Alternative and Quantitative Investment Strategies

Mnacho Echenim, Sonia Jimenez, Anne-Claire Maurice

Grenoble INP-Ensimag

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Notes

Quick recap on the Momentum strategy

- Strategy designed to exploit market inefficiency
  - Exploit the fact that not all financial actors have the same information at the same time, and that there is a time lapse before investors' private information is incorporated into prices
  - Principle: invest in underlying assets with the highest returns, in order to gain from continuing elevated returns
- Related questions
  - Over what period should the returns be computed?
  - After what period of time should the assets be reallocated?

Notes

Goal of the project

- About cryptocurrencies
  - From an abstract point of view, recent market with a high volatility
  - Trading principles can differ largely from traditional finance
  - It seems plausible that the market is not efficient
  - But very few academic results on this topic
- Goal of the project
  - Investigate the efficiency of the cryptocurrency market
  - By applying the Momentum strategy on a set of cryptocurrency data from centralized and decentralized exchanges
- Outcome to produce
  - A Jupyter notebook containing the tests and analyses that were carried out
  - **Nb:** The produced notebook should be considered a report and must be constructed accordingly

Notes

Constructing the Momentum portfolios

Warning

- The algorithms presented below are meant to make sure there is no misunderstanding, they are not necessarily the versions that should actually be implemented
- For the sake of clarity we assume that there are 50 cryptocurrencies under consideration

Input: Value i for portfolio P_{i+1} $(i = 0, \dots, 4)$
Input: Market data for 50 cryptocurrencies
Input: List of rebalancing dates $(t_1, \dots, t_n)$, returns horizon h
foreach *rebalancing date t* **do**
  $R_t := (r_t^1, \dots, r_t^{50})$; // *compute returns* $\frac{S_t - S_{t-h}}{S_{t-h}}$
  $C_t := (c_t^1, \dots, c_t^{50})$; // *order cryptocurrencies, decreasing order of returns*
  $\kappa_t := (c_t^{10i+1}, \dots c_t^{10(i+1)})$; // *extract cryptocurrencies for portfolio* $i+1$
end
return $(\kappa_{t_1}, \dots, \kappa_{t_n})$;

Algorithm 1: GetPortfolioCompo

Notes

Constructing the Momentum portfolios (2)

Computation of the values of P_i $(i = 1, \dots, 5)$

```
Input: Initial value V of portfolio, sequence of compositions
Input: Market data for 50 cryptocurrencies, list of rebalancing dates
foreach date t do
    V_t := UpdateValue(t);
    if t is a rebalancing date then
        //nb: condition above should be true for first date of backtest
        UpdateCompo(κ_t, V_t); self-financing, equally weighted portfolios
    end
end
return (V_{t_1}, ..., V_{t_N});
```

Algorithm 2: BacktestPortfolio

Notes

Outcome of the project

- **Goal:** produce a financial document analyzing the characteristics and performance of the Momentum strategy on cryptocurrencies
- Milestone 1: core characteristics
  - All cryptocurrencies are taken into account
  - Portfolios are rebalanced at the start of each months, returns are computed over a period of 15 days
  - The analyses rely on the statistical indicators described in the upcoming slides
- Milestone 2: centralized vs decentralized exchanges
  - Separate the cryptocurrency instruments depending on whether they are traded on centralized or decentralized exchanges
  - Run the momentum strategy on both categories of instruments and check whether the results are different
- Milestone 3: CRIX
  - Carry out same analyses using the CRIX index instead of the standard market index
- If there is still time
  - Analyze the effect of changing the rebalancing period and over what horizon returns are computed

Notes

Strategy data generation

Portfolio values: generate the following portfolio values (assumption: 50 cryptocurrencies)

- Portfolios $P_1, \ldots, P_5$
- Portfolio P_{1-5}: strategy that consists in buying P_1 and selling P_5

Strategy returns: compute the following daily returns

- Daily return series R_i for portfolio P_i ($i = 1, \ldots, 5$)
- Daily return series R_{1-5} for portfolio P_{1-5}
- Daily return difference $R_1 - R_5$
  - Nb: this difference is the one analyzed in the foundational article on the Momentum strategy: Jedadeesh, N., and Titman, S. (1993) *Returns to Buying Winners and Selling Losers : Implications for Stock Market Efficiency*

Get rid of extreme values for each of these series (winsorization)

Notes

Statistical descriptions

Compute the following indicators for each returns series:

- Mean
- Stddev
- Median
- Min and max return
- Skewness
- Kurtosis

Notes

Sharpe, Treynor, Jensen

Given the series R_f of risk-free rates and the series R_M of market returns, compute the following indicators for each returns series R with stddev σ:

- Sharpe ratio: $\frac{R-R_f}{\sigma}$
- Treynor ratio and Jensen's alpha: perform the regression

$$(R - R_f) = \alpha_J + \beta_M(R_M - R_f) + \varepsilon_P$$

  - $\frac{R-R_f}{\beta_M}$ is the Treynor ratio for the series
  - α_J is Jensen's alpha for the series

Notes

Fama & French and Carhart alphas

Given the following series:

- SMB: "Small minus Big"
- HML: "High minus Low"
- UMD: "Up minus Down"

Perform the following regressions

$$\begin{aligned} R - R_f &= \alpha_F + \beta_M(R_M - R_f) + \beta_S \mathrm{SMB} + \beta_H \mathrm{HML} + \varepsilon_F \\ R - R_f &= \alpha_C + \beta_M(R_M - R_f) + \beta_S \mathrm{SMB} + \beta_H \mathrm{HML} + \beta_U \mathrm{UMD} + \varepsilon_F \end{aligned}$$

- α_F is the Fama & French alpha
- α_C is the Carhart alpha

Nb

The P-Value and R-squared indicators must be computed to evaluate the statistical significance level of all the results

Notes

Data and code for the project

- What is available
  - Daily cryptocurrency data for 100 instruments over 2 years (*crypto_prices.csv*, *exchange_info.csv*, clean data)
  - Series for alpha computations (*data_factors.csv* and *momentum_daily.csv*, data requires some cleaning)
  - CRIX data (*crix.csv*, clean data)
- What to produce
  - A Jupyter notebook with analysis and code

Notes

Details on the available series

data_factors.csv

- **Date** Date for the data (ex: 19260701 → 01/07/1926)
- **Mkt-RF** Market return minus risk-free rate (percent: 0.10 → 0.1%)
- **SMB** Small Minus Big (percent)
- **HML** High Minus Low (percent)
- **RF** Risk-free rate (percent)

momentum_daily.csv

- **Date** Date for the data
- **Mom** Momentum factor (percent)

Warning

There will be some data missing, in particular on week-ends. The `fillna` method on dataframes can be used to fill in missing data

Notes

Timetable

1. Data analysis and handling with Pandas: presentation and hands-on
2. Advanced data analysis and handling with Pandas: hands-on
3. Setting up the Momentum strategy; testing and refactoring
4. Analysis of the results, final notebook version

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