



# ETC5513\_Assignment4

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## Overall analysis from 1990 to 2013

### 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. 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.

**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 .

From the given figure ??, 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.

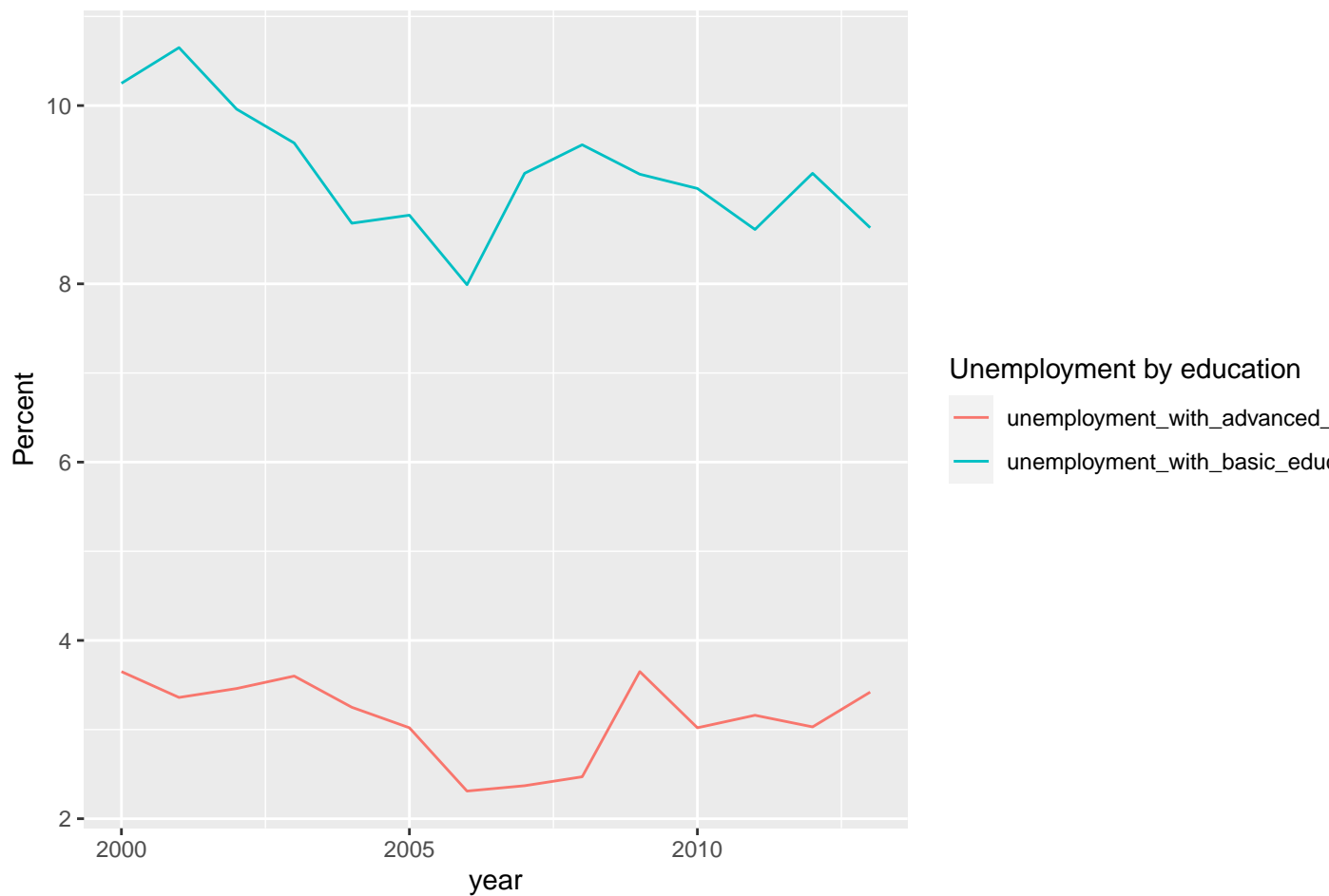
From the given figure ??, the Australian population has been growing steadily from 17,000,000 to over 25,000,000 in the year between 1990 to 2020. Australia has population growth rate around 1.48% averagely according to World Bank data. Migration and birth rate minus mortality rate were included in this growth rate.

From the given figure ??, The inflation rate was fluctuating throughout two decades. The pinnacle was in 1990, about 7% that is main attribute to the recession, While lowest point was given at 1994.

**Table 2:** *Percent change in unemployment with different education level*

year	unemploy_adv_edu	unemploy_bas_edu	unemploy_adv_edu_change	unemploy_bas_edu_change
2000	3.65	10.250000	NA	NA
2001	3.36	10.650000	-7.95%	3.9%
2002	3.46	9.960000	2.98%	-6.48%
2003	3.60	9.580000	4.05%	-3.82%
2004	3.25	8.680000	-9.72%	-9.39%
2005	3.02	8.770001	-7.08%	1.04%
2006	2.31	7.990000	-23.51%	-8.89%
2007	2.37	9.240000	2.6%	15.64%
2008	2.47	9.560000	4.22%	3.46%
2009	3.65	9.229999	47.77%	-3.45%
2010	3.02	9.070000	-17.26%	-1.73%
2011	3.16	8.610000	4.64%	-5.07%
2012	3.03	9.240000	-4.11%	7.32%
2013	3.42	8.630000	12.87%	-6.6%

From the given table ??, the unemployment rate of people with advanced education is much lower than people with basic education, which was changing at the range between 4% to 2%. While the unemployment rate for people with basic education is about 10% to 8% throughout 13 years.



The given figure ?? can demonstrate the change more obviously, the two lines are in completely different levels, that means the unemployment of basic education is much more higher than people with advanced education. However, they changes show similar pattern such as the downward trend from 1990 to 2006 and upward from 2007 to 2009.

**Table 3:** *Percent change in unemployment by gender*

year	Unemploy_F	Unemploy_M	Unemploy_F_Change	Unemploy_M_Change
1990	7.19	6.740000	NA	NA
1991	9.15	9.890000	27.26%	46.74%
1992	9.93	11.310000	8.52%	14.36%
1993	10.00	11.510000	0.7%	1.77%
1994	9.36	9.979999	-6.4%	-13.29%
1995	8.11	8.740000	-13.35%	-12.42%
1996	8.24	8.710000	1.6%	-0.34%
1997	8.07	8.580000	-2.06%	-1.49%
1998	7.33	7.940000	-9.17%	-7.46%
1999	6.66	7.040000	-9.14%	-11.34%
2000	6.06	6.460000	-9.01%	-8.24%
2001	6.45	6.980000	6.44%	8.05%
2002	6.16	6.530000	-4.5%	-6.45%
2003	5.98	5.890000	-2.92%	-9.8%
2004	5.54	5.280000	-7.36%	-10.36%
2005	5.22	4.880000	-5.78%	-7.58%
2006	4.92	4.670000	-5.75%	-4.3%
2007	4.78	4.040000	-2.85%	-13.49%
2008	4.57	3.960000	-4.39%	-1.98%
2009	5.40	5.690000	18.16%	43.69%
2010	5.38	5.070000	-0.37%	-10.9%
2011	5.30	4.890000	-1.49%	-3.55%
2012	5.33	5.140000	0.57%	5.11%
2013	5.61	5.710000	5.25%	11.09%

From the given table 3, the ratios of unemployment male and females show no apparent differences, which is around 4% to 10%, but in 1992 and 1993 women had experienced a high unemployment rate of over 11%, the rate for females was soared from the beginning of 1990s.

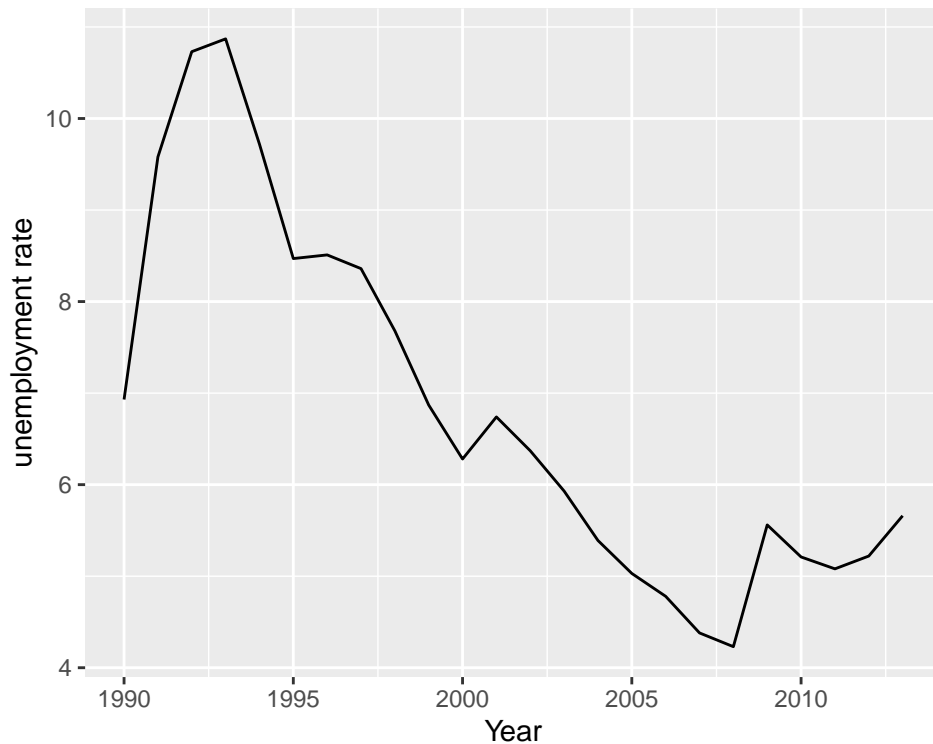
**Table 4:** *Percent change in total unemployment*

year	Unemploy_T	Unemploy_T_Change
1990	6.93	NA
1991	9.58	38.24%
1992	10.73	12%
1993	10.87	1.3%
1994	9.72	-10.58%
1995	8.47	-12.86%
1996	8.51	0.47%
1997	8.36	-1.76%
1998	7.68	-8.13%
1999	6.87	-10.55%
2000	6.28	-8.59%
2001	6.74	7.32%
2002	6.37	-5.49%
2003	5.93	-6.91%
2004	5.39	-9.11%
2005	5.03	-6.68%
2006	4.78	-4.97%
2007	4.38	-8.37%
2008	4.23	-3.42%
2009	5.56	31.44%
2010	5.21	-6.29%
2011	5.08	-2.5%
2012	5.22	2.76%
2013	5.66	8.43%

From the given table 4, the total unemployment rate of Australia showed a generally downward tendency from 1990 to 2013 since in the beginning of 1990 the rate was about 10% but after 13 years the unemployment rate has decreased to 5.66% in 2013.

## 2 Exploring Unemployment Rate

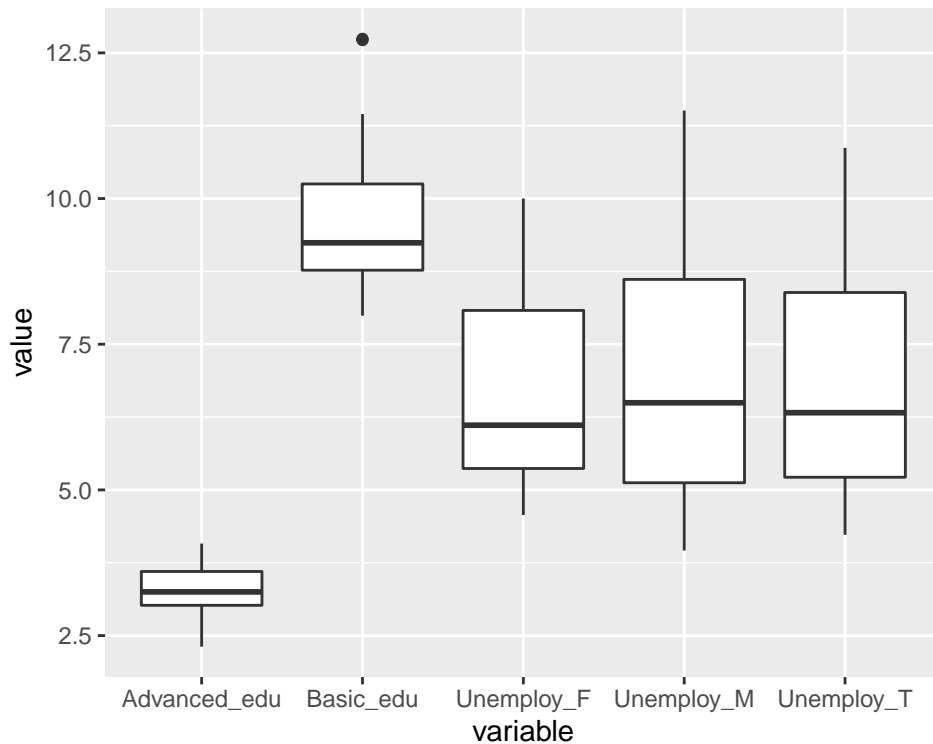
## 2.1 Unemployment rate plot



**Figure 1:** *Unemployment rate from 1990 to 2013*

Figure 1 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 2:** *Box plot of the unemployment rate*

Figure 2 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 are going to plot the unemployment rate by genders.



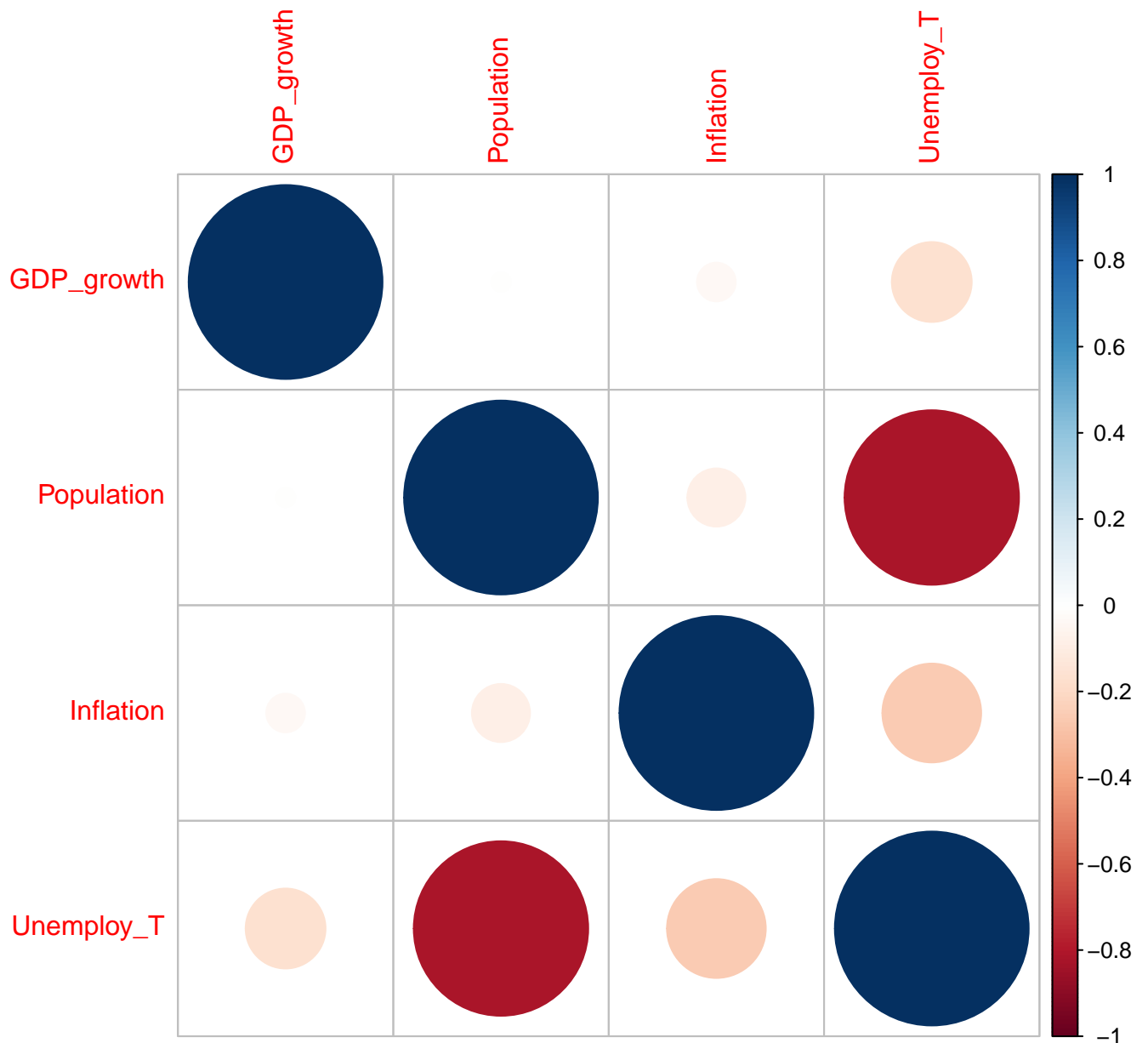
### 2.3 Unemployment rate by genders



**Figure 3:** *Unemployment rate by genders*

Figure 3 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.

## 2.4 Correlation



**Figure 4:** 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 4 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 5:** *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 4, we model the factors that affect the employment rate. Table 5 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 5 to judge whether they have a connection.

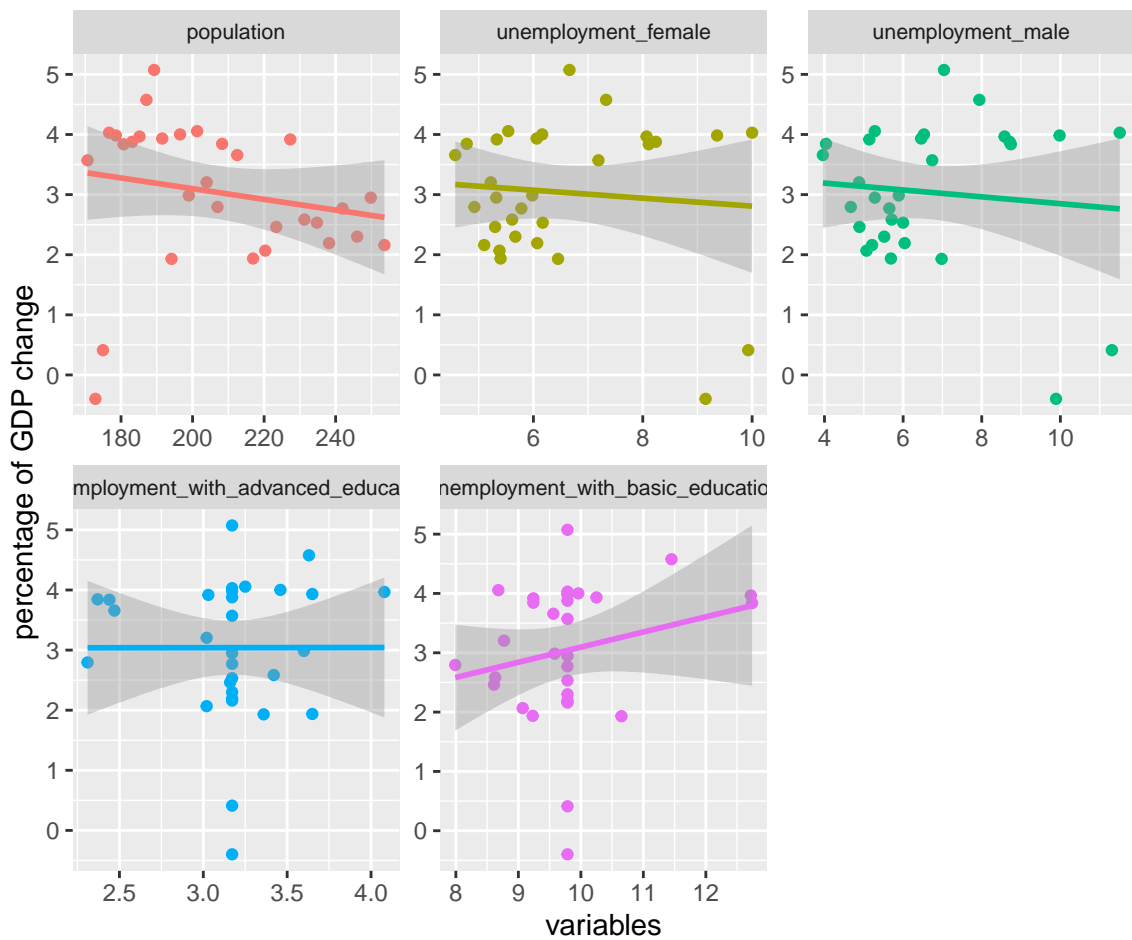


Figure 5: liner model

### 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

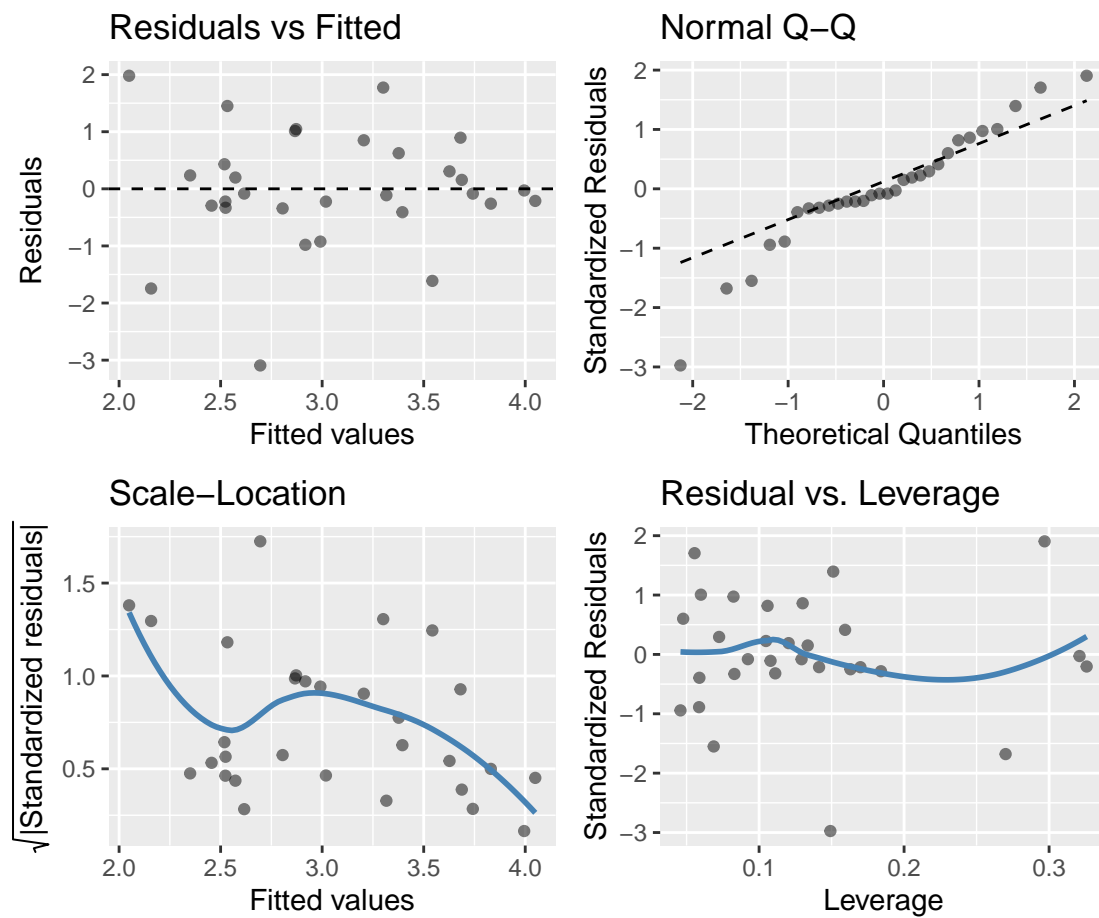


Figure 6: residuals

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	0.3855	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.

International Labour Organization. (2021b) International Labour Organization. (2021a) The World Bank (2019) United Nations Population Division (2019) International Labour Organization. (2021c) International Labour Organization. (2021d) International Labour Organization. (2021e) International Monetary Fund (2020)

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