QRM Workshop 9
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1A) What is the optimal policy and the V@R for a level of significance (probability of the loss exceeding the V@R) of 1%, 5%, 10%, in a given month?

Optimal policy for achieving the expected return of 2% at the lowest possible risk:
aapl 0.197, mcd 0.051, qqq 0.455, spy 0.296, tlt 0

V@R at 10% level of significance: -0.023
V@R at 5% level of significance: -0.030
V@R at 1% level of significance: V@R: -0.042

When we optimize to minimize variance (risk) and obtain an expected return of 2% we will invest according to the abovementioned policy of aapl 0.197, mcd 0.051, qqq 0.455, spy 0.296
By observing the V@R at varying significance levels...
There is a 10% chance to lose 2.3% or more in any given month
There is a 5% chance to lose 3.0% or more in any given month
There is a 1% chance to lose 4.2% or more in any given month

1B) What is the different between the risk-averse and the risk-neutral optimal policies?

GAMS syntax change if we want to maximize expected returns instead of minimizing risk to target a given expected return:
Instead of [Solve portfolio using nlp minimizing variance;]
We use [Solve portfolio using nlp maximizing e_return;] which will give us a max return of 2.9%

		VAR Level of Significance			Policy				
		10%	5%	1%	aapl	mcd	qqq	spy	tlt
Expected Returns	1%	-1.3%	-1.7%	-2.6%	0.0%	18.5%	18.3%	58.8%	4.3%
	2%	-2.3%	-3.0%	-4.2%	18.5%	18.3%	58.8%	4.3%	0.0%
	3%	-6.3%	-8.1%	-11.4%	100.0%	0.0%	0.0%	0.0%	0.0%

1C) What is the impact of the target on the monthly return on the V@R and on the optimal policy?

As monthly expected returns increase we also risk losing more.
We also note that when we want to maximize profit regardless of risk we will invest everything in the security with the highest mean monthly return, regardless of its variance. This will give us the highest expected returns but it also carries the highest risk

2A) What is the optimal policy for beta of 0.9, 0.95 and 0.99? What is the CV@R, V@R, and expect return of the optimal policies?

We aim to minimize CVAR while setting a [Beta]% probability that we won't suffer a bigger loss than the given VAR.

No of scenarios =10000					Policy				
		E Returns	VAR	CVAR	aapl	mcd	qqq	spy	tlt
Beta	0.90	1.6%	-0.04%	0.50%	7.3%	17.6%	26.8%	48.1%	0.1%
	0.95	1.6%	0.40%	0.90%	6.6%	17.6%	25.7%	49.1%	0.9%
	0.99	1.5%	1.20%	1.60%	5.7%	19.3%	23.3%	50.1%	1.6%

2B) How does the number of scenarios influence the previous solution?

CVAR is very sensitive is to the number of scenarios:

If we use more scenarios the results will be more consistent and it will give us a meaningful read between betas. But if we have very few scenarios the results less consistent.

Expected values will not be impacted materially by the number of scenarios.

No of scenarios =10					Policy				
		E Returns	VAR	CVAR	aapl	mcd	qqq	spy	tlt
Beta	0.90	1.7%	-0.20%	-0.20%	0.0%	2.7%	65.4%	19.7%	12.1%
	0.95	1.7%	-0.20%	-0.20%	0.0%	2.7%	65.4%	19.7%	12.1%
	0.99	1.7%	-0.20%	-0.20%	0.0%	2.7%	65.4%	19.7%	12.1%

No of scenarios =5000					Policy				
		E Returns	VAR	CVAR	aapl	mcd	qqq	spy	tlt
Beta	0.90	1.6%	-0.07%	0.50%	5.6%	17.2%	28.6%	47.7%	0.9%
	0.95	1.6%	0.40%	0.90%	5.6%	16.2%	28.1%	48.9%	1.2%
	0.99	1.5%	1.20%	1.60%	4.8%	17.9%	24.5%	50.1%	2.7%

2C) You believe that the historical correlations between the security returns and the SPY are not representative. Choose a correlation matrix that, in your view better represents the future behavior of the stock returns and re-address question A).

We assume that SPY is not representative, and we also observe that QQQ has a negative correlation against SPY. From this we choose to use QQQ as our index of choice to re-address question A.

Different correlational matrix when beta is 0.95					Policy				
Base Stock		E Returns	VAR	CVAR	aapl	mcd	qqq	spy	tlt
Beta	SPY	1.6%	0.40%	0.90%	5.6%	16.2%	28.1%	48.9%	1.2%
	AAPL	1.5%	1.40%	2.10%	0.0%	17.7%	25.3%	55.2%	1.7%
	MCD	1.7%	1.00%	1.70%	12.9%	0.0%	31.5%	53.5%	2.1%
	QQQ	1.2%	1.70%	2.4%	2.8%	15.0%	0.0%	76.0%	6.2%
	TLT	1.7%	0.80%	1.50%	9.5%	12.3%	30.8%	47.4%	0.0%

Readdressing question A… we obtain

QQQ correlational matrix across various betas is 0.95					Policy				
QQQ Base Stock		E Returns	VAR	CVAR	aapl	mcd	qqq	spy	tlt
Beta	0.90	1.2%	1.0%	1.9%	4.3%	14.3%	0.0%	75.5%	5.9%
	0.95	1.2%	1.7%	2.4%	2.8%	15.0%	0.0%	76.0%	6.2%
	0.99	1.2%	2.8%	3.4%	1.8%	15.3%	0.0%	76.4%	6.5%