

## Understanding Expectancy and Other Keys to Trading Success

He who **thinks** he knows, doesn't know. He who knows that he doesn't know, knows.

*Lao Tse*

When I told one of my clients that I was going to write a chapter in this book about expectancy, his response was, "Oh, no, knowing about that is one of our edges." However, I don't think expectancy is a trade secret. In fact, in my opinion, there are six key variables that must be included in a successful trading system. None of these variables are what most people would call "trade secrets." Before we go into the details of expectancy, let us explore these six variables that have such large effects on the profits and losses of a trader or investor.

### THE SIX KEYS TO INVESTMENT SUCCESS

This chapter is probably the most difficult to understand in the book. The material is complex, but it is critically important if you want real success as a trader or investor! In order to simplify the material as much as possible, I have **elected to** repeat it through different metaphors many different times. You only have to "get it" once, however, to really understand the incredible benefits these variables can unleash for you.

Let's think about trading or investing in terms of the following variables:

1. Reliability, **or what percentage of time you make money.** For example, if you made 10 stock trades and made money on 6 of them, then your reliability is 60 percent. It's the number of winning trades you make divided by the total number of trades. Sometimes, reliability is called the "hit rate." Basically, it is the percentage of time you get to be "right" in your system.

2. The relative size of your profits compared with your **losses** when traded at the smallest possible level (i.e., one share of stock or one futures contract). For example, the relative size of your profits and your losses would be the same if you lost \$1 per share on losing trades and made \$1 per share on winning trades. However, the relative size would be quite different if you made \$10 per share on winning trades and only lost \$1 per share on losing trades. It would now be 10 to 1.

You can get a good idea of the relative size of your profits to your losses by taking the average size of your winning trades and comparing that with the average size of your losing trades. This will give you a rough idea of relative size. However, you might have one giant profit and many small losses, so this is not an exact measure.

A more exact measure would be to think of your gains as multiples of the initial risk (**R**) that you took in the trade. Thus, your gains might be a whole series of R multiples. For example, let's say you are willing to risk \$500 on a trade (i.e., you'll get out immediately if you have a \$500 loss so that it doesn't get any bigger). Your basic risk is \$500. Thus, a \$1,000 gain is a **2-R** multiple and a \$5,000 gain is a **10-R** multiple. And if by some misfortune, you have a \$1,000 loss, then you'll have a **2-R** loss. You'll learn more about R multiples later in this chapter.

3. **Your cost of making an investment or trade.** This is the destructive force on your account size whenever you trade due to execution costs and brokerage commissions. Quite often, people simply include these costs when figuring the average gain or the average loss. However, it is also wise to be aware of just how big these costs are for you.

4. **How often you get the opportunity to trade.** Now imagine

holding the first three variables constant. Their combined effect depends upon how often you trade. Let's **say the** combined effect of the first three variables is that you make 20 cents per dollar risked. That means that if you make 100 trades, each risking \$100, you will end up with a total profit of \$2,000.' However, now imagine that it takes one day to make 100 trades. You'd make \$2,000 per day. Now compare that with a system that makes 100 trades each year-you'd only make \$2,000 per year trading. The opportunity factor makes a big difference.

5. The size of your trading or investing capital. The effect of the first four variables upon your account depends significantly upon the size of your account. For example, even the cost of trading will have a significant effect on a \$1,000 account. If it costs \$100 to trade, then you would take a 10 percent hit on each trade before you'd make a profit. You'd have to average more **than** 10 percent profit per trade just to cover the cost of trading. However, the impact of the same \$100 in costs becomes insignificant if you have a million dollar account.

6. Your position-sizing model or how many units you trade at one time (i.e., 1 share of stock versus 10,000 shares of stock). Obviously, the amount you win or lose per share is multiplied by the number of shares traded.

Different trades probably will have different risk levels, or different *R*s. Thus, a 1-*R* loss probably will not be the same for trade *X* as for trade *Y*. Your reaction might be to say, "What good is the concept of *R* if it varies all over the place?" The value comes in through position sizing. For example, if you risk a constant percentage of your equity, like 1 percent, then you will be equating each 1-*R* risk. If you have \$100,000, then you would only take a \$1,000 risk (i.e., 1 percent) on each position. Thus, if 1 *R* is a single dollar on one trade, you would purchase 1,000 shares. If 1 *R* was \$10 on another trade, then you would purchase 100 shares. In each case, your 1-*R* risk would be a constant, representing 1 percent of your equity. We'll be discussing position sizing in much more detail later in this book.

Would you want to focus on just one of those six variables? Or do you think that all six of them are equally important? When I ask the question in that manner, you probably agree that all six variables are important.

However, if you were to devote all your energy to focusing on just one of those variables, which one would it be? Perhaps you think this question is a little naive since all of them are important. Nevertheless, there is a reason behind this question, so write your answer in the space provided.

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A N S W E R :

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The reason I asked you to focus on one item is because most traders and investors often only focus on one of the six items in their day-to-day activity. Their focus tends to be on the need to be right. People are obsessed with it to the exclusion of all else. Yet if all six components are important to success, you can begin to understand how **naïve** it can be to just focus on being right.

The first four variables are part of the topic I call expectancy. They are the primary focus of this chapter. The last two variables are part of what I call money management or position sizing. We'll touch upon position sizing in this chapter, and we'll focus on it in detail in Chapter 12.

## THE SNOW FIGHT METAPHOR<sup>2</sup>

To illustrate the importance of all six variables, let me guide you through a metaphor that might give you a different perspective from one of just thinking about money and systems. Imagine that you are hiding behind a large wall of snow. Someone is throwing snowballs at your wall, and your objective is to keep your wall as large as possible for maximum protection.

**Thus**, the metaphor immediately indicates that the size of the wall is a very significant variable. If the wall is too small, you couldn't avoid getting hit. But if the wall is massive, then you are probably not going to get hit. Variable 6, the size of your initial equity, is a little like the size of the wall. In fact, you might consider your starting capital to be a wall of money that protects you. The more money you have, assuming the other variables stay the same, the more protection you will have.

Now imagine that the person throwing snowballs at you has two different kinds of snowballs-white snowballs and black

snowballs. White snowballs are a little like winning trades. They simply stick to the wall of snow and increase its size. Now imagine the impact of having a lot of white snowballs thrown at you. They would simply build up the wall. It would get bigger and bigger and you would have more protection.

Imagine that black snowballs dissolve snow and make a hole in the wall equivalent to their size. You might think of black snowballs as being “antisnow.” Thus, if a lot of black snowballs were thrown at the wall, it would soon disappear or at least have a lot of holes in it. Black snowballs are a lot like losing trades—they chip away at your wall of security.

Variable 1, how often you are right, is a little like focusing on the percentage of white snowballs. You would naturally want all the snowballs coming to your wall to be white and add to your wall. It’s probably easy for you to see how the people who don’t focus on the big picture might devote all their attention to making as many snowballs as possible be white.

But let’s consider the relative size of the two kinds of snowballs. How big are the white and black snowballs relative to each other? For example, imagine that the white snowballs are the size of golf balls, while the black snowballs are like **6-foot-diameter** boulders. If that were the case, it would probably only take one black snowball to break down the wall—even if white snowballs were being thrown at the wall all day. On the other hand, if the white snowball was the size of a 6-foot boulder, then one snowball each day would probably build up the wall enough to protect you from a continual bombardment of black snowballs the size of golf balls. The relative size of the two kinds of snowballs is equivalent to variable 2 in our model—the relative size of profits and losses. I hope that by visualizing the snow fight metaphor you can understand the importance of variable 2.

Variable 3, the cost of trades, is a little like assuming that each snowball has a slight destructive effect on the wall—regardless of whether it is white or black. Each white snowball has a slight destructive effect on the wall, that is, less, one hopes, than its effect in building up the wall. Similarly each black snowball destroys a little of the wall just by hitting it, and this simply adds to the normal destructive effect of black snow upon the wall. Clearly, the size

of this general destructive force could have an overall impact on the outcome of the snowball fight.

Let’s assume that our snowballs only come at the wall one at a time. After 100 snowballs have hit the wall, the condition of your wall will depend upon the relative volume of white and black snow hitting the wall. In our model, you can measure the effectiveness of the snowball fight by the condition of the wall. If the wall is growing, it means that the total volume of white snow hitting the wall is greater than the total volume of black snow hitting the wall. And the growing wall is like growing profits. You’ll feel more secure as it gets bigger. If the wall is shrinking, then it means that relatively more black, than white, snow is hitting the wall. Eventually, your wall will lose all its protection and you will no longer be able to play the game.

The relative volume of white versus black snow hitting the wall is essentially the snow fight equivalent of expectancy. If relatively more black snow arrives, then the wall will shrink. If relatively more white snow arrives and if the destructive factor of the snowballs is not too great, then the wall will grow. The relative volume of white versus black snow depends both upon the percentage of white and black snowballs and upon the relative size of the two kinds of snowballs. However, the bottom line is the net amount of white or black snow impacting upon the wall.

In the real world of investing or trading, expectancy tells you the net profit or loss that you can expect over a large number of **single-unit**<sup>3</sup> trades. If the total amount of losing trades is greater than the total amount of winning trades, then you are a net loser and have a negative expectancy. If the total amount of winning trades is greater than the total amount of losing trades, then you are a net winner and have a positive expectancy.

Notice that in the expectancy model you could have 99 losing trades, each costing you a dollar. Thus, you would be down \$99. However, if you had one winning trade of \$500, then you would have a net payoff of \$401 (\$500 less \$99)—**despite** the fact that only one of your trades was a winner and 99 percent of your trades were losers. Let’s also say that your cost of trading is \$1 per trade, or \$100 per 100 trades. Using this cost factor in the prior example, you would only have a net profit of \$301. Are you beginning to **under-**

stand why expectancy is made up of all of the first three variables? And just as the effect on the wall was the result of the net volume of black versus white snow, the effect on your equity is the result of the net profits minus the net losses.

Now let's continue our snow fight metaphor just a little further. Variable 4 is essentially the frequency at which snowballs are thrown. Let's say that the cumulative effect of 100 snowballs (white and black) is to add about 10 cubic inches of snow to the wall. Obviously, if a snowball is thrown once each minute, the impact will be 60 times greater than if a snowball is thrown once each hour. Thus, the rate at which snowballs are thrown will have a major impact on the status of the wall."

The frequency of your trades will have a similar effect in the rate of change of your equity. If you make \$500 net after 100 trades, then the amount of time it takes you to make those 100 trades will determine the growth of your account. If it takes you a year to make 100 trades, then your account will only grow by \$500 per year. If you make 100 trades each day, then your account will grow by \$510,000 per month (assuming 20 trading days per month), or \$120,000 per year. Which method would you want to trade? One that makes \$500 per year or one that makes \$120,000 per year? The answer is obvious, but the methods could be exactly alike (i.e., in that both have the same expectancy). The only difference is the frequency of trading.

On the basis of our discussion of the snow fight metaphor, which of the six variables do you think are most important now? Why? What is the basis of your conclusion? I hope that at this time you can see how important variables 1 through 4 are. These are the basis for expectancy, and they determine the effectiveness of your trading system.

Variables 5 and 6—the size of the wall and the position-sizing variables—are the most important factors in your overall profitability. You should already understand how important the size of the wall (variable 5) is in playing the game. If the wall is too small, then a few black snowballs could destroy it. It must be big for protection.

Let's look at variable 6, the variable that tells you how much. Up to this point we've just assumed that **our** snowballs arrive at the wall one at a time. But imagine the impact of having snowballs

arriving in large numbers at the same time. First, imagine the impact on the wall of one black snowball the size of a golf ball hitting the wall. It would make a single, golf-ball-sized dent in the wall. Now, imagine 10,000 of them hitting the wall simultaneously. It totally changes the impact of your thinking, doesn't it?

The metaphor of 10,000 snowballs simply illustrates the importance of position sizing—that part of your system that tells you how much. We've been talking about one unit of size up to now—one snowball or one share of stock. But 10,000 black snowballs the size of golf balls could totally demolish your wall unless the wall is massive.

Similarly, you might have a trading method that only loses a dollar per share of stock when it loses. However, when you purchase your stock in units of 10,000, your loss suddenly becomes enormous. It's now **\$10,000!** Again, notice the importance of position sizing. If your equity is a million dollars, then a \$10,000 loss is only 1 percent. But if your equity is just \$20,000, then a \$10,000 loss is 50 percent.

Now that you have the perspective of seeing all the key variables involved in the success of your system (or your snowball fight), we can focus in on the details of expectancy.

#### LOOKING AT EXPECTANCY UNDER A MAGNIFYING GLASS

Expectancy, as defined in this book, tells you how much you can expect to make on the average (over a number of trades) per dollar risked. So how do you find out the expectancy of a game or a system? Suppose that you are going to play a game drawing marbles. The bag from which you will draw your marbles contains 60 blue marbles and 40 black marbles. According to the rules of the game, when you draw a blue marble, you win the amount you risked, and when you draw a black marble, you lose the amount you risked. Each time a marble is drawn, it is replaced. Notice that you now have a definition for both variables 1 and 2 for this game. What is the expectancy of this game? How much can you expect to win, on the average, per dollar risked?

In this case, expectancy is defined by Formula 6-1:

Formula 6-1: Expectancy = (PW \* AW) less (PL \* AL)

where **PW** is the probability of a winning trade and **PL** is the probability of a losing trade AW refers to the average gain (win) and AL refers to the average loss.

In the game, **PW** = 0.6 and **PL** = 0.4. The average amount won or lost in this game is \$1-you win or lose exactly what you risk. So for each dollar risked, you either win a dollar or lose a dollar. Therefore, in our game:

$$\text{Expectancy} = (0.6 * 1) \text{ less } (0.4 * 1) = 0.6 - 0.4 = 0.2$$

In this particular game, you could expect to make 20 cents for every dollar you risk on the average over many trials. This means that you'd get your dollar back plus make 20 cents on the average over many trials.

This certainly doesn't mean that you'll win every time. Indeed, in this particular example, you'll only win about 60 percent of the time. In fact, over 1,000 trials you could easily have 10 losses in a row. However, over that same 1,000 trials, you'll make on the average 20 cents per dollar risked. Thus, if you risked \$2 on each one, you'd probably make \$400 over the 1,000 trials.

What would happen if our bag of marbles were more complex, like the average system investing in the market? Let's say you have a number of different possibilities of winning and losing. For example, let's say you have a bag of 100 marbles of a number of different colors. And let's give each color a different payoff according to the matrix given in Table 6-1.

Once again, we'll assume that a marble is replaced in the bag once it is drawn out. Notice that the chances of winning are only 36 percent in this game. Would you want to play it? Why or why not? What's the expectancy of this game? How much will you make per dollar risked on the average playing this game? Is it better or worse than the first game?

Fortunately, the normal formula for expectancy is additive. Thus, Formula 6-1 can be transformed as follows into Formula 6-2:

$$\text{Formula 6-2: Expectancy} = \sum_{(i = 1 \text{ to } n)} (\text{PW}_i * \text{AW}_i) \\ \text{less } \sum_{(i = 1 \text{ to } n)} (\text{PL}_i * \text{AL}_i)$$

TABLE 6.1

## Marble Payoff Matrix

Number and Color of Marbles	Win or Lose	Payoff
50 black marbles	Lose	1:1
10 blue marbles	Lose	2:1
4 red marbles	Lose	3:1
20 green marbles	Win	1:1
10 white marbles	Win	5:1
3 yellow marbles	Win	10:1
3 clear marbles	Win	20:1

The summation sign indicates that the formula is additive. In other words, you can add all the positive expectancies (i.e., the winning marbles) and then all the negative expectancies (i.e., the losing marbles). You can then subtract the total negative expectancy from the total positive expectancy to get the expectancy of the game.

Let's go through the process step by step. First, let's look at (**PW\*AW**) for all the winning marbles and add them up.

1. For green, **PW** = 0.2 and **AW** = 1; therefore (**PW \* AW**) =  $0.2 * 1 = 0.2$ .
2. For white, **PW** = 0.1 and **AW** = 5; therefore (**PW \* AW**) =  $0.1 * 5 = 0.5$ .
3. For yellow, **PW** = 0.03 and **AW** = 10; therefore (**PW \* AW**) =  $0.03 * 10 = 0.3$ .
4. For clear, **PW** = 0.03 and **AW** = 20; therefore (**PW \* AW**) =  $0.03 * 20 = 0.6$ .

Now, let's add them all up:  $0.2 + 0.5 + 0.3 + 0.6 = 1.6$ . This gives us the total positive expectancy in the game.

Second, let's look at (**PL \* AW**)-the negative expectancy-for all the losing marbles and add them up.

1. For black, **PL** = 0.5 and **AL** = 1; therefore (**PL \* AL**) =  $0.5 * 1 = 0.5$ .

2. For blue,  $PL = 0.1$  and  $AL = 2$ ; therefore  $(PL * AL) = 0.1 * 2 = 0.2$ .
3. For red,  $PL = 0.04$  and  $AL = 3$ ; therefore  $(FL * AL) = 0.04 * 3 = 0.12$ .

Once again, let's add them all up:  $0.5 + 0.2 + 0.12 = 0.82$ . This is the total negative expectancy of the game.

Finally, the total expectancy of the game is the difference in the two sums. We find the difference by subtracting the total negative expectancy (0.82) from the total positive expectancy (1.6). The resulting answer is 0.78. Thus, over many marble draws in this game, you could expect to make 78 cents per dollar risked. Notice that this game is nearly four times more profitable than the first game.

Just with the two examples, you should have learned a very important point. Most people look for trading games that have a high probability of winning. Yet in the first game, you have a 60 percent chance of winning, but only a 20 cent expectancy. In the second game, you only have a 36 percent chance of winning, but your expectancy is 78 cents. Thus, game 2 is almost four times as good as game 1—assuming the same opportunity factor. Notice that the key factor in your system is not the probability of winning. Instead, the key factor in determining the value of your system is its expectancy per dollar risked.

It's important to put in a word of caution here. Variables 5 and 6 are critically important to your profitability. You can only realize **your expectancy over the long term if you size your positions wisely according to how much equity you have**. Position sizing is that part of your system that tells you how much to risk per position. It's a critical portion of your overall system, and we'll discuss it extensively in Chapter 12.

But let's look at an example just to see how position sizing and expectancy go together. Suppose you are playing game 1—the 60 percent marble game. You have a \$100 total and you start playing the game. Let's say you start the game by risking your entire \$100 on the first draw. You have a 40 percent chance of losing and you happen to draw a black marble. That can happen, and when it does, you will have lost your entire stake. In other words, your position size (i.e., bet size) was too **large** relative to your equity to be safe. You cannot play any more because you don't have any more

money. Therefore, you cannot realize the **20-cent-per-dollar-risked** expectancy over the long run playing the game.

Let's look at another example. Suppose you decide to risk 50 percent of your stake on each draw, not 100 percent. Thus, you start out with a \$50 bet. You draw a black marble and you lose. Now your stake is down to **\$50**. Your next bet is 50 percent of what's left, or \$25. Again, you lose. You now have \$25 left. Your next bet is \$12.50 and you lose again. You are now down to \$12.50. Three losses in a row are quite possible (i.e., about one chance in five with three consecutive events) in a system that only wins 60 percent of the time. You must now make \$87.50 just to break even—that's an increase of 700 percent. You're not likely to make that much at all. Thus, because of improper position sizing, you've again failed to obtain your expectancy over the long run.

Remember that your position size on a given trade must be low enough so that you can realize the long-term expectancy of your system over many trades.

At this point, you might say that you control your risks by your exits, not your position size. However, remember the snow fight metaphor. Risk is essentially variable 2, the size of the wins compared with the size of the losses.

That's what you control by your exits. Position size is essentially another variable (variable 6) on top of the relative size of the gains and losses. It tells you position size relative to your equity.

...your position size on a given trade must be low enough so that you can realize the long-term expectancy of your system over many trades.

#### Opportunity Factor and Expectancy

There's one other variable involved in evaluating your system that's just as important as its expectancy. That factor is opportunity, our fourth variable. How often can you play the game? For example, suppose you could play either game 1 or 2.

However, you are only allowed to draw one marble every 5 minutes playing game 2, whereas you are allowed to draw one marble every minute playing game 1. Under those conditions, which game would you rather play?

Let's look at how the opportunity factor changes the value of the games. Suppose you could play the game for an hour. Since you could draw a marble every minute in game 1, you'd have an opportunity factor of 60, or 60 chances to play the game. Since you could draw a marble every 5 minutes in game 2, you'd have an opportunity factor of 12-or 12 chances to play the game.

Remember that your expectancy is the amount you would win per dollar risked over a large number of opportunities. Thus, the more times you can play a game, the more likely you are to realize the expectancy of the game.

In order to evaluate the relative merits of each game, you must multiply the number of times you can play the game by the expectancy. When comparing the two games over an hour, assuming that you only risk \$1 each time, you'll get the following results:

Game 1: Expectancy of 20 cents times 60 opportunities = \$12.00

Game 2: Expectancy of 78 cents times 12. opportunities = \$9.36

Thus, given the opportunity restraints that we arbitrarily imposed, game 1 is actually better than game 2 assuming you only risked \$1 each time. And when you evaluate expectancy in the market, you must give similar consideration to the amount of opportunity your system presents you. For example, a 50 cent expectancy system (after transaction costs) that gives you three trades per week is much better than a 50 cent expectancy system (again after transaction costs) that gives you one trade each month.

### Prediction<sup>5</sup>

Let's pause for a moment to discuss a common trap for most traders and investors-the prediction trap. Thinking about the concept of expectation a bit will allow one to more clearly see why so many people have been tripped up over the years making *predictions* of what a market or stock will do in the future. They all base their prediction algorithms on history-sometimes even assuming that it will repeat exactly. However, an extremely successful prediction can even result in losing all of your capital. How? You can have a method that is 90 percent accurate and still lose all of your money trading it.

Consider the following "system" that **has 90** percent winning

trades, where the average winning trade is \$275, and 10 percent losing trades, where the average losing trade is \$2,700:

$$\text{Expectation} = (0.9 * 275) - (0.1 * 2,700) = -22.5$$

The expectation is negative. This is a system through which you get to be right 90 percent *of* the time and you *eventually* lose *all* your money *trading it*. There is a strong psychological bias to be *right* about what we do with our investments. In most people, this bias greatly overrides the desire to make a profit overall in our approach, or it inhibits us from reaching our true profit potential. Most people have overwhelming needs to control the market. As a result, they end up with the market controlling them.

It should be clear to you by now that it is the combination of the payoff and the probability that allows you to determine whether a method is viable or not. You also have to consider variable 4 (how **often** you get to play the game) to determine the relative worth of a system or method.

### EXPECTANCY AND *R* MULTIPLES

So far we've been dealing with bags of marbles. In each bag of marbles, we know what the population of marbles is, what the probability of each marble being drawn is, and what its payoff is. None of those things are true when we deal with trades that our system generates in the market.

When you play the market, you don't know the exact probability of winning or losing. **In** addition, you don't know exactly how much you are going to win or lose. However, you can do historical testing and get some idea what to expect. You also can get large samples of data from real-time trading or investing. You can use either of those samples to get a general idea of the expectancy of your system. This effort entails investigating individual trades in an attempt to understand the reward-to-risk ratio of each trade and its frequency of occurrence. After thoroughly performing this exercise, you will have a far greater understanding of the true nature of your methodology.

If you are purely a discretionary, nonsystematic trader, you can review your past trading results to develop insight into how

you are either making or losing money. Following a similar procedure to what we will present here, you should look at each trade on a one-lot or *one-share* basis. Knowing what your risk was going into the trade (your initial exit point) and the closed profit and loss, you can then calculate your *reward-to-risk* ratio for each trade.

### R Multiples

I refer to a trade's reward-to-risk ratio as an "*R* multiple"—*R* simply being a symbol for the initial risk. To calculate a trade's *R* multiple, simply take the number of points captured at the exit of the position and divide by the initial risk. You can just as easily use dollar values per contract or per *100-share* lot. For example, if you risked \$500 and made \$1,500, you would have an *R* multiple of 3. An example is shown in Figure 6-1.<sup>7</sup> The entry was on 8/4/97 at 2,511. The system uses a *3-times* the average true range (ATR, see definitions) stop which was 104 points. Thus, the initial exit is at

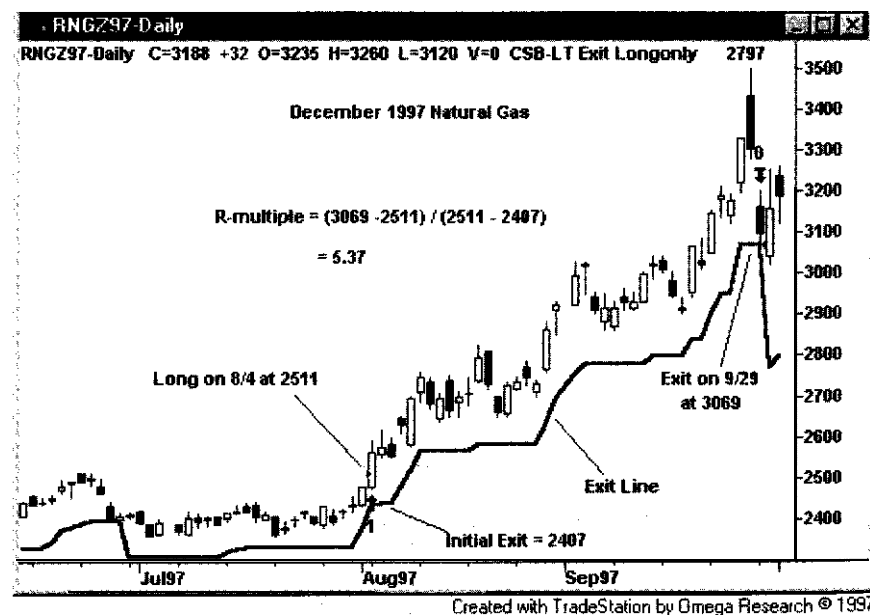


Figure 6-1 Multiples in a trade

2,511–104, or 2,407. The system eventually exits on 9/29/97 at 3,069 for a profit of 558 points. Since the initial risk (1 *R*) was 104 points and the final profit was 558 points, the profit was a 5.37 *R* multiple. Do this for all trades, winning and losing. The losing trades will simply be a negative *R* multiple.

The many individual *R* multiples that compose a historical simulation or previous trading results are the components of your expectation. The nature of these *R* multiples will totally determine your method's overall expectation. It will help you to define the appropriate money management algorithm to apply to the trading method to meet your overall objectives. By the nature of the *R* multiple I am referring to the size, frequency, and order of the individual *R* multiples.

For a moment, think of your system's trades solely as *R* multiples. Then pretend that each trade is simply a marble being drawn from a bag as in our previous examples. Once you draw the marble, you determine its *R* multiple and then replace it into the bag.

In playing this game you want to develop a position-sizing algorithm that is supportive in exploiting the expectation. In addition, you want it to be linked to the initial risk for each trade and the ongoing account equity. For starters, consider a percent risk algorithm where you decide to continuously risk a constant percentage of current account equity. This sort of position-sizing algorithm basically means that a 1-*R* risk becomes the same, no matter when it is taken or in what stock or market it is taken. This is because your position size is always a constant percentage (i.e., 1 percent) of your equity no matter how big the initial risk (*R*) is. See Chapter 12.

In addition, you want to consider the potential *distribution* (the order) of the marbles being drawn. The system's winning percentage is inversely proportional to the length of strings of losing trades. Therefore, you need a position-sizing algorithm that will allow you to withstand potential substantial strings of losing trades while being able to exploit the big winning trades.

Many traders have failed to trade a sound system because (1) they were not prepared for the distribution of trades that the markets presented to them through their method and/or (2) they were overleveraged or undercapitalized. You can estimate the maximum

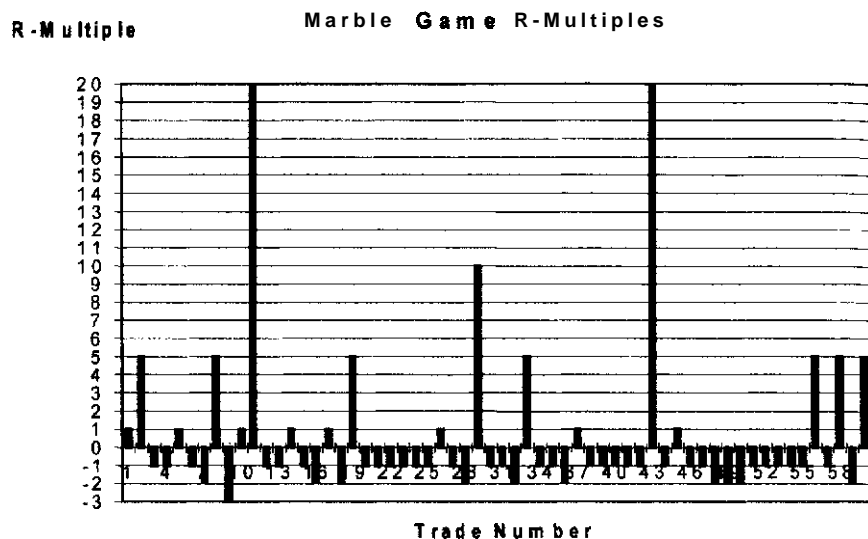


Figure 6-2 Multiples in a marble game

number of losing trades in a row for 1,000 trials given the winning percentage of the system, but you really never know the “true” value. Even flipping a fair coin can yield some lengthy streaks of heads in a row, for example.

Figure 6-2 shows the distribution of trades for one 60-trade sample of a marble game such as the one described in Table 6-1. Note the lengthy losing streak between trades 46 and 55. It’s about this time that many people playing the game develop one of two opinions: (1) They decide it’s *time* for a winning marble to be drawn or (2) they decide to bet against the expectation at some future point in the game so they profit from streaks like these. If the losing streak happens early in the game, opinion 2 is common. If the losing streak happens late in the game, then opinion 1 is common. The psychology of some participants forces them to bet bigger the deeper they go into a losing streak since they “know” a winner is just around the corner. I’m sure you can guess the typical results of such a game.

Figure 6-3 shows the equity curves for the above game betting a constant 1.0 percent, 1.5 percent, and 2.0 percent of current equity for each trade (and staying completely calm and detached the

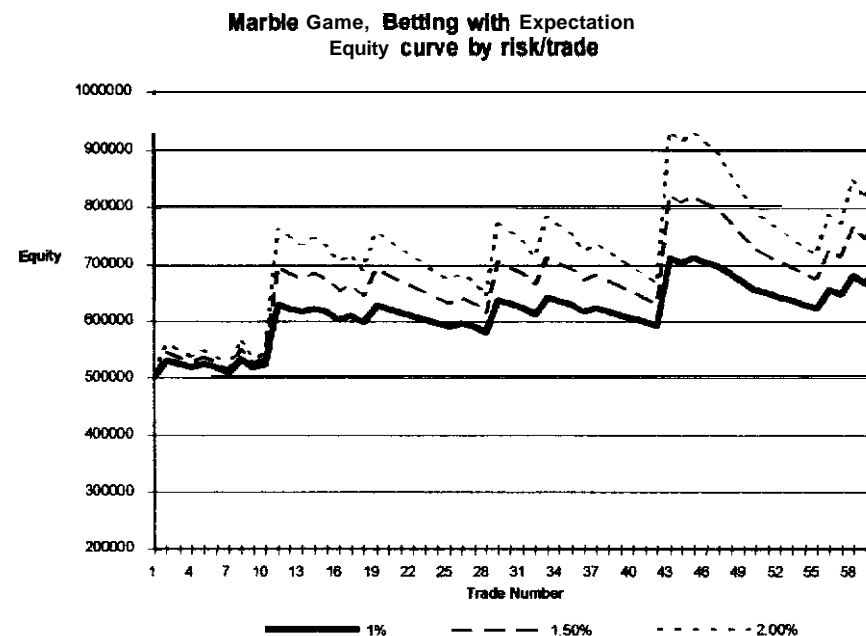


Figure 6-3 Equity curves on marble games according to bet size

whole time). The return for the 60 trials at 1.0 percent was 40.1 percent and the peak-to-trough **drawdown** was 12.3 percent. There were three significant losing streaks of 5, 6, and 10 trades.

Figure 6-4 shows the equity curve betting a constant 1.0 percent of current equity against the expectation. Here you get to be “right” 64 percent of the time and even enjoy a 10-trade winning streak while you lose 37 percent of the starting equity.

If we were trying to better understand how this system works, we would probably evaluate at least 10 times as many trades. At that point we could make a better decision about the position-sizing (in this case, bet sizing) algorithm to use and the leverage level. In addition, we would be able to train ourselves on what to expect from this system in future trades.

We could develop mental rehearsals for many scenarios that we could dream up that may occur in the future—rehearsing how we will respond given each outcome. Keep in mind that even then you don’t **know for** sure what the marble bag (or the market) will

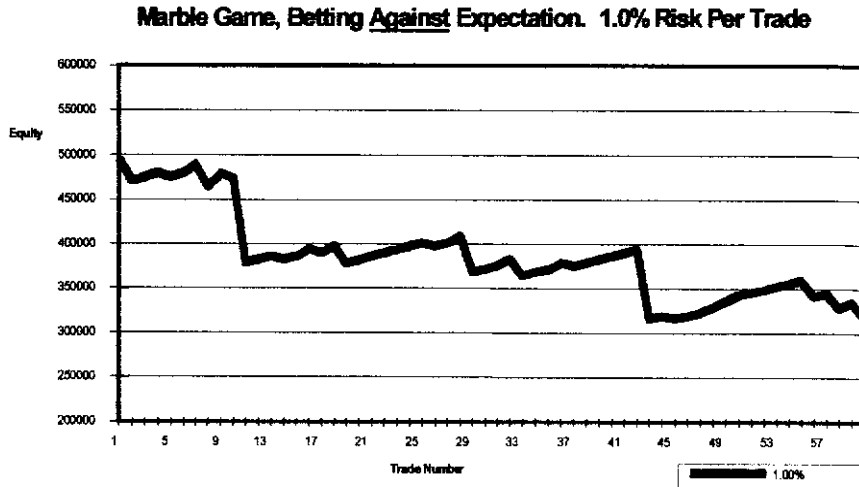


Figure 64 Equity curve betting with the probabilities and against the expectancy

reveal in the future. That's why part of your mental rehearsal should include rehearsing how you will respond to an event for which you are not prepared.

**EXPECTANCY APPLIED TO THE MARKET**

At a recent seminar, one of our attendees asked me why he should bother calculating expectancy when he could just look at his overall profits. The reason is simple. Expectancy is a way of comparing trading systems while factoring out the effects of time, position sizing, and the fact that one is trading various instruments that have different prices.

Let's look at a sample expectancy problem as it applies directly to investing in the market. Suppose you have a trading system that you've traded for 2 years. It has generated 103 trades, 60 of them winners (58.3 percent) and 43 of them losers (41.7 percent). The distribution of your trades is shown in Table 6-2 using only the effect of trading one unit per trade (i.e., minimal position sizing).

Total profit = \$54,147; total loss = \$43,304; net profit = \$10,843

From the table we can calculate that expectancy = (0.417 \*

**TABLE B-2**

Trades Produced by a Sample System over 2 Years

Winning Trades				Losing Trades				
5	23	517	5	4	(\$ 31)	(\$ 18)	(\$ 16)	
5	12	5	32	5	8	(\$ 6)	(5 23)	(\$ 15)
5	6	5	489	\$	532	(\$ 427)	(\$ 491)	(5 532)
5	611	5	431	\$	563	(\$ 488)	(5 612)	(\$ 556)
5	459	5	531	\$	476	(\$ 511)	(\$ 463)	(5 477)
5	561	5	499	\$	521	(\$ 456)	(5 532)	(\$ 521)
5	456	5	479	5	532	(\$ 460)	(5 530)	(\$ 477)
5	618	51, 141	5	995	(\$ 607)	(\$ 478)	(5 517)	
51, 217	51, 014	\$	632	(\$ 429)	(5 469)	(\$ 512)		
\$ 964	5	956	\$1, 131	(5 521)	(\$ 499)	(\$ 527)		
\$1, 217	5	897	\$1, 517	(5 501)	(\$ 506)	(\$ 665)		
<b>\$1,684</b>	<b>\$1,501</b>	<b>\$1,654</b>	<b>(\$ 612)</b>	<b>(\$ 432)</b>	<b>(\$ 564)</b>			
\$1, 464	51, 701	52, 551	(5 479)	(5 519)	(5 671)			
52, 545	52, 366	\$4, 652	(51, 218)	(\$ 671)	(51, 132)			
514, 256			(\$ 988)	(\$1,015)	(\$ 976)			
			(\$1,123)	(51, 311)	(\$ 976)			
			(51, 213)	(51, 011)	(\$ 993)			
			(5 676)	(51, 245)	(51, 043)			
			(\$1,412)	(51, 611)	(53, 221)			
			(\$1,211)	(\$ 945)	(51, 721)			
Average gain = \$1,353.68				Average Loss = (\$721.73)				

**\$1,353.68**) less (0.583 \* \$721.73) = (\$564.48) less (\$420.77) = \$143.71. Obviously, when you have samples of data, you can also take the net profit and divide that by the number of trades and get the expectancy.

Notice that this figure is quite different from the expectancies we got from the marble bags. The reason is that it is not stated as "an expectancy per dollar risked." Thus, it's important to reduce your expectancy down to expectancy per dollar risked. In addition,

**TABLE 6-3**

Groupings of Gains and Losses

Gains			Losses		
Flange	Number	Total Gain	Flange	Number	Total Loss
Scratch	7	\$ 112	Scratch	6	(\$ 109)
\$ 500	15	5 7,760	6500	33	(\$17,081)
\$ 1,000	10	\$10,364	\$1,000	17	(\$18,149)
\$ 1,500	6	\$ 9,521	\$1,500	3	(\$ 4,744)
\$ 2,500	3	5 7462	\$3,000	1	(\$ 3,221)
\$ 4,500	1	\$ 4,652			
\$14,000	1	\$14,256			
<b>Total</b>		\$54,147			(\$43,304)

it's important to determine just what sort of "marbles" make up your expectancy. Table 6-3 shows such distribution of gains and losses from this sample of trades. The trades are grouped into ranges of \$500, simply because it was convenient and because \$500 seemed to best describe the minimum loss.

When you look at a distribution of profit-and-loss groupings, you might notice that the minimum loss<sup>8</sup> has a particular value. In this particular distribution, that minimum loss is about \$500. We can now look at the table somewhat like a bag of marbles and notice what to expect. Here we calculate the payoffs by dividing the approximate gain or loss by the approximate minimum loss of \$500. Table 64 is the result of performing this action.

This system essentially made money on 40 percent of its trades (i.e., 36/90)—not counting the scratch trades. Since the total profitability of the system is about \$10,000, you'll also notice that the entire profit is due to one trade—the one that gave you a \$14,256 profit. Also notice that by just eliminating one loss—the \$3,221 loss—you would increase your profits by 40 percent.

You need to look at these trades in detail. What produced the large gain? Can you expect to have more of them in the future? Is the real probability of such a gain about 0.011 percent, or can you figure out a way to produce more of them?

**TABLE 6-4**

Groupings of Gains and Losses as a Function of the Minimum Amount Risked (Assumed to Be \$500)

Gains			Losses		
Payoff	Probability	Positive Expectancy	Payoff	Number	Negative Expectancy
1 to 1	15/900 = 0.0167	\$7,760	1 to 1	33190 = 0.367	(\$17,091)
2 to 1	10/900 = 0.0111	510,384	2 to 1	17190 = 0.189	(\$18,149)
3 to 1	6/900 = 0.0067	59,521	3 to 1	3190 = 0.033	(54,744)
5 to 1	3/900 = 0.0033	\$7,462	6 to 1	1190 = 0.011	(\$3,221)
9 to 1	1/900 = 0.0011	\$4,652			
28 to 1	1/900 = 0.0011	\$14,256			

How about the losses? What produced the \$3,221 loss? Is the true expectancy of that loss about 1.1 percent, or can you expect to have a lot more of them (or a lot less)? Was the loss due to psychological mistakes? If so, how can you avoid it in the future?

When you look at your system in terms of a payoff matrix as in Table 64, you can begin to answer a lot of questions. We can apply expectancy Formula 6-2 to determine the expectancy per dollar risked. Here we get the following positive expectancy by adding the positive expectancy from the set of winning trades:

$$\begin{aligned} \text{Positive side of expectancy Equation} &= (0.167 * 1) + (0.111 * 2) \\ &+ (0.067 * 3) + (0.033 * 5) + (0.011 * 9) + (0.011 * 25) \end{aligned}$$

When we complete the multiplication, we get the following: 0.167 + 0.222 + 0.199 + 0.165 + 0.099 + 0.275 = 1.127. Thus, our total positive expectancy from the winning trades is \$1.127.

Now we need to find the negative expectancy of the losing trades by determining the contribution of each group of losing trades as follows:

$$\begin{aligned} \text{Negative side of expectancy equation} &= (0.367 * 1) + (0.189 * 2) \\ &+ (0.033 * 3) + (0.011 * 6) = 0.367 + 0.378 + 0.099 + 0.066 = 0.91 \end{aligned}$$

Thus, our total negative expectancy from the losing trades is 91 cents.

Once again, to get the total expectancy per dollar risked we need simply to subtract the total negative expectancy from the total positive expectancy—\$1.127 less \$0.91 = \$0.217. Thus, the expectancy of this system, per dollar risked, is 21.7 cents. This gives us a better basis for comparing this system with another. A \$10,000 profit might make a system seem great, but knowing that the system produces a return of 21.7 cents per dollar risked puts it in a different perspective.

#### USING EXPECTANCY TO EVALUATE DIFFERENT SYSTEMS

Let's look at two different trading systems to determine how expectancy might be used.

##### Fred's System

The first system comes from an option trader named Fred. From May 1 through August 31, he's completed 21 trades, as shown in Table 6-5.

The system made **\$1,890.43** over 21 trades during the 4-month period. This amounts to an average gain of \$90.02 per trade. But what is the expectancy of the system per dollar risked? We can break the table down into arbitrary dollar groupings, as shown in Table 6-6.

Since the minimum loss seems to be about 5150 for Fred's trading, we'll convert Table 6-6 into a probability matrix (Table 6-7) with \$150 being the minimum amount risked. We'll also delete the scratch trades, leaving a total of 18 trades.

Let's apply Formula 6-2 to this matrix to determine an approximate expectancy per dollar risked. First let's calculate the positive expectancy of the winning trades. The positive expectancy is equal to  $(0.056 * 1) + (0.056 * 2) + (0.056 * 3) + (0.056 * 8) + (0.111 * 13) + (0.056 * 25)$ . If we perform the multiplication, we end up with

$$0.112 + 0.168 + 0.448 + 1.443 + 1.4 = \$3.627$$

Next, we must calculate the negative expectancy created by the losing trades. The **negative expectancy** is equal to  $(0.111 * 1) +$

**TABLE 6-5**

Fred's Option Trading Summary

	Gains	Losses
	\$2,206.86	(5143.14)
	\$1,881.86	(566.14)
	\$3,863.72	(5543.14)
	5161.66	(\$1,218.14)
	\$1,119.36	(5143.14)
	5477.79	(\$3,866.57)
	\$48.43	(5340.64)
	5327.36	(5366.14)
	\$21.80	(\$366.14)
		(5356.14)
		(\$493.14)
		(5328.14)
<b>Total</b>	<b>\$10,129.04</b>	<b>(\$8,238.61)</b>
<b>N</b>	<b>9</b>	<b>11</b>
<b>Average</b>	<b>\$1,125.45</b>	<b>(\$746.96)</b>

**TABLE 6 6**

Dollar Grouping of Fred's Trades

<b>Gains</b>		<b>Losses</b>	
<b>Range</b>	<b>Number</b>	<b>Range</b>	<b>Number</b>
Scratch under \$75	2	Scratch under \$75	1
\$100-\$150	1	5150-\$200	2
\$325-\$375	1	\$325-\$375	5
\$475-5650	1	\$475-\$550	2
\$1,200	1	51,200	1
52,000	2	52,000	0
53,800	1	53,600	1

TABLE B-7

Fred's Trades as a Probability Matrix

<i>Gains</i>		<i>Losses</i>	
<b>Payoff</b>	<b>Probability</b>	<b>Payoff</b>	<b>Probability</b>
1 to 1	1/18 = 0.056	1 to 1	2/18 = 0.111
2 to 1	1/18 = 0.056	2 to 1	5/18 = 0.278
3 to 1	1/18 = 0.056	3 to 1	2/18 = 0.111
8 to 1	1/18 = 0.056	8 to 1	1/18 = 0.056
13 to 1	2/18 = 0.111	13 to 1	0
25 to 1	1/18 = 0.056	25 to 1	1/18 = 0.056

$(0.278 * 2) + (0.111 * 3) + (0.056 * 8) + (0.056 * 25)$ . If we perform the multiplication, we end up with

$$0.111 + 0.556 + 0.333 + 0.448 + 1.4 = \$2.848$$

When we subtract the negative expectancy from the positive expectancy to obtain the total, we get the following:  $\$3.627$  less  $\$2.848 = \$0.779$ . Thus, Fred's system produces an expectancy of about 78 cents per dollar risked over the 4-month period of trading. Remember that a lot of rounding went into these calculations.

The biggest fault with Fred's system is that it has a giant **25-to-1** loss that offsets the one **25-to-1** gain. Without that one loss, Fred would have an outstanding system. As a result, Fred needs to study that loss and see if similar losses can be prevented in the future.

#### Ethel's System

Next, let's look at another group of trades—which we'll call Ethel's system. Ethel made these stock trades over a 1-year period. Ethel had one gain of \$5,110 from the purchase of 1,000 shares of stock, another gain of \$680 from the purchase of 200 shares of stock, and a loss of \$6,375 from the sale of 300 shares of stock. All the rest were **100-share** purchases. As a result, we will enter these gains and losses as if they were each a round lot of 100 shares to eliminate the

TABLE 6-B

Ethel's Stock Trading Summary

	<b>Gains</b>	<b>Losses</b>
	5511	52,125
	\$3,668	51,969
	\$555	\$3,963
	51,456	\$589
	\$546	51,329
	\$3,956	5477
	\$340	51,246
	57,356	\$501
	5499	\$503
<b>Total</b>	<b>519,396</b>	<b>\$12,221</b>
<b>N</b>	<b>10</b>	<b>8</b>
<b>Average</b>	<b>\$1,939.60</b>	<b>\$1,527.63</b>

effect of position sizing. Table 6-8 shows a summary of Ethel's stock trading.

The system made \$7,175 over 18 trades during the year. This amounts to an average gain of \$398.61 per trade. Remember that Fred's system only made \$90 per trade. In addition, Ethel's system makes money 55.6 percent of the time, while Fred's system only makes money 45 percent of the time. Ethel obviously has a better system. Or does she?

Let's look at the expectancy per dollar risked of Ethel's system and the opportunity factor. When these factors are considered, does Ethel have the better system? Table 6-9 shows the various dollar groupings of Ethel's system. Ethel had three minimum losses that were about \$500 each—one of \$477, one of \$501, and one of \$589. Thus, we'll assume that Ethel's minimum risk was about \$500. We can develop a probability matrix for Ethel's trades as shown in Table 6-10.

Once again, let's apply Formula 6-2 to the matrix in Table 6-10 to determine an approximate expectancy per dollar risked. First, let's calculate the positive expectancy of the winning trades. The

TABLE 6 9

Dollar Grouping of Ethel's Trades

<b>Gains</b>		<b>Losses</b>	
Range	Number	Range	Number
\$300-\$600	6	\$300-\$600	3
\$1,200-\$1,600	1	\$1,200-\$1,600	2
\$1,750-\$2,250	0	\$1,750-\$2,250	2
\$3,500-\$4,000	2	\$3,500-\$4,000	1
\$7,300-\$7,500	1		

TABLE 6-10

Ethel's Trades as a Probability Matrix

<b>Gains</b>		<b>Losses</b>	
Payoff	Probability	Payoff	Probability
1 to 1	6/18 = 0.333	1 to 1	3/18 = 0.168
3 to 1	1/18 = 0.056	3 to 1	2/18 = 0.111
4 to 1	0	4 to 1	2/18 = 0.111
8 to 1	2/18 = 0.111	8 to 1	1/18 = 0.056
15 to 1	1/18 = 0.056		

positive expectancy is equal to  $(0.333 * 1) + (0.056 * 3) + (0.111 * 8) + (0.056 * 15)$ . If we perform the multiplication, we end up with a total positive expectancy of the following:

$$0.333 + 0.168 + 0.888 + 0.840 = \$2.229$$

Now we need to find the total negative expectancy of the losing trades. That negative expectancy is equal to  $(0.168 * 1) + (0.111 * 3) + (0.111 * 4) + (0.056 * 8)$ . If we perform the multiplication, we end up with a total negative expectancy of the following:

$$168 + 0.333 + 0.444 + 0.448 = \$1.393$$

When we subtract the total negative expectancy from the total positive expectancy, we end up with 2.229 less \$1.393 = \$0.836.

Ethel's expectancy of 84 cents per dollar risked is bigger than Fred's expectancy of 78 cents per dollar risked. In terms of expectancy, Ethel has a slightly better system.

Remember that Fred's profit was mostly a function of one good trade. Well, the same is also true of Ethel's profit. Her one profit of \$7,358 was bigger than her entire 1-year net profit of \$7,175. Thus, one trade made her entire profit over the 1-year period. This is quite often true of good long-term systems.

But what about the opportunity factor? Fred produced 18 trades in 4 months-actually more than 18, but some of them were excluded because they were scratch trades amounting to a gain or loss of less than \$100. In 2 years, Fred might produce three times as many trades. Let's compare the expectancy times the number of opportunities for a 1-year period to really evaluate the systems.

<b>Fred's System</b>			<b>Ethel's System</b>		
Expectancy	Opportunities	Total	Expectancy	Opportunities	Total
78 cents	54	542.12	64 cents	18	\$15.12

When you look at the two systems in terms of expectancy times opportunities, then Fred has a much better system. However, this assumes that both investors made the maximum use of their opportunities.

The comparison of the two systems brings up an interesting variable with respect to opportunity. Ethel only made 18 trades in a 1-year period. But this did not necessarily mean that she only had 18 opportunities to trade. An investor only makes the maximum use of his or her opportunities under the following conditions: (1) He or she is fully invested (i.e., makes full use of the position-sizing algorithm) when there are opportunities to trade; (2) he or she has an exit strategy and exits the market when that strategy is trig-

gered; and (3) he or she makes full use of other opportunities when cash is available to do so. If any of these three criteria is not met, then the comparison of systems by expectancy and opportunity is not necessarily a valid one.

## A REVIEW OF HOW TO USE EXPECTANCY

Just as a review, once you have a system, or at least a rudimentary system, you need to calculate its expectancy and look at a number of issues involving expectancy. Here are the steps involved.

1. **Calculate the overall expectancy of your system. If you already have a system that you have been using or have tested, you can calculate the expectancy of the system by simply dividing the total profit by the number of trades. Note that you do not yet have the expectancy per dollar risked at this point.**
2. **Eliminate the effects of position sizing by only considering single units or 100-share blocks.**
3. **Divide your trades into groups of profits and losses, using \$100 or \$500 ranges depending upon the size of the typical smallest loss.** Your smallest loss relates to where you typically put your disaster stops. This is your system's *1-R* level. In this step, you are simply assessing the expectancy of your system, not trying to improve it.
4. **Convert your groupings of trades into a probability matrix by using your "smallest loss" as a single unit.** This will help you find your expectancy per dollar risked
5. **Calculate the expectancy of your system from the probability table using Formula 6-2.**
6. **If your system includes at least 100 trades and has an expectancy above 50 cents per dollar risked, then it is a good system.** These are just general guidelines for a good long-term system. You can be happier with a much lower expectancy if you get enough opportunity.
7. **Determine the opportunity you will have to obtain your expectancy.**

Look at the size of the "marbles" determined in your proba-

bility matrix. What do your marbles tell you about your system? How can you change your system to include more high-payoff winning trades? How can you change your system to include fewer high-cost losing trades?

### Remember the following:

1. *Expectancy and probability of winning are not the same thing. People have a bias to want to be right on every trade or investment.* As a result, they tend to gravitate toward high-probability entry systems. Yet quite often these systems are also associated with large losses and lead to negative expectancy. As a result, always take your risk in the direction of the expectancy of the system.
2. *Even with a high positive expectancy system you can still lose money.* If you risk too much on a trade and you lose, you can (and probably will) have trouble recovering.

## NOTES

1.  $\$100 \times 100 \times 0.2 = \$2,000$ . This assumes that your 100 trades actually net 20 cents per dollar risked.
2. Adapted from *Market Mastery*, January, 1998.
3. **One share of stock or one futures contract would be a single unit.**
4. This would seem to imply that if the cost of trading is factored in, it's better to trade more frequently than less frequently. While this assumption is true, it doesn't take into account the psychological wear and tear that comes from frequent trading.
5. This section was written by Chuck Branscomb and originally appeared in our *Market Mastery* newsletter (November 1996, pp. 3-5, and December 1996, pp. 24). It has been adapted for this chapter.
6. This section was written by Chuck Branscomb and originally appeared in our *Market Mastery* newsletter (November 1996, pp. 3-5, and December 1996, pp. 2-6). It has been adapted for this chapter.
7. Figure 6-1 was generated using TradeStation®. TradeStation is a registered trademark of Omega Research.
8. This value does not count scratch trades in which you either quickly get out for some reason or raise your stop to break even and then get out. What we are looking at is the typical minimum risk you have on a trade.