ECON 222
Macroeconomic Theory I
Fall Term 2010

Assignment 1 SOLUTION
Due: Drop Box 2nd Floor Dunning Hall by **noon October 1st** *2010*
No late submissions will be accepted
No group submissions will be accepted
No "Photocopy" answers will be accepted

Remarks: Write clearly and concisely. Present graphs, plots and tables in a format that is easy to understand. The way you present your answers will be reflected in the final grade. Even if a question is mainly analytical, **briefly** *explain what you are doing, stressing the economic meaning of the various steps.*

Question 1: The 2008-2009 Recession and the Canadian Economy (30 Marks)

The 2008-2009 downturn involved a sharp and severe contraction in the financial market. What is especially interesting to macroeconomists is the effect of the slump in the financial market on the real economy: output and employment. This question asks you to examine the impact of the most recent recession on the real economy using data from CANSIM (Statistics Canada database). Once you retrieve data, a spreadsheet program such as Microsoft Excel will work well for these purposes.

You can access CANSIM through the library website by searching for "Cansim" under "Databases" on the librarys home page. Once you connect to CANSIM @ CHASS, you should be able to click on "CANSIM Multidimensional View", and then on "CANSIM Multidimensional @ CHASS Main Menu" to access the data.

Note: If you try this from off-campus, you may need to use the Queens library webpage and read 'help with off-campus access' if you haven't already used the off-campus web proxy service.

From here, retrieve series for Canada for the period 1976-01-01 to 2010-06-01 from:

- Table 380-0002: Gross Domestic Product (GDP) at market prices; Seasonally adjusted at annual rates; Current prices (Dollars) [v498086]

- Table 380-0002: Gross Domestic Product (GDP) at market prices; Seasonally adjusted at annual rates; 2002 constant prices (Dollars) [v41707150]

- Table 282-0087: Employment; Both sexes; 15 years and over; Seasonally adjusted [v2062811]

- Table 282-0087: Unemployment; Both sexes; 15 years and over; Seasonally adjusted [v2062814]

Note: one possibility is to select the "As a time series, Columns" option, and save the data as text files one at a time. Then you can import the files in the spreadsheet, and copy the series in the same workbook.

1. Nominal GDP: Plot the first series over time in a graph and briefly comment on the 2008-2009 recession relative to the previous recessions in 1981-82 and the early 1990s.

   Answer. See Figure 1. Canada's GDP measured in terms of current prices dropped sharply during the 2008-2009 recession. Based on nominal GDP, the most recent recession appears much more severe than the recessions in 1981-1982 and in the early 1990s. What we can't tell from looking at nominal GDP is how much of the contraction is due to a decline in prices, and how much is due to a decrease in the quantity of goods and services produced. □

2. Real GDP: Plot the second series over time. In the US, the 2008-2009 contraction in output was driven primarily by a reduction in the quantity of output produced rather than by changes in prices. Does this appear the be the case in Canada?

Answer. See Figure 2. Trends in Canada's real GDP reflect changes in the volume of output. Based on real GDP, the severity of the most recent recession appears more in line with the previous recessions. The fact that the decline in GDP is more severe when measured in nominal terms points to changes in the prices of goods and services as an important determinant of the sharp drop in nominal GDP. This is a key difference between the 2008-2009 recessions in the US and Canada. □

3. Compute the growth rate of annual nominal and real GDP over the past five years (i.e., the percentage change from 2005-2006, 2006-2007, 2007-2008, 2008-2009). Report them on a table (to two decimal places) together with annual nominal and real GDP for those years.

   Answer. See Table 1. Note that because GDP per quarter is expressed as a seasonally adjusted annual rate (SAAR), to obtain annual GDP we take an average of the four quarters. □

4. Using the final two series, compute the average employment rate in Canada for each month and plot it in a graph. Comment briefly on employment in Canada during the 2008-2009 recession relative to the previous recessions in 1981-1982 and the early 1990s.

   Answer: See Figure 3. Employment did not drop as much in Canada during the most recent recession as it did during the recession in 1981-82 and the recession in the early 1990s.
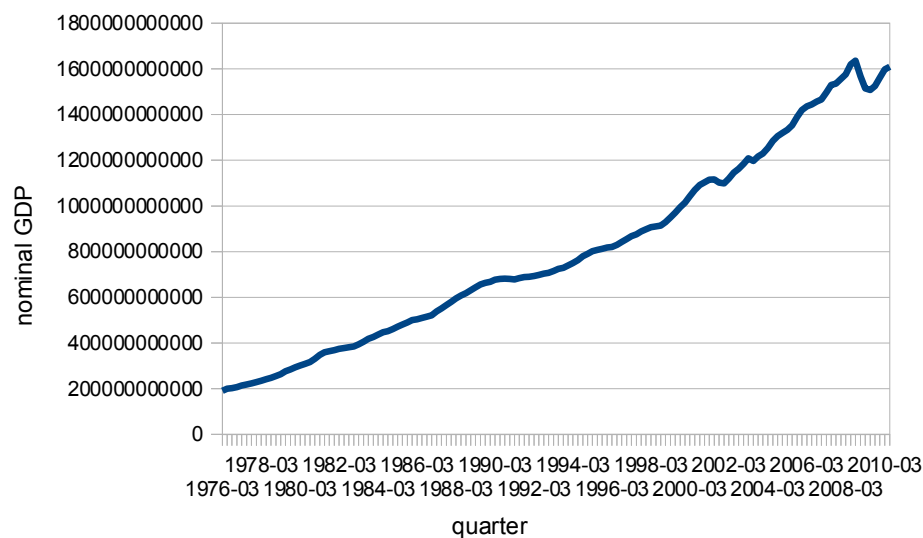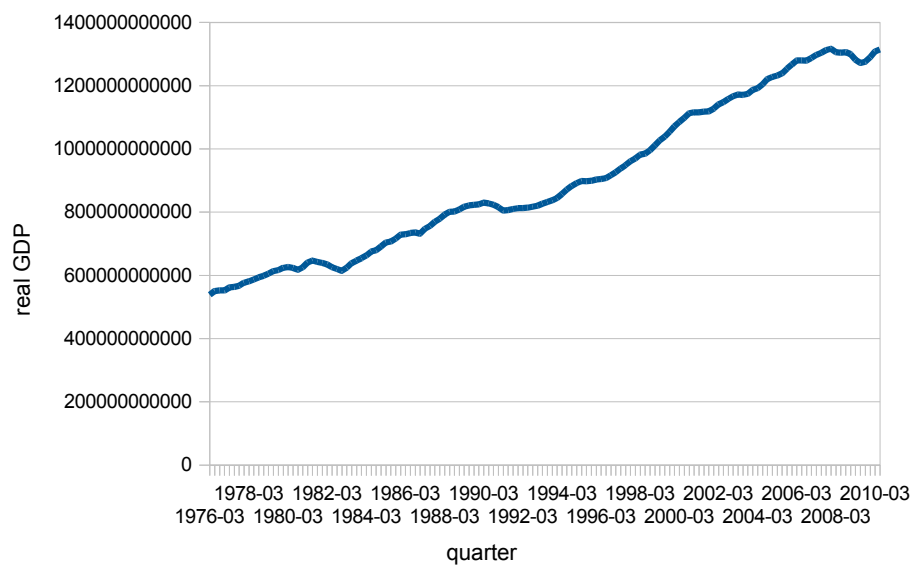

Figure 1: Canadian GDP (current prices)

Figure 2: Canadian GDP (2002 constant prices)

Table 1: Growth Rates of GDP

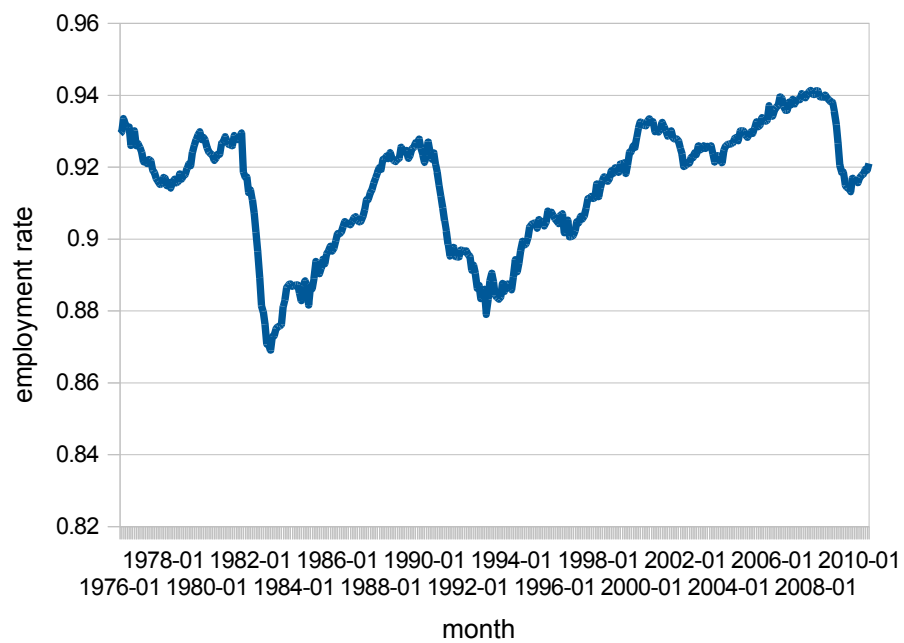|	nominal GDP		real GDP	
YEAR	level	growth rate	level	growth rate
2005	1373845000000		1247507000000	
2006	1450405000000	5.57	1281240000000	2.7
2007	1529589000000	5.46	1307323000000	2.04
2008	1599608000000	4.58	1303715000000	-0.28
2009	1527258000000	-4.52	1279397000000	-1.87

Figure 3: Canadian Employment Rate

Question 2: Employment, Output, Productivity and Inflation (20 Marks)

Suppose there is an economy that produces only two goods: tequila and peyote. In 2008, the economy produced 100 litres of tequila and 200 peyote plants. The unit prices (per litre or per plant) in 2008 were $100 and $500. 1000 people were employed in the tequila sector, and the peyote sector employed 500.

In 2009, the weather was particular sunny and hot, which is good for tequila production but bad for the cultivation of peyote. As a result, the economy produced 120 litres of tequila but only 191 peyote plants in 2009. The tequila and peyote sold for $90 per litre and $550 per plant that year. 1100 people were employed in the tequila sector, while only 450 people worked in the peyote sector.

Answer the following questions:

1. How much is Nominal GDP in 2008 and 2009? What is the percentage change?

   Answer.

   $$GDP_{08} = 100 \times \$100 + 200 \times \$500 = 10000 + 100000 = \$110000$$
   $$GDP_{09} = 120 \times \$90 + 191 \times \$550 = 10800 + 105050 = \$115850$$
   $$\%\Delta_{GDP} = \frac{115850 - 110000}{110000} \approx 5.32\%$$

   □

2. How much is Real GDP in 2008 and 2009, by considering 2008 as the base year? What is the percentage change?

   Answer.

   $$GDP_{08} = 100 \times \$100 + 200 \times \$500 = 10000 + 100000 = \$110000$$
   $$GDP_{09} = 120 \times \$100 + 191 \times \$500 = 12000 + 95500 = \$107500$$
   $$\%\Delta_{GDP} = \frac{107500 - 110000}{110000} \approx -2.27\%$$

   □

3. How much is the GDP deflator in the two years? By what percentage does the price level change from the base year to 2009?

   Answer. The GDP deflator is the ratio of nominal GDP to real GDP. In the base year, nominal GDP equals real GDP, so the GDP deflator is 1. In 2009 it is approximately 1.08, so the price level rose by about 8%.   □

4. What was the growth rate of average labour productivity for the whole economy between 2008 and 2009?

   Answer. The average labour productivity in 2008 was $\frac{110000}{1000+500} = \$73.33$ per worker while in 2009, it was $\frac{107500}{1100+450} = \$69.35$ per worker. Hence, its growth rate is $\frac{69.35-73.33}{73.33} = -5.43\%$.   □

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Question 3: National Accounting (20 Marks)

In Table 2, you find figures taken from some Country's national accounts for the fiscal year 2009. Figures are in billions of dollars. Find:

1. Savings

   Answer. $S = Y + NFP - C - G = 4000 + 150 - 3000 - 500 = 650$ □

2. Private Savings

   Answer. $S_{pvt} = PDI - C = 400$

   □

3. Net Government Income

   Answer. $NGI = T - TR - INT = 1000 - 170 - 80 = 750$; using
   $PDI = Y + NFP + TR + INT - T \Rightarrow 3400 = 4000 + 150 + 170 + INT - 1000 \Rightarrow INT = 80$

   □

4. Gross National Product

   Answer. $GNP = GDP + NFP = 4150$

   □

5. Net Exports

   Answer. $NX = Y - C - I - G = 200$

   □

6. Government Interests Payments

   Answer. $PDI = Y + NFP + TR + INT - T \Rightarrow 3400 = 4000 + 150 + 170 + INT - 1000 \Rightarrow INT = 80$
   □

7. Current Account Balance

   Answer. $CA = NX + NFP = 350$ □

Variable	Value
Y (GDP)	4000
NFP (Net Factor Payments)	150
C (Consumption)	3000
G (Government Expenditures)	500
PDI (Personal Disposable Income)	3400
I (Investment)	300
T (Taxes)	1000
TR (Government Transfers)	170

Table 2: Question 3

Question 4: The Aggregate Production Function (30 Marks)

This question focuses on labour productivity, labour demand, and generally on the production function. Assume that the Aggregate Production Function is represented by the following equation:

$$Y = K^\alpha (AN)^\beta + L^\gamma$$

Y stands for output, K stands for the capital stock, N stands for the number of people employed, L stands for the quantity of land used in production, and A stands for a measure of labour efficiency. α, β, and γ are parameters whose values are between 0 and 1.

Part a)

Derive an analytical expression for:

1. the marginal product of capital (MPK);

   Answer.

   $$MP_K = \frac{\partial Y}{\partial K} = \alpha K^{\alpha-1}(AN)^\beta$$

   □

2. the marginal product of labour (MPN);

   Answer.

   $$MP_N = \frac{\partial Y}{\partial N} = K^\alpha A^\beta \beta N^{\beta-1}$$

   □

3. the marginal product of land (MPL).

   Answer.

   $$MP_L = \frac{\partial Y}{\partial L} = \gamma L^{\gamma-1}$$

   □

Part b)

1. Using a spreadsheet, fix $K = 9$ and $A = L = 1$. Consider $\alpha = \beta = \gamma = \frac{1}{2}$ and plot the MPN vs. N, for $N = 1, 2, \ldots, 15, 16$.

   Answer. Given those values, the expression becomes :

   $$MP_N = 9^{1/2}\frac{1}{2}\frac{1}{N^{1/2}}$$

   It should give a graph that looks like figure 4.   □

2. Suppose the real wage paid to labour is $w = 1$. Again, fix $K = 9$ and $A = L = 1$ and consider $\alpha = \beta = \gamma = \frac{1}{2}$. Find the level of employment (N) in the economy. What happens to the level of employment (N) if labour becomes more productive, for example if $A = 3$?
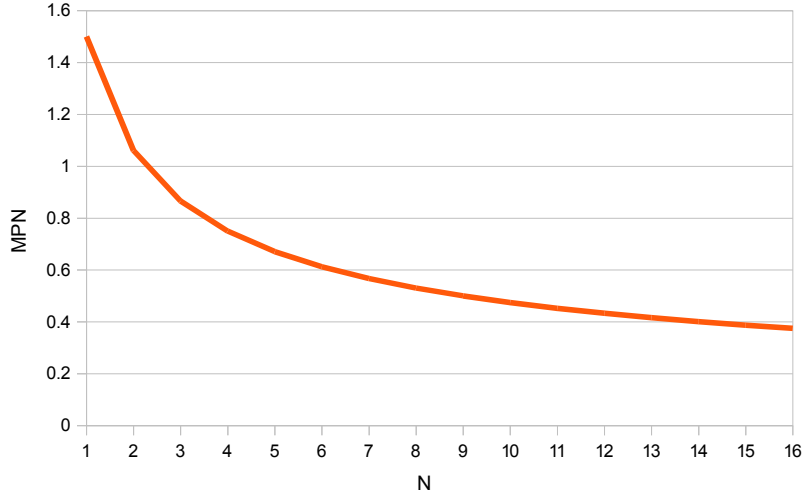
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Figure 4: **Marginal product of labour (Solution to Q4 b) 1))**

	$K = 0$	$K = 1$	$K = 2$	$K = 4$	$K = 16$
$N = 0$	1	1	1	1	1
$N = 1$	1	2.47	3.30	4.62	9.91
$N = 2$	1	2.87	3.94	5.61	12.35
$N = 4$	1	3.39	4.47	6.88	15.47
$N = 16$	1	4.88	7.08	10.54	24.50

Table 3: Question 4, Part b) 3)

Answer. We have :

$$w = K^\alpha A^\beta \beta N^{\beta-1}$$

$$\Rightarrow N = \left(\frac{K^\alpha A^\beta \beta}{w} \right)^{1/(1-\beta)}$$

With the first values, this gives $N = 2.25$ while with $A = 3$, this gives $N = 6.75$. $\square$

3. Use calculus to show that (given K, L and A) the MPN declines as the level of employment (N) increases. Using a spreadsheet, fix $A = 3$ and $L = 1$. Consider $\alpha = 0.65$, $\beta = 0.35$, and $\gamma = 1$ and compute total output for all the pairs shown in Table 3. Report the values in a similar table.

Answer.

$$\frac{\partial}{\partial N} MP_N = (\beta - 1)K^\alpha A^\beta \beta N^{\beta-2}$$

which is negative since $\beta - 1 < 0$ and all other terms are positive. Values can be found in Table 3.

$\square$