Empirical Methods in Finance
Homework 4

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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. Use the electronic drop box to submit your answers. [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 be clear and precise.]

Problem 1: Risk Management using Value-at-Risk and GARCH models

Consider the daily prices for one share in a Deutsche Bank currency fund provided to you in the spreadsheet "Currency_fund_prices.xlsx". The maximum VaR over a 20-day trading period for currency trading was recently set at $100 million.

1. Specify and estimate a parsimonious model for the conditional volatility of the daily log returns on this currency position. You can abstract from variation in the conditional mean of returns. Carefully explain why you chose this model. Provide some evidence that this model is a good fit for the data.

2. Based on these estimates, develop a forecast for the 20-trading-day log return volatility on Jan 11, 2016 (end of day). Report the exact number and explain how you arrived at this number. You can assume daily returns (in levels) are independently distributed over time. (Hint: we assume the returns are uncorrelated across days. What then is the formula for 20-day log return volatility? It's the sum of each of the 20 individual days' expected variance.)

Problem 2: The Single Factor (Market) Model

Download the 48 industry portfolio data (monthly) from Kenneth French's web site. Use the data from 1960 through 2015.[1] Use the value-weighted returns. You may drop the industries that have missing values and are reported as -99.99. Also, download the 3 Fama-French factors from his web site. Use the monthly risk-free rate series provided by French in the same FF factor dataset to compute excess returns on these 48 portfolios.

1. For each industry, regress the industry excess return on the market excess return (the FF market factor) and an intercept.

   (a) Plot the industry betas in a bar plot with industry number on the x-axis. For each bar, convey the ± 2 standard error band of the beta. For instance, you can overlay lines using 'arrows' in R that give error bars (google "building barplots with error bars in R" for an example). The standard errors should be computed allowing for heteroskedastic and non-normal error terms.

   (b) What is the range of estimated betas? What are the min, max, and mean regression R^2 across industries?

   (c) Plot estimated alphas (intercept terms) against estimated betas. Is there a pattern? If so, can we guess at an example of a systemic failure of the CAPM?

2. Now, run rolling regressions of 5 years of data. That is, run first regressions using the data from 1960 through 1964, then from 1965 through 1969, etc. Note that the last year, 2015, will not be used. You should now have 11 market betas per industry. Compute *for each industry* the correlations of adjacent betas (i.e., the beta from 1960-64 vs the beta from 1965-69; the beta from 1965-69 vs. the beta from 1970-74; etc.). Plot these correlations (y-axis) with industry number on the x-axis. Are the betas stable – i.e., highly correlated over time? What are the potential reasons they are not the same across 5-year periods?

[1] Of course, you can always try earlier periods to check the robustness of the results.