Practice Questions for Early–Progress Exam

ECO 3302 – Intermediate Macroeconomics

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1 Math Questions

1. Consider a country that experienced 2% real output growth and no growth in hours worked in 2024. What is labor-productivity growth for this country? Show your derivations.

2. Suppose nominal GDP increased by 5% in 2024. Assuming that inflation was 3%, what was real GDP growth? Show your derivations.

3. Consider the following production functions:

$$
\begin{aligned}
&Y = AK, \qquad \text{where } A > 0, \\
&Y = AK^{\alpha}L^{1-\alpha}, \qquad \text{where } A > 0,\ \alpha \in (0,1) \\
&Y = AK^{\alpha}L^{\beta}, \qquad \text{where } A > 0,\ \alpha, \beta \in (0,1) \text{ and } \alpha + \beta < 1
\end{aligned}
$$

   (a) Calculate the returns to scale for each function.

   (b) Derive the marginal products of capital and labor for each function.

   (c) Derive the second-order derivatives, direct ones and cross partials, for each function.

   (d) Check the Inada conditions for each function.

   (e) Are K and L in the last two production functions q-complements?

4. Derive the real wage and the real rental rate of capital for a perfectly competitive economy with a representative firm operating production functions:

$$Y = AKL, \qquad \text{where } A > 0,$$
$$Y = AK^{\alpha}L^{1-\alpha}, \qquad \text{where } A > 0,\ \alpha \in (0,1)$$
$$Y = AK^{\alpha}L^{\beta}, \qquad \text{where } A > 0,\ \alpha, \beta \in (0,1) \text{ and } \alpha + \beta < 1$$

   (a) What is the effect of a wave of immigration in the real wage? And in the rental price of capital?

   (b) What is the effect of a war that results in half the capital stock in the real wage? And in the rental rate of capital?

   (c) What is the effect of technological progress in the real wage and in the real rental price of capital?

   (d) Is the real wage increasing or decreasing in the capital-labor ratio? and the real rental rate of capital?

5. Derive labor, capital, and profit shares for a perfectly competitive economy for the following two technologies:

$$Y = AK^{\alpha}L^{1-\alpha}, \qquad \text{where } A > 0,\ \alpha \in (0,1)$$
$$Y = AK^{\alpha}L^{\beta}, \qquad \text{where } A > 0,\ \alpha, \beta \in (0,1) \text{ and } \alpha + \beta < 1$$

6. There are three sectors in the economy: agriculture, manufacturing, and services. The value added of these sectors is \$50, \$100, and \$250 millions, respectively. In this economy, consumption is \$240 millions, investment is \$60 millions, and government spending \$120 millions. Total payments to labor are \$300 millions, payments to capital are \$60 millions, and profits amount to \$40 millions. Calculate GDP using both the production and the income method. With the current data, you cannot calculate GDP using the expenditure method, but you could back out the quantity that you need to do so. What is this quantity and what does it account for?

7. Consider an economy that produces and consumes bread and eggs:

Good	Quantity in 2010	Price in 2010	Quantity in 2020	Price in 2020
Bread	90	3	100	7
Eggs	150	6	165	12

   (a) Calculate the percentage change in the price of each good.

   (b) Calculate the percentage change in the GDP deflator.

   (c) Using 2010 as the base year, calculate for each year: nominal GDP, real GDP.

   (d) Using 2010 as the base year, calculate the percentage change in the CPI.

8. Do exercises in WIO2.1: Work It Out—Ch. 2.

9. Consider an economy with:

$$
\begin{aligned}
Y &= C + I + G \\
Y &= 1,000 \\
G &= 180 \\
T &= 300 \\
C &= 160 + 0.7(Y - T) \\
I &= 400 - 25r
\end{aligned}
$$

   (a) Compute national savings, public savings, and private savings.

   (b) Find the equilibrium interest rate.

   (c) Suppose government spending is fixed, but taxes decrease to 200. Compute private, public, and national savings. What is the change in consumption?

   (d) Find the new equilibrium interest rate.

   (e) Plot both the old and the new equilibrium in the same graph.

10. Suppose one country grows at an average annual growth rate of 2% per year and another country grows at 3% per year. How much richer would the fast-growing country be in comparison to the slow-growing country if both of them start at the same initial level of GDP after 10, 20, 50, 100 years?

11. Suppose GDP of country A is \$3 billions today, and \$2 billions 20 years ago. What is the average annual growth rate of this country?

12. Suppose GDP is \$3 billions. How long will it take to quadruple its GDP if GDP grows at an average rate of 5% per year?

13. Suppose GDP is \$3 billions. What was GDP fifteen years ago if the growth rate is 2% per year?

14. Suppose the economy produces according to: $Y(t) = A(t)K(t)^{0.3}L(t)^{0.7}$.

    (a) Decompose the growth rate of GDP into the contributions of technology, capital, and labor. Show each step of your derivations.

    (b) Suppose GDP grows at 2% per year. Capital grows at 0.5% per year and labor at 1% per year. What is the contribution of technology to GDP growth? And of capital? And of labor?

    (c) Now suppose output is given by $Y(t) = A(t)K(t)^{\alpha}L(t)^{\beta}$. You still want to calculate the contributions of technology, capital, and labor to GDP growth. The problem is you don't know the values of α and β. How would you compute these two objects using data?