Macro-based equity allocation

• The goal of this project is to allocate equity portfolios per industry sectors based on macro regimes.

• We are going to allocate portfolios based on macro regimes.

• The regimes are organized around 4 quadrants

• Depending on different macro regimes, we will long and short different industry sectors

• The strategy relies on the idea that equity sectors are performing differently per regime

• We will apply it to the US only as the data is easier to find

• You are free to use any open source package you want, as long as you can pip install it on HackerRank

• Pay attention to be details-oriented, meticulous and to deliver clean and logical code

**1. Equity returns by industry sectors data**

Download the data

• Go to Ken French website to download the "12

Industry Portfolios" (monthly returns)

• The address is: <https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html>

Clean the data

• Replace the missing data by nan

• Returns are given annualized: de-annualize them (put them at monthly frequency instead)

Vizualisation

• Plot the cumulative returns over time for the 12 sectors

• Compute the correlation matrix of the returns and plot the correlation matrix as an heatmap. Make sure the heatmap is easy to read

**2. Macro Data**

US Leading Indicator

Because we need activity data at monthly frequency, we can't use GDP. One simple solution is to use the OECD Composite Leading Indicators (CLI) amplitude and seasonality adjusted for the US, that is available monthly since 1955

• The series is available on FRED: <https://fred.stlouisfed.org/series/USALOLITOAASTSAM>

under the ticker USALOLITOAASTSAM

• You can directly download the cs from the website or use the Fred Python APl, as you prefer

Inflation

• Because we want to control for seasonal effects, we are going to use core CP|

• Note that this is consistent with using a seasonality adjusted CLI

• CPI for urban consumers excluding food and energy is available on FRED at this

address: <https://fred.stlouisfed.org/series/CPILFESL>

• The Fred ticker is CPILFESL

• You can directly download the cs from the website or use the Fred Python API, as you prefer

Data cleaning

• To avoid the regimes change to be too jumpy, we are going to compute the growth rate of both CLI and CPI as "% of latest 3 months over previous 3 months at annualized rate"

• This is called 3m/3m rolling rate

Vizualisation

• Plot the original series and their 3m/3m rolling rate on two different subplots

• ⁠Draw the area under the curve as red when negative and green as positive

**3. Create the quadrant**

• We use a very basic definition of the macro quadrant:

• If the 3m/3m CPI is positive: inflation is "+"

• Else inflation is "-"

• Likewise with CLI 3m/3m: growth is "+" if positive, else "-"

• Define the following regimes:

• Growth +, inflation + = expansion

• Growth +, inflation - = goldilock

• Growth -, inflation + = stagflation

• Growth -, inflation - = recession

• Create the time series of the quadrant, meaning a time series taking these 4 regimes depending on the value of CLI and CP| 3m/3m

• Propose a way to visualize how fast the regimes transition historically and plot it

**4. Long-short allocation**

• The idea is to create a portfolio that long the top 5 performing sectors and short the bottom 5 performing sectors (= meaning the worst performing). Other sectors are neutral (0 weights)

• Long means we are buying the equity (positive weights)

• Short means we are selling (negative weights)

• However, we can not use future data for inferring the allocation

• Hence, if we are allocating in 1990, we can not use the sectors performance in 1991 for instance

• For each month, starting in 1970 (use data since 1957 to train the model but don't allocate before1970):

• Identify the growth/inflation regime corresponding to the month

• Update the average performance of each sector under this regime, using all the past data available (and not future data, so you have to use an expanding window)

• Design an allocation where:

• ⁠The top 5 performing assets under this regime (based on the average performance) are allocated a weight of 20% each.

• For instance, if April 1985 is regime goldilock and sectors a, b, c, d, e ,f are the top

performers under past goldilock regimes, then allocate 20% to sectors a-e

• The worst 5 performing assets under this regime are allocated a weight of -20%

• Other sectors have 0 weight

• Compute the long short portfolio performance over time (which is the weighted sum of the monthly returns of the sectors)

• Plot the cumulated performance of this long short portfolio over time

**5. Benchmarking**

Cumulated performance

• Compute the cumulated performance of a 1/N portfolio

• A 1/N portfolio is a portfolio where each asset has the same weight, fixed weights that don't depends on the regime.

• The sum of the weights of all assets is equal to 1

• Note that there is no negative weights

• Compute the cumulated performance of an inverse vol portfolio

• An inverse vol portfolio is a portfolio where each asset is weighted according to the inverse of its volatility.

• Compute the volatility using a rolling window of 5 years (60 monthly observations)

Sharpe ratio

• Compute the rolling Sharpe for each of the three portfolios

• The Sharpe ratio is the ratio between the average performance and the standard deviation of the returns, assuming cash rate at 0

• Use a rolling window of 5 years

• Plot the information ratio

• Comment the results

**6. Optimized allocation**

- At this stage, we have constructed a long-short portfolio, a 1/N and inverse vol portfolios. Now we are moving to optimized allocation

- Based on the conditional returns and conditional covariance matrix per regime, optimize a long-short portfolio using a standard mean-variance algorithm, where the sum of weights should sum to 0 (so that it mimicks the long-short Fama French style built earlier on)

- Please choose an estimator for the conditional returns and conditional covariance. Explain your choices.

- Pay attention that the estimation should not feature data leakage, can't use future information on returns and risk for allocating at a given point in time

Bonus, if you have time: Compute the performance and Sharpe ratio of the backtested performance over time. Compare with the other allocations and comments the results in terms of risk-returns profile