The Effects of COVID-19 Lockdowns on Unemployment Rates Within New Zealand
Date of Submission: 1st November 2022

Phase Two- Chloe Crowe 300539785
Group One: Fugo Takefusa 300543407 and Anna Toney Halton 300532770

Executive Summary
In March 2020 New Zealand went into lockdown due to Coronavirus 2019 (Covid 19), a global pandemic. New Zealand experienced two lockdowns, the first in March 2020 and the second in August 2021. These Lockdowns meant that New Zealanders were not allowed to go in person to places of work or schools. This investigation's aim is to understand the affected the Covid 19 lockdowns had on the Unemployment rates within New Zealand. The investigation includes understanding the initial data sets, Monthly filled Jobs and Unemployment Rate. These datasets were sourced from Stats New Zealand, an official data collection agency within New Zealand. Both datasets are time series data, which means that each piece of data is directly related to the date that it was collected.

To gain a true understanding of the data the report includes a background of the Coronavirus pandemic and each dataset. It is also important to consider the ethics and privacy guidelines surrounding the use of both data sets.

The investigation aims to investigate if Covid 19 lockdowns affected the unemployment rate in New Zealand. To do this I have used two different prediction methods, I used these predictions to create a forecast starting from March 2020. Creating forecasts from March 2020 shows us what might have occurred if New Zealand did not go into any lockdowns. It is important to remember that there is some uncertainty around the forecasts for events that are out of our control. To create these forecasts, I have used the forecast algorithm Autoregressive Integrated Moving Average (ARIMA) and the Drift method. AIRMA is an algorithm that bases its prediction on its past time series data that are not affected by the time of year. The Drift method creates a forecast based on the average change over time. This means the average past unemployment rate directly affects the future.

Comparing both forecasts to the actual data shows that the Unemployment rate was affected by Covid 19 lockdowns. I found that the total unemployment rate in New Zealand had a sharp increase right during the first lockdown, then decreased quickly after New Zealand moved out of lockdown. Both forecast methods showed slightly different results. The ARIMA method showed that over time the rate of Unemployment within New Zealand would decrease. This was slightly different to the drift method which suggested that the unemployment rate would increase over time. Although these two methods showed different results it highlights the uncertainty around predictions. No one is certain as to what might happen in the future just like at the start of 2020, we were not aware that we would be going into a series of Lockdowns.

Following this investigation, I recommend that it is completed again in a few years' time. As it has been about one year since the last lockdown, it would be interesting to see if Covid 19 lockdowns had a long-term effect on the Unemployment rate.

Background
Coronavirus is a highly infectious disease that presents itself with cold and flu symptoms. Due to its highly infectious nature, it can have life-altering effects on the infected. The specific strain of coronavirus name Coronavirus 2019 (Covid 2019) originated in Wuhan City in China in December 2019. By the start of February 2020 over 300 people had died from the virus with the World health organisation (WHO) declaring it a public health emergency of international concern.
On the 28th of February, the first case of Covid-19 was found in New Zealand. By early March there were more than 100,000 global cases of Covid 19, WHO declared an official global pandemic. The New Zealand government announced that anyone entering the country from the 14th of March must self-isolate for 14 days.
By the 19th of March, New Zealand closed the country's border to all but New Zealand citizens and permanent residents. "The number of confirmed cases worldwide exceeds 200,000. It took more than three months to reach the first 100,000 cases, and only 12 days to reach the next 100,000."[1]
To combat the transmission of Covid 19 the government introduced a four-level alert system on the 21st of March. Within two days of the announcement New Zealand immediately moved into level three. Moving into level four 48 hours later. People were instructed to stay at home with schools and workplaces being closed. On the 25th of March, New Zealand went into its first lockdown, and a state of National emergency was declared. The nation stayed in lockdown until the 27th of April 2020 when we moved into alert level three. On the 13th of May, New Zealand moved into alert level 2 and the state of national emergency expired.
Throughout the next year, New Zealand moved down the alert systems, and living with Covid became the new normal. However, on the 17th of August 2021, New Zealand moved into its second lockdown. New Zealand stayed in lockdown until the 31st of August when New Zealand south of Auckland came out of lockdown. Auckland and Northland remained in lockdown until Northland moved out to level three on the 2nd of September. Auckland remained in lockdown until the 21st of September. On the 2nd of December, New Zealand moved away from alert levels to the traffic light system. There have been no more lockdowns in New Zealand since we moved to the traffic light system.

Alert Level Restrictions:
While in alert level Four New Zealand is in lockdown, and people must stay home. Travel is not allowed unless, for necessities, households must work and learn from home. This means that businesses must close except for necessities and lifeline utilities.
In alert level three, households still must stay at home although, if necessary, people can return to work or school. Travel is allowed but only within their region. Businesses can open if they can trade in a contactless way, however public facilities remain closed.
Alert Level Two and One means that people can return to work and businesses can open with appropriate physical distancing and mask-wearing.
To ease the burden on the New Zealand economy the government announced a 12-billion dollar package, with 8.7 billion towards support for businesses and job support in the form of wage subsidies.

The aim of this analysis is to investigate if COVID-19 lockdowns influenced unemployment rates in New Zealand. I want to compare what might have happened between 2020 and 2022 if there was not a global pandemic. Using forecast methods Autoregressive integrated moving average (ARIMA) an algorithm that bases its prediction on its past time series data that are not affected by the time of year. As well as Drift predictions which creates a forecast based on the average change over time. Both these

---

[1] https://www.rnz.co.nz/news/national/437359/timeline-the-year-of-covid-19-in-new-zealand

predictions will be created from data starting in January 2007 to March 2020. Once I have created these predictions, I plan to compare them to what happened between 2020 and 2021.

Data Description
Within this project we have chosen to work with the data sets Monthly filled jobs and Unemployment Rate by Sex.

These datasets were sourced from the COVID-19 Data Portal and Stats Employment websites. These sites are managed and run by Stats NZ, New Zealand's official data agency. Our goal with these datasets is to use them in a way that tells us how COVID-19 has impacted New Zealand's working population in terms of unemployment rates. Specifically, the impact and continued effect since the occurrence of the 2020 lockdown. From these datasets, we will be able to draw accurate conclusions as to the effect of this time. Throughout this project, we have kept both datasets separate.

The first dataset we have chosen to work with is the Unemployment Rate by Sex. This dataset is helpful as it allows us to visualise trends in unemployment data from January 2007 to 2022. In addition, this data will enable us to draw an excellent overall understanding of any disparities that are found between sexes. Especially during the period of the 2020 lockdown, which we are particularly interested in.
 This dataset contains time series and numerical data in the form of 'Quarter' which is each quarter per year, 'Men,' 'Women,' and 'Total' which is the unemployment rate for both men and women.
In the data sourced from Stats NZ Quarter was in the form of a string, because time series analysis is being performed Quarter got transformed into date format. All other variables in this dataset are doubles. There are no missing values in this dataset.

The second dataset we chose to work with is Monthly Filled Jobs. We believe that this dataset is valuable as it has recorded the number of positions filled in the time period selected. We will be able to determine any trends over the years from this dataset. This information will allow us to draw better conclusions about the effect of the 2020 lockdown.
This dataset contains time series, numerical and categorical data. The variables are 'Resource ID' - character, 'Period'- character, 'Label 1'- character which refers to the industry types, 'Label 2'- character which labels the seasonally adjusted or actual data, 'Value' - Integer, 'Unit'- character, and 'measure'- character, which is the number of filled jobs.
For further analysis 'Period' has been manually transformed into a date as originally it was in a string format.
The original dataset also contained values 'Geo', 'Label3' and 'Multiplier' although these variables only have NA or 0 values which have been removed from the dataset. Once the variables have been removed there are no missing values in the database.

Due to these datasets being sourced from New Zealand's official data agency, Stats NZ, there are no missing data or errors found in our sample of the data. Stats NZ sources its data from surveys such as HLFS (The household labour force survey) and the government. The HLFS is the dataset for the official statistics about New Zealand's labour force. The survey results are collected 5 weeks after the end of each quarter. Throughout the year supplementary data can be added to a quarter of HLFS. For example, in June income statistics are added to the results. Stats NZ has played a key role in the government's Covid-19 response plan. They provided statistics to support the government's decision-making.

Because these datasets have come from surveys, they are subject to all kinds of errors from the survey process. Although we have had no control over the collection of these datasets. Stats NZ would be

careful not to release any data that had obvious flaws and errors. As that would reflect poorly upon them as a government agency. There were no missing values or obvious errors in the data sample from the covid 19 portal, this meant we did not need to clean or fix the sample in any way.

The unemployment rates dataset was reformatted so that the date object was set to be a quarter. This was because the other dataset is formatted in this way and is easier to work with. Then the variable 'Period' was set as a date object for the Monthly Filled Jobs dataset. This way, there are no inconsistencies or issues when we are working with the datasets to build our own conclusions in the project.

Ethics, Privacy and Security
Stats New Zealand, have their own privacy, security, and confidentiality statements. They include Stats New Zealand will not identify individuals in published statistics or research, anyone using Stats NZ data must apply the same standards of practice and data collection. Data is only kept for as long as it has statistical or research value.
As we are using data collected and stored by them, we will follow their privacy, security, and confidentiality guidelines.

The Stats NZ datasets are aggregated, which means that we have no possible ways to identify individuals. The dataset has been carefully anonymised by Stats NZ; An individual's information is protected by Stats NZ and the New Zealand Government's legislations and safeguards. By using data from Stat's NZ, we are agreeing that we will not attempt to identify any individual. As the datasets we are using are publicly available, we can use them without getting informed consent. We will not make assumptions or statements about any individual piece of data other than concerning the sample.
Stats NZ is a government agency, they would be incredibly careful not to release any data that have obvious flaws. Although we cannot assume there are none. Within Stats Terms and Conditions, they state that all information within their datasets is accurate and up to date, although they cannot guarantee it. We will be looking into the dataset ourselves and decide if the dataset is suitable before we use it.

Stats NZ follows strict rules and regulations when collecting survey data. When collecting any data they make sure that they are collecting a range of data. We assume that the data collected is a valid representation of the New Zealand population in this project. This includes not having any response or collection bias in both datasets.

Stat's NZ allows us to use their data for any statistical or research purposes. Considering this we will state only what we have discovered throughout our processes. We will not be using our findings to give any official advice and we will only share our results with those within the Victoria University of Wellington. Any predictions made should not be used in any decision-making. The predictions are made based on a sample and may not be a true representation of the population.

Throughout our findings, we will be transparent about the processes. We will state our data source and explain how and what we discover. Following Stat's NZ statements, we will only keep copies of the data for as long as it has statistical or research value. When the data is no longer needed, all copies will be destroyed.

To keep our project secure we are only keeping copies of our work on our machines and in the cloud. Within the cloud, access to our findings is restricted to our team. This includes our dataset, code, and reports. We are using Git to store files with word documents being stored in OneDrive. Code and reports will only be made editable to those within the group. Only the material from the first phase of the project will be accessible to the other members of group one. Throughout phase two I will not be sharing my findings or work with any other students. I will store a copy of my work on my local machine and my personal cloud. This also means that I do not have access to my other team member's work. We will still share a set of data but any further work completed will not be shared.

Our dataset has been retrieved from a public source (Stats NZ) which means that our data is not private to our group. Although we will be keeping a copy of the datasets on Git and our local machine.

Once the project is completed, we will be uploading a copy to be marked. The findings are purely for educational purposes and should not be used for any decision-making. We will be giving a copy of our report to the university and may use them as work exemplars. As we are using a public database, we can share our results with the public if we do not identify ourselves or anyone else.

Exploratory Data Analysis

The unemployment rate data contains the quarterly unemployment rate from January 2007 to January 2022. It has four variables: Quarter (Quarter when data was recorded), Total (total unemployment rate), Men (the unemployment rate for men) and Women (The unemployment rate for women). There are 61 records in total.

Table 1 shows the Tukey summary statistics of the unemployment data. The ranges of unemployment rate for all variables are between 3% and 7%. Women have higher median and mean unemployment rates compared to men. This is not surprising as traditionally women are homemakers. I will be using sex as a comparison tool as it is not going to be the focus of this investigation.

Table 1: Summary Statistic of Unemployment Rate by Sex

	Men	Women	Total
Minimum	3.100	3.300	3.200
1st Quantile	3.900	4.400	4.200
Median	4.700	5.500	5.000
Mean	4.725	5.311	5.013
3rd Quantile	5.500	6.300	5.800
Maximum	6.700	6.900	6.700

The first figure shows the total unemployment from January 2007 to January 2022. From 2010 to 2020 the unemployment rate was somewhat decreasing. However, there is a sharp rise in the rate immediately after the first lockdown and the rate started to be decreasing again. The second figure shows the unemployment rate by sex. Women generally have a higher unemployment rate than men over time. Both women and men show a clear rise in the rate right after the first lockdown. The unemployment rates are similar for both men and women at the end of the period. Both lockdowns lasted less than three months with both happening mostly within the last quarter of the figures.

Quarterly Total Unemployment Rate

Figure One

Quarterly Unemployment Rate by Sex

Figure Two
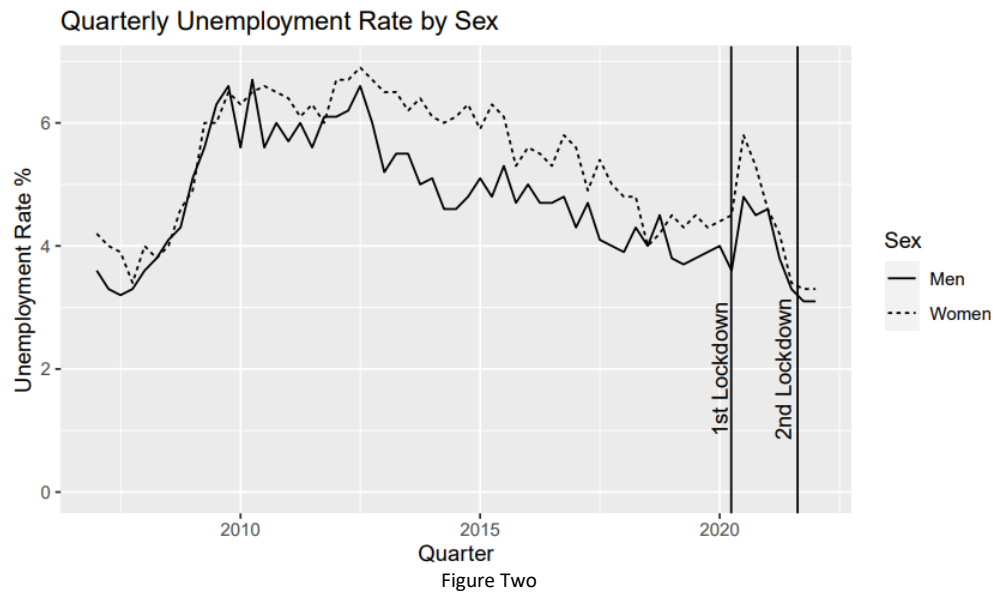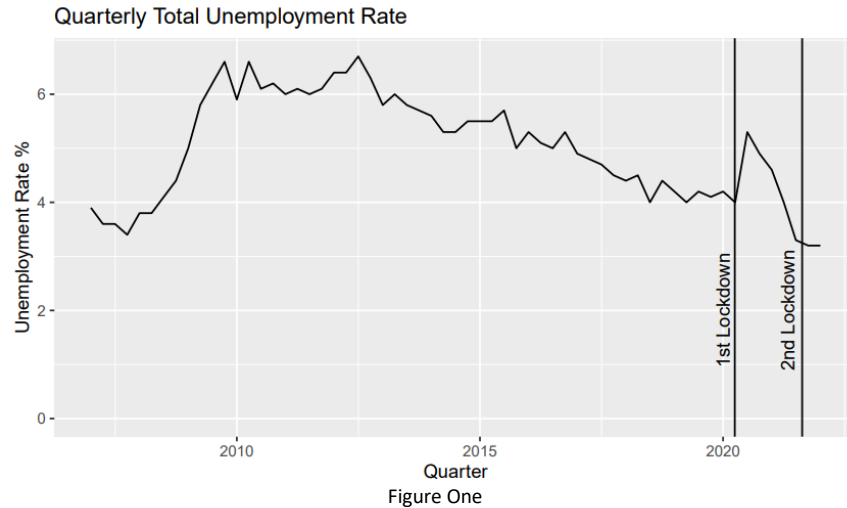
The increase in the unemployment rate after the start of the first lockdown was not a surprise to see. During each lockdown, New Zealand's GDP (gross domestic product) value decreased. New Zealand's economy took a hit which resulted in many people losing their jobs. The government introduced a wage subsidy scheme to help businesses pay and keep their employees while in and recovering from lockdown.[2] For many New Zealanders it meant they still lost their jobs.

---

[2] https://www.rnz.co.nz/news/national/439092/covid-19-employment-hardship-where-does-new-zealand-stand-a-year-on
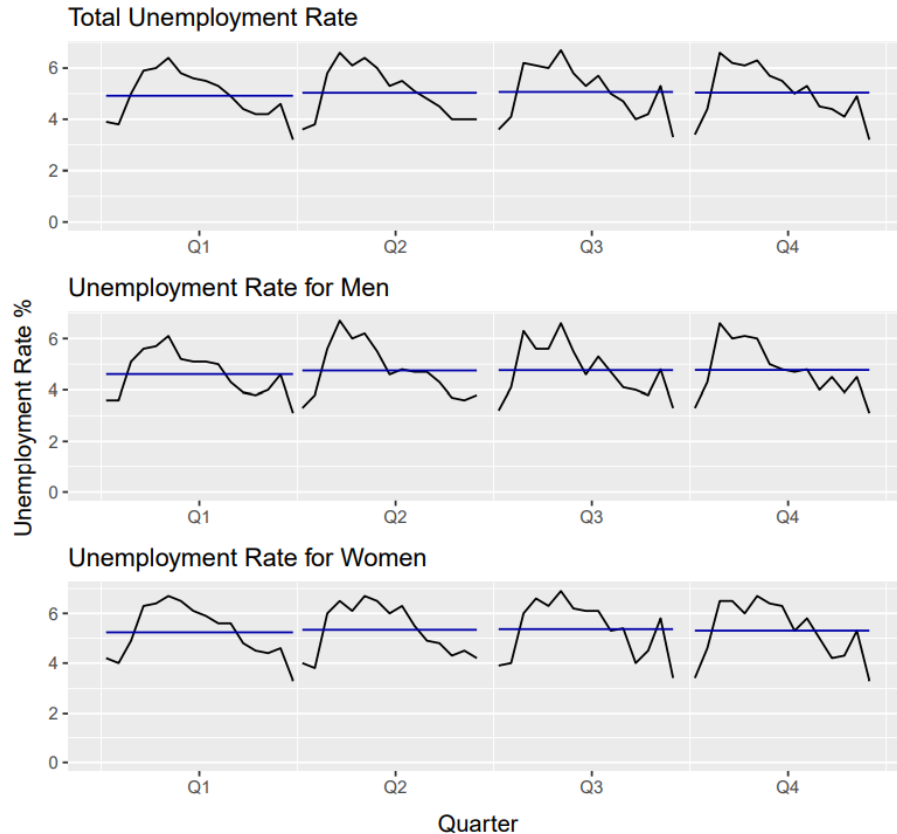
Figure Three

Figure Three shows the seasonal sub-series plot of the unemployment rate. The unemployment rate data was separated by each quarter. The straight horizontal bar indicates the mean employment rate for each quarter. Since the horizontal bars do not change by quarters, there is no significant seasonal pattern in the unemployment rate. This is important to note for the detailed analysis as the conclusion that there are no significant patterns influence the modelling methods. When modelling the unemployment rate data, I can create a general model that is not affected by each quarter.

Number of filled jobs quarterly 2007-2020
Within the dataset Monthly Filled Jobs 'Period' indicates the date the data is recorded. 'Label 1' refers to the industry types and 'Label 2' shows whether the data is seasonally adjusted or actual data (we will only use actual data for our analysis since we can explore seasonal pattern). 'Value' shows the number of filled jobs in that period. Monthly data were converted into quarterly data by using the mean of three months' number of filled jobs. The quarterly data have 60 records for each industry type from January 2007 to October 2021.

Figure Four shows a line graph of the number of filled jobs for each industry type and their total. Service industries have the highest number of filled jobs followed by Goods-producing and primary industries. The number was raising for service industries over the period while the other industries stayed stable. It seems there is no significant change in the numbers due to lockdowns. One of the reasons that there is no significant change is that the same number of jobs opening did not change. Although the demand for these jobs may have been higher. We can see that there is an increase in the number of filled jobs over time. This could be a result of the falling unemployment rate that we observed earlier.

People still needed jobs whether or not they were in a lockdown. The cost of living in New Zealand increased by 5.2% between 2020 and 2021. [3] With the rising cost of living, it is interesting to see not as big of a rise in the number of filled jobs after the lockdown. It would be interesting to complete the analysis in a few years to see if Lockdowns had a long-term effect on the number of filled jobs within New Zealand. The graph shows information from 2007 to 2022. We can see some seasonal change in the data, as the line is not straight. There are peaks and drops in the number of filled jobs.

This is interesting to investigate as it seems that the unemployment rate has not had too much effect on the number of filled jobs in lockdown. As the unemployment rate within the first lockdown drastically increased, I thought that it may mean more jobs are filled. However, there may have been a lack of extra jobs to fill the demand. Since the first lockdown, the size of New Zealand's working population increased. This is another reason why the Unemployment Rate has increased the number of filled jobs did not increase as much.
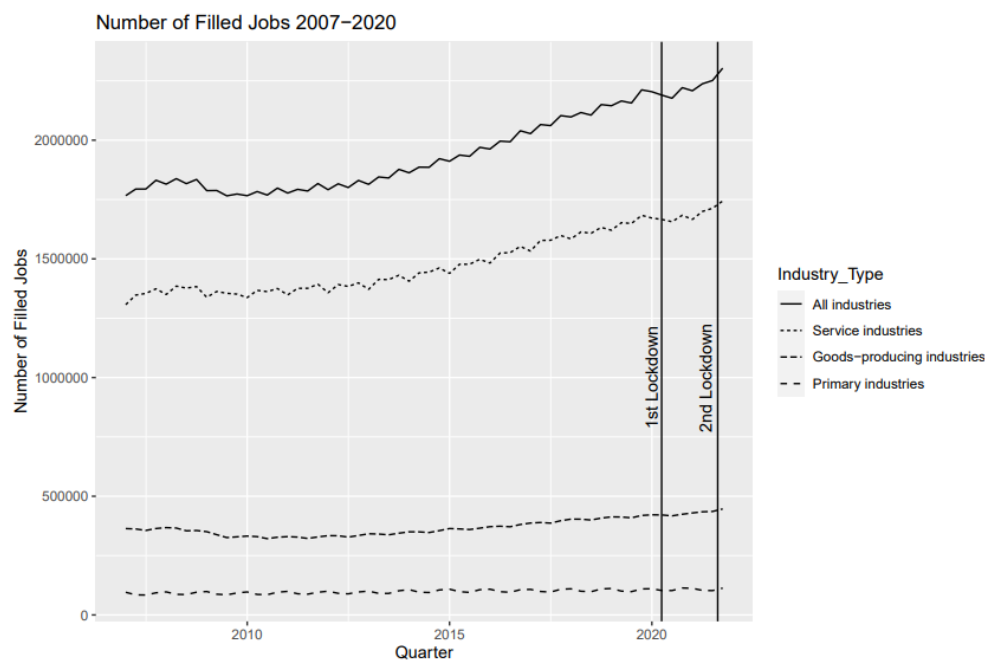

Figure Four

Detailed Analysis Results

For the detailed analysis I have decided to focus on the Unemployment Rate data. I want to investigate the effect that Covid 19 lockdowns have had on unemployment rates. I think that it would be beneficial to investigate how lockdowns in New Zealand have affected the country's unemployment rate.

I am going to do this by creating ARIMA and Drift predictions based on the data before the first lockdown. I will then compare these predictions to what happened.

The unemployment rate dataset has no missing values. In the exploratory Data Analysis stage, the string variable quarter was transformed into a date format. Within the EDA I identified that there were no significant seasonal changes. It is important to note this, as seasonal changes change the method of

---

[3] https://www.stats.govt.nz/news/increase-in-cost-of-living-reaches-new-high#:~:text=The%20cost%20of%20living%20was,than%20the%20December%202020%20quarter.

predictions slightly. This means that my predictions do not need to take into consideration any seasonal patterns. Otherwise, no other manipulation has been done on the data.

My first step was to plot the data before any Covid 19 lockdowns. To do this I created a subset of data that included data from the first of January 2007 to the first of March 2020. This excludes data that may have been affected by covid. Covid was first discovered in New Zealand on the 28th of February because of this I decided to use March first as a cut-off date. As this was before the peak of covid cases and the first lockdown.

Total Unemployment Rate model before Covid 19 Lockdowns
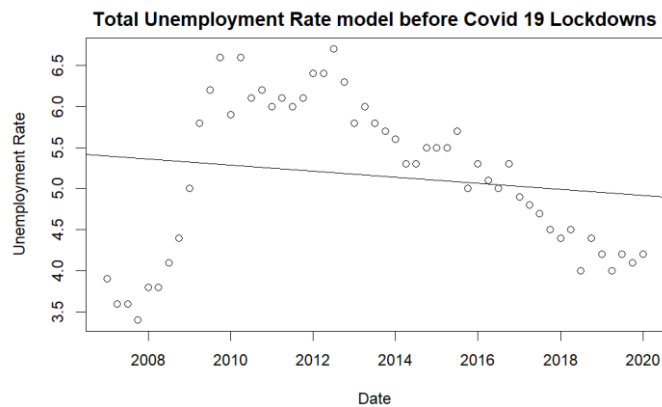
Figure Five

Figure Five shows the regression line through the data. Although the data shows some increases and decreases in the unemployment rate, there is a decrease over time in the rate of the unemployment rate.

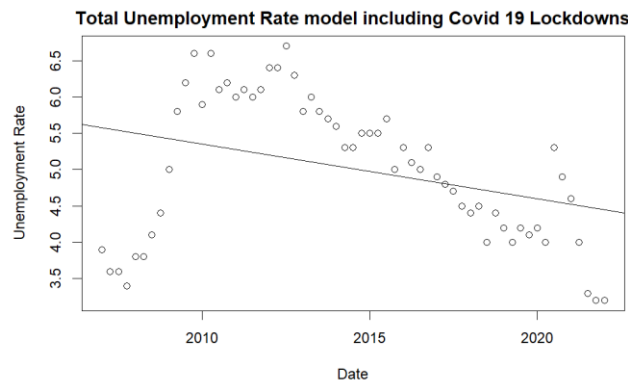**Total Unemployment Rate model including Covid 19 Lockdowns**

Figure Six

Comparing the model in figure Five to figure six, both models show a decrease in the Unemployment rate. Just based on the regression line there is a greater decrease in the unemployment rate in figure six which includes data from both lockdowns. This may be because, after both covid lockdowns, there was a greater increase of people returning or joining the workforce. The decrease in the unemployment rate could be explained by the increase in the cost of living within New Zealand.

There is evidence that covid lockdowns within New Zealand had affected the unemployment rates within New Zealand. Within this next part of the analysis, I will create predictions of the unemployment rate if Covid did not become a global pandemic. Once the predictions are created, I will then compare the predictions to what happened.
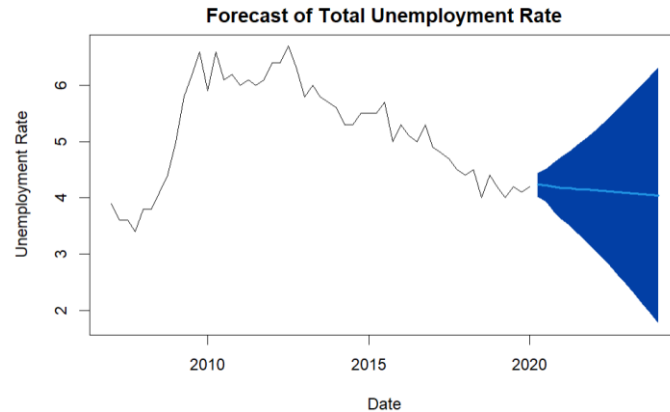
Figure Seven

Figure seven shows the prediction of the unemployment rate on data before the first covid lockdown. The prediction has been created using an autoregressive integrated moving average (ARIMA). This ARIMA prediction contains a prediction interval, the interval creates an estimate of uncertainty around the prediction. Covid 19 lockdowns highlight that prediction intervals are important to take into consideration. An event like this could happen and affect the Unemployment Rate within New Zealand The prediction shows that over time there will be a decrease in the rate of Unemployment within New Zealand. At the start, there is some volatility accounting for the volatile nature of the data. But the prediction highlights that over time there would be a decrease in the unemployment rate.
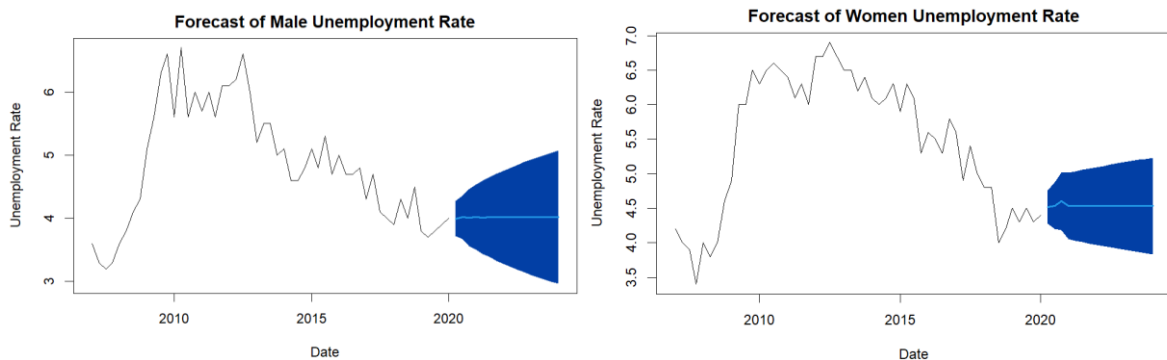

Figure Eight

Using the same method, figure eight shows predictions based on Male and Women unemployment rates. It is interesting that using the total data there is a decrease over time. However, splitting out women and male data it seems that there are no significant changes in the unemployment rate of Men. For Women, there is a sharp increase, then a decrease in the unemployment rate. After this increase, there is no significant change in the unemployment rate of women within New Zealand.
The data about Men seems to have greater uncertainty than women. This is surprising as the data about women have a small bell curve shape, whereas men have an overall decrease in the unemployment rate after about 2012.

To back up my findings I have created forecasts using the Drift method. This forecast is based on the average changes over time.
Figure nine shows the drift forecast of the total unemployment rate over time. This model does not include data after March 1st, it does not include any data from covid lockdowns. Using the drift method,

the forecast shows that the unemployment rate within New Zealand increases. This model also shows intervals around the prediction allowing for uncertainty.

Figure Nine
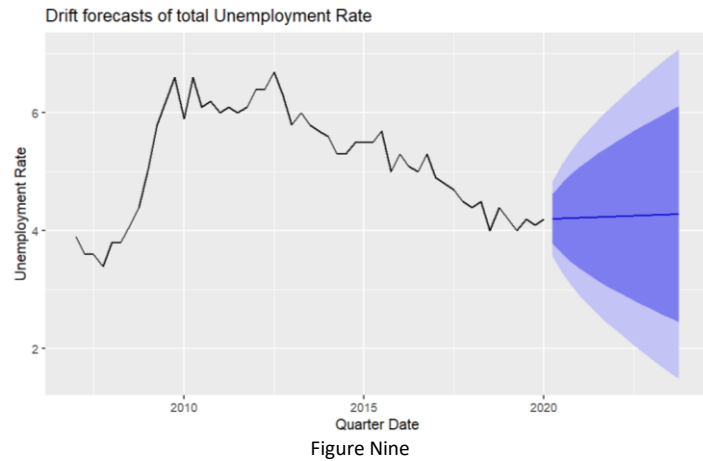
I thought this method was interesting to see as the ARIMA modelling showed a decrease in the unemployment rate over time. We see these results because the drift method considers the average of the past data. The ARIMA modelling considers the data in quarters.

When creating these predictions, I knew that it was going to be important to include prediction intervals. This gave the prediction room for some uncertainty. No one knew how fast and devasting Covid -19 was going to be on the world till it happened. The purpose of the prediction intervals is to account for the possibility of these events.

Figure Six

Figure Seven
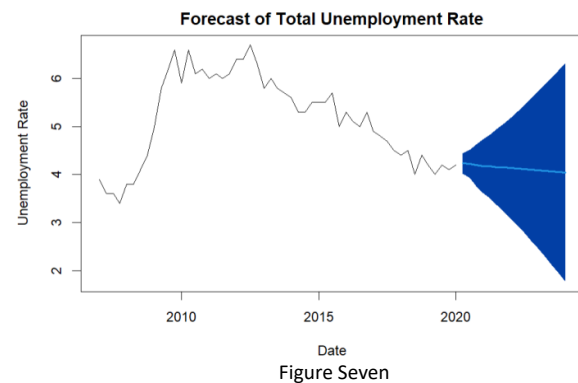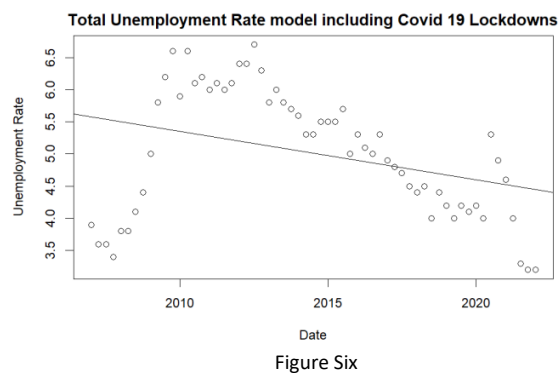
As we saw before in figure Six the Total Unemployment Rate in New Zealand has been decreasing. Comparing the forecasting created using ARIMA shows that after March 2020 we would still expect the Unemployment rate to decrease. Unlike the forecast, the real unemployment rate increased and then fell a lot quicker after the first lockdown. The forecast has a prediction interval, but it does not decrease as quickly as the real rate.

Conclusions and Recommendations

Covid 19 lockdowns affected the total Unemployment rate within New Zealand within a short period of time.

The first lockdowns resulted in an Unemployment rate increasing to 5.3% in 2020, but within a year it had dropped 2% to 3.3%. This is the biggest change in the Unemployment rate within the data within such a short period of time.

The Unemployment rate data shows that over time New Zealand Unemployment rate decreased. Creating predictions from data before any Covid 19 lockdowns show similar trends that over time New Zealand's total Unemployment rate decreases. Covid 19 had a massive effect on New Zealand's economy, the cost of living within New Zealand increased by 5.3% from 2020 to 2021. This increase could be the driving factor behind the decreased Unemployment Rate in New Zealand. The ARIMA predictions show that New Zealand's Unemployment Rate would have decreased even if there was not a global pandemic. Although the decrease would not have been so extreme. The prediction intervals do account for uncertainty but the prediction intervals although decreased faster, it was not as much of a decrease as what really happened.

I would recommend completing this investigation again but in a few years' time. it will be interesting to complete this investigation again to investigate if Covid 19 lockdowns had a long-term effect on the Unemployment Rate within New Zealand. Once New Zealand's economy has recovered from covid 19 it may be that the Unemployment rate increases again.

The findings are directly related to what data I chose to investigate. Throughout this investigation I have focused on the Unemployment Rate data, this has limited me as I am not able to relate my findings to other factors such as the number of people in New Zealand's workforce. Some further work could be comparing the unemployment rate to the number of people within New Zealand's workforce. Over time the workforce would increase due to the increase in population size but did more people enter the workforce after lockdown. Potentially more people sort further education, it would be interesting to be able to relate these findings to other factors. A related investigation could be into how the covid lockdowns affected the cost of living within New Zealand and if that in turn affected the Unemployment rate.

Throughout this investigation, I chose to use two different types of predictions. This limited my investigation as I could only compare the two outcomes. It would be beneficial to investigate using at least one more type of prediction as it may give more insights into the data.

Reference List

https://www.rbnz.govt.nz/-/media/48a70acece5a4869a6f7f5ed3a4b59cc.ashx
https://www.rnz.co.nz/news/national/437359/timeline-the-year-of-covid-19-in-new-zealand
https://www.rnz.co.nz/news/national/439092/covid-19-employment-hardship-where-does-new-zealand-stand-a-year-on
https://www.stats.govt.nz/news/increase-in-cost-of-living-reaches-new-high#:~:text=The%20cost%20of%20living%20was,than%20the%20December%202020%20quarter.