INTERMEDIATE MACROECONOMIC THEORY

PROBLEM SET 1: GROWTH RATES

Due by 5 pm on <u>Mon Jan 30</u> in the bin in front of Prof. Jalil's office, Fowler 215

<u>Instructions</u>: For all questions, be sure to explain your answers and to use graphs whenever appropriate. You should work on each question first, without the aid of the solutions (on the honor system). Once you have either finished solving the question or have gotten as far into solving it as possible, in a different color pen or pencil, you should correct your own work, or finish solving the problem, with the aid of the solutions. If your answer was correct, indicate that you still checked your answer against the solutions by placing a "check mark" in a different color pen or pencil. On the back page, please find the grading guidelines that the student graders receive. Please <u>staple</u> your answers before submitting.

1. *Growth and Development*. This question asks you to quantify economic growth using formulas derived in class.

   a. In 2017, Ethiopia had a per capita income of $1,600, about $4 per day. Compute per capita income in Ethiopia in the year 2057, i.e. 50 years later, assuming four different average annual growth rates: 1%, 2%, 4%, and 6%. Do your results indicate that small differences in growth rates have large effects over time? Why or why not?

   b. The following table shows per capita GDP (measured in constant 2011 dollars) for three countries (United States, China, and India) in 1980 and 2017. Compute the average annual growth rate of per capita GDP for each country between 1980 and 2017. Which country had the largest average annual rate of economic growth? Which had the smallest?

	1980	2017
United States	29,219	54,807
China	826	15,288
India	1,169	6,420

2. *Ratio Scale*. Plot per capita GDP on a ratio scale (with tick marks on the vertical axis that double) between the years 2015 and 2133, based on the following scenario:
   - Per capita GDP in the year 2015 is equal to $10,000.
   - Per capita GDP grows at 2% per year between 2015 and 2085.
   - For the next 20 years (i.e. 2085 to 2105), per capita GDP growth speeds up to 7% per year.
   - For the next 28 years (i.e. 2105 to 2133), per capita GDP growth slows down to 5% per year.

You should not need a calculator or computer program. Instead, please use the Rule of 70—a trick that tells us how often a variable doubles—to depict the evolution of per capita GDP on a ratio scale. <u>Hint</u>: You should label every year that GDP doubles between 2015 and 2133.

3. *Computing Growth Rates.* Suppose $x_t=(1.04)^t$ and $y_t=(1.02)^t$. Calculate the growth rate of z_t in each of the following cases. Hint 1: In class, we showed that a variable that grows at a constant growth rate, g_y, follows the equation $y_t = y_0(1+g_y)^t$, where y_0 is the starting level and y_t is the level "t" periods later. Because we may rewrite $y_t=(1.02)^t$ as $y_t=1(1+0.02)^t$, you should note that $y_0=1$ and $g_y=0.02$ (or 2%). Hint 2: Reasoning analogously, you should be able to determine g_x, the growth rate x. Hint 3: Once you have identified the growth rates of x and y, please apply the properties of growth rates to identify the growth rate of z in each of the following scenarios.

      a. $z=xy$
      b. $z=x/y$
      c. $z=y/x$
      d. $z=x^{1/2}y^{1/2}$
      e. $z=(x/y)^2$
      f. $z=x^{-1/3}y^{2/3}$

4. *True/False.* Decide whether the following statement is true, false, or uncertain and explain why. Your explanation is the important part of the answer.

Statement to evaluate: The growth rate of a product is the sum of the individual growth rates.

[Note: After you answer this question, please study and work through the mathematical proof in the solutions. Please include this proof in your solutions, using a different color pen or pencil.]

GRADING GUIDELINES FOR ECON 251 PROBLEM SETS

Grading Guidelines for problem sets when students have access to the solutions:

2 = Students attempted to answer each question (in good faith and with sufficient effort) and corrected their work in a different color pen or pencil using the solutions.
- For questions solved correctly, students added a check mark or correct sign in a different color pen or pencil.
- For questions not solved correctly, students indicated where they went astray and worked through the correct solution in a different color pen or pencil.
- For questions where students did not have the solutions, students answered the question in good faith and with sufficient effort, even if it is not 100% correct.

1 = Students did not correct their work, show their initial work, or make a good faith attempt at tackling each question with sufficient effort (e.g. by skipping parts of questions).

0 = Students did not make a good faith attempt to work on the problem set.