PART A

Download the monthly data on "10 Industry Portfolios" from Ken French's website at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. Download the monthly risk-free asset data under the Fama / French 3 Factors link at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

Using a 5-year rolling window of 10 industry portfolio data, calculate the following portfolios for each month since June 1931.

1) the portfolio that maximizes the Sharpe ratio without short-sale constraints;

2) the portfolio that maximizes the Sharpe ratio with short-sale constraints;

3) the portfolio where the weight of each asset is inversely related to its variance;

4) the portfolio where the weight of each asset is inversely related to its volatility;

5) the portfolio where assets have the same weight;

6) the portfolio where the weight of each is linearly related to its market capitalization;

7) the portfolio with the minimum variance;

Holding these portfolios for one month and rebalancing at the end of each month, calculate the returns for your portfolios for each month since July 1931. (For example, you use the June 1931 weights to calculate the returns for your portfolios in July 1931.) Compare and explain average performance and total and Sharpe ratios for the period July 1931-December 2025, January 1990-December 2025 and January 2000-December 2025. What approach do you think is the best and why?

PART B

Download the monthly and daily data on 48 Industry Portfolios from Ken French's website at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

For each month t, compute the following industry characteristics:

1) The market capitalization as Average Firm Size x Number of Firms
2) The ratio of book value (BE: book equity) to market value (ME: market equity), ie book-to-market ratio, i.e. Book-to-Market ratio, using the "Sum of BE / Sum of ME" data. (Note: "Sum of BE / Sum of ME" data are annual and need to be converted to monthly data assuming that the ratio remains constant between July of the year s and June of the year s + 1. For example, the ratio of 1926 is the ratio that must be used for July 1926 to June 1927.)
3) The momentum of each industry as the average return for that industry during the last 12 months including month t.
4) The market beta for each industry using daily data for the last 12 months including month t. (Note: To calculate the market beta of an industry, the industry's excess daily returns (R_{it}-R_{ft}) must be regressed on excess market daily returns (the Fama and French (1993) MKTRF factor). (betting against beta factor)

5) the idiosyncratic volatility of each industry using the daily data during month t. (To calculate the idiosyncratic volatility of an industry, this industry's excess daily returns (R_{it}-R_{ft}) must be regressed on the daily three-factor returns of Fama and French (1993), ie MKTRF, SMB, HML. The idiosyncratic volatility is the standard deviation of the residues of this regression.)

For each month t and a given characteristic (market capitalization, book-to-market ratio, momentum, market beta and volatility), sort the 48 portfolios according to this characteristic. Take a long position a) equally-weighted and b) weighted by market capitalization in the 5 industries with the highest characteristic in this month and finance this long position by taking a short position a) equally-weighted and b) weighted by the market capitalization in the 5 industries with the lowest characteristic. Calculate the return of this long-short portfolio at the end of month t + 1. Repeat this exercise for each characteristic.

Evaluate the performance of these strategies according to the Sharpe Ratio and alphas according to the Fama-French models with three, four and five factors during the periods 1950-2025, 1990-2025, 2000-2025. Interpret these results.

PART C

Use the monthly data on 48 Industry Portfolios. As in Part B, compute the following industry characteristics for each month t:

1) The market capitalization as Average Firm Size x Number of Firms
2) The ratio of book value (BE: book equity) to market value (ME: market equity), ie book-to-market ratio, i.e. Book-to-Market ratio, using the "Sum of BE / Sum of ME" data. (Note: "Sum of BE / Sum of ME" data are annual and need to be converted to monthly data assuming that the ratio remains constant between July of the year s and June of the year s + 1. For example, the ratio of 1926 is the ratio that must be used for July 1926 to June 1927.)
3) The momentum of each industry as the average return for that industry during the last 12 months including month t.

For each month t, standardize each characteristic cross-sectionally to have zero mean and unit standard deviation across all stocks at date t as explained in Brandt et al. (2009). For “out-of-sample” results, use data until December 1973 to estimate the coefficients of the portfolio policy by maximizing the equation in (6) using a CRRA utility with a risk aversion coefficient of 5. Then form out-of-sample monthly portfolios using those coefficients in the next year. Every subsequent year, reestimate the portfolio policy by enlarging the sample. Use equation (16) to renormalize the portfolio weights obtained. For the out-of-sample period, report the annualized average monthly return, standard deviation, and Sharpe ratio.