DSC5211C - QRM
Workshop 10
Worst-Case Analysis
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Group 09:

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1. TASK 1: Portfolio management problem

Use Worst case analysis on portfolio management problem

	CVAR	CVAR	CVAR	CVAR	Worst Case
Scenario	1,000	1,000	1,000	1,000	1,000
Beta	0.90	0.95	0.99	0.999	
Portfolio					
SPY	49.40%	50.60%	52.20%	48.40%	48.40%
AAPL	6.80%	7.50%	3.50%	8.70%	8.70%
MCD	17.40%	15.90%	16.60%	19.70%	19.70%
QQQ	23.70%	21.20%	24.30%	17.40%	17.40%
TLT	2.70%	4.80%	3.50%	5.80%	5.80%
Expected return	0.015	0.015	0.015	0.150	0.150
V@R	-0.001	0.004	0.012	0.019	
CV@R	0.005	0.009	0.015	0.019	
Mu					0.019

	CVAR	CVAR	CVAR	CVAR	Worst Case
Scenario	10,000	10,000	10,000	10,000	10,000
Beta	0.90	0.95	0.99	0.9999	
Portfolio					
SPY	48.10%	49.10%	50.10%	47.00%	47.00%
AAPL	7.30%	6.60%	5.70%	2.70%	2.70%
MCD	17.60%	17.60%	19.30%	22.90%	22.90%
QQQ	26.80%	25.70%	23.30%	25.60%	25.60%
TLT	0.10%	0.90%	1.60%	1.70%	1.70%
Expected return	0.016	0.016	0.015	0.015	0.015
V@R	0.000	0.004	0.012	0.026	
CV@R	0.005	0.009	0.016	0.026	
Mu					0.026

When the number of scenarios is 1,000 for worst case analysis, there optimal policy is to put less in SPY and QQQ and more in the rest of the stocks in the portfolio.

Optimal policy when beta = 0.999 is the same as worst case analysis which is put less in SPY and QQQ, and more on the rest.

However, when using 10,000 scenarios for worst case analysis, the optimal policy is still to put less in SPY and QQQ but also put less in AAPL. This optimal policy is reasonable since AAPL has highest risk (i.e. highest price variance). Also, when using more scenarios, the proportion for TLT is immaterial since its mean monthly return is immaterial.

The worst-case scenario and CV@R when the beta is 0.999 (for 1,000 scenarios) or 0.9999 (for 10,000 scenarios) have the same optimal policy, which is expected, since with high beta, the worst scenario was captured in the result.

2. TASK 2: Feeding mix problem

Compare risk neutral, CV@R and Worst-Case scenario analyses:

	Risk Neutral	CVAR	CVAR	CVAR	CVAR	Worst Case
Scenario	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00
Beta		0.90	0.95	0.99	0.999	
Mix						
barley	100.00%	26.70%	28.50%	29.40%	34.40%	34.40%
oats		46.90%	44.30%	42.20%	35.40%	35.40%
sesame		15.30%	18.70%	23.10%	30.20%	30.20%
grnd-meal		11.10%	8.60%	5.30%		
Cost	24.55	29.57	29.60	29.66	29.69	29.69
V@R		42.21	46.35	53.08	63.29	
CV@R		47.57	50.98	57.20	63.29	
Mu						63.29

	Risk Neutral	CVAR	CVAR	CVAR	CVAR	Worst Case
Scenario	10,000	10,000	10,000	10,000	10,000	10,000
Beta		0.90	0.95	0.99	0.9999	
Mix						
barley	100.00%	25.60%	24.10%	21.80%	23.00%	23.00%
oats		48.20%	49.50%	51.50%	50.90%	50.90%
sesame		14.30%	15.20%	16.30%	13.80%	13.80%
grnd-meal		12.00%	11.30%	10.40%	12.30%	12.30%
Cost	24.550	29.58	29.63	29.70	29.63	29.63
V@R		48.25	47.19	53.96	64.64	
CV@R		51.46	51.46	57.28	64.64	
Mu						64.64

Risk neutral case: 100% of feeds will be barley since it is cheapest. The average cost is lowest is the lowest but not always guaranteed.

The worst-case scenario and CV@R when the beta is 0.999 (for 1,000 scenarios) or 0.9999 (for 10,000 scenarios) have the same optimal policy, which is expected, since with high beta, the worst scenario was captured in the result.

Using CV@R analysis: Feeds proportion is varied among the four feeds. The higher the Beta, the higher the CV@R. Even though the barley is cheapest, but its price fluctuates more than oat's price (larger price standard deviation).

However, if taken into account of the requirement for protein and fat, oat has the lowest protein among the four feeds, while grnd-meal has the highest protein per unit. Therefore, grnd-meal will be more value-for-money in terms of protein.

On the other hands, fat is also one of the requirements for the feeds. Sesame has the highest fat and also the best of value-for-money in terms of fat component.

Using Worst-Case analysis: Similar to using CV@R analysis, feeds proportion is varied among the four feeds as well.

There are differences in the results when using 1,000 or 10,000 scenarios.

When using 1,000 scenarios, the optimal policy for using CV@R analyses (for beta of 0.9, 0,95 and 0,99) and Worst-case scenario are significantly different. The higher the beta for CV@R, the least grnd-meal proportion in the optimal policy. Worst case optimal policy did not have grnd-meal in the list due to high mean price and high price fluctuation which is riskier.

However, when using 10,000 scenarios, the optimal policy using worst case scenarios and CV@R with different beta did not varied a lot. The optimal policy is to buy the most oat, then barley and follow by sesame and grnd-meal. The cost of the worst case is $64.64.