Machine Learning for Trading

Algorithmic trading relies on computer programs that execute algorithms to automate some, or all, elements of a trading strategy. Algorithms are a sequence of steps or rules to achieve a goal and can take many forms. In the case of machine learning (ML), algorithms pursue the objective of learning other algorithms, namely rules, to achieve a target based on data, such as minimizing a prediction error.

These algorithms encode various activities of a portfolio manager who observes market transactions and analyzes relevant data to decide on placing buy or sell orders. The sequence of orders defines the portfolio holdings that, over time, aim to produce returns that are attractive to the providers of capital, taking into account their appetite for risk.

Ultimately, the goal of active investment management consists in achieving alpha, that is, returns in excess of the benchmark used for evaluation. The fundamental law of active management applies the information ratio (IR) to express the value of active management as the ratio of portfolio returns above the returns of a benchmark, usually an index, to the volatility of those returns. It approximates the information ratio as the product of the information coefficient (IC), which measures the quality of forecast as their correlation with outcomes, and the breadth of a strategy expressed as the square root of the number of bets.

Hence, the key to generating alpha is forecasting. Successful predictions, in turn, require superior information or a superior ability to process public information. Algorithms facilitate optimization throughout the investment process, from asset allocation to idea-generation, trade execution, and risk management. The use of ML for algorithmic trading, in

particular, aims for more efficient use of conventional and alternative data, with the goal of producing both better and more actionable forecasts, hence improving the value of active management.

Historically, algorithmic trading used to be more narrowly defined as the automation of trade execution to minimize costs as offered by the sell side, but we will take a more comprehensive perspective since the use of algorithms, and ML, in particular, has come to impact a broader range of activities from idea generation and alpha factor design to asset allocation, position sizing, and the testing and evaluation of strategies.

This chapter looks at the bigger picture of how the use of ML has emerged as a critical source of competitive advantage in the investment industry and where it fits into the investment process to enable algorithmic trading strategies.