

# Solow Model Excel Assignment

## Goals of the Assignment

There are two main goals for this assignment. First, it is meant to help improve your understanding of the mechanics of the Solow growth model that we covered in the first half of the class and to make sure you don't forget about it before the final. Second, since many jobs for economics majors require at least a basic knowledge of Microsoft Excel, it is also meant to give you some practice with some of Excel's basic features. If you do not have access to Excel, Google sheets will also work as a free alternative.

## The Assignment

For this assignment, we will be simulating a Solow Growth Model in an Excel spreadsheet. To do this, please try follow these steps.

1. Set up the parameters of the model: Somewhere on your sheet, input the following numbers as values for each parameter. We will use numbers on your student ID to give each of you a unique setup (if any number is a 0, skip it and move to the next number). We will assume a Cobb-Douglas production function  $Y_t = A_t K_t^\alpha L_t^{1-\alpha}$ 
  - a) Set capital's share of income  $\alpha = 0.X$  where X is the first number on your student ID divided by 2 (round to the nearest whole number).
  - b) Set the saving rate  $s = 0.X$  where X is the second number of your student ID
  - c) Set the depreciation rate  $\delta = 0.0X$  where X is the third number of your student ID
  - d) Set the population growth rate  $\eta = 0.0X$  where X is the fourth number of your student ID
  - e) Set the technology growth rate  $\gamma = 0.0X$  where X is the fifth number of your student ID. Calculate  $\tilde{\gamma}$  using your values for  $\gamma$  and  $\alpha$ .
2. Calculate steady state capital per effective worker, output per effective worker, and consumption per effective worker by hand.
3. Set the initial level of technology  $\tilde{A}_0 = 1$  and  $L_0 = 1,000$ . Set  $\tilde{k}_0$  equal to half its steady state value that you calculated in 2. Put these three values in the first row of three separate columns in your spreadsheet.
4. Using Excel formulas (i.e. not calculating by hand), calculate  $\tilde{y}_0, \tilde{c}_0, k_0, y_0, c_0, K_0, Y_0,$  and  $C_0$  putting each in the first row of their own column in your spreadsheet (you should now have 11 columns filled in total). You should be able to calculate all of these variables using  $\tilde{k}, \tilde{A}, L,$  and parameters.

5. Using the growth rates you set in part 1, use an Excel formula to calculate  $\tilde{A}$  and  $L$  for 100 periods (so you should have 100 rows filled in with these values)
6. Using the law of motion for capital per effective worker, calculate  $\tilde{k}$  for 100 periods
7. Calculate values for the other 8 variables for 100 periods (carrying formulas down).
8. From the 100 values you have generated, create graphs of
  - a) Capital per effective worker (include a dashed line at the steady state level of capital that you calculated in 2)
  - b) The natural log of capital per worker
  - c) The natural log of aggregate capital
  - d) The growth rate of capital per worker and aggregate capital (use the difference in the logs as an approximation for the growth rate). You may put these on the same plot or separate plots.
9. Copy the spreadsheet you have created into a new sheet. After period 100, change the saving rate to the value that optimizes steady state consumption (if you are already at this value, choose an arbitrary new value between 0 and 1). Using the new saving rate, starting in period 100, calculate values for all of your variables for 100 more periods (so you will now have 200 total values for each variable). Create a graph for the following variables (start from period 50, plot  $t=50$  to  $t=200$ ). For each graph, include a dashed line at both the original and new steady state values.
  - a) Capital per effective worker
  - b) Output per effective worker
  - c) Consumption per effective worker
10. Copy the original spreadsheet again onto a third sheet. Now double  $\tilde{\gamma}$ . Using the new growth rate, starting in period 100 calculate values for all of your variables forward to period 200. Create graphs (again starting in period 50) for
  - a) Output per effective worker (include dashed lines at both the original and new steady states))
  - b) The natural log of output per worker
  - c) The natural log of aggregate output
  - d) The growth rate of output per worker and aggregate output (again using the difference in logs). You may put these on the same plot or separate plots.
11. You should now have 13 graphs (or 11 if you combined the growth rate graphs). Put these together into a single document (final form must be pdf but any program works to create it), including a brief description (a few sentences) explaining what is happening in each of the three parts.

## Requirements/Tips/Grading

1. Your graphs should include labeled axes and a title. If you have multiple lines on the graph (for graphs where you plot a steady state), include a legend making it clear what each line represents.
2. You must make at least some changes to the default Excel (or whatever program you use) style (e.g. change the color, font, sizes of the lines, gridlines, etc.). This is just to practice making Excel graphs. Don't go overboard with the changes - make sure everything still looks clean.
3. Make sure your final document with graphs and descriptions looks professional and readable. If it is hard for the grader to figure out what you are trying to show you won't get as high a score.
4. The assignment is out of 150 points (around 15% of your final grade in the class). It is meant to be a major assignment in the class (worth more than all the problem sets combined) and it will take time. I do not recommend waiting until the last day to start. TAs will be providing some Excel tips during week 7 TA sections. I highly recommend getting started soon after that.
5. The assignment is due Sunday September 5 at 11:59pm. Late assignments will lose 5 points per day.
6. Grading will be based on the following criteria: If you have all required components and appear to have put some effort into the assignment you will get no less than 120 points (80%) on the assignment (even if there are some mistakes on the actual calculations or graphs). If you are missing some of the required components or if some seem to be very low effort, you will lose points. Otherwise scoring based on:

**120-125 (B):** All required components are included, but there are some major mistakes in calculations and/or graphs look messy and are hard to read. Descriptions of graphs may not describe what is happening in the graphs well.

**130-135 (B+/A-):** All required components are included and graphs are generally well made and easy to read, but there are a few mistakes in calculations, flaws in some graphs, or lack of clarity in the descriptions.

**140-145 (A):** All required components are included, there are only very minor mistakes in calculations or graphs, all graphs are well made and easy to read, and descriptions add some insight to what is happening in the graphs

**150 (A+):** No mistakes in calculations, professional and visually appealing graphs, insightful descriptions. Only the very best assignments will earn a perfect score.