Week05_Report
Question 1

```
● (venv) (base) qianduoduo@qianduoduodeMBP week07_545w5 % python -m unittest test_library.py

test 2.3 passed: two results are identical
.test 6.1 passed: two results are identical
.test 1.2 passed: two results are identical
.test 1.4 passed: two results are identical
.test 1.3 passed: two results are identical
.test 6.2 passed: two results are identical
.test 8.4 passed: two results are identical
.test 8.6 passed: two results are identical
.test 8.5 passed: two results are identical
.test 8.3 passed: two results are identical
.test 8.1 passed: two results are identical
.test 8.2 passed: two results are identical
.test 4.1 passed: two results are identical
.test 1.1 passed: two results are identical
.test 2.2 passed: two results are identical
.test 2.1 passed: two results are identical
.test 7.1 passed: two results are identical
.test 7.3 passed: two results are identical
.test 7.2 passed: two results are identical
.test 3.3 passed: two results are identical
.test 3.4 passed: two results are identical
.test 3.2 passed: two results are identical
.test 3.1 passed: two results are identical
.test 5.5 passed: two results are identical
.test 9.1 passed: two results are identical
.test 5.4 passed: two results are identical
.test 5.3 passed: two results are identical
.test 5.1 passed: two results are identical
.test 5.2 passed: two results are identical
.
----------------------------------------------------------------------
Ran 29 tests in 1.982s

OK
```

I created unit test cases for each test to compare my output with the given output. As a result, my outputs are highly similar or same to the given outputs.

Question 2

	Method	VaR	ES
0	EWMA	0.085770	0.108439
1	T Distribution	0.076476	0.113218
2	Historical	0.075981	0.116777

Compared with VaR and Expected Shortfall (ES) under different distributions, I found that ES is always larger than VaR since ES calculates the average loss beyond VaR, which will have worst-case scenarios. These extreme loss values might make ES larger than VaR.

Question 3

```
portfolio_returns_removed              Date         A         B         C      Total
0  2/15/2022 0:00   0.018803   0.016387   0.011905   0.015826
1  2/16/2022 0:00  -0.002466   0.001568  -0.000049  -0.000352
2  2/17/2022 0:00  -0.026313  -0.016225  -0.015631  -0.019570
3  2/18/2022 0:00  -0.009170  -0.006541  -0.003946  -0.006634
4  2/22/2022 0:00  -0.008427  -0.010623  -0.008892  -0.009309

   Portfolio          VaR95            ES95   VaR95_Pct   ES95_Pct
0          A    8084.881097   10334.968865    0.026070   0.033326
1          B    6360.970714    8259.949618    0.021469   0.027879
2          C    5723.527095    7097.286597    0.020521   0.025446
3      Total   22720.814310   29859.133374    0.025664   0.033727
```

I firstly calculated arithmetic returns and removed the mean for the three portfolios from DailyPrices.csv. Then, I fitted t distribution for the returns of portfolio A and B and normal distribution for the returns of portfolio C to calculate their VaR and ES. I also calculated total VaR and ES by simulating joint returns using the copula. The

simulation is 10000 and alpha is 0.05. Compared results with the one from week 4, they are similar at some extend in values.