Problem1:

Refer to the library directory.

Problem 2:

VaR and ES Calculations

1. **Normal Distribution with EWMA**:
    - **VaR**: 0.09098489734646759
    - **ES**: 0.11409873193041514

The Normal distribution with EWMA considers the volatility clustering commonly observed in financial time series by giving more weight to recent observations. This method assumes returns follow a normal distribution, which might not fully capture the fat-tailed nature of financial returns. However, the use of EWMA helps to adjust for changing market volatility. The ES is higher than the VaR, indicating that when losses exceed the VaR threshold, they are expected to be on average significantly high, which is captured by the ES measure.

2. **MLE Fitted T-distribution**:
    - **VaR**: 0.07647602684516214
    - **ES**: 0.11303045721321459

The T-distribution is used to model data with heavier tails than the Normal distribution, which is more representative of financial returns that can experience extreme changes. The MLE fitted T-distribution provides a more conservative estimate of VaR compared to the Normal distribution with EWMA, as seen in the lower VaR value. This suggests that the T-distribution, by accommodating outliers better, potentially offers a more accurate reflection of the risk of extreme losses. The ES value is slightly lower than that of the Normal distribution with EWMA, reflecting the distribution's ability to better capture tail risk, thus providing a slightly more optimistic expectation of the average loss in the worst scenarios.

3. **Historic Simulation**:
    - **VaR**: 0.07598069069686238
    - **ES**: 0.11677669788562187

Historic Simulation does not assume any specific distribution for the returns. This approach fully captures the empirical distribution of the returns, including any skewness or kurtosis. The VaR and ES values from the Historic Simulation are very close to those calculated with the T-distribution, which suggests that the empirical distribution of your data might closely resemble a T-distribution. The ES here is slightly higher than with the other methods, indicating that based on historical data, the expected loss in the worst-case scenarios can be a bit more severe.

ES is generally higher than VaR across all methods, indicating it accounts for the tail risk beyond the VaR threshold. ES considers the severity of losses in the tail, while VaR only indicates the threshold that losses are not expected to exceed.

Problem 3:

Here are the results from calculation:

The VaR of Portfolio A is: 8052.424068

The VaR of Portfolio B is: 6969.116289

The VaR of Portfolio C is: 5958.707202

The ES of Portfolio A is: 10620.850757

The ES of Portfolio B is: 9260.002818

The ES of Portfolio C is: 7537.643205

The total Value at Risk (VaR) for portfolios A, B, and C combined is $20,980.25, and the total Expected Shortfall (ES) is $27,418.50.

The VaR of Portfolio A decreased from last week's EWMA method ($15,426.97 to $8,052.42) and from the historical simulation ($18,320.26 to $8,052.42).

The VaR of Portfolio B decreased from last week's EWMA method ($8,082.57 to $6,969.12) and from the historical simulation ($11,340.17 to $6,969.12).

The VaR of Portfolio C decreased from last week's EWMA method ($18,163.29 to $5,958.71) and from the historical simulation ($23,807.76 to $5,958.71).

The total VaR calculated this week ($20,980.25) is significantly lower than both methods used the previous week ($38,941.38 using EWMA and $51,701.83 using historical simulation).

This decrease could be due to several factors such as changes in market conditions, different risk modeling techniques, or adjustments in portfolio compositions.