PART I
Introduction

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Introduction to Alpha Design

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An alpha is a combination of mathematical expressions, computer source code, and configuration parameters that can be used, in combination with historical data, to make predictions about future movements of various financial instruments. An alpha is also a forecast of the return on each of the financial securities. An alpha is also a fundamentally based opinion. The three definitions are really equivalent. Alphas definitely exist, and we design and trade them. This is because even if markets are near-efficient, *something* has to make them so. Traders execute alpha signals, whether algorithmic, or fundamental. Such activity moves prices, pushing them towards efficiency point.

HOW ARE ALPHAS REPRESENTED?

An alpha can be represented as a matrix of securities and positions indexed by time. The value of the matrix corresponds to positions in that particular stock on that particular day. Positions in stock change daily; the daily changes are traded in the securities market. The alpha produces returns, and returns have variability. The ratio of return to standard deviation (variability) of the returns is the information ratio of the alpha. It so happens that the information ratio of the alpha is maximized when alpha stock positions are proportional to the forecasted return of that stock.

Expressions and Programs

Alphas can be represented by expressions consisting of variables or programs. Such expressions, or programs, are equivalent to each other, meaning one can always be converted to the other.

HOW DOES ONE DESIGN AN ALPHA BASED ON DATA?

It is simple. A price action is a response to some world event. This event is reflected in the data. If the data never changes then there is no alpha. Thus, it is changes in the data that have the information. A change in information should produce a change in the alpha.

Changes may be characterized in many ways as can be seen in Table 1.1.

Table 1.1   Expression of changes

A simple difference, A − B	Example: today's_price − yesterday's_price
A ratio, A/B	Example: today's_price/yesterday's_price
An expression	Example: 1/today's price. Increase position when price is low

All alpha design is the intelligent search of the space for all possible changes. An expression should express a hypothesis. Examples of this can be seen in Table 1.2.

Table 1.2   Expressions expressed as a hypothesis

Expression	Hypothesis
1/price	Invest more if price is low
Price-delay (price,3)	Price moves in the direction of 3-day change
Price	High-priced stocks go higher
Correlation (price,delay(price,1))	Stocks that trend, outperform
(price/delay(price,3)) * rank(volume)	Trending stocks with increasing volume outperform

QUALITY OF AN ALPHA

An alpha is considered one of good quality when:

- The idea and expression is simple.
- The expression/code is elegant.
- It has good in-sample Sharpe.
- It is not sensitive to small changes in data and parameters.

- It works in multiple universes.
- It works in different regions.
- Its profit hits a recent new high.

ALGORITHM FOR FINDING ALPHAS

Repeat the below steps forever:

- Look at the variables in the data.
- Get an idea of the change you want to model.
- Come up with a mathematical expression that translates this change into stock position.
- Test the expression.
- If the result is favorable, submit the alpha.