ECON 207: Problem Set 1

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1 Macroeconomic Data

1.1 GDP and Inflation

For the following problems, use 2016 as the base year.

	2016	2017
Good 1	Price: \$20 Quantity: 100	Price: \$25 Quantity: 80
Good 2	Price: \$ 20 Quantity: 100	Price: \$20 120

1. Calculate the real and nominal GDP in this economy for each 2016 and 2017.
2. Calculate the GDP deflator in each year. Use this to calculate inflation from 2016 to 2017.
3. Suppose the household basket of goods consists of 100 units of Good 1 and 100 units of Good 2. Calculate the CPI in each year. Use this to calculate inflation from 2016 to 2017.
4. Why may the inflation rate you calculated in Question 3 be overstated? *Hint: Consider the sources of bias in the CPI.*

1.2 Labor Market Variables

Variable	Description	Number
E	Number of Employed Persons	90 million
U	Number of Unemployed Persons	5 million
P	Working Age Population	200 million
h	hours per worker	6.5 hours

1. What is the size of the labor force in this economy?

2. Calculate the labor force participation rate for this economy. Why are economists interested in this statistic?

3. How many total hours of work does this economy provide?

4. Describe the concept of a discouraged worker and how discouraged workers impact the unemployment rate.

2 Modeling Growth

2.1 Cobb-Douglas Production

Inputs capital (K_t) and labor (N_t) combine to produce output according to the following production function:

$$Y_t = 100K_t^{\frac{1}{2}}N_t^{\frac{1}{2}} \tag{1}$$

In this economy: $K_t = 10$ and $N_t = 100$

1. Show that the production function is increasing in capital and labor at these values of K_t and N_t.

2. Show that the production function is constant returns to scale.

3. How much would this economy produce if $N_t = 0$?

4. Write an expression showing the total costs of a firm. *Hint: This will include payments to labor at a wage rage, w_t, and capital at a rental rate, R_t.*

5. Derive the marginal product of labor and the marginal product of capital. What is the relationship between these marginal products and the wage rate and rental rate on capital for a profit-maximizing firm?

2.2 Solow Model

The following equations can be used to characterize the basic solow model (without wages or rental rate on capital).

$$Y_t = AK_t^{\alpha}N_t^{1-\alpha} \tag{2}$$

$$Y_t = C_t + I_t \tag{3}$$

$$K_{t+1} = I_t + (1-\delta)K_t \tag{4}$$

$$I_t = sY_t \tag{5}$$

1. Describe each of these equations in words.
2. Show that: $K_{t+1} = sAK_t^{\alpha} N_t^{1-\alpha} + (1-\delta)K_t$
3. Show that $C_t = (1-s)Y_t$
4. Put each equation into per worker terms. For Equation (4), use the form in Part 2 of this question.
5. Allow: $A = 100$, $\alpha = \frac{1}{2}$, $s = 0.2$, $\delta = 0.1$. Solve for the steady state level of capital per worker (k^*), output per worker (y^*), consumption per worker (c^*), investment per worker (i^*).

2.3 Augmented Solow Model

The capital accumulation equation in the augmented Solow model is:

$$K_{t+1} = sAF(K_t, Z_t N_t) + (1-\delta)K_t \tag{6}$$

1. Labor grows at rate n. Labor-augmenting productivity grows at rate z. Write an expression for each N_t and Z_t in terms of N_{t-1} and Z_{t-1}.
2. Show that $\frac{K_{t+1}}{Z_t N_t} = (1+n+z)\frac{K_{t+1}}{Z_{t+1}N_{t+1}}$.. *Assume $n \times z \approx 0$ for this question and all remaining.*
3. Rewrite the capital accumulation equation in terms of capital per effective units of labor ($\hat{k}_t$, $\hat{k}_{t+1}$).
4. What is the amount of break even investment in this economy? How is this different than break even investment in the basic Solow model?
5. Solve for the steady state value of $\hat{k}$, $\hat{k}^*$, in terms of s, A, n, z, δ.
6. How does $\hat{c}^*$, the steady state value of consumption per unit of effective labor, change when we increase the savings rate, s?