ECO 330: Problem Set 1 Professor Jack Rossbach

Due Date: Sunday, March 6 at 11:59PM EST Spring 2016

Instructions:

Complete the questions for each problem. Answers must be typed and uploaded to blackboard as either a word document or PDF to blackboard. Everybody needs to submit their own assignment and type up their own answers. If you copy another person's work, or allow another person to copy your own work, that will be considered cheating. Paste your code for problem 1 at the end of your assignment.

Problem 1: Lucky or Good? Inequality and shocks to earnings.

It has been observed that shocks to income in the United States can be roughly approximated by a lognormal distribution. In this problem, we are going to simulate an economy where people receive random shocks to their earnings each year, and compare inequality in this simulated economy to inequality in the U.S. economy.

This problem requires the use of **R**: https://cran.r-project.org/

SETUP) Download the code from my website and simulate the following economy

i) The economy starts with 30,000 identical people at time zero, each with income equal to $15,000.

ii) Each year, every person receives an iid shock to their earnings from a lognormal distribution with $\mu = 0.02, \sigma = 0.15$ (mean earnings increase of 3% per year, standard deviation of 15%)

iii) Step ii repeats for 45 years, after which we analyze the simulated economy and answer the following

Questions

1.a) Report the following statistics for the economy at period 0 and after the 45 years of shocks:

Average (mean) income, 80/20 income ratio, highest income, lowest income, Gini coefficient, percentage of people earning less than $15,000/year

What were the actual values for the Gini coefficient and 80/20 income ratio for the United States in 2014?

1.b) Suppose after the 45 years, the economy decides to implement a minimum wage. What happens to the Gini coefficient for income if everybody that previously made less than $15,000 now makes $15,000?

1.c) Plot the new Lorenz curve for the economy following the implementation of the minimum wage. Explain what Monte-Carlo Integration is, and how we used it to estimate the area under the Lorenz curve.

1.d) What does this exercise say about luck as a potential source of inequality? What are some features that are missing from our simulation that are important sources of inequality in the real world?

Challenge question (optional, 5 pts extra credit). When we implemented the minimum wage in question 2, the $15,000 magically appeared out of nowhere. Suppose we fund the minimum wage by implementing a flat marginal tax on all income over $50,000 (e.g. if you make $51,000, only $1,000 is subject to the tax).

What does this marginal tax rate have to be to fund the minimum wage program? What is the new (after-tax, after-minimum wage) Gini coefficient?

Problem 2: Growth Accounting

Read the notes on growth accounting, and download the data for the United States from my website.

2.a) Conduct a growth accounting analysis for the United States, 1950–2010.

2.b) Create a graph showing the evolution of GDP per Working Age Person (WAP) between 1965 and 2012, and its decomposition into productivity, capital, and labor components. When constructing the graph, index each series to be equal to 100 in 1965. Format the graph so that it looks professional.

2.c) Looking at the graph, what is the major component of growth in GDP per WAP in the United States.

2.d) Give two examples of things that affect productivity (TFP).

2.e) On my website, view the growth accounting decomposition for the United States, 2000–2012, that uses seasonally-adjusted quarterly data.

In 2.c) we saw that changes in the labor supply did not have a significant impact on long term growth. Did changes in the labor supply have an impact on GDP per WAP over the recent 2008–2009 recession? If so, what happened to the labor supply during the recession and how did it affect GDP per WAP?

Problem 3: Growth Rates and Choice of Scale

Go to the [World Development Indicators Database]

Download data on **GDP per Capita (constant 2005 US$)** for **Mexico** and **China** from **1960** to **2014**

Note: although we typically prefer to use PPP data in this class, the PPP data only goes back to 1990.

3.a) Construct a graph showing the evolution of GDP per capita for each country using the standard linear scale. Format the graph so it looks professional.

3.b) Looking at the linear graph, can you tell which country grew faster? Does it look like China is catching up to Mexico? (This is an opinion question. There is no correct answer, just put your opinion).

3.c) Repeat part 3.a, but this time make the vertical axis have a logarithmic scale (base 2).

3.d) Note that with exponential growth we have

$$\text{Value in N years} = \left(\frac{100+r}{100}\right)^N \times \text{Value now}$$

Taking logs yields

$$\log(\text{Value in N years}) = N\log\left(\frac{100+r}{100}\right) + \log(\text{Value now})$$

Further, for small values of r it's the case that the following approximation holds

$$\log\left(\frac{100+r}{100}\right) \approx \frac{r}{100} \times C$$

Where C is a constant that depends on the base of the logarithm used (for the natural logarithm, LN, the constant equals 1). This means that exponential growth looks linear when we look at it in a log scale. The higher the growth rate, the steeper the slope will be.

Using this knowledge, looking at the logged graph, which country grew fastest between 1960 and 2014?

3.e) Another useful approximation is that, for small values of r,

$$\left(\frac{100+r}{100}\right)^N \approx e^{\frac{r}{100}\times N}$$

Where $e \approx 2.718$ is Euler's Number, and is used to define the exponential function: $\exp X = e^X$.

Fit an exponential trendline to the data series for both Mexico and China and view the resulting equation. Using our knowledge of the above approximation, what was the growth rate, r, for each country between 1960 and 2014?