Econ 1560 First Midterm Exam

Instructions: Please answer all questions in the blue books. You may not use notes, books, or calculators. Please show your work. There are a total of 5 questions, for 100 points. Questions vary in their level of difficulty. Partial credit will be given for partially correct answers. Good luck!

1) [15 points] What is your estimate of the population of the world in the year 1900? In answering this question, I don’t want you to just give me a number, since this is not a number that anyone should have memorized. Instead, you must provide some justification for your estimate. This justification should be in the form of other facts that you know that can be put together to form a guess about the world population in 1900. You will be graded on the combination of how good your estimate is and what facts and logic you put together to obtain it.

2) [15 points] In a certain country, two thirds of children born are male. Half of children die in the first five years of life (males and females at equal rates). All people who survive to age five live all the way to age 75, at which time they all die. Fertility in the country is as follows: between ages 20 and 39 (inclusive), women have a 30% chance per year of having a child. At all other ages, there is zero fertility.

Suppose that the pattern described above has been in place for a long time. What is the growth rate of population? Show how you got your answer.

3) [15 points] Suppose that the rate of return to schooling is 10% per year. In a certain country, half of the labor force has seven years of schooling, and half of the labor force has 14 years of schooling. What is the fraction of total wages in this economy that represents payments to human capital?

4) [25 points] Consider a country where the production function is

\[ Y = AK^{1/2}(hL)^{1/2} \]

Where \( h \) is the amount of human capital per worker.

In the year 2020, a new drug called NZT is added to the water supply of the country. NZT allows all the people in the country to do four times as much work as they could before – in other words, it quadruples the value of \( h \). Prior to 2020, the economy was in steady state. The level of output per
worker in this steady state was $y = 100$. After 2020, the values of $A$ (productivity), $n$ (population growth), and $y$ (the fraction of output invested) do not change.

Draw a graph with time on the horizontal axis and $y$ (output per worker) on the vertical axis. Show what happens to output per worker following the introduction of NZT. You should label as many points as you can with exact numerical values. For example, if output jumps up, to what level does it jump? If it asymptotes to some level, to what level does it asymptote? Explain or show how you figured out these values.

5) [30 points] An economist has collected data from a number of countries, all of which are described by the Solow model, with physical capital and labor as the only two factors of production (and no population growth or technological progress). The countries are all in steady state. They all have production functions of the form

$$ y = Ak^\frac{1}{3} $$

The economist makes a graph with the natural logarithm of capital per worker on the horizontal axis and the natural logarithm of output per work on the vertical axis. The data points in her sample all lie along a straight line.

A) [15 points] Suppose that the countries in her sample all have the same values of productivity and depreciation. The countries differ only in their values of the fraction of output invested ($y$). What is the slope of the line in the graph that the economist has made?

B) [15 points] Instead, suppose that the countries all have the same values of depreciation and the fraction of output invested. The countries differ only in their levels of productivity. What is the slope of the line in graph that the economist has made?