Week 5 Project

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Problem 1

To calculate the value at risk and expected shortfall for problem 1, I fitted the returns in normal and generalized t distributions, respectively. For the normal distribution, the fitted result was $N(-0.0009, 0.0489^2)$; for the t distribution, the fitted result was $t(4.2511, (0.0001, 0.0364^2))$. Value at risk and expected shortfall results are in table 1.

Table 1 VaR and ES for different distributions

	Normal distribution	T distribution
VaR	0.0820	0.0764
Expected shortfall	0.1020	0.1130

Also, by making a graph of the results, we can conclude that the value at risk in the normal distribution is larger than that in the t distribution, while the expected shortfall in the normal distribution is smaller than that in the t distribution.

The difference could be perfectly explained by the fat tail of the t distribution. To be specific, the t distribution has more extreme values, having more influence on the expected shortfall than the normal distribution. Thus, the expected shortfall in the t distribution is larger.
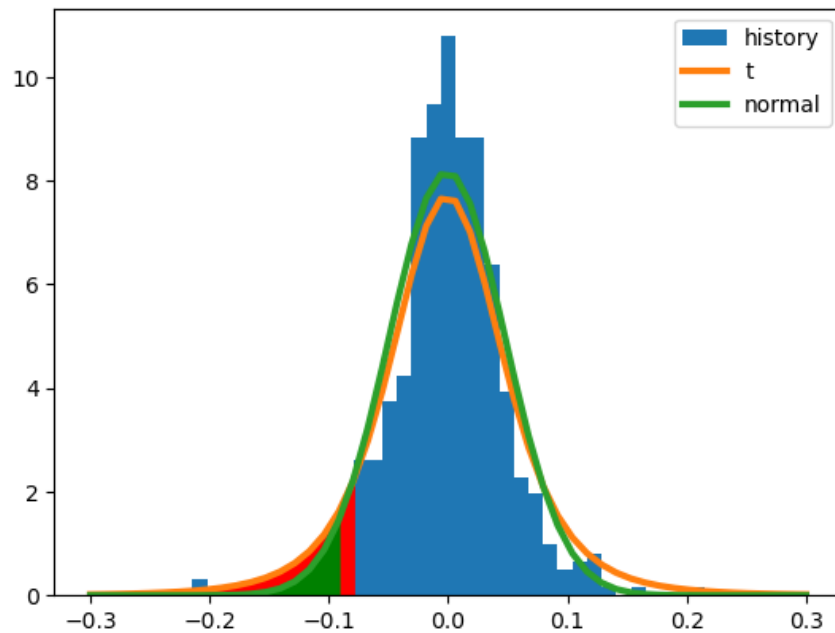

Figure 1 VaR and ES in different distributions

Problem 2

It is hard to build a test suite for the simulation module since answers will always be influenced by random numbers.

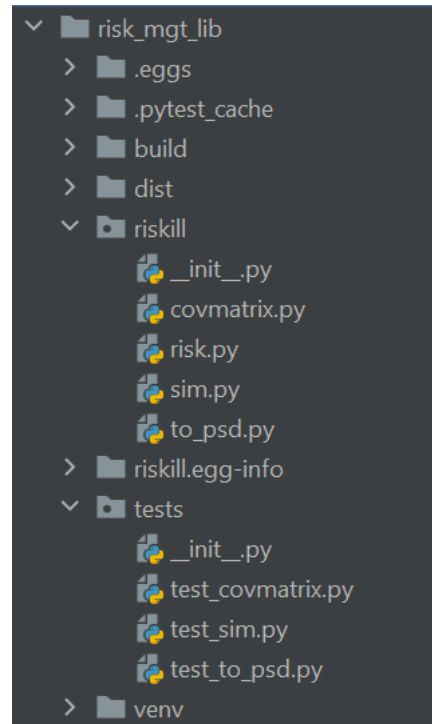Here is my structure of risk management library.

Figure 2 risk management library structure

Problem 3

For problem 3, I fitted a generalized t model to each stock to calculate the portfolios' value at risk and expected shortfall, both in dollar. I displayed my results in table 2 and table 3.

Table 2 VaR for portfolios

portfolio	A	B	C	Total
Monte Carlo with discrete return	5620.37$	4357.73$	3753.22$	13470.81$
Monte Carlo with log return	5539.85$	4382.22$	3736.56$	13450.62$
Historic sim with discrete return	3452.11$	3631.77$	2754.59$	11064.37$
Historic sim with log return	4558.32$	3631.77$	2754.59$	11064.37$
Fitted t distribution	7944$	6693$	5565$	19961$

Table 3 ES for portfolios

portfolio	A	B	C	Total
Fitted t distribution	10408$	8882$	7361$	26446$

From the results, the value at risk using fitted t-distribution was much higher than the results from week 4. As for the expected shortfall, influenced by fat tails in the t distribution, the expected shortfalls for portfolios were much larger, showing a 26,446 dollar loss in total.