# The Foundation of Algo Success

cio blog By Jonathan Larkin July 20, 2016

Jonathan Larkin, Chief Investment Officer at Quantopian

You are a quant and you have the precious raw materials: ideas, a background uniquely yours, a differentiated approach. I'm Jonathan, Quantopian's Chief Investment Officer. I want to give you my experience and perspective. We are in this together and together we can do remarkable things.



On June 6, I joined Quantopian. Previously, I worked at hedge funds where capital was measured in the billions of dollars and trades occurred in global markets 24 hours a day. In Quantopian, I see the foundation of something extraordinary: on one side, the opportunity to open up quantitative investing to eager participants worldwide, agnostic to background or pedigree, and, on the other side, the opportunity to channel the results into exceptional vehicles for investors that break the ceiling of limited capacity traditionally associated with quantitative strategies.

The marshalling of the collective intelligence of the Quantopian community has the potential today to create a powerful value proposition to institutional investors. Institutional investment creates the ability for us to deploy significant capital behind the algos that you, our authors, create.

It's coming and I want you to be prepared.

As an author, what can you do to increase your chances of having your algo licensed by us and utilized in a substantial way in one of our investment vehicles? If you have been involved with Quantopian for some time, you will be familiar with the features and characteristics of algos that we look for; if not, to get a sense of these, take a look here.

To simplify things, however, if I had to choose one governing rule or statistic in evaluation of algo performance, *sine qua non*, it would be *high return per unit risk*, i.e., high Sharpe ratio.[1]

That statement, of course, is not particularly useful to you: it's *descriptive*, but not *prescriptive*. You may rightly protest and ask: "that criterion is all well and good, but what can I do to achieve that? What is a framework or structure within which can I operate and innovate? What have others done to achieve this before me?"

In this, and in subsequent posts, I will attempt to answer those questions. Every month or so, I'll share with you an insight derived from my experience with one goal: to help you create high quality quantitative trading strategies that we would be interested in licensing. I'll talk about the workflow followed by professional quants in addition to topics like researching and evaluating individual alphas, risk aware portfolio construction, and the practical aspects of strategy implementation.

Today however, let's start at the very beginning.

In 1989, Richard Grinold published "The Fundamental Law of Active Management.[2]" Can a journal article published in 1989 guide us on how to produce high Sharpe ratio algos in 2016 on Quantopian? Let's see.

To paraphrase Grinold's "Law," an algo's Sharpe ratio, i.e., its value to Quantopian, is a function of its skill in predicting forward returns **and** how often that skill is put to use in a statistically independent way. The first term is obvious: you want to buy stocks[3] that go up and sell stocks that go down and a trade represents your bet on one of these two outcomes. The second term, known formally as "breadth", is a bit elusive. Mathematically, Grinold's Law expresses Sharpe ratio[4] as the product of two terms: the "IC," or information coefficient, which is the correlation between your algo's predictions and the actual turn of events, and "breadth," expressed as the square root of the number of independent bets your algo makes. As we commonly express Sharpe ratio in annual terms, the number of bets is annual as well.
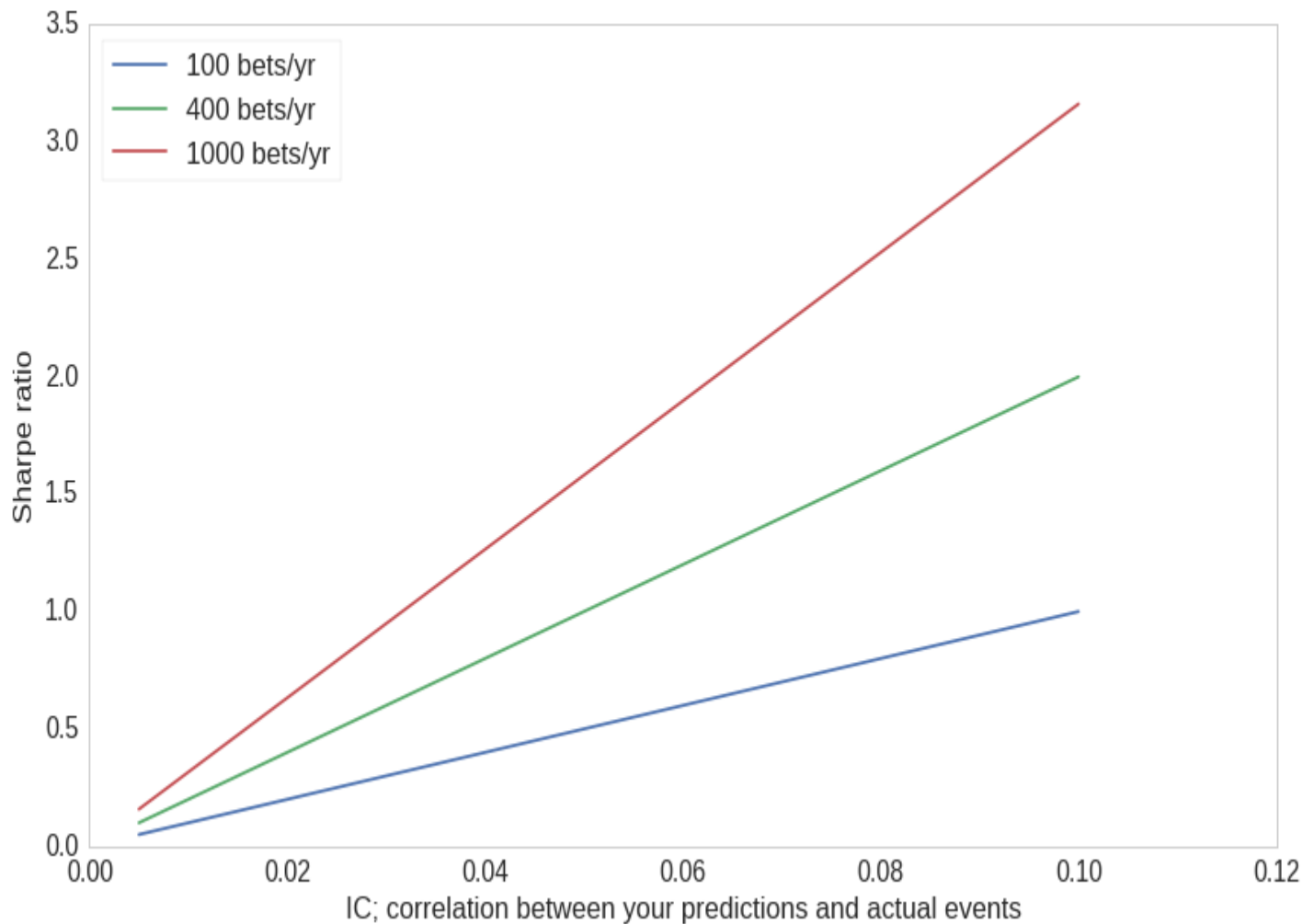
Breadth exists across two dimensions: the cross-section and the time series. Respectively, how many stocks do you make a prediction on per time period, and how many time periods a year do you revise your bets?

For a bet to "count" in this equation, it must be **independent.** If your algo is long 50 stocks and short 50 stocks but the longs are all consumer retail stocks and the shorts are all energy stocks . . . well that's 2 bets, not 100, because stocks of the same sector tend to correlate highly with each other. This is why we primarily seek market neutrality and prefer sector neutrality in prospective algos as these two hedging features help to isolate the uncorrelated portion of stock returns.

Likewise, bets must be independent along the time-series dimension too. Even if your algo runs its stock selection every day, if you have a slow moving signal which is the same day over day and week over week, then your daily output is not independent and you cannot count days as bets. This is why we primarily seek algos that trade actively on both the long and short sides of the book.

As Grinold's Law is quite simple (and over 25 years old), there have been many extensions in the literature allowing for such things as portfolio constraints in the implementation [5] and variability in the IC itself [6] [7]. This post is not an exposition on the Law. In its original form, the mathematical statement may not be complete, but to me it is "directionally accurate" and is a strong battle-tested **philosophical foundation** upon which to build an algo:

**To increase Sharpe ratio and produce a high quality algo, work in a few dimensions:**

- **increase the quality of your predictions**
- **increase the number of bets to which you apply your predictive model, and**

- **ensure that the bets are independent**

Substantial success in algo design is indeed possible. Markets are competitive but they are not perfectly efficient. To paraphrase one famous political economist: there is no royal road to algo success; only those who do not dread the fatiguing climb of its steep paths have a chance of gaining its luminous summits. Our platform is ready; you have an initial map; the summit is waiting for you; time to get started.

---

Footnotes:

1.  Sharpe Ratio is a statistical measurement of the risk adjusted performance of a portfolio, and is calculated by dividing a portfolio's average return by the standard deviation of its returns. It shows a portfolio's reward per unit of risk and is useful when comparing two similar portfolios. As the Sharpe Ratio increases, the better its performance.

2. Grinold, Richard C. 1989. "The Fundamental Law of Active Management." Journal of Portfolio Management, vol. 15, no. 3 (Spring): 30-37.

3.  This post is oriented toward the creation of algos that trade stocks.  We are working to create algo trading using futures.  I will address futures algos in a "future" post.

4. Grinold actually worked in units of the Information Ratio (IR); mathematically, the IR is the ratio of the excess return of a portfolio over its benchmark per unit active risk; i.e., the excess return of a long-only portfolio less its benchmark per unit tracking error. In the time of Grinold's publication, long/short investing was a rarity. Today, in the world of hedge funds and long/short investing, there is no benchmark; we seek absolute returns and in this case, the IR is equivalent to the Sharpe ratio.

5. Clarke, Roger; de Silva, Harindra; and Thorley, Steven 2002. "Portfolio Constraints and the Fundamental Law of Active Management." Financial Analysts Journal, September-October 2002.

6. Ye, Jia. "How Variation in Signal Quality Affects Performance." Financial Analysts Journal, vol. 64, no. 4 (2008), 48-61.

7. Ding, Zhuanxin, The Fundamental Law of Active Management: Time Series Dynamics and Cross-Sectional Properties (June 16, 2010). Available at SSRN: https://ssrn.com/abstract=1625834 orhttps://dx.doi.org/10.2139/ssrn.1625834