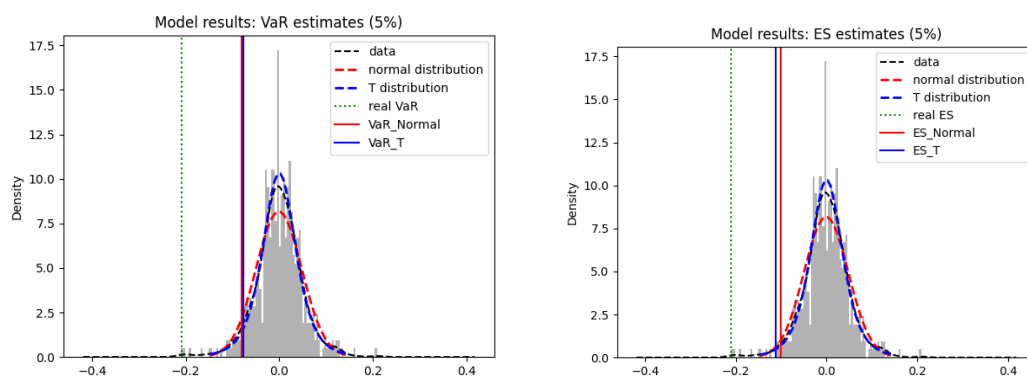


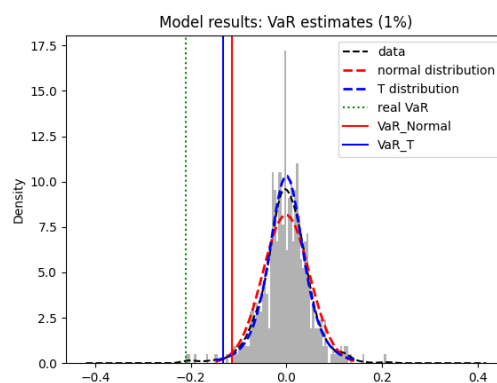
## Problem 1

Fitted the data into normal and t distributions respectively. Use the normal distribution to calculate parametric VaR and ES values, and simulated the t distribution with fitted parameters to get estimated VaR and ES.

Plot the distributions and model results of VaR and ES values together.



It can be observed that the both distribution assumptions result in underestimating both VaR and ES comparing to empirical data. The T distribution is designed to better capture the “fat-tail” characteristic of financial data, but it is showing a smaller VaR than assuming normal distribution. This is caused by the excess kurtosis of T distribution, which makes the “tail” starts earlier and shows a smaller absolute value of VaR when taking 5% percentile. In fact, when considering 1%VaR, T distribution will show larger estimation of risk.



## Problem 2

Created “RiskMgmt” package. Including modules:

covEstimate, expWeighted, getES, getPSD, getVaR, Simulations

### Problem 3

Utilizing modules from problem2, simulate and estimate VaR and ES for portfolios.  
Results:

```
matrix IS PSD
distance between simulated returns and real returns (correlation(spearman) matrices): 78.79364725415387
distance between simulated returns and real returns (covariance matrices): 0.007180336712729331
Portfolio A VaR: -5386.526080461312
Portfolio A ES: -7225.680802651127
Portfolio B VaR: -3986.23695250538
Portfolio B ES: -5452.5602915500085
Portfolio C VaR: -3210.0384071727485
Portfolio C ES: -4397.293480524482
Portfolio total VaR: -12582.801440139441
Portfolio total ES: -17075.534574725618
```

Comparing with results from last week:

```
----Portfolio 1----
VaR[Return] 1.65%
VaR[portfolio Value]: (a loss of) $ 5853.61689664975

----Portfolio 2----
VaR[Return] 1.46%
VaR[portfolio Value]: (a loss of) $ 4668.638078005463

----Portfolio 3----
VaR[Return] 1.10%
VaR[portfolio Value]: (a loss of) $ 3300.227646298663

----Total----
VaR[Return] 1.38%
VaR[portfolio Value]: (a loss of) $ 13469.51153658128
```