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"Depend on the rabbit's foot if you will, but remember it didn't work for the rabbit."
— R. E. Shay

An age-old question facing investors is "*How much to invest?*" This is a challenge to answer whether you are a fund of funds allocating to a group of managers, or a trader sizing the positions in a portfolio. Even after all the analysis—understanding why an investment should generate returns, backtesting, stress-testing and shocking the portfolio—the question remains: "*How much to invest?*"

Many investors suffer from incorrectly sizing their positions even with a positive edge strategy. We have all witnessed managers that oversized a position and made a fortune only to continue oversizing a position and then lose a fortune. A casino, which has a fixed and well-understood edge, cannot allow a gambler to make an outsized bet at the roulette wheel because it cannot afford to lose its entire bankroll on a single random spin.

What, then, is the optimal amount to invest to maximize wealth while minimizing risk? Investing too little—if we only invest $1 and we are wrong, we are not likely to lose much, but we likely won't make much either. Investing too much—if we invest all our wealth and we are wrong we may run the risk of ruin. These questions lie at the very core of Lake Hill's investment and risk management process. We have a variety of scientific and trading tools that can help us answer them.

One tool investors can use to estimate position size is the "Kelly criterion".

wager as a % of bankroll = edge / odds

The physicist John Kelly, Jr. developed the formula while working at Bell Labs in the 1950s. His work became popular in determining optimal size bets for repeatable games, like blackjack.

Figure 1 illustrates how the Kelly criterion generates the maximum long-term returns of these simple games. This figure also illustrates how, even with a positive expected payoff and certain odds (which is certainly *not* known in the financial markets), you can still bet too much and generate negative returns! This is analogous to trying to achieve the highest returns by levering a positive edge investment strategy but not leaving enough room to survive the drawdowns.

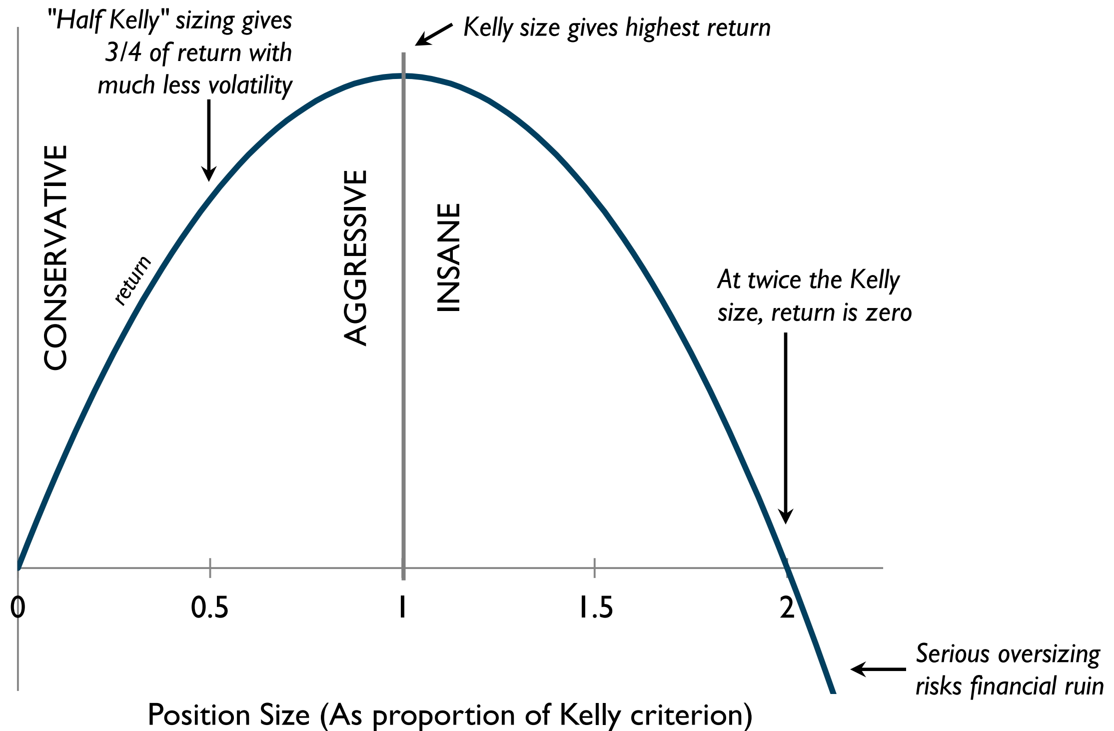

Figure 1: Long-term return of different position sizes in the context of repeatable games with fixed odds and payoffs. Source: *Fortune*'s *Formula* by William Poundstone.

Eventually, investment managers applied the Kelly criterion to finance by using it to navigate the delicate balance between over-allocating and under-allocating positions. Managers may find it useful, but should understand the additional layers of complexity in the assumptions and output: many financial market probabilities and payoffs are uncertain, the edge can vary and the results can be volatile in the short-term.

Even strategies with a proven edge and fixed odds can have difficult periods. A successful card counter, who has a well-known and nearly guaranteed edge, has to be ready to endure days, weeks, or even months of drawdowns before turning a profit. Backtests, simulations and historical data can provide guidance but are no comfort without the necessary self-discipline to stick with a positive edge investment. A solution might be to size the investment according to how the portfolio may perform in both expected *and* unexpected conditions—those never observed throughout history. This exercise may result in making a smaller investment at the onset.

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