**Final Exam, March 2016**

**MgtF 405 Forecasting**

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**Instructions: This is a take-home exam. You must complete all answers working on your own and may not consult with or discuss the exam with any other students or individuals. You have until noon on Monday, March 14 to complete the exam. Your answers should be submitted electronically to the Finals dropbox on Ted. Please submit a file with the answers along with any computer codes used in the analysis. For questions of clarification, please e-mail Leland Farmer at** [**lefarmer@ucsd.edu**](mailto:lefarmer@ucsd.edu) **.**

The final exam makes use of US bond returns data and various macro and financial variables in the **bond\_and\_factor\_data\_final.xlsx** file available in the Finals folder on Ted. Column B in the worksheet bonddata contains monthly excess returns on a two-year Treasury note (measured in excess of the one-month T-bill rate) over the period January 1962 – December 2011. This two-year bond excess return series is the dependent variable that you are trying to predict.

In addition to the bond return data, there are data on 132 macro variables in the macrodata worksheet and data on 147 financial variables in the worksheet financialdata. These are the data from which you can choose variables to forecast monthly bond excess returns. Definitions of the individual variables are contained in two pdf files in the finals folder on Ted.

Make sure to transform any of the predictor variables so they are stationary – you can check if the variables need to be first-differenced by plotting the series to see if they are trending and/or by using a unit root (ADF) test. Variables such as the dividend-price ratio, the price-earnings ratio and interest rates are traditionally kept in levels (i.e., no need to transform those variables).

**Make sure to interpret your findings throughout the analysis of the following questions.**

1. Estimate a range of autoregressive (AR) models with up to four lags for US bond excess returns using data from 1962m01 to 1999m12. Report which AR model you have chosen and explain your model choice. Assess how good your model is using diagnostics such as t-statistics for the AR coefficients and the R2 of the regression. Also, present graphical evidence showing how well your model fits US bond excess returns.

Deliverables: Model estimates and tests

Graphics

Explanation of choice of AR model

1. Next, using data up to 1999m12, estimate a multivariate bond return prediction model that selects from the list of predictors included in the “macrodata” and/or “financialdata” worksheets, possibly in addition to any AR terms from part (1). Your model should use a one-month forecast horizon. Make sure to lag any predictors. Explain if any of the predictor variables is significant and how you select your preferred prediction model. Provide statistical as well as graphical evidence on the model’s in-sample performance.

Deliverables: Model estimates and statistical evidence

Graphics (plots of forecasts)

Explanation of choice of multivariate model

1. Evaluate the multivariate bond return forecasting model in part (2) out-of-sample using data over the period 2000m01–2011m12 (the data sample excluded from the analysis in parts 1 and 2.) The parameters of the forecasting model should be updated recursively using only data that were available on the forecasting date and using an expanding or a rolling estimation window.

Deliverables: Out-of-sample measures of forecasting performance

Statistical tests of bias, efficiency (Mincer-Zarnowitz, etc.)

1. Does your preferred multivariate model from part (2) perform better out-of-sample (2000m01-2011m12) than the autoregressive model from part (1)?

Deliverables: Statistical tests of relative forecasting performance

Plot of evolution in models’ forecasting performance over time

1. Does a simple equal-weighted combination of univariate forecasts using a range of predictors from the worksheets in the data file produce better out-of-sample forecasts during 2000m01-2011m12 than your multivariate forecasts in part (3)?

Deliverables: Statistical tests of relative forecasting performance

1. Suppose you are interested in forecasting bond returns three months ahead. Explain how to construct a multivariate (VAR) forecasting model on monthly data, estimate its parameters and compare its multi-step-ahead performance out-of-sample (2000m01-2011m12) to 3-step-ahead chain-rule forecasts from the AR model from part (1).

Deliverables: Estimates from VAR model

Statistical tests of relative forecasting performance

1. Using the full data sample 1962m01-2011m12, extend your preferred model from part (2) to allow for time-varying volatility using a GARCH(1,1) specification. Do you find evidence that the variance of monthly bond excess returns is time-varying? Using density forecast evaluation tools, is the GARCH(1,1) model correctly specified?

Deliverables: Test for ARCH effects

Estimates from GARCH model

Density forecast evaluation results