2014

Compound Interest and the Power of Saving

Richard H. Serlin, *University of Arizona*

Compound Interest and the Power of Saving

By Richard Serlin

Note: This is not just instructions for an assignment. It is mostly an important and long article. Please do not glaze it. Read it in its entirety. It is a key part of successful personal finance, and thus this course

The following write up is long, including detailed graphics, so you might be able to read it better and more comfortably if you make a print. It's long, in part, because it's more than just assignment instructions. It is also an article, and on a very important subject – saving and investing. Please read it carefully – and all of it – as first, there will be exam questions on it; second, it contains instructions for what you are required to turn in; and third, and most important, it contains very valuable material for helping you to build a secure and prosperous future.

But, please only start reading and doing this assignment after you have read the first six chapters of "All Your Worth". You will understand it better and get more out of it at that time.

As you will see in this assignment, it is amazing how powerful saving can be. Even people with modest incomes can eventually become millionaires – even adjusting for inflation – as long as they save steadily and consistently, year in and year out.

If you save just $100 per week in a balanced diversified stock fund, like the Wilshire 5000, and it ends up earning its historical average return of approximately 7% plus the inflation rate, a real, inflation-adjusted 7% return, then, after 39 years you will have $1 million, in inflation adjusted, today dollars! And after 50 years you will have $2.2 million! And if your spouse does the same, you can double these numbers!

Looking at a more modest, but still very nice goal, $100,000 in savings: If you and your spouse both put away just $100/week, and you get the historical average return on the stock market, you will have $100,000 in savings in just 7-1/2 years! Obviously, a very nice cushion to have. You could put a 20% down payment on a $200,000 home, and still have $60,000 left over.

Why is compound interest, or return, so powerful? Why has it been called the eighth wonder of the world? Because it causes savings to grow exponentially (a ski slope, or ski jump, shaped graph, that takes off over time), and the key to that is that you get interest on interest. And we're going to go over this important phenomenon in detail. But first, let's cover some other issues that are important here, starting with the "approximately 7%, plus the inflation rate" historical return on a highly-diversified stock fund.

Inflation

Inflation is important to consider, especially long-term. The *non*-inflation-adjusted historical average return on the stock market is substantially higher, and it gives much more impressive numbers over the long run. But obviously, we don't want to be misled here. We want to know how much our savings will be in *today's* dollars, *with today's buying power*, and that's why I use the 7% number, the "real" historical return, which adjusts for inflation.

For example, consider 40 years of saving. At time of writing, it's 2014, so consider inflation from 1974 to 2014. Amazingly, $1 in 2014 is only worth 21 cents in 1974. That is, a dollar today only has the buying power that a mere 21 cents did in 1974[1] (Note: the endnotes are hyperlinked, to get to them quickly. Even faster, you can hover over them to see the note.) So clearly, if you did your forecasts in non-inflation adjusted numbers you might think you can expect 5 times the real wealth you'd have 40 years later. So, you want to always think in terms of real dollars when it comes to finance and business. You want to always try to adjust for inflation, at least for longer term calculations. Over a short period, a year, or a few years, it may not matter much. But over decades, it can really add up.

Now, the inflation from 1974 to 2014 was dramatic, but that includes an unusually high inflation period. In recent times, inflation has been far lower. Since the financial crisis of 2008 and Great Recession, it's usually in the ones, and sometimes negative (deflation). This is predominantly due to a shift in the attitudes of those in charge of our Federal Reserve System (often called "the Fed"). The Fed is much more conservative about inflation than it's been at almost any time post-World-War-II, and this is not expected to change much. The official inflation target is just 2%, but the Fed seems to clearly err on the side of less, with the 2% more like a ceiling than an average.

It often seems to the general public that the lower the inflation the better, but this is not at all true. Most macroeconomists fear deflation, as a threat which can cause, deepen, and prolong a recession or depression. The idea is that if prices are falling, people wait to buy, and so demand for goods and services drops, leading to companies laying-off due to insufficient sales to need as many workers.

In addition, the higher inflation is, the lower the Fed can drive down *real* interest rates. The lowest the Fed can drive interest rates on high-grade loans is zero. If the inflation rate is 2%, this means a *real* interest rate of approximately *negative* 2% (Why did I say "approximately"? See this endnote [2] for details, but it is a close approximation.). If the inflation rate is 4%, by contrast, then the Fed can drive real interest rates a lot lower, all the way to negative 4%.

This encourages borrowing and spending, which during a recession can stimulate the economy and get us out quicker. Of course, we can have businesses spend more on R&D, and government spend more on infrastructure and education, things which increase wealth long-run. It doesn't have to be consumers borrowing money to go on a vacation, buy a new luxury car, or other relatively frivolous consumption, to get us out of recession faster.

In any case, this is why some economists advocate a higher inflation target. For those interested in the debate, here[3] is a brief paper by Nobel Prize winning economist Paul Krugman. For our personal finance purposes I'll say that even if the inflation target goes up, I believe inflation is unlikely to consistently exceed the low single digits anytime in the foreseeable future. Nonetheless, even a two percent inflation rate really adds up over decades, so we want to consider it, at least in our long-term financial forecasts and decisions, and look at *inflation-adjusted* numbers.

Note also that inflation does not just mean that prices go up and things get more expensive. Inflation also acts on wages, and usually drives them up too, on average. The personal risk, however, is that with inflation the average wage goes up, but your particular wage may not go up. In that case your *real* wage went down. You get the same amount per year, but prices went up, so you really get less; you have less buying power.

Finally, a bit of jargon: Suppose the interest rate on a loan is 5%, and the inflation rate is 2%. Then, using the terms of economics and finance, we would say the *nominal* rate is 5%, but the *real* rate is (approximately) 3%. That is, 5% – 2%.

If you borrow $100 today, then at the end of the year you will have to pay $105. But due to inflation, that $105 won't really be worth 105 in dollars with today's buying power.

This is because prices will go up by 2%. Therefore, the $105 you will have to pay will only be worth $105/1.02 = $102.94 in today dollars, with today buying power.

So, your real interest will only be $2.94, or 2.94%, even though the nominal interest rate was 5%.

<u>The Historical Average Return of the Stock Market</u>

What is the historical average return of the American stock market? A problem is, different sources give different answers. One reason, that we just discussed, is, are they giving the real, inflation-adjusted, average return, or are they not adjusting for inflation.

But there are other reasons too.

First, different sources use different indices to approximate the return of the American stock market as a whole. Some, for example, use the S&P 500, but that only includes 500 stocks, while there are over 6,000 on major American exchanges. Others use all of the stocks, which is more accurate, and more accurately reflects the high-diversification strategy most commonly recommended by top experts for laypeople.

In addition, there is the time period observed. Those using the S&P 500 (and its precursors) only go back as far as 1928, as that's when this index began. Others go all the way back to 1802, just after the birth of the New York Stock Exchange.

Finally, there are technical issues, like how to weight the stocks in the average, and whether to use the arithmetic mean, or the usually more appropriate geometric mean. This is clearly beyond the scope of this course.

My opinion is that given the best data and techniques, the best approximation of the historical average return on the American stock market, for our purposes, is 7%, inflation-adjusted. And this figure has been surprisingly stable over major sub-periods. University of Pennsylvania, Wharton finance professor Jeremy Siegel goes over this in detail in his seminal book, "Stocks for the Long Run", part of which is assigned in this course. He comes up with an average in the high sixes overall since 1802, and the high sixes to seven in major sub-periods. Rounding up, you get 7%. And I round up in part for an easy to remember digit, and in part because I think there's reason to be optimistic about the stock market's return in the future, at least over the long run, the next 30+ years.

There are a number of reasons, I think, for this optimism in rounding up, but largely we appear to be at the cusp of a robotics/smart computer revolution. And over the next 30+ years this could increase corporate profits substantially, at least for a time. As workers, however, this will be a serious challenge, and a subject for your career plan. It makes education – *and graduating* – even more crucial, to avoid serious risk of robot/computer driven unemployment, and/or poverty wages. The seminal book on this, as of writing in 2014, accessible to laypeople, is "The Second Machine Age", by MIT economist Erik Brynjolfsson and MIT computer scientist Andrew McAfee. I have a book review here.

In the short run, of course, there's certainly risk to even a highly-diversified stock fund. It could go down substantially. In fact, even in the long run there's some risk, but much less, and it's well worth the high average return of stocks for money you can put away long-term. This is why a highly-diversified stock fund, one which tracks the market as a whole, like the Wilshire 5000, is widely considered by top experts to be the go-to long-run investment.

A big point I want to make here is that you will hear various different estimates of the average return of the stock market, even among good sources. And I've gone over major reasons why: different indices representing the market as a whole, different time periods measured, technical issues, like the geometric mean versus the arithmetic mean, and importantly, do they adjust for inflation. Is it the *real* return. But note that even the most conservative estimates give powerful growth to savings over the long run. And I think the 7% I use is best.

Unfortunately, Professor Warren, the author of "All Your Worth", wanted to keep this simple to reach a wide audience; she didn't adjust for inflation, for example, and used a simple arithmetic mean. It's not as accurate. But we can add some complexity to be more accurate in a college course at a major university. This will give us more realistic numbers, which will still be extremely impressive over the long run, as you will see.

For a long time I was reluctant to give a different number than Professor Warren, who without adjusting for inflation, and other things, has 12%. So, in some of my materials, which may not have been updated yet, you may see 12% (or 10.5%, which makes some adjustments, like geometric mean, but still is not inflation-adjusted). I apologize if you see these numbers. They should be updated soon. But again, even the most conservative estimates still give very impressive results.

Ok, so 7%. Now, let's look at what this kind of return means.

Let's suppose that you invest $100 at 7% real.

What happens?

Year 1

You start with $100, your investment, and at the end of the year you get interest equal to 7% of what you started the year with, that is $7\% \times \$100 = \$7$.[4] Note that 7% is equal to .07, so on a calculator you can just input .07 x 100. Likewise, a percentage like 14% is .14.

So you get $7 interest, plus you have your initial investment of $100, so at the end of year 1, your account has $107, and we're assuming 7% real, so that's $107 in inflation-adjusted today dollars, with today's buying power.

Year 2

Now you start the year with your $100 initial investment, *plus* last year's interest of $7 – and you will get interest on *both!* So this year your interest will be:

	Interest Earned this year (Year 2)
On your Initial Investment	$7\% \times \$100 = \$7$
On Last Year's (Year 1's) Interest	$7\% \times \$7 = \$0.49$
Total	$7.49

So this year you get an extra $0.49 in interest, which is equal to your interest on last year's $7 worth of interest. That's where the expression "interest on interest" comes from. So now your account is worth your initial investment of $100, plus year 1's total interest of $7, plus year 2's total interest of $7.49, which adds up to $114.49.

Year 3

	Interest Earned this year (Year 3)
On your Initial Investment	7% × $100 = $7
On Year 1's Interest of $7	7% × $7 = $0.49
On Year 2's Interest of $7.49	7% × $7.49 = $0.52
Total	$8.01

This year you received 7% interest on the $100 you invested in the first place, plus 7% interest on your $7 of first year interest, which came out to $0.49. In addition, you received 7% interest on your $7.49 of second year interest, which came out to $0.52. It all added up to $8.01 in interest.

Year 4

	Interest Earned this year (Year 4)
On your Initial Investment	7% × $100 = $7
On Year 1's Interest of $7	7% × $7 = $0.49
On Year 2's Interest of $7.49	7% × $7.49 = $0.52
On Year 3's Interest of $8.01	7% × $8.01 = $0.56
Total	$8.57

As you can see, all you did was invest $100 one time, yet every year your interest payment keeps getting bigger, because you keep getting more and more interest on interest.

Year 5

	Interest Earned this year (Year 5)
On your Initial Investment	7% × $100 = $7
On Year 1's Interest of $7	7% × $7 = $0.49
On Year 2's Interest of $7.49	7% × $7.49 = $0.52
On Year 3's Interest of $8.01	7% × $8.01 = $0.56
On Year 4's Interest of $8.57	7% × $8.57 = $0.60
Total	$9.17

By year 5, because of all of the interest on interest you are getting, your total interest payment has increased from $7 in year 1 to $9.17 in year 5, a 31% increase in just 5 years! Notice that your interest on the initial investment portion never changes. That's always $7, but the interest on interest portion *always* keeps growing.

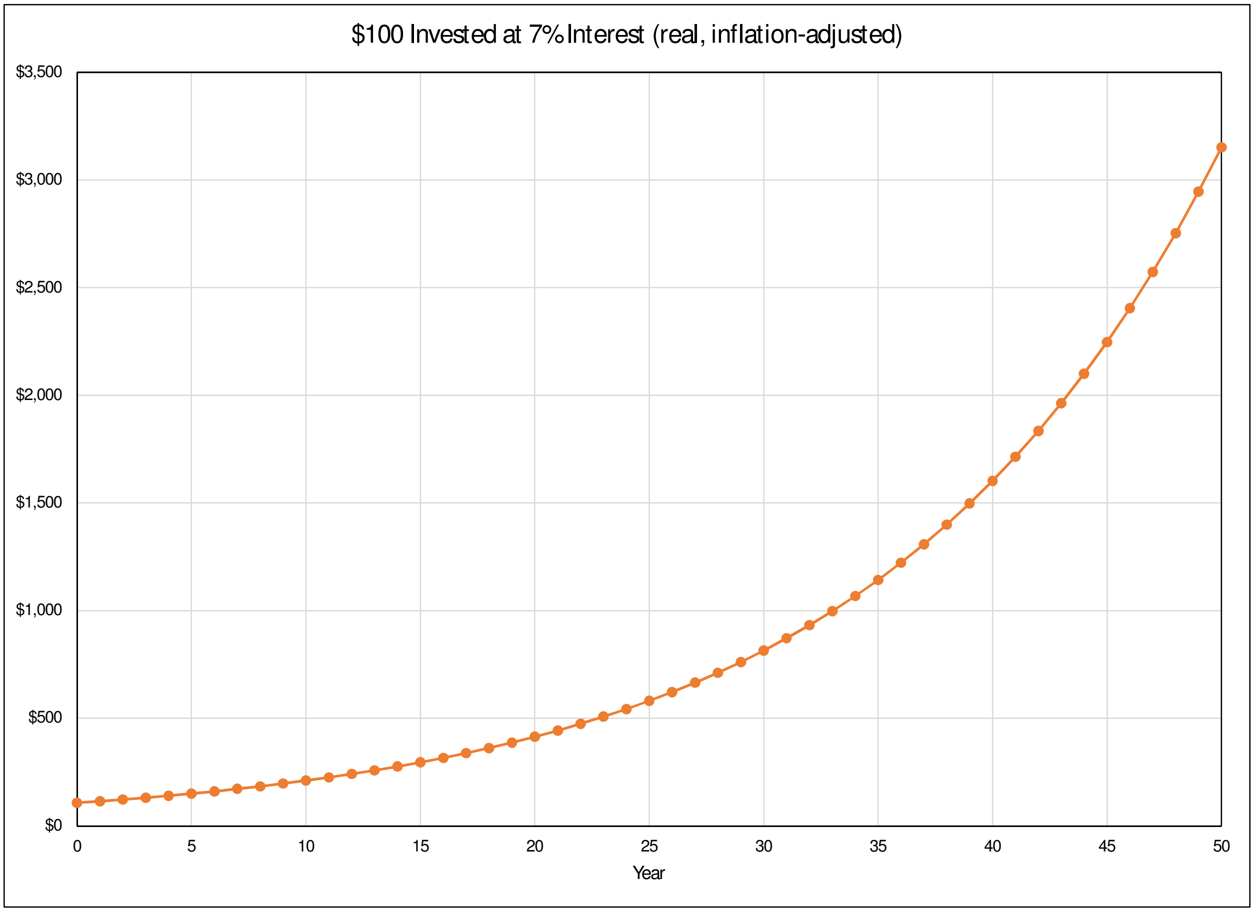
It grows, in part, because you keep having more and more years of interest to get interest on, but also, the size of the most recent interest on interest payment never stops growing. For example, we have seen it grow from $0.49 to $0.52 to $0.56 to $0.60, and it will continue to grow, *and in an exponential, ski-slope-shaped, way*, eventually becoming far bigger than the $7 in interest on the initial investment portion. Now, let's see what happens in the ensuing years – over the long run:

Year	**Total Interest Payment for that Year**	**Amount of Money in the Account at the End of the Year**
0 (Initial investment: $100)	$7.00	$107.00
1	$7.49	$114.49
2	$8.01	$122.50
3	$8.58	$131.08
4	$9.18	$140.26

Year	Total Interest Payment for that Year	Amount of Money in the Account at the End of the Year
5	$9.82	$150.07
6	$10.51	$160.58
7	$11.24	$171.82
8	$12.03	$183.85
9	$12.87	$196.72
10	$13.77	$210.49
11	$14.73	$225.22
12	$15.77	$240.98
13	$16.87	$257.85
14	$18.05	$275.90
15	$19.31	$295.22
16	$20.67	$315.88
17	$22.11	$337.99
18	$23.66	$361.65
19	$25.32	$386.97
20	$27.09	$414.06
21	$28.98	$443.04
22	$31.01	$474.05
23	$33.18	$507.24
24	$35.51	$542.74
25	$37.99	$580.74
26	$40.65	$621.39
27	$43.50	$664.88
28	$46.54	$711.43
29	$49.80	$761.23
30	$53.29	$814.51
31	$57.02	$871.53
32	$61.01	$932.53

Year	Total Interest Payment for that Year	Amount of Money in the Account at the End of the Year
33	$65.28	$997.81
34	$69.85	$1,067.66
35	$74.74	$1,142.39
36	$79.97	$1,222.36
37	$85.57	$1,307.93
38	$91.55	$1,399.48
39	$97.96	$1,497.45
40	$104.82	$1,602.27
41	$112.16	$1,714.43
42	$120.01	$1,834.44
43	$128.41	$1,962.85
44	$137.40	$2,100.25
45	$147.02	$2,247.26
46	$157.31	$2,404.57
47	$168.32	$2,572.89
48	$180.10	$2,752.99
49	$192.71	$2,945.70
50	$206.20	$3,151.90

As you can see, the annual interest payment, and the total amount in your account, really take off over a long period of time, as the interest on interest grows exponentially. $100 becomes $3,152 in 50 years! And that's in inflation adjusted today dollars! Graphically, it looks like this:



This is what I mean when I keep mentioning exponential growth; I mean growth with a ski slope shape, that over a long period of time really takes off! $100 was deposited one time, and 50 years later it grew to $3,152!

I've gotten at a lot of the intuition why the value of an investment with steadily compounded interest takes off over the long run in talking about interest on interest, but another way to see why it takes off is to consider this:

In year 1 you get 7% of $100.00 – so your wealth grows by $7.

In year 2 you get 7% of a bigger amount, $107.00 – so your wealth grows by $7.49.

In year 3 you get 7% of a still bigger amount, $114.49 – so your wealth grows by $8.01.

And so on. You keep getting 7% of a bigger and bigger amount. Look at the graph above. By year 33 your account has grown to about $1,000, so in year 33, you're getting 7% of $1,000, or about $70, as opposed to the only $7 in interest you got in year one. *So now your money is growing at a much faster rate. It's growing at a rate of $70/year, as opposed to the $7/year rate it was growing at when you started out.*

By year 50, your account has grown to about $3,100, so now you're getting 7% of *$3,100* as opposed to the 7% of only $100 you were getting when you started out**.** *Now your money is growing at a rate of 7% x $3,100 = $217/year, as opposed to the $7/year rate it was growing at when you started out – It's growing <u>30 times</u> faster, 30 times!*

In any case, whatever the mathematical intuition, ***the bottom line is, the exponential growth from compound interest, or return, means that if you're willing to save and invest for the long run, you can become very wealthy, and I encourage all of you to take advantage of this.*** This example was with just a one-time investment of $100 – Imagine how wealthy you could get over the long run if you consistently save $100 every week, and don't touch it.

And let's look at that example. What would happen if we saved about $100 *per week*, approximately, we'll say $400 per month?

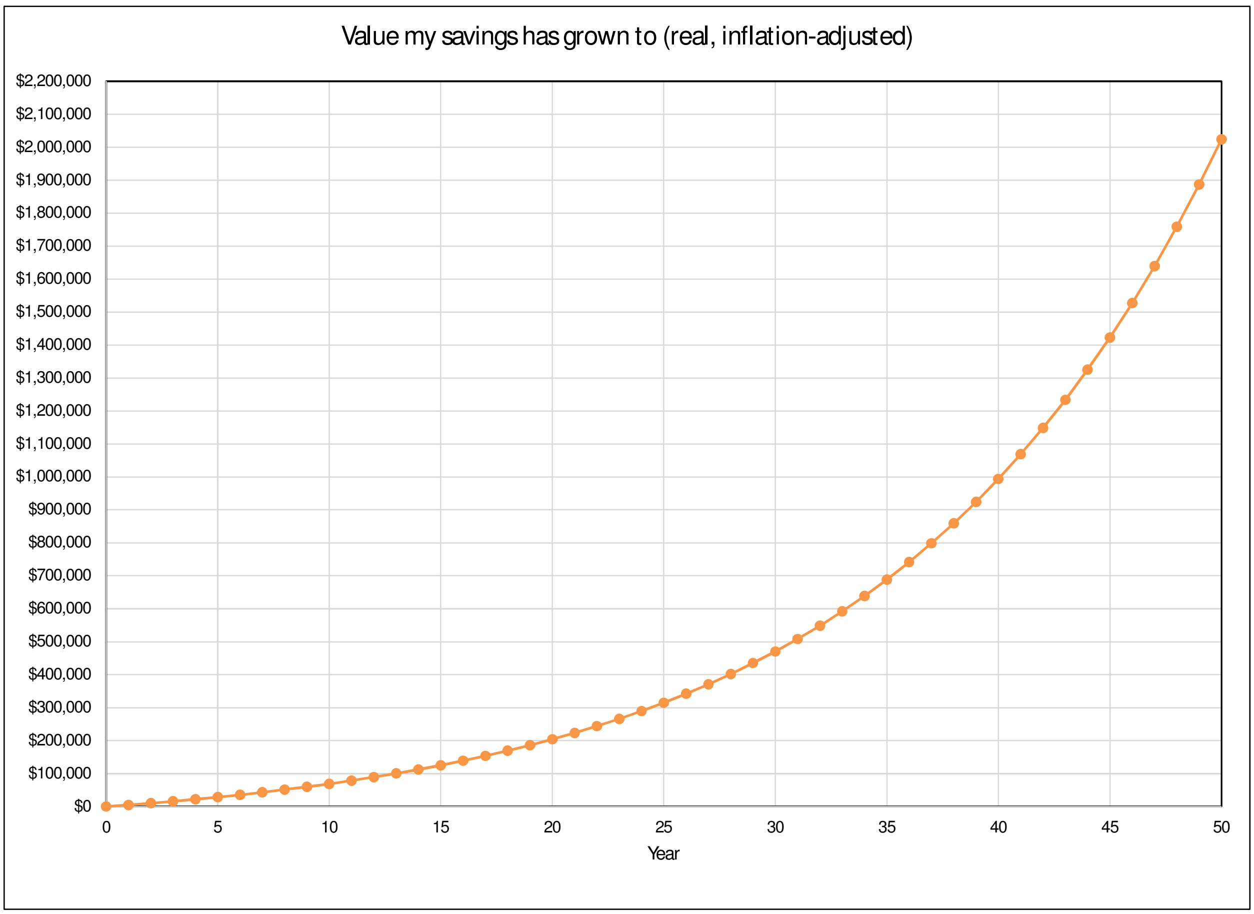
The 7% interest rate, or return, we will be using, remember, is approximately the historical average return on a balanced diversified stock portfolio, like the Wilshire 5000. Here are the results:

Year	**Net Worth**
1	$4,980
2	$10,309
3	$16,011
4	$22,111
5	$28,639
6	$35,624
7	$43,098
8	$51,095
9	$59,652
10	$68,808
11	$78,604
12	$89,087
13	$100,303
14	$112,304
15	$125,146
16	$138,886
17	$153,588

Year	Net Worth
18	$169,319
19	$186,152
20	$204,162
21	$223,434
22	$244,054
23	$266,118
24	$289,727
25	$314,988
26	$342,017
27	$370,938
28	$401,884
29	$434,996
30	$470,426
31	$508,336
32	$548,900
33	$592,303
34	$638,744
35	$688,436
36	$741,607
37	$798,499
38	$859,374
39	$924,511
40	$994,207
41	$1,068,781
42	$1,148,576
43	$1,233,956
44	$1,325,313
45	$1,423,066
46	$1,527,660

Year	Net Worth
47	$1,639,577
48	$1,759,327
49	$1,887,460
50	$2,024,562

Graphically, it looks like this:



Again, notice the exponential, ski slope, growth, how it starts out growing slowly and moderately, but then starts to take off. It takes a little over 30 years to save the first $500,000, but then it's less than ten more years to add another $500,000. At that point, you have $1,000,000, so with the 7% inflation-adjusted return, your money's growing at $70,000 per year (plus the $400/month you keep putting in)! And the growth rate will just keep accelerating! Now it takes only about 6 years to make the next $500,000. By year 50 you have over $2 million, in inflation-adjusted dollars with today's buying power. All from saving just $400 per month! And if your spouse does the same, you can double those numbers!

But what if you want to save $525 per month, starting after you complete your education, and are earning college degree level compensation? Or what if you want to start out saving $475 per month, but then increase it by 20% every 4 years, to account for the fact that throughout one's career compensation typically increases over time, with regular raises and promotions? Then, how will your wealth plan play out?

That's what we are going to work on next. I have designed an easy to use "Future Wealth Calculator" Excel workbook for you, to help answer these kinds of questions, and do this kind of planning. The calculator is available in the Content section of our D2L site. You have full permission to keep this calculator after the course is over for your future financial analysis and planning. You may also let your friends, relatives, or anyone else, copy it.

Even for someone who knows little or nothing about Excel, it shouldn't be too hard to learn how to use the spreadsheets in this workbook. Instructions are included at the bottom of each of the three spreadsheets, however, if you really do know very little or nothing about Excel, I recommend purchasing a copy of the book *Teach Yourself Visually Excel*.

This is an excellent book for beginners and intermediates. You will learn Excel faster, easier, and more enjoyably from this book than the typical ones out there. It contains clear full color step-by-step illustrations of all of the most important tasks in Excel.

It's a great investment. Excel is a widely used and important program in the professions that most of you will go into. Most of you will also have to use Excel in future courses, so if you are not well versed in it, reading this book now, and having it as a reference, can make things a lot easier and more enjoyable in the future.

And, good news, at time of writing in 2014, the University is providing a free copy of Microsoft Office Professional to all students! Office is a suite of programs that includes Excel, as well as Word, Power Point, Outlook, and more! This is a great opportunity, as the list price of this suite is $400. So, there's no excuse not to get and learn Office. It's ubiquitous in the college educated workplace.

With regard to my Future Wealth Calculator Excel workbook, basically, those who are familiar with tables, Excel, and the like, will probably be able to look at the spread sheets, start reading their text, and right away see how it works.

However, many students have little experience with such things. From my experience, a good percentage of those less experienced students take gen. ed. courses like this one. As a result, in the past there was a significant percentage of students who made mistakes on this assignment. Therefore, I have added to this document some very detailed instruction.

Those who are experienced with tables, Excel, etc., will find much of this instruction unnecessary, but, this is a gen. ed. course. It includes students of all backgrounds, including a lot of freshmen. I have to make the material clear to everyone, so if some of this explanation is already clear to you, please just read through it quickly. Don't, however, completely skip any of it. There are some details on what I'd like for the assignment mixed in with the basic explanation of how to use the Future Wealth Calculator, and such.

Ok, now let's get started.

How to Use the Future Wealth Calculator

I programmed the Future Wealth Calculator in Microsoft Excel. It's an Excel workbook. What's a workbook? A workbook in Excel is like a file or document is for Microsoft Word. Excel files are called workbooks. What does a workbook look like? Well, below is a screen shot of my Future Wealth Calculator Excel workbook:

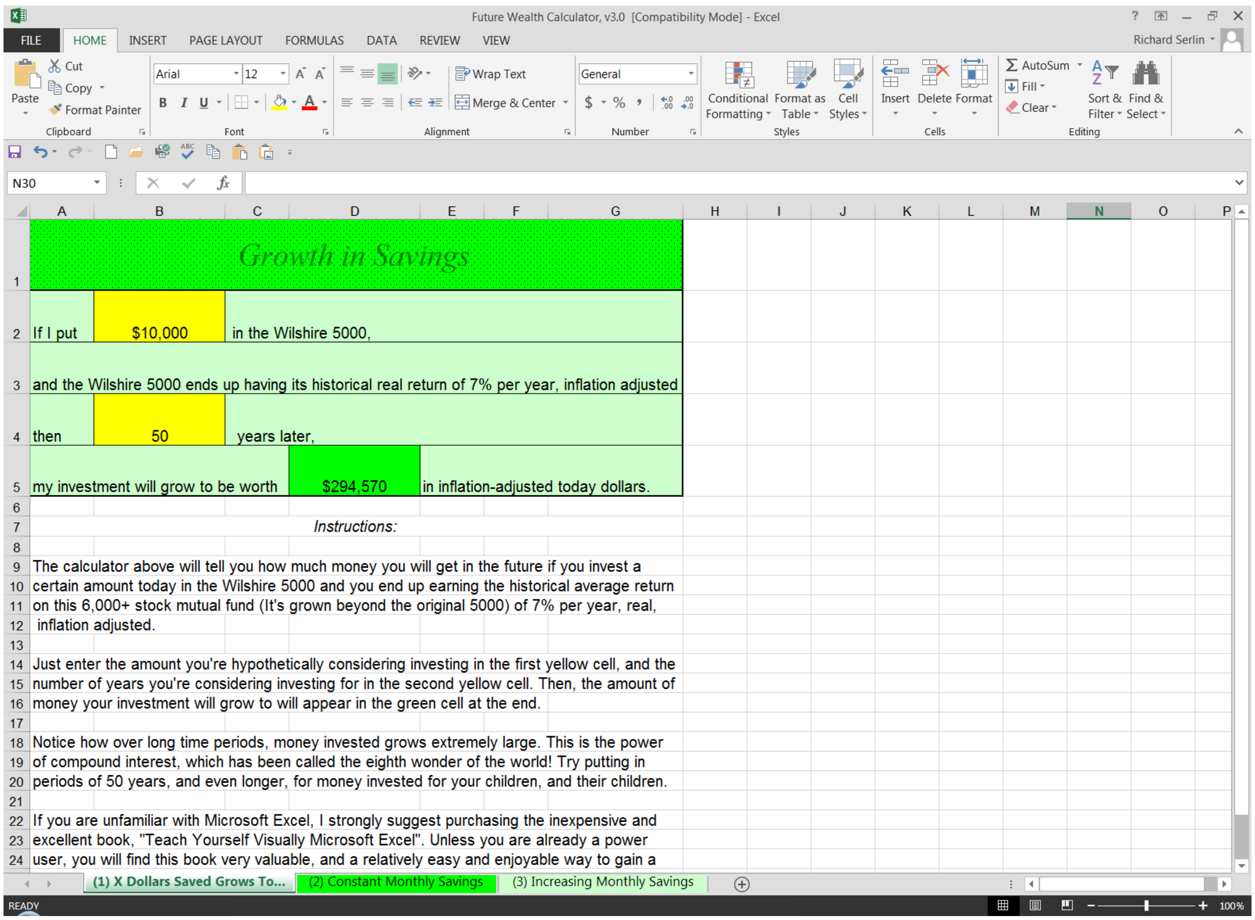


Figure 1

Excel workbooks were patterned after old-fashioned paper accounting workbooks. Those workbooks had a metal spiral at the top to hold all of the pages in, and there were section dividers with tabs at the bottom, so that you could quickly flip to the section that you wanted.

Our Microsoft Excel workbook above is like that. You could imagine a metal spiral at the very top, and then at the bottom there are tabs so that you could flip to the section that you want. The tabs in this workbook are labeled "(1) X Dollars Saved Grows To...", "(2) Constant Monthly Savings", and "(3) Increasing Monthly Savings".

If you want to flip to any of the sections you just click its tab. The sections are called work*sheets* (or sometimes spreadsheets). There are three work*sheets* in this Excel work*book*. You can, however, put as many worksheets as you like in an Excel workbook. If there are too many to fit on the screen, a scrolling apparatus will appear.

Note that the screen shot in Figure 1 above is what the Future Wealth Calculator workbook looks like when displayed in Excel 2013. If you have a different version of Excel, it might look slightly different, but essentially things will be the same for all versions of Excel.

Let's now learn how to use the first worksheet in our Future Wealth Calculator workbook.

A very important general rule for learning how to use any software is to *read the screen*. Many people don't do this nearly enough. Very often the answer to your question is written on the screen. Other times people take a very quick glance at the screen, and then are confused, and they spend a lot of time trying to figure it out without ever just carefully reading what's on the screen. If they had just carefully read the screen, they often would have quickly understood it. In fact, a popular saying among software professionals is "RTS", for "Read The Screen".

I think it is especially true in the case of my Future Wealth Calculator that if you just don't rush, and take the time to read *all* of the words, it can really make it clear what's going on, and how to use the calculator.

For example, let's look at the first worksheet of the Future Wealth Calculator workbook, "(1) Dollars Saved Grows To..." This sheet is printed in its entirety above in Figure 1, but below I'm going to just zoom in and reprint the top part:

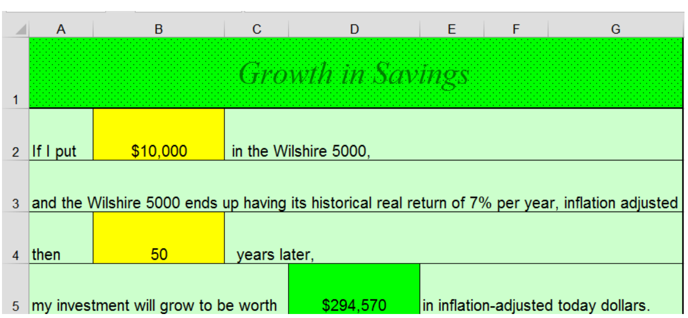


Figure 2

Now, please just read the *whole* thing.

As you can see, it's very clear English. It has a headline, "Growth in Savings", and below the headline it says, "If I put $10,000 in the Wilshire 5000, and the Wilshire 5000 ends up having its historic real return of 7% per year, then 50 years later, my investment will grow to be worth: $294,570 in inflation-adjusted today dollars".

Very clear: $10,000 grows to $294,570, inflation-adjusted, if you keep it in the Wilshire 5000 for 50 years, and if the Wilshire 5000 ends up averaging 7% real, as it historically has.

A great thing about Excel is that you can try different numbers, any ones you like. For example, suppose you want to see what $10,000 would grow to after 60 years if you got the 7% real average return in the Wilshire 5000. Then all you have to do is click once on the yellow cell (the boxes are called cells) in Figure 2 above that currently has 50 in it. Then, just type in 60, and hit Enter. Once you do, Excel will calculate the new answer and display it in the darker green box, as in the screen shot below:

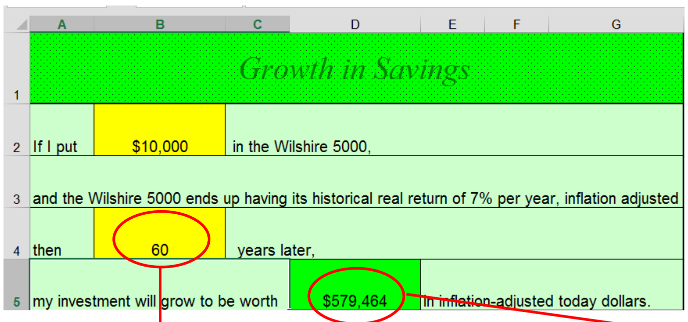


Figure 3

First, you clicked on this yellow cell, and typed in "60", over the "50" that was there before. Then, after you hit enter, Excel immediately re-calculated and it changed the dark green cell from $294,570 to the new answer $579,464.

So now you can see how much your $10,000 will grow to after 60 years. The answer appears in the green box, $579,464. By the way, 60 years may seem too long, but if you're saving for your children, it's not. Even for yourself, money you put into your 401k at 25 you'll probably need at 85, especially with the advances in medicine and lifespan that will occur over the next 60 years.

And you can use this worksheet to see how much any amount will grow to after any number of years if you earn 7% inflation-adjusted in the Wilshire 5000. For example, if you want to see how much $2,572 will grow to after 28 years in the Wilshire 5000 earning a 7% real return, then all you do is click on the first yellow cell, type in 2572, and hit enter, and then click on the second yellow cell, type in 28, and hit enter. Excel will then re-calculate the number in the green cell to give you the correct answer: $18,298. The screen will look like this:

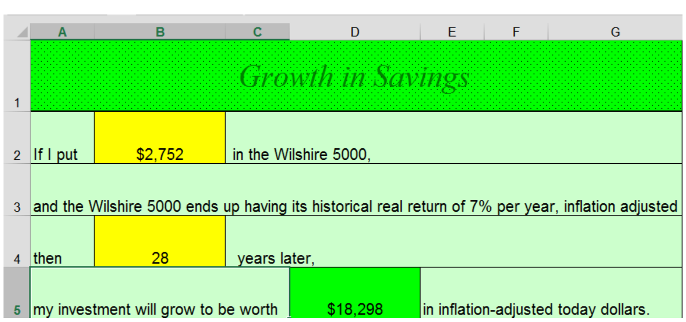
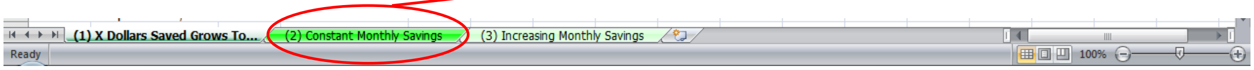


Figure 4

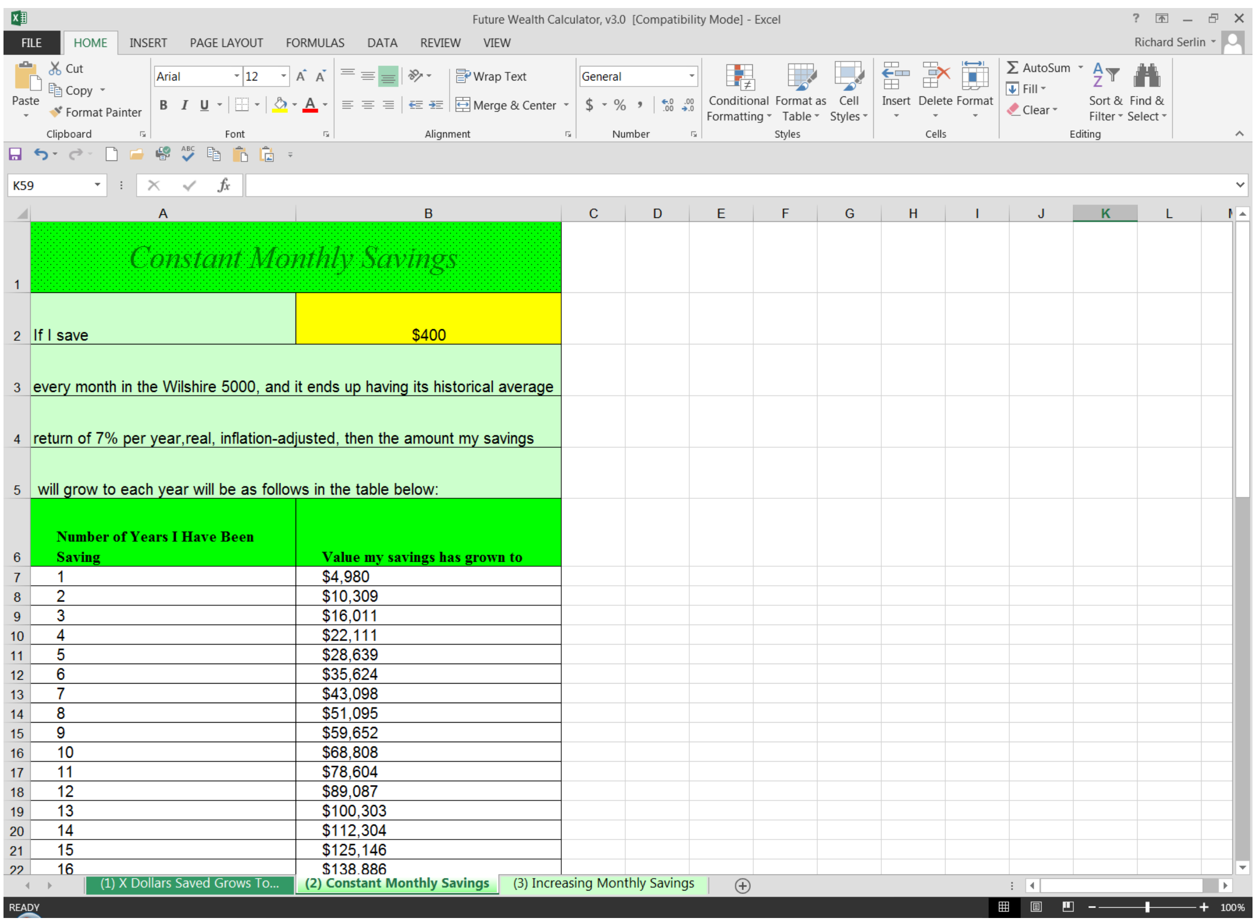
Throughout the Future Wealth Calculator Excel Workbook, I have designed it so that cells where you input the numbers you want are yellow, while cells that give you output, or answers, are in the darker green. You can see this in Figure 4 above. Your inputs are in yellow cells, and the answer is in a dark green one.

Ok, now let's learn how to use worksheet 2, "Constant Monthly Savings".

To get to worksheet 2, just click its tab at the bottom of your screen



You will then see worksheet (2) Constant Monthly Savings, which looks like this:



Again, and as always, remember, RTS – Read The Screen!

So, please read it now, entirely, from the top down to the first numbers in the table. And please read it. Don't glaze it. Haste doesn't always make waste, but if you have something important, and it will take only a little extra time to read, or do it, well, then in that case, it's worth spending the time to do it carefully and not rush.

This is important. This assignment is worth a large percentage of your grade, and much more importantly it can teach you a great deal that will help your personal financial wealth and security throughout your life, so it's worth spending the little bit of extra time to read the whole screen, and not glaze it.

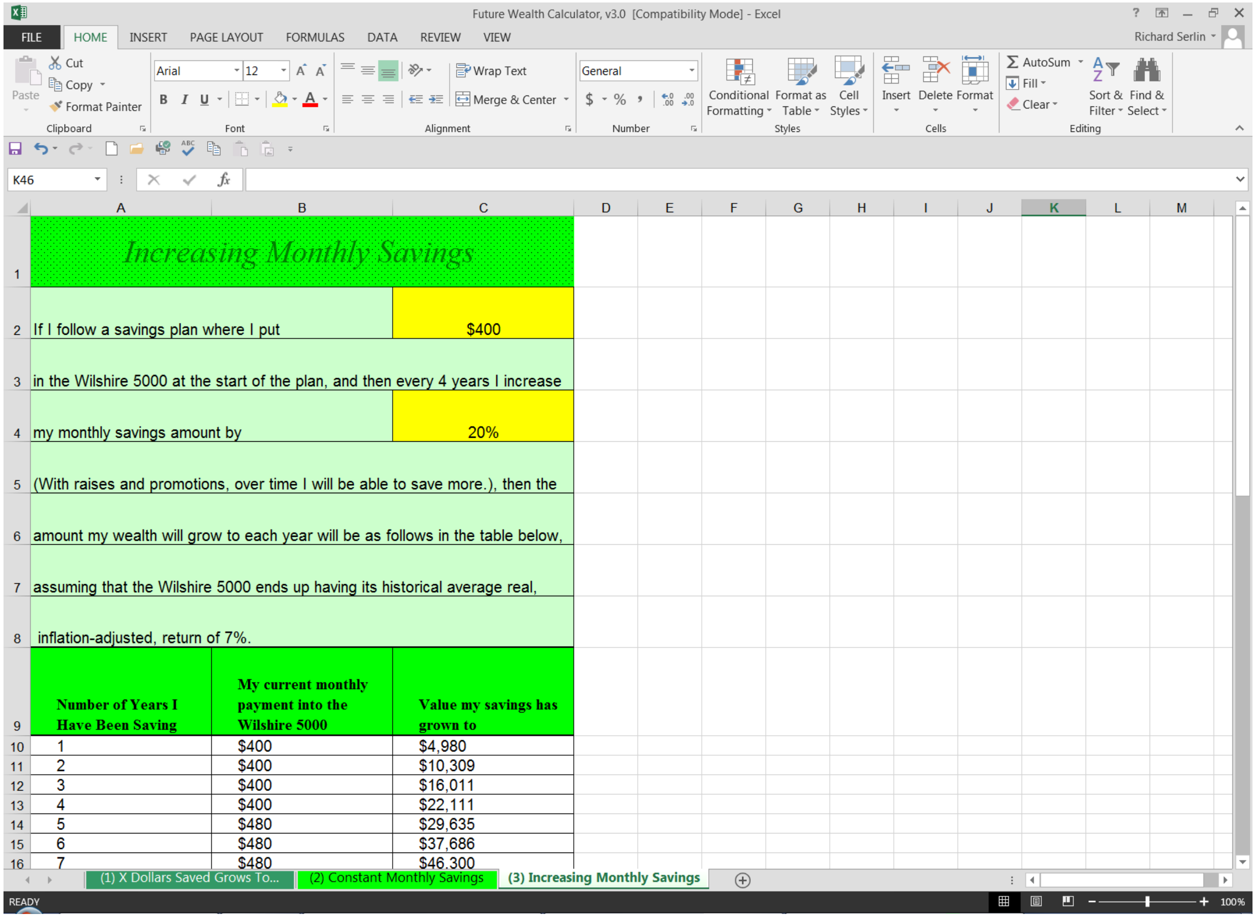
The admonition against being penny wise, pound foolish applies to time as well as money. The one minute you save from glazing instead of reading could cost you a lot more than a minute in confusion later, in a lower grade, and in worse understanding of a tool and assignment that can really help you in your future personal financial success.

Sometimes it's worth rushing, if you get good at doing something fast, if something is not that important, etc., but if that is not the case, don't save a minute here and there if it's going to cause you to be confused and/or do a poor job on something important. And, if you do end up confused in a computer program, or some reading, try going back and reading it again in a <u>*non-rushed careful way*</u>. Patience. Patience. Rushing less can often lead to better grades, *and much better competence*, in school *and career*. And this is especially true when it comes to instructions. You can really impress your boss, or professor, if you just take a relatively little time to carefully read instructions right from the beginning, from the first word, in order, thoroughly. Then, suddenly you're the person who really knows what's going on, and does things right and smart.

You can see that like in worksheet 1, it's also very straightforward. You have a headline of "Constant Monthly Savings" and then the straightforward text, "If I save $400 every month in the Wilshire 5000, and it ends up having its historical average return of 7% per year, real inflation-adjusted, then the amount my savings will grow to each year will be as follows in the table below:" And then the table follows.

So, what's in the table. Again, just read each word – don't glaze. The table's column headings are straightforward: First column, "Number of Years I Have Been Saving". Second column, "Value my savings has grown to". So just look at the table. After 5 years you see your savings will grow to $28,639. After 10 years, $68,808, and so on.

Now let's look at the last worksheet in our Excel Future Wealth Calculator, "(3) Increasing Monthly Savings". As before, just click the tab at the bottom of the page for that worksheet to make it appear. Once you do, it will look like this:



Increasing Monthly Savings

If I follow a savings plan where I put $400
in the Wilshire 5000 at the start of the plan, and then every 4 years I increase
my monthly savings amount by 20%
(With raises and promotions, over time I will be able to save more.), then the
amount my wealth will grow to each year will be as follows in the table below,
assuming that the Wilshire 5000 ends up having its historical average real,
inflation-adjusted, return of 7%.

Number of Years I Have Been Saving	My current monthly payment into the Wilshire 5000	Value my savings has grown to
1	$400	$4,980
2	$400	$10,309
3	$400	$16,011
4	$400	$22,111
5	$480	$29,635
6	$480	$37,686
7	$480	$46,300

Once again, where do we start? RTS – Read The Screen.

You can see that like in the previous worksheets, it's straightforward. You have a headline of "Increasing Monthly Savings" and then the straightforward text, "If I follow a savings plan where I put $400 per month in the Wilshire 5000 at the start of the plan, and then every 4 years I increase my monthly savings amount by 20% (because as I get raises and promotions, I will be able to save more), then the amount my wealth will grow to each year will be as follows in the table below, assuming that the Wilshire 5000 ends up having its historical average real, inflation-adjusted, return of 7%."

So, the idea is this: The previous worksheet, *Constant* Monthly Savings, showed what your wealth would grow to if you saved the same amount every month, year in and year out. But, hopefully, you will get periodic raises and promotions. There are often ups and downs, layoffs, retraining, etc., but on average the long-term trend has been that income steadily increases until sometime in the fifties for college degreed individuals.

Now, steadily increasing wages throughout your career used to be common a generation ago. Over time you moved up, got more experience, seniority, etc. But it's a very different world today. Over time your skills can become obsolete; your health and energy can become much worse; the company where you had gained seniority and company-specific expertise can lay you off with much greater likelihood than in the past, and loyalty to employees is nothing like it used to be.

Moreover, you will be facing a revolution in smart artificial intelligence (AI) computers and robots which will make many skills obsolete quickly, and not just for the non-college degreed at all. These unprecedentedly intelligent and capable computers will be able to do much of what physicians, lawyers, middle managers, and engineers do now. And you may have to retrain fast to gain new skills in the new environment.

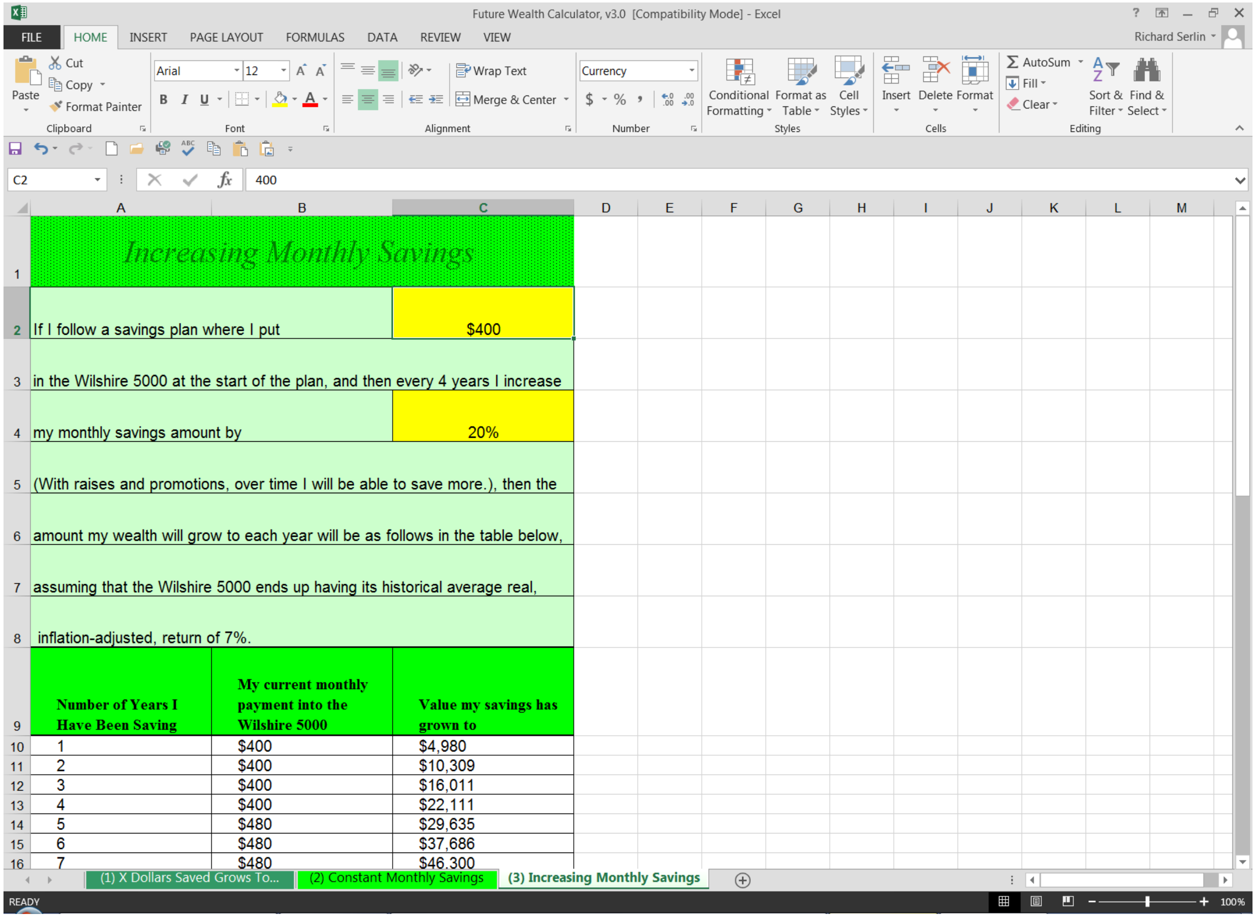
For those without a college degree it could be, and for many will be, disastrous. There are projections that over the next generation at least 90% of fast food jobs will be taken by advanced robots and computers, that can be employed at effectively a fraction of even the minimum wage. And there are similar projections for manufacturing. Relatively good low-skilled jobs like package delivery can be, by and large, taken over by computer driven vehicles, which are already logging millions of miles in test cars. On board robots would transport the packages from the curb to the home or business, as test prototypes are already doing.

The last thing you want is to not graduate college today, and I hope you take this to heart and study hard.

This revolution is just taking off, but it will be in full-swing in the heart of your careers, over the next 10-30 years. It's something you will want to think about and research in your career plan assignment.

For this worksheet, we will be positive and assume that you study hard, become well educated, and maintain your skills. And as such, steadily get raises of 20% every 4 years. Let's look at the results:

For this example we will assume that your starting savings rate, when you complete your education and start your first career job, is $400/month. So we put $400 in the first yellow cell and hit enter. Here are the results:



Future Wealth Calculator, v3.0 [Compatibility Mode] - Excel

Increasing Monthly Savings

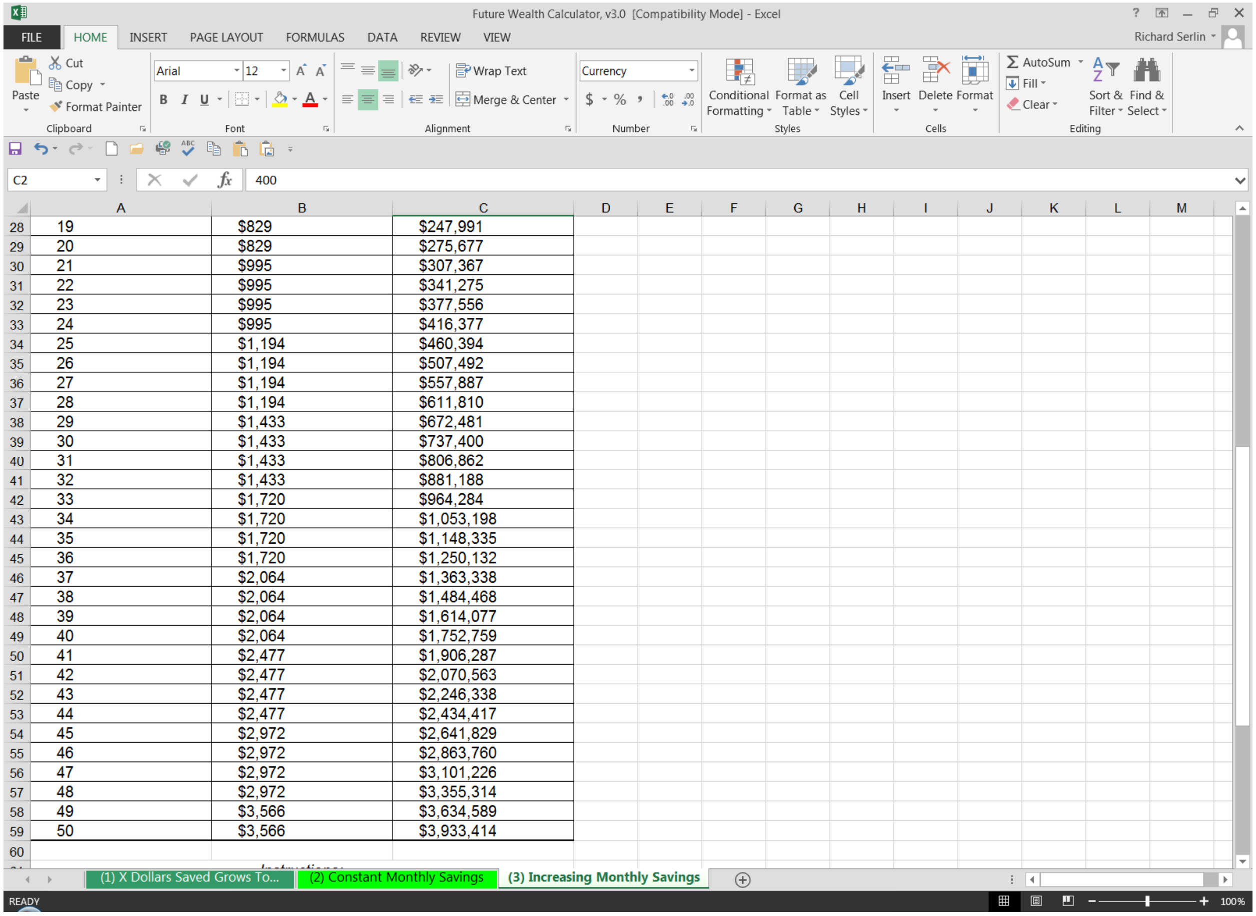
If I follow a savings plan where I put	$400
in the Wilshire 5000 at the start of the plan, and then every 4 years I increase	
my monthly savings amount by	20%
(With raises and promotions, over time I will be able to save more.), then the	
amount my wealth will grow to each year will be as follows in the table below,	
assuming that the Wilshire 5000 ends up having its historical average real,	
inflation-adjusted, return of 7%.	

Number of Years I Have Been Saving	My current monthly payment into the Wilshire 5000	Value my savings has grown to
1	$400	$4,980
2	$400	$10,309
3	$400	$16,011
4	$400	$22,111
5	$480	$29,635
6	$480	$37,686
7	$480	$46,300

(1) X Dollars Saved Grows To... | (2) Constant Monthly Savings | (3) Increasing Monthly Savings

As you can see, in year 5 your monthly savings amount jumps 20% to $480. By the end of that year you have accumulated $29,635, a nice start, especially if your spouse has done the same.

Scrolling down the table:



	A	B	C
28	19	$829	$247,991
29	20	$829	$275,677
30	21	$995	$307,367
31	22	$995	$341,275
32	23	$995	$377,556
33	24	$995	$416,377
34	25	$1,194	$460,394
35	26	$1,194	$507,492
36	27	$1,194	$557,887
37	28	$1,194	$611,810
38	29	$1,433	$672,481
39	30	$1,433	$737,400
40	31	$1,433	$806,862
41	32	$1,433	$881,188
42	33	$1,720	$964,284
43	34	$1,720	$1,053,198
44	35	$1,720	$1,148,335
45	36	$1,720	$1,250,132
46	37	$2,064	$1,363,338
47	38	$2,064	$1,484,468
48	39	$2,064	$1,614,077
49	40	$2,064	$1,752,759
50	41	$2,477	$1,906,287
51	42	$2,477	$2,070,563
52	43	$2,477	$2,246,338
53	44	$2,477	$2,434,417
54	45	$2,972	$2,641,829
55	46	$2,972	$2,863,760
56	47	$2,972	$3,101,226
57	48	$2,972	$3,355,314
58	49	$3,566	$3,634,589
59	50	$3,566	$3,933,414
60			

We see that by year 20, from steady increases in income every four years, you are now saving $829/month, and your savings are up to $275,677, and hopefully, if you're married, your spouse has saved as much or more. By year 50, you're saving $3,566/month. But this is an optimistic scenario. It assumes raises will continue throughout your 60's, and even into your 70s. Usually, even if things go well, inflation-adjusted incomes top out in the 50s and plateau or somewhat decline in the 60s. On the other hand, even if you don't get any more raises after, say, 55, your savings rate can still increase simply because usually your expenses drop a lot as your children become self-sufficient.

Ok, now, what to turn in. You are asked to submit this form, filled out, to the D2L dropbox:

Personal Financial Analysis and Planning: Key Findings		
Section 1: Estimating Your Monthly After-Tax Starting Pay		
Your forecasted annual starting pay, including all forms of cash compensation such as bonuses and commissions		
Your forecasted tax rate including all taxes, federal, state, local, etc. (if you are unsure, just use 30%. That should be fine for a ball park estimate)		
Your forecasted *annual* after-tax starting pay		
Your forecasted *monthly* after-tax starting pay		
Amount you save each month, if you save 20% of your starting monthly after-tax pay		
Section 2: Future Wealth		
A. Saving 20% of Your Forecasted Starting After-Tax Pay Every Month		
Value of Savings in Inflation Adjusted Today Dollars After:	5 years	
	10 years	
	20 years	
	30 years	
	40 years	
	50 years	
B. Saving 20% of Your Forecasted Starting After-Tax Pay Initially, but then Increasing Your Monthly Savings by 20% Every 4 Years.		
Value of Savings in Inflation Adjusted Today Dollars After:	5 years	
	10 years	
	20 years	
	30 years	
	40 years	
	50 years	

The first thing you're asked is, "Your forecasted annual starting pay, including all forms of cash compensation such as bonuses and commissions".

How do you get this? Well, you're also asked to do a career plan research paper. And for that you'll also have to research job incomes. And I talk more about this in the instructions for your career plan assignment. But basically, the main way to do this is to google things like "job incomes" and "job income surveys". And you will also want to do a lot of googling of your specific career. So, if your first choice career is dentistry, you would google things like "dentistry career" and "dentists income".

This will lead you, at least at time of writing, to sites like salary.com and the Bureau of Labor Statistics' "Occupational Employment Statistics". You want to look at a number of sources, if possible. And, you'll have to think about and interpret what you find. Was it a large sample? Was the average skewed a lot higher by the high incomes of a minority, but most people make much less?[5] How close did their category fit your career? You have to apply some intelligence and thinking to statistics, or sometimes you can be misled.

And, if it's an average across all of the people in the career, as it usually is, you will have to adjust their number for the fact that you are looking to estimate a starting income, which is usually substantially lower than average. To find decent estimates of starting pay, it's often very helpful to ask a professor in that area, or a counselor at the University of Arizona's Career Services Center.

And finally, you will want to adjust for personal factors, like how good is your GPA.

So, there's a lot of guesstimation, but if you research this well, and put in some thought, you should be able to get at least a decent ballpark estimate. And that's definitely good enough to make this assignment very useful and illuminating. So, don't worry too much about getting it that precise. It's a definitely good idea for your career planning and decision making to spend some time researching this well. You may be surprised at what you find, and it's certainly better to find out now, when you're young enough to easily change course. But don't worry about losing points because I don't like your estimate.

Ok, suppose you settle on an estimate of $45,000/year to start. You enter that in the first yellow cell. Next, you're asked, "Your forecasted tax rate including all taxes, federal, state, local, etc. (if you are unsure, just use 30%. That should be fine for a ball park estimate)" If you're not sure here, as I say 30% is fine. So, let's enter that in the next yellow cell.

Now we need, "Your forecasted annual after-tax starting pay", so we have to subtract 30% for taxes out of our $45,000/year. You could multiply 30% x $45,000 to get $13,500, and then subtract that from $45,000 to get $31,500.

Or, a shortcut, you could note that if you're paying 30%, then you're keeping 100% – 30%. So you're keeping 70%. And 70% of $45,000 is .70 x $45,000 = $31,500.

So, your after-tax yearly income is $31,500, and that's what you enter in the next yellow cell.

But that's your yearly after-tax income. You're asked next for your monthly after-tax income. There's 12 months in a year, so you divide by 12. $31,500/12 months = $2,625/month. And you enter than in the next yellow cell.

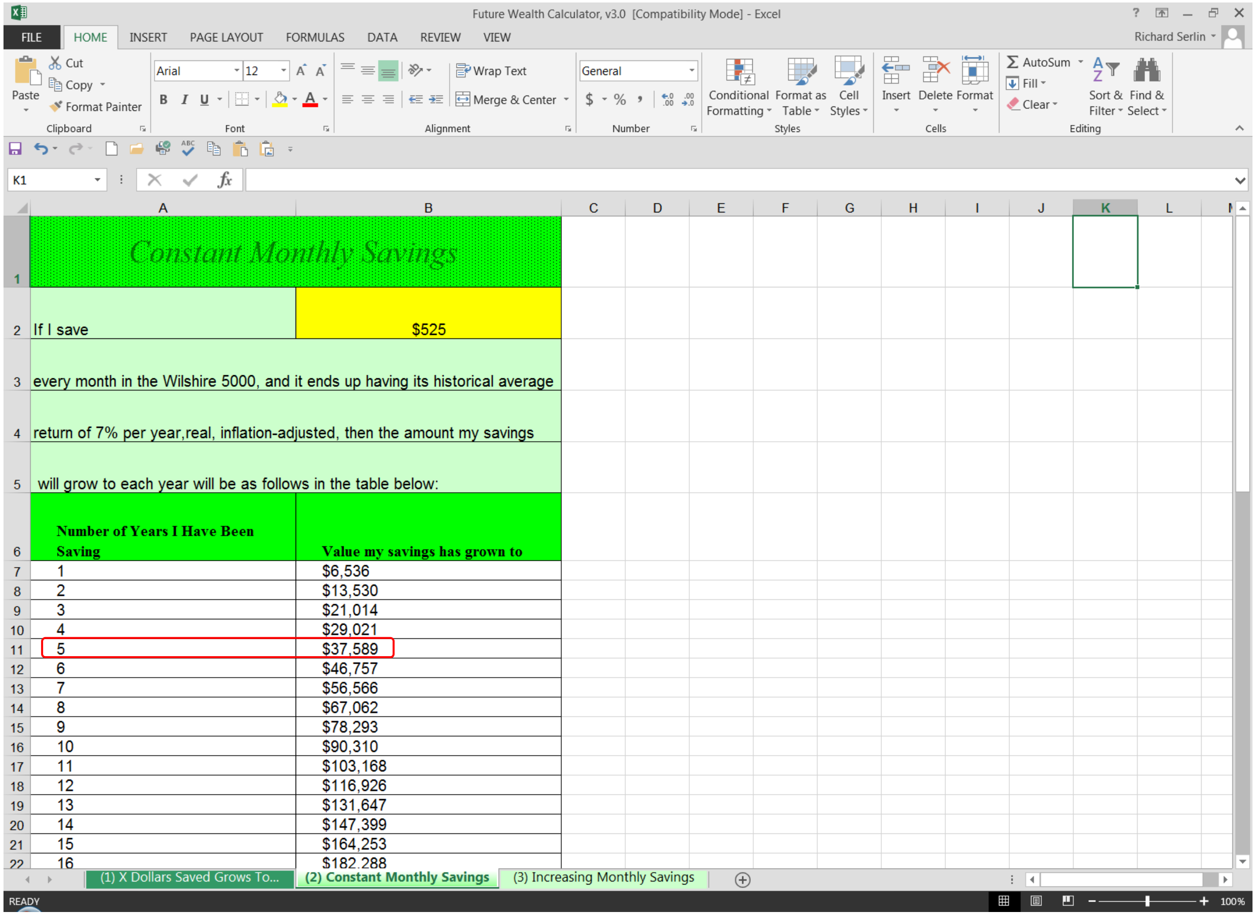
Finally, you're asked how much will it be if you save 20% of that monthly after tax pay, so .20 x $2,625 x .20 = $525, and you enter that in the final yellow cell of section 1.

So, in this example we'll be looking at what happens if we save $525/month once we finish our education and start our first career job! And here's how it looks so far:

Personal Financial Analysis and Planning: Key Findings	
Section 1: Estimating Your Monthly After-Tax Starting Pay	
Your forecasted annual starting pay, including all forms of cash compensation such as bonuses and commissions	$45,000
Your forecasted tax rate including all taxes, federal, state, local, etc. (if you are unsure, just use 30%. That should be fine for a ball park estimate)	30%
Your forecasted *annual* after-tax starting pay	$31,500
Your forecasted *monthly* after-tax starting pay	$2,625
Amount you save each month, if you save 20% of your starting monthly after-tax pay	**$525**

Now, on to the next section. Here, we'll need to use the Future Wealth Calculator Excel workbook. In part A we're asked how much our wealth will grow to over time, inflation-adjusted, if we do, in fact, save that much consistently for 5 years, 10 years, etc., all the way up to 50 years.

So, we open up our future wealth calculator, and go to the second sheet, the one labeled, "Constant Monthly Savings", and we put in, for this example, the monthly savings amount of $525. It will look like this:



Future Wealth Calculator, v3.0 [Compatibility Mode] - Excel

Constant Monthly Savings	
If I save	$525
every month in the Wilshire 5000, and it ends up having its historical average	
return of 7% per year,real, inflation-adjusted, then the amount my savings	
will grow to each year will be as follows in the table below:	
Number of Years I Have Been Saving	**Value my savings has grown to**
1	$6,536
2	$13,530
3	$21,014
4	$29,021
5	$37,589
6	$46,757
7	$56,566
8	$67,062
9	$78,293
10	$90,310
11	$103,168
12	$116,926
13	$131,647
14	$147,399
15	$164,253
16	$182,288

(1) X Dollars Saved Grows To... | (2) Constant Monthly Savings | (3) Increasing Monthly Savings

So, for example, what's the answer for how much wealth we'll have after 5 years. It's right in the table, within the red rectangle to be exact. After 5 years our savings will grow to $37,589. So that's what we enter, like so in the key findings form, like so:

Section 2: Future Wealth		
A. Saving 20% of Your Forecasted Starting After-Tax Pay Every Month		
Value of Savings in Inflation Adjusted Today Dollars After:	5 years	$37,589
	10 years	
	20 years	
	30 years	
	40 years	
	50 years	

And you just keep doing that for the rest of section A.

For section B, you're asked what happens to your wealth if you increase your monthly savings contribution by 20% every four years, to account for (hopefully) periodic raises.

Remember, the third sheet of the future wealth calculator gives us this, the one labeled, "Increasing Monthly Savings". So, again, same thing. You enter, in our example, $525. And then just read your answers off of the table below, and enter them into the key findings sheet.

All you turn into the D2L dropbox is your fully completed key findings sheet, just that one page.

Once you've done this, I think you'll be very impressed to see how much wealth you can accumulate over the long term, with consistent saving. This shows why compound interest, or return, has been called the eighth wonder of the world!

I encourage you to put this up on your wall! A reminder of the power of saving!

---

[1] This is from an inflation calculator at the Bureau of Labor Statistics, at: http://data.bls.gov/cgi-bin/cpicalc.pl . The calculator uses the consumer price index (CPI). Inflation is not uniform across everything. A 3% inflation rate does not mean that every price went up by exactly 3%. Some things went up by more; some went up by less, and some things, especially high-tech, went down in price. The CPI is the average increase in price for the combination of goods that a typical person purchases, typical in the judgment of the economists who design and administer it. It's not a perfect measure of inflation, but it's pretty good.

[2] Approximately, due to the properties of the math. If you just say, my interest rate was 0%; inflation was 2%, so my real interest rate was 0% – 2% = –2%, this is close to correct, but not quite correct. Of course, I hate to say something that's not completely true, so I do note this in this endnote. But the math behind this is something I'd never ask about on an exam in a personal finance 101 course.

For those interested, the main intuition is that if prices go up by 2%, you don't have 2% less buying power. It's not like you had a dollar and someone took 2 cents from you. Instead, it's like this: You had 1 dollar. The thing you wanted to buy cost 1 dollar. But then, it's price went up by 2% to $1.02. Now, your 1 dollar can't buy a whole thing anymore, only a percentage of a whole thing. What percentage? $1.00/$1.02 = .98039, or 98.039%. So you went from the power to purchase 100% of a unit to the power to purchase 98.039% of a unit, for a loss in purchasing power of 100% – 98.039% = 1.961%, not the 2% you get if you do it the simple, but not quite correct, way.

In our example in the text, we have 0% interest and 2% inflation. But usually you have a nonzero interest rate, like 5% interest and 2% inflation. Again 5% – 2% won't be correct as the real interest, just a close approximation. But here there's a second factor in addition to the one I went over above, the inflation is not just applied to the principle, it's also applied to the interest, making the simple calculation of real interest further off. For this example, what's the correct real interest rate? You start with a dollar; you get 5%, so you end with $1.05. But the price to buy a unit of something went from $1.00 to $1.02, so your end buying power went to $1.05/$1.02 = 1.02941, or a 2.941% increase, and that's your real interest, or return (the commonly used general word in finance for the gain on any investment, whether it's bonds, stocks, a business venture, etc.)

[3] "Inflation Targets Reconsidered" by Paul Krugman, draft paper for ECB Sintra conference, May 2014, at: https://webspace.princeton.edu/users/pkrugman/pksintra.pdf .

[4] This is with regular, annual compounding. You've probably heard phrases like "compounded monthly" or "continuously compounded". The idea is this: Instead of paying you 7% once, at the end of one year, suppose they pay you 3.5% every 6 months. This is called semi-annual compounding, and this would actually get you more money. I'll show you why: After 6 months, your balance becomes $103.50, which is your initial $100, plus 3.5% of

$100. Then, over the next 6 months you get interest on this new balance of $103.50. So, in the second 6 month period you're getting paid interest on a balance of $103.50, not your initial $100. This is the advantage. With regular annual compounding you only get interest on $100 for the entire year. But with semi-annual compounding, for the second half of the year, you get interest in a bigger amount, $103.50. You get interest on that $3.50 of interest. So with greater compounding, you get more interest on interest, and so a higher effective rate.

Finishing up the example, in the last 6 months, you get interest of $103.50 x 3.5% = $3.62. Add this to your $103.50 and you get a total of $107.12. So, your effective rate is 7.12%, a little better than the 7% you get with annual compounding. So, 7% compounded semi-annually is equal to getting 7.12% compounded annually.

So you want compounding as often as possible, to get the most interest on interest. Monthly compounding is even better than semi-annual compounding. The best is continuous compounding, basically compounding every nanosecond (The math is beyond the scope of this course.) This gives an effective rate of 7.25%.

So, if you're saving you want greater compounding, so you get more in interest. If you're borrowing, you want less compounding, so you pay less in interest.

To learn more about such things, you can take a first term pure finance course (as opposed to personal finance), like FIN 311 at the University of Arizona. But this course can be hard to get into for a non-business major. You could also buy the text for such a course and do some reading on your own. The current edition of such a text is crazy expensive, over $200! But interestingly, by just one or two editions old, maybe ten years, or less, the price plummets to under $10!

And very little of the fundamentals ever changes, but especially over just ten years. For example, one of the top books is, *Fundamentals of Financial Management*, 13th edition, by Brigham and Houston. As of writing in 2014, the amazon price is $257.75! This newest edition was published in 2012, but get just one edition older, from 2009 – only three years older – and you can get a used copy in good shape for $3.97, yes, that's right, $3.97! And very very little changed in basic finance in those mere three years. This is why, unless there's something unusual, I never assign the current edition of a finance text.

[5] A helpful way to get by this is to see if you can find the median. The median is the level where half the people make at least this much. Half make more, and half make less. So, if the median income is $80,000, then you know that if you're doing at least as good as the guy in the middle, you're making at least $80,000.

By contrast, if the *average*, also called *the mean*, is $80,000, it's possible that 95% of the people make less than $80,000, or even a lot less, but those in the top 5% make so much that they boost the average to $80,000. This is something you see a lot of in, for example, sales, where the top salespeople make vastly more than the typical salesperson.

The median is the 50th percentile. Some sources will also give other percentiles, like the 10th percentile and 25th percentile. So, for example, if the 25th percentile is $50,000, that means 25% of the people make less than $50,000, and so 75% make more than this.

Obviously, percentiles are nice to know, but you want to look at how reliable the source is, the size of the sample, how they gathered their data, and so forth, to get an idea of how much to trust these numbers.