Market Mastery Second Quarter 2005

Welcome to the second edition of *Market Mastery* in it's new quarterly format.

As a *Market Mastery* Subscriber – you have the benefit of being the first to read Van's ideas, insights and thoughts through this newsletter.

This edition features Van latest work. Van is currently updating and revising his work on position sizing in a new publication, the *Definitive Guide to Position Sizing and Expectancy*. This publication will override his existing work, the Special Report on Money Management. This Definitive Guide to Position Sizing and Expectancy will be for sale later this year, but you are the first to get this information. This issue features the first four of 17 chapters of this new work that has Van so excited.

Understanding Expectancy & The Golden Rules of Trading

By

Van K. Tharp, Ph.D.

Introduction to Expectancy: One of the key fundamentals that every trader/investor must know is "how do you evaluate the effectiveness of your trading methodology." Part One of this book does just that with a thorough evaluation of the topic of expectancy.

In Chapter 1, we explore the Golden Rules of Trading – some core trading fundamentals that you must follow if you are to survive and prosper in today's market. Then, in Chapter 2, we move on to understanding risk and how to properly think about all of your trades in terms of risk-to-reward ratios (or R-multiples as we call them). Both these chapters are critical to understand if you want to survive long-term trading the markets.

In Chapter 3, we get into core ways to monitor how good your system is. It not just expectancy or the average risk-reward ratio in your trading. It's not expectancy times opportunity, although that gets you a little closer. You also have to consider the variability of your system, because if you have a low-variability system, especially when it comes to losses, you can typically make much better returns out of the same expectancy.

Chapter 4 covers the psychological biases that prevent most people from ever using any of this material. If you want to succeed, you must overcome these biases and

In This Issue

Market Mastery

PUBLISHER/EDITOR
Van K. Tharp, Ph.D.

PRODUCTION DIRECTOR
Cathy W. Hasty

Market Mastery is published by International Institute of Trading Mastery, Inc., 102-A Commonwealth Court, Cary, NC 27511, Telephone (919) 466-0043; Fax (919) 466-0408; web site www.iitm.com

make yourself efficient with respect to the market.

So let's get started with the Golden Rules of Trading/Investing.

The Golden Rules of Trading

I bought my first stock when I was 16 years old – over forty years ago. And, considering the knowledge I had about investing at the time, I really did a fairly good job of doing research on the stock. Here's what I did. First, read an article in *Fortune Magazine* on the top growth stocks for that year – I believe it was 1962. The stock I picked was a small mobile home manufacturer, which had the highest growth over the last year in its earnings per share of any stock listed in that article. With that I thought I had done my homework – and it was probably more homework than the average person does before they buy their first stock.

Anyway, the stock was selling for $8 per share. I bought 100 shares with the $800 I'd saved up – which was a lot of money in those days. And what happened? First, within a year or so, the stock went as high as $20 per share. In fact, I don't think I lost any money initially – the stock just did a steady climb. I was deliciously happy and I'd more than doubled my money. However, then it started to go down. And eventually it went below my $8 purchase price.

Now that I was in the hole on my purchase, what did I do? Did I re-evaluate the stock fundamentals? No, I didn't. Did I look to see if there was a better stock, based upon my initial screening criteria – and remember several years had now passed? No, I didn't.

Instead, I just assumed that the same criteria held and the stock was an even better buy now that it was valued at less than I paid for it. When it hit $4 per share, it must have been twice as good as it was when I originally bought the stock at $8, so I bought another hundred shares. And when it hit $2 per share, it seemed like it was an even better buy, so I bought another hundred shares. I now had $1400 invested in this stock and I owned 300 shares. What do you think happened? It went to zero. Within another year or so the company went bankrupt. My $1,400 went to zero. I have no idea where those shares are – I wish I did because I'd frame them. But that stock is now totally worthless. And when I ask people at my workshops, "how many of you have stock that is now worthless," at least half of the people in the workshop are usually willing to raise their hands. That says something to me. A lot of stock ends up going bankrupt!

So what was my mistake? Actually, there were many. But most people would say that I picked the wrong stock. Just think about it. In the early 1960s, I invested $1400 in the stock market. If I had put that $1400 in Microsoft when it was founded in 1975, that investment would be worth millions. If I had put that $1400 in Intel when it was founded in 1968 or even when it went public in 1978, that investment would be worth millions. Even an investment in the original Dow Jones Industrial stock, General Electric, in 1968 would be worth a small fortune today. I could have put $1400 into Berkshire Hathaway when it was founded in 1964 and today have over $5 million from that one investment. So it would seem that my mistake was that I invested in the wrong stock.

That argument is totally fallacious. For every stock I mentioned that would have made me millions, there are thousands of companies that, just like the one I invested in, no longer exist. So the first argument is that my chances of finding one of those great companies that would have made me millions were very, very small. If your criteria is picking the right stock, no matter how good your criteria are, you are still more likely to pick a stock that will eventually go bankrupt than you are of finding one that will make you a fortune.

Second, let's look at the stock I bought. It went from $8 to $20 – that's a 150% gain – in about a year. That doesn't sound like I bought the wrong stock. So what were my problems? There were many.

- I didn't establish any initial risk parameters to say, "I'm wrong about this stock if it drops to this point." If you don't know how to do that, then a 25% drop is usually sufficient to say that something is wrong. Thus, my initial stop loss should have been about $2 per share so that I would get out if the stock dropped to $6 per share.
- Second, I had no way to take profits. I could have said, "if this stock doubles, I'll get out." I could have established a 25% trailing stop. That means that whenever the stock makes a new high, a 25% drop from that point becomes my exit. Table 1 shows my stock at various points and how a 25% trailing stop would have worked. Notice that as the price gets higher, my trailing stop gets higher. And as the price goes down, my stop doesn't change. Thus, when the price goes to $20 and then back down to $15, I'm out. I have a profit of $7 per share. Since my initial investment was $8, I have a profit of 87.5%. However, since my initial risk was only $2, my $7 profit is actually 3.5 times my initial risk. I like to call this a 3.5R profit – where R stands for my initial risk.

Table 1: A 25% Trailing Stop

Stock Price	Trailing Stop
$8	$6
$10	$7.50
$12	$9
$14	$10.50
$16	$12
$18	$13.50
$20	$15
$18	$15
$16	$15
$14	Out at $15

- Third, I had no understanding of position sizing. What that really means is that I risked too much. I had $800 and I risked all of it on one stock. Now, if I had kept a 25% trailing stop, I would have only risked 25% of it or $200 on that stock. But as you'll learn later in this guide, risking 25% on one stock is still way too high. (Incidentally, today's solution to the problem would have been to buy 10 shares – then my risk would have only been 2.5% of my $800. However, that wasn't an option in 1962, when it cost you $65 to buy the 100 shares and $65 to sell it. And if you wanted to buy 10 shares – it might have cost more than $65 because there would have been an extra cost to buy an odd lot.)
- Fourth, I added to a losing position. You should never add to a losing position, but that's what I did.
- Fifth, I had no plan, no rules and no discipline.

Those are all huge mistakes and I didn't understand any of them at the time. But you will understand them when you've finished this book. And understanding them is the key to making sure that you don't make the same mistakes.

As a result, of my many years of study of the best traders and investors in the world, I believe that there are certain "Golden Rules of Trading" that you must follow. I've listed the ten most important below and these rules form the foundation of everything else that follows in this book.

The Golden Rules of Trading:

1. ***Never open a position in the market without knowing your initial risk*** – that point at which you will get out of the position to preserve your capital. This point is your initial stop loss and it establishes your initial risk (which we'll call R for short). In my first investment if I had said, "Get out if the stock drops to $6 per share," I would have been following the first rule. My initial risk, or R, would have been $2 per share.

2. ***Next, you must define your profit and loss in your trades as some multiple of your initial risk***. We call these R-multiples. If your risk is $100 and you make $200, you have a 2R gain. If your risk is $100 and you lose $150, then you have a 1.5R loss. It's a pretty simple concept. In other words, you must start thinking in terms of risk and reward. In my first investment, had I followed the 25% trailing stop rule, I would have had a profit of 3.5R or a profit that was 350% times bigger than my initial risk.

3. ***Make sure you limit your losses to 1R or less***. If you set an initial stop level and then change your mind when it goes down (i.e., because you don't want to take a loss), then you are in real trouble. This is what produces 5R losses or more and those can turn a great system into a losing system very easily.

4. ***Make sure that your profits, on the average are bigger than 1R***. Let's say you have one 10R profit and nine 1R losses. If you add those up you have 10R in profit and 9R in losses, so you have a total gain

Continued

of 1R. Thus, even though you lost money on 90% of your trades, you still made money overall because your average gain was huge. That's the power of having an average gain that is much bigger than 1R.

What's typically known as the golden rule of trading is a summary of these first four rules. It simply states: ***Cut your losses short and let your profits run.*** What we're talking about here is simply doing your best to make sure your losses are 1R or less and that your profits are much bigger (if possible) than 1R. Incidentally, the Nobel Prize for economics in 2002 was awarded to two psychologists, Daniel Kahneman and Amos Tversky, for their discovery of Prospect Theory. While the topic sounds a bit complex, what Kahneman and Tversky actually proved, in my opinion, is that people have a natural bias to cut profits short and let their losses run – which is the opposite of the Golden Rule.

5. The next fundamental is to ***understand your trading system in terms of the mean*** (what's the average R) ***and the standard deviation*** (how much variability is there in the results) ***of your R-multiples***. Your system, when you trade it, will generate a number of trades. The results of those trades can be expressed as a multiple of your initial risk, or a set of R-multiples. You should know the characteristics of that distribution for any system that you plan to trade. And most people never know this.

Now if you spend some time and calculate the mean and standard deviation of your R-multiples, you'll know a lot about your system. The mean R-multiple is what we've been calling the Expectancy of your system. In other words, *expectancy just tells you what to expect from your system in terms of R over many trades*. If your expectancy is 0.33R, then you know that after 20 trades, then you'll probably be up by about 6R to 7R. And that's valuable information to know.

The *standard deviation of R just tells you how variable your system is*. That's also a good thing to know. It tells you how much your results are likely to vary after any given sample of 20 trades.

Let's say your expectancy is 0.33R, but your standard deviation is 3R. What this means is that even though your average gain after 20 trades would total about 6.6R, you only have about a 65% chance of being profitable after 20 trades because of the huge variability. Part one of this book is all about expectancy, and understanding the mean and standard deviation of your R-multiple distribution is very important to telling you how to trade the system you adopt.

6. The next golden rule is that ***you must have some core objectives for your trading***. Those objectives must be stated in terms of what you'd like to make as a goal for your trading and what you would call ruin for your system – the point at which you'd stop trading. When you have those two things, then you have a chance to meet your objectives and you can also calculate the optimum position sizing to meet your objectives. We'll be covering this topic in part three of this book.

7. Of course, this now leads to the next golden rule, which is that in ***order to meet your objectives, you must practice proper position sizing***. Ed Seykota once said that the most important question you could ever ask yourself as a trader is "how much" should I invest once I know the expectancy of my system. Position sizing will be covered extensively in part two of this book. And some of the key rules involving position sizing might include:

- Invest a percentage of your equity so that you invest more as you win and less as you lose.
- You might start out with a percentage of your equity that has a very low probability of reaching your ruin point and then switch to another percentage of your equity when you have enough money to make sure that you don't reach that level. You could do this through a *market's money model* or a *fixed ratio model*. Both will be discussed extensively in this book.

8. Another key golden rule is to ***simulate your system to determine exactly what percentage you can risk.*** I'm now using a software that I had personally developed for me that allows me to do this directly. You can request a report from us and have it done for you as well, with our specific recommendations. For example, how did I know that with a system with an expectancy of 0.33 and a standard deviation of 3R that I'd only be profitable after 20 trades about 65% of the time? I know the answer because I simulated the system. Again, this topic is discussed extensively in this book.

9. The ninth golden rule is to ***know the big picture (what factors are influencing the market); have a way to measure these factors; and have a business plan that helps you capitalize on these factors.*** You then need three or four systems that meet rules 1 through 8 above.

10. Lastly, in my opinion, Golden Rule 10 is ***to follow the ten tasks of trading and to master yourself.*** This rule is the key that makes everything else work. We'll be discussing rules nine and ten in part four of this book.

Risk (R) and R-multiples

By

Van K. Tharp

So let's look at the first golden rule in much more detail to be sure that you understand it. That rule, if you remember it, is to always have an exit point when you enter a position. The purpose of that exit point is to help you preserve your trading/investing capital. And that exit point defines your initial risk in a trade.

Most people define the risk in a trade by its potential volatility – how much can you expect your account (or that position) to fluctuate. However, that's not the definition of risk that we'll use here. Here risk is defined as ***how much*** you'll lose per unit of your investment (i.e., share of stock or number of futures contracts) if you are wrong about the position. I call this initial Risk (R) for short.

Let's look at some examples:

Example 1:

Let's say you buy a stock at $50 and decide to sell it if it drops to $40. What's your initial risk?

The initial risk is $10 per share. So in this case, 1R is equal to $10.

Example 2:

Let's say that you buy the same stock at $50, but decide that you are wrong about the trade if it drops to $48. At $48 you'll get out. What's your initial risk?

In the second example, your initial risk is $2 per share, so 1R is equal to $2.

Example 3:

Let's say that you buy a stock for $24 and you decide to keep a 25% trailing stop. That means you'll sell if it drops 25% from the entry price or from a subsequent higher closing price the stock makes. What's your initial risk? What's 1R for you?

In the third example, you'd sell the stock if it drops 25% to $18. Thus, your initial risk is $6/share and 1R is $6 for you.

Example 4:

Let's say you have a soybean contract at $5.20 per bushel. You decide to sell if it drops 10 cents. What's your initial risk per contract, given that one contract is 5,000 bushels? What's 1R for you?

In this case, you must multiply 5,000 by your loss per bushel of 10 cents. Your initial loss is $500, so 1R is $500 per contract.

Example 5:

Let's say that you want to do a foreign exchange trade, buying the dollar against the euro. Let's say that one hundred dollars is equal to 77 euros. The minimum unit you must invest is $10,000. You are going to sell if your investment drops down by $1000. What's your risk? What's 1R for you.

I made this example sound complex, but it isn't. If your minimum investment is $10,000 and you'd sell if it dropped $1000 to $9000, then your initial risk is $1000, and 1R is $1000.

Are you beginning to understand? R represents your initial risk per unit. It's not your total risk in the position because you might have multiple units – it's simply the initial risk per share of stock or per futures contract or per minimum investment unit.

Understanding R-multiples:

The next key point for you to understand is that all of your profits and losses should be related to your initial risk. You want your losses to be 1R or less. That means if you say you'll get out of a stock when it drops $50 to $40 then you actually do get out when it drops to $40. If you get out when it drops to $30, then your loss is much bigger than 1R. It's twice what you were planning to lose or a 2R loss. And you want to avoid that possibility at all costs.

You want your profits to ideally be much bigger than 1R. For example, you buy a stock at $8 and plan to get out if it drops to $6, so that your initial 1R loss is $2 per share. You now make a profit of $20 per share. Since this is 10 times what you were planning to risk we call it a 10R profit.

Let's look at some more examples to make sure that you understand. Here the answers will be given at the end of the exercises.

1. You buy a stock at $40 and plan to exit if it drops to $38. However, the stock goes to $37 and then gaps down five points at the open the next day. You get out as soon as you can at $31.

Your $9 per share loss is what multiple of your initial risk?

2. You buy a stock at $40 and plan to exit if it drops 10% to $36. You eventually sell when the stock rises to $80 per share. What's your profit as an R-multiple?
3. You buy a stock at $40 with a planned exit at $36. You sell it at $45, what's your profit as an R-multiple?
4. You buy a stock at $60 and plan to get out if it drops to $55. However, when it goes that low, you don't sell. Instead, you just stop looking at it and hope it will go back up. It doesn't. It becomes part of the headline business news involving corporate scandal and eventually the stock becomes worthless. What's your loss as an R-multiple?
5. You buy a stock at $50 and plan to sell it if it drops to $49. However, the stock takes off and jumps $20 in three weeks where you sell it. What is your profit as an R-multiple?
6. You buy a stock at $50 with a 25% trailing stop. The stock goes as high as $64 and then drops 25% where you get out at $48. What is your loss as an R-multiple?
7. You buy a stock option at $3. You determine that if the option drops by 50%, you'll get out. However, you get lucky and the underlying stock goes up $10 and your option goes up in value to $12 where you sell. What is your profit as an R-multiple?
8. You buy a stock option for $4.50. You decide that you'll sell the option if it drops to $3 or less. However, the stock gaps down overnight and you find yourself with an option that's only worth $1.5. You decide to hang on, hoping the stock will come back. It doesn't. Instead, the option expires worthless. What's your loss as an R-multiple?
9. You buy a futures contract for corn at $3 per bushel. You decide that you'll sell if wheat drops to $2.90 per bushel. Instead, wheat goes up to $4.50 per bushel. What is your profit as multiple of your initial risk?
10. You decide to buy a $40 stock when it breaks out of a trading range at $40.35. You decide that you'll sell it if it moves back into the trading range at $40 and you also keep a 10% trailing stop on it as it become profitable. The stock moves to $57.20 and then you get stopped out at $51.48. What's your profit as an R-multiple?

Answers: *Be sure you understand these answers before moving ahead in this workbook. In each case, I indicate what a 1R loss is. I then divide the profit or loss by 1R to determine the R-multiple. It's that simple.*

1. A 1R loss is $2. Your loss per share is $9, so you have a 4.5R loss.
2. A 1R loss is $4. Your profit per share is $40, so you have a 10R profit.
3. A 1R loss is $4. You profit per share is $5, so you have a 1.2R profit.
4. A 1R loss is $5. Your loss per share is $60, so you have a 12R loss. Hopefully, you can understand why you never want to let this happen.
5. A 1R loss is $1. You profit per share is $20, so you have a 20R profit. And hopefully, you understand why you want this to happen all the time.
6. A 1R loss is $12.50. Your loss per share is $2, so you have a 0.16R loss. This is the sort of loss you want. Some people might argue that you allowed a profit to turn into a loss. However, the key is, your followed your rules.
7. A 1R loss is $1.50 or half the value of the option. Your profit is $9 which is a 6R profit.
8. A 1R loss is $1.50. Your total loss is $4.50, so you have a 3R loss.
9. A 1R loss is 10 cents. Your total profit is $1.50, so you have a 15R gain.
10. Your initial risk is a 1R loss of 35 cents. Your profit is $11.13 (i.e., $51.48 less your cost of $40.35 = $11.13). If you divide $11.13 by 35 cents, you get a profit of 31.8R. Again, this is the kind of profit you want.

Using the total risk to keep track of your R-multiples.

It can get quite complex to keep track of the risk per unit and the profit or loss per unit. In addition, there are also transaction costs involved which won't get figured into your profit or loss per share. As a result, an easier way to determine the R-multiple distribution of your trades is using the total initial risk and the total profit or loss (after costs) to determine your R-multiples.

Let's say that you have a $100,000 account and you want to keep your total risk per position to about 1% of your account value or $1,000. Here's what a sample of trades might look like.

1. You buy a stock at $40 and plan to exit if it drops to $38. You buy 500 shares which at a risk

Table 2-1: Determining R-multiples from Total Risk			
Transaction	**Total Risk**	**Profit or (Loss) Including costs**	**R-multiple**
400 CSCO at $23	**$1000**	**$2,317**	
80 IBM at $80	**$1000**	**($813)**	
300 VLO at $50	**$1000**	**$3,413**	
400 HRB at $51	**$1000**	**($1,531)**	
500 IRF at $13	**$1000**	**$3,890**	
400 ISIL at $16	**$1000**	**($776)**	
600 LSI at $5.35	**$1000**	**$4561**	
500 MYL at $17.50	**$500**	**($567)**	
400 ORI at $31	**$800**	**($2314)**	
300 SRA at $40.77	**$600**	**$1,571**	
	Total	**$9,571**	

of $2 per share gives you a total risk of $1000. However, the stock goes to $37 and then gaps down five points at the open the next day. You get out as soon as you can at $31. Your total loss is $9 per share times 500 shares or $4,500. You also had transaction cost of $24, making your actual total loss $4,524.

Notice how this is quite similar to the initial example. Your initial total risk is $1000. Your total loss was $4500, so you had a 4.5R loss. Wasn't this the same answer you got for the first example above? It should have been. However, your actual total loss, including transaction costs was $4524. Thus, your actual R-multiple loss was 4.524R. Notice how the only difference between using total risk and risk per share is that with total risk you can include your costs in the R-multiple which makes it a little more accurate.

Let's do one more example.

2. You buy a stock at $40 and plan to exit if it drops 10% to $36. Since you want to keep your total risk to $1000, you only buy 250 shares. Notice that 250 shares time $4 risk per share equals $1000 in total risk. Now, you eventually sell when the stock rises to $80 per share. Your total profit for your 250 shares is what? If your transaction cost are $35, then what's your profit as an R-multiple?

This problem is again like the second example above, only now we are using total risk. Your total risk is $1000, so you can call 1R a thousand dollars. Your 250 shares of stock cost $10,000 and you are selling it for $20,000 less your transaction costs in and out of $35. Thus, your profit is $10,000 less $35 or $9,965. Since your initial risk is $1,000, your profit as an R-multiple is 9.965R. In the per share example, we got 10R – the only difference being the transaction costs.

Table 2-1 shows the typical monthly transactions of a trader. You see the stock, the initial risk, and the profit or loss (including transaction costs). Your job is to fill in the R-multiple. Notice that this trader didn't hold his total risk constant at $1,000, so you'll have to take that into account.

I'll make it easy on you. All you have to do is divided the total profit or loss (including transaction costs) by the initial risk to get the R-multiple for that column. Do it now.

Okay, Table 2-2 now shows the answers that you should have gotten from doing the exercise. We've rounded them to two decimal places. Are those the answers you got?

Notice that it wasn't that hard to calculate your R-multiples. The only problem came when the total initial risk varied and you had to divide by a different number.

Notice that in Table 2-2, I've given a total and average profit and a total and average R. In this case, they are fairly similar. The total profit is $9571 and your total R is 9.65R. The relationship is similar, however, because the initial risk was pretty close to $1,000 for all of the trades.

What if You Don't Know Your Initial Risk?

What if you don't know what your initial risk was? Perhaps your initial exit was variable and it wasn't possible to say exactly what it would be at the onset. Perhaps you didn't understand the first golden rule and you didn't have an exit.

Anyway, for some reason, you have a set of trades and you don't know what your initial risk is. Nevertheless, you'd still like to get a rough idea of your R-multiple distribution of your system. What can you do?

What I recommend is that you use your average loss to represent 1-R. Let's see how that works out in the last sample. We had five losses.

Table 2-3 shows the five losses.

Notice that we're 20% over $1,000 using this estimation. Nevertheless, at least it gives us an idea of what 1-R might be for this system. Now let's plug in $1200 as 1-R into Table 2-2 and see how much it changes

Continued

the results. These are shown in Table 2-4.

Notice that the only difference here is that the total and average R is smaller. Thus, it is not a bad estimate.

However, when you use total risk in determining your R-multiples, there is sort of an assumption that you are using the same factor in determining what your total risk will be (i.e., like 1% of your equity). When it varies, you are probably just as accurate to use the average loss to determine 1-R.

Table 2-2: Determining R-multiples from Total Risk

Transaction	Total Risk	Profit or (Loss) Including costs	R-multiple
400 CSCO at $23	$1000	$2,317	2.32R
80 IBM at $80	$1000	($813)	-0.82R
300 VLO at $50	$1000	$3,413	3.41R
400 HRB at $51	$1000	($1,531)	-1.53R
500 IRF at $13	$1000	$3,890	3.89R
400 ISIL at $16	$1000	($776)	-0.78R
600 LSI at $5.35	$1000	$4561	4.56R
500 MYL at $17.50	$500	($567)	-1.13R
400 ORI at $31	$800	($2314)	-2.89R
300 SRA at $40.77	$600	$1,571	2.62R
Total	$8,900	$9,751	9.65R
Average	$890.00	$975.10	0.965R

Table 2-3: Using Average Loss to Determine 1-R

Transaction	Profit or (Loss) Including costs
80 IBM at $80	($813)
400 HRB at $51	($1,531)
400 ISIL at $16	($776)
500 MYL at $17.50	($567)
400 ORI at $31	($2314)
Total Loss	$6001
Average Loss	$1200.20

Table 2-4: Determining R-multiples from Average Loss

Transaction	Total Risk	Profit or (Loss) Including costs	R-multiple
400 CSCO at $23	$1200	$2,317	1.93R
80 IBM at $80	$1200	($813)	(0.68R)
300 VLO at $50	$1200	$3,413	2.84R
400 HRB at $51	$1200	($1,531)	(1.28R)
500 IRF at $13	$1200	$3,890	3.24R
400 ISIL at $16	$1200	($776)	(0.65R)
600 LSI at $5.35	$1200	$4561	3.80R
500 MYL at $17.50	$1200	($567)	(0.47R)
400 ORI at $31	$1200	($2314)	(1.93R)
300 SRA at $40.77	$1200	$1,571	1.31R
	Total	$9,571	8.11R

Evaluating How Good Your Trading System Really Is

by

Van K. Tharp

The basic, most-traditional way of evaluating the quality of a system is through its expectancy. And the traditional definition of expectancy is usually given by the following formula.

Expectancy = [(Average Profit) * (Probability of Winning)] Less

[(Average Loss) * (Probability of Losing)]

However, the formula is incorrect because expectancy really gives you the average profit per dollar risked, whereas this formula simply gives you the average profit. Thus, the formula must be corrected as follows:

Expectancy ={ [(Average Profit) * (Probability of Winning)] Less

[(Average Loss) * (Probability of Losing)]}/ Average Risk Amount

And the way you'd determine expectancy is to follow that formula. Let's look at how we might use the data previously given in Table 2-1 to calculate expectancy in this manner. We already know that the average loss is $1200.20. Our system has five winners and five losers, so the probability of winning and losing are each 50%. So, all we need to calculate expectancy is to subtract the size of the average win and divide the result by the average risk.

Let's determine what that is. Table 3-1 shows the winning trades from our sample.

Table 3-1: Calculating Our Average Gain	
Transaction	**Profit Including costs**
400 CSCO at $23	**$2,317**
300 VLO at $50	**$3,413**
500 IRF at $13	**$3,890**
600 LSI at $5.35	**$4,561**
300 SRA at $40.77	**$1,571**
Total Profit	**$15,752**
Average Profit	**$3,150.40**

Thus, we know that the average gain is $3,150.4 and that the probability of winning is 50%. Thus, the first part of the formula is $1,575.20.

We also know that the average loss is $1,200.20 and that the probability of losing is 50%. Thus, the second part of the formula is $600.10.

And to determine the expectancy, we subtract $600.10 from $1,575.20 and we get $975.10. The average risk is $890 so the expectancy is $975.10/$890 = $1.096. And So what does that really tell us? It tells us that we can expect to make a little over a dollar per dollar risked with this system.

But let's take a look at Table 2.2 again (from the last chapter).

Do you see, the number $975.10 in that table? It's the average profit/loss of the system. Thus, ***the traditional definition of expectancy really refers to the average profit or loss of the system*** and, as I already said, needs to be corrected by dividing it by the average risk per trade.

Table 2-2: Determining R-multiples from Total Risk			
Transaction	**Total Risk**	**Profit or (Loss) Including costs**	**R-multiple**
400 CSCO at $23	**$1000**	**$2,317**	**2.32R**
80 IBM at $80	**$1000**	**($813)**	**-0.82R**
300 VLO at $50	**$1000**	**$3,413**	**3.41R**
400 HRB at $51	**$1000**	**($1,531)**	**-1.53R**
500 IRF at $13	**$1000**	**$3,890**	**3.89R**
400 ISIL at $16	**$1000**	**($776)**	**-0.78R**
600 LSI at $5.35	**$1000**	**$4561**	**4.56R**
500 MYL at $17.50	**$500**	**($567)**	**-1.13R**
400 ORI at $31	**$800**	**($2314)**	**-2.89R**
300 SRA at $40.77	**$600**	**$1,571**	**2.62R**
Total	**$8,900**	**$9,751**	**9.65R**
Average	**$890.00**	**$975.10**	**0.965R**

However, if you look at the R-multiple column in Table 2-2, it becomes obvious that we can also express expectancy with respect to R. In fact, another definition of expectancy is really the average R-value of the system. Thus, Table 2-2 really shows that the expectancy of this system can either be expressed in terms of dollars gained per dollar risked or in terms of R.

Sometimes, when people do not know the initial risk for every trade, they use the average loss to reflect R. When we plugged that into the formula, the best we got was an estimate of expectancy (i.e., 0.811R) and not as accurate as when you use the actual risk for every trade, which gives you 0.965R.

Thus, of three possible formulas for expectancy

• Average profit/average amount risked = 1.096

• Using the average loss to equal the average risk = 0.811

Versus

• Using the average R-multiple = 0.965

Only the average R-multiple gives us any better than an approximation of expectancy.

However, when we go through this exercise, expectancy becomes quite easy to understand. The expectancy of your system is the average of the R-multiples (both positive and negative) of your system. It tells you what you can expect to achieve in terms of R, on average, over many trades.

On our system given in Table 2-2, expectancy was 0.965R. Thus, we know that we will make nearly one times our risk on the average over many, many trades. In fact, over 10 trades we can expect to make 9.65R. Over 100 trades we could expect to make 95.5R.

This information is quite valuable because it tells us that if we were to risk 1% of our equity on every trade, we'd make an average of 0.965% per trade. Furthermore, after 100 trades, we'd probably be up 100% or more – actually more, since 1% would continue to get bigger as we continue making money. That is, when you have 100,000, you'd be risking 1% of that or $1,000. But when you have $110,000, you'd be risking 1% of that or $1,100. Thus, your 1% risk would continue to go up as you made money.

What About Variability?

The way I've presented this information it looks very simple and straightforward. You make 0.965R, on the average, per trade. And if your total risk were 1% per trade, you'd make 0.965% per trade. After 100 trades, you'd probably be up over 100%. Well, on the average, you would be! But the average is not the total picture, what about deviations from the average?

To understand how much your system can deviate from the average, you must not only know the average R-value (i.e., expectancy), you must also know the variability of R or its standard deviation.[1] This variability will tell us how far away from the mean (expectancy) most samples that you will draw are likely to be. It would be great if all samples were at the mean, but that is never the case because it would mean that there was no variability to the sample. Every R-multiple, in our sample, would have to be 0.965R.

You can calculate the expectancy and standard deviation of the R-multiples of your trade samples by simply using an Excel spreadsheet. Put your sample R-multiples in a column. Go to the blank cell at the end of the column, and click on the function (Fx) at the top. A box will pop up and then you need to click on statistical, which will give you another box. You can then click on AVERAGE, which will give you the expectancy and then click on STDEV and you'll get the standard deviation. That's all you need to know.

Before you go on, plug in the 10 R-multiples from Table 2-2 into an Excel spreadsheet. Find the average (expectancy) and the standard deviation of R (STDEV). You should get the values 0.965 and 2.661225. Now that you can do that, you can keep a running calculation of the expectancy and the standard deviation of the R-multiples of your trades. This is a good practice to do at least once each week.

Table 3-2 shows you a sample of what your trades might look like if you put them into Excel every week. It's really pretty simple and I strongly recommend that you do that.

You need to set up a spreadsheet with the following columns at the top:

1. Date

2. Trade

3. Entry Price

4. Stop Price

5. Number of Shares (Contracts)

6. R-value (Difference between #3 and #4 x (times) the number of shares)

7. Percent Risk (not necessary here, but good policy to include)

8. Total Entry Cost Including Commissions

9. Total Exit Price Less Commissions

10.Total Profit/Loss (i.e., the difference between #8 and #9)

11. R-multiple (which is #10 divided by #6)

At the bottom of your spreadsheets you can simply total the R-multiples and divide by the number of trades to get an example of expectancy.

Notice in this table:

[1] The standard deviation is a measure of the variability of a sample of data. It's not important for you to understand how to calculate the formula, because you can use a simple calculator or an Excel spreadsheet to determine the standard deviation. All you really need to know is that the standard deviation really gives you a measure of the variability of your sample.

1) How easy it is to calculate the risk: This is a $50,000 account so all trades should have approximately $250 risk (1/2% risk) or $500 risk (1% risk). I deliberately selected some data that shows two different risk levels which you need to factor out (i.e., by dividing by R) in order to get the expectancy.

2) R-multiples can be calculated automatically and it is easy to sort them and see the R-multiple distribution.

3) The R-multiple total, the expectancy, and the standard deviation can be calculated automatically at the bottom of the spreadsheet.

So What's the Downside?

And now that you know your standard deviation, you can get an estimate of the downside. If you look at the original way the trades came up in Table 2-2, you'll see that at one point we had two losses in a row. Those losses were a 1.13R loss followed by a 2.89R loss. Thus, in our original sample we had a peak drawdown of 4.02R. But what if we had five losses in a row – which is quite possible in a 50% system with enough trades? We could have a drawdown of 7 to 10R?

And if you risked 10% on each trade, you'd be pretty close to bankrupt by the end of the losing streak. You wouldn't be bankrupt, because each time you'd only risk 10% of your remaining equity. That might look like the sequence of trades in Table 3-3.

Most people would consider the system to be totally broken and stop trading. Yet it is something that is possible. And by the way, risking 10% is way too much risk for this system or for any system.

How Do You Evaluate A System?

When you know all three pieces of information – all three of which you should understand at this point – it's –possible for you to totally evaluate how good your system is. Those three pieces of information are:

1. The expectancy of your system as an R-multiple

2. The standard deviation of your system

3. The number of trades it generates.

Let's take a look at the R-multiple distribution of six different systems and see which one's you'd want to trade. Three systems are given in Table 3-4 and another three systems are given in Table 3-5.

You'll notice that the expectancies and standard deviations are all over the place. Each system also produces a different number of trades and each system has a different win rate. One system wins 90% of the time, while another system only wins 10% of the time. So which system would you want to trade and why? Also notice what your criteria

Table 3-3: Five Losses in a Row

Trade	Equity	Risk	R-Multiple	Result
1	$100,000	$10,000	-0.82	-$8,200
2	$91,800	$9,180	-1.53	-$14,045
3	$77,755	$7,776	-0.78	-$6,065
4	$71,690	$7,169	-1.13	-$8,101
5	$63,589	$6,359	-2.89	-$18,378
	$45,211	Totals	-7.15	-$54,889

Table 3-2: How to Set Up a Spreadsheet, Calculate Expectancy and Your R-multiple Distribution

# Shares	Stock Symbol	Entry Price	Stop Price	Entry Risk	Gain/Loss	R-Multiple	% Risk	R-multiples Sorted	Selling Price
50	BRCM	194.1250	189.13	250.00	1643.75	6.58	0.45%	7.70	227
55	INSP	221.0000	216.00	275.00	2117.50	7.70	0.49%	7.53	259 1/2
55	HLIT	130.0000	125.00	275.00	378.13	1.38	0.49%	6.58	136 7/8
55	TXN	150 1/8	145	281.875	629.06	2.23	0.50%	2.23	161 9/16
55	JDSU	255	250	275	2069.38	7.53	0.49%	2.20	292 5/8
25	JDSU	281.1875	276.00	129.69	285.94	2.20	0.23%	1.83	292 5/8
60	EMLX	179.5000	174	330.00	(360.00)	(1.09)	0.59%	1.38	173 1/2
60	COMS	112.0000	107	300.00	(420.00)	(1.40)	0.54%	0.26	105
80	NEON	87.8125	82.6	417.00	(355.00)	(0.85)	0.74%	(0.10)	83 3/8
35	SDLI	447.5000	439.00	297.50	544.69	1.83	0.53%	(0.11)	463 1/16
70	EMLX	194.0625	189.00	354.38	(457.19)	(1.29)	0.63%	(0.81)	181
70	INCY	231.6875	225.50	433.13	(48.13)	(0.11)	0.77%	(0.85)	231
80	EMLX	214 1/2	209 1/4	420	(40.00)	(0.10)	0.75%	(1.00)	214
475	MPEG	3.2600	2.26	475.00	(484.50)	(1.02)	0.91%	(1.00)	2.24
40	INSP	255.2500	250.00	210.00	(170.00)	(0.81)	0.40%	(1.02)	251
80	NEWP	170 9/16	165	445	115.00	0.26	0.86%	(1.09)	172
95	EMLX	211	206	475	(665.00)	(1.40)	0.91%	(1.18)	204
80	EMLX	219.6875	214.00	455.00	(455.00)	(1.00)	0.88%	(1.29)	214
80	HLIT	140.1250	135.00	410.00	(485.00)	(1.18)	0.86%	(1.40)	134
45	JDSU	279.0000	270.00	405.00	(1440.00)	(3.56)	0.78%	(1.40)	247
65	BRCM	244.5625	239.00	361.56	(1011.56)	(2.80)	0.71%	(2.80)	229
75	TXN	180.9375	175.00	445.31	(445.31)	(1.00)	0.87%	(3.56)	175
				Totals	946.75	13.096			
				Expectancy =		0.448			
				Standard Deviation=		**3.093**			

Continued

are for deciding which system you like the best.

Write down which system you would prefer to trade and why. Also note what your criteria were for your selection. If you had more than one criteria, list them in order of your preference.

____

____

____

____

However, make your decision about which system is best without looking at the appendix.

Method 1: Rank in Terms of Expectancy. The first way to evaluate the systems might be to rank them in terms of their expectancy. And if two systems were fairly close, you might prefer the system with the higher winning rate. If you did that, you'd probably have the following results as show in Table 3-6.

You'll notice from the first analysis, that the expectancy is almost inversely related to the win rate. That's actually quite common for trading systems and it's one reason people tend to lose money. They are attracted toward systems with high win rates, which sometimes have a very low (or even negative) expectancy. Notice that our 90% system had a negative expectancy.

Expectancy alone is a very naïve way to evaluate systems. It doesn't take into account variability or potential drawdowns or the number of trades. Was your initial evaluation of the systems anything like this?

<u>Method 2: Expectancy Times Number of Trades.</u> The next way you might evaluate the systems is to multiple the expectancy by the number of trades it would give you in a month. The net result would be how much you'd expect to be up in terms of R at the end of the month. So let's look at Table 3-7 which ranks our six systems with respect to this criterion.

Notice that this changes things a little bit. System 3-5 is still the best system. But system 3-6, with 35 trades now ranks second. And the two systems with the most trades, 3-2 and 3-3, were not helped because their expectancies were either negative or very low.

<u>Method 3: Using Statistics to Evaluate the System.</u> The first two methods of evaluating the six systems that we've used above, did not take into effect the variability of the systems and the potential for large drawdowns. What if we were to use some method that we take those factors into effect?

Well, we can use the following formula to do that:

System Quality = [Expectancy / Standard Deviation R]/ square root of Number of Trades

This is actually equivalent to a statistical t-score which you would use to evaluate if the expectancy is significantly better than zero. And it is a great tool to determine which system is really best.

So let's look at the various systems with this in mind. These are shown in Table 3-8

Notice what has happened. System 3-4 actually has the best ratio between expectancy and its standard deviation, and even though it only has 12 trades per month, that's still enough for it to be in first place. However, system 3-2, which had the worst positive expectancy and the smallest standard deviation, has now vaulted into second place. It suddenly looks like a pretty good system, just because it has a lot of trades and very low variability. And system 3-6, which ranked fairly high in our other tests, now becomes the lowest ranking positive expectancy system. Notice that nothing can save system 3-3 with its negative expectancy.

So by the most accurate measure system three-four is the best system and system three-two is the second best. Did you rank either of these systems as the best systems in your initial evaluation of the six systems? If not, what was your thought process that caused you to pick the others.

Rating Your System

Using the System Quality Formula, let's see if we can make some guidelines for evaluating a system. These are given in Table 3-9. You will understand how I developed these criteria later in this book.

I expect that most people with systems will have scores of 1.75 or less, so don't be upset if your system's score isn't excellent. I suspect that there are very few systems that rank as high as 2.0 or better.

In addition, you probably need to be very careful with highly ranked systems. Chances are you have not yet seen your worst-case loss (although that probably applies to every system). However, for highly ranked systems, a significant loss (i.e., a 5-R psychological loss) could significantly damage your equity because you may have overestimated your position sizing.

All of these quality scores *assume that you have 100 trades* (i.e., N = 100). N, in the formula, should refer to the number of trades gathered in a fixed amount of time (i.e., one year). And in order to compare your system on this standard, you must use the number of trades you make per year and use that as N in the formula. This is because there is a very critical issue of how fast you get the 100 trades.

A system that makes 100 trades in a week is going to be much better than a system that makes the same 100 trades over a three-year period. For example, a system with an expectancy of 0.35 that makes 100 trades in a month will have an average gain of 35R at the end of the month. When you compare that with another system that has an expectancy of 1.25, but only takes three years to make 100 trades (i.e., 2.78 trades per month) will only have an average gain of 3.47 R per month. The second system might have a system rating of 2, compared with a system rating of 1 for the first system. However, most people would still be happier with the first system because it makes money fast.

Statistical Assumptions in Using this Material

One major difficulty in using this material to evaluate your system and that difficulty is the statistical assumptions we must make to assume that your R-multiple distribution is valid. In other words, does your sample of trades really reflect what will happen when you trade your system?

When you make ten trades, what you've really done is taken a sample of 10 (ten) trades from the universe of possible trades that your system might generate. And the questions you must ask yourself are 1) is this system statistically profitable and 2) how accurately does this sample of trades represent the population of trades that my system might generate.

Let's look at the two questions separately:

First, is my system statistically profitable? If you look at the formula we gave you for determining how good your system is, you'll find that it is also a formula that you can use for looking up whether or not your system will be statistically profitable.

System Quality = (Expectancy / Standard Deviation)]/ (square root of Number of Trades)

This formula is basically the formula for a t-score. When you use a t-score, you are asking the question is this result statistically different from the hypothesis that my system is not profitable. That is, if you have a positive expectancy, what you are asking is the question: "Is this significantly different from a zero or negative return?" And if there is a 95% probability that it is different, then you can reject the hypothesis that it has a negative or zero return on the average.

Generally, the larger the number, the more likely it is that you can reject the hypothesis. Appendix II shows some t-scores at various percentiles that you can use to answer this question for yourself.

Incidentally, the t-score is based on the assumption that your data fit a normal bell curve. Most trading systems have fat tails – i.e., that have one or two big trades that make up most of the profits. Nevertheless, the t-score will at least give you a rough estimate of how good your system is as we have already recommended.

Second, we need to ask the question: How well do these trades from my system adequately represent the actual trades that my system will generate? This is an even more important question if you are going to use your R-multiple distribution to determine such things as how to do position sizing with your system. For example, if you think your system only has a 10% probability of a 20R drawdown, but your sample of trades doesn't adequately represent what your system could do, then you could easily have a 50R drawdown. Thus, the whole issue of "do my

Table 3-4: The First Three Sample Systems

System 3-1		System 3-2		System 3-3	
	R-multiple	Number	R-multiple	Number	R-multiple
7	-1R	10	-1R	1	-10R
1	-5R	10	+1.3R	9	+1R
2	+10R				
20% win rate		50% win rate		90% win rate	
25 Trades per Month		75 Trades per Month		60 Trades per Month	

Table 3-5: The First Three Sample Systems

System 3-4		System 3-5		System 3-6	
Number	R-multiple	Number	R-multiple	Number	R-multiple
55	-1R	18	-1R	2	-10R
12	-2R	2	50R	4	-5R
3	-5R			10	-1R
5	+1R			5	+3R
4	+5R			2	+15R
3	+10R			1	+30R
3	+25R				
17.6% win rate		10% win rate		33% win rate	
12 Trades per Month		15 Trades per Month		35 Trades per Month	

trades adequately represent my system?" is very important.

Generally, the larger your sample is the more likely it is to adequately represent the true population statistics. Thirty is usually considered the minimum size to begin to reflect the population. Thus, if you have 30 trades, you probably have enough trades to begin to estimate the overall performance of your system.

Unfortunately, with trading it's a bit more complicated than just having a large number of trades. You must also ask the question, what kind of market did I have when I took my sample of trades. Generally, there are six kinds of markets:

- Up volatile markets (this was the stock market in 1999)
- Up flat markets (this means that everything goes up very smoothly) – it's almost a straight line up without a lot of choppiness. You are going to have to subjectively decide what's volatile and what's not. But if you compare a lot of different markets, it's not that hard to do.
- Flat, volatile markets. The stock market was basically flat in 2004. Sometimes it was volatile and sometimes it reflected the next kind of market, flat and non-volatile.
- Flat, non-volatile markets. The first part of 2005 definitely reflected this kind of market. The major averages went nowhere and they seldom moved by much more than a percentage point in an entire week.
- Down, volatile markets. This was definitely the NASDAQ market in 2000.
- Down, quiet markets. Most bear markets also have periods like this when the averages move down every week, but not radically.

Table 3-6: Ranking the Systems by Expectancy

System	Expectancy	Win Rate
3-5	4.10	10%
3-4	2.87	17.6%
3-6	1.05	33.3%
3-1	0.80	20%
3-2	0.15	50%
3-3	-0.10	90%

Table 3-7: Ranking the Systems by Expectancy Times Number of Trades

System	Expectancy	Number of Trades	Expectancy* Number Trades
3-5	4.10R	15	61.5R
3-6	1.04R	35	36.4R
3-4	2.87R	12	24.44R
3-1	0.8R	25	20R
3-2	0.15R	75	11.25R
3-3	-0.1R	60	-6R

Table 3-8: Ranking the Systems by Our Statistical Formula

System	Expectancy/Standard Dev.	Square Root N	Formula
3-4	0.34	3.46	1.18
3-2	0.13	8.66	1.13
3-5	0.26	3.87	1.01
3-1	0.17	5	0.85
3-6	0.12	5.92	0.71
3-3	-0.03	7.75	-0.23

Table 3-9: Using the System Quality Formula to Rate Your System Based Upon 100 Trades

Quality Score	Rating Of Your System
Less than 0.75	Probably very hard to trade
0.75 to 1.25	Average System
1.26 to 1.75	Good System
1.76 to 2.50	Excellent System (few exist)
Above 2.50	Superb System (may not exist)

These can eat you to death if you are long.

While you might not trade your system in all six kinds of markets, to get an adequate idea of how your system will perform overall, you'd need a large sample of trades (ideally 100 plus, but certainly at least 30 trades) from each of these six markets.

If you don't meet these criteria, and few people ever do, then you really have no idea what to expect from your system. The best you can usually say is something like, "I have 50-100 trades from a volatile bear market (i.e., fill in the kind of market that was going on when you made the trades) and I have a pretty good idea how my system will perform under those conditions. Furthermore, I need to make sure I only trade under these conditions.

What Can I Expect In The Future?

By

Van K. Tharp, Ph.D

The purpose of this chapter is to give you an idea of what to do when you want to ask the question: What can I expect from my system in the future? Most people backtest their system to determine if it gives them a good enough return (i.e., expectancy). In my opinion, this exercise that most people go through is simply to give enough confidence to trade a system, because whatever data you use to test your system is only one sample of many possible samples.

For some people, testing one sample, through backtesting, is enough to gain the confidence needed to trade a system. If you like the sample, you might conclude that you'll trade the system. But your real job at this point is to now ask some very standard questions. These include:

1. Is my data statistically reliable? Does my sample really represent the kind of results I can expect from my system?

2. Is this system valid? Does it really do what it is supposed to do?

3. And lastly, if the first two questions are acceptable, what can I expect from this system in the future? What will happen in terms of drawdowns? What can I expect to earn? How variable will my performance be?

4. And, with the objectives I have in mind and the results of my testing, how should I position-size this system to adequately meet my objectives?

So the key now is how do you answer these questions?

Is My Sample Reliable?

So you've now done some backtesting on your system. You have a sample of 25 trades, representing a year of trading. Now you must ask yourself the critical question: "Are these results representative of what could really happen with my trading system, trading real money in the markets?"

There are several rules of thumb that you can generally use to help you answer this question. First, is your sample size large enough. Statisticians usually require a minimum sample size of thirty to even begin to estimate the overall population. In other words, your system could generate an infinite number of trades and you need at least thirty samples to even begin to estimate what that infinite population might look like. If you have 100, or better yet, 500 samples, then you can feel even better about the results you might be getting.

As traders, however, we can do even better than have a large sample size. You can use some common sense logic by asking yourself some important questions. These include:

1. What is the purpose of my system? For example, your system might be a trend following system. Wouldn't it make sense that your system would only work well when the markets are trending? But will it perform equally well in down-trending markets as in up-trending markets? Will it perform equally well when the market is volatile and trending (very active with large daily ranges) as when the markets are quiet and trending? And now that you know what the system was designed to do, you should ask yourself the next question:

2. What kind of markets did I take my sample from? Generally, there are six kinds of markets: 1) up-trending, volatile; 2) up-trending, quiet; 3) sideways, volatile; 4) sideways, quiet; 5) down-trending, volatile; and 6) down-trending, quiet. In order for you to adequately predict how your system will do in the future, you need to sample at least 30 trades from each of those kinds of markets. That means you need a sample of at least 180 trades – 30 from each of the six kinds of markets to adequately answer the question, "How will my system perform in the future." A sample of 500 trades really won't do you any good if it is just from up-trending quiet and volatile markets. Why? Because it won't tell you how your system will perform in other types of markets.

3. Lastly, you can restrict your system to trading certain kinds of markets by putting some sort of filter on it. For example, *Safe Strategies for Financial Freedom* recommends trading Bear Market Mutual Funds in a down market. However, this requires either a 1) quiet, down market or 2) a volatile, down market for it to work. So how do I filter for those markets? First, I require that the 1-2-3 model be in the red-light mode (see *Safe Strategies for Financial Freedom* for how that model works). And, second, I require that all three major indices be down over the last five weeks. The model doesn't take a trade unless those conditions are

met. And the chances are pretty good that you won't see this sort of signal in an up market, although it might happen occasionally in a sideways market.

Is Your System Valid?

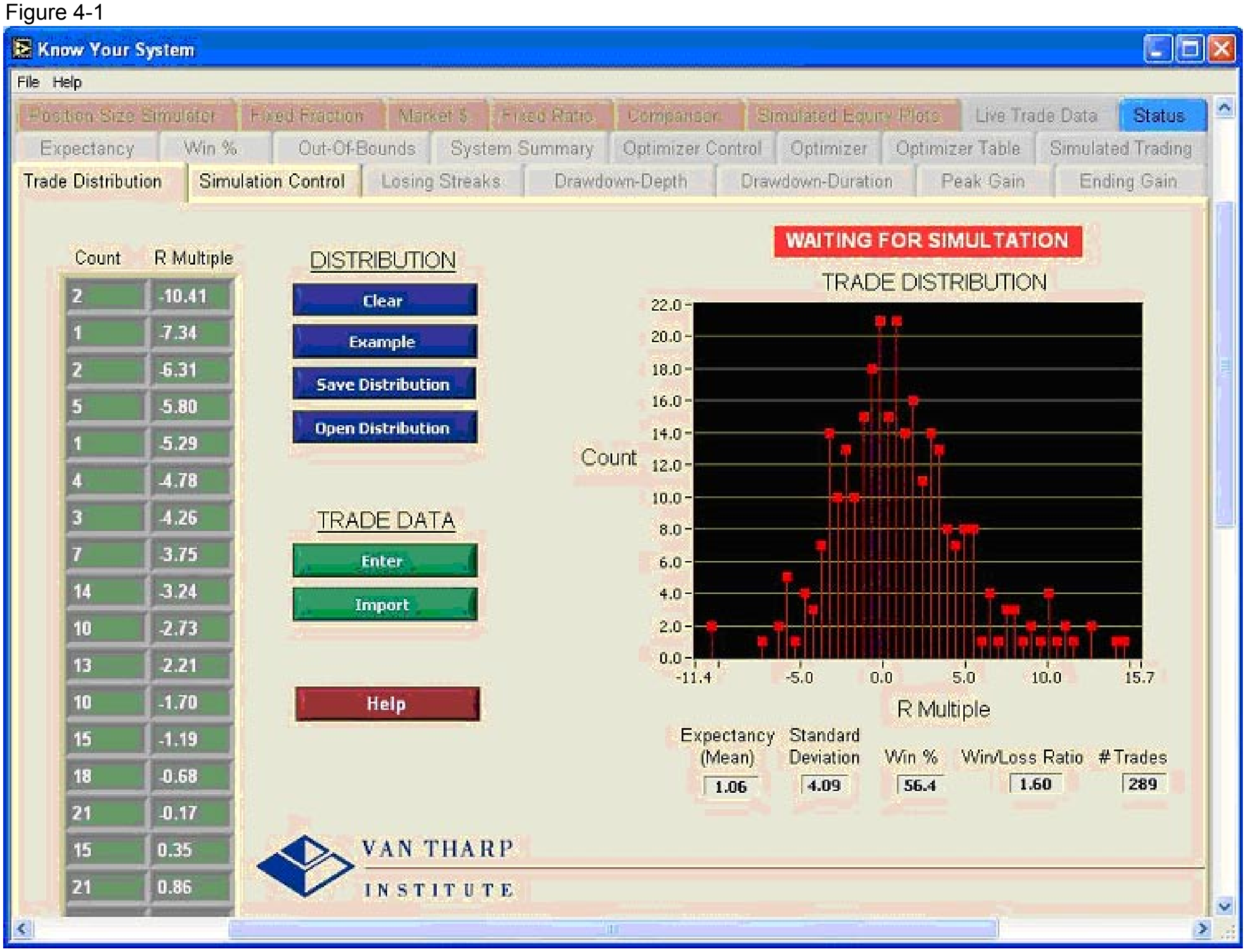
Once you are satisfied that the answer to the first question is okay – "yes, your sample of trades does represent the real performance of your system" – then you must ask the second question: "Does this system do what it is supposed to do – make money?" If it does, then you probably have a decent system. There are several ways that you can answer this question.

First, you can do a Monte Carlo simulation of your system to determine if a sufficient number of samples make money. Let's say you have a sample of 30 trades. You want to determine what happens when you sample 10,000 30-trade samples. What percentage of these samples make money? You then have to determine what number you will be happy with.

Most people would probably be happy with the system if 95% of the samples made money. Think of the implications of this. It means that in a year, you'd only have about one losing month every other year. That would delight most people. Ninety-five percent of the samples making money is usually required for statistical significance, so most people don't have a system that is statistically valid.

What happens if only 85% of your samples make money? This would mean that you'd lose money in two of the ten months of trading. Would you be satisfied with that? Most people probably would, since it's still way above average. How about if only 75% of your samples make money, implying that you'd only make money in 9 out of the 12 months of the year. Or how about 60%, implying that you'd only make money in 7 of the 12 months – would you be happy with that? Anyway, at some point, you'd decide that your system wasn't good enough and wasn't worth trading. And my suspicion is that most of you would

Figure 4-1



want at least 75% of your samples to make money.

Another approach to this would be to look at the system quality formula in which you plug in the exact number of trades you will have in a year into your sample (i.e., N= ?). Now you basically have a t-score and you can get a rough idea of whether or not your results are statistically different from zero (i.e., the assumption you won't make money) simply by using a table. Again, most of you won't have a statistically significant system.

Once you are happy that your system will make money, you can go on to answer the third and fourth questions.

What Can I Expect From My System in the Future?

Question three now takes system performance testing way beyond the scope of backtesting. In backtesting you only have one sample – a historical sample of some many months or years of data. You might have 1000 samples of data, but it still just represents what happened in the past – not what will happen in the future.

However, you can get a better idea of what might happen in the future by taking your data sample and plugging the R-multiple distribution into a Monte Carlo simulator, like the *Know Your System* software that I had personally developed for my trading. Through the simulator, you can now begin to answer questions like:

1) What can I expect from my systems in terms of drawdowns? What is the maximum drawdown in terms of R? What is the probability of getting a drawdown as big as 20R in my sample of 100 trades? How long might that drawdown last?

2) How will I know what to expect in terms of losing streaks? What's the chances of getting a losing streak of 10 in a row or bigger with this system in 100 trades?

3) How will I know when this system is broken or no longer working?

4) And most importantly, given the results of the simulation, how can I position-size this system to adequately meet my objectives in trading it.

The first three questions are answered below, but we'll wait until the section on position sizing to answer question four.

Our first objective is to show you about simulating your system and we'll use the results to answer these questions.

First, we plug our R-multiple distribution into *Know Your System*. This looks something like Figure 4-1. Notice that on the first page you get a picture of the system R-multiples, the expectancy and standard deviation of the system, and the win-loss ratio. These are all shown in the figure.

You then run the simulator. In the case of the figure, we are running a simulation of 10,000 runs of 130 trades. This takes about 15 -30 seconds to do with one of today's fast computers.

Here's what happens when we run the simulator. It takes the R-multiple distribution we plug into it and assumes that it is the population of trades possible for our system. Now you can plug in the simulator a number of ways, first you can simply enter the R-multiple distribution. You can also import an Excel spreadsheet that has your trades in it. And lastly, you can even importants a series of profit and losses from an Excel spreadsheet and *Know Your System* will assume that your average loss is equal to 1R.

For trade one, the simulator randomly selects an R-multiple value from the sample it has and assumes it's the result of the first trade. For trade two, it does the same thing and it could select the same value again, because every time it selects randomly from the possible population. For example, you could have a 20R trade that only occurs 1% of the time. That particular trade might be sampled ten times in a row. This would be a very unlikely occurrence (with a probability of 1.0E – 20), but it's possible. Anything is possible and that's the beauty of the simulator. It tells you what is possible in 2,500 to 10,000 samples of your data. And it will determine an entire equity curve in terms of R for you for each sample.

Figure 4-2 shows you what a hypothetical set of equity curves (in terms of R) might look like for 10,000 samples. The middle one is what you can expect, on the average, but there is also a chance for curves at the extremes and that's how you begin to learn what you can expect from your system. The lines show what might be expected; what's above average and what's below average.

One of the most important questions that most people want to answer about their system is, "What's possible in this system in terms of drawdowns?" *Know Your System,* because it uses R-multiples for its input, also calculates its downdowns in terms of R-multiples. But isn't that rather useful information? What's the peak drawdown against you in terms of its cumulative R-multiple?

Suppose you had the following sequence of trades: +1R, +2R, +10R (here you make an equity peak and then start a drawdown), -2R, +1R,

Figure 4-2

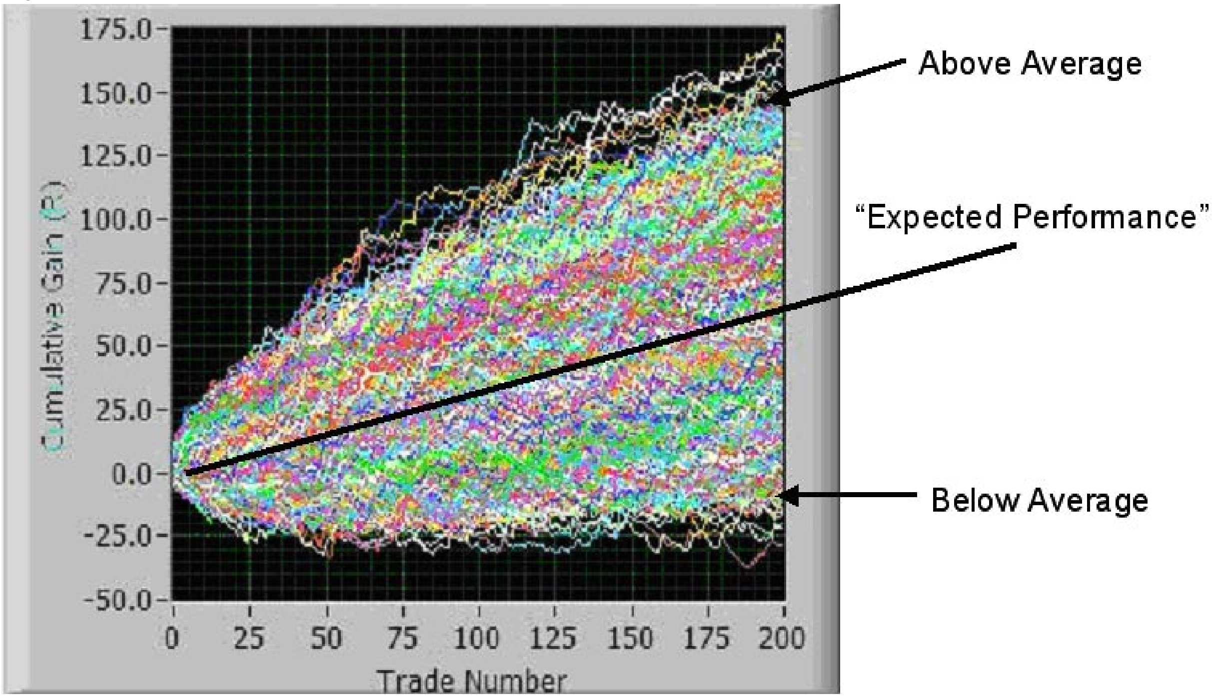
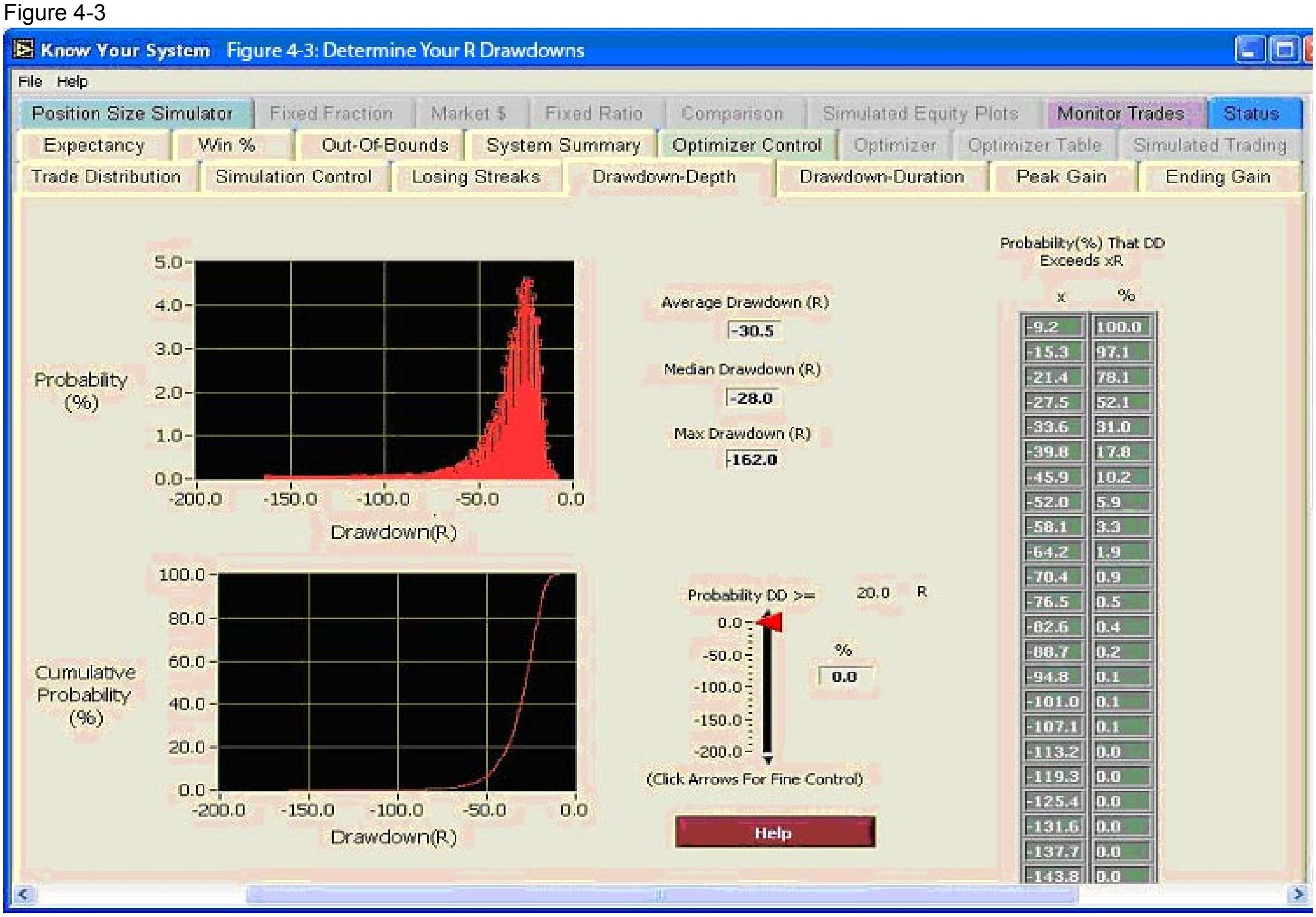


Figure 4-3



-3R, +1R, -2R, -1R, -1R, -5R, (the drawdown peak occurs here and then you start to move out of it) +2R, +2R, +1R, +10R, +5R, etc. If you add up all of those R-multiples during the drawdown, you'd find they added up to a total drawdown of –12R. You then get four trades, giving you +15R, so by the time you hit the 10R, you are at a new equity peak in terms of R. If you didn't hit a new peak, but instead started another streak of losing trades, then you might find that your peak-to-trough drawdown was even bigger than –12R.

Anyway, suppose you are simulating 200 trades as we are doing in this example, what the simulator does is determine the maximum peak-to-trough drawdown achieved during the 200 trades. It keeps track of that number for each of the 10,000 simulations and then let's you know what the average peak-to-trough drawdown is and what the chances are of getting a drawndown as big as X-R. This is illustrated in Figure 4-3.

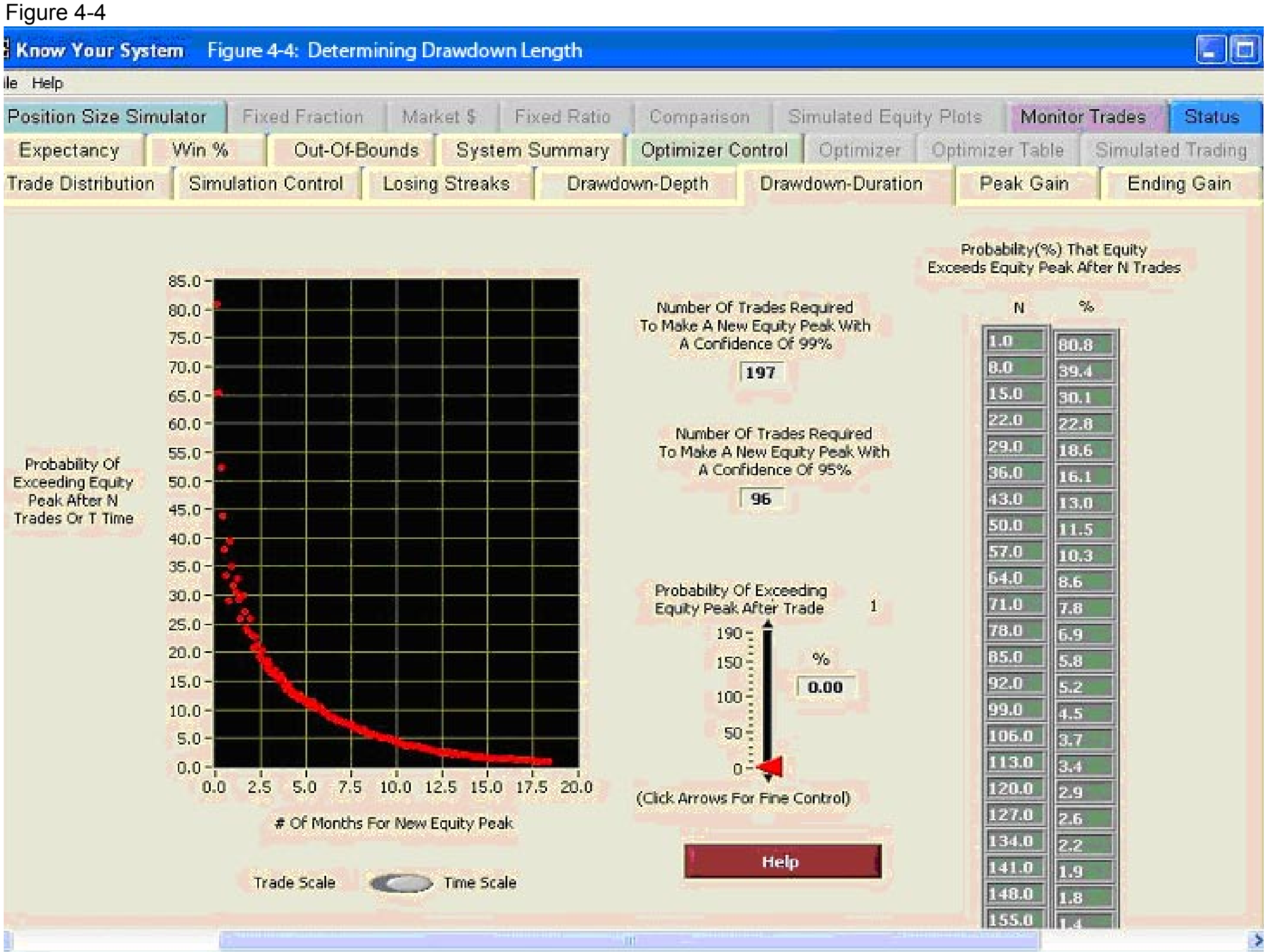
Figure 4-3 shows a bar chart of the peak drawdowns plus a cumulative probability chart. Those both show up in the figures. It also shows you your average (mean) drawdown, your median drawdown (50% above and below this number) and your maximum drawdown in the 10,000 simulations. It also gives you the option of asking the question, "what is the probability of getting a drawdown as big as X or bigger?"

You can determine that by moving the arrow to the appropriate R level and the answer appears in the box at the side.

The other thing the simulator can tell you about your potential drawdowns is "how long could they last?" These can be measured in terms of trades (i.e., how many trades will it take to get out of this drawdown with a 95% certainty?) or in terms of months (i.e., how many months will it take to get out of this drawdown with a 95% certainty). These data are show in Figure 4-4.

In Figure 4-4, you can see, depending upon the size of the drawdown, a graph showing how long it takes to

Figure 4-4



N	%
1.0	80.8
8.0	39.4
15.0	30.1
22.0	22.8
29.0	18.6
36.0	16.1
43.0	13.0
50.0	11.5
57.0	10.3
64.0	8.6
71.0	7.8
78.0	6.9
85.0	5.8
92.0	5.2
99.0	4.5
106.0	3.7
113.0	3.4
120.0	2.9
127.0	2.6
134.0	2.2
141.0	1.9
148.0	1.8
155.0	1.4

get out of it. As mentioned above, you can set this to show how many trades it takes or how long it takes. *Know Your System* can determine how long it takes because you've already told it how many trades you are likely to make each month.

Notice that we've set the drawdowns to certain confidence levels. For example, the little box in the top middle of figure 4-4 tells you how many trades it will take to have a 99% certainty of getting out of the drawdown.

The second box gives you a 95% certainty. Of course, most drawdowns will take much less time. You can also use the arrow to determine how long it could take to get out of a specific sized drawdown. Are you beginning to see how useful this information can be?

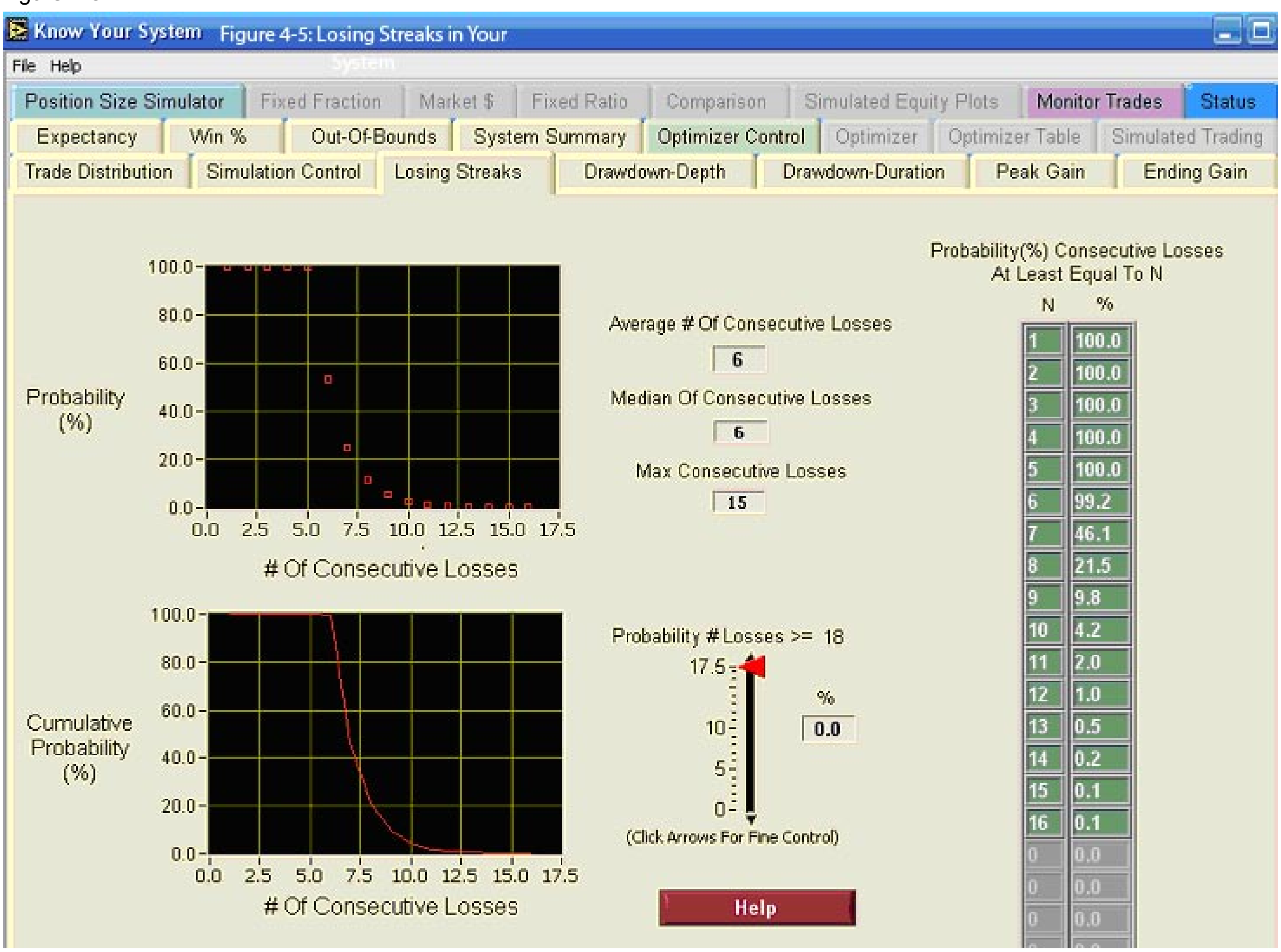
Another very interesting thing the simulator can do is tell you about potential losing streaks that you might have to face. This is shown in Figure 4-5.

The graphs at the left of the figure show the probability of each sized losing streak plus the cumulative probability. Furthermore, the little boxes in the middle show the average number of consecutive losses, the median number, and the maximum number.

You can also determine the probability of any particular losing streak just by moving the arrow to the appropriate length losing streak and then reading the probability in the little box.

There are always precautions to determining such data. For example, one of my clients tested his system over eight years and had 2000 samples. They determined that the system had 70% winners and that the largest losing streak was 11 consecutive losses. However, now they were doing real trading. They had 84 trades. The system had 52% winners and had already reached 8 consecutive losses. Was the system broken? The temptation was certainly to say, the system was broken. But most of the characteristics of the system appeared normal. And, I pointed out to my client that when you get a streak of 8 losses in 100 trades, it will certainly take your

Figure 4-5



hit rate down. Chances are that the system was not broken, but had just hit one of those periods. And they knew it was possible to get 11 losses in a row, so it had not exceeded its outer boundaries.

At this point in your testing, you might feel a little discouraged. In the case of our sample system, it shows that we can expect an average of 6 consecutive losses and that it's possible to get as many as 15 losses in a row. We've also determined that our average drawdown is 30R and it could get as big as 152R. It looks very discouraging, but remember these are average and worst case scenarios. Now we need to see what's possible from the profit side.

As a result, now we want to look at how much profit can we expect at the end of 130 trades. And what's the likelihood of that occurring.

This now takes us to two more screens in the simulator. One shows us the peak equity gain during the 200 trades and the other shows us the ending equity gain. The peak equity gain is only interesting if you want to see how much of that you are likely to give up before you reach the end of your 130 trades (i.e., unless you want to stop trading should you reach that number). As a result, let's look at the ending equity screen. This is shown in Figure 4-6 (see page 22).

The two graphs in Figure 4-6 show both a bar chart and a cumulative probability chart showing the average ending gain in terms of R. The top box shows that our average ending equity will be 181R, while the second box shows that the median ending equity will be 101R. And the third little box in the middle shows that the maximum ending equity could be as big as 308R. Suddenly, the news is much more encouraging. If we just risked about 1% on each trade, we'd probably be up as much as 100% at the end of the 200 trades. Great!

We can also use the arrow at the bottom of the middle of the figure to calculate the probability of an ending equity being greater than or equal to a particular R value. So let's say we wanted at least 20R at the end. The box shows us that we have a 94.3% probability at the end of 130 trades of being up by 20R or more. Again, excellent news compared with the drawdown and losing streak news.

The next thing we want to get is an overall summary of what to expect from the system. This is critical and it gives us a good idea what to expect overall with one standard deviation boundary conditions around the mean.

So let's look at our system's summary page. This is given in Figure 4-7 (see page 23). The figure shows each of the following statistics, which can be very valuable.

- The win/loss ratio.
- The expectancy plus or minus one standard deviation.
- The average number of losing streaks.
- The peak gain, plus or minus one standard deviation.
- The ending gain, plus or minus one standard deviation.
- The probability of breaking even (i.e., making money or better) at the end of the number of trades we have entered.
- The 95% drawdown duration.
- The average yearly gain in terms of R (based upon the number of trades you said you'd make each month).
- And the gain to drawdown ratio which is important.

This information now gives you some very important guidelines against which to evaluate your system. Will it meet your objectives? That is, can you tolerate the drawdowns and does it make enough money for you to tolerate those drawdown. All sorts of things that are very valuable.

At this point, we should have answered your question about whether or not the system can meet your trading objectives. However, now we need one more piece of information. How do we know when the system is broken?

This is shown by the boundary conditions. *Know Your System* has a built-in function where it shows you what can happen to your system in terms of R-drawdown as a particular probability level. This is shown in Figure 4-8 (see page 24).

Essentially what this figure shows is some cumulative R-multiple total that you decide is out of bounds. How do you determine that? You set the arrow to indicate the percentage of paths that you might want to accept. In the figure, this is set for 75%. You then press calculate, and *Know Your System* will draw a graph to indicate what when your data now falls into the out of bounds condition. For example, between 10-15 trades for this system, out-of-bounds seems to fall at about –10R. However, by the time you reach 20 trades you should be profitable. Thus, if your data fall outside of these criteria, you know that you either got a bad sample (i.e., in the bottom 25%) or you can say that your system is broken. And, of course, if you set the out-of-bounds criteria higher enough (i.e., 95-99%), then you really do know the outer limits of your system where you might want to say that "something is wrong."

Figure 4-6

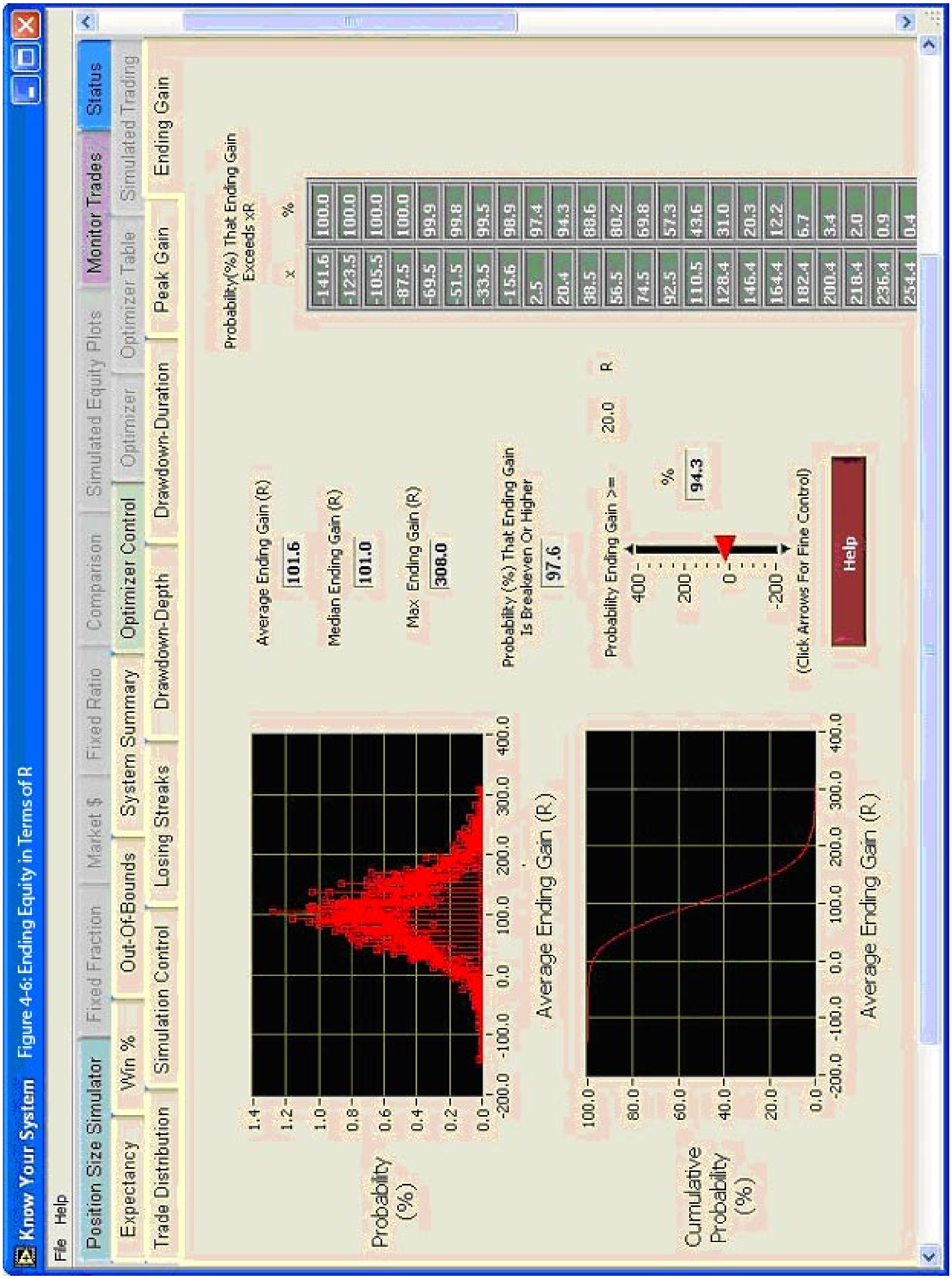

Know Your System
Figure 4-6: Ending Equity in Terms of R
File Help
Position Size Simulator
Fixed Fraction
Market $
Fixed Ratio
Comparison
Simulated Equity Plots
Monitor Trades
Status
Expectancy
Win %
Out-Of-Bounds
System Summary
Optimizer Control
Optimizer
Optimizer Table
Simulated Trading
Trade Distribution
Simulation Control
Losing Streaks
Drawdown-Duration
Drawdown-Depth
Peak Gain
Ending Gain
Probability (%)
Average Ending Gain (R)
Cumulative Probability (%)
Average Ending Gain (R)
101.6
Median Ending Gain (R)
101.0
Max Ending Gain (R)
308.0
Probability (%) That Ending Gain Is Breakeven Or Higher
97.6
Probability Ending Gain >= 20.0 R
% 94.3
(Click Arrows For Fine Control)
Help
Probability(%) That Ending Gain Exceeds xR
x %
-141.6 100.0
-123.5 100.0
-105.5 100.0
-87.5 100.0
-69.5 99.9
-51.5 99.8
-33.5 99.5
-15.6 98.9
2.5 97.4
20.4 94.3
38.5 88.6
56.5 80.2
74.5 69.8
92.5 57.3
110.5 43.6
128.4 31.0
146.4 20.3
164.4 12.2
182.4 6.7
200.4 3.4
218.4 2.0
236.4 0.9
254.4 0.4

Figure 4-7

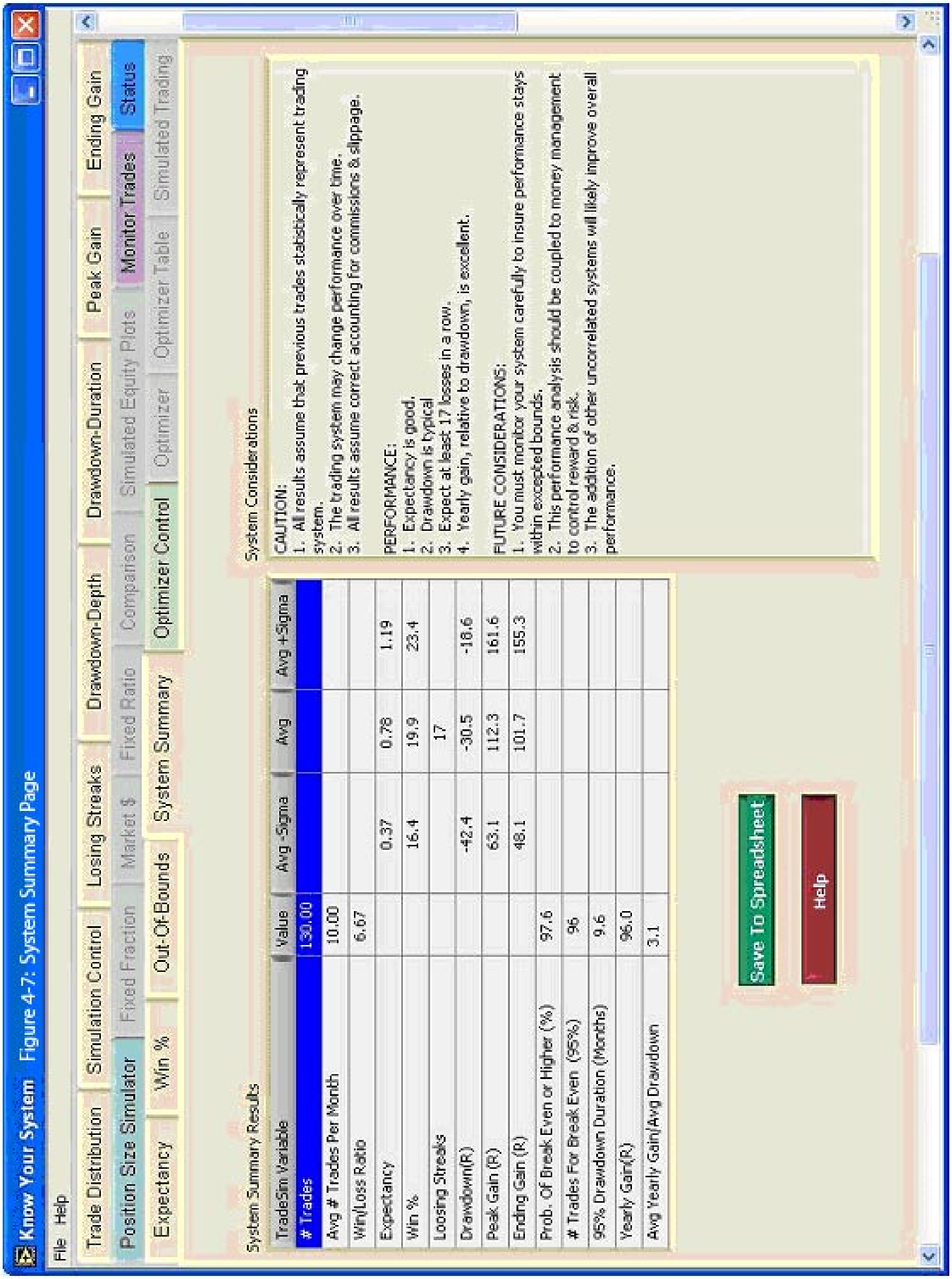
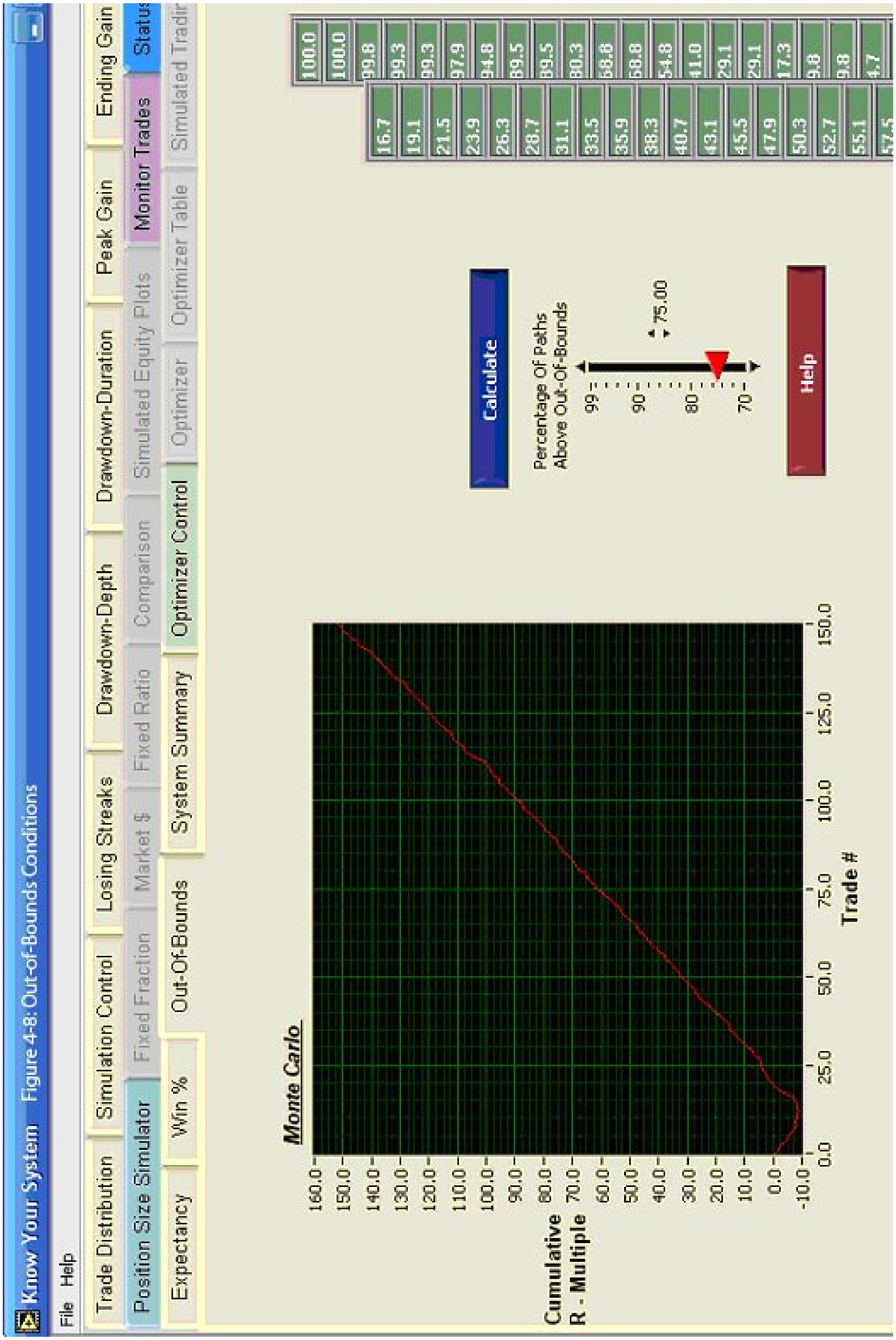

Know Your System Figure 4-7: System Summary Page
File Help
Trade Distribution
Simulation Control
Losing Streaks
Drawdown-Depth
Drawdown-Duration
Peak Gain
Ending Gain
Position Size Simulator
Fixed Fraction
Market $
Fixed Ratio
Comparison
Simulated Equity Plots
Monitor Trades
Status
Expectancy
Win %
Out-Of-Bounds
System Summary
Optimizer Control
Optimizer
Optimizer Table
Simulated Trading
System Summary Results
TradeSim Variable | Value | Avg -Sigma | Avg | Avg +Sigma
Trades | 130.00
Avg # Trades Per Month | 10.00
Win/Loss Ratio | 6.67
Expectancy | 0.37 | 0.78 | 1.19
Win % | 16.4 | 19.9 | 23.4
Loosing Streaks | 17
Drawdown(R) | -42.4 | -30.5 | -18.6
Peak Gain (R) | 63.1 | 112.3 | 161.6
Ending Gain (R) | 48.1 | 101.7 | 155.3
Prob. Of Break Even or Higher (%) | 97.6
Trades For Break Even (95%) | 96
95% Drawdown Duration (Months) | 9.6
Yearly Gain(R) | 96.0
Avg Yearly Gain/Avg Drawdown | 3.1
Save To Spreadsheet
Help
System Considerations
CAUTION:
1. All results assume that previous trades statistically represent trading system.
2. The trading system may change performance over time.
3. All results assume correct accounting for commissions & slippage.
PERFORMANCE:
1. Expectancy is good.
2. Drawdown is typical
3. Expect at least 17 losses in a row.
4. Yearly gain, relative to drawdown, is excellent.
FUTURE CONSIDERATIONS:
1. You must monitor your system carefully to insure performance stays within excepted bounds.
2. This performance analysis should be coupled to money management to control reward & risk.
3. The addition of other uncorrelated systems will likely improve overall performance.

Figure 4-8



The Van Tharp Institute, 102-A Commonwealth Court, Cary, NC 27511, 919-466-0043, www.vantharp.com