Suggested Solutions for Problem Set #1

1. (3 points; 1/4 point each) Based on what you learned in your principles course, and in your own words, define each of the following terms. (It's important that this is your own words, not copied or paraphrased from a source. If you can't define these terms in your own words, reconsider whether this is the course for you.)

- gross domestic product: total annual economic output of a nation
- unemployment rate: percent of the labor force unemployed (out of work & looking for work)
- labor: an input to the production process; people's work effort
- inflation rate: percentage change over time in some average measure of prices
- economic growth: more than one definition exists. [1] increases over time in the standard of living (real GDP per capita); [2] increases in real GDP (even if real GDP per capita declines). Also sometimes it's used in a long-run context to refer to potential output; sometimes in a short-run context to refer to actual output.
- aggregate demand: total demand for domestically-produced final goods and services by households, businesses, government agencies, and the rest of the world
- money: anything that is accepted in exchange for goods and services, used as a unit of account, and which has a store of value. In the U.S. currently, coins, currency, checking balances, denominated in dollars, are money.
- capital: an input to the production process, machines and buildings
- fiscal policy: changes in G, TA, or TR by the fiscal authorities (in the US, the Congress with the approval of the President). In some definitions, also add: undertaken with the goal of affecting the macroeconomy.
- monetary policy: changes in interest rates and the money supply, by the central bank
- government deficit: annual difference between government spending (G + TR) and government revenues (TA)
- government debt: accumulation over time of the annual deficits minus the annual surpluses. Total outstanding value of IOU's issued by the government

2. Crank through the calculus!

a. Use the rules of natural logs and calculus to show that the rate of growth over time of a product of two variables, xy, is the sum of the rates of growth of the variables x and y.

$$growth\ rate\ of\ xy = \frac{dln(xy)}{dt} = \frac{d(\ln x + \ln y)}{dt} = \frac{d(\ln x)}{dt} + \frac{d(\ln y)}{dt}$$
$$= \frac{d(\ln x)}{dx}\cdot\frac{dx}{dt} + \frac{d(\ln y)}{dy}\cdot\frac{dy}{dt} = \frac{1}{x}\cdot\frac{dx}{dt} + \frac{1}{y}\cdot\frac{dy}{dt} = \frac{\left(\frac{dx}{dt}\right)}{x} + \frac{\left(\frac{dy}{dt}\right)}{y}$$
$$= \frac{\Delta x\ over\ time}{x} + \frac{\Delta y\ over\ time}{y} = growth\ rate\ of\ x + growth\ rate\ of\ y$$

The notation we will use is $g(xy) = g(x) + g(y)$

b. Use the rules of natural logs and calculus to show that the rate of growth over time of a quotient of two variables, x/y, is the difference between the rates of growth of the variables x and y.

$$growth\ rate\ of\ \frac{x}{y} = \frac{dln\left(\frac{x}{y}\right)}{dt} = \frac{d(\ln x - \ln y)}{dt} = \frac{d(\ln x)}{dt} - \frac{d(\ln y)}{dt}$$
$$= \frac{d(\ln x)}{dx}\cdot\frac{dx}{dt} - \frac{d(\ln y)}{dy}\cdot\frac{dy}{dt} = \frac{1}{x}\cdot\frac{dx}{dt} - \frac{1}{y}\cdot\frac{dy}{dt} = \frac{\left(\frac{dx}{dt}\right)}{x} - \frac{\left(\frac{dy}{dt}\right)}{y}$$
$$= \frac{\Delta x\ over\ time}{x} - \frac{\Delta y\ over\ time}{y} = growth\ rate\ of\ x - \ growth\ rate\ of\ y$$

The notation we will use is $g\left(\frac{x}{y}\right) = g(x) - g(y)$

c. Use the rules of natural logs and calculus to show that the rate of growth over time of a variable x raised to a constant power b, x^b, is the constant b times the rate of growth of the variable x.

$$growth\ rate\ of x^b = \frac{dln(x^b)}{dt} = \frac{d(\mathrm{b} \cdot \ln x)}{dt} = b \cdot \frac{d(\ln x)}{dt}$$
$$= b \cdot \frac{d(\ln x)}{dx} \cdot \frac{dx}{dt} = b \cdot \frac{1}{x} \cdot \frac{dx}{dt} = b \cdot \frac{\left(\frac{dx}{dt}\right)}{x}$$
$$= b \cdot \frac{\Delta x\ over\ time}{x} = b \cdot growth\ rate\ of\ x$$

The notation we will use is $g(x^b) = b \cdot g(x)$

3. *For each activity listed below, indicate where the activity would be recorded on the expenditure side of U.S. GDP accounting. Your choices are C, I, G, GX (exports), IM (Imports), and NR (not recorded). Give a brief explanation for each answer; one sentence should suffice.*

a. The federal government pays salaries to federal workers and makes payments to independent contractors who have contracts with the federal government.

G. This is federal government spending for a service.

b. A California resident spends $50 in their favorite Thai restaurant in Berkeley.

C. It doesn't matter what type of cuisine it is; the restaurant is in Berkeley. This is spending by a household for a final service.

c. A Berkeley restaurant buys a new dishwashing machine that was manufactured in Mexico.

I and IM. The dishwashing machine is investment spending by a business; the machine will be used over and over to produce the restaurants final product, meals. Because it was manufactured in Mexico, it is also recorded in imports.

d. A California resident travels to Thailand and spends $50 on a restaurant meal in Bangkok.

C and IM. Purchase of a restaurant meal so this is a household buying a final service, C. But the restaurant meal was produced outside of the US, so it is also recorded in IM. Note that it doesn't matter where the transaction takes place. All that matters is the residency of the buyer (here, US) and the location of production (in this question, Bangkok Thailand).

4. (4 points total; 1 point each)
Consider this argument
An increase in K or an increase in L will generate economic growth.

a. Construct a truth table for this argument.
. Notation: $A = \uparrow K, B = \uparrow L, C = "there\ is\ growth"$

Row #	A	B	A or B	C	$A\ or\ B \rightarrow C$
1	T	T	T	T	T
2	T	T	T	F	F
3	T	F	T	T	T
4	T	F	T	F	F
5	F	T	T	T	T
6	F	T	T	F	F
7	F	F	F	T	T
8	F	F	F	F	T

b. If neither K nor L are increasing, is the argument false? Explain.

No. If neither K nor L are increasing, we are in rows 7 or 8. If neither K nor L are increasing, the premise is false. When the premise is false, the entire argument is (by default) true.

c. Using the 5-step Olney method, identify an assumption that is critical to the argument (step 3). Explain why the assumption is critical (step 4).

The argument is false if the premise is true and the conclusion is false. The task here is to brainstorm – what are circumstances under which "increase in K or increase in L" is true but "there is growth" is false. In effect, you are thinking of the implicit assumptions that were necessary for the conclusion "there is growth" to be true when the premise "increase in K or increase in L" is also true.

There are a number of possibilities, and you may have even come up with a good possibility not mentioned here.

- Argument assumes there is not a drop in L so large that it swamps the effect of the increase in K.
- Similarly, argument assumes there is not a big drop in K that swamps the effect of the increase in L
- Argument assumes there is not a drop in productivity (E) that swamps the effect of increases in K or L.
- Argument assumes the definition of growth is "increase in potential output" and not "increase in output per worker" or "increase in standard of living"

Change any one of those 4 assumptions (and you may have thought of a 5th), and the conclusion "there is growth" will be false.

d. Connect your critique in part c to your truth table in part a. Be sure to point out which row of your truth table is relevant to your critique

The argument is false in rows 2, 4, or 6 of the truth table above.

If you focused on possible drops in K, you were focused on row 6. If you focused on possible drops in L, you were using row 4. If the assumption you identified was something else that had to be true even if both K and L increased, then you were using row 2.