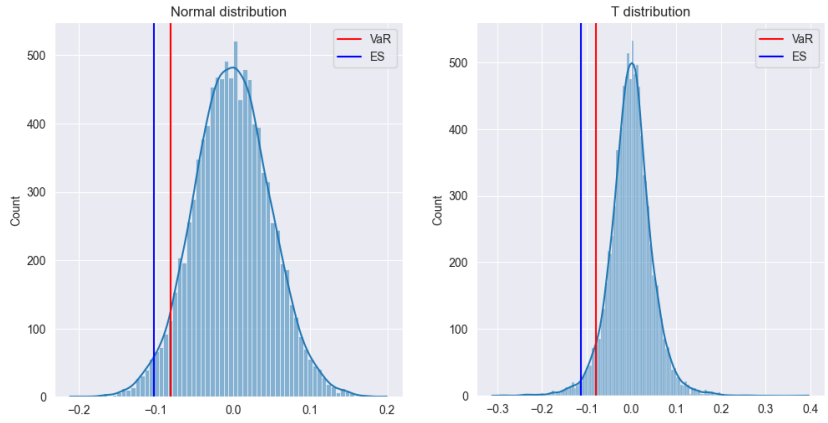
Problem1:

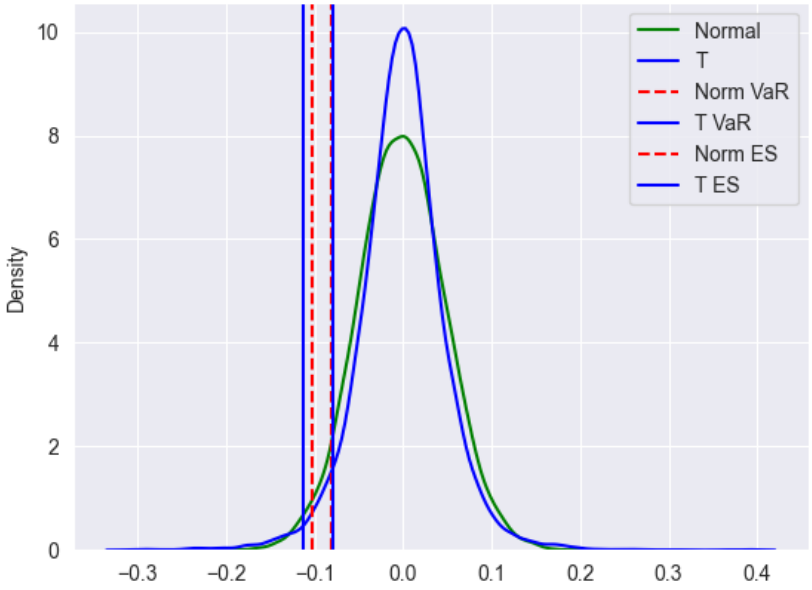
My process:

1. Use normal distribution to fit X and simulate
2. Use MLE T distribution to fit X and simulate
3. Plot out the distribution and VaR, ES

Result:

	Normal	Generalized T
VaR	0.0806	0.0787
ES	0.1027	0.1133





Conclusion:

T distribution has more tail values than normal distribution. Fitting by generalized T generates a smaller VaR than Normal, but a larger Expected shortfall, which also indicates that expected shortfall is better at measuring data with heavy tails.

Problem2:

See the folder 'risklib' under my main repo.
I currently have 6 modules inside:

1. **covar:** 4 methods of covariance calculation
2. **riskstats:** VaR and ES calculation
3. **fitted_model:** fit a normal or generalized t distribution to a given data and store the fitted results in the FittedModel Class
4. **simulate:** Non-PSD fixes methods and PCA simulation
5. **VaR:** Delta Normal, Monte Carlo and historical simulation to calculate VaR

Problem3:

My process:

1. Import modules from my library: fitted_model, portfolio, riskstats, simulate
2. Use portfolio module to calculate current value, prices and returns for selected portfolio
3. Use generalized t method in the 'fitted_model' module to fit t for each stock, and calculate U
4. Calculate correlation matrix R from fitted U
5. Use pca simulate method in 'simulate' module to draw simulations based on R
6. Convert simulated values to Usim matrix
7. Get the simulated returns by using cdf calculation method in the 'fitted_model' module
8. Used the simulated returns to calculate VaR and ES using the 'riskstats' module

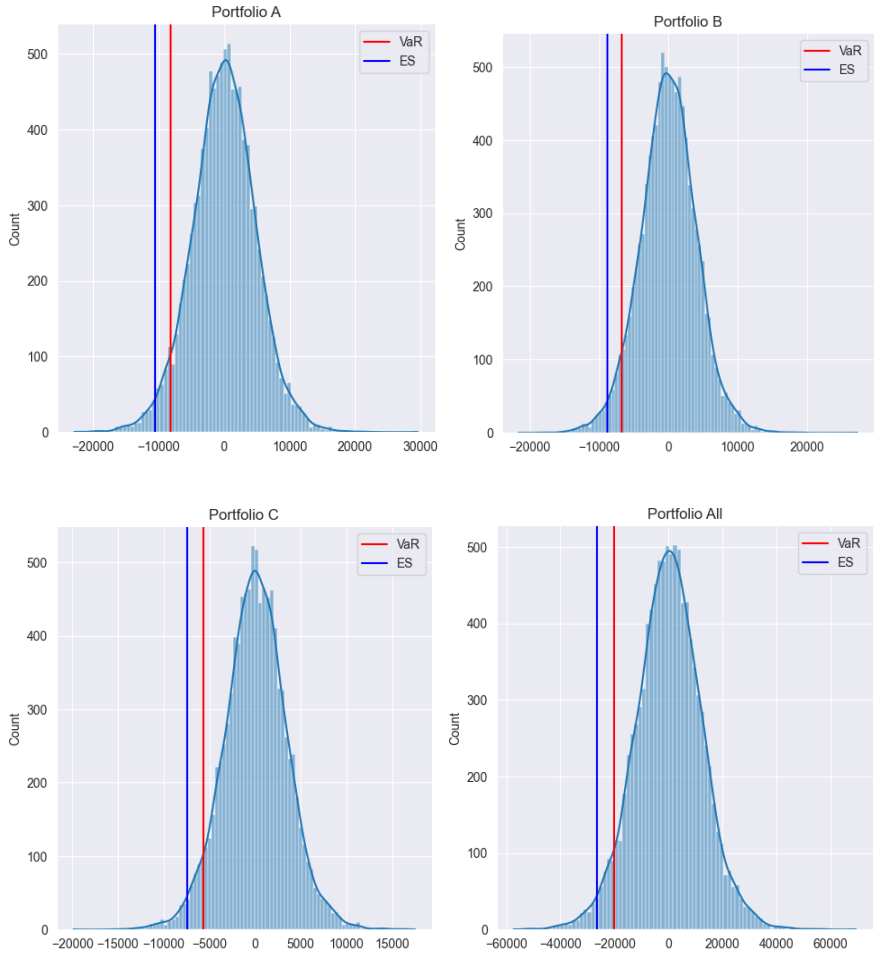
Result:

	A	B	C	All
VaR	8142.45	6752.62	5696.51	20286.75
ES	10543.91	8797.95	7469.78	26495.17

VaR from week4:

	A	B	C	All
Delta Normal	5670.2	4494.6	3786.59	13577.08
Monte Carlo	5605.31	4337.6	3769.5	13304.87
Historic	9138.87	7001.12	5558.72	20564.36

Generalized T fitting distribution:



Conclusion:

By comparing the results from generalized T and the three VaR calculation from week4, we can see that the historical simulation has the largest VaR, followed by generalized T. Delta Normal and Monte Carlo simulation generate VaR smaller than the other two. It is probably related to the kurtosis or the tail of the data. Since the data is not distributed normally and has heavy tail, simulation based on normal distribution can not capture this feature well, while t distribution take this into account. Therefore, generalized T has a result closer to historical simulation.