Reporting Average Annual Returns

How complicated could this be?

In the investment world I hear this term used all of the time, “average annual returns”. I take it for granted that the one providing the information is providing a true representation of the investment product performance over several years of management. As I tried to calculate the performance of my portfolio I learned just how complicated the math is. I suspect those reporting the numbers often don’t know how they are calculated and thus really don’t know if what they are reporting is correct or not. Others will report average annual returns calculated in a way that makes the result look much better than reality. Do some knowingly inflate their returns numbers to enhance the appearance of their management skills, I don’t know. But, it pays to know how returns are calculated and what number is really being reported. Let’s do the math.

I will start with two investment accounts and the S&P500 Total Returns. First, we must chose the right S&P500 product to track returns. Reporting the S&P 500 can be done in two ways. One, to simply report the S&P500 index, ticker SPX; and two, report the S&P index including dividends on all of the components of the S&P index, known as the SP500TR. If a fund manager compares performance to only the index, the manager’s performance will appear better since the manager’s fund likely includes some dividends, but he has left them out of the benchmark. I will use the S&P 500 total Return. Warren Buffet listed his performance by year in his annual 2018 letter to shareholders. I have been actively managing my portfolio for the last five full calendar years. So, I want to compare these portfolios against five years of S&P performance. I will use the actual monthly balances from my brokerage accounts to represent my performance.

	Warren	S&P TR	Terry
2013	32.7%	32.39%	55.2%
2014	27.0%	13.69%	59.1%
2015	-12.5%	1.38%	48.4%
2016	23.4%	11.96%	9.7%
2017	21.9%	21.83%	28.1%

What is the average annual performance of each?

Add them up and divide by 5, right? Wrong. The percentage returns of financial products compound and thus, a simple average does not express how the underlying investments performed. The simple average does not take into account that the principal goes up or down each year and thus we need to take into account the compounding effect in series of investments. What we are really looking for is the rate one would need to achieve for each of the five years to yield the final investment value. This would be the one figure that we could use to evaluate the performance of one portfolio versus the other. What we really want is the compound annual growth rate (CAGR) for each of the portfolios.

I will start with an assumption of a beginning investment amount of $1000.00 and calculate what that investment would be worth at the end of five years assuming the returns above for each portfolio. We can do this the hard way in an Excel spreadsheet by calculating the balances each year and letting them compound. Assuming a $1000.00 investment, the resulting total in each account at the end of five years is shown here:

	Warren		S&P 500 TR		Terry	
		$1,000.00		$1,000.00		$1,000.00
2013	32.7%	$1,327.00	32.39%	$1,323.90	55.2%	$1,551.50
2014	27.0%	$1,685.29	13.69%	$1,505.14	59.1%	$2,467.66
2015	-12.5%	$1,474.63	1.38%	$1,525.91	48.4%	$3,661.76
2016	23.4%	$1,819.69	11.96%	$1,708.41	9.7%	$4,017.32
2017	21.9%	$2,218.20	21.83%	$2,081.36	28.1%	$5,144.98

I will calculate this total in another way to assure that I am getting the correct answer. Using the Excel function:

Final Value = FVSCHEDULE(I , C3:C7)

Where:

I = Initial Investment

C3:C7 = the range of cells in question

	Warren	S&P TR	Terry
Initial Investmet	$1,000.00	$1,000.00	$1,000.00
2013	32.7%	32.3%	55.2%
2014	27.0%	13.6%	59.1%
2015	-12.5%	1.4%	48.4%
2016	23.4%	11.9%	9.7%
2017	21.9%	21.8%	28.1%
Final Value	$2,218.20	$2,077.08	$5,144.98

Using this calculation, we get the same final value if investing the $1000.00 in each portfolio.

The Average Annual Return would then be the Compound Annual Growth Rate (CAGR) of the $1000 investment for five years to produce the final value in each of these cases. Since we know the CAGR formula, we simply enter it in the spreadsheet:

Compound Annual Growth Rate = Final Value/Initial Investment)^(/Number of Years)-1

	Warren	S&P TR	Terry
Initial Investmet	$1,000.00	$1,000.00	$1,000.00
2013	32.7%	32.3%	55.2%
2014	27.0%	13.6%	59.1%
2015	-12.5%	1.4%	48.4%
2016	23.4%	11.9%	9.7%
2017	21.9%	21.8%	28.1%
Final Value	$2,218.20	$2,077.08	$5,144.98
Compound Annual Growth Rate	17.27%	15.74%	38.76%

So, now I know the annual growth rate. Is it the average? Well, it certainly is the percentage that one would need to achieve each year if investing $1000.00 for five years to get these final results. I am not sure I believe that; so, I will test it. What would happen then if I used a spreadsheet to invest $1000.00 and substituted the CAGR for the yearly interest rates; I should get the same resulting Final Value.

Test the calculated CAGR in each case						
	Warren		S&P 500 TR		Terry	
		$1,000.00		$1,000.00		$1,000.00
2013	17.27%	$1,172.74	15.74%	$1,157.42	38.76%	$1,387.64
2014	17.27%	$1,375.31	15.74%	$1,339.62	38.76%	$1,925.54
2015	17.27%	$1,612.88	15.74%	$1,550.50	38.76%	$2,671.96
2016	17.27%	$1,891.48	15.74%	$1,794.58	38.76%	$3,707.72
2017	17.27%	$2,218.20	15.74%	$2,077.08	38.76%	$5,144.98

Okay, that works. I have proved that the CAGR which I calculated actually yields the expected results. Over the last five years, the portfolios have performed as if one had invested 17.27%, 15.74% and 38.76% respectively each year.

Is there a simpler way to make these Average Annual Returns calculations?

One could calculate the Geometric Mean of the interest rates and get the same result. This formula will provide the correct result:

Geometric Mean = ((1+x1)*(1+x2)*(1+x3)….(1+xn))^(1/n)-1

	Warren	S&P TR	Terry
Initial Investmet	$1,000.00	$1,000.00	$1,000.00
2013	32.7%	32.3%	55.2%
2014	27.0%	13.6%	59.1%
2015	-12.5%	1.4%	48.4%
2016	23.4%	11.9%	9.7%
2017	21.9%	21.8%	28.1%
Geometric Mean	17.27%	15.74%	38.76%

The Geometric Mean calculation provides the same result at calculating the CAGR. I know from testing above that these percentages are correct. A problem with this formula is that when there is a long list of returns, one has to write out each term in the equation. For five or ten entries this is okay, but for a long list it is difficult to write out. The point is, however, the long formula for the Geometric Mean yields the same result as the Compound Annual Growth Rate.

Why Is This Important:

In order to make a fair comparison between portfolios the Average Annual Return is the first measure we turn to. The Average Annual Returns percentage implies that if I had money to invest and I placed that money into each of these portfolios I would get the same final returns that the investment manager did. Thus, it is important to calculate the correct rate to assure that if I placed my hard-earned cash in the portfolio the Average Annual

Returns rate would exactly replicate the performance of the original portfolio. What if the wrong calculation is used and this results in an incorrect annual rate? That would mis-represent the portfolio performance. I could not get the same results with my investment. We must know that the comparison is fair and accurate.

Is there another, simpler method to calculate the Average Annual Return rate?

Excel provides a function for calculating the Geometric Mean:

Geometric Mean = GEOMEAN(range of cells containing interest rates)

Here is our spreadsheet using the Excel GEOMEAN function to calculate the Average Annual Returns.

	Warren	S&P TR	Terry
Initial Investmet	$1,000.00	$1,000.00	$1,000.00
2013	32.7%	32.3%	55.2%
2014	27.0%	13.6%	59.1%
2015	-12.5%	1.4%	48.4%
2016	23.4%	11.9%	9.7%
2017	21.9%	21.8%	28.1%
GEOMEAN()	#NUM!	10.98%	33.62%

Wrong answer! The Excel GEOMEAN function is not the same as the Geometric Mean long formula. First, we should know that the Excel GEOMEAN will not work with negative numbers. Second, it will not work with rates formatted in the way shown above. A very real concern is that in the S&P TR and Terry cases, the answer that the GEOMEAN formula yields in our context **is not correct, but it is close to correct**. This leads individuals to mis-use the GEOMEAN formula while assuming that the function just works. The mis-use of the GEOMEAN function is common in web-based tutorials on analyzing returns. Those who mis-use it will report returns which are lower than their actual annual return rates; doing themselves a dis-service.

The correction to using the GEOMEAN function is to modify the rate data for calculating investment returns. I have added another column in which 1 is added to each percentage rate in the cell to the left, i.e. =1+W39. Those rates are used in the GEOMEAN calculation and the 1 is then taken back out. This method accommodates negative percentage numbers and the final GEOMEAN results match those which we know to be correct from the testing above in the Geometric Mean formula and CAGR calculations. Thus method causes the GEOMEAN calculation to equal the CAGR calculation.

	Warren		S&P 500 TR		Terry	
		Add 1		Add 1		Add 1
2013	32.70%	132.70%	32.30%	132.30%	55.15%	155.15%
2014	27.00%	127.00%	13.60%	113.60%	59.05%	159.05%
2015	-12.50%	87.50%	1.40%	101.40%	48.39%	148.39%
2016	23.40%	123.40%	11.90%	111.90%	9.71%	109.71%
2017	21.90%	121.90%	21.80%	121.80%	28.07%	128.07%
GEOMEAN()-1		17.27%		15.74%		38.76%

Now we get the result that we know to be correct.

What happens if I just add the column of percentages and divide by five? Let's try it and see.

	Warren	S&P TR	Terry
Initial Investmet	$1,000.00	$1,000.00	$1,000.00
2013	32.7%	32.3%	55.2%
2014	27.0%	13.6%	59.1%
2015	-12.5%	1.4%	48.4%
2016	23.4%	11.9%	9.7%
2017	21.9%	21.8%	28.1%
Simple Average	18.50%	16.20%	40.07%

Wrong answer! Again, this result is close to the correct answer and thus it could be misleading. The simple average always overstates the actual Annual Average Return (CAGR) rate. Will many managers report this number? Will they simply not know it is correct? Do they know it is incorrect and report it to inflate their returns? I don't know. What I do know is that I need to check the math.

The Bottom Line:

I have learned a couple of things from this exercise. First, now I know how to calculate the number to fairly compare a series of investment returns, including my own. Second, if asking someone else for returns numbers, I would ask for the Compound Annual Growth Rate to be more specific. I would avoid asking for their Geometric Average (Mean) return.

If someone quotes the Average Annual Return rate, I want to assure that I believe that the one who made the calculations knows which formulas to use. I believe I could trust numbers where a third-party auditor is required. But, I would be skeptical the methods of unaudited results calculated by individuals. I should also be wary of returns quoted by third parties who clearly do not know how the calculations were made.

It's complicated.