FinTech 545 Final Project

Instructions:

This project should be completed on your own. You are welcome to discuss the problems with your classmates, but all work should be your own.

Be verbose. Clearly explain your reasoning, methods, and results in your written work. Write clear code that is well documented.

The final product should be a paper with all results and discussions. I will look at your code if questions arise and your code can earn you partial credit.

Project is due 4/19 at 8am in your repository. A pull will be done at that time. Documents and code checked in after the instructor's pull will not be graded.

Data for problems can be found in CSV files with this document in the class repository.

This project is worth 60 points.

Part 1:

You own the 3 portfolios in the file "initial_portfolio.csv." The risk free rate is in "rf.csv." Daily prices of the stocks are in "DailyPrices.csv."

You bought these portfolios at the end of 2023. Model the returns of stocks using CAPM with SPY as the market. Use the data up to the end of 2023 for the regression.

Your holding period on these portfolios is to the end of the price data.

Use you the fitted models to attribute the realized risk and return for each portfolio and the total portfolio for the holding period. Split the attribution between the systematic and idiosyncratic components. You should calculate the idiosyncratic contribution for each stock, but present the total in your output.

Discuss the results.

Part 2:

Use your fitted CAPM results from Part 1, assume 0 alpha, and the expected return of the SPY is the average prior to the holding period. Assume the average risk free rate prior to the holding period is the expected risk free rate for the holding period.

Create the optimal maximum Sharpe Ratio portfolio for each sub portfolio.

Rerun the attribution from Part 1 using the new optimal portfolios.

Discuss the results comparing back to Part 1.

Given the fitted CAPM you have an expectation of the idiosyncratic risk contribution for each stock. How does the model compare to the realized values?

Part 3:

Investigate the Normal Inverse Gaussian and the Skew Normal distributions. Explain how these distributions apply to finance, especially in relation to this class.

Part 4:

Implement the Normal Inverse Gaussian and Skew Normal distributions (you can use implemented distributions in your stats package if exist). Using the pre-holding period data, create a risk model fitting each stock to the Normal, Generalized T, Normal Inverse Gaussian, and the Skew Normal choosing the best fit for each stock.

Make the assumed return on each stock to be 0%

Report the best fit model for each stock and the parameters.

Calculate the 1 day VaR and ES for each portfolio and the total portfolio using a Gaussian Copula and the fitted models. Do the same assuming a multivariate normal.

Discuss the difference between the two approaches.

Part 5:

Using your best fit risk model, calculate a risk parity portfolio for each sub portfolio using ES as the risk metric.

Rerun the attribution from Part 1 using the new optimal portfolios and the previously fit CAPM beta.

Discuss the results comparing back to Part 1 and Part 2.