Finance Essentials

Calculating Historical Return Statistics From Adjusted Closing Prices

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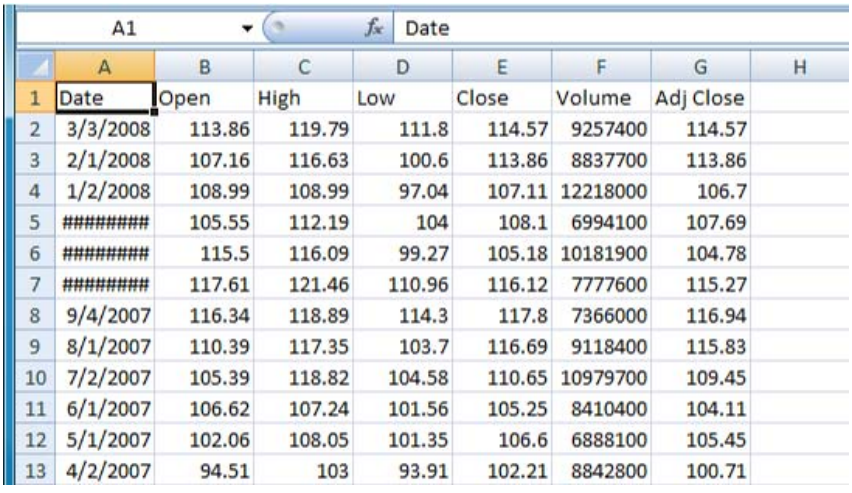
This document explains how to combine various historical prices tables downloaded from Yahoo! Finance into one spreadsheet, calculate returns from prices, and calculate return statistics. In this document, I am using three stocks—IBM (IBM), Coca-Cola (KO), and Anheuser-Busch (BUD)—but the process can be extended to as many stocks as you may have. Monthly price histories for these stocks for February 2003 to March 2008 were downloaded using the process described in "Downloading Stock Prices From Yahoo! Finance." The three files historical data files created in the download process and used here are `table-IBM`, `table-KO` and `table-BUD`. The files you want to combine must have historical prices for identical dates. You must ensure that this is the case before following the steps outlined in this document. You can check the start and end dates, and the number of data points by opening the historical tables one at a time.

Consolidating Adjusted Prices

Step 1. Start Excel. It should open with a blank workbook. This workbook will be used to calculate and store stock returns and statistics. Save the blank workbook in some location (e.g., Desktop) under some filename that makes sense to you. I will use the name `Returns` in this document.

Step 2. Using Windows Explorer browse to the historical prices file for a stock downloaded from Yahoo! Finance. For my example, I am using `table-IBM`. Double click on it to open it in Excel. The file in Excel should look something like this:



A1 | Date

	A	B	C	D	E	F	G
1	Date	Open	High	Low	Close	Volume	Adj Close
2	3/3/2008	113.86	119.79	111.8	114.57	9257400	114.57
3	2/1/2008	107.16	116.63	100.6	113.86	8837700	113.86
4	1/2/2008	108.99	108.99	97.04	107.11	12218000	106.7
5	########	105.55	112.19	104	108.1	6994100	107.69
6	########	115.5	116.09	99.27	105.18	10181900	104.78
7	########	117.61	121.46	110.96	116.12	7777600	115.27
8	9/4/2007	116.34	118.89	114.3	117.8	7366000	116.94
9	8/1/2007	110.39	117.35	103.7	116.69	9118400	115.83
10	7/2/2007	105.39	118.82	104.58	110.65	10979700	109.45
11	6/1/2007	106.62	107.24	101.56	105.25	8410400	104.11
12	5/1/2007	102.06	108.05	101.35	106.6	6888100	105.45
13	4/2/2007	94.51	103	93.91	102.21	8842800	100.71

Step 3. Select the Date column, copy it, switch to the `Returns`, select column A and paste. This will paste dates in column A of `Returns`. Widen the column width to see all the entries instead of the hash

marks ("`#########`") in some cells.

If the data you downloaded is of monthly frequency, as in the example used in this document, the day of the month is irrelevant and should be ignored. The best thing is to format the Date column so it only shows Month and Year. I formatted my Date column as `YYYYMM` (four digit year and two digit month). If you don't know how to do that or don't want to do that, you should make it a point to not think that the data in a row is for the day indicated in the Date column.

Step 4. Switch to `table-IBM`, select the Adj Close column, switch to `Returns` workbook, select column B and paste. This will paste adjusted prices for `IBM` in column B of `Returns`. Edit the column heading to append the stock ticker to the heading. In my example, the column heading will be Adj Close - IBM. Change the width of the column so the column heading fits in the column.

Step 5. Using Windows Explorer browse to the historical prices file for the second stock. I am using `table-KO` for my example. Double click on it to open it in Excel. Select the Adj Close column, switch to `Returns` workbook, select column C and paste. This will paste adjusted prices for `KO` in column C of `Returns`. Edit the column heading to append the stock ticker to the heading. Change the width of the column so the column heading fits in the column.

Step 6. Repeat Step 5 for as many stocks as necessary. In my case, I have three stocks. So, my workbook, at the end of the process, looks like this:

M6

	A	B	C	D	E
1	Date	Adj Close - IBM	Adj Close - KO	Adj Close - BUD	
2	200802	113.86	58.09	47.09	
3	200801	106.7	58.62	46.17	
4	200712	107.69	60.98	51.97	
5	200711	104.78	61.7	52.35	
6	200710	115.27	61.03	50.59	
7	200709	116.94	56.79	49.32	
8	200708	115.83	52.82	48.74	
9	200707	109.45	51.18	47.8	
10	200706	104.11	51.38	51.12	
11	200705	105.45	51.7	52.28	
12	200704	100.71	50.92	47.93	
13	200703	92.88	46.83	49.17	

Calculating Returns

Step 1. The adjusted prices table is sorted by Date in descending order. For calculating returns, it is convenient to have the table in increasing order by Date. So, select the entire table and sort it in

ascending order by Date. The table will now look like this:

J10

	A	B	C	D
1	Date	Adj Close - IBM	Adj Close - KO	Adj Close - BUD
2	200302	73.87	35.39	41.65
3	200303	74.32	35.83	41.74
4	200304	80.45	35.76	44.67
5	200305	83.58	40.34	47.32
6	200306	78.32	41.27	45.95
7	200307	77.13	39.99	46.59
8	200308	78.01	38.7	46.54
9	200309	84.02	38.39	44.55
10	200310	85.12	41.47	44.48
11	200311	86.28	41.75	47
12	200312	88.32	45.57	47.78
13	200401	94.56	44.22	46.01

Step 2. To calculate the return for a particular month, we need the adjusted price for that month and for the previous month. By construction, we don't have the price for the month preceding the first month in the table. So, we cannot calculate the price for the first month. The price for the second month can be calculated as:[1]

$$r_2 = \frac{p_2^* - p_1^*}{p_1^*} = \frac{p_2^*}{p_1^*} - 1$$

where p^* denotes the fact that we are using adjusted prices which incorporate the effect of cash dividends, stock dividends and stock splits. If we were using unadjusted prices we would have to adjust the return calculation formula for dividends and splits. By providing the adjusted prices, Yahoo! Finance makes that job easy for us. In row 1 of a blank column after the adjusted prices, insert label Return - TKR, where TKR is the ticker of the first stock, IBM in my case. Leave the row 2 of the column blank. In row three, enter the formula to calculate the return. The figure below shows the formula in my example:

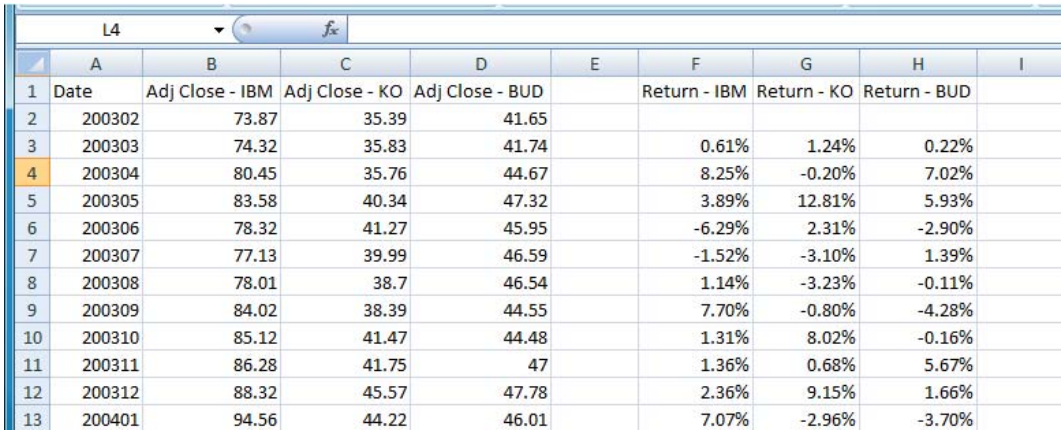
SUM =B3/B2-1

	A	B	C	D	E	F	G
1	Date	Adj Close - IBM	Adj Close - KO	Adj Close - BUD		Return - IBM	
2	200302	73.87	35.39	41.65			
3	200303	74.32	35.83	41.74		=B3/B2-1	
4	200304	80.45	35.76	44.67			
5	200305	83.58	40.34	47.32			
6	200306	78.32	41.27	45.95			
7	200307	77.13	39.99	46.59			
8	200308	78.01	38.7	46.54			
9	200309	84.02	38.39	44.55			
10	200310	85.12	41.47	44.48			
11	200311	86.28	41.75	47			
12	200312	88.32	45.57	47.78			
13	200401	94.56	44.22	46.01			

Step 3. Enter column headings for other stocks in subsequent columns. Copy the return formula across to all the stocks and down all the way to calculate the returns for months 2 through the last month in

[1] If you want to calculate the underlying continuously compounded rate, you can use the formula $\ln(\frac{p_2}{p_1})$ where ln is the natural log function.

the table for all the stocks. Format the returns as percents.



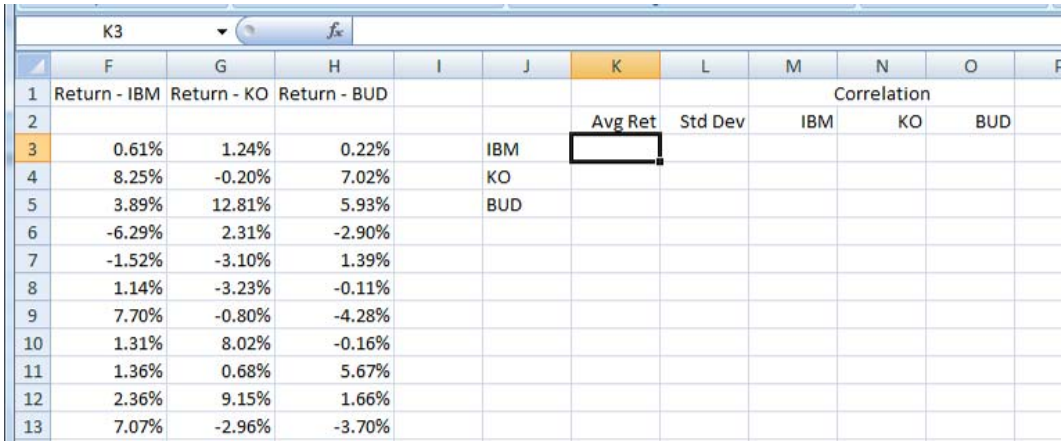
	A	B	C	D	E	F	G	H	I
1	Date	Adj Close - IBM	Adj Close - KO	Adj Close - BUD		Return - IBM	Return - KO	Return - BUD	
2	200302	73.87	35.39	41.65					
3	200303	74.32	35.83	41.74		0.61%	1.24%	0.22%	
4	200304	80.45	35.76	44.67		8.25%	-0.20%	7.02%	
5	200305	83.58	40.34	47.32		3.89%	12.81%	5.93%	
6	200306	78.32	41.27	45.95		-6.29%	2.31%	-2.90%	
7	200307	77.13	39.99	46.59		-1.52%	-3.10%	1.39%	
8	200308	78.01	38.7	46.54		1.14%	-3.23%	-0.11%	
9	200309	84.02	38.39	44.55		7.70%	-0.80%	-4.28%	
10	200310	85.12	41.47	44.48		1.31%	8.02%	-0.16%	
11	200311	86.28	41.75	47		1.36%	0.68%	5.67%	
12	200312	88.32	45.57	47.78		2.36%	9.15%	1.66%	
13	200401	94.56	44.22	46.01		7.07%	-2.96%	-3.70%	

Calculating Return Statistics

In my worksheet, the returns are stored in the following ranges:

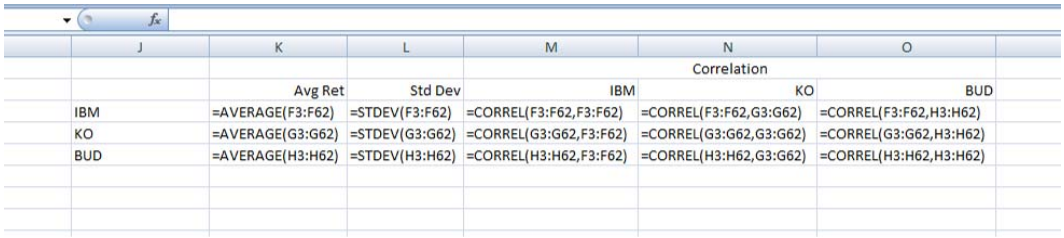
IBM	F3:F62
KO	G3:G62
BUD	H3:H62

Step 1. To calculate the historical statistics for the stock returns, I start by entering labels as follows:



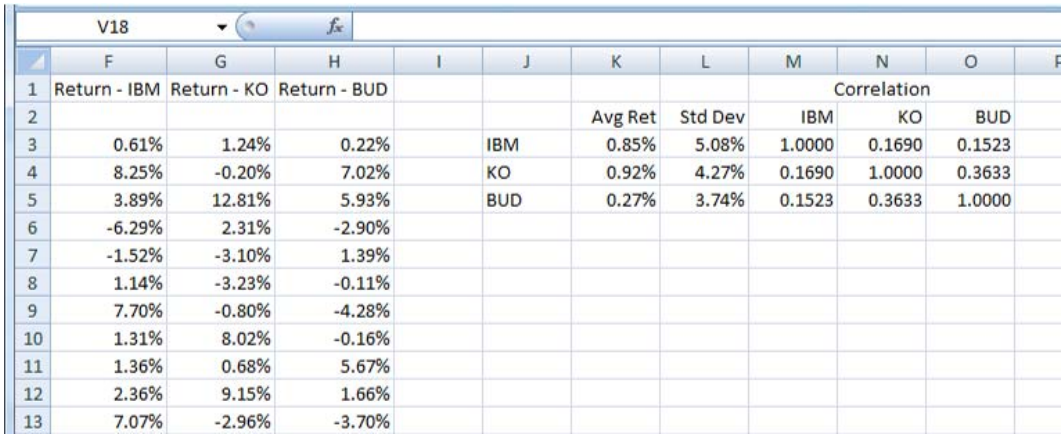
	F	G	H	I	J	K	L	M	N	O	P
1	Return - IBM	Return - KO	Return - BUD						Correlation		
2						Avg Ret	Std Dev	IBM	KO	BUD	
3	0.61%	1.24%	0.22%		IBM						
4	8.25%	-0.20%	7.02%		KO						
5	3.89%	12.81%	5.93%		BUD						
6	-6.29%	2.31%	-2.90%								
7	-1.52%	-3.10%	1.39%								
8	1.14%	-3.23%	-0.11%								
9	7.70%	-0.80%	-4.28%								
10	1.31%	8.02%	-0.16%								
11	1.36%	0.68%	5.67%								
12	2.36%	9.15%	1.66%								
13	7.07%	-2.96%	-3.70%								

Step 2. Now I enter the formulae in various cells using Excel's `AVERAGE`, `STDEV`, and `CORREL` functions. The following figure shows the formulae entered:



	J	K	L	M	N	O
					Correlation	
		Avg Ret	Std Dev	IBM	KO	BUD
	IBM	=AVERAGE(F3:F62)	=STDEV(F3:F62)	=CORREL(F3:F62,F3:F62)	=CORREL(F3:F62,G3:G62)	=CORREL(F3:F62,H3:H62)
	KO	=AVERAGE(G3:G62)	=STDEV(G3:G62)	=CORREL(G3:G62,F3:F62)	=CORREL(G3:G62,G3:G62)	=CORREL(G3:G62,H3:H62)
	BUD	=AVERAGE(H3:H62)	=STDEV(H3:H62)	=CORREL(H3:H62,F3:F62)	=CORREL(H3:H62,G3:G62)	=CORREL(H3:H62,H3:H62)

Step 3. The resulting numbers, properly formatted, are as follows:



	F	G	H	I	J	K	L	M	N	O
1	Return - IBM	Return - KO	Return - BUD					Correlation		
2						Avg Ret	Std Dev	IBM	KO	BUD
3	0.61%	1.24%	0.22%		IBM	0.85%	5.08%	1.0000	0.1690	0.1523
4	8.25%	-0.20%	7.02%		KO	0.92%	4.27%	0.1690	1.0000	0.3633
5	3.89%	12.81%	5.93%		BUD	0.27%	3.74%	0.1523	0.3633	1.0000
6	-6.29%	2.31%	-2.90%							
7	-1.52%	-3.10%	1.39%							
8	1.14%	-3.23%	-0.11%							
9	7.70%	-0.80%	-4.28%							
10	1.31%	8.02%	-0.16%							
11	1.36%	0.68%	5.67%							
12	2.36%	9.15%	1.66%							
13	7.07%	-2.96%	-3.70%							

So, the average return on IBM over the period was 0.85% per month with a standard deviation of 5.08% per months. The correlation of IBM returns with KO returns was 0.1690, while the correlation of IBM returns with BUD returns was 0.1523.

Step 4. If some stocks have more returns than others, you have to decide how to deal with the different lengths of data for different stocks. There are two possibilities:

- Use returns for the common set of months across all stocks. In other words, discard all months for which even one stock does not have returns. This method will be OK as long there is sufficient number of months of data common across all stocks.
- For each individual statistic, use as much data as you can use. To calculate average return and standard deviation, use the full set of returns for each stock. To calculate correlations, use all the returns that are common between the pair of stocks for which you are calculating the correlation.