to such events. Covid-19 had a long-term impact on unemployment which is not evident in our analysis. Hence, even if it does seem like the unemployment rate improved after the initial soar, it doesn't rule out the fact that many businesses and people's lives were impacted due to covid. Even though many govt. policies helped in ameliorating the unemployment rate, but it still was more than the unemployment rates of the same quarter in previous years.

Also, I performed statistical tests in my analysis and one of the important assumptions were linearity. The relationship between variables was not completely linear but we assumed the relationship to be completely linear.

There are no ethical considerations while using the datasets in our analysis. While we are trying to assess the socio-economic impact of covid by analyzing the unemployment rate and market hotness score, they may not provide us the complete picture as I am not accounting here impacts like the financial burden due to medical expenses, and the impact on mental health affecting the work.

Also, we know that in such events, there are particular sections of society that are more vulnerable than others. When we say, people bought houses due to the plummeting mortgage rate, there were also people who lost houses or had to sell them to meet their needs. When the unemployment rate improved, people working in IT sectors were not affected much since the new remote work policies facilitated the running of the sector. On the other hand, people working as delivery persons or people working in the manufacturing or leisure sector took a hit.

Conclusion

- The unemployment rate peaked with the onset of the covid-19 but the trend changed during the covid which could be due to many external factors which are beyond the scope of the project to assess.
- But the impact was clearly visible when we performed trend analysis on a period just before and after the covid-19 start. The unemployment rate was impacted differently in different economic sectors. The most impacted sector was leisure and hospitality but it is also the one that boomed the most after the situation improved.
- The market hotness index decreased with the onset of covid-19 as the market reacted and many restrictions were put into place. But during the period of covid-19, the hotness index improved which is due to a decrease in the mortgage rate.
- The analysis led to a better understanding of the immediate and long-term socio-economic impact of the pandemic.

References

[1]https://www.bls.gov/opub/mlr/2021/article/unemployment-rises-in-2020-as-the-country-battles-the-covid-19-pandemic.htm#:~:text=Total%20civilian%20employment%2C%20as%20measured,3.6%20percent%20to%2013.0%20percent

[2] https://www.bankrate.com/real-estate/covid-impact-on-the-housing-market/#process

[3]https://www2.census.gov/library/publications/2022/economics/coronavirus-pandemics-economic-impact.pdf.

[4]https://www.vox.com/22264268/covid-19-housing-insecurity-housing-prices-mortgage-rates-pandemic-zoning-supply-demand.