Problem Set 1

MSU EC 410
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due 10/1/15

1. Two fictitious countries, Bigsea and Tadloch, produce only two products: boats, which are traded internationally, and seafood restaurant meals, which are not. The countries have equal populations. Bigsea's currency is called "big" and Tadloch's currency is called "tad". [Note k ≡ 1000.]

	Boats	**Restaurant Meals**
Bigsea	50 *@ 30k bigs/boat*	4k *@ 15 bigs/meal*
Tadloch	30 *@ 400 tads/boat*	3k *@ 2 tads/meal*

a. If the exchange rate does a perfectly good job equating prices of traded goods (i.e. so that the law of one price holds for traded goods) what is the exchange rate, in "bigs per tads"?
b. Under the exchange rate in (a), what is the ratio of Bigsea's GDP to Tadloch's?
c. Using the PPP method, calculate the ratio of GDPs first using Bigsea's prices, then Tadloch's prices. Why are the ratios different?
d. What happens *in this example* to the ratio between GDPs when the PPP method is employed instead of the exchange rate method? Why does this happen here?

Imagine that Tadloch undergoes an inflationary period, such that prices of boats and meals go up by 50%. Assume Bigsea has zero inflation. Assume production quantities are unchanged.
e. If the exchange rate continues to do a perfectly good job equating prices of traded goods (i.e. so that the law of one price holds for traded goods), what should the new exchange rate be in "bigs per tads"?
f. Assuming the exchange rate of part e., calculate the ratio of Bigsea's GDP to Tadloch's using the exchange rate method. Has it changed from part b)? Why or why not?

2. Use the following goalposts in calculating the HDI.

"GOALPOSTS"	0% Progress	100% Progress
Income	$100	$75,000
Life Expectancy	20	85
Average Education	0	15
Expected Education	0	18

[Hint: You may want to use Excel to speed the following calculations, since the question involves re-calculating the same thing several times with different numbers. But, it is still necessary to show work at each step.]
a. Calculate the HDI (Human Development Index) for a country with PPP income of $15,000, average education of 9 years, expected education of 11 years, and life expectancy of 65. How can this number be interpreted as percentage progress toward development?
b. What would the country's HDI be if their income improved to $35,000 and all other numbers stayed the same? What is the percentage increase in the HDI as compared to part a.?
c. One might think the goalpost of $75,000 is somewhat arbitrary. Change this income goalpost to $125,000 and re-calculate the HDI for parts a. and b. What happens to the percentage increase in the HDI (from part a. to part b) under the new goalpost (i.e. is it higher or lower than under the original goalpost)?

d. If instead of income improving as in part b., to what level would life expectancy need to increase in order to give the same HDI as in b.? (That is, assuming the numbers of part a., find what level of life expectancy would be needed to achieve the same improvement in the HDI as the income increase in part b. achieved.)
e. What level of income represents 50% progress from $100 to $75,000, according to the HDI income component measure?

3. In 1870, the U.S. had an average income of about $2758 and the U.K. of about $3463. In 1999, the figures were $30,600 and $22,640, respectively. If each country grew at a constant rate over these years, in which year did the U.S. overtake the U.K. in terms of average income?

4. Consider a farmer who can either plant or market/consume his crop. Whatever amount he plants becomes a crop twice the size the following year. For example, if he plants seed from 2 ears of corn, he gets 4 ears of corn at harvest. Assume he starts off with 50 bushels of corn.
a. If he decides every year to market/consume half his crop and plant the rest, what will his harvest be next year? What will his consumption be? How fast will his production and consumption grow over time?
b. If he decides every year to market/consume 2/5 of his crop and plant the rest, what will his harvest be next year? What will his consumption be? How fast will his production and consumption grow over time?
c. Compare the consumption of the farmer in each of the first five years under plans a. and b.
d. Why might the results of plan b. not be realistic?

5. Imagine the following goal of Lenin/Stalin at the beginning of the Soviet regime in Russia: to overtake (i.e. equal) and surpass the world's industrialized economies in terms of GDP per capita. To achieve this goal, the main instrument of control is the fraction of national production that is devoted to building the nation's productive capacity: new machines, factories, transportation equipment, and roads. That is, the main instrument to achieve this goal is what fraction of GDP to devote to investment. The rest of national production is used for consumption, i.e. to produce consumer items like clothing and food. The country begins with relatively little capital, being mostly rural and non-industrialized. Assume each of the following:

- GDP per capita starts in USSR at $300/year.
- The world's industrialized economies start with GDP per capita of $5000/year.
- Population growth rates are 2% everywhere in the world.
- All capital depreciates at 8% per year.

a. At what average annual rate will income per capita in the USSR have to grow in order to overtake (i.e. to equal) the industrialized nations' income per capita in exactly 30 years? Assume the industrialized nations' income per capita is growing at 2% per year.
b. If the USSR sustains the growth rate of part a., how long *after* it has overtaken the industrialized nations' GDP per capita will it take for it to attain **double** the industrialized nations' GDP per capita? Again, assume the industrialized nations' GDP per capita is growing at 2% per year.
For parts c.-e., assume the basic growth framework of Harrod-Domar, and that 1 ruble's worth of capital always produces 0.5 ruble's worth of output (i.e. A=0.5). Also, assume inputs are used more efficiently in the industrialized countries, so that A=0.6 there.
c. What fraction of national output must the USSR devote to building new capital goods in order to attain the growth rate of part a.? What fraction would be left for consumer items? [Hint: another word for the fraction of output devoted to building new capital goods is the investment rate, i.e. the ratio I_t/Y_t. And, remember that savings equals investment, so the investment rate equals the savings rate.]
d. At what rate are the industrialized countries saving if they are growing at 2% per year?
e. What would you calculate the ratio of consumption per capita in the USSR to consumption per capita in the industrialized countries when the USSR overtakes the industrialized countries (i.e. when GDP per capita is equal)? Assume the savings rates of parts c. & d. What would the ratio be when the USSR reaches double the industrialized nations' GDP per capita?