**ECON 256: Midterm Practice Math/Formula Questions**

1. Suppose a country has a population of 20 million people and a GDP of 1 billion dollars. What is the GDP per capita of the country?

   GDP per Capita = \$1billion/20million = \$1000million/20million people = \$50/person

2. Use the following formula: Total Growth $= 100 \times \left(\left(\frac{100+r}{100}\right)^N - 1\right)$. If the growth rate is 10 percent, what will total growth be after 2 years? (Reported as percentage and rounded to nearest integer)

$$\text{Total Growth} = 100 \times \left(\left(\frac{100+10}{100}\right)^2 - 1\right) = 100 \times (1.1^2 - 1) = 100 \times 0.21 = 21\%$$

3. Consider the production function $Y = K^{0.5}L^{0.5}$. How much output do we get if $K = 9$ and $L = 4$?
   - **A.** 6.5, **incorrect since formula is not** $\frac{9}{2} + \frac{4}{2}$
   - B. 5, **incorrect since formula is not** $3 + 2$
   - C. 6, since $(9)^{0.5} \times (4)^{0.5} = 3 \times 2 = 6$ <- This is correct answer
   - D. 9, **incorrect since formula is not** $\frac{9}{2} \times \frac{4}{2}$

The Dynamics of the Solow Growth Model are determined by the following two equations (I plugged in a savings rate of 10 percent, depreciation rate for capital of 10 percent, TFP=4, a capital share of 0.5):

$$\frac{K_{t+1}}{L_{t+1}} = (1 - 0.10)\frac{K_t}{L_t} + 0.10\frac{Y_t}{L_t}$$

$$\frac{Y_t}{L_t} = 4\left(\frac{K_t}{L_t}\right)^{0.5}$$

4. Suppose $\frac{K_0}{L_0}$ =9, what is $\frac{Y_0}{L_0}$? Use the above equations for the Solow Growth Model.

$$\frac{Y_0}{L_0} = 4\left(\frac{K_0}{L_0}\right)^{0.5} = 4(9)^{0.5} = 4 \times 3 = 12$$

5. Suppose $\frac{K_0}{L_0}$ =9, what is $\frac{K_1}{L_1}$? Use the above equations for the Solow Growth Model.

$$\frac{K_1}{L_1} = (1 - 0.10)\frac{K_0}{L_0} + 0.10\frac{Y_0}{L_0} = (0.9) \times 9 + 0.1 \times 12 = 9.3$$

6. In the Solow Growth Model, steady state output per worker is given by the equation

$$\frac{Y}{L} = A^{\frac{1}{1-\alpha}}\left(\frac{s}{\delta}\right)^{\frac{\alpha}{1-\alpha}}$$

Suppose $s = 0.4$, $\delta = 0.2$, $\alpha = 0.5$, and $A = 5$. What is $\frac{Y}{L}$?

$$\frac{Y}{L} = (5)^{\frac{1}{1-0.5}} \left(\frac{0.4}{0.2}\right)^{\frac{0.5}{1-0.5}} = 5^2 \times (2)^1 = 50$$

7. The Law of Motion for Capital is

$$K_{t+1} = (1-\delta)K_t + I_t$$

Suppose $K_0 = 0$, the depreciation rate is 10 percent, and investment each period is always equal to $100$. What is $K_2$?

$$K_1 = (1-0.10) \times K_0 + I_0 = (1-0.10) \times 0 + 100 = 0 + 100 = 100$$

$$K_2 = (1-0.10) \times K_1 + I_1 = (1-0.10) \times 100 + 100 = 90 + 100 = \mathbf{190}$$

8. If we have a standard Cobb-Douglas production function, and a firm faces a capital wedge, $\tau^k$, (unobserved cost that acts as a tax or subsidy to capital costs), then efficiency implies that

$$\frac{\alpha}{1-\alpha} = \tau^k \frac{rK}{wL}$$

(*subscripts suppressed here compared to the slides since we only have 1 firm*). Suppose that the capital wedge is $\tau^k = 2$, and $\alpha = \frac{1}{3}$. What should the capital labor ratio, $rK/wL$, be according to the above formula?

$$\frac{\left(\frac{1}{3}\right)}{1-\left(\frac{1}{3}\right)} = 1.5\frac{rK}{wL}$$

$$\frac{\left(\frac{1}{3}\right)}{\left(\frac{2}{3}\right)} = 1.5\frac{rK}{wL}$$

$$\frac{1}{2} = 2\frac{rK}{wL}$$

$$\frac{rK}{wL} = \frac{1}{4}$$

This implies that the capital labor ratio should be ¼. Equivalently, that the firm should spend 20% of its input costs on capital ($1 in capital for every $4 in labor = $1 in capital for every $5=($1+$4) in input costs.