Problem 1

Use the data in problem1.csv. Fit a Normal Distribution and a Generalized T distribution to this data. Calculate the VaR and ES for both fitted distributions.

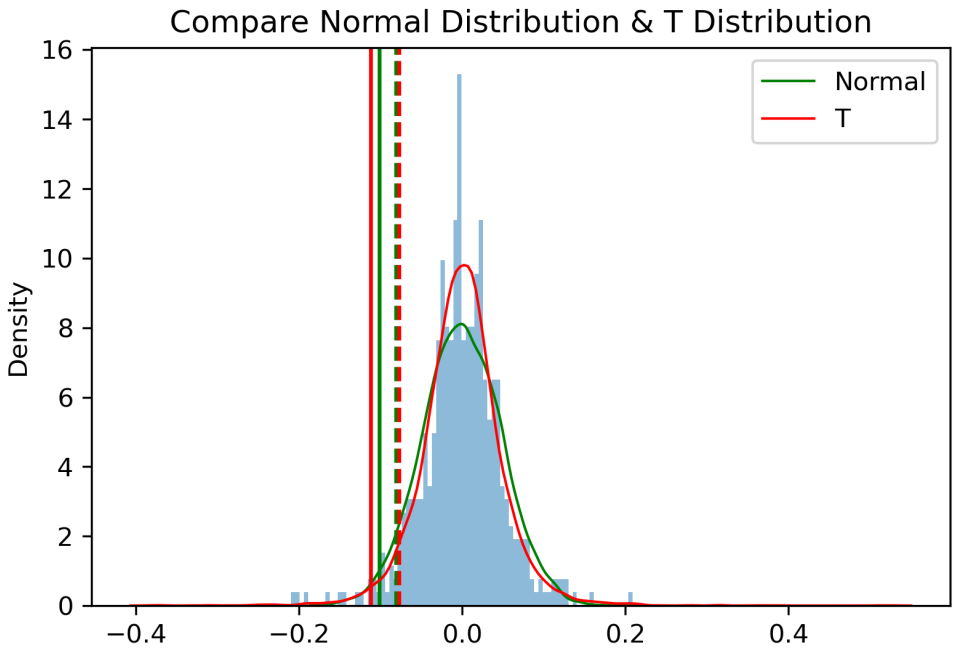
Overlay the graphs the distribution PDFs, VaR, and ES values. What do you notice? Explain the differences.

Answer:

Using the data in problem1.csv, through different fitting methods, the obtained VaR and ES are as follows.

Method	VaR	ES
Normal Distribution	0.0806	0.1012
T Distribution	0.0771	0.1120

Overlay the graphs the distribution PDFs, VaR, and ES values and get the result. The dotted line represents VaR, and the solid line represents ES.



It can be seen from this figure that the VaRs generated by the two methods are very close, and the ES generated by the Generalized T distribution is obviously larger than that generated by the normal distribution. The pdf curve of the Generalized T distribution is sharper and has fat tails.

The reason for this result is that the simulation results of the normal distribution are more concentrated in the center, and the T distribution has a fat tail, so there will be more distributions in relatively more extreme cases, so the calculated ES will be larger.

Problem 2

In your main repository, create a Library for risk management. Create modules, classes, packages, etc as you see fit. Include all the functionality we have discussed so far in class. Make sure it includes

1. Covariance estimation techniques.
2. Non PSD fixes for correlation matrices
3. Simulation Methods
4. VaR calculation methods (all discussed)
5. ES calculation

Create a test suite and show that each function performs as expected.

Answer:

By publishing my own python library, you can install it with `pip install risk_mgmt.` It covers the above and performs as expected.

Problem 3

Using Portfolio.csv and DailyPrices.csv. Assume the expected return on all stocks is 0. This file contains the stock holdings of 3 portfolios. You own each of these portfolios.

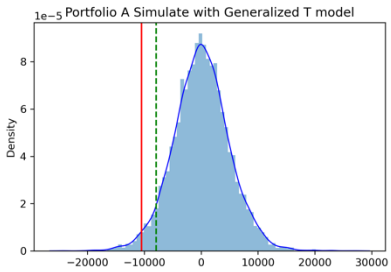
Fit a Generalized T model to each stock and calculate the VaR and ES of each portfolio as well as your total VaR and ES. Compare the results from this to your VaR form Problem 3 from Week 4.

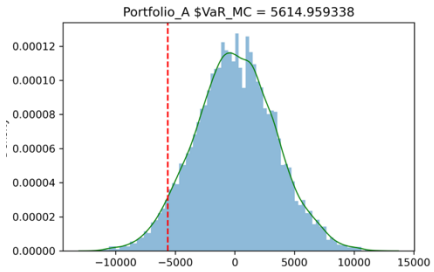
Answer:

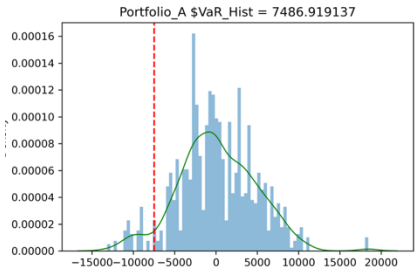
The VaR calculated by Generalized T model, Monte Carlo simulation, and Historic methods are as follows.

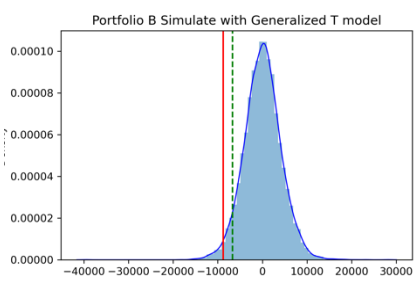
Portfolio	Current Value	Generalized T		Monte Carlo	Historic
		VaR	ES		
A	299950.06	7923.37	10466.31	5614.96	7486.92
B	294385.59	6693.39	8795.63	4475.64	7273.77
C	270042.83	5653.49	7439.26	3732.25	5310.07
Total	864378.48	19987.87	26412.08	13311.81	17832.39

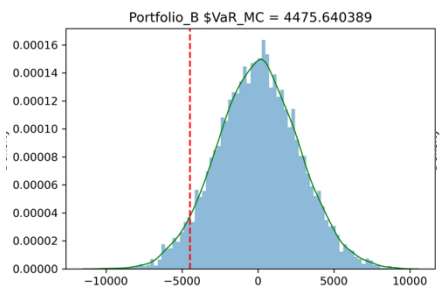
The data obtained by Generalized T model, Monte Carlo simulation and Historic simulation are as follows.

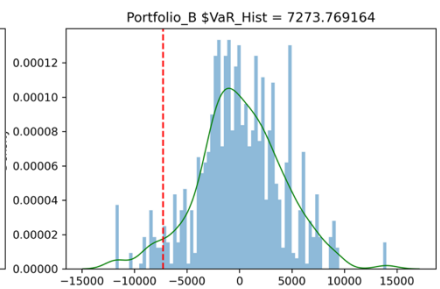


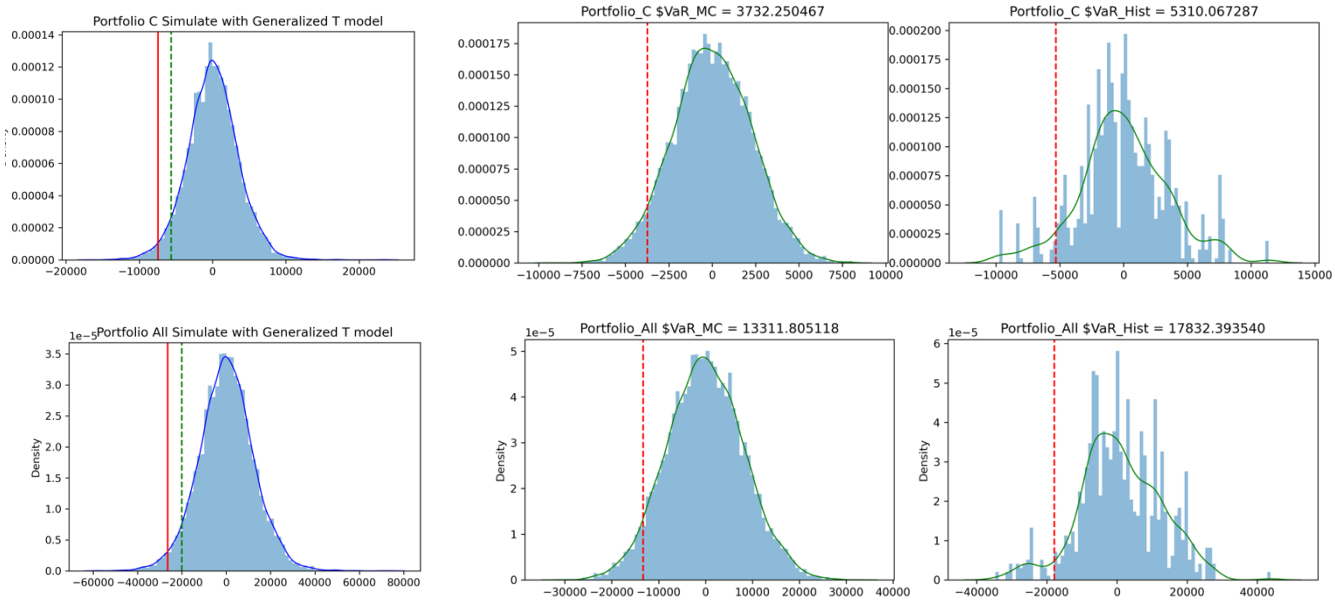












By comparing the Generalized T model with the calculation results of last week, it can be seen that its simulation results are closer to the simulation results of the Historic simulation.

The results are more in line with the stock's past performance than the previous two methods. At the same time, because the probability of occurrence of extreme cases is not underestimated, that is, the distribution with fat tails, the calculation result is larger than the result of Monte Carlo simulation. This should also be more in line with the actual situation.

Compared with the results of the Historic simulation, due to the limited past data, the Historic simulation may not be smooth enough, which may be the reason for the large difference in some data from the Generalized T model.

In short, this simulation may be closer to the real situation, while taking into account the probability of extreme situations. However, as discussed in class, it has its own limitations.