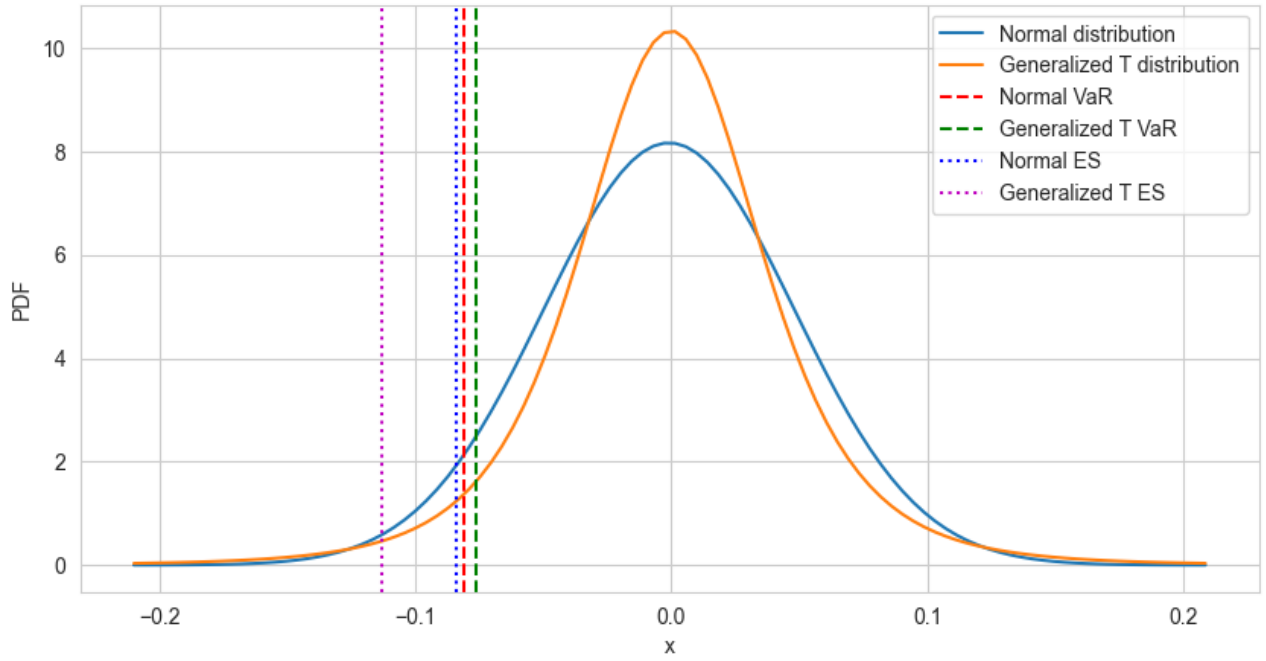
Problem 1



Normal distribution: VaR at 95% confidence level: **0.081**

Expected Shortfall at 95% confidence level: **0.084**

Generalized T distribution: VaR at 95% confidence level: **0.076**

Expected Shortfall at 95% confidence level: **0.113**

Based on the numbers given in the result, we can see that the VaR for the Generalized T distribution is lower than that for the Normal distribution. This suggests that the Generalized T distribution, which has more fat distribution, may be a better fit for the data and the risks associated with the portfolio. However, the Expected Shortfall for the Generalized T distribution is higher than that for the Normal distribution, indicating that the Generalized T distribution is more conservative in its estimates of losses. Therefore, in order to say which one is better, I think it depends on the risk preference, which means that the Generalized T distribution is assigning a higher probability to extreme negative events, which could be seen as a good thing if the investor is risk averse.

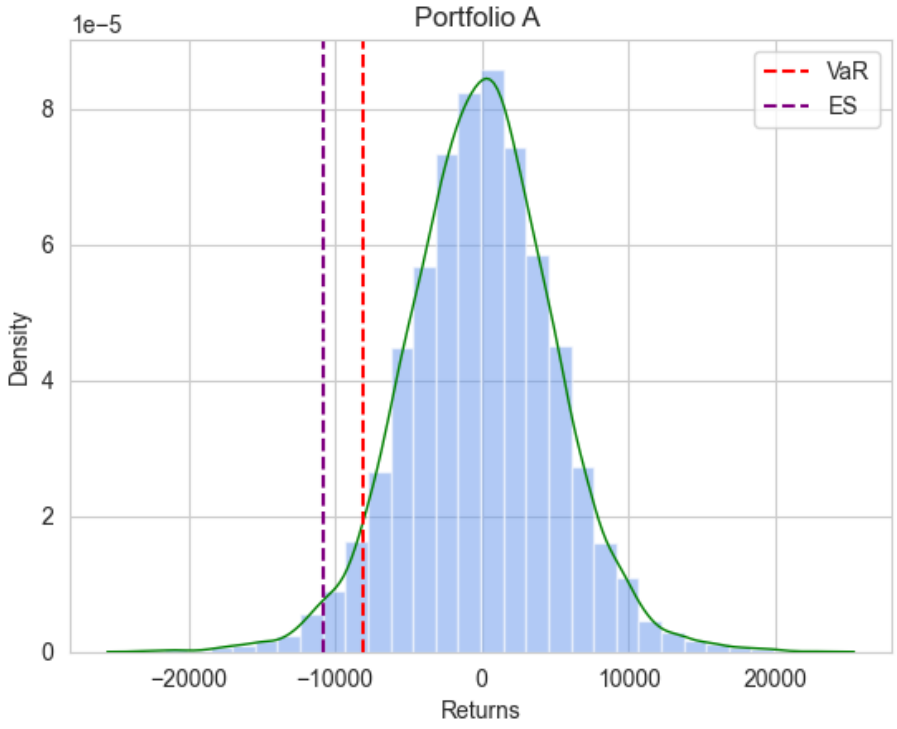
Problem 2

I wrapped up my functions as class into separate py files under a folder named QuantPackage

Here is the structure of my Package
-QuantPackage
- __pycache__
- covariance.py
- es.py
- npsd_fix.py
- simulations.py
- setup.py

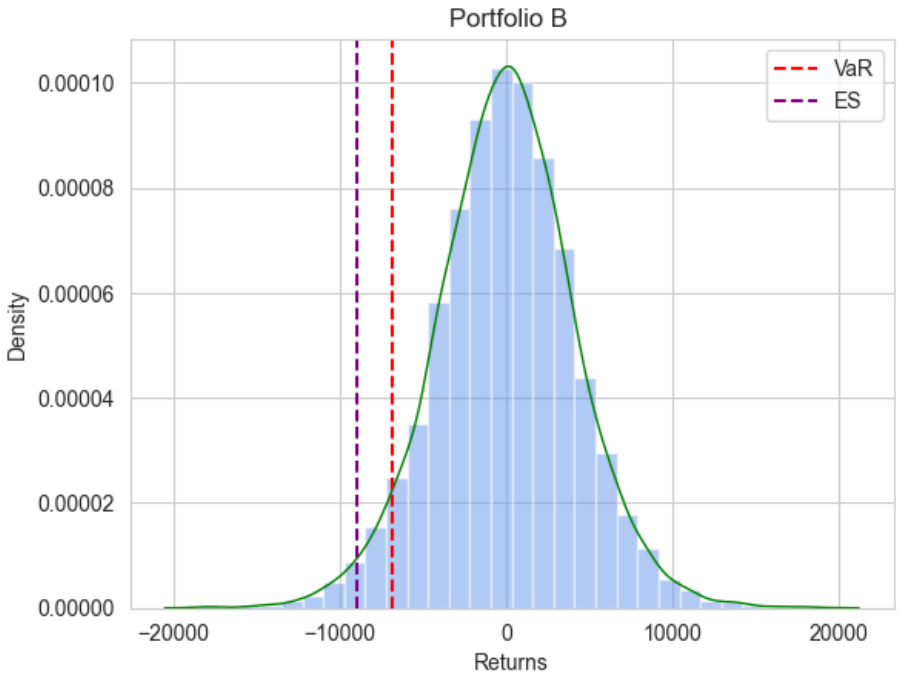
And I build test suits by making a simple dataset, and fit them into the model, if pass, it will return “Test Passed”, I must admit that not all of the tests passed, may be it due to the testcases, and I will fix then later.

Problem 3



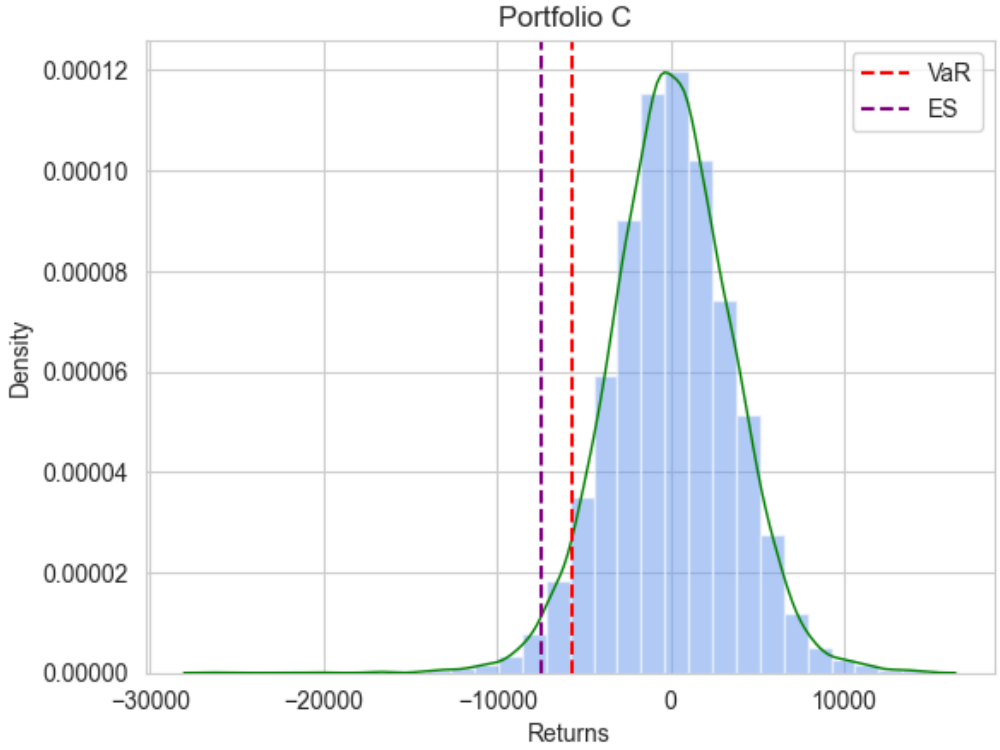
VaR: 8105.924534511023

ES: 10276.340604003083



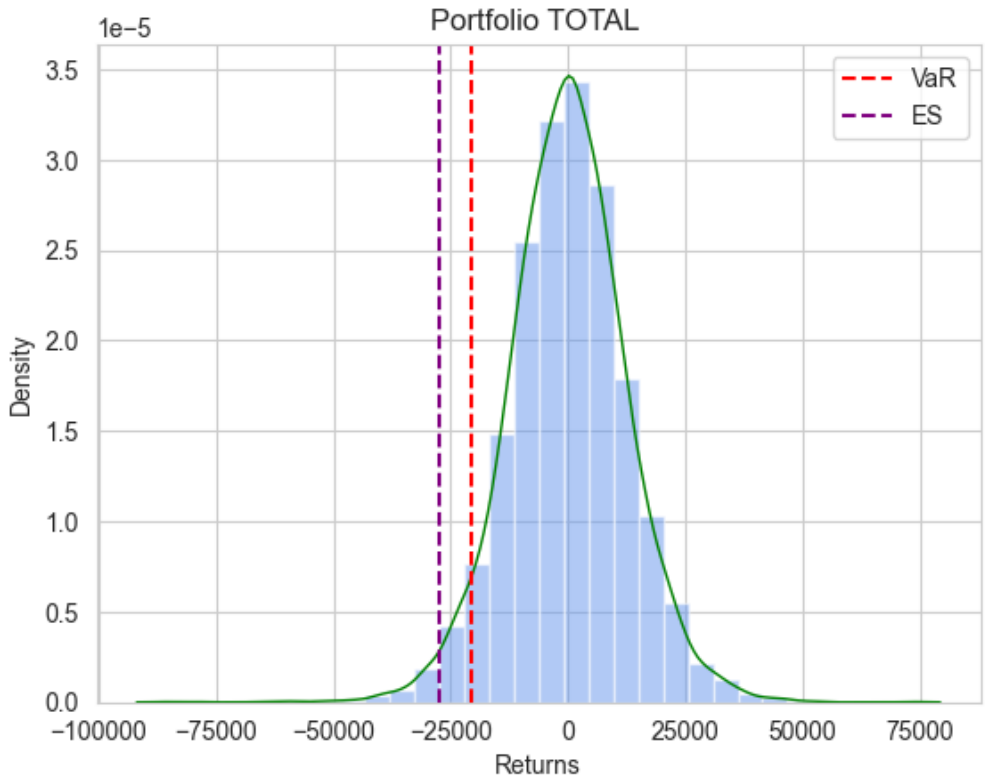
VaR: 6383.78207834358

ES: 8932.161243857



VaR: 5346.392843538192

ES: 7583.380142346217



VaR: 21560.828675779

ES: 24341.6748632365

I did the last week simulations again since I was wrong last week, and I found that the results from T distribution are little lower but close than the Vars calculated by Historical distribution, but larger than Monte Carlo and Normal simulation. According to the analysis from question1, we know that T distribution include more extreme events, which means it cover more values from first and last quantiles. In the contrast, normal distribution is more conservative and include more “normal days” data, the same as Monte Carlo. That’s why T distribution is very close to Historical distribution, which includes real “bad days”.