# Final FinTect 545

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1. (5 pts) Explain the difference in thinking between data modeling for risk analysis vs data modeling for forecasting.

Data modeling for forecasting is focused on the future, and the goal is to predict future values. The model uses the expected future value. Modeling for risk analysis is focused predicting the distribution of future values. This encompasses not just the expected value, but also the variance, skewness, kurtosis, and other moments of the distribution. The goal is to understand the potential outcomes and their likelihoods, especially the magnitude of and likelihood of downside events.

1. (5pts) Using problem2.csv
   1. Calculate the Mean, Variance, Skewness and Kurtosis of the data (2)

Mean: 0.04558

Variance: 0.01304

Skewness: 0.19654

Kurtosis: 1.05955

* 1. Given a choice between a normal distribution and a t-distribution, which one would you choose to model the data and why based on part a alone (1)?

Given the kurtosis is greater than 1, I would choose the t-distribution.

* 1. Fit both distributions and prove or disprove your choice in b. (2)

Normal AICC: -1498.9943166561643

T AICC: -1516.628955621469

T-Distribution is better

1. Using problem3.csv
   1. Calculate the pairwise covariance matrix of the data. (1)

1.47048 1.45421 0.877269 1.90323 1.44436

1.45421 1.25208 0.539548 1.62192 1.23788

0.877269 0.539548 1.27242 1.17196 1.09191

1.90323 1.62192 1.17196 1.81447 1.58973

1.44436 1.23788 1.09191 1.58973 1.39619

* 1. Is the matrix at least positive semi-definite? Why? (2)

Min(eigvals(c)) = -0.09482978874911373

The matrix is not positive semi-definite as the smallest eigenvalue is negative.

* 1. If not, find the nearest positive semi-definite matrix using Higham’s method as defined in the notes. (2)

1.47048 1.33236 0.884378 1.6276 1.39956

1.33236 1.25208 0.619028 1.4506 1.21445

0.884378 0.619028 1.27242 1.07685 1.05966

1.6276 1.4506 1.07685 1.81447 1.57793

1.39956 1.21445 1.05966 1.57793 1.39619

1. Using problem4.csv – Calculate the exponentially weighted covariance matrix with lambda = 0.94. Assume the data are normally distributed with 0 mean and this covariance.
   1. What are the risk parity portfolio weights using standard deviation as your risk measure? (3)

Portfolio weights are:

[0.08325194470526755, 0.08296831943674841, 0.2131321542254191, 0.42411305053917386, 0.1965345310933912]

* 1. What are the risk parity portfolio weights using expected shortfall as your risk measure? (2)

Portfolio weights are the same as part a. Multivariate normality is assumed and ES is a multiple of VaR in that case. This means the optimized values will not change.

1. You own a portfolio of 3 assets with the following starting weights (0.3, 0.2, 0.5). The returns of each asset for 30 days (after the starting weights are calculated) are in problem5.csv. You do not rebalance your portfolio during this 30 day period.
   1. Calculate the ex-post return contribution of each asset. (5)

|  |  |  |  |
| --- | --- | --- | --- |
| X1 | X2 | X3 | Total |
| 6.55125% | 0.221981% | 14.8831% | 8.10983% |

* 1. Calculate the ex-post risk contribution of each asset. (5)

|  |  |  |  |
| --- | --- | --- | --- |
| X1 | X2 | X3 | Total |
| -0.0620223% | 0.28271% | 1.25798% | 1.47867% |

1. A price time series for 2 assets for the past year are in problem6.csv.
   1. Assumptions
      1. Use arithmetic returns for your models
      2. Assume 0 mean returns for each asset going forward.
      3. The current risk free rate is 4.75%
      4. There are 252 trading days in a year.
      5. The current implied volatility of options is constant.
      6. Report VaR and a $ value and at the 5% level.
   2. Portfolio
      1. 100 Shares of stock A
      2. 100 American Put options on Stock A
         1. Strike = 100
         2. TTM = 1 year
         3. Implied Vol = 20%
         4. Dividend of 0.025 is paid 60 and 220 days from current.
      3. 50 Shares of stock B
      4. -50 (you are short) European Call Options on Stock B
         1. Strike=100
         2. Current Call Price = $6.50
         3. TTM = 100 days
         4. The stock does not pay dividends.
   3. Using a delta normal approach, calculate the 1 day VaR and ES of the portfolio (5)

VaR = $159

ES = $200

* 1. Using a Monte Carlo simulation and assuming multivariate normality, calculate the 1 day VaR and ES of the portfolio. (5)

VaR = $159

ES = $198

* 1. Using the best fit model for each asset (choose between a normal and a t-distribution), calculate VaR and ES for the portfolio. (5)

The normal model is the best fit for both distributions. The VaR and ES are the same as part d.

* 1. Compare and contrast the results of a, b, and C. Which would you choose to use and why? (5)

The models are all very close. This is because the long time to maturity of the options makes the gamma of the options small. The value function for those options is nearly linear in the underlying asset. Therefore the delta normal model is a good approximation. The two Monte Carlo models assume normallity, so the Delta Normal model, which assumes linear payoff functions and normallity is a good choice.

If the options had a shorter time to maturity, the gamma would be larger and the delta normal model would be less accurate. In that case, the Monte Carlo models would be the better choice.