Final Exam
Financial Econometrics, Econ 40357
University of Notre Dame
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Monday 16 November 2020

INSTRUCTIONS: 3 points extra credit if the entire exam is typed and submitted as a single pdf document. If you are using Microsoft Word, which is unfriendly to math and equations, use regular English letters instead of Greek. Also, replace subscripts with notation following these examples. Write the regression

$$r_{t,i} = \alpha_i + \beta_i r_{t,m} + \epsilon_{t,i}$$

as

$$r(t,i) = a(i) + b(i)r(t,m) + e(t,i)$$

Instead of $E_t(X_{t+1})$, the expectation of X_{t+1} conditional on information known at time t, write as $E(X(t+1)|I(t))$ or $E(t)[X(t+1)]$. The exam is not cumulative and covers material since the midterm.

A **review** of the **rules**: Test is open book, open note, open internet, but not open people. Any communication with other people is forbidden and will be considered cheating. **Don't be a cheater! Do not cheat!** Submit via email, a pdf of your own work by 10 p.m. tonight. Exams received after the deadline will lose points.

1. Let r_t be a daily stock return series. Louie is thinking of estimating the model

$$r_t = m + u_t, \tag{1}$$

where conditional on information available at $t-1$, $u_t \sim N(0, s_t^2)$. We going to model s_t^2 as,

$$s_t^2 = a_0 + a_1 u_{t-1}^2 + b s_{t-1}^2 \tag{2}$$

   (a) (2 points) What is s_t^2 called?
   (b) (2 points) What is the model in eq.(2) called? (i.e., what is it's name?)
   (c) (10 points) What are the admissible range of values for the coefficients m, a_0, a_1, and b?
   (d) (5 points) Why might this model be preferable to the model in eq.(3)?

$$s_t^2 = a_0 + \sum_{j=1}^{p} a_j u_{t-j}^2 \tag{3}$$

   (e) (2 points) What is the model in eq.(3) called? (i.e., what is its name?)

2. (10 points) Suppose Louie estimates the monthly return on a particular ETF to have conditional mean 0.008333 3 and conditional variance 0.00038351. His client, Sookie wants to invest $1 millon in this ETF but wants to know the 5% value at risk for the next month. What does Louie say is the 5% value at risk?

3. In empirical finance, the dominant empirical framework might say,

$$r_{t,i} = a_i + b_i f_t + e_{t,i}$$

where $r_{t,i}$ is the **excess** return on asset $i = 1, ..., n$, and f_t is the high-minus low book to market excess return. (i.e., the return on a portfolio on the largest quintile of book-to-market firms minus the return on the portfolio of the smallest quintile of book-to-market.) In addition,

$$\bar{r}_i = c + Lb_i + d_i$$

where $\bar{r}_i = \frac{1}{T}\sum_{t=1}^{T} r_{t,i}$.

   (a) (8 points) What is the interpretation of a_i and b_i in the first equation? What restrictions does the theory of finance impose on these coefficients?

   (b) (8 points) What is the interpretation of the second equation and for the coefficients?

   (c) (8 points) What restrictions does the theory of finance impose on the coefficients c and L?

   (d) (10 points) Bill estimates the first equation by least squares and saves the estimated b_i. Then he estimates the second equation by least squares. The t-ratio for L reported by the regression package is 2.0. Bill claims that L is statistically significant and claims the data support the model. What is wrong with Bill's claim?

   (e) (15 points) Tell Bill how to get the "correct" t-ratio?

4. For this problem, use the Eviews workfile FF25FinalExam.wf1. The workfile contains returns on the Fama-French 25 double sorted portfolios on book to market and firm size.

   (a) (10 points) Compute the first four principal components of this data set. Be sure to normalize the scores. Report the loadings matrix.

   (b) (10 points) For portfolios 10 and 25, regress their returns on the first 3 principal components and report the regression R^2, then repeat by regressing on all 4 principal components. Report the regressin R^2 from each regression. Based on your analysis, how many factors do you think are driving these portfolio returns?

   (c) (Extra Credit 7 points) For all 25 portfolios, report the **average** proportion of variance explained by **each** of the four principal components.