

PHYS 350 Lab #1
17 January 2013

Goals: (1) Become intimately familiar with exponential growth, both as it applies to finance/accounting (which are both important for this class) and as it applies to energy and resource management. (2) Master the use of a spreadsheet program to manipulate and calculate practical quantities. (3) Improve your skills for preparing clean, dramatic, and effective presentations of these results.

You will all perform this lab individually, though you are encouraged to learn collaboratively. Make sure you understand the difference between absolute and relative references, between numbers and calculations, how to make excel "charts", how to format your numbers, etc. I will provide plenty of help and suggestions, so don't just struggle blindly. Discuss your results in a brief writeup, including any figures or tables you think would be appropriate (2 pages should cover it, plus whatever tables and figures you add). Turn in your report and your spreadsheets. Electronic submission is acceptable, but make sure I can print them out before you turn your computer off).

Warning: If you log off (or the computer crashes), you will lose all of your work. Save and backup frequently (email yourself if you don't have a flash drive).

Part I. Earning Interest

Generate a table illustrating the growth in a \$1000 investment over a period of 20 years (total principal available each year) assuming

- a. 2% interest rate, compounded yearly
- b. 7% interest rate, compounded yearly
- c. 10% interest rate, compounded yearly
- d. 10% interest rate, compounded quarterly
- e. Make a chart showing "time" on the x axis and "principal" on the y axis for your 7% growth curve (part b). Is the shape and doubling time what you expected? Use Excel's trendline to fit an exponential curve, display your equation on the chart, and compare the exponential growth rate with your interest rate.

Part II. Paying Interest

Make a spreadsheet illustrating how a 30-year mortgage works. Note that you will frequently do things like this in industry; it's not just something for homeowners.

- a. Start with the following assumptions: \$300,000 "cost", \$50,000 "downpayment", no "fees due at closing" (it's much better not to include those in the loan!), no escrow (payments include only principal and interest, not insurance, etc), 30 year term, 5% interest rate, compounded monthly for 360 months. Put these numbers at the top of your spreadsheet; we will want to see how changing our assumptions changes the results. Use "window/freeze panes" so that you can scroll down but still see these numbers on the top.
- b. Use the "PMT" function to calculate the amount of the monthly payment.

- c. Set up 360 months of payments, with the following columns... month#, principal due at beginning of month, interest paid, principal paid, extra principal paid (make them all 0 initially), principal due at end of month, total paid to date, equity (as a fraction of total price; i.e. what fraction you currently "own")
- d. In the bottom row, total up the 360 columns. In your report, discuss the total principal and interest paid and the total cost of the loan. Also put the total cost at the top of your spreadsheet so you can see it.
- e. Make a "chart" illustrating the amount of principal and the amount of interest paid each month. Alternatively, you can plot the fraction of the monthly payment that goes to interest (or principal), whichever you find to be most illustrative.
- f. When everything is perfect, make sure you save it. Copy it to a new tab (and rename it "original" or something like that) and then use the original sheet (which has your charts linked to it) to change some assumptions and see what they do to the term and cost of the mortgage. Change the interest rate and downpayment amount and see what they do to your total cost.
- g. Let's say each month you can afford to add \$100 to your payment each month. How much does this shorten the term and reduce your cost? (warning, you might have to pay careful attention to the rows near the bottom).
- h. Let's say you win the lottery and have \$10,000 of cash sitting around. Is it better to prepay the mortgage or invest it at, say, 5%? You can use your spreadsheet to calculate this exactly.

Part III. Exponential Growth in Energy, Population, or Consumption

Take a break, then surf the internet to find some real numbers describing something either population, energy, or resource related that you expect to be growing exponentially (though not necessarily at a constant rate).

- a. Enter a reasonable amount of data on your spreadsheet along with any necessary annotations and references (if you are lucky and clever, you shouldn't have to re-enter the data themselves).
- b. Make a professional-looking plot of your data.
- c. Use excel's "trendline" capability to fit an exponential function to your data and display the equation on your chart.
- d. Make a second plot that is semi-logarithmic and fit a straight line to your data.
- e. Discuss any changes, trends, lessons learned, etc.