Homework 4
Due February 23, 2022 @11:59 pm

Instructions. This is a group assignment. The maximum group size is four people; you may be a group of one if you like. Please answer the following questions and upload your solutions to the Canvas site prior to 11:59 pm on Wednesday, February 23. Only one member of each group should upload the solutions. Please be sure to put the names of all group members at the top of the first page of your solutions.

You may prepare your solutions using word processing (e.g., Word) or typesetting (e.g., Latex) software. Or, you may scan handwritten solutions to a pdf file, provided your handwriting is neat and legible. If our TA cannot read your handwriting that you will not receive credit for your solution.

The file IE420.s2022.HW4.data.xlsx contains the month-end NAVs of six Fidelity mutual funds during the period running from December 1999 through December 2021 and the monthly returns during the period running from January 2000 through December 2021. When the return is not available (because the mutual fund did not yet exist) the return is replaced by a missing value code -99. The file also contains the monthly returns on the Fama-French factors $r_M - r_f$, r_{SMB}, and r_{HML}, and the risk-free return r_f for each month. In this homework you will use the monthly returns during the period running from January 2022 through December 2021, a total of 240 months. If a fund's returns are not available for the entire period, then use the returns that are available.

0. (0 points, but necessary for Questions 1 and 2) As a preliminary step, compute the excess returns $r_{i,t} - r_{f,t}$ for the six mutual funds, where $r_{i,t}$ is the return on fund i during month t and $r_{f,t}$ is the risk-free rate of return during month t.

1. (total 3 points) Using the excess returns of the six mutual funds that you computed in Question 0, estimate the parameters of the single-factor model

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_i(r_{M,t} - r_{f,t}) + \epsilon_{i,t}$$

for each of the six mutual funds using ordinary least squares. (Use an appropriate function in Excel, R, Python, Matlab, or other computer software.)

(a) (2 points) What are the six estimates β_i? What are the six estimates α_i? (I suggest creating a small table that displays the six pairs of estimates.) What is the average of the six estimates α_i?

(b) (1 point) Some of the point estimates of α_i are positive, and some are negative. Are any of the α_i estimates statistically significant at the 5% level? If so, for which of the funds is the estimate of α_i statistically significant at the 5% level? (*Remark*: Here, "statistically significant at the 5% level" means that a test with a size of 0.05 rejects the null hypothesis that $\alpha_i = 0$.)

Remark: Note that the estimates of α_i are likely upward-biased because my selection of the six funds creates a survivorship bias in their returns. Specifically, I selected six funds that exist

today. Mutual funds that exist today are unlikely to have a track record of very poor performance, because a fund management company can disappear a track record of poor returns by merging a poorly performing fund into a fund with a better track record.

2. (total 3 points) Using the excess returns of the six mutual funds that you computed in Question 0, estimate the parameters of the three-factor model

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_i^M (r_{M,t} - r_{f,t}) + \beta_i^{SMB} r_{SMB,t} + + \beta_i^{HML} r_{HML,t} + \epsilon_{i,t}$$

for each of the six mutual funds using ordinary least squares. (Use an appropriate function in Excel, R, Python, Matlab, or other computer software.)

(a) (1 point) What are the estimates of β_i^M, β_i^{SMB}, and β_i^{HML} for the six mutual funds? What are the six α_i estimates? (I suggest creating a small table that displays the six sets of estimates.)

(b) (1 point) One fund has both the second largest positive exposure to r_{SMB} and the largest positive exposure to r_{HML}. Which fund is this? Do you think this this fund tends to invest in small stocks, or in large stocks? In growth stocks, or in value stocks?

(c) (1 point) Another fund has the largest negative exposure to r_{HML}. Which fund is this? Do you think this fund tends to invest in growth stocks, or in value stocks?

3. (1 point) What are the average returns on the three factors $r_M - r_f$, r_{SMB}, and r_{HML} during the period running from January 2002 through December 2021?

4. (total 2 points) The average returns on the factors $r_M - r_f$, r_{SMB}, and r_{HML} are estimates of the (expected) risk premia $E[r_M - r_f]$, $E[r_{SMB}]$, and $E[r_{HML}]$ on the factors.

(a) (1 point) Using the estimate of the market risk premium $E[r_M - r_f]$ and the α_i and β_i estimates from Question 1, what is the expectation $E[r_i - r_f]$ for fund FBCVX?

(b) (1 point) Now, assume that the CAPM describes the expected return on fund FBCVX. Based on this assumption and your estimate of the market risk premium $E[r_M - r_f]$, what is the expectation $E[r_i - r_f]$ for fund FBCVX?

5. (1 point) Now let's again consider the three-factor model

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_i^M (r_{M,t} - r_{f,t}) + \beta_i^{SMB} r_{SMB,t} + \beta_i^{HML} r_{HML,t} + \epsilon_{i,t},$$

Using the estimates of the expected risk premia $E[r_M - r_f]$, $E[r_{SMB}]$, and $E[r_{HML}]$ from Question 3 and the estimates α_i, β_i^M, β_i^{SMB}, and β_i^{HML} from Question 2, what is the the expectation $E[r_i - r_f]$ for fund FLCSX?