Finance 395 4 (Johnson) – Homework 1

Due Tuesday 9/23/2025 at 11:59pm

Instructions: Type up your solution clearly, using tables and graphs where appropriate.

In addition to showing your results, you must also explain and discuss your results in words, as you would in a paper. How do we interpret them? What can we learn about finance from them? If you just report results without any interpretation your grade will suffer.

Attach the code you use to your writeup as an Appendix.

This is an individual assignment. You are allowed to discuss informally with other students but your code and writeup must be done independently and should not be shared with other students prior to the deadline.

Problem 1

asdf the autocorrelation of US stock market indices, both value- and equal-weighted, using the tools described in Lecture 1. Demonstrate and correct for the small-sample bias by simulating random samples.

Problem 2

Using the daily returns of the value-weighted market index you downloaded for Problem 1, evaluate how well the past year of daily returns can forecast the next day's market index return using the following "machine learning" techniques:

1. LASSO
2. Ridge Regression
3. Elastic Net
4. Neural Network – don't go crazy here, one hidden layer is fine for this exercise

For the first three, include the past five days of realized returns individually but also the sum of past returns over the prior 10, 21, 42, 63, 84, 105, 126, ... 252 days. For the neural network, include all 252 lags independently.

Problem 3

Download data on the returns of the Fama French 25 Portfolios Formed on Size and Book-to-Market.

(A) Compute the maximum Sharpe Ratio portfolio (tangency portfolio) combining the four extreme portfolios (smallest and largest values of Size and Book-to-Market). Verifying that:

$$\mathbb{E}(r_i) = r_f + \beta_{i,\text{msr}} \left(E(r_{\text{msr}}) - r_f \right)$$

holds among the four extreme portfolios. Assess how well this asset pricing model works for the remaining 21 assets. You don't need a formal statistical test here, just an informal assessment of fit (does it line up well or poorly?)

(B) Compute the pricing portfolio's Sharpe Ratio. Would you expect this Sharpe Ratio to be attainable in practice? Why or why not?

(C) Compute the optimal portfolio formed among only the four extreme portfolios for an investor with log utility over portfolio returns. Comment on how this differs from the tangency portfolio.

(D) Find the portfolio weights for maximum Sharpe Ratio portfolio (tangency portfolio) among all portfolios using all 25 assets, and report its Sharpe Ratio.

Problem 4

This problem requires data from "Hw1p45.xlsx," available on the course website. Use the quarterly real return on the CRSP value-weighted index and Treasury Bills from this data set, along with the non-durables consumption data in the spreadsheet, to replicate the empirical test of the Hansen and Jagannathan (1991) bound.

(A) How do you interpret your findings?

(B) How do your results compare those in the original Hansen and Jagannathan (1991)?

(C) Say we added additional assets beyond the CRSP value weighted index and Treasury Bills. How would this change the Hansen Jagannathan (1991) bound?

Problem 5

This problem requires data from "Hw1p45.xlsx," available on the course website. Replicate Figure 4 of Mehra and Prescott (1985), using the non-durables consumption data in the spreadsheet to calculate the moments of λ. Add a point for the observed average (real) risk-free rate and average risk premium. Interpret your findings, and compare the results to those in the original Mehra and Prescot (1985) paper.