Problem 1

For the first problem, we use the data called problem1.csv, and fit a normal distribution and a generalized T distribution to the data respectively. The VaR and Expected Shortfalls (ES) are calculated for each fitted distribution. And we draw the results in the same graph and observe the pattern.

The VaR value for the normal distribution is about 0.0855, and the Expected Shortfalls (ES) is about 0.1046. And the VaR value for the T distribution is about 0.0825, and the Expected Shortfalls (ES) is about 0.1188. We could find that the VaR values are quite close, and the ES value for normal distribution is slightly lower than that of the t distribution. Here we discuss the reasons:

The normal distribution is symmetric and has lighter tails compared to the t-distribution. Lighter tails imply that extreme events (both high and low) are less likely to occur in a normal distribution compared to the t-distribution. VaR, being a measure of risk at a specific probability level, is affected by (but not determined by) the tails of the distribution. In a normal distribution, the tails are not heavy enough to capture extreme events effectively. Hence, VaR might underestimate the actual risk in situations where extreme events occur more frequently. The t-distribution has heavier tails compared to the normal distribution, making it more robust in capturing extreme events. Heavier tails imply that extreme events (both high and low) are more likely to occur in a t-distribution compared to a normal distribution. VaR for a t-distribution would be higher than that for a normal distribution at the same probability level because it needs to cover these more likely extreme events. On the other hand, ES measures the average loss beyond VaR. Due to the heavier tails of the t-distribution, the losses beyond VaR tend to be higher on average. This results in a higher ES for the t-distribution compared to the normal distribution.

In a word, the t-distribution, with its heavier tails, may provide a more conservative estimate of risk, especially in situations where extreme events are more likely. VaR and ES values reflect this difference in capturing extreme events, leading to slightly higher VaR for the normal distribution and higher ES for the t-distribution in the given context.

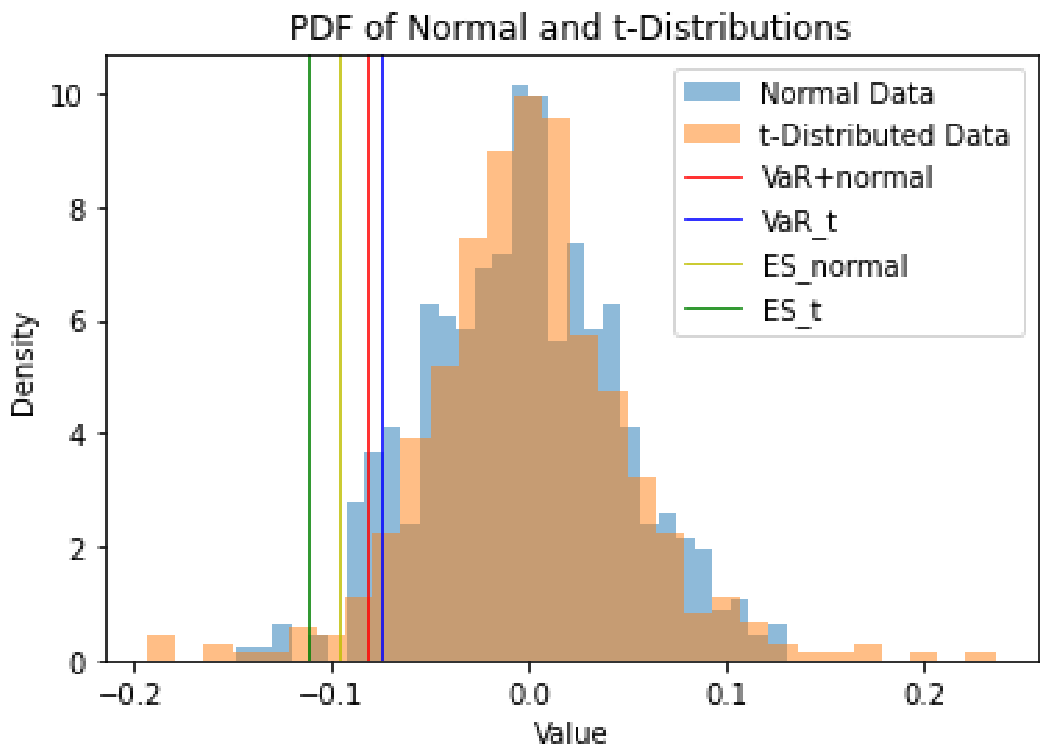
```
print(VaR1)
print(ES1)
[2]  ✓ 0.2s

0.08550668683206059
0.10463409477296971
```

```
27  print(VaR2)
28  print(ES2)
```

```
✓ 0.0s

0.08252804614788416
0.11876912544006334
```



Problem 2

See in the codes in GitHub. We firstly generate the code for each simulation or calculation, and then generate a suitcase to test the code.

Problem 3

For Asset A:

```
32
[14] ✓ 1.4s

... VaR:  21060.107433205387
    ES:  28279.714487442863
```

For Asset B:

```
[16]  ✓  1.4s

...   VaR:  12042.618933706053
      ES:  16132.638858042772
```

For Asset C:

```
      32
[17]  ✓  1.5s

...   VaR:  26476.66385351571
      ES:  35311.08349690529
```

For All Assets:

```
      VaR:  59311.71437211522
      ES:  77699.57729189718
```

And here is the results from last week:

```
✓ 0.4s

The current value for A is: 1089316.16
VaR for A with Weighted Covirance is: 15426.97
VaR for A with Historic Simulation is: 17933.41

The current value for B is: 574542.41
VaR for B with Weighted Covirance is: 8082.57
VaR for B with Historic Simulation is: 10983.46

The current value for C is: 1387409.51
VaR for C with Weighted Covirance is: 18163.29
VaR for C with Historic Simulation is: 23083.95

The current value for All is: 3051268.07
VaR for All with Weighted Covirance is: 38941.38
VaR for All with Historic Simulation is: 48481.10
```

Comparing the results for each assets, we could find that the VaR values for each asset and all assets are much larger if we use the t models.
The T model assumes that asset returns follow a Student's t-distribution, which allows for heavier tails compared to a normal distribution. The presence of heavier tails in the t-

distribution leads to higher VaR estimates compared to a normal distribution, especially for extreme events. The weighted covariance approach often assumes a normal distribution of returns. If the returns are not normally distributed or have heavy tails, this approach may underestimate the risk, especially in extreme market conditions. And historical simulation uses past data to estimate VaR. It does not assume a specific distribution and directly uses historical returns to estimate the quantiles. However, it may not capture extreme events that have not occurred in the historical data