

# 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.

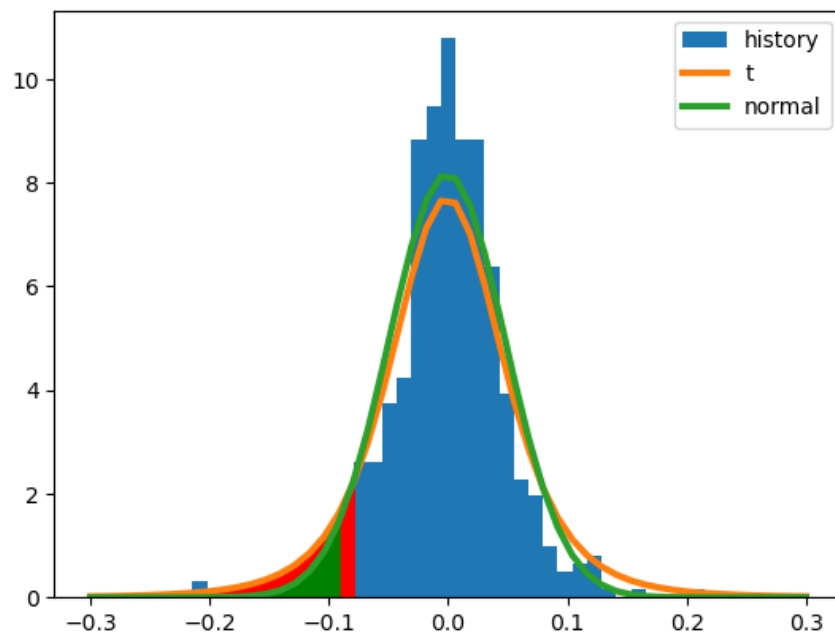


Figure 1 VaR and ES in different distributions

## 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.

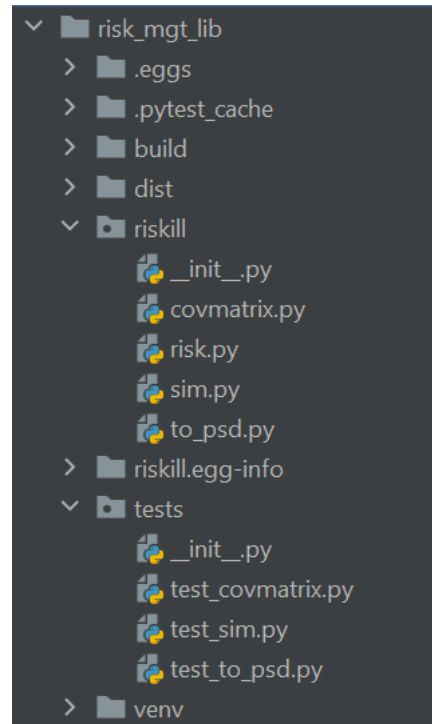


Figure 2 risk management library structure

## 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	10648\$	9506\$	8121\$	28232\$

Table 3 ES for portfolios

portfolio	A	B	C	Total
Fitted t distribution	14620\$	13050\$	11338\$	39004\$

From the results, the value at risk using fitted t distribution was more than double 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 large, showing a 39,004 dollar loss in total.