

**Homework will be graded for both content and neatness. Sloppy or illegible work will not receive full credit. This homework requires the use of Microsoft Excel.**

1) Assume that the economy is composed of three firms: Albert's furniture (Firm A), Brian's lumber yard (Firm B), and Carl's timber harvesting (Firm C). As their names suggest, Firm B purchases timber from Firm C to produce lumber, which is then used by Firm A to produce furniture. Albert directly sells his furniture to consumers. Therefore, only Firm A is producing a final good. Assume that all intermediate goods are used in the production final goods.

	Firm A	Firm B	Firm C
Sales	\$7,000	\$3,000	\$2,000
Raw Materials			
Wages	\$1,500	\$250	\$1,130
Interest Payments	\$750	\$50	\$300
Rent	\$1,250	\$600	\$210
Profit	\$500	\$100	\$360
Factor Expenditures			
Value Added			

Factor of Production	Factor Payment
Labor	Wages
Capital	Interest
Land	Rent
Entrepreneurship	Profit

A) Complete the table.

	Firm A	Firm B	Firm C
Sales	\$7,000	\$3,000	\$2,000
Raw Materials	\$3,000	\$2,000	\$0
Wages	\$1,500	\$250	\$1,130
Interest Payments	\$750	\$50	\$300
Rent	\$1,250	\$600	\$210
Profit	\$500	\$100	\$360
Factor Expenditures	\$4,000	\$1,000	\$2,000
Value Added	\$4,000	\$1,000	\$2,000

B) Compute GDP using the following equivalent approaches.

i) Product

*Only Firm A produces a final good. The total market value of Firm A's output is \$7000. Therefore, the product approach says that GDP is \$7000.*

ii) Expenditure

*Consumers are spending \$7000 on final goods/services, so GDP via the expenditure approach is also \$7000. In other words,  $C = \$7000$ ,  $I = \$0$ ,  $G = \$0$ ,  $NX = \$0$ ;  $Y = C + I + G + NX = \$7000$ .*

iii) Value Added

*GDP = sum of the value added by firms =  $\$4000 + \$1000 + \$2000 = \$7000$ .*

iv) Income

*GDP = sum of factor income = sum of factor payments made by firms =  $\$4000 + \$1000 + \$2000 = \$7000$ .*

C) Although they agree theoretically, briefly discuss why these four approaches to calculating GDP may disagree when applied to a real-world industrialized economy, such as the United States. Does this inconsistency suggest that GDP is a poor measure of economic activity? Why or why not?

*Real-world data is subject to measurement error and accounting mistakes, so it is not unreasonable that the different methods used in calculating GDP would disagree slightly. Any proposed measure of the level of economic activity in a country would be affected by these problems, so such inconsistency does not imply that GDP is a poorly constructed measure. However, we should be worried if the various GDP approaches are giving us wildly different results.*

2) Working as a research assistant, the US Bureau of Economic Analysis (BEA) has provided you with the following table concerning quarterly US GDP. However, the file has been corrupted, with multiple entries missing. The use of Excel is required for this problem.

	2008 I	2008 II	2008 III	2008 IV
<b>Gross domestic product</b>	<b>14,373.90</b>	<b>14,497.80</b>	<b>14,546.70</b>	<b>14,347.30</b>
<b>Personal consumption expenditures</b>	<b>10,095.10</b>	<b>10,194.70</b>	<b>10,220.10</b>	<b>10,009.80</b>
Goods	3,447.20	3,474.90	3,463.00	3,227.50
Durable goods	1,145.80	1,126.50	1,088.50	1,019.90
Nondurable goods	2,301.40	2,348.40	2,374.50	2,207.60
Services	6,647.90	6,719.80	6,757.10	6,782.30
<b>Gross private domestic investment</b>	<b>2,214.80</b>	<b>2,164.60</b>	<b>2,142.70</b>	<b>2,022.10</b>
Fixed investment	2,223.00	2,214.00	2,179.60	2,066.60
Nonresidential	1,705.00	1,719.70	1,711.00	1,638.70
Structures	586.30	610.6	620.4	620.7
Equipment and software	1,118.70	1,109.20	1,090.60	1,018.00
Residential	518.1	494.30	468.6	427.8
Change in private inventories	-8.2	-49.40	-36.90	-44.5
<b>Net exports of goods and services</b>	<b>-744.50</b>	<b>-738.7</b>	<b>-757.5</b>	<b>-590.5</b>
Exports	1,803.60	1,901.50	1,913.10	1,706.20
Goods	1,247.30	1,326.20	1,338.50	1,155.70
Services	556.30	575.3	574.6	550.5
Imports	2,548.10	2,640.20	2,670.50	2,296.70
Goods	2,143.20	2,226.80	2,243.30	1,892.50
Services	404.9	413.4	427.20	404.2
<b>Government consumption expenditures and gross investment</b>	<b>2,808.40</b>	<b>2,877.10</b>	<b>2,941.40</b>	<b>2,905.90</b>
Federal	1,038.40	1,069.50	1,108.30	1,114.30
National defense	703.6	725.6	763.60	758.9
Nondefense	334.8	343.9	344.7	355.40
State and local	1,770.00	1,807.60	1,833.10	1,791.60

A) Complete the table.

*See above.*

B) Are imports added to or subtracted from US GDP? Provide a short rationale.

*Subtracted; imported goods are not produced in the US, and should only be counted in the GDP of the originating country. Adding imports to US GDP would effectively double-count those goods. Using the expenditure approach, imports are included in C (e.g., if a household purchases a bottle of French*

***wine the expenditure will be recorded as part of consumption expenditure) but then subtracted out in NX. This prevents the inclusion of imported goods in domestic output when computing GDP using the expenditure approach.***

C) Your faculty advisor notices that US net exports increased substantially in the fourth quarter of 2008. This coincided with the worst of the financial crisis, during which international trade declined sharply. Strictly looking at the data, what is your explanation for this?

***Both exports and imports declined, but the fall in imports was larger. Therefore, net exports increased. In other words, the decline in imports outweighed the decline in exports.***

D) In 2008, stock market indices lost 20-25% of their value. Housing prices continued to collapse, and many households viewed real estate as an important form of wealth. Given these economic events, give a brief argument as to why US imports fell by 15%.

***Devalued stock markets and falling housing prices both imply that consumer wealth is decreasing, so consumer demand for both durable and non-durable goods should decrease. This includes demand for imported goods and services, which explains the decline in US imports.***

3) The following question deals with the GDP accounting equation and an approximation discussed by Mankiw 7e on p. 26. Equations (1) – (4) are provided, so you can take them as known already. “%Δ” stands for percentage change, and is defined in the typical way as  $\% \Delta Y = (Y' - Y) / Y = \Delta Y / Y$ .

$$Y_N = C + I + G + NX \quad (1)$$

$$Y_R = Y_N / \text{GDP Deflator} = Y_N / D \quad (2)$$

$$\% \Delta(AB) \approx \% \Delta A + \% \Delta B \quad (3)$$

$$\% \Delta(A/B) \approx \% \Delta A - \% \Delta B \quad (4)$$

Variable	Definition
$Y_N$	Nominal GDP
$Y_R$	Real GDP
C	Consumption
I	Investment
G	Gov't Exp.
NX	Net Exports
D	GDP Deflator

(1) is the GDP accounting equation; this is how GDP is defined using the expenditure approach. Total spending (GDP) equals the sum of expenditure on each of the four components. Equation (2) is just the definition of Real GDP when Nominal GDP is provided, translating between the two with the GDP Deflator. (3) and (4) are “arithmetic tricks” that Mankiw talks about on page 26 of the text.

A) Let’s say that you know how fast the components of GDP are growing, and you know how much each component contributes towards the total. This information can be used to calculate the growth rate of Real GDP, provided that the inflation rate is known. In the question, you will show exactly how to do this. Write the growth rate of Real GDP ( $\% \Delta Y_R$ ) in terms of the growth rates of C, I, G, and NX ( $\% \Delta C$ ,  $\% \Delta I$ ,  $\% \Delta G$ ,  $\% \Delta NX$ ) and the component shares of GDP ( $C / Y_N$ ,  $I / Y_N$ ,  $G / Y_N$ ,  $NX / Y_N$ ). Assume that the inflation rate is 3%. [HINT: start by using (2) and (4) to write  $\% \Delta Y_R$  in terms of  $\% \Delta Y_N$  and  $\% \Delta D$ .  $\% \Delta D$  is given to you in the problem.  $\% \Delta Y_N$  can be written in terms of component growth rates and component shares. Remember that  $\Delta Y_N = \Delta C + \Delta I + \Delta G + \Delta NX$ , divide by  $Y_N$ , and do some algebra.]

$$Y_R = Y_N / D$$

$$\% \Delta(Y_R) \approx \% \Delta(Y_N) - \% \Delta D$$

$$\% \Delta(Y_R) \approx (\Delta Y_N) / Y_N - \% \Delta D$$

$$\% \Delta(Y_R) \approx (\Delta C + \Delta I + \Delta G + \Delta NX) / Y_N - \% \Delta D$$

$$\% \Delta(Y_R) \approx (\Delta C) / Y_N + (\Delta I) / Y_N + (\Delta G) / Y_N + (\Delta NX) / Y_N - \% \Delta D$$

$$\% \Delta(Y_R) \approx (\Delta C / C)(C / Y_N) + (\Delta I / I)(I / Y_N) + (\Delta G / G)(G / Y_N) + (\Delta NX / NX)(NX / Y_N) - \% \Delta D$$

$$\% \Delta(Y_R) \approx (\% \Delta C)(C/Y_N) + (\% \Delta I)(I/Y_N) + (\% \Delta G)(G/Y_N) + (\% \Delta NX)(NX/Y_N) - 3\% \blacksquare$$

**B)** Let  $C / Y_N = 0.65$ ,  $I / Y_N = 0.10$ ,  $G / Y_N = 0.20$ , and  $NX / Y_N = 0.05$ . What is the effect on  $\% \Delta Y_R$  of a 1% increase in  $\% \Delta C$ ? What is the effect on  $\% \Delta Y_R$  of a 1% increase in the inflation rate? [*HINT: This is asking for the derivatives  $\partial(\% \Delta Y_R) / \partial(\% \Delta C)$  and  $\partial(\% \Delta Y_R) / \partial(\% \Delta D)$ . You can differentiate directly.*]

$$\% \Delta(Y_R) \approx (\% \Delta C)(0.65) + (\% \Delta I)(0.10) + (\% \Delta G)(0.20) + (\% \Delta NX)(0.05) - \% \Delta D$$

$$\partial(\% \Delta Y_R) / \partial(\% \Delta C) = 0.65 \quad ; \quad \% \Delta Y_R \text{ increases by } 0.65\%.$$

$$\partial(\% \Delta Y_R) / \partial(\% \Delta D) = -1 \quad ; \quad \% \Delta Y_R \text{ decreases by } 1\%.$$

**C)** For the United States in the fourth quarter of 2008:  $\% \Delta C = -2.05\%$ ,  $\% \Delta I = -5.62\%$ ,  $\% \Delta G = -1.21\%$ , and  $\% \Delta NX = 22\%$ . Compute  $\% \Delta Y_R$ .

$$\% \Delta(Y_R) \approx (-2.05\%)(0.65) + (-5.62\%)(0.10) + (-1.21\%)(0.20) + (22\%)(0.05) - 3\%$$

$$\% \Delta(Y_R) \approx -4.04\%$$

4) You are given prices for three goods from 2007-2009. The Consumer Price Index (CPI) market basket is two units of rice, one unit of apples, and one unit of oranges. The CPI is constructed in the usual way, with a value of 100 meaning that the overall price level has not changed.

(price per unit)	2007	2008	2009
Rice	0.5	0.4	0.3
Apples	0.25	0.4	0.6
Oranges	0.4	0.5	0.4

A) With 2007 as the base year, what is the CPI in 2007? [HINT: no calculation required]

$$CPI_{2007} = 100.$$

B) With 2007 as the base year, what is the CPI in 2008? What about 2009?

$$CPI_{2008} = 103; CPI_{2009} = 97.$$

C) What is the inflation rate from 2007 to 2008?

$$\pi_{2008} = \% \Delta CPI = (103 - 100)/100 = 3\%$$

D) Using 2008 as the base year, what is the CPI in 2009? Between 2008 and 2009, did inflation or deflation occur? What is the inflation/deflation rate?

$$CPI_{2009} = 94; \text{deflation}; \pi_{2009} = \% \Delta CPI = (94 - 100)/100 = -6\%.$$

E) Briefly discuss the sensitivity of the CPI measure to the specification of the market basket.

*The market basket used to construct the CPI should be that of a representative consumer; the market basket should be what the average consumer purchases on a yearly basis. If the CPI is inappropriately weighted towards a particular good (the market basket contains too many units of the good), the measure will be too sensitive to changes in the price of that good. For example, let's say that the CPI gives high weight to orange juice, and the price of orange juice doubles while the general price level falls. Although deflation has occurred in the economy, the CPI reports that the expenditure required to purchase the market basket of goods has increased, which suggests inflation as measured by the percentage change in the CPI. A price index that is poorly constructed can mislead policy makers and the general public. Therefore, if we want the CPI to be an accurate indicator of the overall price level*

*in the economy (at least those prices faced by consumers), the market basket should be representative. Survey data can tell us, roughly, what the “average” consumer buys.*

**F)** Households start to consume a new good which was not in the CPI market basket before. This good was commercialized due to a recent technological advance. How could you keep the CPI measure consistent across time while accounting for this new good?

*The CPI breaks down household expenditure into a number of categories: transportation, housing, clothing, entertainment, and so on. If the new good is a refinement of a pre-existing good, such as the LCD computer monitor replacing the previous CRT technology, then you could simply replace the old good with the new. However, you’ll have a discrete change in the CPI when the old good is removed, timing is important (when do you make the replacement?), and consistency is problematic. If the new good has no pre-existing analogue, then the problem becomes more difficult. For example, let’s say that the television was just invented. Since the TV is classified as entertainment, you could phase out older forms of entertainment, such as radio, and gradually increase the number of TVs in the market basket. Again, this could be done based on survey data, but there is no straightforward methodology.*

5) The following data on the labor force is provided to you by the US Bureau of Labor Statistics (BLS). Again, the database has been corrupted.

Adult Pop.	15000	Adult Pop., % Female	45%	Adult Pop., % Male	55%
Labor Force	10000	Labor Force, % Female	40%	Labor Force, % Male	60%
Unemployed	1000	Unemployed, % Female	55%	Unemployed, % Male	45%
Employed	9000	Employed, % Female		Employed, % Male	

A) What is the total unemployment rate?

$$UR = U/LF = 1000/10000 = 10\%.$$

B) What is the total labor force participation rate?

$$LFPR = LF/Pop. = 10000/15000 = 67\%.$$

C) What is the unemployment rate for females? What is the labor force participation rate for females?

$$UR_F = U_F/LF_F = 550/4000 = 13.75\%.$$

$$LFPR_F = LF_F/Pop._F = 4000/6750 = 59.26\%.$$

D) What is the unemployment rate for males? What is the labor force participation rate for males?

$$UR_M = U_M/LF_M = 450/6000 = 7.5\%.$$

$$LFPR_M = LF_M/Pop._M = 6000/8250 = 72.73\%.$$

- 6) “Accounting frameworks affect behavior. More generally, information affects behavior. What we gather our information about, and how we describe success, affects what we strive for. If GDP is what we think is success, people will strive for growing GDP. Politicians, for example, will then describe how they increased GDP x%, creating a sense of importance to the measure. By doing that though, they focus policies on things that will increase GDP.” – Joseph Stiglitz

Do you think that GDP is an accurate/fair measure of human welfare/standard of living? Why or why not? What about real GDP/capita? How could it be improved, if improvement is necessary? Answer this in a few paragraphs.

*I will just outline one possible response.*

GDP is not inflation-adjusted or in per-capita terms, so at least those modifications need to be made in order to get a measure of per-person standard of living or welfare. GDP measurement is subject to a number of flaws, such as measurement error, accounting error, and the presence of a well-developed underground economy. However, any aggregate measure on the national level is subject to the same problems. Inaccuracy of the measure is secondary to its construction in terms of the problem of using GDP as an indicator of how well off the average citizen is.

Do not read too much into the meaning of GDP figures. GDP is only a measure of the level of output, the general level of economic activity in a country. It has no component that captures income inequality, the environmental consequences of production, social stability, democracy, education, health, happiness, and so on. In other words, it is a very one-dimensional measure that does not give a complete picture in terms of human welfare. The welfare of a large collection of individuals in a country cannot be reduced to a single number though the best possible algorithm; any such attempt is reductionism at best and deceptive at worst. RGDP/capita is accurate in terms of capturing the economic dimension of welfare, but such a measure alone cannot be used to fairly assess quality of life either in cross-section or over time.

Improvement or refinement of RGDP/capita is not necessary. The problem is not how GDP is constructed, but rather its interpretation by policy makers, political commentators, and the general public. In the political sphere, too much weight is placed upon maximizing GDP growth as a measure of societal and economic progress. Although GDP is an important indicator of social welfare, it should be used in conjunction with other measures of education, environmental quality, and human health.