

Value-At-Risk

FINANCE TOYS

The aim of this program is to measure portfolio risk using Value-At-Risk (VaR) approach
 If you need more theory on that issue you can look at wikipedia:
http://en.wikipedia.org/wiki/Value_at_risk

To be brief, this approach allows you to find the maximum loss on your portfolio of stocks with a given probability

First, we create a portfolio of 10 stocks

In excel file you can change the parameters of this portfolio: number of shares of each type and confidence interval (probability)

If you want to open short position (sell short), you should put "-" before the number of shares

This file calculates maximum loss for portfolio for 1 week and for 10 weeks periods with a given probability

1. Portfolio creation

STEP 1

We choose 10 stocks and quantity of each stock

In this example 10 stocks of large american corporations were chosen

The number of shares is chosen absolutely randomly

Stock	Ticker	Quantity	Price	Volume	Share
			\$	\$	%
Apple	AAPL	100	314,795	31,480	11.6%
Citi	C	500	4,168	2,084	0.8%
General Electric	GE	2000	15,94	31,880	11.8%
ExxonMobil	XOM	1000	69,88	69,880	25.8%
Alcoa	AA	2000	13,31	26,620	9.8%
AT&T	T	1230	28,14	34,612	12.8%
American Express	AXP	250	43	10,750	4.0%
Caterpillar	CAT	127	84,69	10,756	4.0%
Coca-Cola	KO	100	64,61	6,461	2.4%
Home Depot	HD	1500	31,16	46,740	17.2%
Total			271,262		100.0%

Next, I found price performance for each stock for the last 24 periods (although it is better to use larger arrays) and calculated prices change for each period (the column next to the price)
 I took weekly data (the prices at the end of the week)

Thus price changes look more interesting. You can choose any interval: minute, hour, day, quarter etc

Date	AAPL	Change	C	Change	GE	Change	XOM	Change	AA	Change	T	Change	AXP	Change	CAT	Change	KO	Change	HD	Change
18/06/10	274.074		4.01		15.95		63.1		11.11		25.43		42.03		65.85		52.31		31.94	
25/06/10	266.7	-2.7%	3.94	-1.7%	14.91	-6.5%	59.1	-6.3%	11.23	1.1%	24.79	-2.5%	42.67	1.5%	64.71	-1.7%	50.26	-3.9%	30.2	-5.4%
02/07/10	246.94	-7.4%	3.79	-3.8%	13.88	-6.9%	56.57	-4.3%	10	-11.0%	24.29	-2.0%	39.42	-7.6%	59.18	-8.5%	50.05	-0.4%	27.76	-8.1%
09/07/10	259.62	5.1%	4.04	6.6%	14.95	7.7%	58.78	3.9%	10.94	9.4%	24.83	2.2%	42.58	8.0%	64.72	9.4%	52.4	4.7%	28.26	1.8%
16/07/10	249.9	-3.7%	3.9	-3.5%	14.55	-2.7%	57.96	-1.4%	10.41	-4.8%	24.69	-0.6%	41.38	-2.8%	63.94	-1.2%	52.37	-0.1%	27.11	-4.1%
23/07/10	259.94	4.0%	4.02	3.1%	15.71	8.0%	59.72	3.0%	11.05	6.1%	25.54	3.4%	44.79	8.2%	69.31	8.4%	54.75	4.5%	28.25	4.2%
30/07/10	257.25	-1.0%	4.1	2.0%	16.12	2.6%	59.68	-0.1%	11.17	1.1%	25.94	1.6%	44.64	-0.3%	69.75	0.6%	55.11	0.7%	28.51	0.9%
06/08/10	260.091	1.1%	4.06	-1.0%	16.45	2.0%	61.97	3.8%	11.59	3.8%	26.54	2.3%	43.5	-2.6%	71.56	2.6%	56.75	3.0%	28.68	0.6%
13/08/10	249.1	-4.2%	3.88	-4.4%	15.38	-6.5%	59.91	-3.3%	10.64	-8.2%	26.72	0.7%	41.73	-4.1%	68.01	-5.0%	55.73	-1.8%	27.31	-4.8%
20/08/10	249.64	0.2%	3.75	-3.4%	15.03	-2.3%	58.89	-1.7%	10.57	-0.7%	26.45	-1.0%	40.76	-2.3%	68.86	1.2%	55.3	-0.8%	28.17	3.1%
27/08/10	241.62	-3.2%	3.76	0.3%	14.71	-2.1%	59.8	1.5%	10.32	-2.4%	26.94	1.9%	40.91	0.4%	65.9	-4.3%	56.16	1.6%	28.74	2.0%
03/09/10	258.77	7.1%	3.91	4.0%	15.3925	4.6%	61.32	2.5%	10.88	5.4%	27.44	1.9%	41.8	2.2%	70.08	6.3%	57.56	2.5%	29.85	3.9%
10/09/10	263.41	1.8%	3.91	0.0%	15.98	3.8%	61.2	-0.2%	11.17	2.7%	27.83	1.4%	40.19	-3.9%	71.26	1.7%	58.52	1.7%	29.68	-0.6%
17/09/10	275.37	4.5%	3.95	1.0%	16.29	1.9%	60.78	-0.7%	11.1715	0.0%	28.17	1.2%	41.37	2.9%	73.18	2.7%	57.56	-1.6%	29.89	0.7%
24/09/10	292.32	6.2%	3.904	-1.2%	16.66	2.3%	61.75	1.6%	12.2	9.2%	28.58	1.5%	43.13	4.3%	79.73	9.0%	58.62	1.8%	31.64	5.9%
01/10/10	282.52	-3.4%	4.09	4.8%	16.36	-1.8%	62.54	1.3%	12.23	0.2%	28.81	0.8%	41.78	-3.1%	78.22	-1.9%	59.12	0.9%	31.82	0.6%
08/10/10	294.07	4.1%	4.19	2.4%	17.12	4.6%	64.38	2.9%	12.89	5.4%	28.22	-2.0%	37.99	-9.1%	80.37	2.7%	59.41	0.5%	31.89	0.2%
15/10/10	314.74	7.0%	3.95	-5.7%	16.3	-4.8%	65.19	1.3%	13.13	1.9%	28.33	0.4%	39.09	2.9%	79.75	-0.8%	59.94	0.9%	30.7	-3.7%
22/10/10	307.47	-2.3%	4.11	4.1%	16.055	-1.5%	66.34	1.8%	12.72	-3.1%	28.29	-0.1%	39.03	-0.2%	78.33	-1.8%	61.61	2.8%	31.48	2.5%
29/10/10	300.98	-2.1%	4.17	1.5%	16.02	-0.2%	66.49	0.2%	13.14	3.3%	28.52	0.8%	41.46	6.2%	78.6	0.3%	61.32	-0.5%	30.9	-1.8%
05/11/10	317.13	5.4%	4.49	7.7%	16.73	4.4%	70	5.3%	14	6.5%	29.27	2.6%	44.07	6.3%	83.54	6.3%	62.58	2.1%	31.92	3.3%
12/11/10	308.03	-2.9%	4.29	-4.5%	16.25	-2.9%	70.99	1.4%	13.49	-3.6%	28.46	-2.8%	42.7	-3.1%	81.04	-3.0%	62.92	0.5%	31.44	-1.5%
19/11/10	306.73	-0.4%	4.268	-0.5%	16.22	-0.2%	70.54	-0.6%	13.38	-0.8%	28.32	-0.5%	42.75	0.1%	83.97	3.6%	64.32	2.2%	31.22	-0.7%
26/11/10	314.795	2.6%	4.168	-2.3%	15.94	-1.7%	69.88	-0.9%	13.31	-0.5%	28.14	-0.6%	43	0.6%	84.69	0.9%	64.61	0.5%	31.16	-0.2%

We need this table for further calculations

2. Choose confidence interval

STEP 2

In the blue cell you can enter a confidence interval: from 0.90 to 0.99

I chose 0.95

This figure is the probability that the potential losses for portfolio will not be higher than VaR, which we will determine in the end

from 90% to 99.9%

Enter confidence interval

3. Calculation of K-coefficient

STEP 3

K-coefficient is the inverse value of standart normal distribution

We use NORMSINV function to calculate this

K-coefficient =

4. The calculation of average weekly change and standart deviation

STEP 4

1) calculate average weekly change for each stock

2) Calculate standart deviation for each stocks using function STDEV

	AAPL	C	GE	XOM	AA	T	AXP	CAT	KO	HD
Average weekly change	0.687%	0.233%	0.086%	0.481%	0.914%	0.455%	0.200%	1.199%	0.941%	-0.051%
Standart deviation	4.165%	3.693%	4.313%	2.750%	5.098%	1.725%	4.590%	4.583%	1.999%	3.426%

5. Calculation of 1 week volatility multipliers

STEP 5

Just following the steps:

- 1) Make links to the number of shares in the row 1
- 2) Make links to stock prices in the row 2
- 3) Calculate the value of position: price x quantity
- 4) Make links to weekly volatility
- 5) Calculate volatility multiplier: weekly volatility x value of position
- 6) Make links to average weekly change
- 7) Calculate average weekly change in \$: average weekly change x value of position

Stock	AAPL	C	GE	XOM	AA	T	AXP	CAT	KO	HD
Number of shares	100	500	2000	1000	2000	1230	250	127	100	1500
Share price, \$	314.8	4.2	15.9	69.9	13.3	28.1	43.0	84.7	64.6	31.2
Value of position	31479.5	2084.0	31880.0	69880.0	26620.0	34612.2	10750.0	10755.6	6461.0	46740.0
Weekly volatility	4.17%	3.69%	4.31%	2.75%	5.10%	1.72%	4.59%	4.58%	2.00%	3.43%
Volatility multiplier	1311.2	77.0	1374.9	1921.7	1357.1	596.9	493.4	492.9	129.1	1601.4
Average weekly change, %	0.69%	0.23%	0.09%	0.48%	0.91%	0.46%	0.20%	1.20%	0.94%	-0.05%
Average weekly change, \$	216.1	-4.9	27.4	336.2	243.2	157.6	21.5	129.0	60.8	-23.6

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)

6. Calculation of 10 weeks volatility multipliers

STEP 6

- 1) Calculate volatility multipliers for 10 weeks: weekly volatility multiplier x square root of 10
- 2) Calculate average prices changes for 10 weeks: average weekly change x 10

10 weeks volatility multiplier, \$	4146.45478	243.34712	4347.9244	6077.0602	4291.382	1887.564	1560.258	1558.788	408.3556	5064.202
Average 10 weeks change, \$	2161.31035	48.526677	274.26521	3362.1863	2432.335	1576.45	214.9973	1289.842	608.2414	-236.166

7. Find correlations between the stocks

STEP 7

Create correlation matrix in which you calculate correlations between all stocks
For correlations calculations we use CORREL function

Correlation matrix

	AAPL	C	GE	XOM	AA	T	AXP	CAT	KO	HD
AAPL	1.00	0.75	0.69	0.90	0.97	0.75	-0.04	0.91	0.82	0.83
C	0.75	1.00	0.66	0.82	0.84	0.52	0.33	0.72	0.66	0.62
GE	0.69	0.66	1.00	0.64	0.74	0.77	0.12	0.81	0.69	0.72
XOM	0.90	0.82	0.64	1.00	0.93	0.74	0.09	0.89	0.89	0.75
AA	0.97	0.84	0.74	0.93	1.00	0.78	0.06	0.94	0.86	0.79
T	0.75	0.52	0.77	0.74	0.78	1.00	-0.11	0.90	0.91	0.72
AXP	-0.04	0.33	0.12	0.09	0.06	-0.11	1.00	0.05	0.00	-0.08
CAT	0.91	0.72	0.81	0.89	0.94	0.90	0.05	1.00	0.95	0.76
KO	0.82	0.66	0.69	0.89	0.86	0.91	0.00	0.95	1.00	0.65
HD	0.83	0.62	0.72	0.75	0.79	0.72	-0.08	0.76	0.65	1.00

9. Create two columns with 1 week and 10 weeks volatility multipliers

STEP 8

Make links to weekly and 10-weeks volatility multipliers which we calculated in steps 5 and 6, respectively
We need this table for calculations with excel functions

Volatility (\$)	1 week	10 weeks
AAPL	1311.22	4146.45
C	76.95	243.35
GE	1374.93	4347.92
XOM	1921.74	6077.06
AA	1357.05	4291.38
T	596.90	1887.56
AXP	493.40	1560.26
CAT	492.93	1558.79
KO	129.13	408.36
HD	1601.44	5064.20

9. Calculate VaR for 1 week and 10 weeks

STEP 9

1) Calculate portfolio volatility

All calculation are made with a single formula but if we look at each action separately it would be the following:

- Multiply two matrices: volatility multipliers and correlations matrix
- Multiply the result by weekly volatility matrix calculated in step 8
- Calculate the square root from the result

For matrix multiplication use function MMULT

Make similar calculations for 10 weeks period

- Multiply matrices: 10 weeks volatility multiplier and correlation matrix
- multiply the result by 10 weeks volatility matrix calculated in step 8
- calculate the square root of the result

2) Calculate average change for portfolio

Simply sum up average weekly changes of all stocks calculated in step 5

Similarly sum up 10 weeks changes of the stocks calculated in step 6

3) Calculate VaR

Calculate VaR using formula:

Average change of portfolio - (K-coefficient x absolute value of portfolio volatility)

The calculation of absolute value with ABS function

	1 week	10 weeks
Portfolio volatility	8089.6728	25581.792
Average portfolio change	1173.19874	11731.987
Portfolio VaR	-12133.13	-30346.3

- 1)
- 2)
- 3)

What does the result mean

The loss of your portfolio will be not more than -12,133 \$ or -4.47% for 1 week; and not more than -30,346 \$ or -11.19% for 10 weeks with 0.95 probability
Portfolio value (just to remind)= 271,262 \$

If any questions - lamanalista@gmail.com