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BUILDING WINNING ALGORITHMIC TRADING SYSTEMS

A TRADER'S JOURNEY
FROM DATA MINING
TO MONTE CARLO SIMULATION
TO LIVE TRADING

KEVIN J. DAVEY

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A Trader's Journey from Data Mining to
Monte Carlo Simulation to Live Trading

Kevin J. Davey

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*To Amy, Owen, Kathryn, Andrew, and Guardian Angel Anthony—
My love, my children, my life*

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Of course, none of my success would have been possible without my great wife, Amy. Imagine a spouse who fully supported her husband as he walked away from a great career to become a trader, an endeavor where 90 percent of people fail. Her support has been 100 percent positive, and I cannot imagine surviving as a trader, and a person, without it. She is one in a million, and I'm lucky to have found her.

Finally, this book would not be possible without the many traders and wannabe traders who have contacted me over the years. Realizing my words actually helped individuals avoid the many unscrupulous people in this industry gives me great joy. I hope reading this book helps you in the same way.

Happy Trading!

Kevin J. Davey
May 2014

INTRODUCTION

I wanted to throw up. The bile in my stomach had reached an unsustainable level, but there was no bathroom near me. Speeding down the freeway at 75 miles per hour, with no exit in sight, I'd have to swallow hard and accept my fate. I really wanted to just curl up and die. Well, not exactly. I wanted to vomit first, *then* curl up and die.

1

Was it trichinosis from eating pork not cooked to shoe leather consistency, as my Mom always predicted would happen? Nope. An undercooked juicy red hamburger laced with *E. coli*? Not exactly. It was meat that was the culprit, but in the form of live cattle. Live cattle futures, to be exact. Live cattle, all 40,000 pounds of them, had led to my sudden urge to vomit. Specifically, bovine spongiform encephalopathy, more commonly known as mad cow disease. I didn't have the disease, but my ill-fated speculative investment did.

This was at the end of December 2003, a month that had started with great personal and professional promise. I recently had been promoted to vice president of quality assurance at Argo-Tech, the midsize aerospace firm I was lucky enough to be part of, before it was bought out by a soulless mammoth corporation. I also had been honored as a "40 Under 40" recipient from *Crain's Cleveland Business* magazine—recognized as one of Cleveland, Ohio's, up-and-coming business stars under the age of 40. My futures trading account was doing pretty well, to the point where I felt confident I knew what I was doing (many times that feeling is soon followed by a slap in the face by the market, but I digress). Finally, my first child was on the way in a few months. All things considered, I was on a roll.

Then disaster struck. Three times. Quickly.

On December 12, 2003, my beautiful and amazing wife Amy and I had our first son, Anthony. He was two months premature and was stillborn. The joy of planning

for the arrival of our firstborn suddenly and tragically became planning for a funeral and burial. It is nearly impossible to understand the gut-wrenching pain that comes with losing a child, until it happens to you. I certainly was not prepared for it. Dreams were destroyed that day, life suddenly became unfair, hope and joy seemed a distant memory. Needless to say, Amy and I were both mentally, physically, and emotionally devastated.

Less than a week later, on December 17, the second calamity hit. My father passed away on his 75th birthday. Ironically, after three open-heart bypass surgeries over the previous 30 years, it was not his clogged arteries that got him, but cancer—a nasty cancer that is common to chimney sweepers. That made sense, I suppose, since he was a firefighter, and in his prime chased many raccoons out of chimneys, as the co-owner of a pest control company. After watching him lying in bed while life slowly left his body, my head began spinning like a top. To say I could not think straight was an understatement.

With two such life-changing events within a week, you probably would guess that I would not be trading or taking up any other type of mental and emotional task. But you'd be wrong. I was still trading. Looking back on it now, I was completely crazy to trade. Yet I did. On December 23, about an hour or so before the close, on a whim I decided that I should buy live cattle futures. I'm sure I had my reasons, but I am equally sure that those reasons were contrived by my mind in order to justify the trade. I wasn't in my right mind at all. I had no business trading.

I'm sure you know how this story ends. After the close on December 23, the U.S. Department of Agriculture announced that a case of mad cow disease was found in the United States. The impact on the market would be terribly negative. Since I was long cattle futures, and the market was certainly headed for a free fall, my account was in for a slow death, temporarily slowed only by the daily limits in the futures markets. I could only lose \$600 per day per contract, at least until the exchange ex-



FIGURE 0.1 Mad Cow Disease Causes Live Cattle Futures to Collapse

panded the daily downside limit. For my account size, having a “locked limit” down even with one contract was extremely painful.

A week later, after three days of a locked limit down market—where I could not exit at any price—I was finally able to liquidate, with a \$5,400 loss.

This was about seven times the maximum loss I had expected, and as a percentage of my account, it was brutal. Not the end of the world, but it really made me wonder. Was the past month just the start of a prolonged losing streak, both in trading and in life? What was I doing trading anyhow, after all the recent emotional hits to my psyche? And trading on a whim, a hunch? When was I going to stop such destructive behavior? Could I stop such destructive behavior and finally turn into a winning trader? Could this series of unfortunate events provide the impetus to rise from the ashes, to turn my trading around? So many questions—ones I had no answer for.

As it turns out, as bad as this trade was, mad cow disease probably saved my trading life. This book documents that trading story, warts and all. Along the way, I got better and better at developing mechanical trading systems, and later in the book I show you the process I use to develop winning algorithmic trading systems.

■ Who Can Benefit from This Book?

Regardless of the type of trader you are, or your experience level with trading, I think you’ll find something in this book that resonates for you.

For beginner traders, I hope this book is an eye-opener for you. I can’t, and I won’t, fill your head with thoughts of trading profits raining down from the sky. Anyone who tells you trading is easy is flat-out lying to you. Sure, you can make lots of money trading, but you also need to be prepared for a lot of losing, a lot of drawdowns, and a lot of risk. Whenever someone tells me trading is a piece of cake, I always suspect that they are half-baked. My story, as painful as it is at times, is a realistic journey for many retail traders. Of course, as I tell all beginners, read what I have written, but then read books by other traders, too. Keep an open mind to everything. After a lot of reading, you’ll be able to make solid judgment calls on what is correct, what is BS, and what you like and don’t like. The amount of misinformation about trading is staggering, so all beginners must be wary.

For intermediate or slightly experienced but struggling traders, maybe your failures up until this point aren’t a result of psychology or confidence. Many trading books nowadays put a lot of emphasis on the mental aspect, but all the mental preparation in the world won’t help you if you are developing strategies incorrectly. If you’ve ever lost money after you started trading a strategy right after optimizing it, then you probably realize you were doing something wrong. The process detailed in this book should be right up your alley, since it will steer you in the right direction.

For expert traders, most of what I present here you'll have already seen before in some fashion. Certainly, there are many great trading books that discuss many of the issues and problems that I address here. But there is always something new to learn, a different approach to try, and a different way to think. You probably find many items in this book that are different from your current method, and you'll likely benefit from incorporating these new ideas in your trading.

Although the book is designed around algorithmic or mechanical trading, which is what I primarily do, discretionary traders can benefit from the concepts detailed in this book. Maybe there are parts of your discretionary approach that can be statistically tested. For example, let's say your discretionary entry consists of a moving average crossover, combined with your intuition. It might be impossible to test your intuition, but a moving average crossover can be walk-forward tested and gently optimized. Or perhaps you want to evaluate breakeven or moving stops for your exit. There are many wrong ways to test this, but only a few correct ways. You'll learn a correct way in this book. Therefore, utilizing the concepts in this book, you can improve your discretionary approach a great deal, all because you'll know how to properly design and test a trading system. Whether it is a 100 percent mechanical strategy, or a part mechanical and part discretionary system, putting actual performance numbers to entries and exits can only give you confidence and make for a better trading approach.

I have organized *Building Winning Algorithmic Trading Systems* into seven parts. In all seven sections of the book, you'll see me use certain terms interchangeably:

Strategy or trading system—the approach used to trade. This can be rigid rules, general guidelines and principles, or flat-out random guessing. The net result is your strategy or trading system.

Mechanical or rule-based trading or algorithmic trading—a style of trading in which all the rules are defined 100 percent. There is no discretion involved, no decisions to be made by the trader.

Hybrid or mixed trading system—a style of trading that includes aspects of algorithmic trading, along with discretionary trading. An example would be a mechanical system that gives entry and exit signals, but gives the trader the option to accept or reject the signal.

In Part I, I walk you through my trading history. I think my early ups and downs—mostly downs—are pretty typical of new or beginning traders. I paid “tuition” to the market for many years. But I was able to persevere, winning the World Cup Championship of Futures Trading[®] in 2006, and finishing second in 2005 and 2007. After those successes, I reached the point all part-time, hobby shop, retail traders dream of: I was able to leave a promising career and live the dream of trading full time.

In the second part of this book, I tell you how I currently do things. From evaluating trading systems to designing new trading systems, I lay out my process. It is not

perfect, and it is ever evolving, but it contains crucial information that I wish I had when I started out. Even if you just follow bits and pieces of what I do, you should be able to save thousands in market tuition.

In Parts III-VII, I build a trading system, from concept to live trading. It is a good trading system, but by no means the Holy Grail (which, by the way, does not exist). I also discuss in this section what I think is the closest one can get to the Holy Grail—diversification. Finally, I discuss how I monitor my strategies in real time, with a real-time diary of my trading progress through a number of months.

I hope that by reading my story, you'll be able to avoid my mistakes and learn from them. Trust me because, as you'll see, I've made a ton of them.

PART I

A TRADER'S
JOURNEY

The Birth of a Trader

It was 1989, and I was California dreamin'. Actually I wasn't dreaming, I was already in California, living a young single man's dream. A year or so out of college, I was residing in sunny Manhattan Beach, California, with a small apartment three blocks from the soft white sand so wonderful that they used it to help create Waikiki Beach in Hawaii. I had graduated the year before, summa cum laude, with a bachelor's degree in aerospace engineering from the University of Michigan, a top-tier engineering school. Then I had turned my back on Massachusetts Institute of Technology (MIT), California Institute of Technology (Cal Tech), Stanford University, Purdue University, and Michigan, all of whom had accepted me in their aerospace master's degree program. I turned down those great schools to live and work in sunny California, a lifelong dream.

I still remember the precise moment I made that fateful decision. On a bitterly cold winter's day in Ann Arbor, Michigan, I was walking down South University Avenue to one of my final-semester classes. The wind was blowing so hard in my face that I actually leaned into the wind to see if it would keep me up. At that point, falling face-first onto the ice-covered sidewalk would not have been much worse than feeling the stinging wind in my face. What seemed like a gale-force wind kept me upright, and then I knew—I did not want, or need, to live where it was cold in the winter when aerospace engineering graduates like me were flocking to jobs in sunny southern California. My mind was made up. Sun and sand it was.

A few weeks after graduation, I packed up my belongings, and with my sister Karen as my driving companion, drove cross-country to warm and sunny Los Angeles.

One year later, I was settled in. I had a close group of friends, most of them Midwestern transplants like me. We'd while away the weekends playing beach volleyball, usually capping the day off with a few drinks at a local pub. I loved beach living and all the entertainment it provided. Driving around the beach cities in my little red T-roof sports car, life was pretty good.

But something was missing.

I couldn't put my finger on it, but I knew this wasn't the life for me. Well, beach life certainly agreed with me, but my choice of career was the wrong one. Sure, designing future fighter airplanes and working on secret government projects was fulfilling to a degree. But I just didn't feel like it was my future. I could not see myself doing that kind of work for even 5 years, much less a career of 30 or 40 years. I needed a jolt to wake me up. That jolt came in the form of junk mail that appeared in my mailbox one day, and it changed everything.

The junk mail booklet was from Ken Roberts, a futures and commodities trader. Or at least that is how he presented himself. Looking back on it, he was definitely more of a salesman than a trader. With a nice, folksy smile and a cowboy hat, Ken laid out the riches that awaited anyone brave enough to trade futures, or commodities, as they were more commonly referred to back then.

He had a compelling story in that little booklet of his, and I'll admit I was quickly hooked. Looking at a chart of sugar, as shown in Figure 1.1, seeing all the potential profit just waiting for me, how could I not be?

At that point, words like *drawdown*, *risk of ruin*, and *emotional control* were not in my vocabulary. But *massive profits*, *easy money*, and *simple trading* suddenly were! And with a money-back guarantee, how could I go wrong? It was a risk-free entry pass into a world of unlimited profit potential—or so my naive self-thought. So I sent a check and dreamed that night about all the riches that would soon be flowing my way.

A few weeks later, I received the full trading course. It was a hefty manual, full of charts with profitable examples. Initially, I was duly impressed. But then I started to



FIGURE 1.1 Sugar Skyrocketing = Unlimited Profits?



FIGURE 1.2 Good Head and Shoulders Pattern or Just a False Signal?

look a little closer at the details. Turns out the whole course was primarily based on the 1-2-3 head and shoulders pattern. As most traders and investors know, this pattern is a classic chart pattern, as shown in Figure 1.2. It is easy to find on just about any chart you look at—you can find a profitable example or two on most any chart, any instrument, and any time frame.

The problem is that the head and shoulders pattern gives a lot of false signals and usually looks good only in hindsight. Of course, I did not know that at first. I only knew I could look at a chart, pick out the head and shoulders pattern, and see how well it worked.

I eventually found out I was missing two key pieces of the puzzle. First, when you look at a chart with a head and shoulders or any other pattern in it, it is easy to see the winning trades because you are looking at both the pattern and the outcome of that pattern. If you try hiding the outcome of a pattern, it becomes much more difficult to find the good patterns.

The second key I was missing is that the existence of a pattern, by itself, doesn't necessarily mean a trade should be taken. If you take every single head and shoulders trade you see, you will soon be broke, as shown in Figure 1.3. Of course, the naive wannabe trader in me was oblivious to this fact.

After a month of dutifully following and paper trading all the head and shoulders signals, and finding most of them to be unprofitable, I sent all my trading records, along with the manual, back for a refund. True to his word, Mr. Roberts refunded my money.

My dream of trading riches was shattered, at least temporarily. On the bright side, I now saw futures as the way to go—I just realized head and shoulders patterns were not going to be the way. Once I abandoned the get-rich-quick idea with the 1-2-3 head and shoulders patterns, I did what many scientific, numbers-oriented people do: I looked to mathematical formulas to help me in my decision making. And I started where many people do: moving averages.



FIGURE 1.3 Many Head and Shoulders Look Good but Eventually Fail

■ My Moving Average Debacle

I'm sure every trader or investor has seen or used moving averages at some point in their trading career. Moving averages are a great way to see the general market direction, simplifying sometimes chaotic price action. But it comes at a price—lag. Moving averages will always lag whatever their calculation is based on, which can be a major problem.

There are many ways to trade with moving averages. In the simplest method, you simply buy when the price is above the moving average, and sell (or sell short) when price is below the moving average. This scheme works very well during prolonged trends, but gets absolutely hammered during trading range price action (see Figure 1.4).

Early market technician pioneers rectified this by employing two, or even three, moving averages. By using more moving averages, the idea was to filter out some of the trading range whipsaw trades, and leave the long-term, profitable trend trades.



FIGURE 1.4 Great in Trends, Moving Averages Fail in Trading Ranges



FIGURE 1.5 Triple Moving Average Crossovers Can Be Deceiving

After my unsuccessful foray into futures with chart patterns, I was struck by the apparent awesomeness and simplicity of the triple moving average. Looking at a chart, it was easy to see the profitable trades, while the unprofitable whipsaw trades were much harder to detect (see Figure 1.5). During the whipsaw periods, the moving average lines were very close together, and seeing crosses of lines was exceedingly difficult. Obviously, I had learned little from my head and shoulders experience, where what I saw on the chart was deceiving me.

I quickly became a convert to the whole moving average concept, and after a few quick successful tests (I did not understand the need for testing over hundreds of trades at this point, so 10 or 20 trades, computed by hand, were good enough for me!), I decided to fund my first account. Even though I had recently purchased a condo in expensive southern California, which took most of my savings, I was able to scrape together \$5,000 to open an account. Naturally, I was nervous beyond belief. This was my nest egg, at the mercy of moving averages. In retrospect, the insanity of this is obvious, but at the time profits were all I could see.

I decided that my triple moving average system would work perfectly with live hogs, as the contract was called back then. I don't recall if this was the result of testing, where hogs looked the best, or if it was based on margin requirements, with hogs requiring relatively small margin. I suspect the latter. I liked the lower volatility of hogs, too, especially when compared to other agricultural products like soybeans and pork bellies.

With my trusty calculator, the daily newspaper, and a sheet of paper with five columns on it, every morning before work I'd record the date, closing price, and calculate the 4-, 9-, and 13-day moving averages. Then, once I got to work, I'd call my broker and place any necessary trades.

The first few days and weeks of my first trading system went fairly well. I lost more than I made, and I learned firsthand about slippage, broker's errors, and the

general inefficiency of phoning in orders. But I was surviving, which I thought was the most important thing.

Then disaster struck. I was long hogs, and one morning, I was up \$400. I was feeling great—this was my ticket to riches! At lunch, I spent a half-hour trying to convince my ultra-conservative and risk-averse engineering coworker Dave that speculating in commodities was easy for a technical-minded person. Just a few calculations, some simple math (no calculus required), and poof! Money would just add up in my account. He wasn't buying it, and I wondered why.

After lunch, I found out why. I checked hog prices right after lunch. I went from up \$400 to down \$800. A \$1,200 swing in an hour or so. Twenty-five percent of my account vaporized, just like that. I was numb. And I still had the position open since my system hadn't given me a close signal yet.

A few days later, and a few quick whipsaw losers after the big loss, I totaled the damage: \$1,500 in losses—30 percent of my account. Never in my wildest dreams had I expected that outcome. Panic set in. I stopped trading temporarily. Thank goodness I avoided the urge to double or triple my size to avenge my losses (such misguided dalliances would come later in my trading journey).

I took the weekend to regroup, and figure out my next steps. Clearly, I mistakenly thought, after a handful of trades, it was obvious that my triple moving average system was no good. If that system was terrible, my money-losing-addled mind reasoned, then the opposite system would be the answer, right? Sort of like the episode of *Seinfeld* where George Costanza flourishes when he begins to do the exact opposite of what he has always done before.

It was a *eureka* moment for me—if my first system was so bad, then the opposite system had to be just as good! Plus, I did not even need to test or evaluate this plan. All I had to do was add \$1,500 to my initial account balance, instead of subtract it (for some reason, commission and slippage losses somehow became money makers in my twisted reasoning, but that is another story). Sunday night I went to sleep, in my mind thinking I had made \$1,500 with my reverse trading system, when in actuality I had lost \$1,500 with the original system. I was excited and happy. Monday morning, I was ready to jump in with both feet.

Fast-forward a few weeks, and hogs finally hit a great trend. It was a trend that a triple moving average system picked up perfectly. If only I were trading the original method! Of course, with the “opposite” method, big trends were a killer, and that is exactly what the market provided me—a huge losing trade. After that losing trade, my account was now down \$3,000, a 60 percent account loss brought on by the triple moving average and reverse triple moving average systems. I had had enough. I raised the white flag, called it quits for a while, and decided I needed more education.