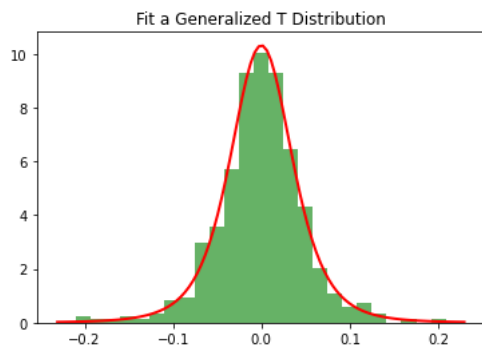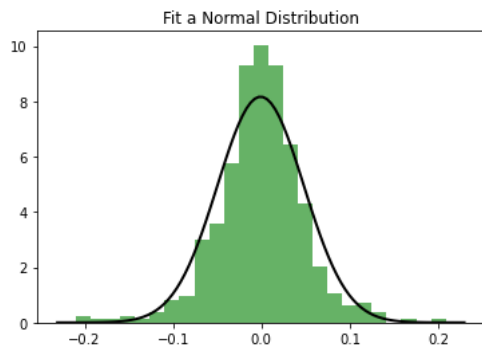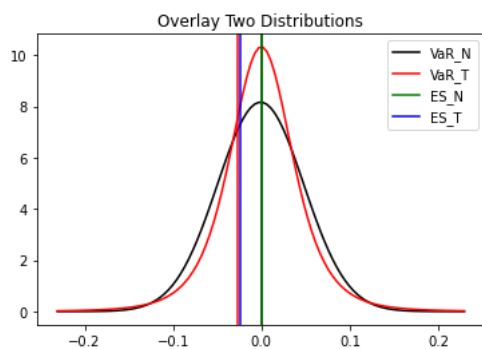# Week 05

Kunyu Liu

## Problem 1

Fit a Normal Distribution:





```
VaR of fitted Normal Distribution is -0.000307
ES of fitted Normal Distribution is -0.000186
VaR of fitted T Distribution is -0.03
ES of fitted T Distribution is -0.02
```



The expected shortfall and VaR for normal distribution is close to 0, while

other two values are significant smaller than 0. The t distribution is a much better model of stock (and other asset) returns than the normal model.

Compare VaRα and ESα by considering their ratio as α → 0.

In the case of the normal distribution

Esα / VaRα → 1 as α → 0.

However, in the case of the t distribution with ν > 1 dof we have

Esα / VaRα→ ν / ν − 1 > 1 as α → 0.

## Problem 2

test:

1. Covariance estimation techniques.

   Covariance matrix for DailyReturn.csv

```
            AAPL        MSFT        AMZN    ...            GM           TFC          TJX
AAPL     0.000058    0.000088    0.000158  ...    1.352818e-05 -0.000032 -1.588678e-05
MSFT     0.000088    0.000140    0.000260  ...    1.329909e-05 -0.000063 -2.014420e-05
AMZN     0.000158    0.000260    0.000626  ...   -2.969253e-05 -0.000227  2.543016e-05
TSLA     0.000099    0.000161    0.000312  ...    1.576838e-05 -0.000088 -6.350284e-07
GOOGL    0.000273    0.000420    0.000936  ...   -7.913438e-07 -0.000311 -1.184947e-05
...         ...         ...         ...    ...            ...          ...          ...
LMT      0.000024    0.000035    0.000042  ...    1.224781e-05 -0.000002 -2.737007e-05
SYK     -0.000040   -0.000029    0.000055  ...   -3.957780e-05 -0.000086  9.335525e-05
GM       0.000014    0.000013   -0.000030  ...    4.310161e-05  0.000043 -1.745585e-05
TFC     -0.000032   -0.000063   -0.000227  ...    4.284140e-05  0.000150 -4.091695e-05
TJX     -0.000016   -0.000020    0.000025  ...   -1.745585e-05 -0.000041  7.176188e-05

[100 rows x 100 columns]
```

2. Non PSD fixes for correlation matrices

```
n=500
Distance near_psd() = 94969370.39
Distance higham_nearPSD() = 0.07
```

3. Simulation Methods

```
Simulating with 59 PC Factors: 100%  total variance explained
Norms 1 is 0.00028
```

4. VaR calculation methods (all discussed)

```
VaR is -1.88 using normal distribution
VaR is -1.46 using normal distribution with Exponentially Weighted variance
VaR is -1.50 using MLE T distribution
VaR is -1.12 using historical data
```

5. ES calculation

```
ES of fitted Normal Distribution is -0.000186
```

# Problem 3

```
          VaR          ES
A      0.014495  0.026720
B      0.012328  0.027053
C      0.009838  0.018531
Total  0.011814  0.023766
```

The results are different. Generally, the expected shortfall of the portfolios is greater than that of value at risk. 4. VaR is not a sub-additive risk measure so that it doesn't lend itself to aggregation.

The tail risk of expected shortfall is less significant than that of VaR. This is because VaR completely disregards any loss beyond the confidence level while expected shortfall takes this into account as a conditional expectation.