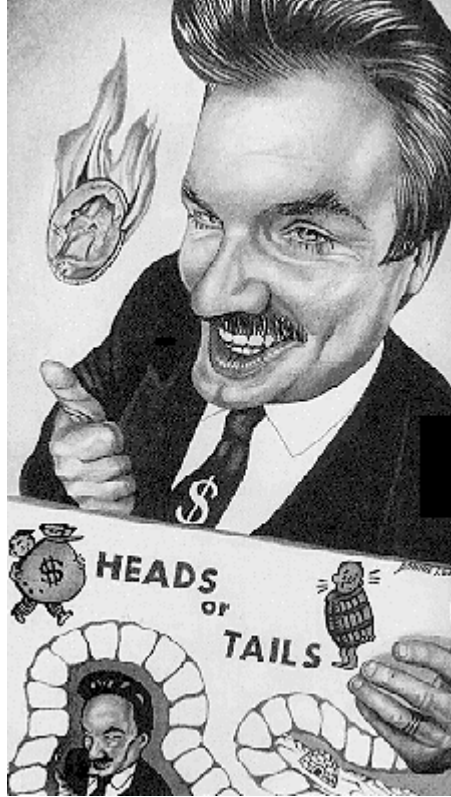


# Determining Optimal Risk

by Ed Seykota and Dave Druz



*Seasoned traders know the importance of risk management. If you risk little, you win little. If you risk too much, you eventually run to ruin. The optimum, of course, is somewhere in the middle. Here, Ed Seykota of Technical Tools and Dave Druz of Tactical Investment Management, using subject matter and materials that they have used in lectures and workshops around the US, present a method to measure risk and return.*

Placing a trade with a predetermined stop-loss point can be compared to placing a bet: The more money risked, the larger the bet. Conservative betting produces conservative performance, while bold betting leads to spectacular ruin. A bold trader placing large bets feels pressure — or heat — from the volatility of the portfolio. A hot portfolio keeps more at risk than does a cold one. Portfolio heat seems to be associated with personality preference; bold traders prefer and are able to take more heat, while more conservative traders generally avoid the circumstances that give rise to heat.

In portfolio management, we call the distributed bet size the heat of the portfolio. A diversified portfolio risking 2% on each of five instrument & has a total heat of 10%, as does a portfolio risking 5% on each of two instruments.

Our studies of heat show several factors, which are:

- 1 Trading systems have an inherent optimal heat.

- 2 Setting the heat level is far and away more important than fiddling with trade timing parameters.
- 3 Many traders are unaware of both these factors.

## COIN FLIPPING

One way to understand portfolio heat is to imagine a series of coin flips. *Heads, you win two; tails, you lose one* is a fair model of good trading. The heat question is: What fixed fraction of your running total stake should you bet on a series of flips?

This puzzle has been presented in numerous workshops and lectures. The participants generally come up with some amazingly complex ways to arrive at a solution. Overall, the simplest way is to notice that:

- 1 In the long run, heads and tails balance.
- 2 The order of heads and tails doesn't matter to the outcome.
- 3 The result after  $n$  sets of head/tail cycles is just the result of one head/tail cycle raised to the  $n$ th power (see sidebar, "Coin flipping math").

So we can get our answer simply by making a table of results of just one head/tail cycle.

Figure 1 represents such a heat test. It shows an optimal bet size of 25%, at which point one head/tail cycle delivers 12.5% profit, after a 50% gain and a 25% drawdown. As is typical of heat tests, at low heat, performance rises linearly with bet size. At high heat, performance falls as losses dominate, because drawdowns are proportional to heat squared (see Figures 2 and 3). In practice, a trader may prefer to bet the coin at less than optimal heat, say 15% to 20%, taking a slightly smaller profit to avoid some drawdown-induced stress.

**The results of the 12-year simulation recall the coin flips described previously. Return initially rises with increasing heat and then falls as drawdowns dominate.**

Heat tests show profitability and volatility over a range of bet sizes. Heat tests can help traders communicate with their investors about and ultimately align on betting strategy before trading begins. Otherwise, investors may become disenchanted with traders who trade well yet ultimately deliver either too little or too much heat.

## ACTUAL HEAT TEST

To study actual portfolio betting strategies, we fired up our system testing engine and simulated a trading system over a range of heats. The engine trades all instruments simultaneously (see sidebar, "System test"). The engine rolls deliveries forward to stay with the most active deliveries.

The results of the 12-year simulation recall the coin flips described previously. Return initially rises with increasing heat and then falls as drawdowns dominate. This heat test shows optimal performance for heat around 140% (about 28% per each of five instruments), at which point the system delivers about 55% return per annum (see Figure 4) with average drawdown around 40% per annum (see Figure 5) and

maximum drawdown over 90%. In actual practice, few investors would have the stomach for such an optimum. Most would prefer less drawdown and less gain. In any event, heat testing can provide a focus for traders and their investors and help align on critical issues of bet sizing, return and drawdown before beginning new trading relationships.

*Ed Seykota, who was interviewed in Market Wizards, operates Technical Tools, a purveyor of historical and daily financial data. Dave Druz, a computer programmer, heads Tactical Investment Management, a commodity trading advisory firm and commodity pool operator to the Tactical Futures Funds.*

**ADDITIONAL READING**

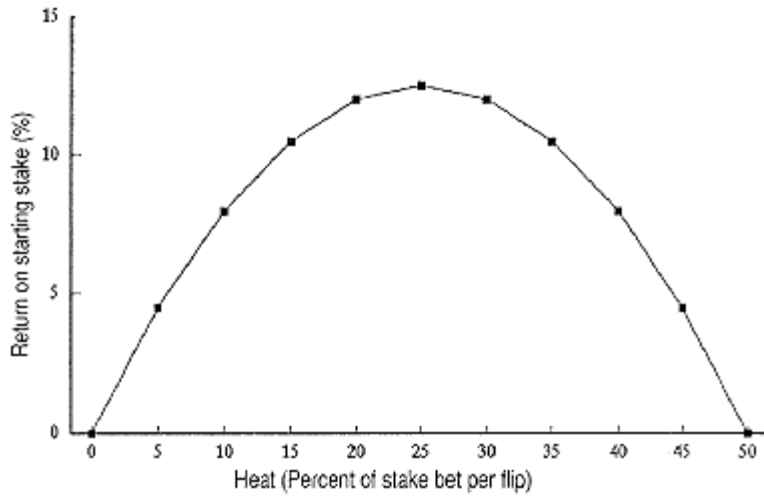
Colby, R.W., and T.A. Meyers [1988]. *The Encyclopedia of Technical Market Indicators*, Business One Irwin.  
 Schwager, Jack D. [1989]. *The Market Wizards*, New York Institute of Finance/Simon & Schuster.

**HEAT TEST OF ONE HEAD/TAIL CYCLE**

Starting stake	% bet	Win-on heads	Total	Lose on tails	Total
100	0	0	100	0.0	100.0
100	5	10	110	5.5	104.5
100	10	20	120	12.0	108
100	15	30	130	19.5	110.5
100	20	40	140	28	112.0
100	25	50	150	37.5	112.5
100	30	50	160	48	112.0
100	35	70	170	59.5	110.5
100	40	30	180	72	108.0
100	45	30	190	85.5	104.5
100	50	100	200	100	100.0

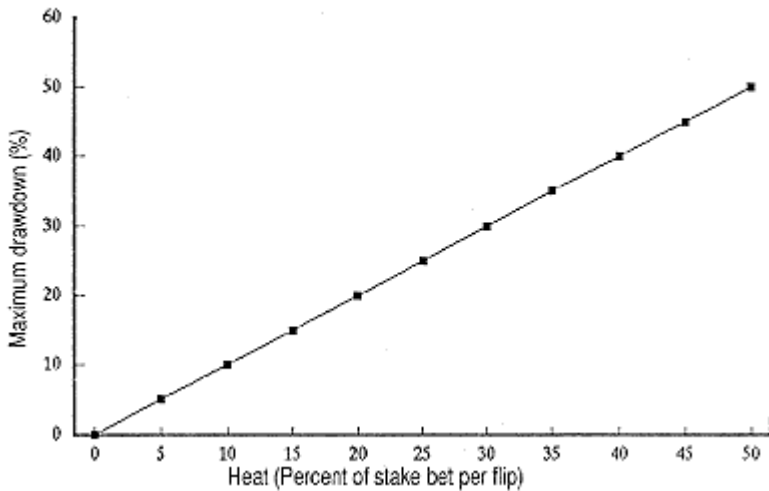
**FIGURE 1:** *The percent bet is the percentage bet of the running stake. The "Win-on heads" is always 200% of the bet. The "Lose-on tails" is the bet. The final total shows the result of one cycle. Beyond a 25% bet (lower half of table) the final total begins to suffer.*

**RETURN VS. HEAT** Two-flip coin toss: Heads then tails



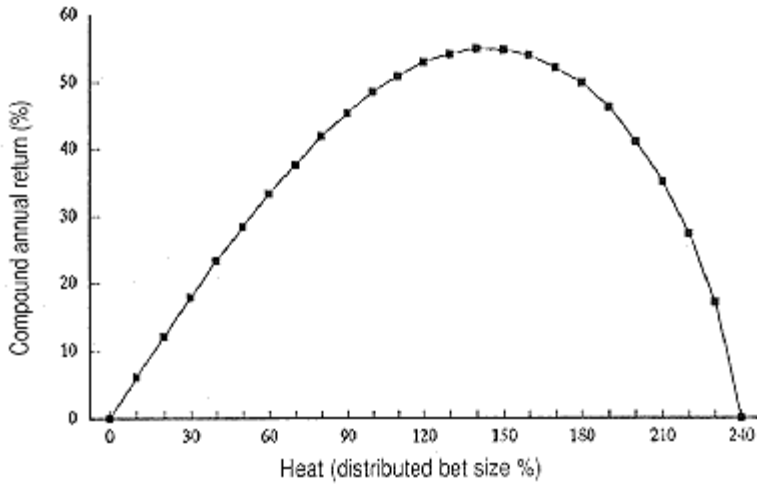
**FIGURE 2:** Plotting the return versus the heat illustrates that the optimal amount bet is 25% of the stake. The curve has a peak (point of zero slope) at 25%

**DRAWDOWN VERSUS HEAT** Two-flip coin toss: Heads then tails



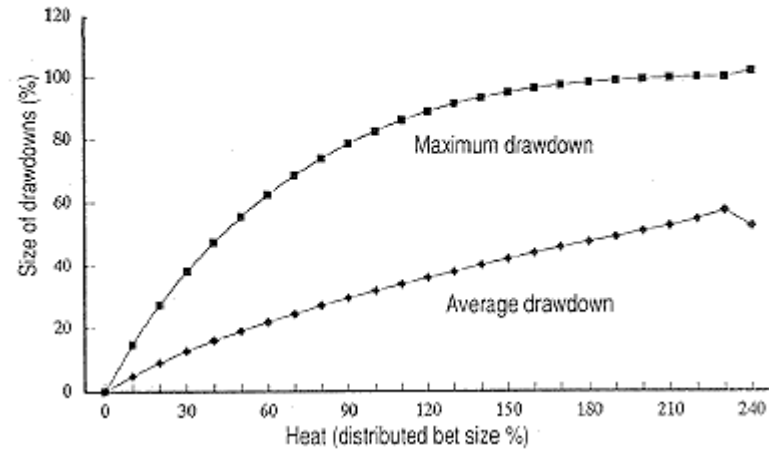
**FIGURE 3:** Plotting the drawdown versus the heat of heads you win two, tails you lose one bet illustrates that the drawdown rises with the amount bet.

### RETURN VERSUS HEAT, FIVE-MARKET PORTFOLIO



**FIGURE 4:** *The optimal level of heat is near 140%; then increasing heat causes losses to dominate.*

### DRAWDOWN VERSUS HEAT, FIVE-MARKET PORTFOLIO



**FIGURE 5:** *As heat is increased, the size of the drawdowns reaches maximum of over 90%.*