MGMT 675

AI-ASSISTED FINANCIAL ANALYSIS

RICE | BUSINESS
Jones Graduate School of Business

ALPHAS AND BETAS

OBJECTIVES FOR THIS WEEK

1. Estimate the cost of equity capital for CVX
2. Evaluate the performance of Fidelity Magellan relative to a Fama-French benchmark

COST OF EQUITY CAPITAL

CAPITAL ASSET PRICING MODEL

Expected stock return is $r_f + \beta \times \overline{r_m - r_f}$

1. Get today's r_f from FRED
2. Get historical $\overline{r_m - r_f}$ from French's data library
3. Estimate beta by running regression

$$r - r_f = \alpha + \beta(r_m - r_f) + \varepsilon$$

Let's estimate the beta first.

DATA FOR REGRESSION

The regression is:

$$r - r_f = \alpha + \beta(r_m - r_f) + \varepsilon$$

a. CVX return r from Yahoo adjusted closing prices

b. Risk-free rate r_f from French's data library

c. Market excess return $r_m - r_f$ from French's data library

COMPUTE CVX RETURNS

- Ask Julius to pip install yfinance==0.1.70 and import yfinance as yf
- Then (all instructions at once to avoid repeated downloads) ask Julius to:
  - use yf.Ticker to get CVX closing prices (= adjusted closing prices) since 2010
  - downsample to end-of-month and compute returns as 100 times percent change
  - convert dates to pandas monthly period format

GET FAMA-FRENCH FACTORS

Ask Julius to use the pandas datareader get the monthly Fama-French factors since 2010 from French's data library,

PREPARE DATA FOR THE REGRESSION

- Ask Julius to do an inner merge on the dates of the CVX returns and Fama-French factors.
- Ask Julius to keep only the last 120 rows.
- Ask Julius to add the excess CVX return to the dataframe by subtracting RF from the CVX return.
- Ask Julius to show the head and tail of the dataframe.

RUN THE REGRESSION

- Ask Julius to regress the excess CVX return on MKT-RF, including an intercept, and show a summary of the results.
- Ask Julius to assign the MKT-RF regression coefficient to a new variable called beta.

ESTIMATE THE MARKET RISK PREMIUM

- Ask Julius to use pandas datareader to get the annual Fama-French factors from French's data library starting in 1926.
- Ask Julius to compute the mean of MKT-RF and assign it to a new variablecalled market_premium.

GET THE CURRENT RISK-FREE RATE

- Ask Julius to use pandas datareader to get 1-month Treasury bill yields from FRED.
- Ask Julius to get the most recent 1-month Treasury bill yield and assign it to a new variable called rf.

CVX COST OF EQUITY CAPITAL

Ask Julius to compute rf + beta * market_premium.

VISUALIZE THE REGRESSION

- Ask Julius to produce a scatter plot with the excess CVX return on the y axis and MKT-RF on the x axis.
  - Tip: we might need to give Julius the name of the dataframe containing the excess CVX return and MKT-RF.
  - Look back at the code where Julius showed the head and tail of the dataframe to find the name.
- Ask Julius to include the regression line on the scatter plot.

VISUALIZATION TIPS

- We can ask Julius to set the style of the plot. I like the seaborn whitegrid style.
- There are other choices: seaborn plot styles
- If Julius is balky at including the regression line, ask it to create a seaborn regplot with ci=None.
- You can also specify the colors of the points and the line (the line could be a different color than the points).

INTERACTIVE PLOTS

- Suppose we're giving a presentation in which we show the regression plot.
  - We anticipate there might be questions about some of the points - e.g., extreme values.
  - We could tag them with annotations, but it creates clutter.
  - It might be useful to be able to hover over points and have pop-ups with details.
- This requires html.

USE PLOTLY

- Ask Julius to use the dataframe containing the CVX excess return and MKT-RF and to convert the dates to strings.
- Ask Julius to use plotly to create a scatter plot with a regression line, the CVX excess return on the y-axis, and MKT-RF on the x-axis.
- Ask Julius to include the date in the hover data.
- Ask Julius to save the figure as html.

SEE THE RESULTS

- Download the html file.
- Open it from Windows Explorer or the Mac Finder (it probably won’t work opening it from your web browser).
- More visualization coming next week.

MUTUAL FUND PERFORMANCE

PERFORMANCE MEASURES

- Rankings
- Performance relative to benchmark (large cap, …)
- Performance after adjusting for risk exposures
  - relative to benchmark adjusting for benchmark beta
  - or including other risk exposures
  - alpha = average return after adjustments

FAMA-FRENCH FACTORS: MOTIVATION

- Certain types of stocks have beaten others historically
- Efficient markets view: must be due to risk exposures that investors care about
- Not sure what risks are, but use difference in returns of different types of stocks as proxies

FAMA-FRENCH 5 FACTORS

- MKT-RF = market return minus T-bill return
- SMB = **S**mall stock return **M**inus **B**ig stock return
- HML = **H**igh book-to-market (value) return **M**inus **L**ow book-to-market return
- CMA = **C**onservative (low asset growth) return **M**inus **A**ggressive return
- RMW = **R**obust (high profitability) return **M**inus **W**eak return

DATA

- Start a new chat.
- Repeat the steps in the Yahoo/Fama-French merge, except
  - Get FMAGX (Fidelity Magellan) from Yahoo for the maximum history possible
  - Get the monthly 5-factor Fama-French factors from French's data library for the maximum history possible
  - Keep all months after doing an inner merge (not just last 120)

RUN REGRESSION

- The regression is

$$r - \mathrm{RF} = \alpha + \beta_1 \times \mathrm{MKT\text{-}RF} + \beta_2 \times \mathrm{SMB}$$

$$+\beta_3 \times \mathrm{HML} + \beta_4 \times \mathrm{CMA} + \beta_5 \times \mathrm{RMW} + \varepsilon$$

- Ask Julius to add the excess FMAGX return to the dataframe (FMAGX return minus RF).
- Ask Julius to regress the excess FMAGX return on the Fama-French factors and report the summary.

INTERPRETATION

- A risk-adjusted benchmark for FMAGX is

$$(1-\beta_1)\times \mathrm{RF} + \beta_1 \times \mathrm{MKT} + \beta_2 \times \mathrm{SMB}$$

$$+\beta_3 \times \mathrm{HML} + \beta_4 \times \mathrm{CMA} + \beta_5 \times \mathrm{RMW} + \varepsilon$$

- Call this BMARK. The regression can be restated as

$$r - \mathrm{BMARK} = \alpha + \varepsilon$$

- $\alpha + \varepsilon$ is over-performance when positive and under-performance when negative.

HISTORY OF OVER OR UNDER-PERFORMANCE

- Ask Julius to add a variable called over_under to the dataset defined as (regression intercept + regression residuals) / 100.
- Ask Julius to compute the cumulative product of (1 + over_under) and to plot it.

ATTRIBUTION ANALYSIS

- Attribution analysis is breaking down the benchmark.
- How much return comes from market exposure? size exposure? value exposure? …
- We can calculate the average return to the value exposure as $\beta_3 \overline{\mathrm{HML}}$, etc.
- We can visualize these by plotting the cumulative product of $1 + \beta_3 \times \mathrm{HML}/100$, etc.
- Ask Julius.