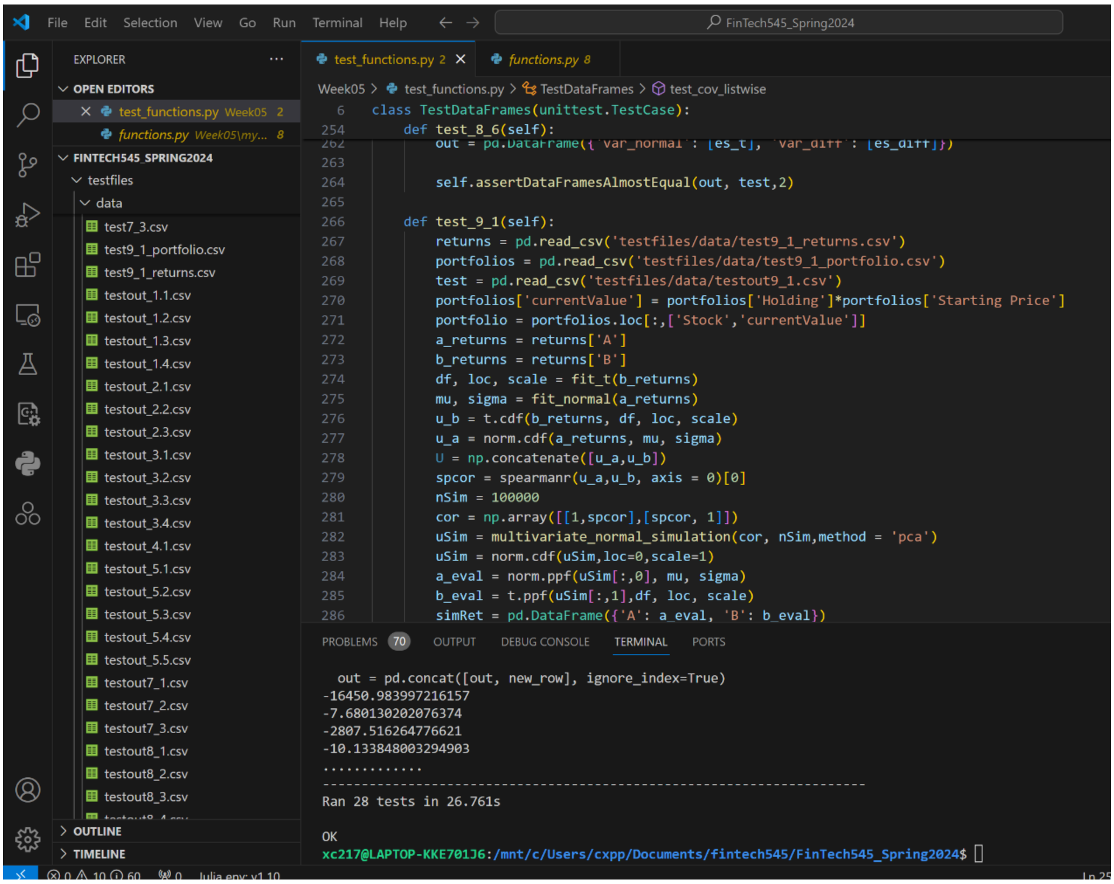
Q1

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

Please check the repo https://github.com/dompazz/FinTech545_Spring2024/tree/main/testfiles and make sure that all your functions can pass test files in the repo. Present your test cases pass results.

The Library and Test are provided in the file. The screen shot is as follows:

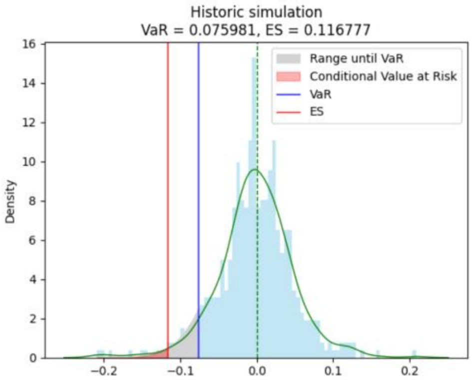


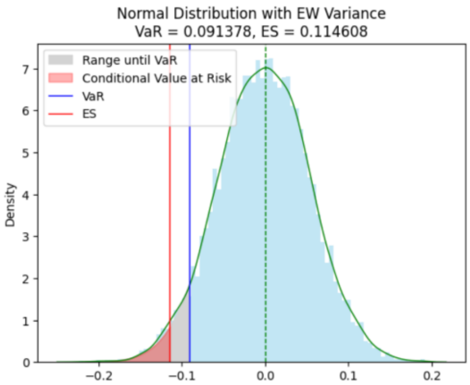
Q2

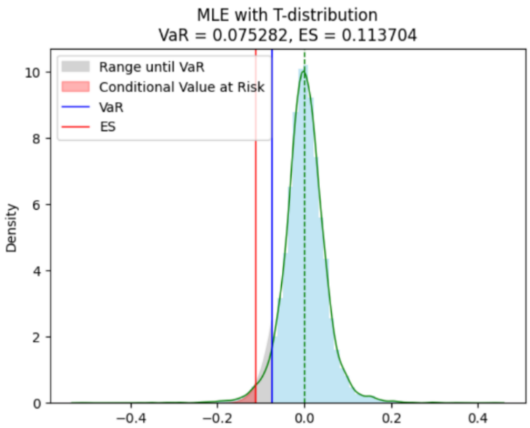
Problem 2:
Use the data in problem1.csv.
Calculate VaR and ES:

a. Using a normal distribution with an exponentially weighted variance (lambda=0.97);
b. Using a MLE fitted T distribution
c. Using a Historic Simulation

Compare difference between VaR and ES under different probabilistic distributions. Explain the differences.







Methods	VaR	ES
Normal + EW	0.092366	0.115236
MLE + t	0.077007	0.115599
Historical	0.075981	0.116777

Explain the differences:

For the VaR, the normal +EW method can get the biggest one, since EW method gives the latest data more weight in calculating, so maybe the recent data's volatility is larger. The MLE + t method uses maximum likelihood estimation to fit the data and assumes that returns follow a t-distribution, a distribution with thicker tails than the normal distribution, so is better able to capture extreme changes in financial asset returns, so this approach is generally considered more accurate than the normal distribution model. Using the t-distribution may result in higher risk estimates because it takes into account extreme events in the return distribution. The historical method is totally decided by the given data, and my result is that the historical data has the least VaR, and it is very similar to MLE + t method. This condition maybe because the data is more likely to be T distribution.

For ES, the results calculated by the three methods are very similar, which means that although EW method's VaR is larger, its left tail is shorter(thinner) than the other two method's tails. Based on the graph, we can see that the historical method's tail is the longest one.

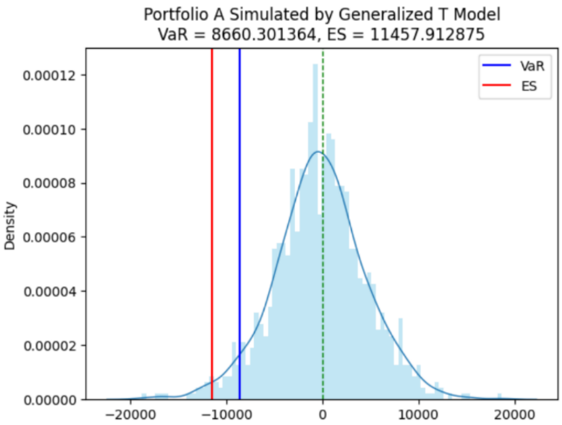
Q3

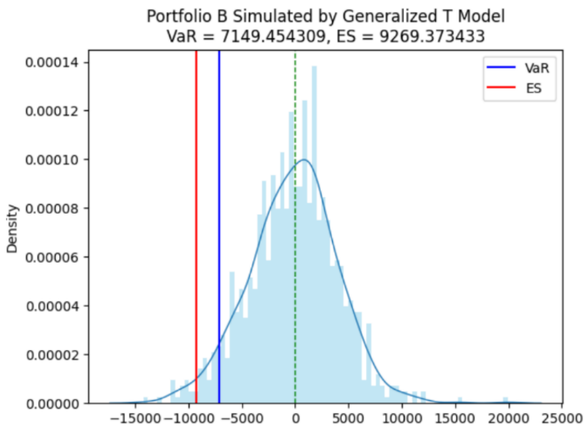
Problem 3:
Use your repository from #1.
Using Portfolio.csv and DailyPrices.csv. Calculate arithmetic returns. Assume the expected return on all stocks is 0. This file contains the stock holdings of 3 portfolios. You own each of these portfolios.

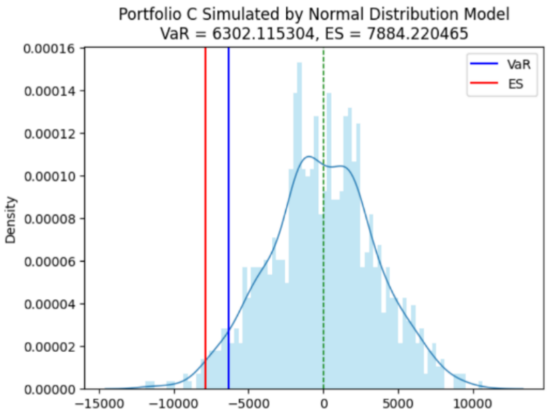
Fit Generalized T models to stocks in portfolios A and B, and fit a normal distributions to stocks in portfolio C. Calculate the VaR and ES of each portfolio as well as your total VaR and ES. You will need to use a copula. Compare the results from this to your VaR form Problem 3 from Week 4.

My results are as follows:

	VaR	ES
A	**8660.30**	**11457.91**
B	**7149.45**	**9269.37**
C	**6302.11**	**7884.22**
Total	**21889.52**	**29088.54**







Compare VaR from problem 3 in Week4:

	VaR	Week4 Normal+ EW	Week4 Monte Carlo
A (Fit T)	8660.30	15426.97	14014.13
B (Fit T)	7149.45	8082.57	7474.11
C (Fit Normal)	6302.11	18163.29	16285.41

Total	21889.52	38941.38	35642.05

For A and C, the VaR calculated this week is smaller than the VaR in week 4, this is because the EW in week 4 includes more recent data, thus making the VaR larger since the recent data's volatility is larger. For B, I thing the data is more like a distribution between t distribution and normal distribution, so the three method's results are similar.