Upside and Downside Beta

FINANCE TOYS

We have already discussed the calculation of simple Beta here:
http://www.financetoys.com/valuation/wacceng.htm

This time we will calculate Upside and downside Beta

Beta describes the relation of returns between the stock and the market.
For example, if Beta equals 1.2, this means that when market goes up/down by 1%, the stock grows/falls by 1.2% (in theory of course)
Beta shows whether the stock grows/falls faster or slower than the market.

Upside Beta analyses the stock's behavior during the upward market's movements.
I.e. Upside Beta shows how the stock grows/falls when the market grows.

Why do you need to calculate Upside Beta?

For example, you expect that the market will go up next week and you need to pick up the stock that
will outpace the market. In this case, choose the stock with the highest Upside Beta

Downside Beta on the opposite analyses the stock's behavior when the market falls
For example, you expect the market to fall next week. Choose the stock with a lowest Downside Beta
If Downside Beta is less than 0, the stock will go up when the market goes down.

Next we will calculate simple, upside and downside Betas

STEP 1 CALCULATING SIMPLE BETA

First download the weekly values of the market index (S&P) and the stock prices
We traditionally use the stocks of Apple (Ticker: AAPL) and Citi (Ticker: C)
By the way, we use relatively small selection of values in this example. We recommend you to use more values
for more reliable results

We use weekly data, because we want to analyze the stock's performance over the week
You can use daily, monthly, yearly data if you want.

After that calculate weekly returns for the index and for the stocks (to the right)

The formula for Beta is
Beta = Cov (Rs; Rm) / Var (Rm)

Cov (Rs; Rm) is the covariance of the stock's and market's returns
You can calculate covariance using COVAR function in excel (if you are interested you can also look at
the definition of covariance in excel).
Var (Rm) is the dispersion of market returns.
You can calculate Var using VAR function in excel.

Stock	Cov (Rs; Rm)	Var (Rm)	Beta
AAPL	0.00065	0.00049	1.31
C	0.00074	0.00049	1.51

We can see that Citi's Beta is higher than Apple's which means that Citi's stocks grows and falls faster than the
market and than Apple's stocks.

STEP 2 CALCULATING UPSIDE BETA

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For the calculation of Upside Beta we need to exclude all negative values of market's returns because we analyze
the stock's behavior on growing market.

Use "if" excel function to choose only positive values of S&P returns first (see "Upside Changes" column to the right)
= if (S&P return > 0, value of S&P return, 0)

Then use "if" function to choose only those return values of the stocks which correspond to the positive values of
S&P's returns
= if (S&P return > 0, value of the stock's return, 0)

Stock	Cov (Rs; Rm)	Var (Rm)	Upside Beta
AAPL	0.00021	0.00015	1.35
C	0.00024	0.00015	1.58

As wee see, Citi and Apple grow faster than the market
In theory for every 1% growth of S&P index Citi's and Apple's stocks should gain 1.58% and 1.35% respectively

STEP 3 CALCULATING DOWNSIDE BETA

For the calculation of Downside Beta we need to exclude all positive values of returns because we analyze
the stock's behavior on falling market.

Use "if" excel function to choose only negative values of S&P returns (see "Downside Changes" column to the right)
= if (S&P return < 0, value of S&P return, 0)

Then use "if" function to choose only those return values of the stocks which correspond to the negative values of
S&P's returns
= if (S&P return < 0, value of the stock's return, 0)

Stock	Cov (Rs; Rm)	Var (Rm)	Downside Beta
AAPL	0.00024	0.00018	1.30
C	0.00023	0.00018	1.28

Citi's stocks should fall slower than Apple's stocks when the market goes down. At the same time we should note than neither of these stocks can be considered as "defensive" stocks (the stocks that do not fall when
the market falls).

So if the market falls by 1% Apple's and Citi's stocks should fall by 1.3% and 1.28% respectively.

We calculated the simplest Upside and Downside Betas to measure the stocks' performance on growing and falling market. But you can also calculate Betas relative to a risk free rate.
The formula for Downside Beta looks like this:

$$\beta_{im}^{(BL)} = \frac{E\left[(R_i - R_f)\min(R_m - R_f, 0)\right]}{E\left[\min(R_m - R_f, 0)\right]^2}$$

More information on that topic you can find here:
http://www.efmaefm.org/efma2006/papers/310329_full.pdf

	Prices ($)			Change (%)			Upside changes (%)			Downside changes (%)		
	AAPL	C	S&P	AAPL	C	S&P	AAPL	C	S&P	AAPL	C	S&P
01.01.2010	210.732	3.31	1122.87									
08.01.2010	211.98	3.59	1147.96	0.6%	8.5%	2.2%	0.6%	8.5%	2.2%	0.0%	0.0%	0.0%
15.01.2010	205.93	3.42	1137.6	-2.9%	-4.7%	-0.9%	0.0%	0.0%	0.0%	-2.9%	-4.7%	-0.9%
22.01.2010	197.75	3.25	1098.67	-4.0%	-5.0%	-3.4%	0.0%	0.0%	0.0%	-4.0%	-5.0%	-3.4%
29.01.2010	192.063	3.32	1080.22	-2.9%	2.2%	-1.7%	0.0%	0.0%	0.0%	-2.9%	2.2%	-1.7%
05.02.2010	195.46	3.22	1064.52	1.8%	-3.0%	-1.5%	0.0%	0.0%	0.0%	1.8%	-3.0%	-1.5%
12.02.2010	200.38	3.18	1081.21	2.5%	-1.2%	1.6%	2.5%	-1.2%	1.6%	0.0%	0.0%	0.0%
19.02.2010	201.67	3.42	1112.29	0.6%	7.5%	2.9%	0.6%	7.5%	2.9%	0.0%	0.0%	0.0%
26.02.2010	204.62	3.4	1109.61	1.5%	-0.6%	-0.2%	0.0%	0.0%	0.0%	1.5%	-0.6%	-0.2%
05.03.2010	218.95	3.5	1139.17	7.0%	2.9%	2.7%	7.0%	2.9%	2.7%	0.0%	0.0%	0.0%
12.03.2010	226.6	3.97	1147.25	3.5%	13.4%	0.7%	3.5%	13.4%	0.7%	0.0%	0.0%	0.0%
19.03.2010	222.25	3.9	1153.92	-1.9%	-1.8%	0.6%	-1.9%	-1.8%	0.6%	0.0%	0.0%	0.0%
26.03.2010	230.9	4.31	1170.4	3.9%	10.5%	1.4%	3.9%	10.5%	1.4%	0.0%	0.0%	0.0%
02.04.2010	235.97	4.18	1179.92	2.2%	-3.0%	0.8%	2.2%	-3.0%	0.8%	0.0%	0.0%	0.0%
09.04.2010	241.79	4.55	1195.66	2.5%	8.9%	1.3%	2.5%	8.9%	1.3%	0.0%	0.0%	0.0%
16.04.2010	247.4	4.56	1189.28	2.3%	0.2%	-0.5%	0.0%	0.0%	0.0%	2.3%	0.2%	-0.5%
23.04.2010	270.83	4.86	1216.78	9.5%	6.6%	2.3%	9.5%	6.6%	2.3%	0.0%	0.0%	0.0%
30.04.2010	261.09	4.37	1191.94	-3.6%	-10.1%	-2.0%	0.0%	0.0%	0.0%	-3.6%	-10.1%	-2.0%
07.05.2010	235.86	4	1142.43	-9.7%	-8.5%	-4.2%	0.0%	0.0%	0.0%	-9.7%	-8.5%	-4.2%
14.05.2010	253.82	3.98	1136.52	7.6%	-0.5%	-0.5%	0.0%	0.0%	0.0%	7.6%	-0.5%	-0.5%
21.05.2010	242.32	3.75	1085.03	-4.5%	-5.8%	-4.5%	0.0%	0.0%	0.0%	-4.5%	-5.8%	-4.5%
28.05.2010	256.88	3.96	1085.73	6.0%	5.6%	0.1%	6.0%	5.6%	0.1%	0.0%	0.0%	0.0%
04.06.2010	255.965	3.79	1066.69	-0.4%	-4.3%	-1.8%	0.0%	0.0%	0.0%	-0.4%	-4.3%	-1.8%
11.06.2010	253.51	3.88	1095.96	-1.0%	2.4%	2.7%	-1.0%	2.4%	2.7%	0.0%	0.0%	0.0%
18.06.2010	274.074	4.01	1124.45	8.1%	3.4%	2.6%	8.1%	3.4%	2.6%	0.0%	0.0%	0.0%
25.06.2010	266.7	3.94	1078.21	-2.7%	-1.7%	-4.1%	0.0%	0.0%	0.0%	-2.7%	-1.7%	-4.1%
02.07.2010	246.94	3.79	1030.15	-7.4%	-3.8%	-4.5%	0.0%	0.0%	0.0%	-7.4%	-3.8%	-4.5%
09.07.2010	259.62	4.04	1076.69	5.1%	6.6%	4.5%	5.1%	6.6%	4.5%	0.0%	0.0%	0.0%
16.07.2010	249.9	3.9	1067.49	-3.7%	-3.5%	-0.9%	0.0%	0.0%	0.0%	-3.7%	-3.5%	-0.9%
23.07.2010	259.94	4.02	1103.63	4.0%	3.1%	3.4%	4.0%	3.1%	3.4%	0.0%	0.0%	0.0%
30.07.2010	257.25	4.1	1108.68	-1.0%	2.0%	0.5%	-1.0%	2.0%	0.5%	0.0%	0.0%	0.0%
06.08.2010	260.091	4.06	1123.6	1.1%	-1.0%	1.3%	1.1%	-1.0%	1.3%	0.0%	0.0%	0.0%
13.08.2010	249.1	3.88	1077.49	-4.2%	-4.4%	-4.1%	0.0%	0.0%	0.0%	-4.2%	-4.4%	-4.1%
20.08.2010	249.64	3.75	1074.18	0.2%	-3.4%	-0.3%	0.0%	0.0%	0.0%	0.2%	-3.4%	-0.3%
27.08.2010	241.62	3.76	1061.31	-3.2%	0.3%	-1.2%	0.0%	0.0%	0.0%	-3.2%	0.3%	-1.2%
03.09.2010	258.77	3.91	1101.74	7.1%	4.0%	3.8%	7.1%	4.0%	3.8%	0.0%	0.0%	0.0%
10.09.2010	263.41	3.91	1113.38	1.8%	0.0%	1.1%	1.8%	0.0%	1.1%	0.0%	0.0%	0.0%
17.09.2010	275.37	3.95	1126.98	4.5%	1.0%	1.2%	4.5%	1.0%	1.2%	0.0%	0.0%	0.0%
24.09.2010	292.32	3.904	1148.64	6.2%	-1.2%	1.9%	6.2%	-1.2%	1.9%	0.0%	0.0%	0.0%
01.10.2010	282.52	4.09	1144.59	-3.4%	4.8%	-0.4%	0.0%	0.0%	0.0%	-3.4%	4.8%	-0.4%
08.10.2010	294.07	4.19	1165.92	4.1%	2.4%	1.9%	4.1%	2.4%	1.9%	0.0%	0.0%	0.0%
15.10.2010	314.74	3.95	1176.8	7.0%	-5.7%	0.9%	7.0%	-5.7%	0.9%	0.0%	0.0%	0.0%
22.10.2010	307.47	4.11	1186.64	-2.3%	4.1%	0.8%	-2.3%	4.1%	0.8%	0.0%	0.0%	0.0%
29.10.2010	300.98	4.17	1187.03	-2.1%	1.5%	0.0%	-2.1%	1.5%	0.0%	0.0%	0.0%	0.0%
05.11.2010	317.13	4.49	1222.64	5.4%	7.7%	3.0%	5.4%	7.7%	3.0%	0.0%	0.0%	0.0%
12.11.2010	308.03	4.29	1202.37	-2.9%	-4.5%	-1.7%	0.0%	0.0%	0.0%	-2.9%	-4.5%	-1.7%
19.11.2010	306.73	4.268	1195.3	-0.4%	-0.5%	-0.6%	0.0%	0.0%	0.0%	-0.4%	-0.5%	-0.6%
26.11.2010	315.76	4.11	1183.75	2.9%	-3.7%	-1.0%	0.0%	0.0%	0.0%	2.9%	-3.7%	-1.0%
03.12.2010	317.44	4.45	1223.5	0.5%	8.3%	3.4%	0.5%	8.3%	3.4%	0.0%	0.0%	0.0%
10.12.2010	320.56	4.77	1243.44	1.0%	7.2%	1.6%	1.0%	7.2%	1.6%	0.0%	0.0%	0.0%
17.12.2010	320.61	4.7	1246.54	0.0%	-1.5%	0.2%	0.0%	-1.5%	0.2%	0.0%	0.0%	0.0%
24.12.2010	323.6	4.68	1253.63	0.9%	-0.4%	0.6%	0.9%	-0.4%	0.6%	0.0%	0.0%	0.0%
31.12.2010	322.56	4.73	1262.88	-0.3%	1.1%	0.7%	-0.3%	1.1%	0.7%	0.0%	0.0%	0.0%