Algorithmic Trading
Session 11
Performance Analysis II
Risk, Return and Efficiency Ratios

Oliver Steinki, CFA, FRM

Outline

- **Introduction**
- **Returns**
- **Risk**
- **Efficiency**
- **Summary and Questions**
- **Sources**

Introduction

Where Do We Stand in the Algo Prop Trading Framework?

- As we have seen, algorithmic proprietary trading strategies can be broken down into three subsequent steps: Signal Generation, Trade Implementation and Performance Analysis
- **Performance Analysis** is conducted after the trade has been closed and used in a backtesting context to judge whether the strategy is successful or not. In general, we can judge the performance according to five different metrics: return, risk, efficiency, trade frequency and leverage
- Sessions 10 -12 deal with the question of analyzing performance
  - **Session 10**: Performance Measurement
  - **Today's Session 11:** Performance Analysis I: Returns, risk and efficiency
  - **Session 12:** Performance Analysis II: Frequency of trades and leverage

Introduction

Performance Analysis

- Performance Analysis is a critical aspect of portfolio management. We split the analysis into five metrics: return, risk, efficiency, trade frequency and leverage
- Return is expressed as the geometric mean growth rate of the portfolio
- Risk is defined as the downside deviation of returns and can be expressed in terms such as standard deviation, downside standard deviation, maximum drawdown and length of maximum drawdown
- Efficiency measures set risk and return in relation. They are expressed through classical ratios such as Sharpe and Treynor measure, but also more modern ones such as the Sortino ratio. Win/Loss and Average Profit/Loss also indicate efficiency. A comparison to a benchmark is an indirect way of efficiency measurement as one targets a better return than the benchmark with similar risk or similar returns with lower risk
- Trade frequency is important to judge the impact of transaction costs and infrastructure requirements. The higher the trade frequency, the bigger the impact of transactions costs and requirement of a sophisticated infrastructure
- Leverage is another expression for money management. It deals with the question of which percentage of the total portfolio to invest in a given trade and how one can optimize this

Introduction

Methodology

- The methodology of a trading strategy is of qualitative nature, yet important for investors. Many investors have a bias towards a certain strategy, e.g. momentum based, mean-reverting, market-neutral or directional
- The level of complexity of the methodology is an important criteria of quantitative trading strategies. Although it does not have a direct impact on the quantitative performance metrics we cover, it will be relevant for your choice of potential investors as they might consider your strategy a "black box" if it is too complex for them
- Does the methodology rely on sophisticated or complex statistical or machine learning techniques that are hard to understand and require a PhD in statistics to grasp? Do these techniques introduce a significant quantity of parameters, which might lead to optimisation bias? Is the strategy likely to withstand a *regime change* (i.e. potential new regulation of financial markets)? All these factors will also determine who your potential investors are

Returns

Recap

- We have seen in previous sessions that the arithmetic mean is not a useful statistic in evaluating growth. It might give misleading information as a 50 percent decline in one period followed by a 50 percent increase in the next period does not produce an average return of zero
- The proper measure of average investment return over time is the geometric mean. It is this growth rate that any rational investor tries to maximize
- Investors are not only interested in the total return, but also in the average annualized returns and the best and worst days / months / years

Risk
Recap

- Volatility is used as a proxy for risk of a strategy. Most often, the standard deviation of returns is used as volatility measure, although more advanced techniques only consider the downside deviation of returns. A higher frequency strategy will require greater sampling rates of standard deviation, but a shorter overall time period of measurement

- The maximum drawdown is the largest overall peak-to-trough percentage drop on the equity curve of the strategy. Momentum strategies are well known to suffer from periods of extended drawdowns (due to a string of many incremental losing trades). Many traders will give up in periods of extended drawdown, even if historical testing has suggested this is "business as usual" for the strategy. You will need to determine what percentage of drawdown (and over what time period) you can accept before you cease trading your strategy, especially if you trade your own money. This is a highly personal decision and thus must be considered carefully. Investors will also give you some form of maximum drawdown constraint and might pull their money if you break these

- The length of the peak to valley measures how quickly the equity curve falls from the peak to the subsequent bottom. The peak to through or recovery measures the time it takes one reaches again the same height of the equity curve as the previous peak

Efficiency Measures

Recap

- When two investments' returns are compared, their relative risk must also be considered. Efficiency measures set returns in relation to risk in order to get some form of x units of return per z units of risk measure
- Examples are classical ratios such as Sharpe and Treynor measure. Modern ratios focus on a more advanced definition of risk, such as the Sortino ratio
- Win/Loss and Average Profit/Loss also indicate efficiency. Ideally one combines a high percentage of winning trades with higher average profits than average losses
- A comparison to a benchmark is an indirect way of efficiency measurement as one targets a better return than the benchmark with similar risk or similar returns with lower risk

Efficiency Measures

Review: Performance Drivers of Quantitative Trading Strategies

- Quantitative Investment Strategies are driven by **four success factors**: trade frequency, success ratio, return distributions when right/wrong and leverage ratio
- The higher the success ratio, the more likely it is to achieve a positive return over a one year period. Higher volatility of the underlying – assuming constant success ratio – will lead to higher expected returns
- The distribution of returns when being right / wrong is especially important for strategies with heavy long or short bias. Strategies with balanced long/short positions and hence similar distributions when right/wrong are less impacted by these distributional patterns. Downside risk can further be limited through active risk/money management, e.g. stop loss orders
- Leverage plays an important role to scale returns and can be seen as an "artificial" way to increase the volatility of the traded underlying. It is at the core of the money management question to determine the ideal betting size. For example, a 10 times leveraged position on an asset with 1% daily moves is similar to a full non-leveraged position on an asset with 10% daily moves

Summary and Questions

- Performance Analysis is a critical aspect of portfolio management. We split the analysis into five metrics: return, risk, efficiency, trade frequency and leverage
- Return is expressed as the geometric mean growth rate of the portfolio
- Risk is defined as the downside deviation of returns and can be expressed in terms such as standard deviation, downside standard deviation, maximum drawdown and length of maximum drawdown
- Efficiency measures set risk and return in relation. They are expressed through classical ratios such as Sharpe and Treynor measure, but also more modern ones such as the Sortino ratio. Win/Loss and Average Profit/Loss also indicate efficiency. A comparison to a benchmark is an indirect way of efficiency measurement as one targets a better return than the benchmark with similar risk or similar returns with lower risk

- Questions?

Sources

- Portfolio Construction, Management, and Protection by Robert A. Strong
- www.quantstart.com and www.quantgekko.com