**Prob1:**

After testing all cases in data, we can have these results:

1.1Arrays are approximately equal: True

1.2Arrays are approximately equal: True

1.3Arrays are approximately equal: True

1.4Arrays are approximately equal: True

2.1Arrays are approximately equal: True

2.2Arrays are approximately equal: True

2.3Arrays are approximately equal: True

3.1Arrays are approximately equal: True

3.2Arrays are approximately equal: True

3.3Arrays are approximately equal: True

3.4Arrays are approximately equal: True

4.1Arrays are approximately equal: True

5.1Arrays are approximately equal: True

5.2Arrays are approximately equal: True

5.3Arrays are approximately equal: True

5.4Arrays are approximately equal: True

5.5Arrays are approximately equal: True

7.1mu is approximately equal: True

7.1sigma is approximately equal: True

7.2mu is approximately equal: True

7.2sigma is approximately equal: True

7.2nu is approximately equal: True

mu sigma nu Alpha B1 B2 B3

0 2.257214e-08 0.048548 4.598387 0.042634 0.974887 2.041193 3.154802

mu sigma nu Alpha B1 B2 B3

0 0.0 0.048548 4.598293 0.042634 0.974889 2.041192 3.154801

8.1VaR\_absolute is approximately equal: True

8.1VaR\_diff\_from\_mean is approximately equal: True

8.2VaR\_absolute is approximately equal: True

8.2VaR\_diff\_from\_mean is approximately equal: True

8.4ES\_absolute is approximately equal: True

8.4ES\_diff\_from\_mean is approximately equal: True

8.5ES\_absolute is approximately equal: True

8.5ES\_diff\_from\_mean is approximately equal: True

Stock VaR95 ES95 VaR95\_Pct ES95\_Pct

0 A 94.314357 117.854494 0.047157 0.058927

1 B 108.31591 152.252229 0.036105 0.050751

2 Total 152.856258 200.801152 0.030571 0.04016

Stock VaR95 ES95 VaR95\_Pct ES95\_Pct

0 A 94.460376 118.289371 0.047230 0.059145

1 B 107.880427 151.218174 0.035960 0.050406

2 Total 152.565684 199.704532 0.030513 0.039941

**Prob2:**

a. Using a normal distribution with an exponentially weighted variance (lambda=0.97);

b. Using a MLE fitted T distribution

c. Using a Historic Simulation

I have set the alpha as 0.05

For a:

VaR absolute: 0.09116934

VaR relative: 0.09028951

ES absolute: 0.1141065222243895

ES relative: 0.11322669273469874

For b:

VaR absolute: 0.07647602684516216

VaR relative: 0.07638230431847998

ES absolute: 0.11321790139118343

ES relative: 0.11312417886418621

For c:

VaR absolute: 0.078245

VaR relative: 0.077067

ES absolute: 0.116337

ES relative: 0.115159

For method a, it is more affected by the recent observations rather than the older ones because it is calculated by assuming a normal distribution with an exponentially weighed variance. The difference between VaR and ES can be due to different tail sensitivity because ES is more sensitive to tail risk while VaR will ignore some tail events.

For method b, which uses MLE fitted T distribution, it has larger tails than normal distribution, which means that it will perform better in capturing extreme events. The difference between VaR and ES can be the difference of the shape of fails and the degree of freedom.

For method c, the difference between VaR and ES can be due to that VaR gives a cutoff point and ignores the losses beyond the threshold, which provides no insight into the extreme losses beyond this point, while ES captures the average of the tail losses and thus accounts for the severity of losses beyond VaR.

**Prob3:**

For last assignment’s data:

Delta Normal VaR method:

A: 19466.5044

B: 11504.0442

C: 26815.5607

Total: 52931.1706

Historical VaR method:

A: 17404.9077

B: 11485.4864

C: 21225.4686

Total: 46410.0203

Then using problem 1’s management library fit generalized T models to stocks in portfolios A and B and fit a normal distributions to stocks in portfolio C. Calculate the VaR and ES of each portfolio as well as total VaR and ES, using a copula:

For portfolio a:

VaR\_95: 4882.921791

ES\_95: 6680.561868

VaR\_95\_Pct: 0.0129

ES\_95\_Pct: 0.017649

For portfolio b:

VaR\_95: 4026.901598

ES\_95: 5689.493577

VaR\_95\_Pct: 0.010543

ES\_95\_Pct: 0.014896

For portfolio c:

VaR\_95: 3575.631472

ES\_95: 4542.796752

VaR\_95\_Pct: 0.011749

ES\_95\_Pct: 0.014927

Total:

VaR\_95: 11894.829191

ES\_95: 15997.311604

VaR\_95\_Pct: 0.011171

ES\_95\_Pct: 0.015024

After comparing the results between the last assignment and this assignment, we can find that the data are greatly different. This can be due to different distribution assumptions. For this assignment, we have used generalized T models for portfolio A and B, and normal distribution for portfolio C, while last assignment we have used only Delta Normal VaR method or historical VaR method. The different method will have different tail sensitivity which means they have different performance on capturing the extreme event. Moreover, for this assignment, we have used copula modeling for dependency between stocks in portfolio A and B while last week’s assignment does not have dependency between stocks. Therefore, based on these differences, the results can be various greatly. Therefore, we should pick suitable method when we facing different cases of portfolios.