VaR Simulation Report

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1. User defined inputs and rationale

ts: start date is set to 2008, 1, 1

te: end date is set to 2011, 1, 1

d: number of mutual funds in the portfolio is set to = 5

Since there is no

Tau: time horizon is set to 365

Delta: rolling period is set to 7

Alpha: confidence level is set to 0.95

m, total investment is set to 500000

2. Implementation

Three helper functions implemented.

diff_dates(date1, date2):

- Takes in two dateTime objects
- Calculate days between two dates

ceil(n):

- The mathematical ceiling function

var_calc(ret, alpha, val):

- Given a return series and confident level, and value of investment, using historical simulation to calculate VaR and CVaR.
- CVaR is calculated as the expected loss given the loss exceeded VaR at a confident level
- VaR is calculated using a more conservative approach. Rounded to a higher order statistics instead of average. See http://www.columbia.edu/~amm26/lecture%20files/VaR.pdf for detail. Credit Prof Allan Malz and IEOR 4745 at Columbia U

3. Results

Q: In calculation of VaR and CVaR, does it matter if returns are annualized or not?

Yes. Indeed it matters. Since we are calculating VaR based on returns, so all the calculations are based on returns. If the returns are annualized, we are calculated the yearly VaR on an

annualized return, of which sampling frequency is every 1 days/week/month/year, depending on tau.

If the return was not annualized, the VaR calculated would simply be the daily/monthly/yearly VaR, which means how much investment are at risk on a day/month/year.

For since not required, my implementation is not annualized. One can compare different results generated.

For the user defined set of parameters given above, results are follows.

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We picked 5 assets: PGIM Corporate Bond Z, USAA High Income, SEI Mid-Cap F
(SIMT), Fidelity® Municipal Income, Lord Abbett Income A
At 95.0% confident level, VaR of the portfolio is 79439.8299223685
At 95.0% confident level, CVaR of the portfolio is 88547.50912865394
```

For reference, I generated a dataframe that aims to compare different tau and sigma values. Columns are tau values and rows are delta values.

	1	7	30	90	365
1	4282.592525	12537.848075	30881.589891	75386.349521	81414.579572
7	NaN	11849.479581	28420.079096	72323.94538	79439.829922
30	NaN	NaN	21862.235295	63151.810865	77505.239613
90	NaN	NaN	NaN	27083.47677	73803.825781
365	NaN	NaN	NaN	NaN	-148457.81527

(VaR Table)

Notice that it is an upper triangular matrix since tau is the time periods that used to calculate return, and delta is the rolling window. It doesn't make sense to let delta > tau.

	1	7	30	90	365
1	7602.125921	21518.286413	52471.544236	91004.19283	89432.670667
7	NaN	20280.462712	53238.277034	89365.839066	88547.509129
30	NaN	NaN	48668.630304	88736.39319	88472.102748
90	NaN	NaN	NaN	66891.221689	87652.802467
365	NaN	NaN	NaN	NaN	86611.037437

(CVaR Table)

It is readily observable that as the tau grows, both Var and CVaR grow larger. Which is correct since we are using a return in a year as a variable, so it could be larger fluctuations.