



# SOLUTION DESIGN DOCUMENT

STOCK PERFORMANCE PREDICTABILITY VIA PIOTROSKI F-SCORE:  
EVIDENCE FROM AMERICAN DEPOSITARY RECEIPTS

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## 1. Repository

Link to GitHub repository: <https://github.com/rexlaboratory/adr-piotroski-f-score>

## 2. Data Sources

**2.1 ADR Stock Universe.** The stock universe used in this research is from [adr.com](http://adr.com), a website owned by J.P. Morgan that houses information on depositary receipts including ADR stocks [2]. From this data, the list of ADR stocks and their ticker names are identified.

**2.2 Stock Price and Financial Data.** The ADR stock prices and financial information are retrieved from Yahoo Finance data.

## 3. Data Processing

**3.1 Python Libraries.** The following Python libraries are used in data processing.

1. [Yfinance](#) package is used to fetch the stock prices. Stock prices are used in calculating returns.
2. [Yahoo Query](#) package is used to fetch the financial information. Financial information is used in calculating the F-score.
3. [Concurrent Futures](#) package is used in parallel processing to aid in fetching the financial data. This helped gain a slight improvement in run time.
4. [Pandas](#) package is used in data merging, manipulation, transformation, and presenting the major results.

**3.2 Functions.** The following are the primary functions used in the Python code for analysis.

1. Calculate *Piotroski F-score* based on the financial data, using a nine-point scorecard [3]. The F-score is the basis for classifying stocks as 'expected winner' or 'expected loser'.
2. Calculate *equal-weighted returns* based on stock prices. The portfolio return rate is compared against the benchmark.
3. Calculate *precision* based on the number of 'actual winners' out of 'expected winners' and the number of 'actual losers' out of 'expected losers'.

## 4. Performance Metrics

**4.1 Portfolio Returns and Benchmark.** A benchmark index is created using equal-weighted stock returns by market group. The equal-weighted returns of high-F-score stocks, equal-weighted returns of low-F-score stocks, and the benchmark are then summarized and compared.

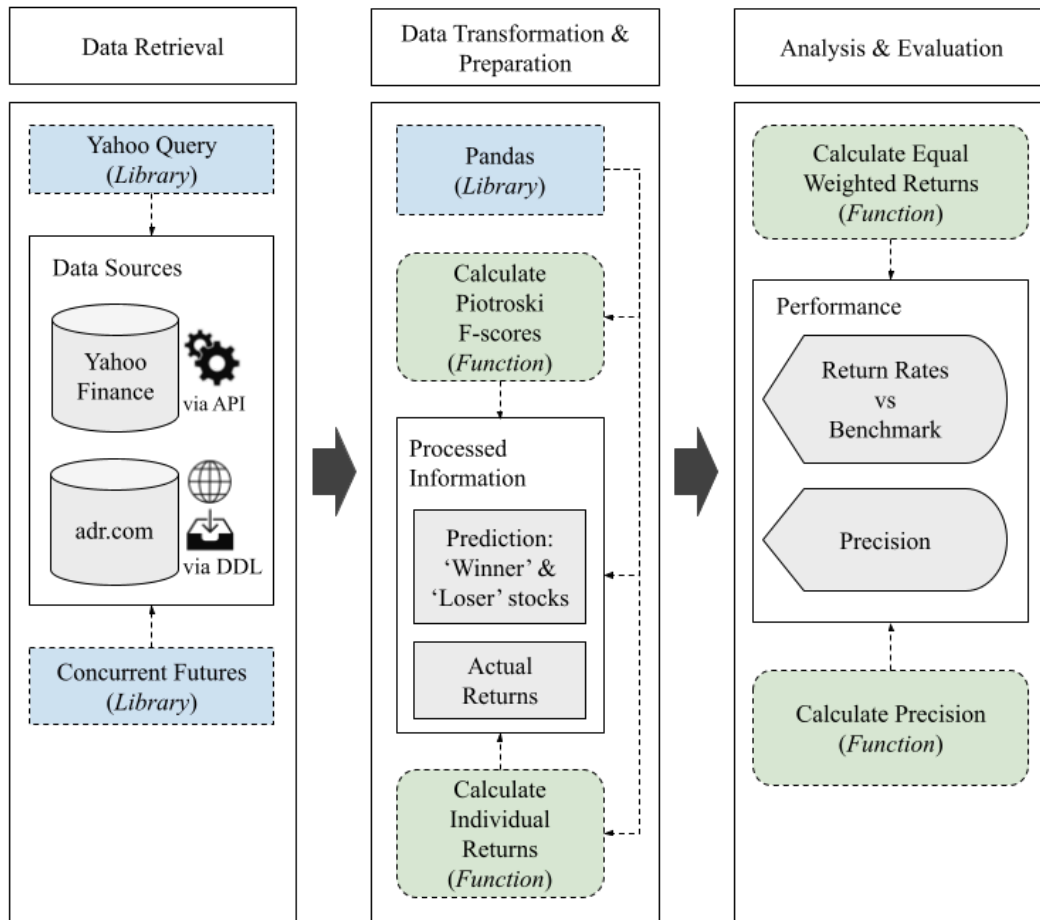
**4.2 Accuracy Metric.** The accuracy metrics are set up based on the definition of *precision*, a measure of specificity also known as *positive predictive value (PPV)* [1].

## 5. Pseudocode

1. Identify the list of foreign ADRs and extract it.
2. Retrieve the stock prices and financial information for each stock.
3. Transform data and compute Piotroski F-Scores.
  - a. Transform data to prepare for F-score calculation.
  - b. Calculate F-scores.
4. Measure the performance of the Piotroski F-score classifier in predicting 'winner' and 'loser' stocks.
  - a. *Benchmark*. Set up an ADR stock index by market group (i.e., benchmark).
  - b. *Return-based metrics*. Compare the return rates of High-F-score ADR stocks against the Benchmark and Low-F-score stocks.
  - c. *Precision metrics*. Compute the precision of the F-score in predicting 'winner' stocks; compute the precision of the F-score in predicting 'loser' stocks.

Note: The visualization of the solution design and the data elements are provided in *Figure A1* and *Figure A2*, respectively, in the Appendix section.

## Appendix



**Figure A1. Overview of Solution Design (Methodology)**

## Appendix (cont'd)

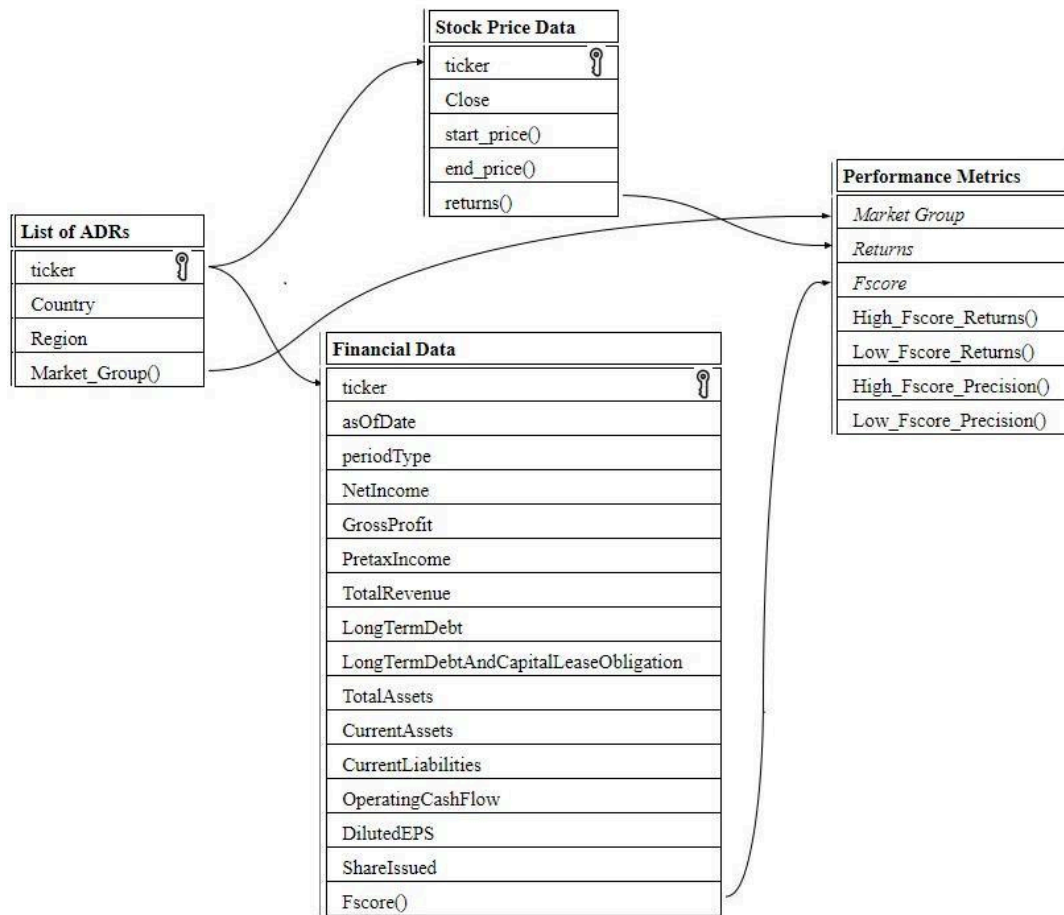


Figure A2. Data Elements

## Bibliography

- [1] Irizarry, R. *Advanced Data Science - Statistics and Prediction Algorithms Through Case Studies*. Harvard University Dana-Farber Cancer Institute, 2023. Retrieved from <https://rafalab.dfci.harvard.edu/dsbook-part-2/>. Accessed 06 February 2023.
- [2] J.P. Morgan Depositary Receipts. Depositary Receipt (DR) Universe. J.P. Morgan Chase & Co., 2024. Retrieved from <https://adr.com/dr/drdirectory/drUniverse>. Accessed 11 January 2024.
- [3] Piotroski, J. D. *Value investing: The Use of Historical Financial Statement Information to Separate Winners from Losers*. Journal of Accounting Research, 2000. Retrieved from <https://gm10b7le2-mp01-y-https-www-proquest-com.proxy.lirn.net/scholarly-journals/value-investing-use-historical-financial/docview/206723328/se-2>. Accessed 10 January 2024.