



ETC5513_Assignment4

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1 Population and GDP analysis

1.1 Introduction

This report aims to analyze factors related to GDP growth from 1990 to 2019 in Australia. There are several parts we want to figure out by analyzing the data: overall changes in unemployment, population, GDP growth, unemployment with different education level, and unemployment by genders from 1990 to 2020. The comparison between different categories of unemployment. The factors related to the GDP growth and their relations. The report is based on the Data of the world bank. The population data provided at United Nations Population Division (2019), and variables of unemployment rate for people with different level of education are extracted from International Labour Organization. (2021a) and **advancededucation**. Similarly unemployment rate of genders can be found at International Labour Organization. (2021b) and **maleunemployment**. In terms of economic variables GDP and inflation, The World Bank (2019) and International Monetary Fund (2020) are the sources of these mentioned variables. The data about total unemployment rate is from **totalunemployment**. All data of ABS presented on this website is provided under a Creative Commons Attribution 4.0 International license, it is open data and free to share and adapt for any purpose even commercially.

1.2 Missing value in original data

Table 1: *Missing values in data*

| variable | n_miss | pct_miss |
|--------------|--------|----------|
| Advanced_edu | 7 | 29.16667 |
| Basic_edu | 7 | 29.16667 |
| year | 0 | 0.00000 |
| GDP_growth | 0 | 0.00000 |
| Population | 0 | 0.00000 |
| Unemploy_F | 0 | 0.00000 |
| Unemploy_M | 0 | 0.00000 |
| Inflation | 0 | 0.00000 |
| Unemploy_T | 0 | 0.00000 |

From the given table 1 There are significant proportion of missing values in variables unemployment with advanced education and basic education. That means the research concerning these two variables should begin at 2000 .

1.3 Overall changes in GDP and Population

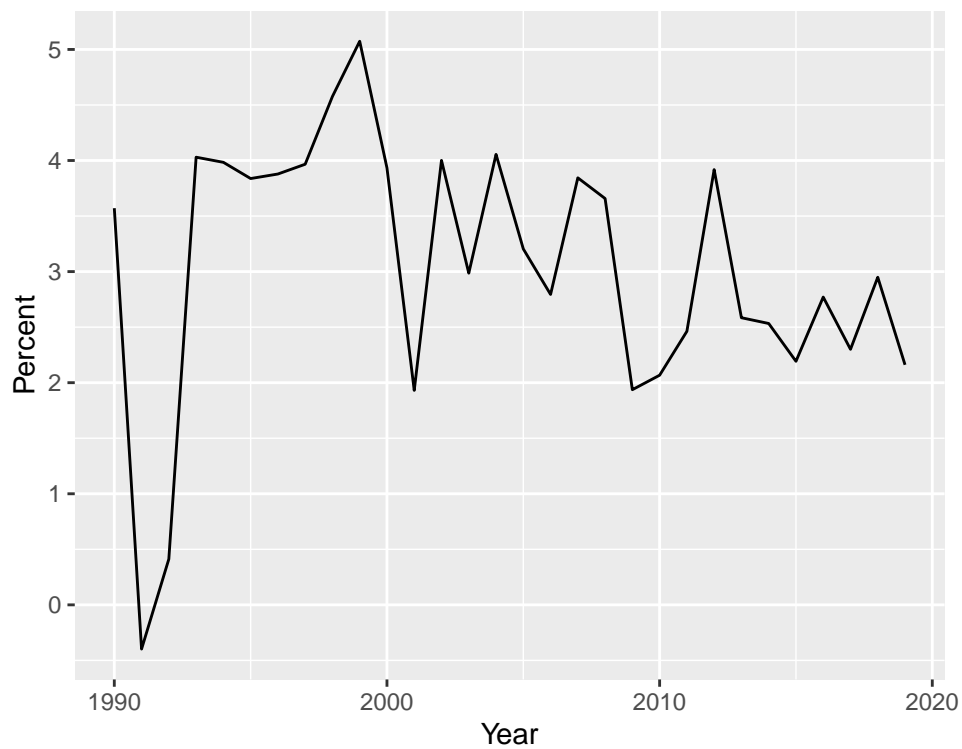


Figure 1: GDP Change from 1990 to 2020

Table 2: Percent change in GDP growth

| year | GDP_growth | GDP_growth_Change |
|------|------------|-------------------|
| 2007 | 3.844230 | 37.56% |
| 2008 | 3.657954 | -4.85% |
| 2009 | 1.936994 | -47.05% |
| 2010 | 2.067417 | 6.73% |
| 2011 | 2.462756 | 19.12% |
| 2012 | 3.918163 | 59.1% |
| 2013 | 2.584898 | -34.03% |

From the given figure 1 and table 2, only the beginning of 1990s has experienced a negative growth which was about -0.3%, and the following growth of years was fluctuating around 2.5% even after 2008 the year of financial crisis the growth is still positive. The negative growth in 1990s attribute to recession mainly resulted from Australia's efforts to address excess domestic demand, curb speculative behaviours in commercial property markets and reduce inflation. Interest rates were increased to a very high level because the transmission of tighter monetary policy took longer than expected to put downward pressure on demand and inflation. At the same time, countries in other parts of the world, in particular the United States, also entered recession, compounding the effect of tighter monetary policy in Australia. (The unemployment rate peaked at just over 11 per cent.)

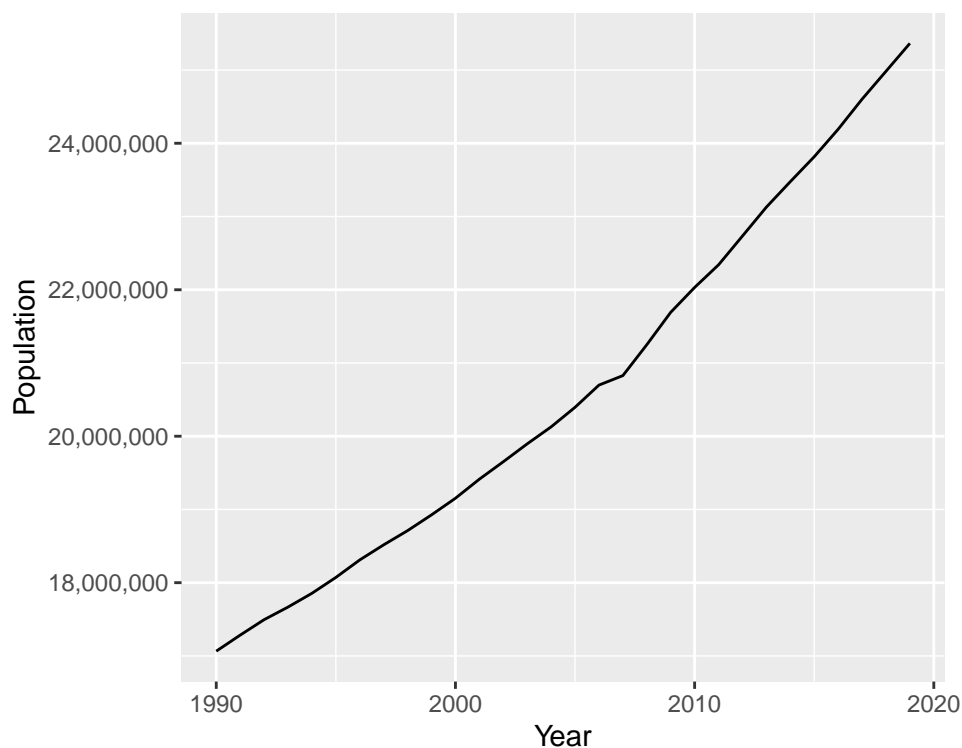


Figure 2: *Population Change from 1990 to 2020*

Table 3: *Percent change in Population*

| year | Population | Population_Change |
|------|------------|-------------------|
| 2003 | 19895400 | 1.24% |
| 2004 | 20127400 | 1.17% |
| 2005 | 20394800 | 1.33% |
| 2006 | 20697900 | 1.49% |
| 2007 | 20827600 | 0.63% |
| 2008 | 21249200 | 2.02% |
| 2009 | 21691700 | 2.08% |
| 2010 | 22031750 | 1.57% |

From the given figure 2 and table 3, the Australian population has been growing steadily from 17,000,000 to over 25,000,000 in the year between 1990 to 2020. Australia has population growth rate around 1.48% averagely according to World Bank data. Migration and birth rate minus mortality rate were included in this growth rate. However, the population growth rate has experienced a downward trend from 2006 to 2007, which has dropped from 1.49% to 0.63% making the line no as smooth as previous years. The reason why the increase has weakened is because Australia government had tightened the policy for international migration at that particular time.

1.4 Further analysis between GDP and population

Table 4: *Percent of Population in different age group*

| year | 0_14 | 15_64 | 65_over | International migrants (% of population) |
|------|----------|----------|----------|--|
| 1990 | 22.08942 | 66.85183 | 11.05875 | 23.13414 |
| 1995 | 21.57035 | 66.57259 | 11.85706 | 22.91521 |
| 2000 | 20.88242 | 66.79390 | 12.32367 | 22.95594 |
| 2009 | 19.03234 | 67.59111 | 13.37656 | 26.54431 |
| 2014 | 18.88734 | 66.25805 | 14.85461 | 28.21841 |
| 2018 | 19.27545 | 64.80335 | 15.92120 | NA |

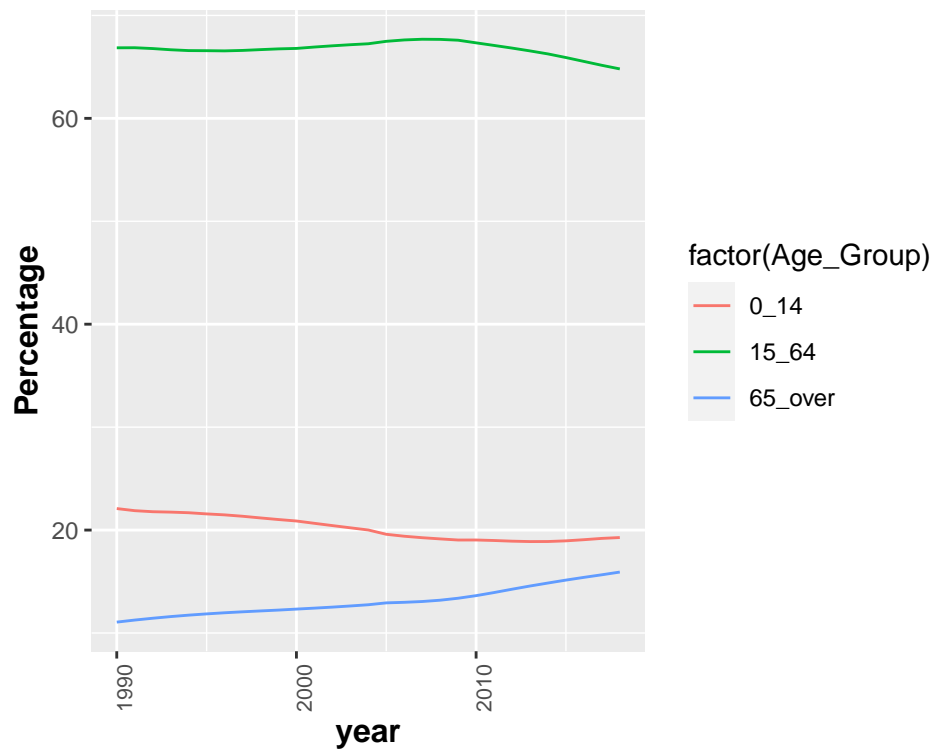


Figure 3: *Population age proportion*

Looking at the age distribution of Australian , the figure 3 and table 4 shows the Australia's population is aging gradually. The percentage of people over the age of 65 has risen from 11.058% in 1990 to 15.921% in 2018. On the contrary, the proportion of children is gradually decreasing, from 22.089% in 1990 to 2018. 19.275% of the year. There is also a slight downward trend for young adults aged 15 to 65, but more importantly, the proportion of international immigrants in Australia's population has increased significantly, from 23.13% to 28.24% in the same period. This explains why the birth rate is decreasing year by year and the population is getting old, the total population of Australia is increasing year by year, because a large number of international immigrants fill up the labor force and promote economic development to a certain extent.

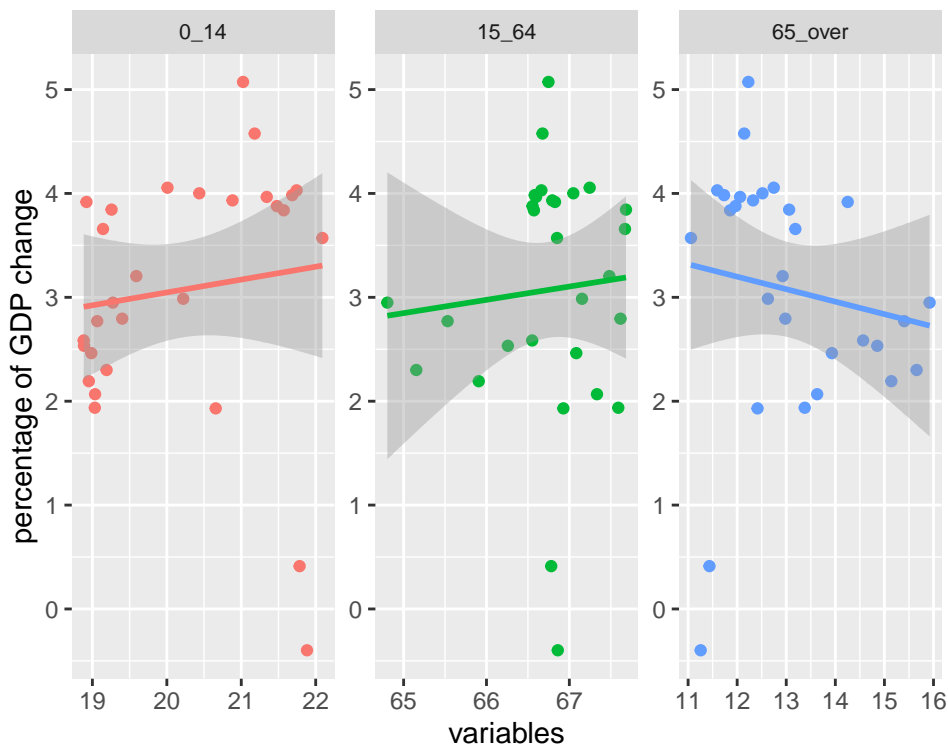


Figure 4: *Linear Model*

| term | estimate | std.error | statistic | p.value |
|-------------|----------|-----------|-----------|---------|
| (Intercept) | -7.3136 | 22.2978 | -0.3280 | 0.7455 |
| '0_14' | 0.1206 | 0.1994 | 0.6048 | 0.5506 |
| '15_64' | 0.1191 | 0.3312 | 0.3596 | 0.7221 |
| '65_over' | | | | |

The figure 4 shows single liner regression to judge whether they have a connection. The increase in the percentage of the elderly population has a negative impact on GDP. This may be because the Australian government's annual financial burden will be heavier due to the pension and living security of the elderly, and the elderly cannot work like the young to drive economic development. The increase in the proportion of children and young adults can significantly promote economic development. From a global perspective, young adults have always been the main force in economic construction. At the same time, a series of activities such as education and medical care brought

about by raising children can also stimulate consumption and promote economic development. This is no exception in Australia.

2 Exploring Unemployment Rate

2.1 Unemployment rate plot

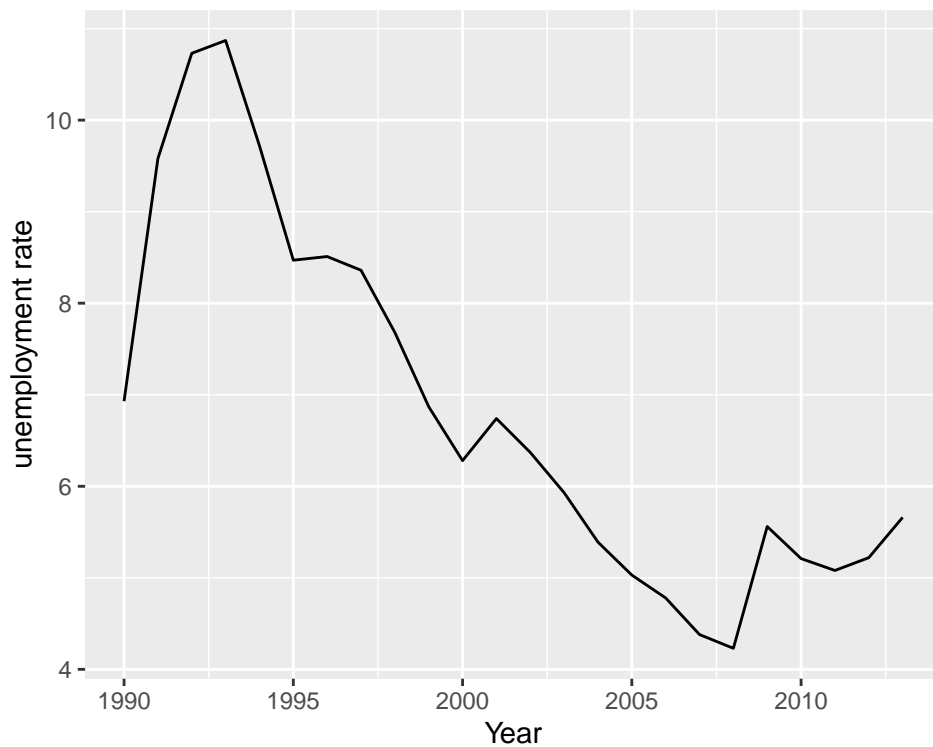


Figure 5: *Unemployment rate from 1990 to 2013*

Figure 5 shows the changes in the unemployment rate from 1990 to 2013. First, there is a long-run downward trend in the unemployment rate, which is consistent with the idea that Australia's long term unemployment ratio is relatively low among other countries in the world. Second, there are two peaks in the graph. The first peak is around the early 1990s, at the time, Australia was experiencing a recession. The second peak is around 2008 due to the global financial crisis.

2.2 Boxplot

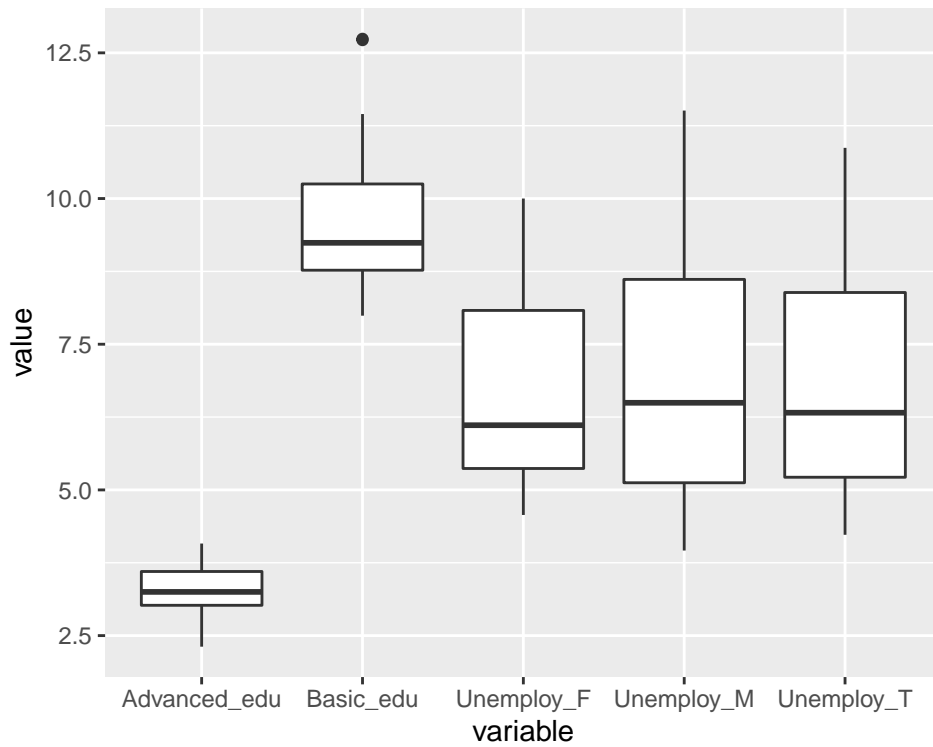


Figure 6: *Box plot of the unemployment rate*

Figure 6 shows the mean value of advanced education is higher than the mean of the basic education in the boxplot. It means that people with advanced education has a lower unemployment rate than people with basic education.

We also notice that the average male unemployment rate is slightly higher than the female unemployment rate. To see this in details, we plot the unemployment rate by genders.

2.3 Unemployment rate by genders

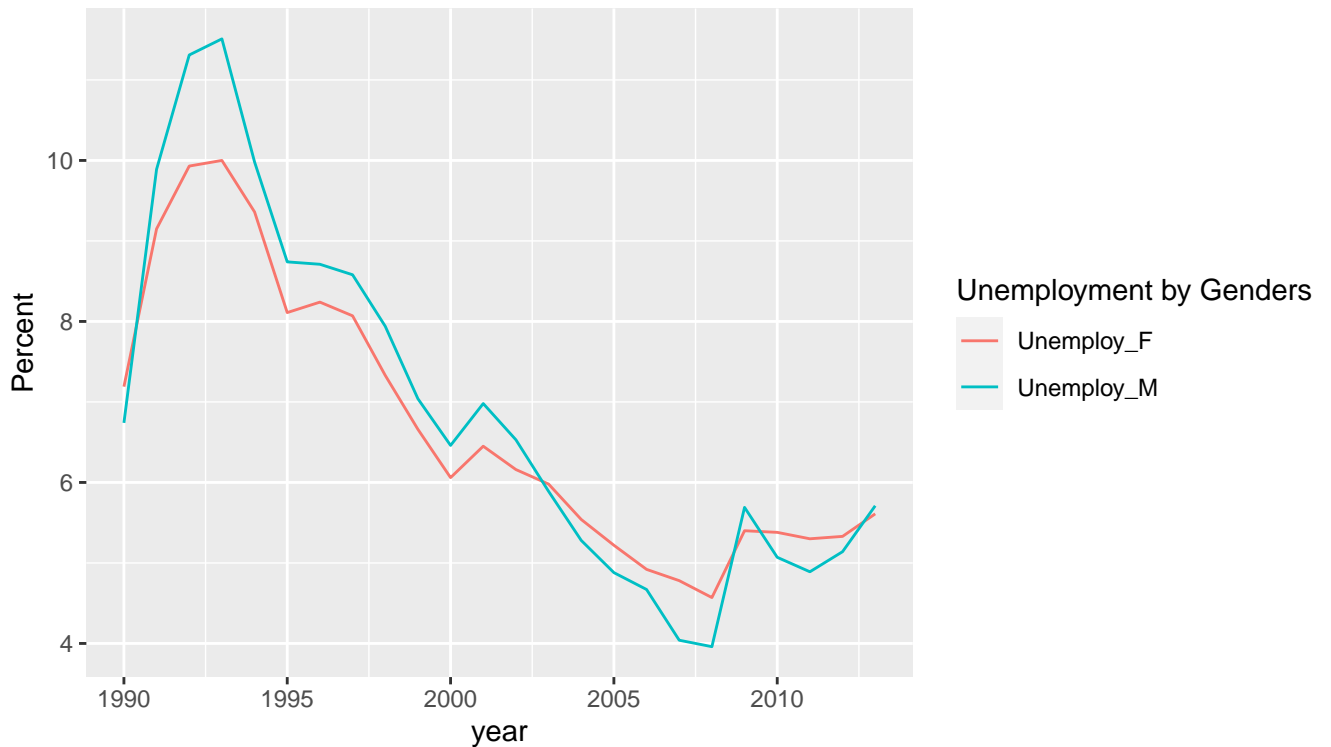


Figure 7: *Unemployment rate by genders*

Figure 7 shows that female unemployment rates have been consistently below male rates, despite there are some pick-ups in unemployment rates for females over the past few years.

In addition, the pattern of unemployment rate by genders is consistent with the total unemployment rate. Since female and male unemployment rates are the subsets of the total unemployment rate.

2.4 Correlation

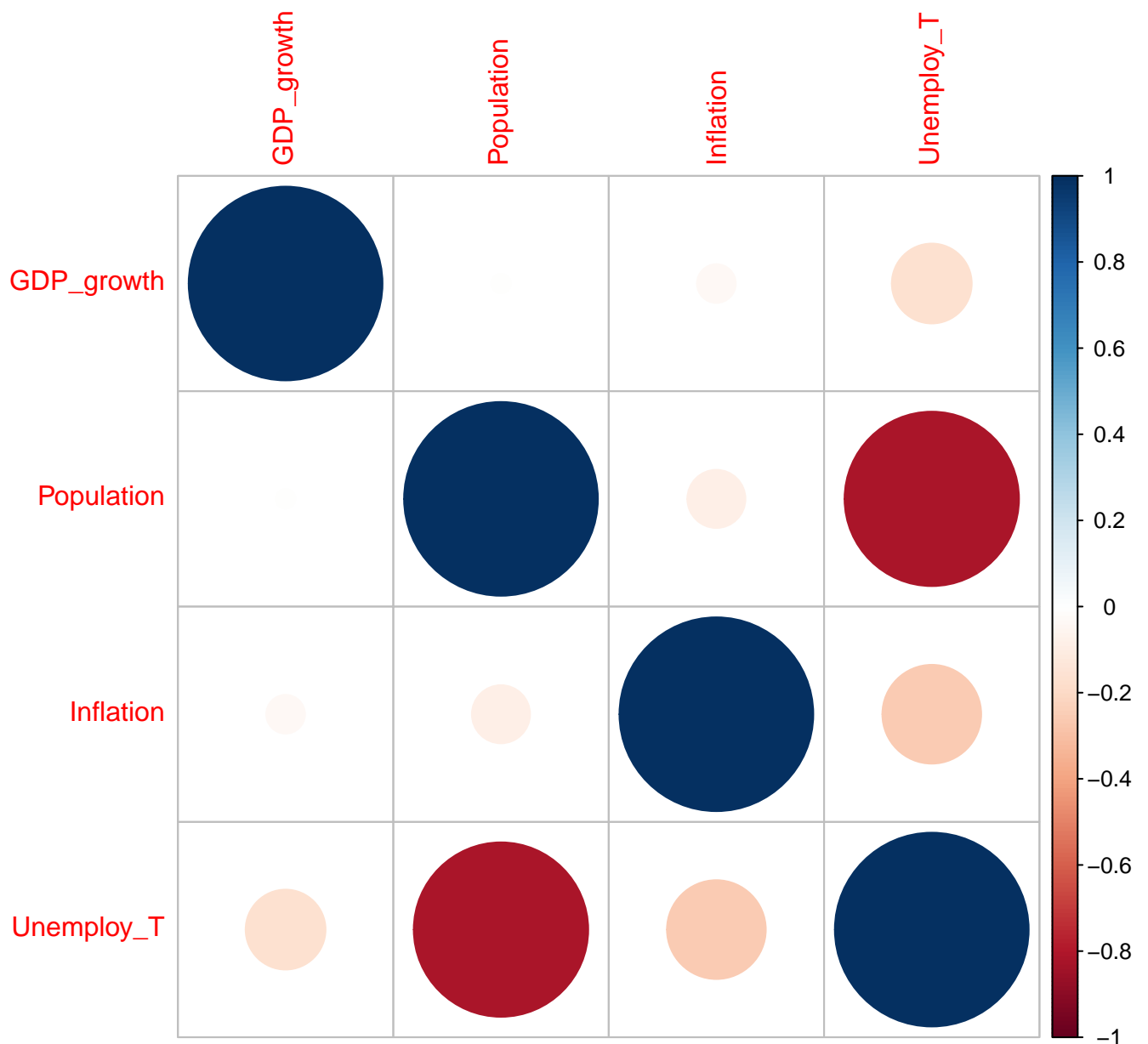


Figure 8: Correlation Graph

We expected the unemployment rate has a negative association with GDP. The low unemployment rate would lead to an increase in GDP. Based on the Phillips curve, inflation and the unemployment rate have maintained an inverse relationship historically. Therefore, we expected to see an inverse relationship between inflation and the unemployment rate. Besides, low population growth may lead to a low unemployment rate.

Figure 8 shows the sign of coefficients as we expected except for the variable population. One possible reason is that the correlation graph could be wrong as it is just an estimation.

2.5 Linear model for the unemployment rate

Table 6: *The estimated linear model for the unemployment rate*

| | Estimate | Std. Error | t value | Pr(> t) |
|-------------|------------|------------|-----------|-----------|
| (Intercept) | 27.1939625 | 2.3091897 | 11.776409 | 0.0000000 |
| GDP_growth | -0.3001259 | 0.1556400 | -1.928334 | 0.0681313 |
| Population | -0.0000009 | 0.0000001 | -8.371780 | 0.0000001 |
| Inflation | -0.4371258 | 0.1294037 | -3.378000 | 0.0029892 |

Based on Figure 8, we model the factors that affect the employment rate. Table 6 shows that all the coefficients are significant under the 10% level of significance. Finally, The value of R squared is equal to 79.95%. Therefore, the 79.95% of the variance for the unemployment rate can be explained by GDP_growth, Population and Inflation.

3 The influence of different factors on GDP

3.1 The relationship between different variables

Because there are missing values in some years of some variables in the original data, which will affect the estimation of the regression model, it is necessary to interpolate the missing values. Here I use the mean to interpolate. At the same time, I deal with the variable population in millions of units. And I made some single liner regression in figure 9 to judge whether they have a connection.

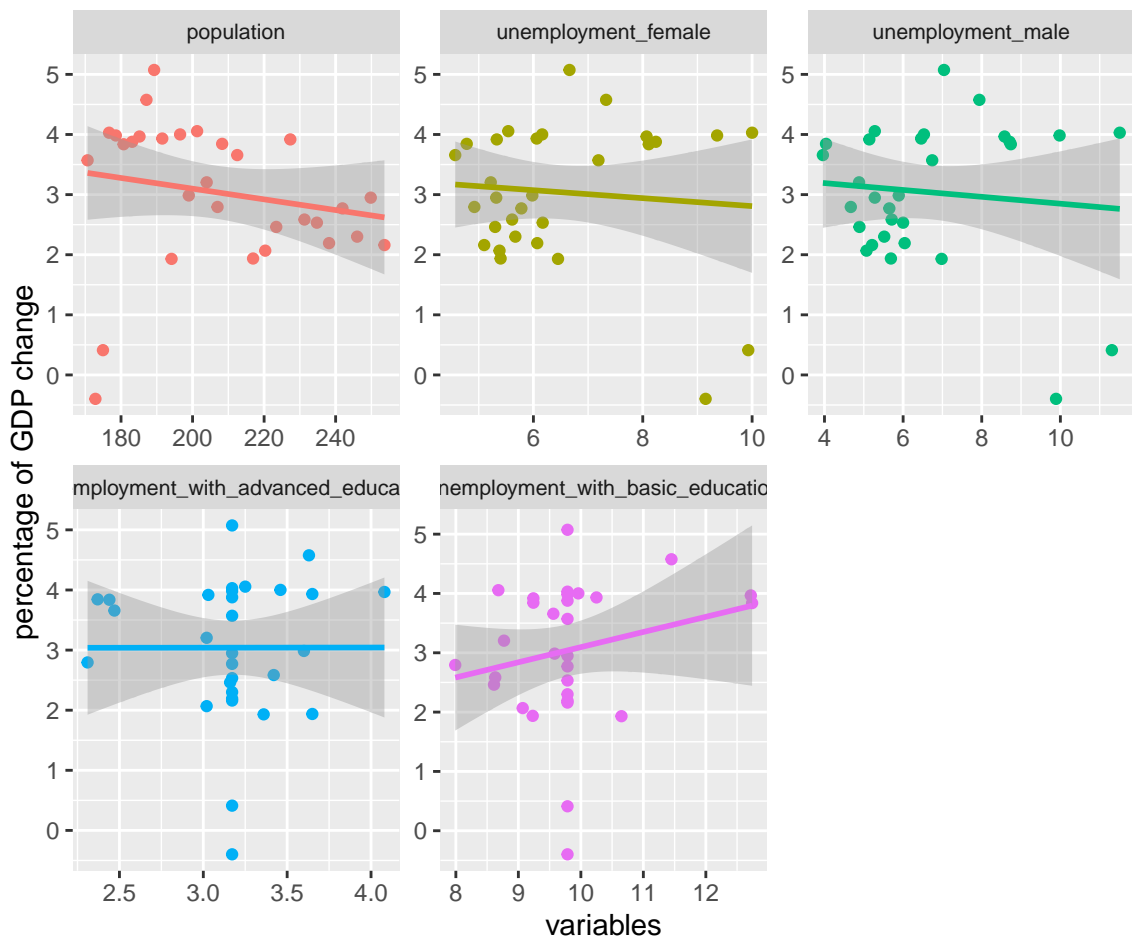


Figure 9: liner model

3.2 judgement about the regression model

| term | estimate | std.error | statistic | p.value |
|--------------------------------------|----------|-----------|-----------|---------|
| (Intercept) | 6.5313 | 4.8638 | 1.3428 | 0.1919 |
| population | -0.0234 | 0.0124 | -1.8932 | 0.0705 |
| unemployment_with_advanced_education | 0.0315 | 0.6093 | 0.0518 | 0.9591 |
| unemployment_with_basic_education | 0.3809 | 0.2490 | 1.5937 | 0.1241 |
| unemployment_female | 0.1105 | 1.0815 | -0.1022 | 0.9195 |
| unemployment_male | 0.1652 | 0.8168 | -0.3247 | 0.7482 |

3.3 Variance Inflation Factors

It can be found that in table most variables are not significant when using the whole model for regression. I think this is due to the existence of multicollinearity in the data. Let's judge whether there is serious multicollinearity.

| Variables | Variance Inflation Factors |
|------------------------------------|----------------------------------|
| population | 2.156211 |
| unemployment_1w | 234.795 |
| unemployment_1w/advanced_education | 348.467 |
| unemployment_1w/basic_education | 642.743 |
| unemployment_1w/tertiary | 620.962 |

By calculating the variance expansion factor in table we can find that the model has serious multicollinearity, so we need to delete the variables.

3.4 diagnostic diagram

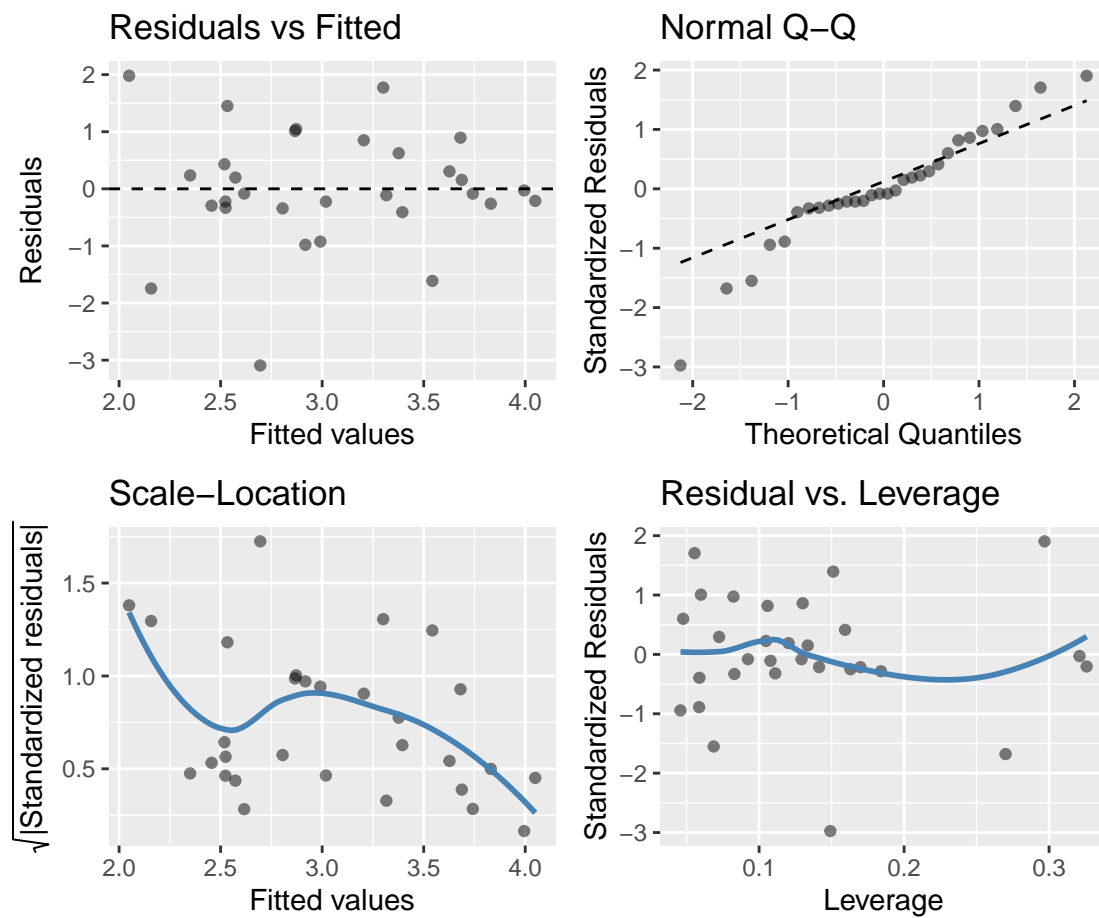


Figure 10: residuals

| term | estimate | std.error | statistic | p.value |
|-----------------------------------|----------|-----------|-----------|---------|
| (Intercept) | 6.2908 | 3.5992 | 1.7478 | 0.0923 |
| population | -0.0229 | 0.0113 | -2.0351 | 0.0522 |
| unemployment_with_basic_education | 0.1355 | 0.2245 | 1.7175 | 0.0978 |
| unemployment_male | 0.13445 | 0.1475 | -2.3356 | 0.0275 |

The regression model with stepwise regression method excluding highly correlated variables shows that variables population, unemployment_with_basic_education, unemployment_male have a significant impact on GDP growth at the significance level of 10%. To be specific, every 1 million increase

in population will reduce GDP by 0.0229%. This may be because the Australian government is unable to provide sufficient employment opportunities and the demographic dividend has not been fully released. From the perspective of variable `unemployment_with_basic_education`, every 1% increase in the employment rate of people with basic education will increase the GDP growth by 0.38% on average. This main reason may be the industrial structure in Australia is undergoing adjustment, and some industries are eliminating people with only basic education to reduce the labor cost. Finally, every 1% increase in male unemployment rate will reduce GDP growth by an average of 0.34%, which shows that male workers still dominate all walks of life in Australia. Through the above model analysis of variables. We can know that the variables “population”, “unemployment rate of basic education” and “unemployment rate of men” have a certain impact on Australia’s GDP.

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