Mgmt 237E: Empirical Methods in Finance
Homework 8

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Please use Matlab/R to solve these problems. You can just hand in one set of solutions that has all the names of the contributing students on it in each group. The problem set is due on March 6 by 9:45 AM. Use the electronic drop box to submit your answers. Submit the Matlab or R file and the file with a short write-up of your answers separately.

[The quality of the write-up matters for your grade. Please imagine that you're writing a report for your boss at Goldman when drafting answers these questions. Try to be clear and precise.]

Problem 1: Market-timing and Sharpe ratios

Assume you have an estimate of expected annual excess market returns for each time t, called x_t. You estimate the regression

$$R^e_{t+1} = \alpha + \beta x_t + \varepsilon_{t+1},$$

and obtain $\hat{\alpha} = 0$, $\hat{\beta} = 1$, and $\sigma\left(\hat{\varepsilon}_{t+1}\right) = 15\%$. Further, the sample mean and standard deviation of x_t are both 5%.

1. Calculate the standard deviation of excess returns based on the information given.

2. Calculate the R^2 of the regression based on the information given.

3. Calculate the sample Sharpe ratio of excess market returns based on the information given.

4. Recall from investments that a myopic investors chooses a fraction of wealth

$$\alpha_t = \frac{E_t\left[R_{t+1}^e\right]}{\gamma\sigma_t^2\left[R_{t+1}^e\right]}$$

in the risky asset (the market) at each time t, where we assume risk aversion coefficient, γ, equals 40/9. Further, assume that the residuals ε_{t+1} are i.i.d., so $\sigma_t(\varepsilon_{t+1}) = 15\%$ for all t. Given this, calculate the weight the investor chooses to hold in the risky asset if $x_t = 0\%$ and if $x_t = 10\%$. What is conditional Sharpe ratio in each of these cases?

5. Assume T is large (i.e., $T \to \infty$) and that x_t is either 0% or 10% at each time t, with equal probability (0.5).

   (a) What is the unconditional average excess return for an investor that holds α_t each period?

   (b) What is the unconditional standard deviation? The following may be helpful for calculating the unconditional variance. You could also simulate a very long series to check your math.

$$\begin{aligned} Var\left(\alpha_t R_{t+1}^e\right) &= E\left[E_t\left[\left(\alpha_t R_{t+1}^e\right)^2\right]\right] - E\left[E_t\left[\alpha_t R_{t+1}^e\right]\right]^2 \\ &= E\left[\alpha_t^2 E_t\left[\left(R_{t+1}^e\right)^2\right]\right] - E\left[\alpha_t E_t\left[R_{t+1}^e\right]\right]^2 \\ &= E\left[\alpha_t^2\left(x_t^2 + \sigma_t^2\left(\varepsilon_{t+1}\right)\right)\right] - E\left[\alpha_t x_t\right]^2. \end{aligned}$$

   (c) Finally, what is the unconditional Sharpe ratio of this strategy?

Problem 2: VAR implementation

Use the data on quarterly excess stock market returns, the market Dividend / Price ratio, and the difference between the 10-yr Treasury yield and the Fed Funds rate in the excel spreadsheet "MktRet_DP_TermSpread.xlsx". The interest rate data is from the FRED data depository, available online from the St. Louis Fed.

1. Plot each series. Give the sample mean, standard deviation, and first order autocorrelation of each series. From the first-order autocorrelation, calculate the half-life of each series (see ARMA notes for exact half-life formula).

2. Estimate a VAR(1). Give the coefficient estimates, their White standard errors, and the R^2 from each regression.

3. Is the VAR stationary?

4. What is the volatility of quarterly expected returns given the return forecasting regression?

5. Plot the one-quarter ahead expected return series. Plot the four quarters ahead expected return series. Plot the twenty quarters ahead expected return series. Comment on how the persistence of the term spread and the DP-ratio affects the expected return forecasts at different horizons.

6. Plot the impulse-response function for returns from a one standard deviation positive shock from each of the three shocks in turn (as in Lecture 11b) using 20 lags.

7. Using 80% of the data as a training sample, report results from an out-of-sample test where you re-estimate the model at each time t (as in Lecture 11b).