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Introduction

WHY MEAN REVERSION?

This book presents methods for the development—the design, test, validation, and analysis—of statistically sound, practical, tradable swing trading systems.

The technique used to identify the entry is often used to describe the type of trading system. Those techniques include:

- Trend following. Buy when prices have already shown an upward trend, with the expectation that they will continue to rise.
- Mean reverting. Buy when prices are unusually low, with the expectation that they will return to more normal values.
- Seasonality. Buy when historical patterns of time suggest prices will rise.
- Patterns. Buy when a pattern that often precedes a rise in price is identified.
- Cycles. Buy when a low point in a price cycle has been detected, expecting that prices will rise.

Swing trades are meant to include trades that last between one day and a few days. Each system developed in this book is intended to take either a long or a short position in a single highly liquid index or exchange traded fund (ETF). We will test the systems on a variety of tradable issues, but the intent of those tests is system validation rather than portfolio construction.

There is no question that every successful trade is a trend following trade for the period it is active. When we are long, we need a rising trend; when

we are short, we need a falling trend. With swing trades, we are entering the long position when prices are recognized to be at relative lows.

MEAN REVERSION VERSUS TREND FOLLOWING

The systems described are mean reversion systems. Whether the pattern that triggers the entry is based on an indicator, a price pattern, position within a cycle, or something else, it will always be that the price has deviated significantly from the mean, and the trade is taken with the expectation that the price will revert to the mean. We will be buying low and selling higher; not buying high and selling higher, as a trend following breakout system would.

Regression to the mean is normal in many ways:

- Children of tall parents tend to be tall, but less tall than their parents.
- Children of short parents tend to be short, but less short than their parents.
- Intelligence of children, as measured by IQ, tends to be more nearly average than their parents.
- Performance in athletics, such as baseball batting averages, tends to improve after bad months and decline after good months.
- Stocks that have the highest P/E ratios in one year tend to have lower ratios the next year, and vice versa.
- Mutual funds that performed best one year tend to drop in ranking the following year, and vice versa.
- The accuracy of navy pilots landing on aircraft carriers tends to be mean reverting.

While developing systems, it is often possible to design the logic so that the resulting trades can be either mean reverting or trend following by providing switches or extending ranges of parameter values. This is done in some of the systems described. It is useful both to:

- Determine whether the best performance comes from being mean reverting or trend following.
- Automatically adjust the system when a regime change is detected.

Swing trading is active trading and has short holding periods. Some would say that, in itself, is a bad thing—that the proper technique is to buy and hold. From my point of view, each trader has the responsibility to maximize the growth of his or her account while holding risk of a drawdown to a tolerable level. Throughout this book the goal will be

to develop trading systems that achieve that objective. Whether they have low or high turnover, and long or short holding periods, the results, measured in terms of profit potential for a given level of risk, will speak for themselves.

The goal is to develop systems the trader can be confident will perform well. Confidence comes from successful completion of the validation phase of the development process, and from understanding the distribution of profit and distribution of drawdown that the system is likely to provide in the future.

None of our criteria will involve purity of doctrine or adherence to traditional wisdom. The determination of success will be based on statistical evidence, applied to systems developed using sound modeling and simulation procedures.

SYSTEM OVERVIEW

The target characteristics of most of the systems described in this book are:

- Trades SPY, or a similar index or ETF.
- Development period is 1/1/1999 through 1/1/2012.
- Takes only long positions.
- Trades about 24 times per year.
- Holds a few days.
- Is highly accurate with a high percentage of winning trades.
- Uses end-of-day data.
- Most entries are made at the close of trading at the closing price.
- Exits are made either at the close of a day or at an intra-day price that is pre-computed.
- Profit targets are used.
- Maximum holding periods are used.
- Trailing exits are used.
- Maximum loss exits are not used.
- System logic is generally simple.
- Data is often transformed.
- Auxiliary data series are sometimes used.

EXPLANATIONS

TRADES ETFs

The focus is on exchange traded funds, ETFs. The techniques described may be applicable to other tradable issues—individual equities, FOREX contracts, futures contracts, traditional mutual funds, prices of fine art,

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or whatever you wish—but results of testing those issues is not reported here.

We develop the systems using ETFs in large part because it is easier. Most ETFs are designed to follow an index. SPY, for example, is designed to track the S&P 500 index—500 individual stocks combined as a weighted average. The averaging process dampens the volatility of the individual issues, resulting in an index price series that is smoother than those of the individual components.

Although the system is developed using the price series of an index or ETF, the signals can be used to take positions in either that issue or in a related tradable—futures contract, one individual issue, many individual issues, another ETF, or an option.

TEST PERIOD

The test period used is 1/1/1999 through 12/31/2011. Prices for many issues are roughly the same at the end of this period as they were at the beginning. This provides a 13 year period with little upward or downward bias. Systems that are profitable during periods of rising prices may be simply taking advantage of a bull market. That is not a bad thing, but it does depend on identifying the bull market. Systems that are profitable during flat periods have removed the bull market bias.

LONG ONLY

Each of the systems will be designed to identify either a long entry or a short entry, but not both. That is, each system will be either long / flat or short / flat.

There are several advantages to a system that is choosing between only two alternatives rather than three:

- The program for long / flat will be shorter, clearer, have fewer parameters, be easier to program, and run faster.
- The rules and parameters needed to decide whether to be long or flat are fewer and simpler than the rules and parameters needed to decide which of three categories—long, flat, or short.
- The accuracy of identification of long signals will be higher when there are only two categories.
- Separating long / flat systems from short / flat systems removes any temptation to treat signals as being symmetric.

Any time the number of rules and parameters is increased, there should be an increase in the value of the model. Adding logic to detect the short

portion of short / flat in a long / flat / short system does nothing to increase the performance of the long trades, but does increase the likelihood of loss of generality and does increase the curve-fitness of the model.

Also read Curse of Dimensionality in Chapter 3.

Systems that are long / flat are making binary decisions—they are asking whether the correct position is long or flat. From the perspective of machine learning and pattern recognition, they are binary classifiers. They sort every pattern, no matter how it is defined, into one of two categories—long or not long.

(Everything said about long / flat systems can also be said about short / flat systems. Discussing only one at a time makes the text of this book clearer. I am often confused by descriptions that try to include both long and short—such as “go long (short) when the indicator rises (falls) through the critical level”—so they will be avoided.)

There is a bias toward rising equity prices. Some of the contributing factors include:

- Resource extraction.
- Population growth.
- Inflation.
- Productivity improvement.
- Survivorship bias.
- Feedback from long-only investments.
- Legislative rules.

Bottoms in prices are more clearly defined than tops. It is easier to develop a system that selects long entries than one that selects short entries.

It is more common to be long than to be short. Short trades are prohibited in some accounts, such as most IRA accounts.

The logic to identify short entries is typically not just the symmetric opposite of the long entry. So isolating long and short signals produces programs that have fewer logical statements and fewer variable parameters.

Prices act differently as they are rising than as they are falling. Particularly in rising markets, price drops are often steeper and of shorter duration. While any given technique might be effective in either a long / flat or short / flat system, the specific rules and parameter values are not necessarily symmetric. If the system buys when the 3 and 9 period simple moving averages cross, the best signals to short do not necessarily

come from 3 and 9 period averages, from the same method of computing the average, or even from use of a moving average crossover as the indicator.

TRADES 24 TIMES A YEAR, HOLDS A FEW DAYS

There are two seasonality patterns that occur regularly. One is related to the end of the month, the other to options expiration. In general, it is profitable to be long for a few days beginning a few days before the end of the month, and also be long about a week before options expiration Friday. These are almost reliable enough to trade as systems. But regardless of that, they do suggest that there are about 24 good opportunities to enter a long position each year. (And, perhaps, 24 opportunities to enter a short position.) Readers of my book, *Modeling Trading System Performance*, will appreciate that frequent trading is important as it allows for frequent compounding. And, short holding periods are important to limit exposure to drawdown.

You are taking in a lot of uncertain, inaccurate, or biased information, and making a certain decision—be long, flat, or short.

The goal is to trade highly liquid ETFs, such as SPY. For the most part, the data analyzed to generate the trading signals will be the daily data of those same ETFs.

Tests will be run on three groups:

- Highly liquid ETFs, including SPY, QQQ, IWM, EEM, and GLD.
- Sector ETFs, including the nine S&P sector funds XLB, XLE, XLF, XLI, XLK, XLP, XLU, XLV, and XLY.
- A group of highly liquid issues that were at approximately the same price at the beginning of the test period as they were at the end, including AEP, ALL, BAC, BK, CMCSA, COF, CSCO, DD, DELL, DIS, EWJ, F, GE, HD, HNZ, INTC, IVV, KO, MRK, MS, MSFT, PFE, QQQ, RTN, SMH, SPY, T, TWX, VZ, WY, XLU, XLV.

KISS

Some developers suggest the KISS—Keep It Simple and Straightforward—or some variation. As we will see in a later chapter, KISS can be effective. But I caution developers that simple and straightforward systems are easily discovered by others. I do recommend that systems have as few subjective decisions and as few optimizable parameters as possible. Simple does not necessarily mean common, obvious, easy, trivial, unsophisticated, ordinary, or traditional.

Rather, uniqueness, and often sophistication and elegance, is a requirement to keep the system from rapidly losing its edge as other traders begin discovering the same patterns.

I am in agreement with Nate Silver who, in *The Signal and the Noise*, recommends we should aim to be right on a high percentage of little trades rather than searching for a few big wins.

TRADE-OFFS

Mean reversion systems that trade frequently and have a high percentage of winning trades:

- Are easier to analyze to determine system health.
- Give more precise estimates of system performance.
- Have smaller gains per trade.
- Can be traded with smaller accounts.
- Can be traded at higher fraction.
- Are designed to take advantage of volatility.
- Benefit from frequent compounding.
- Through shorter holding periods, are less exposed to drawdowns.
- Are not self correcting when in losing trades.

Trend following systems that trade infrequently and have a low percentage of winning trades:

- Are much more difficult to analyze to determine system health.
- Give highly variable estimates of system performance.
- Are designed to capture larger gains from longer trends.
- Require larger trading accounts.
- Must be traded at lower fraction.
- Are self correcting when in a losing trade.
- Through longer holding periods, are exposed to higher drawdowns.

