Nov-79 (64)

bar point still has value, especially if your opponent should reenter on your one-point, your real objective is to limit the possibility of his reentering at all. Your priority shifts from securing your bar point to securing points in your home table.

Diagram 11 illustrates this point. Black's runners have escaped. White is considerably behind in the race. White's only hope is to hit and contain black long enough to catch up. White rolls a 6-2. How should he play it?

For the 6, white should move W11 to W5 and for the 2, W9 to W7. White could have used this roll to make his bar point. Had black's runners not escaped, this would have been preferable. Since black's runners are no longer a factor, white should concentrate on building points in his home table rather than securing his bar point.

White could also have used the 6-2 to make his two-point. He should, however, secure his high points first, so that even if black reenters, he will not escape easily. If black is forced to reenter low, white may get the chance to hit him again (even if he must slot to do so) before black escapes. For these reasons, slotting to the five-point, in the hope of securing it on a subsequent turn, is the best move.

Slotting two men can be advantageous when there is no prospect of your opponent opening up on his next turn. In diagram 12, white has rolled a 6-4. Here, slotting two men simultaneously is white's strongest move. There is no prospect of black leaving a shot on his next turn, and therefore white can afford to build his home table as quickly as possible—even if it means leaving himself vulnerable. White should move W9 to W3 for the 6 and W8 to W4 for the 4.

With the distribution of white's men, almost anything white rolls on his next turn will allow him to secure W4 and W3. This would give white a four-point board with which he is then ready to hit black.

In summary, knowledge of how and when to slot is valuable, regardless of the position of your opponent's runners. You now have that knowledge. Good luck. **9**

(Next month: Bearing Off)

The Mathematics of Gambling:

Letters from Readers

by Edward O. Thorp

Q: *I read and reread* **Beat the Market** *and then proceeded to short 1,800 shares of Loews T warrants at an average price of $17.18 per share and buy long 600 Loews Common at $46.10 per share. My question is, are the principles still applicable today? Also, I have a gut feeling that you have a strategy for options that is more exciting than the warrant hedge.*

L.C.

A: I wish that you had read *Beat the Market* more carefully. Loews warrants has a senior security which can be used at par to exercise the warrants. I refer to the ASE LTRW warrants expiring 11/20/80 with an exercise price of $40. The senior security is the 6.875 percent bond of 1993. As of July 16, the bond price was $78. This gives an effective exercise price of $31.54 and a tangible value or conversion value for the warrants of $18.21. The warrant price, then, was $18.63. That means that there was only about 42 cents of premium in the warrant to capture, and it would take more than a year to do so.

The yield on the common was about 2.4 percent. Therefore, the expected yield on your position was very low. If I had the position you describe, I would have closed it out at this time. Since I don't know when you entered the position and don't have the corresponding bond price, I can't tell you if you made a good choice, initially. At the prices I quote, I see that you are losing $1.45 per warrant, or a total of $2,610 on the short side, and you are gaining $3.65 per share of common, or a total of $2,190 on the common for a net loss before liquidating commissions of $420.

You could avoid mistakes like this by taking the Value Line Options and Convertible Service. Each week, they give a summary of the relevant warrant statistics, including the information I quoted you.

The principles of *Beat the Market* are still applicable, and there are warrant situations from time to time which are attractive. It is also true that options now offer much greater opportunities than the warrants. However, this whole area has come to involve considerable specialized knowledge, and unless you have considerable money and knowledge of the financial markets, do not invest in this area. On the other hand, for those who have the prerequisites that I mentioned, the rewards have been, and continue to be, impressive.

Q: *I recently finished reading* **Beat the Market** *and as always, I was impressed by the quality of your work. Perhaps you would consent to enlighten me even more on a few points.*

What is the general equation for the family of curves in figure 6.3? And what is the first derivative of that function with respect to S/E? You see, I own a microcomputer, and those two equations would make it easier for me to compute both W/E and the mix than to obtain them from figure 6.3.

Have there been any important changes since your book was written?

And finally, do you have any advice for a beginning investor like myself? My funds are limited, and my ability is untested, but my enthusiasm is unbounded.

K.F.

A: Please refer to my above letter to L.C. I add that since *Beat the Market* was written, the Black-

Scholes option evaluation formula has been developed and replaces the various curves, formulas and graphs in *Beat the Market*. This option evaluation formula applies to warrants as well as to options. The detailed use of the formula is somewhat involved and requires considerable specialized financial background.

Judging from your letter, it would be unwise for you to make investments in the warrant or option area unless and until you are comfortable with the use of that formula. Even then, I recommend caution because the area is highly competitive and filled with very skilled and knowledgeable people. It is no place for a beginning investor. It is also no place for someone whose funds are limited. A book which may be helpful to you is *The Stock Options Manual* by Gary Gastinau. Thank you for your favorable comments.

Q: *As an amateur blackjack player, I have read both your original book as well as the revised version and enjoyed them very much. I wonder if you might help me with a few questions.*

Sports Illustrated *recently ran an article about an individual who programmed a microcomputer to keep track of cards and indicate strategy for blackjack. If such a computer were available to a person, what strategy should be programmed? Would, for example, your point count or 10's count strategies be appropriate? Or is there a more complete and powerful strategy which could be employed, given a computer capability?*

Is it actually against the law in Nevada to use a concealed computer to keep track of cards and strategy? The article indicated the detected individuals were turned over to the police, who arrested them and charged them with "swindling and bunco steering," but the charges were later dropped.

And finally, do both your point count and 10's count strategies work equally well for both single and multiple decks, or do the strategy tables need to be modified for a multiple deck? And why doesn't your point count strategy call for keeping track of excesses or lack of aces and adjusting the predicted advantage accordingly, as described for the 10's count strategy?

R.J.

A: If a microcomputer were used to determine blackjack play, I think that a suitable strategy would be one which closely approximated the exact calculation of best play. The various card counting strategies don't do this as well as a specially programmed computer could. One idea is to follow the approach Roger Bamford used for his "black box," as described in the 1967 edition of Richard Epstein's book, *The Theory of Gambling and Statistical Logic*. So the answer to your question is, given a computer capability, a more complete and powerful strategy than any of the card count strategies currently used by humans could and should be employed.

I don't think it is against the law in Nevada to use a concealed computer to track cards and develop playing strategy. However, I'm not offering you legal advice, and if you want to be sure, you ought to talk to a lawyer.

The point count and 10 count strategies are given in *Beat the Dealer* for one deck. They are almost correct for multiple decks; however, small changes are needed to make them fully correct. But the difference between using the one deck strategy for several decks, instead of using the correct several deck strategy, is on the whole, small.

If I wrote another edition of *Beat the Dealer*, I would certainly include the refinement of the point count theory in which the player keeps track of an excess or lack of aces and adjusts the predicted advantage accordingly. That's a good improvement, and it's one I've known about and used since 1961. I thought at the time I wrote *Beat the Dealer*, it would be too burdensome to include. However, as you know, the good strategies being marketed today include that feature as a player option.

From a letter to Allan Wilson, forwarded to E.O.T.:

Q. *Is there a formula for figuring the optimal percentage of your bankroll to bet on a number of simultaneous, independent events, in all of which you have an advantage?*

I have been doing some computer runs on some particular cases and can get a good approximation. For example, when you are making three bets, each with a 45 percent advantage, maximum results seem to occur by betting about 28 percent of your bankroll on each.

In particular, I am interested in the optimal approach to betting football games (on a $10 bet, if you lose, you lose $11). Several groups of pointspreads have had a positive result over the past several years. For instance, a 4½-5 point underdog has won 60 percent of the time in the last nine years (approximately 200 games). This sample may not be statistically large enough to confidently wager on, but I am willing to risk a limited amount of capital on it.

Assuming that I am willing to set aside a bankroll for this venture and also assuming that I do actually have an advantage (approximately 15 percent advantage in this particular case, taking into account the bookie's vigorish), here's the type of thing I am faced with: Suppose on a Saturday that there are three games with a 15 percent advantage. Would I be better off betting 15 percent of my bankroll on a single game (the optimal amount for a single game), or betting a certain percentage on two or three games? My computer runs indicate that I would be better off betting the three games.

Closer to actuality, there may be one 15 percent game, one 10 percent game, one 25 percent game, and one 30 percent game. What is my best strategy? A formula would be very helpful.

G.E.

A: As you know, Dr. Wilson has forwarded your letter to me for my response to you. Your question has been answered by mathematicians. Here is the "formula."

Suppose at a given time there are N independent favorable bets. Then you should allocate to each of those bets fractions $f_1, f_2, \ldots, f_N$ in such a way that the mathematical expected value of the logarithm of your capital after the bets are resolved is maximized.

To understand what this means and how to use it, if you have a mathematical background or a mathematical consultant available, you can read the articles which I have written on the subject. The articles also have additional references.

- "Optimal Gambling Systems for Favorable Games," *Review of International Institute of Statistics,* 37:3 (1969), 273-293. (Z *191*,497)
- "Portfolio Choice and the Kelly Criterion," *Proceedings of the 1972 Business and Economics Section of the American Statistical Association,* 1972, 215,224. Reprinted in *Stochastic Optimization Models in Finance,* Academic Press, edited by W.T. Ziemba, S.L. Brumelle, and R.G. Vickerson.

You can find these papers in a large university library. I must warn you, though, that they are mathematically involved. You can use the general formula to produce a specific simple formula in any example like the football example that you discussed. I will explain how to do some of these things in next month's column on money management. 9B