

Data Science and Analytics

Documentation

Seven Springs, PA

2022

TEAM 2214-014

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1. Introduction

In December 2019, scientists detected the first known cases of COVID-19 in Wuhan, China. Within a few months, the COVID-19 virus had spiraled into a global pandemic, creating an unprecedented international public health crisis. In the United States, the pandemic has affected everyone in one way or another, but its effects differ among various racial and ethnic groups.

According to Cowger et al. (2020), Black and Hispanic people are more likely to live in the high-density, urban locations that were hit hardest by the virus in the first few months of the pandemic. McLaren (2020) further points out that a disproportionately high number of Black and Native American people use public transit, which is associated with higher COVID-19 contraction rates. As a direct result of disparities in income, access to healthcare, education quality, and housing, along with historical and systematic disenfranchisement, some racial and ethnic groups run a higher risk of contracting and dying from COVID-19 (Bauer et al. 2020).

COVID-19 and the subsequent shutdown has also led to an economic crisis in the United States. In April 2020, unemployment claims numbered a record-breaking 175,000, thrice as much as the number of new unemployment claims during the Great Recession of 2009 (Gulyas and Pytka, 2020). While the pandemic has clearly affected the entire workforce in the US labor market, COVID-19 has had a greater impact on women, non-white workers, lower-wage earners, and those with less education (Bauer et al., 2020). As shown in Stevenson (2020), during a period of job growth in December 2019, women held more nonfarm payroll jobs than men for the first time ever. However, by May 2020, men once again held more of that type of job, partially reflecting the job losses in the leisure and hospitality industry, where women account for 53 percent of workers.

2. Research Purpose

In observing these social and economic disparities in the context of the COVID-19 pandemic, we aim to examine how the COVID-19 pandemic affects the unemployment rates of disadvantaged groups of workers in the US labor market. Since researchers detected the first strain in December 2019, the COVID-19 pandemic has disrupted households, business sectors, industries, and economies on a global scale. In an attempt to mitigate the spread, many countries instituted safety policies such as stay-at-home orders and social distancing protocols, causing many businesses to halt operations for an extended time period or face closure altogether. As a result, an unprecedented number of individuals were left unemployed. Safety policies furthermore mandated many people to isolate at home, and working parents had to deal with new childcare responsibilities as schools and daycares closed. The unprecedented nature of this pandemic and its unevenly distributed impacts on the US labor market thus prompts the question: which population demographic has the economic decline affected the most, and to what extent?

We hypothesize that historically disadvantaged groups of workers such as women, people of color, minorities, and workers with low education and/or income levels are more likely to lose their jobs and become unemployed, as compared to other groups. To verify our hypothesis, we conduct a series of quantitative analyses by first collecting data from the Federal Reserve Economic Data and Current Population Survey (CPS), which is the primary source of labor force statistics for the population of the United States. After cleaning up, organizing, and analyzing the collected data, we go further by investigating and comparing how unemployment rates of disadvantaged workers, classified by their demographic characteristics, change from the pre-COVID-19 to COVID-19 time period.

Much of the growing literature focuses on the impacts of the pandemic-induced recession on unemployment. This research contributes to broadening the scope of this field of literature by investigating the unemployment status of disadvantaged workers in the US labor market, which will continue to create severe disruptions to the US economy for years to come. In addition, this project takes focus on an already prevalent issue, regarding inequalities of sex, race, education, and income in employment opportunities; we provide further aid to socio-economically disadvantaged minority workers with inadequate access to various resources.

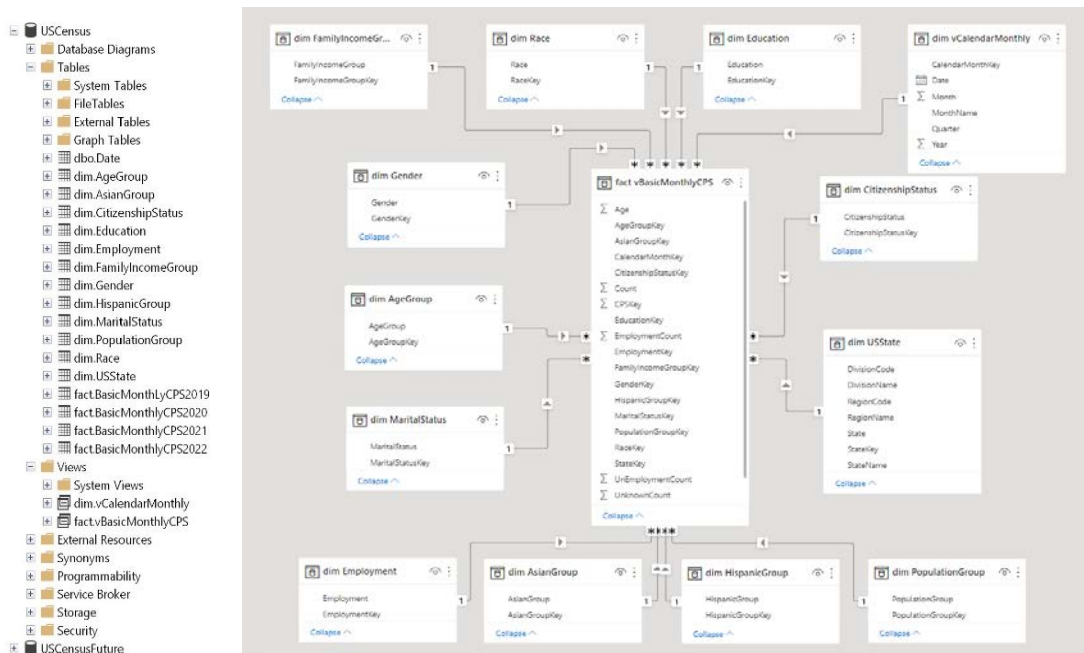
3. Methods

To study the impact of COVID-19 on the unemployment rates of disadvantaged groups of workers in the US labor market, we conduct a series of quantitative analyses based on data from January of 2019 to February of 2022, collected from the Federal Reserve Bank of Saint Louis and Current Population Survey (CPS) provided by US Census Bureau. In total, we collected 38 monthly data sets and 4 data dictionary files. We mainly focused on the US population aged between 16 and 67, the primary working age for adults, and analyzed the data related to labor force status, gender, race, age, education, marital status, citizenship status, location, and income levels.

A relational database with multi-dimensional model was designed on MS SQL Server to clean, import, store, and query data. The monthly CPS datasets that contained a total of 5,070,612 rows and 388 columns from 38 CSV files were imported to 4 yearly fact tables. Based on the data dictionary provided by the Bureau of US Census, 12 subjects were selected to generate 12 dimensional tables. Out of the 12 subjects, Race, Education, Age, Family Income, Marital Status, and Citizenship Status were re-grouped with fewer categories than those in the data dictionary. An additional view was populated as the time dimension by SQL scripts. Then a view was also created to combine the data from 4 yearly fact tables with 12 selected columns corresponding to the primary key in 12 dimensional tables. All 'null' values or unmatched key values from the fact tables were converted to '-1' which represents the additional 'Unknown' group pre-created in each dimension table.

Microsoft Power BI Desktop was then connected to the database as an interactive analysis and visualization tool to analyze the collected data. The following snapshot displays the structure of the database along with the multi-dimensional model displaying the one-to-many relationship between the dimensional and fact tables.

Snapshot: The Database Structure and Multi-dimensional Model



4. Results

4.1 Trends of Unemployment Rate in the United States

Figure 1. Historical Unemployment Rate Since 1950

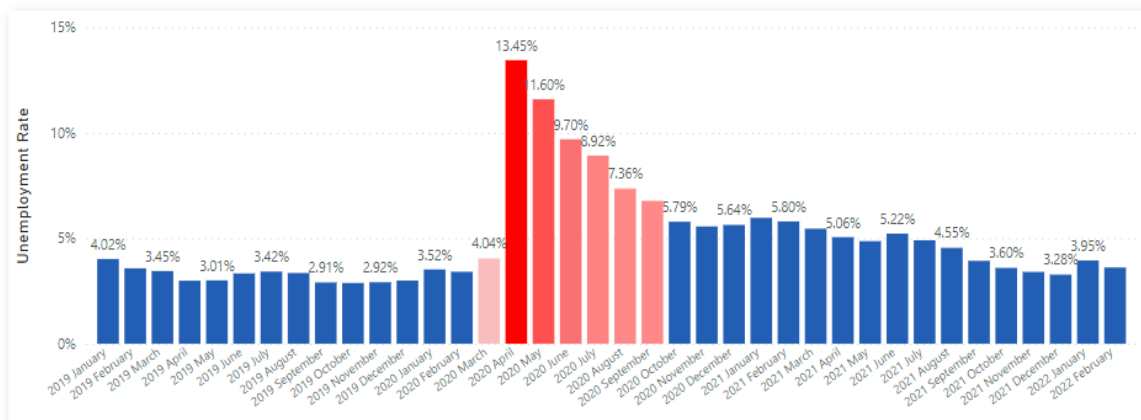


Source: Using data from the Federal Reserve Bank of Saint Louis at <https://fred.stlouisfed.org/series/UNRATE>. The shaded areas represent economic recessions in the US history since 1950.

As Figure 1 shows, when an economic recession takes place, the unemployment rate tends to increase. During the most recent recession from February to April 2020, caused by the COVID-19 pandemic, there was an unprecedented increase in the US unemployment rate. Particularly, the unemployment rate reached an abrupt and extraordinary record at 14.8% in April 2020, which lends strong support that the COVID-19 pandemic has generated a significant impact on unemployment rate.

More clearly, Figure 2 illustrates that based on our sampled population aged between 16 and 67, the unemployment rate rose from 3.41% in February 2020 to 4.04% in March 2020 and peaked at a high of 13.45% in April 2020. The unemployment rate gradually fell to 5.79% by October 2020 and returned to 3.60% in October 2021, which was the rate of unemployment before the pandemic.

Figure 2. The Average Unemployment Rate for Workers Aged 16-67
(Seasonally Adjusted, Monthly, January 2019 to February 2022)

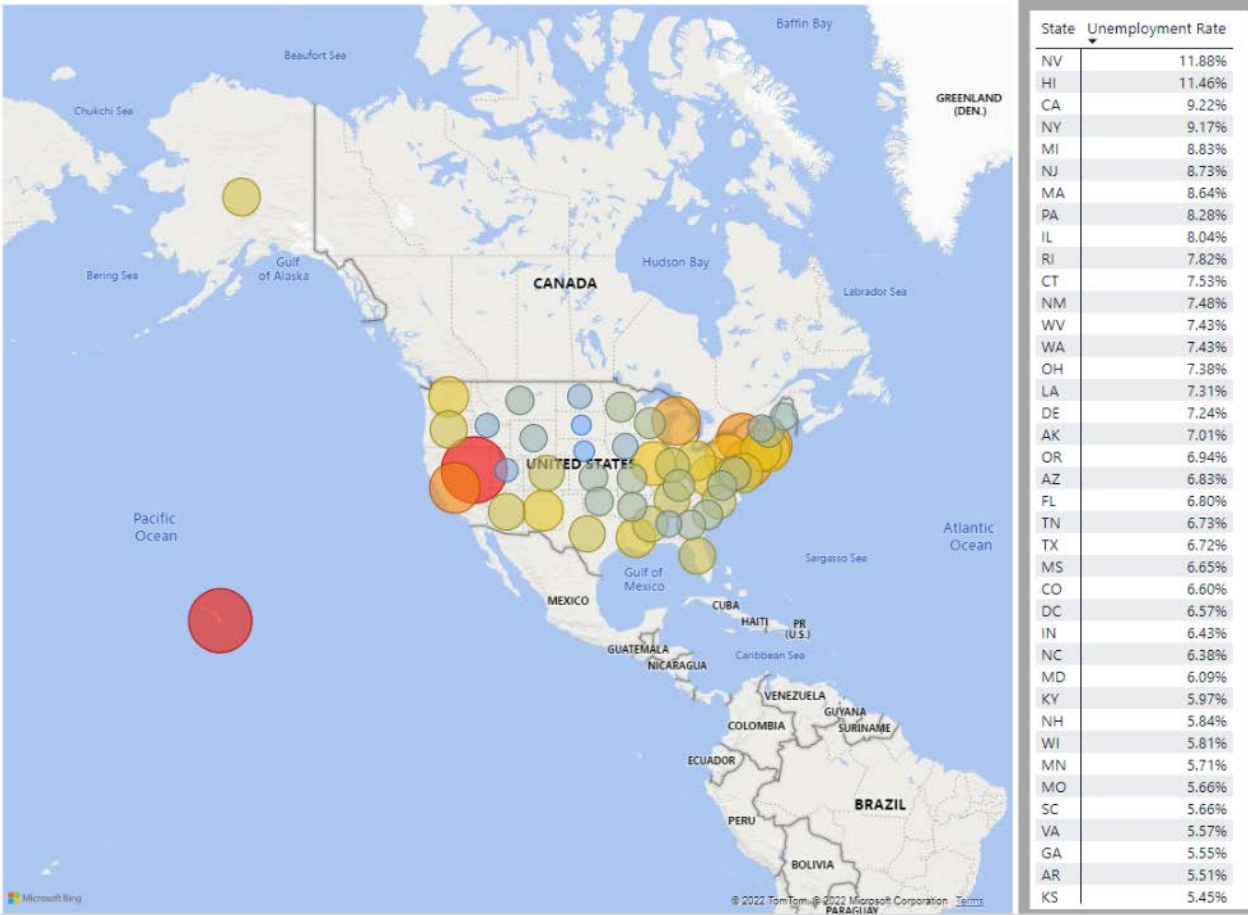


Source: Data collected from Monthly Current Population Surveys by US Census from January 2019 to February 2022.

Below, we will analyze how unemployment rates vary over time by location, gender, race, education, income, and age, with particular attention given to the year of 2020, the most tumultuous year during the COVID-19 period.

4.1.1 Unemployment Rates by State

Figure 3. Unemployment Rates by State
(January 2020 to December 2020)



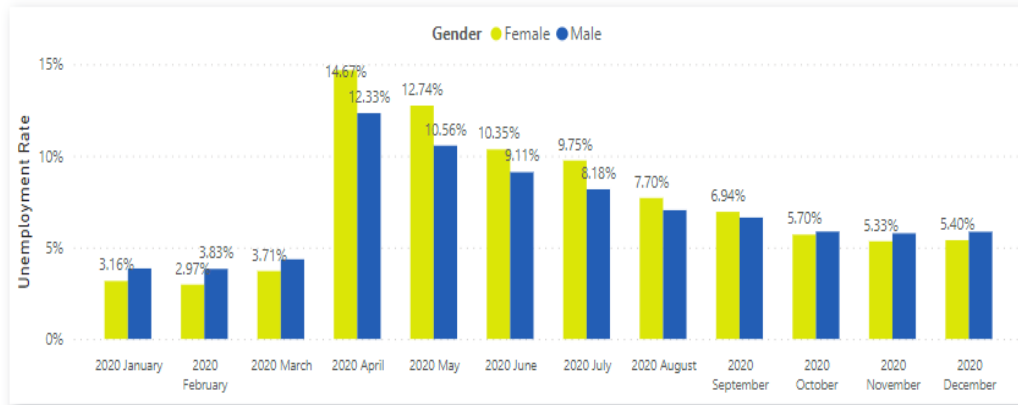
Source: Data collected from Monthly Current Population Surveys by US Census from January 2019 to February 2022.

The unemployment rates of every state in the US increased during the early period of the pandemic, especially in states with a higher proportion of jobs in non-essential service sectors with higher-risk exposure to COVID-19, such as the entertainment, tourism, and catering industries. For all states, their unemployment rates climbed to the peak in April 2020 and have since declined.

Figure 3 displays that states with the highest unemployment rates in 2020 were Nevada (11.88%), Hawaii (11.46%), California (9.2%), New York (9.17%) and Michigan (8.83%). The states with lowest unemployment rates in 2020 were South Dakota (3.97%), Nebraska (4.08%), Utah (4.54%), Idaho (4.67%) and Iowa (4.93%).

4.1.2 Unemployment Rates by Gender

Figure 4. Monthly Unemployment Rate by Gender
(January 2020 to December 2020)

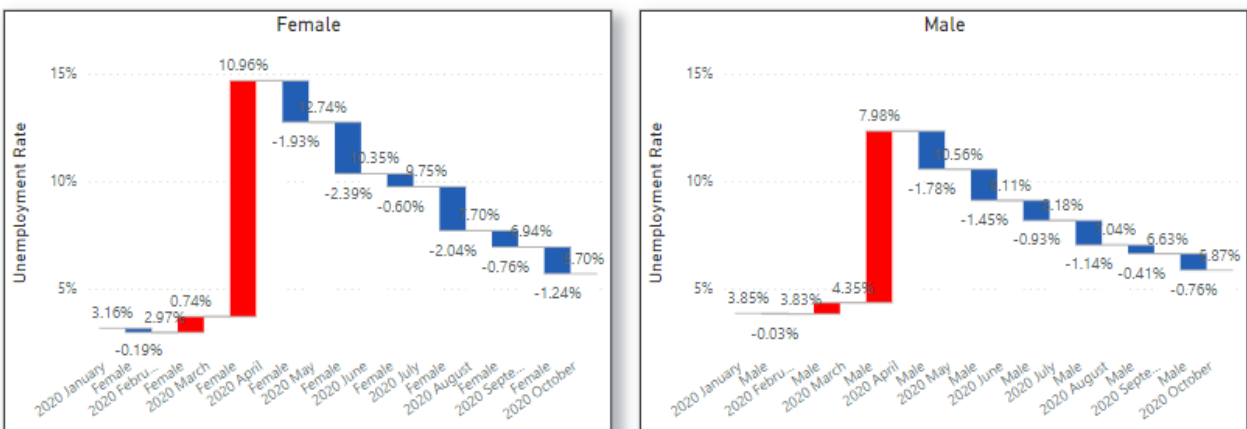


Source: Data collected from Monthly Current Population Surveys by US Census from January 2019 to February 2022.

As seen in Figure 4, female workers overall experienced a higher unemployment rate (that peaked at 14.67% in April 2020) than male workers (whose unemployment rate peaked at 12.33% in April 2020) during the Pandemic.

In contrast, as shown below, Figure 5 displays that females tended to return to work faster than males after April 2020. The change in unemployment rate from March 2020 to April 2020 for female workers (10.96%) was higher than that for male workers (7.98%). From May 2020 to October 2020, the recovery rate for female employment was higher than for male employment in every month except July 2020, which was slightly slower.

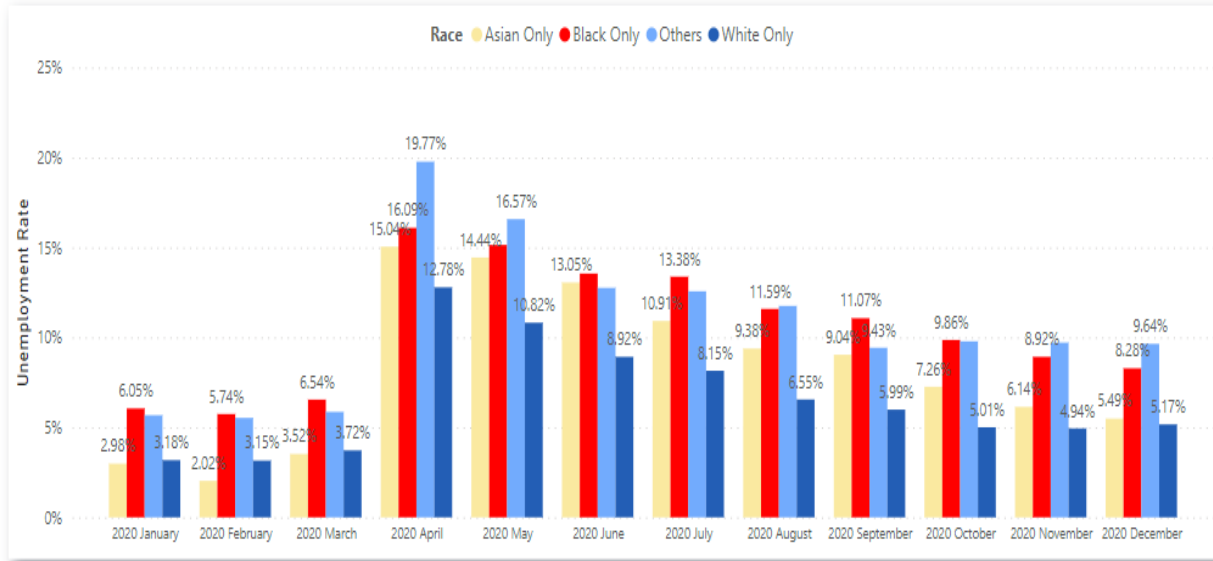
Figure 5. Month-to-Month Changes in Unemployment Rate by Gender
(January 2020 to October 2020)



Source: Data collected from Monthly Current Population Survey by US Census from January 2019 to February 2022.

4.1.3 Unemployment Rates by Race

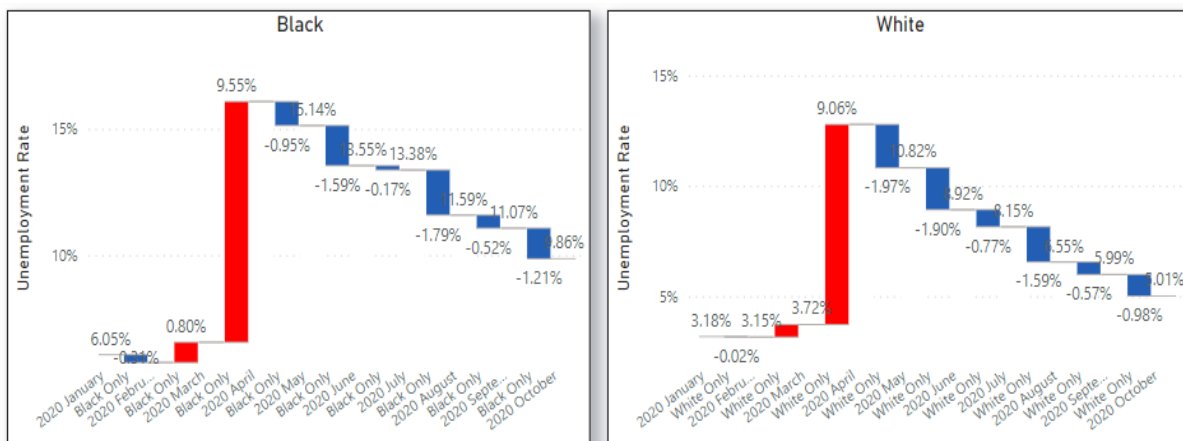
Figure 6. Monthly Unemployment Rates by Racial Group
(January 2020 to December 2020)

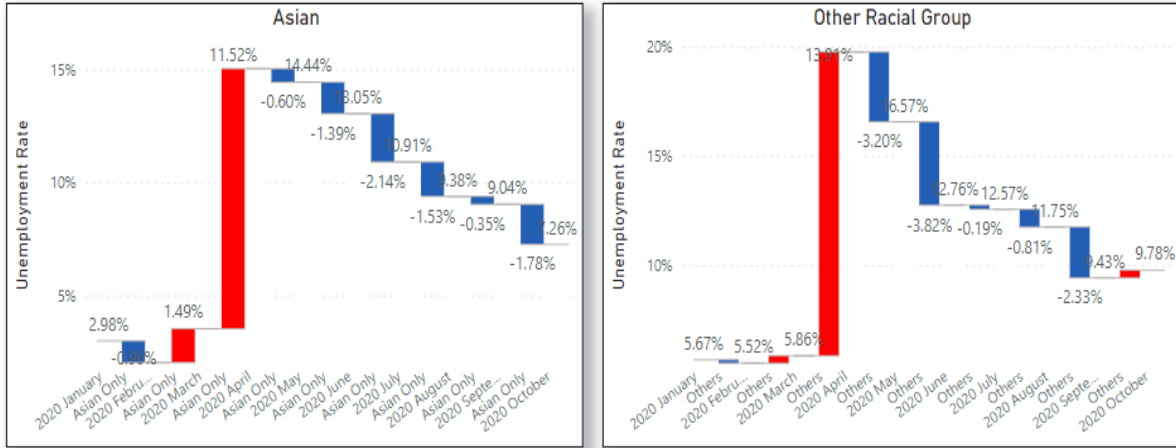


Source: Data collected from Monthly Current Population Survey by US Census from January 2019 to February 2022.
Note: Races were regrouped from the original groups in the Data Dictionary. All races including American Indians, Natives and 2 or more race combinations have been regrouped to the group of 'Others'.

Figure 6 compares the monthly unemployment rates for Blacks, Asians, Whites, and Others before and during the pandemic from January 2020 to October 2020. All groups suffered a sharp increase in unemployment rate in April 2020, where Other Racial Group jumped to 19.77%; Blacks, 16.095%; Asians, 15.04%; and Whites, 12.78%.

Figure 7. Month-to-Month Changes in Unemployment Rate by Racial Group
(January 2020 to October 2020)

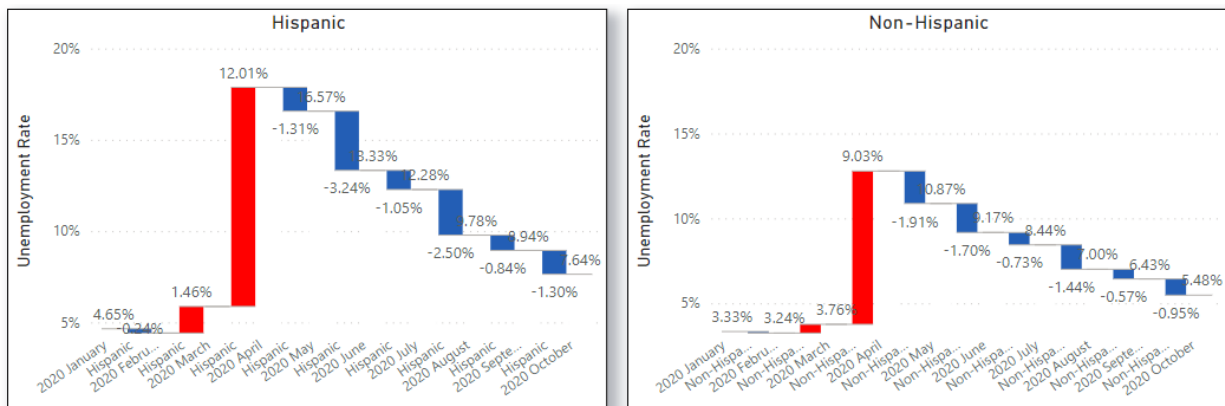




Source: Data collected from Monthly Current Population Survey by US Census from January 2019 to February 2022.
 Note: Races were regrouped from the original groups in the Data Dictionary. All races including American Indians, Natives and 2 or more race combinations have been regrouped to the group of 'Others'.

Figure 7 further reveals that the Other Racial Group had the largest increase in unemployment rate (13.91%) from March 2020 to April 2020. Asians had the second largest increase (11.52%); Blacks had 9.55%, a little bit higher than the unemployment increase that Whites experienced (9.06%) from March 2020 to April 2020.

Figure 8. Month-to-Month Changes in Unemployment Rate by Hispanic Ethnicity (January 2020 to October 2020)

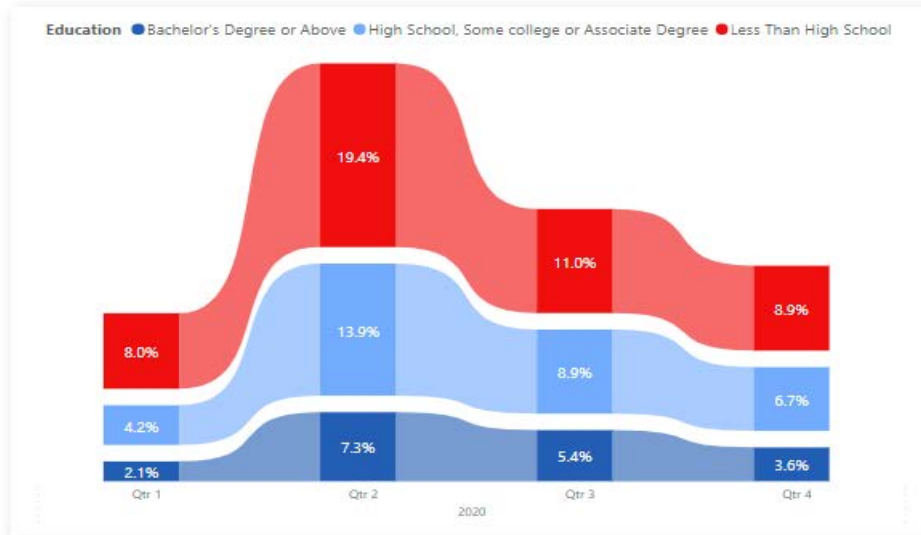


Source: Data collected from Monthly Current Population Survey by US Census from January 2019 to February 2022.

The CPS data also splits the surveyed population into two groups: Hispanic vs. Non-Hispanic. Figure 8 shows that the unemployment rate change from March 2020 to April 2020 for Hispanic workers was significantly higher than for Non-Hispanic workers (12.01% vs. 9.03%), while the recovery rate of employment for Hispanic workers was much lower than for Non-Hispanic workers in May 2020 (1.31% vs 1.91%).

4.1.4 Unemployment Rates by Education

Figure 9. Quarterly Unemployment Rates by Education
(Quarters 1 to 4, 2020)



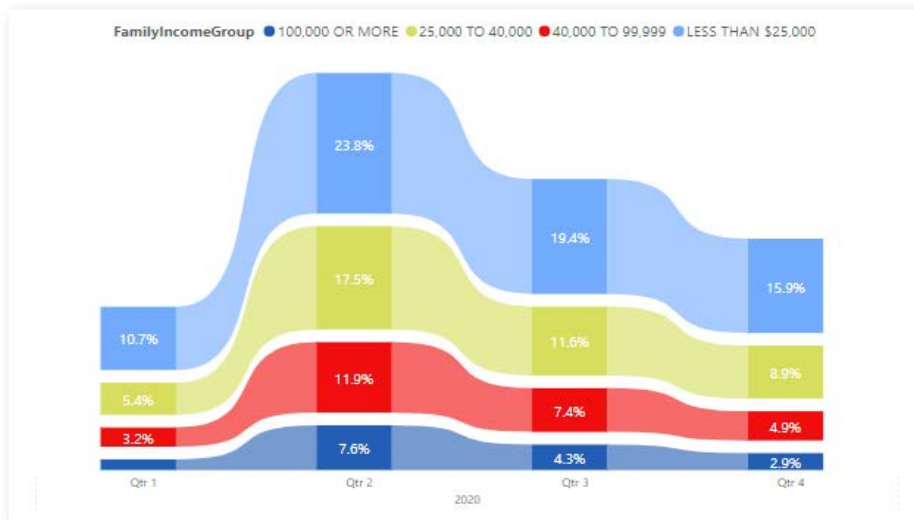
Source: Data collected from Monthly Current Population Survey by US Census from January 2019 to February 2022.

The analysis on education, family income, and age also indicates that disadvantaged workers had a higher unemployment rate during the pandemic period.

As seen in Figure 9, in the second quarter of 2020, the education group with Less Than High School had a much higher unemployment rate (19.4%) than the other two groups, while the group of Bachelor's Degree or Above had the lowest unemployment rate (7.3%).

4.1.6 Unemployment Rates by Family Income

Figure 10. Quarterly Unemployment Rates by Family Income
(Quarters 1 to 4, 2020)

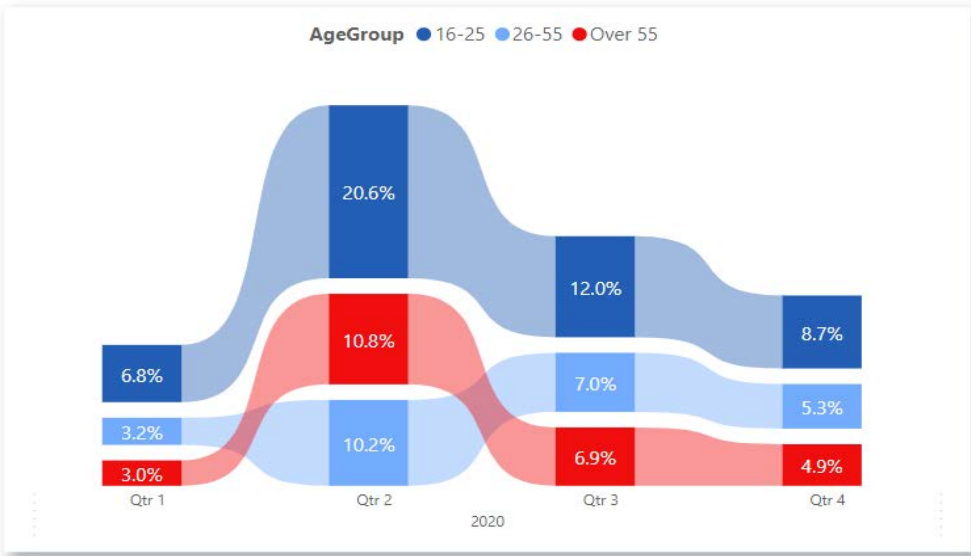


Source: Data collected from Monthly Current Population Survey by US Census from January 2019 to February 2022.

Figure 10 illustrates that workers with lower family income had higher unemployment rates in the pandemic, relative to other groups. Furthermore, in the second quarter of 2020, families with income Less than \$25,000 (below the poverty line) had the highest unemployment rate (23.8%) and families with the income of \$100,000 or More had the lowest unemployment rate (7.6%).

4.1.7 Unemployment Rates by Age

Figure 11. Quarterly Unemployment Rate by Age Group
(Quarter 1 to 4, 2020)



Source: Data collected from Monthly Current Population Survey by US Census from January 2019 to February 2022.

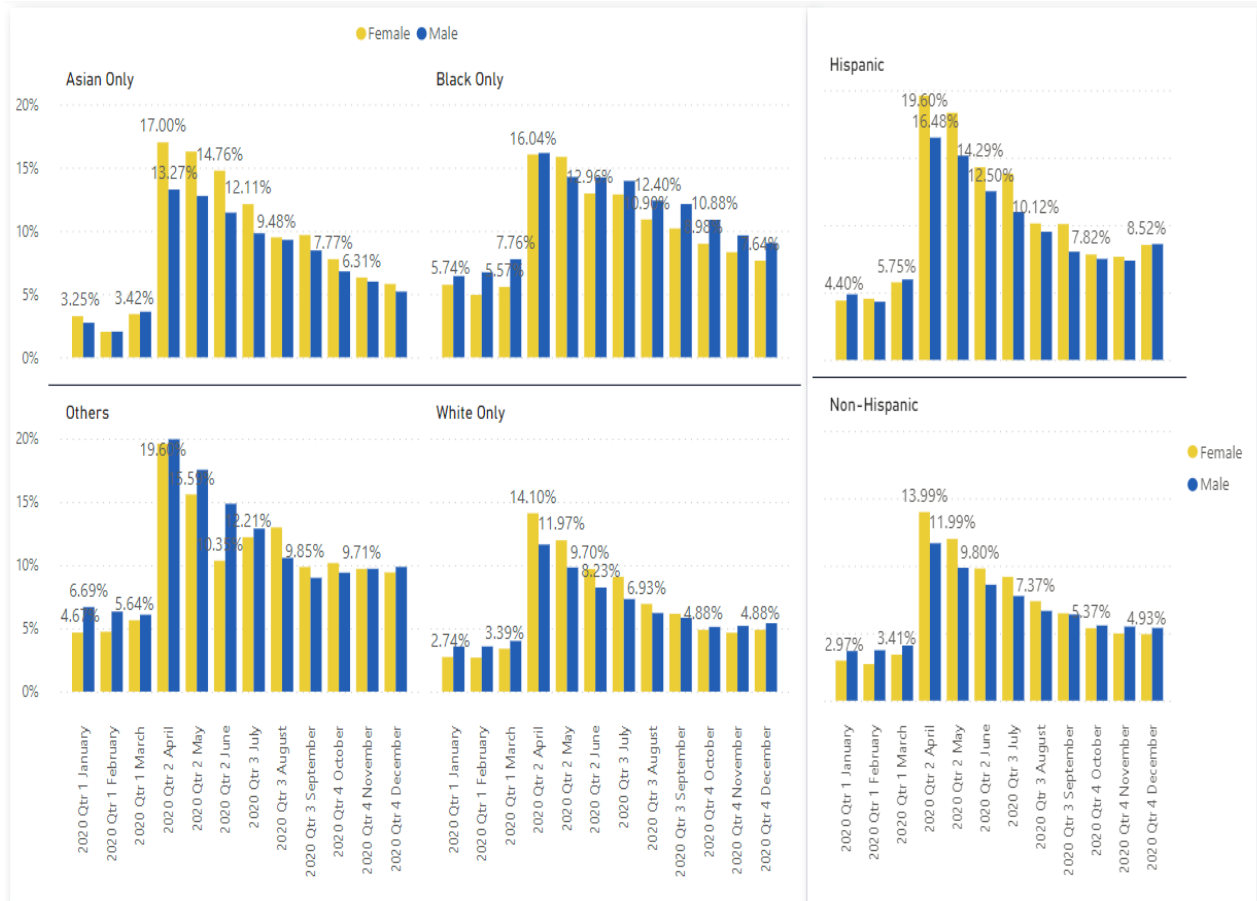
Figure 11 demonstrates that workers in the age group (16-25) suffered from the highest unemployment rate at 20.6%, as compared to workers in other two age groups (26-55 and Over 55) with quarterly unemployment rates at 10.2% and 20.6%, respectively in the second quarter of 2020. After the peak, workers in the group of Over 55 had the lowest unemployment rate starting from the third quarter of 2020.

4.2 Disadvantage Workers by Gender, Race, Education, and Income

Below, we study how unemployment rates differ across various disadvantaged groups of workers classified by gender, race, education, and income.

4.2.1 Unemployment Rates for Disadvantaged Workers by Gender and Race

Figure 12. Unemployment Rates for Female and Male Workers of Color
(January 2020 to December 2020)

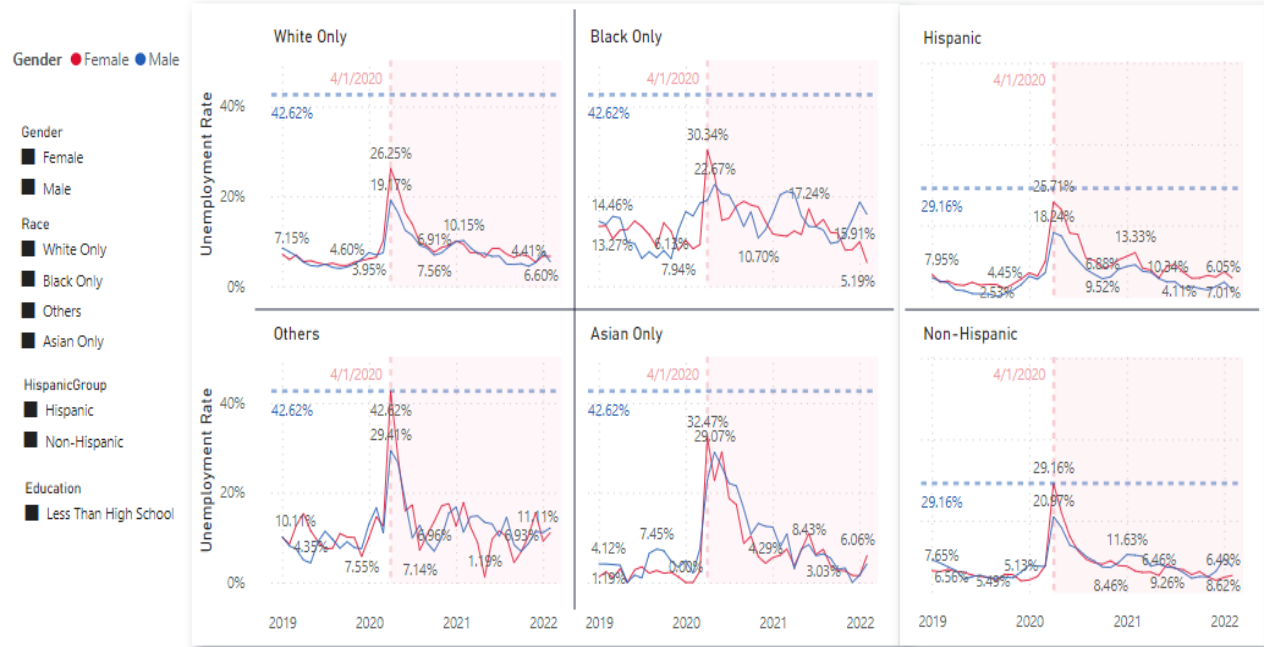


Source: Data collected from Monthly Current Population Surveys by US Census from January 2019 to February 2022.

Comparing all the unemployment rates of 2020 in Figure 12, we find that, prior to April 2020, the unemployment rates for all females and males were quite normal without any significant difference between them. Among all females and males, Black females had the highest unemployment rate at around 6%. From April to December 2020, female workers of color tended to have higher unemployment rates than male workers of color. The unemployment rates increased sharply in April 2020 with 19.6% for Hispanic females and females of other minorities, 17% for Asian females, 16.04% for Black females, and 14.10% for white females.

4.2.2 Unemployment Rates for Disadvantaged Workers by Gender, Race, and Education

Figure 13. Unemployment Rates for Disadvantaged Female and Male Workers of Color with Low Education



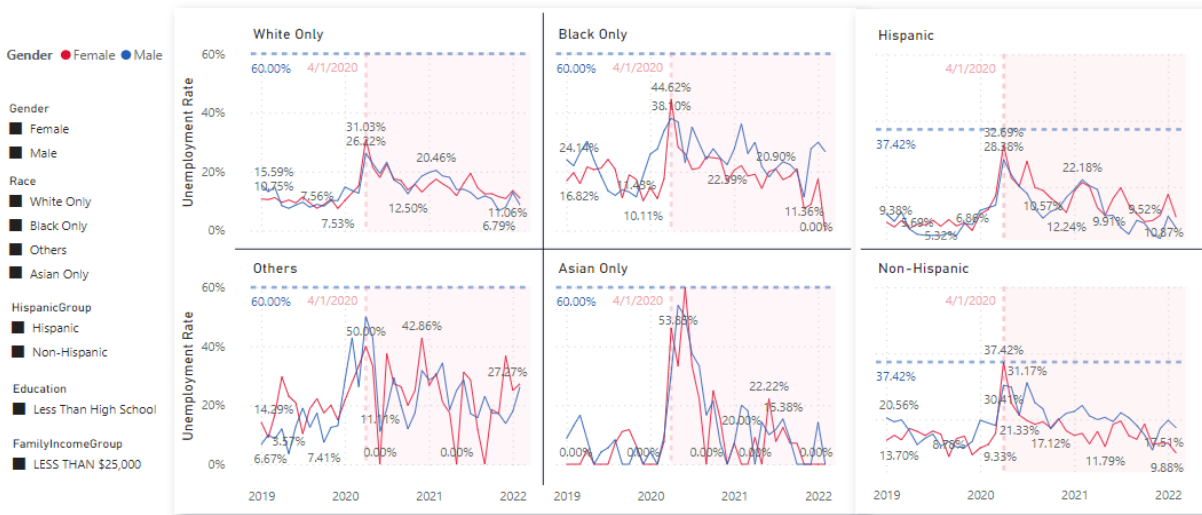
Source: Data collected from Monthly Current Population Surveys by US Census from January 2019 to February 2022.

Note: the red line traces the trend of unemployment rate for females while the blue line shows the trend of unemployment rate for males

When factoring in educational attainment, unemployment rates for females and males that do not have a high school diploma continued to rise during the entire sampled time period (2019-2022). In Figure 13, the rate for female workers of color grew even higher, as compared with male counterparts with the same attributes. Before April 2020, females of color without a high school diploma had already had very high unemployment rates. In particular, the average unemployment rate for black females with low education levels was above 10%, the highest unemployment rate in the figure. During the pandemic, the unemployment rates for females of color with low education rose higher. Specifically, the unemployment rate for other female minorities of low education peaked at 42.62% in April 2020, as compared with other male minorities with the same education level (29.4%). For Asian and black females of low education, their unemployment rates peaked at 32.34% and 30.34%, respectively. In contrast, Hispanic females with low education had a relatively lower unemployment rate at 26.7% in April 2020.

4.2.2 Unemployment Rates for Disadvantaged Workers by Gender, Race, Education, and Income

Figure 14. Unemployment Rates for Disadvantaged Female and Male Workers of Color with Low Education and Income



Source: Data collected from Monthly Current Population Surveys by US Census from January 2019 to February 2022.
 Note: the red line traces the trend of unemployment rate for females while the blue line shows the trend of unemployment rate for males

In Figure 14, we compare workers of different races with low-education and low-income levels (below the poverty line of \$25,000) to understand how their unemployment status differs between the Pre-COVID-19 and COVID-19 period. It turns out that regardless of gender, workers of color with both low education and income levels tended to have higher unemployment probabilities than workers with low education level during the pandemic. Obviously, when more negative factors kick in, workers become more disadvantaged, and it is easier for them to lose their jobs during the pandemic.

As for Asian, Hispanic, and other minority workers, we find that females overall had higher unemployment rates than males during the COVID-19 pandemic. In addition, the unemployment rates for females and males with low education and income levels were higher than those of other groups of the same race with higher education and income levels during the COVID-19 pandemic. Interestingly, female workers of other minorities and female blacks tended to have lower unemployment rates than their male counterparts during the COVID-19 pandemic. The possible explanation is that during COVID-19, Black and Hispanic males were more likely to lose their jobs than before, forcing their spouses/partners to join or return to the labor force and make every effort to keep their jobs in order to maintain their living standards.

Among all different workers of color, Asians with low education and income levels display the highest change in unemployment rate from the pre-COVID to COVID-19 period. In April 2020, the unemployment rate jumped to 53.85% for female Asians of low education and income levels. This result suggests that Asian workers of low education and income had experienced the highest surge in unemployment during the Pandemic because they primarily worked for service industries with higher-risk exposure to COVID-19, such as jobs in restaurants, laundry, and hotels. Hence, these striking unemployment figures reflect the precariousness of many Asian low-income workers against the coronavirus and their job vulnerability due to the COVID shutdown.

5. Conclusion

In this study, we investigated how the unemployment rates of disadvantaged groups of workers classified by their gender, race, education, and income differ from the pre-COVID-19 to the COVID-19 time period. Our findings reveal that female minorities were more likely to be unemployed than male minorities during the COVID-19 period. The unemployment rates were also higher for disadvantaged workers who had low levels of education and income. In particular, among these disadvantaged workers with low education and income levels, Asian workers experienced the highest change in unemployment from the Pre-COVID to COVID-19 period, relative to Blacks, Hispanics, and other minorities due to the pandemic recession.

These findings have policy implications that can help mitigate unemployment vulnerability for disadvantaged workers. Policies favoring increased telecommuting and working from home should be implemented to encourage females to stay in the labor force, allowing for flexibility and more time for childcare. Implementing vaccination mandates and increased safety measures to mitigate the threat of exposure to the virus may incentivize and bring disadvantaged workers back into the labor force, especially those who are more likely to work in industries with a higher-than-average exposure to the virus. Furthermore, policy makers ought to reduce and eliminate structural disparities in education, income, and wealth to avoid segregation based on racial and ethnic membership and class in order to achieve social cohesion and economic equity.

6. Next Steps

While our research provides a good basis for the impacts of the COVID-19 pandemic on unemployment, it requires further research to analyze how the pandemic continues to influence the labor market choices of disadvantaged workers, especially as vaccinations become more widely available and in-person activities return to normal. In addition, further research is required to analyze how other potential factors explain the employment choices of disadvantaged workers, such as immigration, occupation, and age. As our analytic sample is restricted to working age U.S. citizens, future research is also needed to analyze how generalizable our results are to the entire population and verify how robust our results are by studying more of population demographics.

7. References

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Unemployment Rates of Disadvantaged Workers in the US Labor Market During the COVID-19 Pandemic

2214-014

Seven Springs, PA

Introduction

Since December 2019, when COVID-19 was first detected, the pandemic has created a public health crisis and an economic crisis in the United States. It has affected all workers in the US labor market, but its effects differ among various racial and ethnic groups.

The unprecedented nature of this pandemic and its unevenly distributed impacts on the US labor market prompt the question: which population demographic has the economic decline affected the most, and to what extent?

This research project contributes to broadening the scope of unemployment-related literature by investigating the unemployment rates of disadvantaged workers in the US labor market, which will continue to create severe disruptions to the US economy for years to come.

This project takes focus on inequalities of sex, race, education, and income in employment opportunities; by conducting this research, we aim to provide further aid to socio-economically disadvantaged minority workers with inadequate access to various resources.

Purpose

This research aims to examine and compare differences in the unemployment rates of disadvantaged groups of workers in the US labor market before and during the COVID-19 Pandemic.

To achieve this purpose, we conduct a series of quantitative analyses based on the data collected from the Federal Reserve Bank of Saint Louis and Bureau of the US Census. After cleaning and analyzing the collected data, we further investigate how unemployment rates of disadvantaged workers, classified by their demographic characteristics, change from the pre-COVID-19 to COVID-19 time period.

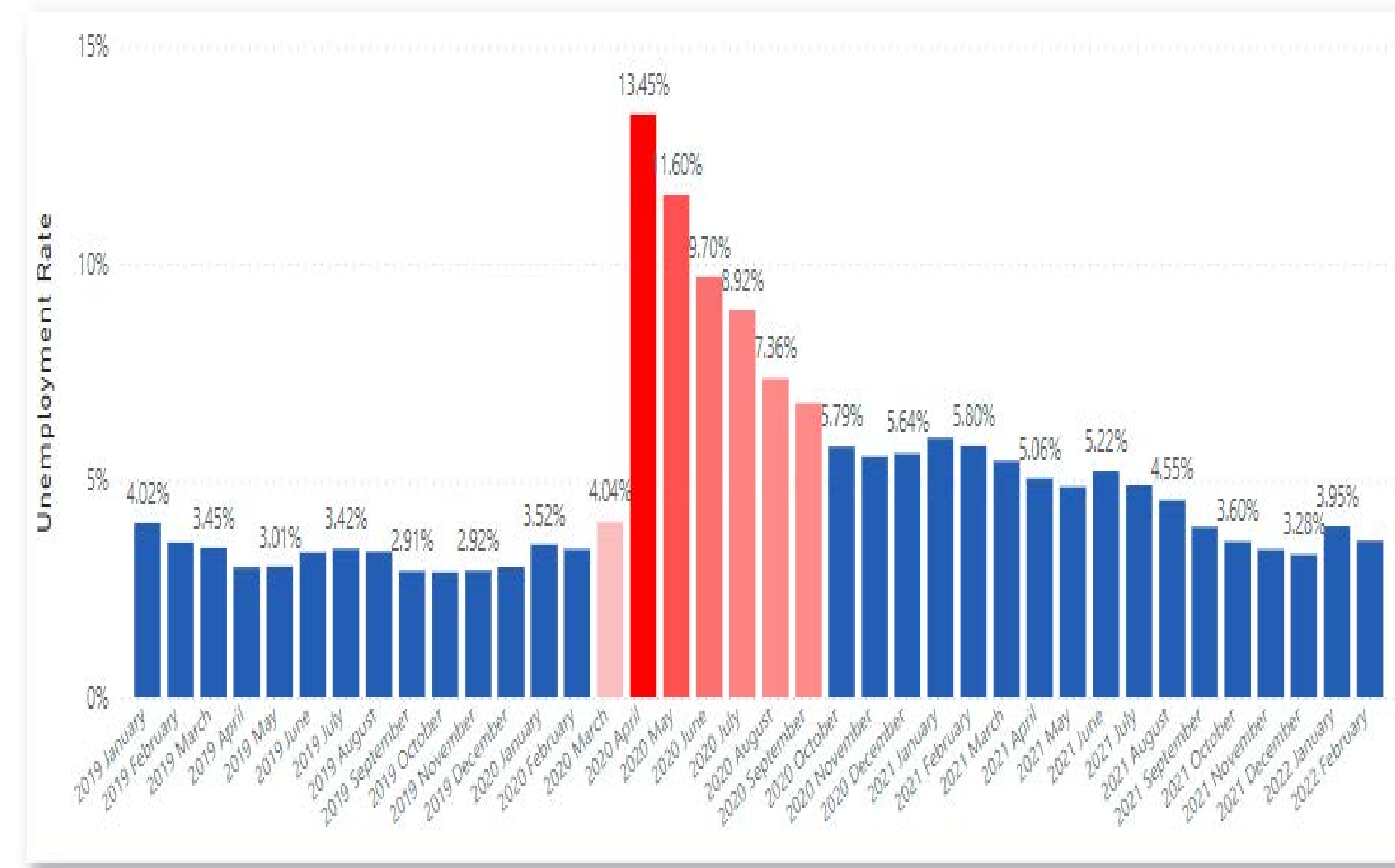
Methods

First, data was collected from the Federal Reserve Economic Data and Current Population Surveys from January of 2019 to February of 2022 on United States citizens aged 16 to 67, the primary working age for adults.

Next, a relational database with multi-dimensional model was designed on MS SQL Server to clean, import, store, and query data and Microsoft Power BI Desktop was connected to the database and utilized as an interactive analysis and visualization tool to analyze the data.

Results

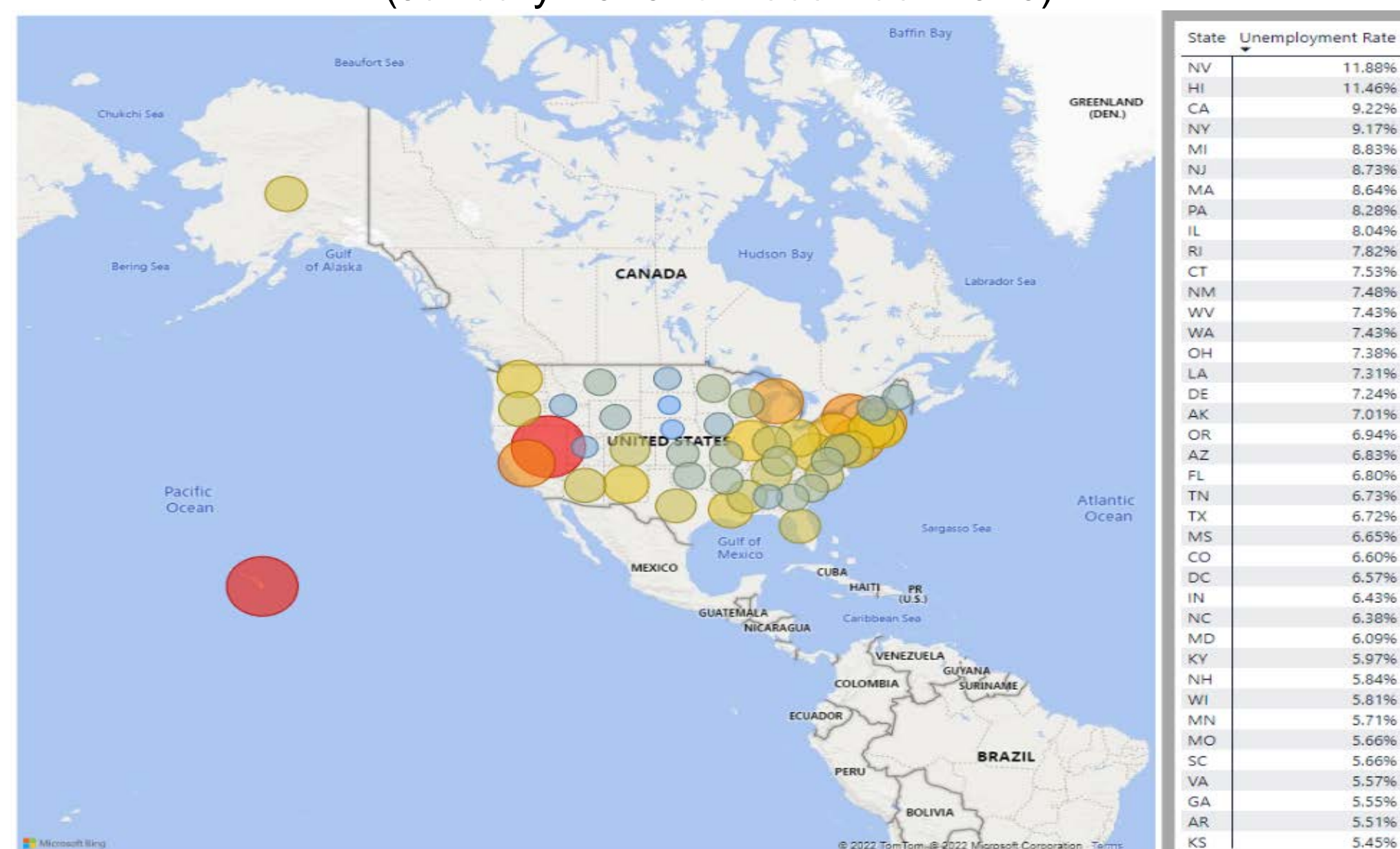
Figure 1. The Average Monthly Unemployment Rates For the Working Age Group
(January 2019 to February 2022)



Red bars highlight an unusual, sharp increase in unemployment rate during February and October 2020.

The average unemployment rate peaked at a high of 13.45% in April 2020.

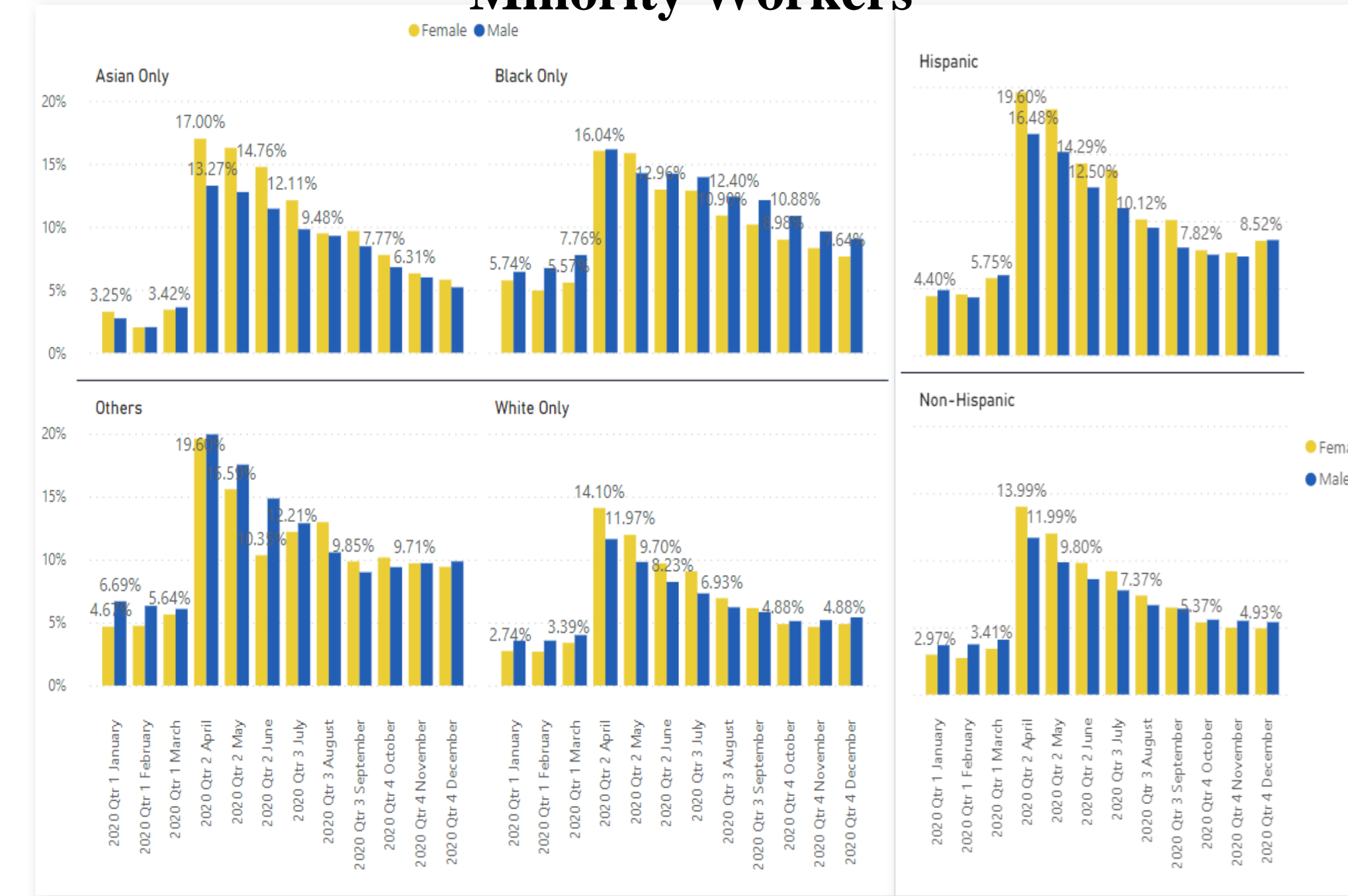
Figure 2. Unemployment Rates by State
(January 2020 to December 2020)



Red dots highlight the top 3 states with the highest unemployment rates in 2020: Nevada (11.88%), Hawaii (11.46%), and California (9.2%).

Results

Figure 3. Unemployment Rates for Female and Male Minority Workers



First row from left to right: Asians, Blacks, Hispanics
Second row from left to right: Others, Whites, Non-Hispanics.

Yellow bars highlight unemployment rates for females while blue bars highlight unemployment rates for males.

Female minorities had higher unemployment rates than male minorities during April to December 2020.

Figure 4. Unemployment Rates for Disadvantaged Minority Workers with Low Education and Income



First row from left to right: Whites, Blacks, Hispanics
Second row from left to right: Others, Asians, Non-Hispanics.

The red line traces the trend of unemployment rate for females during January 2019 to February 2022, while the blue line is used for males.

The pink shaded area represents the COVID-19 time period.

Asian minorities experienced the largest change in unemployment rates from the Pre-COVID to COVID-19 period.

Conclusion

Overall, female minorities were more likely to be unemployed than male minorities during the COVID-19 pandemic.

The unemployment rates for disadvantaged workers increased further when more negative factors, such as low education and low income, were considered.

Among disadvantaged workers with low education and income levels, Asian workers experienced the largest change in unemployment rate relative to Blacks, Hispanics, and other minorities due to the pandemic recession.

Policies that encourage females to stay in the labor force and bring disadvantaged workers back into the labor force should be implemented. Policy makers ought to reduce and eliminate structural disparities in education, income, and wealth to achieve social cohesion and economic equity.

Next Steps (TPACK)

Analyze how the pandemic continues to influence the labor market choices of disadvantaged workers, especially as vaccinations become more widely available and in-person activities return to normal.

Analyze how other potential factors explain the employment choices of disadvantaged workers, such as immigration, occupation, and age.

Analyze how generalizable our results are to the entire population and verify how robust our results are by studying more of population demographics.

References

Bauer, L., Broady, K., Edelberg, W., & O'Donnell, J. (2020). Ten facts about COVID-19 and the U.S. economy. The Hamilton Project, Brookings Institution, Washington, DC. https://www.brookings.edu/wp-content/uploads/2020/09/Future-Shutdowns_Facts_LO_Final.pdf.

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