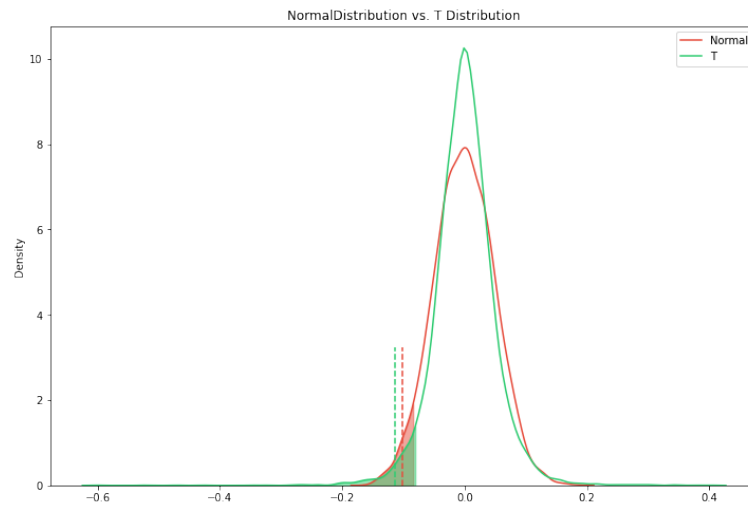# Fintech545 Homework 4

qw112 Qiyu Wu

Question 1. Normal and a Generalized T Distribution

For the problem, I use MLE to fit a normal Distribution and a generalized t distribution.

	VaR	ES
Normal Distribution	0.0822	0.1022
T Distribution	0.0763	0.1142

NormalDistribution vs. T Distribution

- **Expected Shortfall:** From the above graph, we can see that the T distribution has a fat tail, which contributes the increase of Expected shortfall. This is because Expected shortfall is the expectation over the whole left tail area.

- **VaR:** From the table, we can find that T distribution has a lower VaR value. It is because the T distribution has a lower sigma than normal distribution here, which lead that the distances of these two distributions are different.

Question 2. Library: QuantRisk

I have create a library for my previous functions used in the homework. All the functions have been tested by using test suite. For files named mill and ts_sim, they has been proved based on the previous homework.

Question 3. Portfolio Fitting with T Distribution

VaR($)	Portfolio A	Portfolio B	Portfolio C	Total
Normal VaR	5618.944064	4382.329498	3754.823054	13486.8134
T VaR	7321.87367	6083.282769	4213.866454	17316.648493
T ES	9697.83096	8192.52733	5858.4264	23507.5362

- From the above table, we can find that Normal VaR has the lowest estimation about risk. It is because that normal distribution has the more narrow tail than t distribution;

- When compared to Expected Shortfall, VaR generally is smaller than it. It is because of the fat tail of T distribution, which contributes to the higher estimation of risk level.