FINTECH 545 FINAL

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Problem1

#a

This is the log return. I dropped all nan values.

Price1 Price2 Price3

Date

2023-04-13 0.018993 0.003195 -0.000451

2023-04-14 0.002168 0.007144 0.002393

2023-04-15 -0.006809 -0.002536 -0.000854

2023-04-16 -0.003761 -0.004983 -0.002282

2023-04-19 -0.001601 -0.005461 -0.001421

2023-04-20 0.002864 0.000578 0.001313

2023-04-21 -0.001993 0.003972 -0.000706

2023-04-24 0.003410 0.005293 -0.000427

2023-04-25 0.006229 0.003376 0.000830

2023-04-26 -0.006950 -0.005061 -0.000667

2023-04-27 0.009240 0.004083 0.001317

2023-04-28 0.008836 -0.002461 -0.000957

#b

Pairwise Covariance Matrix:

[[0.09000000000000001, 0.11616778283337, 0.01289133815358598], [0.11616778283337, 0.09000000000000001, 0.015150806409572592], [0.01289133815358598, 0.015150806409572592, 0.09]

#c

It is not PSD.

#d

Fixed Matrix:

[[0.09 0.08998502 0.01228759]

[0.08998502 0.09 0.01391191]

[0.01228759 0.01391191 0.09 ]]

Problem 2

#a

The call price is: 6.801866322511721

#b

The delta of the call is: 0.5084801613020203

#c

The gamma of the call is: 0.023104378660025782

#d

The vega of the call option is: 28.309901459443246

#e

Rho of the call option is: -3.6872810452777642

#f

VaR at 5% is: 60.461567591870654

#g

ES at 5% is: 79.06241228618667

#h

This is similar to a covered call

Problem 3

#a

[0.37140965 0.34794704 0.2806433 ]

#b

[0.352 0.3394 0.3086]

#c

As we can see, the maximum Sharpe ratio portfolio is [0.37, 0.35, 0.28], and the risk parity portfolio is [0.35, 0.34, 0.31]. There is difference but the difference is small. Also, their ER, SDand SR is similar too. This is because the correlation matrixes are equal, so the risk parity portfolio is the max Sharpe ratio portfolio. The little difference is perhaps because of digital accuracy.

This is the correlation matrix I am talking about:

[[1. 0.88 0.88]

[0.88 1. 0.88]

[0.88 0.88 1. ]]

These are ER, SD, SR values:

ER Optimal: 0.14115218197083818

SD Optimal: 0.18035036046673555

SR Optimal: 0.5331410578942137

ER RP: 0.14148229019665012

SD RP: 0.18095388639326654

SR RP: 0.5331871678454336

Problem 4

#a

new weights for each period:

[[0.43226518 0.15549249 0.41224233]

[0.44480495 0.15171745 0.4034776 ]

[0.45716808 0.16549373 0.37733819]

[0.46624717 0.16555259 0.36820024]

[0.47921907 0.15739076 0.36339018]

[0.46930371 0.16718065 0.36351564]

[0.46969817 0.16270907 0.36759276]

[0.42953883 0.17382824 0.39663293]

[0.4201786 0.16851823 0.41130318]

[0.40786885 0.16518321 0.42694794]

[0.43319934 0.16759738 0.39920328]

[0.41514963 0.15558505 0.42926532]

[0.44915144 0.15009118 0.40075737]

[0.45214956 0.15247169 0.39537876]

[0.44972802 0.16321312 0.38705886]

[0.43479535 0.15645844 0.40874621]

[0.42310482 0.17341374 0.40348145]

[0.4336153 0.17309293 0.39329177]

[0.45661383 0.17155924 0.37182694]

[0.43953408 0.16967044 0.39079548]]

#b

Asset1 Asset2 Asset3 Portfolio Value

1 -0.012221 0.024968 -0.035901 -0.023153 Return Attribution

#c

2 0.012564 0.000161 0.021275 0.033999 Vol Attribution

Problem5

#a

Price1:

VaR: 0.04891275687040775

ES: 0.10489991622767447

Price2:

VaR: 0.09871574198213295

ES: 0.19094033270882227

Price3:

VaR: 0.09403475703427944

ES: 0.1933242642515971

Price4:

VaR: 0.07867808610927796

ES: 0.14823893554428932

#b

Price1 and Price2:

VaR: 0.1265274558131182

ES: 0.2515723412821313

Price3 and Price4:

VaR: 0.14317437418844747

ES: 0.27835547661766824

#c

Price1, Price2, Price3 and Price4:

VaR: 0.2228997256864318

ES: 0.402755071498205