14.02 Principles of Macroeconomics
Problem Set 1

Fall 2017

Question 1: Economic Data (Lecture 2)

This exercise helps you to get familiar with some economic data and the FRED website (https://fred.stlouisfed.org/).

- Using the search tab on the right-top, find the series you want.
- Do all the following analysis in annual frequency. You can change the frequency of the series by clicking "EDIT GRPH" and changing the part, "Modify frequency:".
- Then click "DOWNLOAD" to download the series. Use whatever software you want for the plot (Excel is perfectly fine for this question).
- Do not worry even if your figure does not look like the one in the lecture note.

(a). Unemployment and Non-employment

1. Download unemployment rate (series "UNRATE"). Plot the unemployment rate in line plot, over the period of 1960-2016.

2. Download employment to population ratio (series "EMRATIO"). Compute

$$\text{non-employment to population Ratio} = 100(\%) - \text{(employment to population ratio)}.$$

Plot the non-employment to population ratio over the period of 1960-2016.

3. Explain in short how the definition of "non-employment to population ratio" differs from "unemployment rate". As of 2016, is the unemployment rate similar to the one in 2006? As of 2016, is the non-employment to population ratio similar to the one in 2006?

(b). Okun's Law and Phillips Curve

4. Download real GDP (series "GDPC1"). Compute output growth rate

$$g_t = \frac{GDP_t - GDP_{t-1}}{GDP_{t-1}} \times 100,$$

where GDP_t is the real GDP in year t. Using the unemployment rate you downloaded (a), compute the change in the unemployment rate as

$$\Delta u_t = u_t - u_{t-1},$$

where u_t is the unemployment rate in year t. Plot Δu_t on y axis against g_t on x axis over the period of 1960-2016 (in scatter plot). (Plotting best fitting linear line is recommended, but not required).

5. Download CPI (series "CPIAUCSL"). Compute inflation rate in percentage points:

$$\pi_t = \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}} \times 100,$$

where CPI_t is CPI in year t. Then compute the changes in the inflation rate at year t as

$$\Delta \pi_t = \pi_t - \pi_{t-1}.$$

Plot $\Delta \pi_t$ on y axis against unemployment rate (which you downloaded in part (a)) on x axis over the period of 1960-2016 (in scatter plot). (Plotting best fitting linear line is recommended, but not required).

Question 2: NGDP, RGDP, Inflation (Lecture 2)

(a) Three Ways to Measure GDP

Steel Company			**Oil Company**			**Car Company**		
Revenue from sales		$130	Revenue from sales		$200	Revenue from sales	$500	
Expenses		$50	Expenses		$180	Expenses		$400
Wages	$10		Wages	$70		Wages	$220	
Oil Purchases	$40		Steel Purchases	$110		Steel Purchases	$20	
						Oil Purchases	$160	
Profit		$80	Profit		$20	Profit		$100

Table 1: Economy with three firms

Consider an economy with three firms, steel company, oil company and car company, as in Table 1. Steel and oil are used as intermediate inputs for other products, and car is the final goods.

1. Explain how you compute GDP as the value of final goods and services produced in this economy.

2. Explain how you compute GDP as the sum of value added in this economy.

3. Explain how you compute GDP as the sum of incomes in this economy.

(b) Real and Nominal GDP

Consider an economy with two goods, cars and phones, as in Table 2

	Cars		Phones	
Year	Quantity	Price	Quantity	Price
2014	5	$2,000	10	$200
2015	10	$1,000	20	$400
2016	12	$1,200	30	$200

Table 2: Two-goods Example Economy

4. Compute nominal GDP in each year.

5. Compute real GDP in each year using 2015 as the base year.

6. Using your previous answers, compute GDP deflator in each year. Using this, compute inflation rate between year 2014 and 2015 and between year 2015 and 2016.

Question 3: Government Spending Multiplier (Lecture 3)

Consider the following economy. The demand for goods, Z, is given by

$$Z \equiv C + I + G, \tag{1}$$

where C is consumption, I is investment, and G is the government spending. Consumption function is given by

$$C = c_0 + c_1 Y_D, \tag{2}$$

where $c_0 \geq 0$, $0 < c_1 < 1$, and $Y_D \equiv Y - T$ is the disposable income, where T is taxes.

When we say "exogenous variables", this refers to the variable determined outside of the model. In this context, c_0, c_1, I, G are assumed to be exogenous variables throughout the question. C, Y are endogenous variables. Hereafter, we assume T is sometimes exogenous and is sometimes endogenous.

(a). Exogenous G and T

For now, assume both G and T are exogenous.

1. Using equation (1) and equation (2), and the equilibrium condition, $Y = Z$, derive the the expression for equilibrium output, Y, as a function of exogenous variables.

2. What is the government spending multiplier in this economy? (That is, how much does equilibrium output change in response to an increase in G?) Is the increase in output larger or smaller than initial shift in demand? Summarize your findings in words.

3. Let $S \equiv Y - T - C$ denote the private saving. Derive the IS relation, which expresses I in terms of S, T, and G.

4. How much does the private saving, S, increase in response to an increase in G? (Use your answer to 3).

(b). Balanced Budget, $G = T$

Now we require balanced budget. We assume G is exogenous, but T is endogenous and has to adjust so as to keep $T = G$.

5. Derive the expression for equilibrium output, Y, in terms of exogenous variables.

6. What is the government spending multiplier in this economy? How does your answer compare to 2? Summarize your findings in words.

7. Derive the IS relation in this economy, which relates S in terms of exogenous variables.

8. How much does the private saving, S, increase in response to an increase in G?

(c). Endogenous Tax Revenue

We now assume tax revenues depend on output. That is, we assume

$$T = t_0 + t_1 Y$$

with $t_0 \geq 0$, $0 < t_1 < 1$. Also assume G is exogenous.

9. Derive the expression for equilibrium output in terms of exogenous variables.

10. What is the government spending multiplier in this economy? How does your answer compare to 2 and 6? Summarize your findings in words.

11. How much does public saving, $T - G$, decrease in response to an increase in G? Is it less than or greater than one?

12. What is the multiplier for an increase in t_0? (That is, how much does equilibrium output change in response to an increase in t_0?)