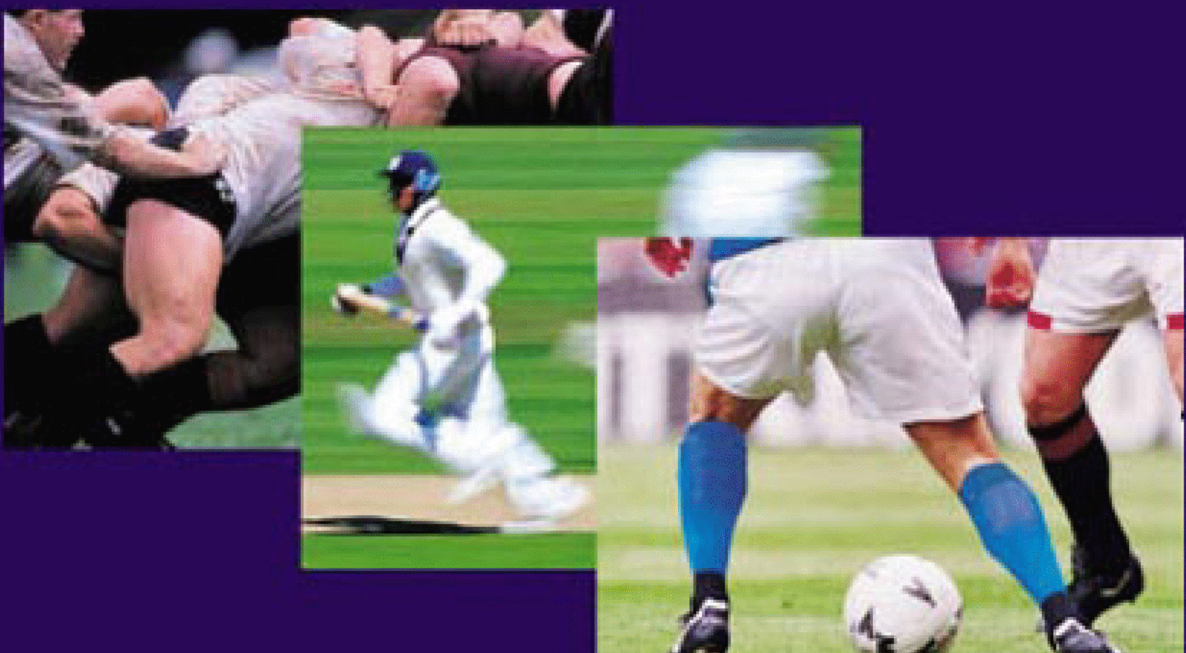
HIGH STAKES

FIXED ODDS SPORTS BETTING

The Essential Guide



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Published in 2003 by

High Stakes Publishing,

21 Great Ormond Street, London, WC1N 3JB

www.highstakes.co.uk

A CIP catalogue record for this book is available from the British Library.

ISBN 1-84344-019 9 Fixed Odds Sports Betting

2 4 6 8 10 9 7 5 3 1

Printed by Cox & Wyman

Acknowledgements

I would like to thank Andrew O'Hara for his assistance in proofreading the first draft, Mike Shor, of Gametheory.net, for his material contribution, and Paul Ross, Mark Hodson, Andy Baxter, Ian Blair and Kevin Kelly, without whose encouragement and insights this book would not have been completed.

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What Is Investment?

One of the tenets of capitalist economics is the principle of investment, the idea of committing capital to make a profit. Traditional sources of investment have included banks and building societies, stock markets and property. Profits from these types of investment may come in two forms, to a greater or lesser extent, depending on the nature of the investment. These are capital growth and income. Capital growth occurs when the investment increases in value. One typical measure of capital growth is the price of a share on a stock market. An investor may buy some shares at £5 each. After a year, if they are worth £10, the investor has doubled his capital. In contrast, if the price falls to £2.50, the value of the capital has halved. Another measure is the price of a house, which, like shares on a stock market, can go up and down. How the value of an investment will change over time will depend upon a whole host of influencing factors that operate within any particular investment market. Naturally, any investor wants to avoid markets that are falling, and concentrate on investments that will return profits. Clearly, not every investment will be a successful one. A successful investor is one who can identify more winners than losers through an assessment of profitability and analysis of risk.

Certain capital investments also return what is termed an income. A let property, for example, returns an income through rental receipts. The size of the income is normally quoted as a percentage of the initial capital investment. If a landlord buys a house for £50,000 and generates £5,000 each year from rents, the income yield is said to be 10%. Many shares on a stock market pay an income in the form of a dividend. Again, the size of dividend may be quoted as a percentage of the value of each share. Perhaps the most common investment income is that achieved through a bank or building society savings account, the size of which will be determined by the interest rate. A savings account holder, of course, may choose to reinvest any income earned by the capital by leaving it where it is. Such income compounded over time will allow the initial capital to grow.

One might ask at this point, what has all this got to do with sports betting? After all, isn't sports betting just a form of gambling, and what has gambling got to do with investing? The answer to these questions will depend to a large extent on the aims and interests of the sports bettor. Whether he considers his sports betting to be gambling or investing will be governed by his approach to sports prediction and money management, the level of professionalism attributed to both, and even by his view of what it actually means to gamble or invest.

What Is Sports Betting?

To have a bet is to make an agreement between two parties that the one proved wrong about an undetermined outcome of a specified event will forfeit a stipulated payment, most often a sum of money, to the other. Sports betting, then, is concerned with bets or wagers agreed where the specified event central to the betting terms involves a sport, for example a football game, a tennis match, a golf tournament or an athletics race. Horse racing is perhaps the oldest and most popular form of gambling, with more money changing hands in this betting market than in any other. Increasingly, however, and particularly since the advent of Internet gambling, sports including rugby, cricket, tennis, golf, snooker, cycling, swimming, athletics, skiing, motor racing and, most popular of all, football, are gaining more attention as a medium for betting.

Sport is about settling arguments: arguments about who is the fastest, strongest, most accurate and so on. Betting is about settling arguments too, and that is why sport lends itself so easily to betting. Wherever the element of competition is present in sport, a speculation can be made on the outcome of a particular event. Furthermore, sport has become increasingly popular as entertainment in recent years, with viewers becoming progressively more knowledgeable about the teams and players they are watching. Being able to speculate on a sporting event, and confirm one's convictions about the likely outcome with a financial reward, is a natural attraction that adds to the viewing excitement.

Sports Betting: Gambling or Investing?

Gambling and investing have one primary aim in common: to make a profit. Furthermore, both gamblers and investors speculate on the chances of making a profit, by taking a risk in the hope of gaining an advantage. Perhaps the most obvious apparent difference between gambling and investing concerns the level of exposure to risk as a result of any speculation to gain an advantage. For most fixed odds bets,[1] the risk is infinite: that is, if the bettor is wrong, he loses his entire stake. By contrast, the investor is very unlikely to lose all his money, and may choose to withdraw any remaining capital invested if its value falls. The bettor, however, usually knows in advance what he will win if his speculation proves correct.[2] Frequently, since the risk is so much higher than for standard investments, the rewards will be higher too. The investor can only guess at what profit he may hope to secure, and unless he is extremely lucky, an equivalent profit (as a percentage of the initial stake or capital invested) will take much longer to secure.

Another obvious difference between gambling and investing concerns the period of speculation in terms of time. Whereas traditional forms of investment discussed earlier are generally made over weeks, months or years,[3] the resolution of a bet on the outcome of a game usually involves no more than a few hours or days at most.[4] Generally then, gambling might be considered to be high-risk, short-term speculation, whereas traditional forms of investing are lower risk and longer term. On the face of this assessment, it might seem rather imprudent to risk money through sports betting, as the risk of losing your capital is just too high to justify placing the bet in the first instance, no matter what profit is available to the speculator. Bettors, or punters, of course, rarely place only one bet, and the size of any one stake will invariably be much smaller than the total capital a punter has made available for his betting. Instead, by having many smaller wagers, a punter can effectively spread his exposure to risk, because it is very unlikely that all the bets will lose.

The similarity between such risk-managed gambling and a traditional investment strategy may become more apparent by means of the following example. Consider first a stock market investor who buys units in a FTSE100 tracker fund. Buying 100 units at £10 each, the investor watches as the prices fluctuates over the next 200 days, rising to £12 by the end of this period. A profit of £200 or 20% on the initial capital invested has been made. At the same time, a gambler bets 1% of his £1,000 betting fund, or

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[1] Certain handicap bets allow for ties where stakes are returned without loss or profit.

[2] The potential profit is exactly calculable for fixed odds betting, but not for spread bets until the result of the event is known. Spread betting shares parallels with financial market trading.

[3] In recent years the phenomenon of day trading on stock markets has increased in popularity.

[4] Ante post betting involves betting on an event weeks, months or even years in advance.

£10 every day that the value of the FTSE100 tracker fund will rise. If he is correct, he wins £10. If he is incorrect, he loses his £10 wagered. During the gambling period, the value of the fund rises on 110 days, when a £10 profit is made, and falls on 90 days, when £10 is lost. Overall, the gambler has made £200 profit, the same as the investor, because there were 20 more days when the value of the fund rose than when it fell, despite losing all money staked on the losing days. Notice however, that although the profit is 20% on the initial betting fund, the percentage profit over turnover is only 10%, because the gambler wagered a total of £2,000, compared to the £1,000 invested in one lump sum by the investor.

What are the chances of either the investor or the gambler losing all their capital through this speculation? The investor will lose all his capital if the value of the fund falls to nothing. Such an event is of course highly unlikely, and consequently such an investment fund would be considered a very safe or low-risk form of investment. By contrast, the gambler risking 1% of his betting fund with each wager will lose everything if there are 100 more days on which the value of the fund falls than when it rises. Clearly, during a 200-day gambling period, the probability of such an occurrence is low, but not negligible. Suppose that on 50 days the value of the fund rises by £20 and on 150 days it falls by £5. After 200 days, the investor would see his capital increase by 25% to £1,250, but the gambler would have lost everything. Conversely, suppose that on 150 days the fund rises by £5 but on 50 days falls by £35. This time the investor loses everything, whereas the gambler is up £1000, or 100% on the initial betting fund.

Clearly, the relative profitability and risk associated with traditional capital investment and fixed odds gambling is not as straightforward as that presented in this oversimplified comparison. Furthermore, real-life investment and gambling markets are rarely found to overlap, with the exception perhaps of financial and sports spread betting, making a comparative assessment even more problematic. Finally, a lot of sports betting, particularly fixed odds betting, has the added disadvantage that a third party, the bookmaker, is taking a sizeable percentage of any profits, thereby making it an inherently riskier form of money-making. Nevertheless, it is by adopting a professional approach to forecasting and, more importantly, money management, that a successful punter can turn apparently higher-risk gambling into a lower-risk investment strategy. This book aims to reveal some of the techniques and tools available to the punter to invest in the world of fixed odds sports betting.

What Is Fixed Odds Betting?

What Are Odds?

When a bet is placed between two parties on a specified event, the total amount risked by both is usually agreed before the outcome of the event. The most basic of bets might involve two friends, Paul and Mark, having a wager on the outcome of an England football game. Paul might offer Mark £10 if England win, whilst Mark will pay Paul £10 if England fail to win. Provided that England has roughly a 50-50 chance of winning, then this would be a fair wager. If, however, England were playing San Marino, a realistic chance of an England win might be 95%. In this case, Mark would have a distinct advantage over Paul, since the chances of him losing £10 are much less than those of him winning £10. Consequently, Paul and Mark might agree to change the terms of the bet, with Paul paying Mark £10 if England win, but Mark paying Paul £200 if they do not. Since the chances of San Marino drawing or beating England are very small, Mark must risk a much larger sum in order to gain his potential reward from Paul, if Paul is to accept the bet. To ensure that any bet between Paul and Mark is fair and acceptable to both, the relative proportions of the amount risked by the two parties will be dependent upon the expected probability of England winning their game. The amount risked or wagered by each party is known as the stake.

Table 2.1 details some potential wagers, with accompanying stakes, that Paul and Mark might have together over a number of England matches played on neutral territory in a World Cup. In each case, Paul is offering to reward Mark if England win, whilst Mark is offering to reward Paul if England fail to win.

Table 2.1. Wagers and odds

Match	Paul's stake	Mark's stake	Ratio	Estimated chance of England win
England v Brazil	100	25	4/1	20%
England v Germany	100	100	1/1	50%
England v Poland	100	150	2/3	60%
England v Scotland	100	400	1/4	80%
England v Malta	100	900	1/9	90%

The ratio of Paul's stake to Mark's stake is known as the odds. In the England v Brazil game, for every £1 that Mark stakes on an England win, Paul has agreed to pay him £4, provided England win. By contrast, in the England v Malta game, Mark expects to win only £1 by risking a £9 stake backing England. The nature of the odds, that is the ratio of the two stakes, is determined by the estimated probability of England winning their game. In the England v Scotland game, for example, it is estimated that England have an 80% chance of victory. The size of Mark's stake then will be 80% of the sum of the two stakes. If Paul's stake is 100, Mark's will be 400. Mark's odds on an England victory are 1/4; Paul's odds on England failing to win are 4/1. The expected probability of all possible betting outcomes will total 100%. "Odds" is really just a betting term for probability.

Who Is the Bookmaker?

Loosely speaking, anyone offering odds on an event is known as a bookmaker, or bookie for short. Paul and Mark in the examples above could both be considered bookmakers, setting odds for each other in a friendly wager. But the term properly applies to persons or businesses that provide an odds market for one or more events, with prices available for all possible event outcomes, adjusted according to the demand of the bookmaker's customers, the punters. "Bookmaking" technically refers to the management of betting probabilities for the purposes of making a profit over a large number of events for which odds are offered. A "book" is simply the full record of betting transactions at all the available odds made with the punters for a particular event.

Unlike the wager on England between Mark and Paul, a bookmaker will never offer a book where the expected probability of all possible betting outcomes on a single event totals 100%. By reducing the odds for each betting outcome, the totality of expected probabilities is increased above 100%, thereby ensuring that, if managed correctly, the book will make a profit for the bookmaker. The size of this expected profit margin is sometimes referred to as the bookmaker's overround, a concept developed further in Chapter 3. Although in this sense bookmakers' odds are unfair odds, overround betting was actually introduced in the early 19th century to remove the necessity to cheat. The standardisation of the bookmaker's profit margin according to mathematical principles effectively professionalised the betting industry.

Fractional versus Decimal Odds

The presentation of betting odds as ratios or fractions is a very British phenomenon. Decimalised currency, of course, has only been in use in the UK since 1971. Even in the last 30 years, fractional odds have remained very popular in Britain, and today one will still see them used in the windows of high street bookmakers to lure potential customers. Typical sports betting odds include 4/9, 8/15, 8/13, 5/6, 10/11, 1/1 (or evens), 5/4, 6/4, 2/1 and 9/4. Knowing the fractional odds allows one to determine how much one must risk in order to achieve a specified reward. For odds of 8/15, a winning stake of £15 will return a profit of £8 (and of course the £15 stake), whilst a £4 stake at 9/4 could return a profit of £9. Fractional odds simply describe the potential profit that can be won from a unit stake. A winning £1 stake will earn a profit of £(9/4) or £2.25. If the stake is higher than the potential profit, the betting price is said to be odds-on; if lower, then it is termed odds-against. Where the stake is the same as any potential gain, the odds are known as evens, since there should be roughly an even 50-50 chance of winning and losing if the odds are fair.

In Europe, and increasingly in Britain since the growth of online sports betting, decimal odds are being used instead of fractions. Instead of 4/9, 5/4 and 15/8, one may instead see 1.44, 2.25 and 2.88. These three pairs of odds may look quite different and yet are equivalent in terms of the size of stake and potential profit. Whereas fractional odds show just the winnable profit for a certain stake, decimal odds describe the total return, including both stake and profit, if the bet wins. For all decimal odds, a unit stake is assumed. Consequently, odds of 2.25 describe a bet, which, if won, will return a profit of 1.25 **and** the original stake of 1. Decimal odds less than 2 will be odds-on, whilst prices greater than 2 will be odds-against. Decimal odds of 2 are evens (or 1/1).

It is fairly straightforward to convert from fractional odds into decimal odds, because the size of the fractional odds represents the potential profit from a winning bet.

$$\text{Decimal odds} = \text{Fractional odds} + 1$$

For fractional odds of 9/4, the value of the decimal odds will be given by:

$$(9/4) + 1 = (9/4) + (4/4) = (13/4) = 3.25$$

Usually, decimal odds are rounded to the nearest 2 or at most 3 decimal places. Consequently, fractional odds of 10/11 would be rounded to 1.91 (since 21/11 = 1.909090909…).

Converting from decimal odds back into fractional notation is a little more problematic. Sometimes the decimal odds quoted do not fit neatly into fractions. Although 2.5 converts simply back to 6/4, there is no simple fraction that is equivalent to 2.64 (the nearest being 13/8). The simplest way to think of 2.64 in fractional terms, then, would be as 1.64/1.

There are advantages to using either presentation of odds. On the one hand, fractional odds help one to visualise the stake and potential profit with simple integer numbers. On the other hand, decimal odds allow for a much greater range of potential prices, since there are only so many manageable fractions available. Furthermore, certain fractions like 7/3, 11/6 or 13/7 are traditionally not used. Many bookmakers who now quote decimal odds, however, reveal the legacy of fractional odds usage by also constraining the number of betting prices available. Whilst the bookmaker may round odds of 15/8 to 2.88, they may not offer 2.76, 2.77, 2.78…. 2.85, 2.86 and 2.87 as available prices between 7/4 and 15/8. Most often, this will be to the advantage of the bookmaker. Perhaps the most significant benefit of decimal odds over their fractional counterparts, however, comes from their obvious suitability to computer analysis for the development of sports prediction and betting systems.

Table 2.2 provides a quick summary of the typical fractional odds available with bookmakers and their decimal equivalents.

Table 2.2. Fractional to decimal conversion

Fractional odds	Decimal odds	Fractional odds	Decimal odds	Fractional odds	Decimal odds
1/10	1.1	Evens	2	11/2	6.5
1/9	1.11	11/10	2.1	6/1	7
1/8	1.13	6/5	2.2	13/2	7.5
1/7	1.14	5/4	2.25	7/1	8
2/13	1.15	11/8	2.38	15/2	8.5
1/6	1.17	6/4	2.5	8/1	9
2/11	1.18	13/8	2.63	17/2	9.5
1/5	1.2	7/4	2.75	9/1	10
2/9	1.22	15/8	2.88	10/1	11

Fractional odds	Decimal odds	Fractional odds	Decimal odds	Fractional odds	Decimal odds
1/4	1.25	2/1	3	11/1	12
3/10	1.3	11/5	3.2	12/1	13
1/3	1.33	9/4	3.25	14/1	15
4/9	1.44	12/5	3.4	16/1	17
1/2	1.5	5/2	3.5	20/1	21
8/15	1.53	13/5	3.6	25/1	26
4/7	1.57	11/4	3.75	33/1	34
8/13	1.62	14/5	3.8	50/1	51
4/6	1.67	3/1	4	66/1	67
8/11	1.73	100/30	4.33	100/1	101
4/5	1.8	7/2	4.5	150/1	151
5/6	1.83	4/1	5	200/1	201
9/10	1.9	9/2	5.5	500/1	501
10/11	1.91	5/1	6	1000/1	1001

Why Are They Called Fixed Odds?

The history of fixed odds dates back to the 19th century and the origins of football gambling. During the 1880s, newspapers started offering fixed prizes for correctly predicting the outcome of games. These prizes became known as “fixed odds”.

Today, licensed bookmakers still offer fixed odds “prizes” for correct football match prediction. The term “fixed odds” is perhaps more appropriate for the high street bookmaker, who publishes a long list of football matches and their accompanying betting odds for the coming weekend several days in advance. This is an expensive process and cannot be repeated if mistakes are made or if the bookmaker needs to alter a price in response to customer demand. Consequently, once the list goes to print, the betting odds become fixed.

An Internet bookmaker has more flexibility in this respect, and can change a price to manage his projected liability. Nevertheless, with the exception of the most popular football leagues like the English Premiership, betting odds for the majority of matches remain unchanged up until kick-off. Even for high profile games like Manchester United versus Arsenal, where bookmakers can expect to see a large turnover, the odds available for the standard home/draw/away market may not fluctuate by more than about

10% from the original prices. Prices for other fixed odds football betting, including correct score, double result and total goals rarely change at all.

Spread Betting versus Fixed Odds

This book is about fixed odds, but there is another field to sports gambling in the form of spread betting, and it is worth devoting a little time to compare and contrast the two forms. Sports spread betting has its origins in the financial markets. Indeed, the majority of spread betting today continues to focus on price movements of company stocks and market indices. Since spread betting involves taking a position on whether a "price" will finish higher or lower after a specified time, it was natural for this form of speculation to evolve directly from financial trading.

Sport lends itself equally well to spread betting. Rather than speculate on a particular aspect of a sporting event for which the bookmaker has made available a fixed odds price, the punter instead considers whether the spread betting firm's prediction is too high or too low. Unlike in fixed odds where you generally either lose your whole stake or win your fixed profit,[5] the amount you win or lose from a spread bet depends on how right or wrong you are. For example, a spread betting firm may predict that Manchester United will finish the season with 82 points. You must then decide whether the actual total will be higher or lower. If you believe that Manchester United will finish with more than 82 points, you will "buy"[6] 82 points at a specified amount per point, for example £10. If Manchester United then go on to finish with 90 points, your profit will be £80 (8 points x £10 per point). On the other hand, if they do badly and finish with 65 points, your loss will be £170. Conversely, if you believe that 82 points is simply not achievable, you might decide to "sell" 82 points at £10 per point. If Manchester United finish with more, you will make a loss; if with fewer, a profit. If they finish with 82 points exactly, you will neither gain nor lose.

Spread betting firms will aim to balance their books by having roughly the same number of buyers and sellers for each market that they offer. If a particular event is attracting more buyers than sellers, the firm will simply raise the value of their prediction to attract more sellers into the market. With the exception of the Internet bookmakers, such price adjustment is

[5] Returned stakes with no profit or loss are possible with Asian handicap betting.
[6] The terms "buy" and "sell" in spread betting come direct from the language of financial trading.

not available in fixed odds betting. Furthermore, since price changes are easily accommodated, one can continue to both spread bet throughout a sporting event and even choose to close a position before the finish.[7] Test match cricket, for example, which lasts up to 5 days, is particularly suited to spread betting of this nature, with markets available on the number of runs either side may score, or the total number of runs in a game.

Of course the spread betting firms also want to make a profit. If they simply offered Manchester United at 82 points and successfully managed to balance the turnover between the “buyers” and “sellers”, they would make nothing. Consequently, there are different “buy” and “sell” prices, similar to those one will find when buying or selling shares. The difference between the buy and sell price is known as the “spread”, and this generates the firm’s commission. Manchester United’s total points might be available to buy at 83 points, and available to sell at 81 points. If Manchester United finished on 82 points, both buyers and sellers who maintained their position until the end of the season would actually lose.

There are three basic categories into which spread bets fall: total number bets; supremacy and match bets; and performance index bets. These are decided by the totals of certain numbers in sporting events from which winners are declared, for example goals in football, runs in cricket, points in rugby or shots in golf. A spread on Manchester United’s end-of-season points total is an example of a total number bet. Where a total points spread is offered for all teams in the league, this is known as the index.

Individual football games, with relatively few goals scored per game in comparison to runs hit in a cricket match, are not as well suited to total number spread betting. More usually, supremacy spreads are available, where the spread betting firm offers a price for the number of goals one team will beat another by. Prices are usually quoted to 1 decimal place because of the low scoring in most games, with a typical spread of 0.3. The spread for an England v Scotland game might be 0.9-1.2. If the game finishes 3-1, buying 1.2 at £10 per (decimal) point will profit £80, whilst selling 0.9 would lose £110.

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[7] In-running fixed odds betting, provided by Internet bookmakers, is becoming an increasingly popular phenomenon, where the bookmaker changes the odds during a sporting event, and offers an alternative to spread betting. In-running odds, however, are only available with a few Internet bookmakers and for only a selected number of televised sporting events, most usually football and tennis.

Where points, runs, goals and lengths are not suitable to measure success, a performance index is generally used, which enables quotes on a variety of other sporting events to be made. A different number of points are awarded to the winner, runner-up, third place and so on. A performance index may also be used for special markets like bookings in a football game, with 10 points awarded for a yellow card and 25 for a red card, or the performance of a particular player during a Test match, with points awarded for wickets taken, catches made and runs scored.

In contrast to fixed odds betting, spread betting's popularity lies in the thrill of not knowing exactly how much one is risking or how much one can win. This is because it is the exact result that determines the make-up of the bet, so one will always maintain an interest in the game. Unfortunately, this is what makes spread betting a far more risky and addictive form of gambling. Additionally, because of its origins in the financial markets, spread betting has tended to attract the more sophisticated type of gambler who is better equipped and more prepared to risk larger sums of money. Since the spread betting firms primarily cater for this wealthier clientele, a typical fixed odds gambler may well feel overawed by the prospect of losing several hundred pounds from even a £2 per run buy at 300 runs in the first innings if the England cricket team collapse, when his usual wager might be a £25 bet on them simply to beat India at Lords at 11/10. With a fixed odd bet, the stake is all that can be lost. A spread bet, however, can win or lose many times more than the unit stake agreed.

Fixed Odds Betting Markets

There are many types of fixed odds betting markets available and most are suited to the full range of sports that fixed odds betting attracts. The most popular and common market is match betting, and the earlier discussion on fixed odds was largely made with reference to this type of wager. In standard match bets between two teams or players, winning odds are available for both, and the wager will either win or lose depending on the outcome of the event. Match bets are most popular in football and, because a significant proportion of games end without any winner, the "draw" is offered as a betting option. This means that if the match is drawn, only "draw" bets will win, and bets on either team to win will not be due any return. Football fixed odds match betting is sometimes known as 1X2 betting. On fixed odd coupons, a “1” denotes the home team, with the away team represented by a “2” and the draw by an X.

Occasionally, bookmakers may reduce the 3 outcomes for a football match to 2, by what is known as “Double Chance” betting, where a single price is offered on a win or draw. If the backed team wins or draws, the bet wins; if the team loses, so does the bet. With double chance bets there is no possibility for the draw. The win/draw odds will always be shorter than for both the individual win and draw odds, because the chances of either outcome occurring are greater than for each one separately.

Head-to-head betting is similar to match betting, where one backs one team or player. Sometimes, however, and unlike in 1X2 match betting, if a match is tied, half the face value of the wager will be paid (or a third if there is a three-way tie), as according to dead heat rules in horse racing. Head-to-head betting is quite common in golf, where such markets are available over 18 holes (1 round) or 72 holes (all 4 rounds). For 18-hole betting, they are commonly known as 2-ball or 3-ball bets, depending on the number of players going head-to-head in the bet. Rather confusingly, bookmakers tend to call 72-hole bets match bets.

An increasingly popular fixed odds market is total points/goals betting, sometimes known as over/under. A commonly available over/under bet available in football is over/under 2.5 goals. By introducing a decimal, this removes the possibility of a draw, leaving only two possible outcomes. Some bookmakers like to introduce an extra outcome to the book. William Hill online, for example, offer 3 outcomes: fewer than 2 goals; exactly 2 goals; and more than 2 goals. Other bookmakers introduce even more, although this is with a view to increasing their profit margin on the book. Other common forms of over/under markets include total points betting in American Football, rugby and Australian Rules Football, total games betting in tennis and total frames betting in snooker.

Correct score betting is popular only with football, where the total number of typical scores is limited. This type of market is not used for the majority of other sports, which have much higher points totals. The chances of correctly predicting the exact score in a cricket match are, of course, very slim. The odds are dependent on the actual match odds between the two teams. For example, Arsenal, if quoted at 4/9 to beat Newcastle at home, would be in the region of 6/1 to win the game 1-0. In contrast, Bolton, 7/2 to beat Manchester United at home, would be around 10/1 to win 1-0. Bolton are perceived as having a much smaller chance of winning than Arsenal, and therefore their odds to win 1-0, or indeed by any score, are greater. Very often, correct score books are offered together with the first goal scorer in a game. These bets are known as “Scorecast”.

Some sports are played with two halves, most obviously football, but also rugby as well. Some bookmakers now offer books for the half-time result only, and more typically the “double result”, that is, the result at both half-time and full-time. For football matches this means a total of 9 betting possibilities is commonly available. This is a popular alternative to simply backing an outright result, which may often be at unattractively short odds. Obviously the risk is greater since there are more possible outcomes (9 as compared to 3 with standard match betting), but consequently the odds are better. The highest odds are obviously available for the home team to be winning at half-time and the away team to win after 90 minutes. Typically, odds of 28/1 can be found for this unlikely double result, and can be even higher if the home team is a strong favourite.

In sporting contests with large fields or competitors, even the shorter-priced competitors may have quite high odds. In a typical golf tournament, particularly where there are no strong favourites, the shortest price might be as high as 10/1. To increase the chances of a punter winning something from this bet, it may be offered each way. Each way bets are actually two bets, one for the win and one for a high placing, and are settled as two bets. The place part is calculated at a fraction of the win odds. This fraction will vary by sport and event, and will always be displayed where each way betting is available. For most golf tournaments, the place part is usually settled at one quarter of the full win odds, for places 1st, 2nd, 3rd, 4th and sometimes 5th. By contrast, in a football tournament, where there are fewer participants, the each way part may be settled at half odds for 1st and 2nd place only. Consider a £10 each way bet on England to win the World Cup at 10/1. If England win, a £150 profit would be made; £100 for the win at 10/1 and £50 for finishing in the top 2 at 5/1. If England lost in the final, the profit would only be £40; £50 from the place part minus the £10 stake lost on the win.

For some sporting contests, there may be an overwhelming favourite, with virtually no possibility of losing. The All Blacks rugby union team would be expected to defeat Holland every time they met, and you would be lucky to find odds of even 1.01. By introducing a points handicap, this increases the chances of being able to win the bet by backing Holland. The idea, as with most handicaps, is to give both sides a reasonably even chance of winning by giving the underdog a start. In this example one might see:

All Blacks -74, 10/11 Holland +74, 10/11

Both odds are close to 50:50, or evens. The fact that they are actually a little less is the result of the introduction of the bookmaker's profit margin. Here, Holland, the outsider, are awarded a head start of 74 points, whilst the All Blacks, the favourites, concede a handicap of -74 points. If Holland lose the game, but by a margin smaller than 74 points, any bet backing Holland would win at 10/11, whilst wagers for the All Blacks win only if the victory margin is greater than 74 points. If the margin of victory is same as the quoted handicap, all bets on the selected team will lose. There is no possibility for a betting tie or stake refund in standard handicap betting. The magnitude of the handicap, negative for one side and positive for the other, need not necessarily be the same for both sides. Where it is the same, this is sometimes called a line bet, particularly in American sports.

For most fixed odds betting, there is no such thing as a betting tie, with the exception of dead heats in head-to-head betting. To some, this scenario may seem a little too risky. Bets either win or lose – there is no half-way house. Asian handicap betting introduces a number of other scenarios into the betting outcome, where stakes are either returned with no profit or the bet is settled as a split stakes bet, with half winning and half losing. At the same time, it eliminates the possibility of a draw in a football match.

Asian handicaps are, as the name suggests, a special type of handicap betting popular in the Far East and commonly used in football betting. In addition to typical +1, 0, and -1 handicaps seen in standard handicap football match betting, Asian handicap allows for a ¼ goal, ½ goal and a ¾ goal start. These are sometimes called ¼ ball, ½ ball and ¾ ball. On the face of it this may not seem to make a lot of sense, since any team that beats (or loses to) a ½ goal start will also beat (or lose to) a ¼ goal start. However, there is more to ¼ and ¾ ball betting than meets the eye.

As for standard handicap betting, the underdog will be awarded a head start of a handicap, and the favourite will concede a handicap of the same magnitude. For the purposes of bet settlement, the predetermined number of the handicap will be added to the real number of goals. Where no handicap is awarded (0:0 handicap), a drawn game will result in a tied bet and returned stakes. If either side win, bets backing that team will win, whilst bets backing the other will lose. Similar rules apply for 1 goal (0:1) and 2 goal (0:2) Asian handicaps, as summarised in Table 2.3. When ½ ball handicaps are applied, bets can only be won or lost – a tied bet is impossible. If the handicap is set at ¼ (or ¾, 1¼, 1¾ etc) of a goal, then any bets on the match will be settled as a split stakes bet, with half the stake going on the handicap ¼ of a goal less than the quote and half on the handicap a ¼ of a goal more. For example, with a ¼ ball handicap, half the stakes will be settled as though the handicap was 0, and half as though the handicap was ½. It follows, then, that if a team beats a ¼ ball handicap by ½ or more, the backer will win the whole bet; if they lose by ½ or more, the backer will lose the whole bet. It is only when the result falls within ¼ of the handicap that the result is different from a conventional handicap. When a team beats the handicap by a ¼, the backer receives half stakes on a win, and half returned. For example, if £10 were staked at odds of 1.95 for a ¼ ball advantage, a drawn game would return a profit of £4.75. This is known as a “win ½”. If a team loses by a ¼, the backer has only half his stake returned. This is known as a “loss ½”.

Table 2.3 provides a summary of bet settlement for a number of Asian handicaps and a number of match results. The bets are settled as if the punter has backed the away team with the specified handicap. Stakes are returned for tied bets, whilst win ½ and loss ½ bets are settled according to split stake rules as described above.

Table 2.3. Bet settlements for Asian handicap

Hand-icap	**Result**								
	0:0	**1:0**	**0:1**	**1:1**	**2:0**	**2:1**	**0:2**	**1:2**	**2:2**
0:0	Tie	Loss	Win	Tie	Loss	Loss	Win	Win	Tie
0:¼	Win ½	Loss	Win	Win ½	Loss	Loss	Win	Win	Win ½
0:½	Win	Loss	Win	Win	Loss	Loss	Win	Win	Win
0:¾	Win	Loss ½	Win	Win	Loss	Loss ½	Win	Win	Win
0:1	Win	Tie	Win	Win	Loss	Tie	Win	Win	Win
0:1¼	Win	Win ½	Win	Win	Loss	Win ½	Win	Win	Win
0:1½	Win	Win	Win	Win	Loss	Win	Win	Win	Win
0:1¾	Win	Win	Win	Win	Loss ½	Win	Win	Win	Win

In an attempt to attract spread bettors into fixed odds gambling, some online bookmakers have started to offer specialised markets, particularly for football matches. Special bets include odds on the number of corners and bookings a televised match will have, odds for team performance, or the time of first and last goal scorer. These bets have their origins in the spread markets, and it is only through the availability of online gambling that fixed odds bookmakers have been able to break into this market.

All the fixed odds betting markets discussed above are short-term markets, that is, the odds are set only a few days at most in advance of the sporting events. In the case of in-running markets, Internet bookmakers may change match odds during the course of a game (usually live football) every 10 minutes. It is possible, however, to place bets on sporting contests weeks, months and sometimes years in advance. Such bets are called “ante post” bets.

The term “ante post” comes from the world of horse racing. Betting on the horse is usually of two kinds: “post,” when wagering does not begin until the numbers of the runners are hoisted on the board; and “ante-post,” when wagering opens weeks or months before the event. Ante post sports bets might include a bet on the next winner of the World Cup, the Premiership champions, the Ashes Series, World snooker champion and so on. Taking a price months in advance can pay dividends, if during the intervening period it becomes clear that the player or team one backed is increasingly favoured to win. The opposite of course is equally possible, and serious ante post bettors will usually have a deep understanding of their market to reduce the chances of the odds moving against them. The main downside to ante post betting is the return period of any potential win. Having to wait months or even years to collect on relatively fewer bets, at generally higher stakes or higher odds than for most match or handicap bets, can seem unappealing.

Different Types of Fixed Odds Bets

Knowing the various fixed odds markets is one thing, but what sort of bet can one actually place? There are all sorts of fixed odds wagers available, although not all of them are suitable or indeed available for every betting market.

The simplest of all bets is the single. With a single bet on a sports event, only one outcome is backed, and the bet can generally either win or lose, although in Asian handicap, there are other possibilities. With a simple win/lose single, a selection must be successful to achieve a return. A typical single match bet might be Liverpool to beat Manchester United at 2/1. If Liverpool win, a £10 stake would realise a profit of £20; if they draw or lose, the stake is lost. Singles odds are today generally available for almost any sporting contest one can think of, from home wins, draws and away wins in football matches bets, to ante post wagers on the next Olympic downhill skiing champion. This has not always been the case.

Prior to the growth in online gambling, punters were restricted to betting at their local high street bookmaker. Whilst the fixed odds football coupons printed every week for forthcoming weekend games had every match (1X2) bet available, one was only allowed to bet a minimum of 3 selections as a treble. A treble is one bet involving 3 selections in different events. All must be successful to achieve a return. If any of the selections were home wins, the minimum bet was a fivefold accumulator (one bet involving five selections in different games). The only occasion, in football at least, when a single bet was allowed was if the game was televised, an FA Cup match or an international.[8] Several theories have been proposed as to the reasoning behind this. The plain fact is, however, that the bookmaker's expected profit margin grows with an increase in the number of selections included in a bet. Whilst the potential return from a fivefold accumulator looks much more attractive than from a single, the chances of securing a return are disproportionately smaller for all but a handful of punters.

Multiple bets, as we have seen, involve more than one selection. With the new age of online sports betting, doubles, in addition to singles, have become popular wagers for football match betting. A double is one bet involving two selections in different events, both of which must be successful for the bet to win. The odds for a double are calculated by multiplying together the separate odds for the two single bets. This is obviously easier to do using decimal notation. Consider two football match bets with fractional odds:

Birmingham to beat Aston Villa, 6/4
Newcastle to beat Sunderland, 4/5

[8] Some of the major high street bookmakers in the UK relaxed these rules in 2002, and singles for the majority of football matches are now available on the printed coupon.

The odds for a Birmingham/Newcastle double are (6/4) multiplied by (4/5). Initially, it is not exactly obvious what the odds for the double should be. Instead, it is easier to convert to decimal notation, and use a calculator or computer to determine double odds. In this case 6/4 is equivalent to 2.5, whilst 4/5 is equivalent to 1.8. The odds[9] for the double are then 4.5.

Despite the relaxation of betting rules, with most Internet bookmakers now allowing singles for the majority of football matches and other sporting events, multiple bets remain fairly popular with the punters. Some may not be aware of the mathematics working against them with these bets; others may be but remain impulsively attracted to the lure of the bigger returns. Sometimes the only limit to the number of selections included within a multiple bet is the bookmaker's maximum allowable payout on one bet. Stories abound of winning bets containing 15, 18, or even 20 selections in an accumulator. A few may be true, although many may be put out by the betting industry in an effort to maintain the punters' interest in the multiple bet, a policy clearly advantageous to the bookmakers.

There is a way to find 7 bets from only 3 selections, making use of what have incorrectly become known as permutations or "perms". Consider the following 3 selections:

Bolton to beat Charlton, evens
Leeds to beat Liverpool, 6/4
Southampton to beat Tottenham 5/4

First off, each selection can be taken as a single match bet. Secondly, there is one treble available at odds of 11.25, calculated by multiplying together the odds for each of the 3 singles (2 x 2.5 x 2.25). However, there are also 3 doubles available too, by "perming" any 2 games from the 3 selections. Such a series of bets is commonly known as a "Patent", or a "Trixie" if the singles are left out leaving only 4 bets.

Bolton and Leeds, 5 (or 4/1)
Bolton and Southampton, 4.5 (or 7/2)
Leeds and Southampton, 5.625
Bolton, Leeds and Southampton, 11.25

[9] Odds of 2.5 can of course be expressed as the real fraction 10/4 (simply 6/4 +1). Since 1.8 is 9/5 as a real fraction, odds for the double are (10*9)/(4*5) = 90/20 or 4.5. The double odds expressed in fractional notation are then (90/20) -1 = 70/20 or 7/2.

Strictly speaking, the 3 double bets that form part of the Patent are "combinations" of doubles taken from 3 available selections, because the order in which each is selected is not important to us, as it is for a true permutation. Whether Bolton or Liverpool is selected first on the betting slip will not affect the outcome of the bet.

The greater the number of selections to choose from, the greater the number of combinations available. Combinations are not, of course, restricted to doubles. If we wish to choose from 4 matches, there are 6 combinations of doubles and 4 combinations of trebles available, in addition to 1 fourfold and 4 singles. Taking the doubles, trebles and the fourfold together as a series of 11 bets is commonly know as a "Yankee", whilst including the singles as well in a 15-bet series is a "Flag".

There is really no limit to the number of combinations of bets we can choose, apart from the bookmaker's rules and regulations. A "Canadian" is a series of 26 bets involving 5 selections in different events, consisting of 10 doubles, 10 trebles, 5 fourfolds plus 1 fivefold. For those who want to link up six selections in 1 six-timer, 6 five-timers, 15 four-timers, 20 trebles and 15 doubles – adding up to 57 bets – they can choose a "Heinz", after the number of Heinz food varieties. A "Goliath" is usually considered to be the ultimate in multiple bets (although there is no reason why it need be), with seven selections linked up in 1 seven-timer, 7 six-timers, 21 five-timers, 35 four-timers, 35 trebles and 21 doubles making 120 bets in total. For any combination-type bet, a minimum of 2 selections will need to win for the punter to gain a profitable return, although frequently with the larger combination bets, more winners will be required. Whether they perform better or worse than taking the selections merely as singles alone will be explored in more detail in Chapter 6. Any of the bets may be taken each way, effectively doubling the number of bets in the permutation.

Unless a punter is familiar with the types of bets described above, he may sometimes want to know how many ways "r" teams can be permed from "n" selections. For example, how many ways can 3 teams be combined to form trebles from 6 selections? The simplest method uses a calculator with an ^nC_r button, where "n" is the total number of selections, i.e. 6, and "r" is the number we wish to "perm", in this case 3. C is simply shorthand for "Combination". Entering these figures into the calculator returns a result of 20. In other words, there are 20 ways of perming 3 teams from 6 selections, or 20 treble combinations available from 6 selections. This calculation can also be performed on a computer with a spreadsheet or statistics software application. In Excel, for example, entering =COMBIN(6,3) in a spreadsheet cell will return an answer of 20. For those without a calculator or computer, the ^nC_r formula is given by:

$$\frac{n!}{r!(n-r)!}$$

where ! is known as the factorial. 6!, for example, is 1x2x3x4x5x6, or 720. 3! is 1x2x3, or 6. Consequently, $^6C_3$ = 720/36 = 20. Alternatively, one can calculate the number of perms using "Pascal's Triangle".

1	n = 0
1 1	n = 1
1 2 1	n = 2
1 3 3 1	n = 3
1 4 6 4 1	n = 4
1 5 10 10 5 1	n = 5
1 6 15 20 15 6 1	n = 6

In 1653, the French mathematician Blaise Pascal described a triangular arrangement of numbers corresponding to the probabilities involved in flipping coins, or the number of ways to choose r objects from a group of n indistinguishable objects. The first number on the left of every row corresponds to the position r = 0, and is 1 for every value of n since, in mathematics, 0! = 1, and therefore there is only one way of choosing no teams from any number of selections. For the purpose of betting permutations this is, of course, irrelevant. r increases incrementally by 1 for every figure to the right of the last one. The values shown in Pascal's triangle, then, determine the number of ways of choosing and combining r selections from an available of total n. For n = 6, the third number (r = 3) to the right of the first one, 1, is 20. For the purposes of betting, this tells us there are 20 possible trebles available from a total of 6 selections. Using Pascal's Triangle, we can also see that there are 15 possible combinations of both doubles and fourfolds from a selection of 6, 6 fivefolds and 1 sixfold, which make up the Heinz, a total of 57 bets.

It is a simple matter of adding further rows to Pascal's Triangle if we want to determine more complex combinations, by inserting a 1 at the left and right of each new row, and then noting that every number in the interior of the Triangle is the sum of the two numbers directly above it. Consequently, the next two rows of numbers would be:

1 7 21 35 35 21 7 1	n=7
1 8 28 56 70 56 28 8 1	n=8

The Age of the Internet

Prior to the 1990s almost all licensed fixed odds sports betting was controlled by the high street bookmakers. In Britain, this concerned a few very large betting firms like Ladbrokes, William Hill and Coral, who all had established reputations. If someone wanted to have a wager, this usually involved strolling down to the local betting shop and filling in the coupon. If successful, a return trip was necessary to collect the winnings. For those betting more regularly this could become a rather tiresome and time-consuming exercise, although others, particularly those more interested in racing, would (and still do) treat the visit to the betting shop as integral to the whole gambling experience.

In the last decade or so, however, sports betting has found the Internet to be an excellent medium within which to take place, and there are now possibly a 100 or more online sportsbooks ready and waiting to take punters' money. The large UK high street firms now have considerable market turnover through their online enterprises, but there are also some very reputable online bookmakers who essentially exist only in cyberspace, including Sportingbet and SportingOdds from the UK, Interwetten and Bet&Win from Europe, and Gamebookers from the Americas. Whilst some punters still prefer to deal in cash with their local bookie, there are a number of distinct advantages to sports betting online.

The most obvious advantage of online gambling is one of convenience. With the Internet, a bet can be placed in a matter of seconds simply by sitting at a computer in the comfort of one's own home. Furthermore, with almost all online bookmakers, bets can be placed 24 hours a day, 7 days a week, 365 days a year. It is a simple matter of opening a betting account with an online bookmaker, usually requiring nothing more than a credit or debit card, and occasionally further evidence of identification. Online accounts can be opened within minutes and used immediately. For punters with little to spend, initial deposits of only £10 are permitted with some bookmakers, with minimum stakes of as little as 50 pence or less.

Frequently, online firms will have attractive offers of free bets or deposit bonuses for newly opened accounts to attract custom. Winnings are usually credited soon after the events have taken place, and account monies can normally be withdrawn relatively quickly with a simple click of the mouse. Furthermore, online fixed odds betting is free of tax.[10]

A second significant advantage of online betting is the generally greater availability of the numerous fixed odds betting markets. High street bookmakers do cater for a range of bets, including match bets, correct score and scorecast, and ante post. However, since online betting coupons are so much more flexible than written or printed ones, they offer a potentially much greater range of events and betting media to choose from. Over/under betting and betting in-running are becoming increasingly popular, as are the range of special bets normally only available to spread bettors. Additionally, singles are available for almost every event with the majority of online bookmakers. Some high street bookmakers in the UK have finally relaxed their rules concerning minimum trebles on the football long list coupon, but it is likely that this has been in response to the widespread availability of football match bet singles online.

Perhaps the most important advantage of online fixed odds betting is the availability of choice in the betting odds. In a busy high street, there might be two or three firms available from which to choose. Provided you have an available betting account, there are literally dozens online. It is always in the punter's interest to secure the best possible price for his bet since the bookmaker's odds are weighted unfairly in their favour to ensure that they are generating a profit from their business. Each bookmaker, however, will take a slightly different view regarding what he considers the correct price of an event to be, which may vary quite considerably. There may even be rare occasions where prices for an event vary so much that it becomes possible to back all possible outcomes with different bookmakers and still ensure that a small profit is made whatever the outcome of the event. Such betting opportunities are known as arbitrage, a term again more familiar to spread bettors.

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[10] In October 2001, the Government abolished tax on high street betting in the UK. Before then, every high street wager attracted a 9% levy. It was really the availability of offshore bookmakers operating via the Internet that forced the Government to consider other means of raising tax revenue through gambling. Instead, tax on profits is now paid by the bookmakers. This was a major victory for the punter and it has resulted in significant increase in betting turnover – a win/win situation for all concerned.

Despite the advantages of Internet betting, there are a few downsides that the punter ought to be aware of. Firstly, there are sometimes currency and transaction costs associated with depositing into and withdrawing from a betting account, depending on the method used. Debit card deposits in the UK are normally free of charges, but a credit card deposit to a foreign bookmaker may attract a small percentage fee. Withdrawals may also be limited to a minimum amount and may only be free of charge a restricted number of times each month. Whilst these extra costs are usually low, punters who have a high turnover and movement of betting funds between accounts may find this a rather unattractive aspect of online sports betting.

Secondly, most online bookmakers identify the maximum allowable stake or win available with them in their terms and conditions. This is usually a significant sum of money, sometimes as much as £100,000. However, for some events, if the bookmaker is required to manage his liabilities in response to punter demand, the maximum available stake will be much reduced from this. Such reduced maximum stakes are more commonly found with multiple bets, where the potential wins are much higher. Nevertheless, punters adopting a specific money management plan may be rather put out to find that they are unable to take a betting opportunity at the best odds because their desired stake is larger than the maximum allowable for that event. Sometimes telephone betting, if available, can circumnavigate this difficulty.

Finally, punters need to be aware of depositing with unknown or less reputable online bookmakers. There may be over 100 firms available to choose from, and many offer very attractive odds in comparison to the more established ones. However, there are several incidences of failing bookmakers who have ceased trading and frozen customer accounts. If bankruptcy ensues, a punter with an account there may never see his money again. More common are stories of delayed payments or refused withdrawals. Often these may simply be the result of either fraudulent betting activity or a failure on the part of the account holder to read the terms and conditions of the bookmaker. A few, nevertheless, may involve genuine grievances.

Despite these highlighted annoyances, online fixed odds sports betting is definitely here to stay and is likely to continue growing in popularity in the near future, as more and more people switch on to the age of the Internet and the thrills of having a bet.

Beating the Bookmaker

Odds and Probabilities

Fixed odds betting is all about chance, or probability. As we saw in Chapter 2, the odds, for example, of England winning the Ashes Series are related to the probability of England winning the Ashes Series. If the betting odds are equal to the true odds that an event will occur, then they are said to be “fair” odds. Of course, exactly what the fair odds are supposed to be is very much open to debate. Unlike the flipping of a coin, where it is known in advance exactly what the true chance of each outcome (heads or tails) will be, it is no simple task to estimate exactly what the true probability of an Ashes win for England will be. For coin flipping or dice rolling, the probability function that describes the chance of one or another result occurring can be calculated perfectly from first principles. In sports prediction, by contrast, the probability function can only be estimated by observation of a team or player’s past performance, and other influencing factors. Furthermore, for extended events, like Test match cricket or a golf tournament, future influencing factors like the weather may very well affect the chances of one particular result occurring. Determining the fair odds for Chelsea to win the Premiership, 9 months before any of the games have been played, must, surely then, be even more complicated.

In a sense, then, true or fair odds in sports are merely estimations of the expected probability, or chance, of something occurring, rather than exact calculations. Bookmakers have their own opinion about what the fair odds for each event should be. If they are wrong, and the punter spots the mistake, this is where the profit can be made.

Table 3.1 shows the range of probabilities and their associated fair odds, in fractional and decimal notation. Probability, as a fraction of 1, is simply the inverse of the decimal odds and, further, by multiplying by 100, the probability can be expressed as a percentage.

Table 3.1. Odds and their probabilities

Fractional odds	Decimal odds	Probability	Fractional odds	Decimal odds	Probability
1/10	1.1	90.9%	9/4	3.25	30.8%
1/9	1.11	90.0%	12/5	3.4	29.4%
1/8	1.13	88.8%	5/2	3.5	28.6%
1/7	1.14	87.5%	13/5	3.6	27.8%
2/13	1.15	86.7%	11/4	3.75	26.7%
1/6	1.17	85.7%	14/5	3.8	26.3%
2/11	1.18	84.6%	3/1	4	25.0%
1/5	1.2	83.3%	100/30	4.33	23.1%
2/9	1.22	81.8%	7/2	4.5	22.2%
1/4	1.25	80.0%	4/1	5	20.0%
3/10	1.3	76.9%	9/2	5.5	18.2%
1/3	1.33	75.0%	5/1	6	16.7%
4/9	1.44	69.2%	11/2	6.5	15.4%
1/2	1.5	66.7%	6/1	7	14.3%
8/15	1.53	65.2%	13/2	7.5	13.3%
4/7	1.57	63.6%	7/1	8	12.5%
8/13	1.62	61.9%	15/2	8.5	11.8%
4/6	1.67	60.0%	8/1	9	11.1%
8/11	1.73	57.9%	17/2	9.5	10.5%
4/5	1.8	55.6%	9/1	10	10.0%
5/6	1.83	54.5%	10/1	11	9.1%
9/10	1.9	52.6%	11/1	12	8.3%
10/11	1.91	52.4%	12/1	13	7.7%
Evens	2	50.0%	14/1	15	6.7%
11/10	2.1	47.6%	16/1	17	5.9%
6/5	2.2	45.5%	20/1	21	4.8%
5/4	2.25	44.4%	25/1	26	3.8%
11/8	2.38	42.1%	33/1	34	2.9%
6/4	2.5	40.0%	50/1	51	2.0%
13/8	2.62	38.1%	66/1	67	1.5%
7/4	2.75	36.4%	100/1	101	1.0%
15/8	2.88	34.8%	150/1	151	0.7%
2/1	3	33.3%	200/1	201	0.5%
11/5	3.2	31.3%	500/1	501	0.2%

The Bookmakers' Profit Margin – the Overround

Bets between friends, like Paul and Mark in Chapter 2, may involve fair odds. For professional bookmakers, however, there would be very little point in their offering a betting service if they weren't making a profit themselves. In spread betting, betting firms secure their revenue via the spread, the difference between the "buy" and "sell" prices, as in the financial markets. In fixed odds betting, the profit is achieved by manipulating the odds.

The fair odds for selecting any particular card from a standard deck of 52 are 51/1, with a probability of 0.0192 or 1.92%. As one might expect, the sum of probabilities for all cards will be 52 x 0.0192, which equals 1 or 100%. To gain an edge over the punter, a bookmaker will reduce those odds, for example to 48/1. These odds are then "unfair", since their associated probability is now higher, at 0.0204 or 2.04%, than the true chance of picking any particular card. The sum of the probabilities for all cards is now 52 x 0.0204, that is 1.061 or 106.1%. Mathematically, of course, the sum of probabilities for all possibilities must be 1.00 or 100%. The difference between this and the bookmaker's sum of probabilities represents the bookmaker's profit margin. A book with a total percentage over 100 is said to be **overround**. In the case just mentioned, the book is overround by 6.1%. This may be expressed by saying that the overround is 106.1%, or 1.061 as a decimal. That is, for every 100 units paid out to punters, the bookmaker can expect to take 106.1, or a profit of 6.1% on turnover. If a punter decided to back the selection of every single card at 48/1 with a 1 unit stake for each, obviously only one card would win and the bookmaker's overall gain would be 3 units, paying out 49 units in winnings and returned stake money, but receiving 52 units, a profit of 6.1%. The bookmaker's gain is the punter's loss, which expressed as a percentage is 5.8% (3/52). It is worth noting here that there is a simple relationship between a bookmaker's overround and a punter's expected loss, if backing all possible outcomes on a specific event, given by:

$$\text{punter's loss} = [1 - (1/\text{overround})] \times 100\%$$

where the overround is expressed as a decimal.

If a bookmaker offered 9/2 for numbers 1 through to 6 from a throw of a standard 6-sided dice, the overround would be 109.1% (1.091) and a punter's expected loss 8.3% by backing all 6 possible throws.

Since the true probabilities associated with card drawing or dice rolling are mathematically fixed, a punter would be very unwise to bet at the unfair odds offered by a bookmaker. Initially he may be lucky, but over the long term the mathematics would conspire against him, leaving him at a loss, the magnitude determined by the size of the overround using the above equation. In view of this, it is remarkable how many gamblers are still happy to place bets on such games at a casino. When an edge is achievable, for example through card counting, the casino's regulations will usually prevent such a professional from benefiting from his knowledge. In sports betting, however, the fair odds of a particular event occurring cannot be known exactly, and this is perhaps why so many punters, with a belief that they know more than the bookmakers, are prepared to accept the disadvantage that they face through the overround. For his chosen bets, the punter will hope that the bookmaker has made a mistake in the estimation of the fair odds, allowing him to overcome this disadvantage.

Typical Overrounds in Sports Betting

With the relaxation of betting restrictions by Internet, and more recently high street bookmakers, the most commonly available bet is the single, in particular the football single match bet. With fixed odds for 3 possible outcomes – the home win, draw, and away win – a typical overround on these bets is about 111 to 112%, although some Internet bookmakers may go as high as 118% for the less popular European football leagues. Consider the following fixed (decimal) odds for a typical weekend football coupon for the English Premiership:

Table 3.2. Typical fixed odds for 10 Premiership matches

Match	Home	Draw	Away	Overround
Arsenal v Tottenham	1.53	3.5	5.5	112.1%
Birmingham v Fulham	2.3	3.2	2.7	111.8%
Blackburn v Everton	2.1	3.25	3	111.7%
Chelsea v Middlesbrough	1.72	3.2	4.5	111.6%
Leeds v Bolton	1.5	3.5	6	111.9%
Liverpool v Sunderland	1.36	4	7.5	111.9%
Man City v Charlton	1.66	3.4	4.5	111.9%
Newcastle v Southampton	1.61	3.4	5	111.5%
West Brom v Aston Villa	2.62	3	2.5	111.5%
West Ham v Man Utd	4	3.25	1.8	111.3%

Calculating the overround for any book is a simple task of summing the inverse of the home, draw and away odds and multiplying by 100%. Here, the inverse of the decimal odds for one result, of course, is the bookmaker's estimation of the probability of that result occurring, after manipulation to include his advantage. It is not initially obvious whether the bookmaker has focused more of his expected profit margin on one of the results, or has spread it more evenly over the three, since the overround only provides a measure of the bookmaker's expected return for the book. For now we will assume the latter, although a strong case (presented in Chapter 8) can be made for the alternative. Accordingly, the bookmaker's estimations for the chance of each result occurring are shown in Table 3.3, in conjunction with what the bookmaker must have initially considered the true (fair) chances to be, that is before he has built in his profit margin.

Table 3.3. Bookmaker's unfair and fair estimations for 10 Premiership matches

Match	**Bookmaker's unfair estimations**				**Bookmaker's fair estimations**		
	H%	**D%**	**A%**	**Total%**	**H%**	**D%**	**A%**
Arsenal v Tottenham	65.4	28.6	18.2	112.1	58.3	25.5	16.2
Birmingham v Fulham	43.5	31.3	37.0	111.8	38.9	28.0	33.1
Blackburn v Everton	47.6	30.8	33.3	111.7	42.6	27.5	29.8
Chelsea v Middlesbrough	58.1	31.3	22.2	111.6	52.1	28.0	19.9
Leeds v Bolton	66.7	28.6	16.7	111.9	59.6	25.5	14.9
Liverpool v Sunderland	73.5	25.0	13.3	111.9	65.7	22.3	11.9
Man City v Charlton	60.2	29.4	22.2	111.9	53.8	26.3	19.9
Newcastle v Southampton	62.1	29.4	20.0	111.5	55.7	26.4	17.9
West Brom v Aston Villa	38.2	33.3	40.0	111.5	34.2	29.9	35.9
West Ham v Man Utd	25.0	30.8	55.6	111.3	22.5	27.6	49.9

Of course, whether the bookmaker's idea is accurate about what exactly the true chance of a particular result occurring is, is open to debate by his customers. If both parties disagree, there may be an opportunity for the punter to make a profit, provided he is more accurate in estimating the true chance of an outcome than the bookmaker. Nevertheless, it is worth noting that the average percentages for the bookmaker's fair estimations for the home wins, draws and away wins across the 10 matches are 48.3%, 26.7% and 24.9% respectively, very similar to the long-term average spread of home wins, draws and away wins for the English Premiership. On average, then, this bookmaker must be doing something right.

Finally, it is a simple procedure of inverting the fair estimations to calculate what the bookmaker considers to be the fair odds. These are shown below and may be compared back to the original odds offered by the bookmaker. Novice punters may be surprised to see by how much the bookmaker's actual odds offered differ from the bookmaker's idea of the fair odds.

Table 3.4. The bookmaker's idea of the fair odds for 10 Premiership matches

Match	**Actual odds**			**Fair odds**		
	Home	**Draw**	**Away**	**Home**	**Draw**	**Away**
Arsenal v Tottenham	1.53	3.5	5.5	1.72	3.92	6.17
Birmingham v Fulham	2.3	3.2	2.7	2.57	3.58	3.02
Blackburn v Everton	2.1	3.25	3	2.35	3.63	3.35
Chelsea v Middlesbrough	1.72	3.2	4.5	1.92	3.57	5.02
Leeds v Bolton	1.5	3.5	6	1.68	3.92	6.71
Liverpool v Sunderland	1.36	4	7.5	1.52	4.47	8.39
Man City v Charlton	1.66	3.4	4.5	1.86	3.80	5.03
Newcastle v Southampton	1.61	3.4	5	1.80	3.79	5.58
West Brom v Aston Villa	2.62	3	2.5	2.92	3.35	2.79
West Ham v Man Utd	4	3.25	1.8	4.45	3.62	2.00

Other types of bets attract different overrounds, and it is usually the case that the greater the number of possible outcomes to a sporting event or one of its elements, the greater the bookmaker's overround. The correct score bet in football can have as many as 24 possible options on which to bet. A typical overround for this type of bet may be anything from 130 to 160%, depending on the bookmaker. Quite how a punter is meant to consistently overcome a 60% disadvantage in the odds is a mystery, no matter how informed he may be. Where the bookmaker has offered odds of 5/1 for Manchester City to beat Charlton 1:0, the fair odds based on the bookmaker's assumptions may actually be 9/1.[11] Of course, it is possible to predict the correct score in a game once in a while, but to sustain a profitable run over the long term is quite another matter.

To some extent, the high overround in correct score betting may protect the bookmaker against dangerous liabilities in a market where the lowest odds are generally 5/1 or higher. Any win by the punters on an unfavourable result, from the point of view of the bookmaker, could result in a substantial loss of revenue. Many punters, however, are less persuaded by the obvious lack of value in a 5/1 bet on a 1:0 result than

[11] It is also worth noting that approximately 10% of games in the English Premiership finish 1-0.

they might be in the 4/6 odds available for the Manchester City home win. A payout of £5, instead of 66 pence, for a £1 stake will always look more attractive, a fact that encourages bookmakers to offer disproportionately meaner odds for correct score betting than for simple match betting, even though they appear to be much more generous to the untrained eye.

In contrast to correct score betting, total goals betting in football, where there are usually only 2 possible outcomes (over 2.5 goals or under 2.5 goals), attract overrounds that are commonly less than 110%.[12] For the same bookmaker in Tables 3.2 to 3.4, Table 3.5 shows the overrounds for total goals betting for the 10 Premiership matches. With only 2 odds making up a book, it becomes much harder for a bookmaker to hide behind more unattractive prices, particularly where the fair odds are close to 50-50. Consequently, a typical total goals overround will be a few per cent lower than for its corresponding match bet overround.

Table 3.5. Odds and overround for total goals betting

Match	Over 2.5 goals	Under 2.5 goals	Overround
Arsenal v Tottenham	1.72	2	108.1%
Birmingham v Fulham	2	1.72	108.1%
Blackburn v Everton	1.9	1.8	108.2%
Chelsea v Middlesbrough	1.8	1.9	108.2%
Leeds v Bolton	1.83	1.83	109.3%
Liverpool v Sunderland	1.9	1.8	108.2%
Man City v Charlton	1.83	1.83	109.3%
Newcastle v Southampton	1.72	2	108.1%
West Brom v Aston Villa	2.2	1.61	107.6%
West Ham v Man Utd	1.8	1.9	108.2%

Punters with a keen interest in keeping the bookmaker's disadvantage to a minimum may very well be attracted to other 2-way betting opportunities. Asian handicap betting, where the draw is eliminated, generally has a low overround, sometimes as little as 106%. In addition to total goals betting and Asian handicap in football, match bets in tennis, snooker, darts, and in fact any two-player sport where there is no possibility of the draw offer excellent betting opportunities. Standard handicap and total points betting in American sports like basketball, ice hockey and American Football have some of the smallest overrounds available, sometimes even as low as 103

[12] In an attempt to increase the overround, some bookmakers have introduced additional total goal options, with 3, 4 and sometimes more available.

or 104%. With such opportunities available across the Internet, it is a wonder that many punters still enjoy a visit to their local high street bookmaker to place bets on the first person to score in a televised football game, or a scorecast bet on the first scorer and correct score. Such is the lure of the big win.

Doubles, Trebles and Accumulators?

At this point, an inexperienced punter might ask what happens to the overround for a double, treble, accumulator or perm? It is, after all, frequently argued that, in placing a bet, doubles and higher accumulator bets invariably produce a superior return to singles. To see the effect on the overround of combining more than one selection into a bet, let us consider, first of all, the first two Premiership games in Table 3.2.

Table 3.6. Odds for a double

	Match 1	**Home**	**Draw**	**Away**
Match 2	*Odds*	*1.53*	*3.5*	*5.5*
Home	*2.3*	3.519	8.05	12.65
Draw	*3.2*	4.896	11.2	17.6
Away	*2.7*	4.131	9.45	14.85

Match 1 = Arsenal v Tottenham
Match 2 = Birmingham v Fulham

The shaded area in Table 3.6 above displays the odds for the 9 possible double combinations of the 2 individual match bets: Arsenal/Birmingham, Arsenal/Draw, Arsenal/Fulham, Draw/Birmingham, Draw/Draw, Draw/Fulham, Tottenham/Birmingham, Tottenham/Draw and Tottenham/Fulham. Single odds for each game are also shown (italicised). Table 3.7 shows the bookmaker's percentage estimations for each of the 9 possible double combinations. Again, estimations for the single results are shown (italicised).

Table 3.7. Bookmaker's estimations for a double

	Match 1	H%	D%	A%	Total%
Match 2	*Estimations*	*65.4*	*28.6*	*18.2*	*112.1*
H%	*43.5*	28.4	12.4	7.9	48.7
D%	*31.3*	20.4	8.9	5.7	35.0
A%	*37.0*	24.2	10.6	6.7	41.5
Total%	*111.8*	73.0	31.9	20.3	125.3

Match 1 = Arsenal v Tottenham
Match 2 = Birmingham v Fulham

The important point to take from Table 3.7 is that the sum of the bookmaker's estimations for all 9 possible result combinations is now considerably higher than for either of the single matches considered independently. We can see that the overround for this book is 125.3%, whereas for Arsenal v Tottenham it is 112.1% and for Birmingham v Fulham 111.8%. Of course, a much simpler way to calculate the overround accompanying any double, made up of these two games, is to multiply the two single overrounds using their decimal notation. Sure enough, 1.118 x 1.121 = 1.253. This multiplication rule can be used to determine the overround for any accumulator bet, whether trebles, 4-folds, 5-folds, 6-folds, or the combinations that make up Patents, Trixies, Yankees, Canadians and so on. The larger the accumulator, the larger the overround will be, and consequently the greater the disadvantage the punter will face. Just how this disadvantage grows as the accumulator size increases is starkly illustrated in Table 3.8, in which the price of each part of an accumulator is 10/11 (1.91) and the overround 110%.

Of course, it is still true to say that doubles, trebles and accumulators have the potential to pay out more than a single on a win. The point of the analysis here is to demonstrate merely that the punter has to work harder to overcome the disadvantage imposed by the overround, as the size of the accumulator increases. Some experienced sports bettors would argue that it is difficult enough trying to beat the 112% overround on football match bet singles. Why then make life tougher by introducing large accumulator bets into a betting portfolio, which really only exist to line the pockets of the bookmakers? Others may choose to disagree with this generalisation, arguing that if you can beat the bookmaker's odds on singles, it makes sense to enhance your profits by grouping them in doubles or trebles. The merits of this reasoning will be explored further in Chapter 6.

Table 3.8. The effect of overround on profit[13]

Type of bet	Bookie's odds	Fair odds	Over-round	Profit (bookie's odds)	Profit (fair odds)	Loss of profit	% Loss of profit
Single	1.91	2.10	110.0%	0.91	1.10	0.19	17.4%
Double	3.64	4.41	121.0%	2.64	3.41	0.77	22.4%
Treble	6.96	9.26	133.1%	5.96	8.26	2.30	27.9%
4-fold	13.28	19.45	146.4%	12.28	18.45	6.16	33.4%
5-fold	25.36	40.84	161.1%	24.36	39.84	15.48	38.9%
6-fold	48.41	85.77	177.2%	47.41	84.77	37.35	44.1%
7-fold	92.42	180.11	194.9%	91.42	179.11	87.68	49.0%
8-fold	176.45	378.23	214.4%	175.45	377.23	201.78	53.5%
9-fold	336.85	794.28	235.8%	335.85	793.28	457.43	57.7%
10-fold	643.08	1667.99	259.4%	642.08	1666.99	1024.91	61.5%

Finding Value and Gaining an Edge

Once a punter knows what he's up against, he can set about overcoming the bookmaker's odds to make a profit. Yet if the bookmaker's odds are unfair, how can a punter ever win? Given the disadvantage the overround imposes, it is no surprise that as many as 95% of gamblers fail to win at fixed odds sports betting. There is no denying that most bookmakers, particularly the well-established firms, are very good at setting prices, estimating the true chance of sporting results and locking in a profit margin.

Nevertheless, as we have seen, sports are not statistically quantifiable, in the sense that cards or other forms of casino gambling are, where simple laws of probability govern the outcome of games like blackjack, roulette and craps. I know that I have a 1/37 chance of landing a number 36 on a European roulette wheel (1/38 chance on an American wheel). But how can I know what the true probability is of Ronnie O'Sullivan winning the world snooker championship again? And if I think I know what his chances are, how can I be sure that my estimate is more accurate than the bookmaker's?

Unfortunately, the answers to these questions only come with time and experience, by acquiring a "knowledge" of a sport and its betting market,

[13] After the 12Xpert: http://members.aol.com/the12Xpert/

and a familiarity with the way bookmakers set their odds. The good news, however, is that whilst bookmakers are very good at setting odds for sporting events, they, like punters, can make mistakes, sometimes very glaring ones, which knowledgeable bettors will snap up without a moment's hesitation. William Hill, for example, astonishingly offered 200/1 on Primoz Peterka, the back-in-form Slovenian ski jumper, to win the opening ski jumping World Cup competition of the 2002/03 season at Kuusamo, Finland, despite the fact that he had won the qualifying competition the night before, and had been double world champion in previous seasons. The true odds, by contrast, were likely to be nearer to 10/1, and most other bookmakers had priced accordingly. Peterka won, and William Hill ceased offering odds for the ski jumping World Cup thereafter. Of course, such large mistakes are relatively rare, but smaller pricing errors do and must exist to account for the few per cent of gamblers who **are** profiting regularly from fixed odds sports betting.

Punters differ in the methods they use to acquire a sports betting "knowledge". Some like to adopt a more mathematical approach by using rating systems based on past performance to predict future outcomes. This approach is explored in more detail in the next chapter. Others spend hours each week poring over sports journals and Internet sites to glean as much information as they can about a particular event, including news about the weather, and team or player injuries and morale. Still others base their judgement on a subjective feel for the forthcoming event, relying on an inkling or a hunch about what may happen. And finally there are punters who simply pay others to do the thinking for them, by subscribing to one or more sports advisory services.

There is no right or wrong approach to seeking a betting edge. Ultimately, the best one is the one that works for you, one that returns a profit. However, what each approach has in common is a shared aim of finding "value" in the odds, where the true chance of a win is greater than that estimated by the bookmaker. Many punters fail to appreciate the importance of value betting, preferring to subscribe to the "back winners, not losers" school of gambling. Betting on Liverpool at Anfield to beat Sunderland at 4/11, it might be argued, is surely preferable to betting on Sunderland to beat Liverpool at 13/2, even if the bookie has restricted Liverpool's odds but been generous with Sunderland's. Liverpool, simply, are too good, however poor the price.

This analysis is confused because the punter has failed to assess Liverpool's chance of a win in probabilistic terms, but instead rather simply by whether he thinks they will or won't be victorious. "Winners" cannot win all the time, no matter how much a punter is convinced that they can. The important question a punter should instead be asking is whether the true chance of a winner is greater than that which the bookmaker has unfairly (in his mind), but potentially mistakenly (in the punter's mind), estimated it to be. In other words, is the bookmaker's price greater than that which the punter considers to be the fair price? If it is, then he has found betting value, provided he can estimate prices better than the bookmaker, of course.

A value bettor will be generally unconcerned about backing the underdog, or perhaps more relevantly backing a team which **he** thinks will **not** win (underdog or not), provided there is value in the bookmaker's odds. A value bettor estimating the likelihood for the Liverpool win to be 70%, with a 15% chance of a Sunderland win would back the away team, despite believing that Liverpool should win. According to these estimations, the fair odds for the two teams are 1.43 and 6.67 respectively. If the punter is right, and the game could be played 100 times, a 13/2 bet on Sunderland each time would, on average, return £12.50 profit from 100 £1 stakes. By contrast, backing Liverpool at 4/11 would, on average, lose him £4.55. He might believe that Liverpool should win each time, but in this case so does the bookmaker, who has cut his odds. Equally, however, the bookmaker has underestimated the chance of a Sunderland win, offering odds that the value bettor considers, in this case, to represent value.

Since odds are just probabilities, value betting offers really the only way to beat the bookmaker. A punter can back as many "winners" as he likes, but if he fails to take into account the bookmaker's prices, it may not be enough to return a profit. There will always be some losers to upset the applecart. Really, the argument about value betting is a hypothetical one. The "back winners, not losers" philosophy is itself inherently all about finding a betting edge. If a punter is finding winners **and** making a profit with them, it means simply that he is winning more bets than the bookmaker believes the punter ought to be winning, according to the odds the bookmaker had set. If this is the case, the punter **has** found value and established a betting edge, whether he quantitatively set out to do so or just followed his hunches. Successful betting, then, is really all about understanding and managing probabilities. Know the true chances of a sporting win, and there may be profitable opportunities waiting at the bookmakers. As Geoff Harvey says in his book *Profitable Football Betting*, "Find the value, [and] the winners will take care of themselves."

Comparing Bookmakers

One of the most important unwritten rules of sports betting of which a punter should be aware is to always take the best price available. The corollary of this is that it is important to compare odds from a number of bookmakers. Not all bookmakers offer the same price for a sporting outcome. When you have identified a value bet, choose the bookmaker with the highest odds. Intuitively, this is obvious, but many punters are creatures of habit, preferring to walk down to their local high street bookmaker. Others do have online accounts, but only with one or two firms with whom they feel comfortable.

Today there are at least 20 or 30 well-established and reputable Internet bookmakers with whom it is possible to safely do business, and perhaps 100 or more fixed odds firms altogether. If you find a decent price with a new bookmaker, it takes only 5 minutes to open a betting account, with many online bookmakers accepting initial deposits of as little as £20. Frequently, price variations of as much as 10% or more may be found. Even better prices can often be found with the betting exchanges,[14] where you can bet against other punters rather than against a traditional bookmaker.

The highest available price may be close to, or occasionally even better than, the fair odds. Of course, each bookmaker will believe that their odds have the disadvantage of their overround safely built into them. Nevertheless, where prices vary considerably from one bookmaker to the next, obviously not all bookmakers can be right. Those with the highest prices may very well have made a mistake, as illustrated in Tables 3.9a, 3.9b and 3.10 for the English 1st division match between Norwich and Crystal Palace on 16th November 2002.

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[14] Person-to-person betting exchanges enable one to bet directly with other players on all major sporting events, and with no official bookmaker imposing an overround, prices are often superior to those with the bookmakers. Furthermore, punters can act as both backers and layers of bets. The exchange then deducts a small commission, usually 5%, from winning bets.

Table 3.9a. Variation in bookmakers' prices: odds

Bookmaker	**Odds**		
	Home	*Draw*	*Away*
Canbet	2.04	3.2	3.6
BetInternet	1.9	3.25	3.5
Centrebet	1.88	3.4	3.75
Gamebookers	1.88	3.35	4.05
Bet&Win	1.85	3.15	3.75
Internet1x2	1.85	3.25	3.75
Interwetten	1.85	3	3.7
Paddy Power	1.8	3.4	3.75
Eurobet	1.8	3.25	3.85
Sportingbet	1.8	3.3	4
Expekt	1.75	3.3	4.1
Bet 365	1.727	3.5	4
Average	1.826	3.286	3.836

Table 3.9b. Variation in bookmakers' prices: estimations

Bookmaker	**Bookmaker's unfair estimations**			**Overround**		**Bookmaker's fair estimations**[15]		
	Home	*Draw*	*Away*	*Decimal*	*%*	*Home*	*Draw*	*Away*
Canbet	49%	31%	28%	1.08	108%	45%	29%	26%
BetInternet	53%	31%	29%	1.12	112%	47%	27%	26%
Centrebet	53%	29%	27%	1.09	109%	49%	27%	24%
Gamebookers	53%	30%	25%	1.08	108%	49%	28%	23%
Bet&Win	54%	32%	27%	1.12	112%	48%	28%	24%
Internet1x2	54%	31%	27%	1.11	111%	48%	28%	24%
Interwetten	54%	33%	27%	1.14	114%	47%	29%	24%
Paddy Power	56%	29%	27%	1.12	112%	50%	26%	24%
Eurobet	56%	31%	26%	1.12	112%	49%	27%	23%
Sportingbet	56%	30%	25%	1.11	111%	50%	27%	23%
Expekt	57%	30%	24%	1.12	112%	51%	27%	22%
Bet 365	58%	29%	25%	1.11	111%	52%	26%	22%
Average	55%	30%	26%	1.11	111%	49%	27%	23%

In Table 3.9b, each bookmaker's assessment of the true chance of a home win, draw and away win has been calculated by dividing each of the

[15] The sum of the average fair estimations equals 100%, although due to rounding this is not quite the case in Table 3.9b.

bookmaker's actual (unfair) estimations by their decimal overround for the book. By assuming, firstly, that a bookmaker's overround (or advantage) is spread proportionally across each result, and secondly, that the average of all bookmakers' fair estimations represents a close approximation to the true chances,[16] it becomes possible to determine a more realistic value of a bookmaker's expected profit margin for each home, draw and away odds, or rather, what we should predict it to be based on this comparison analysis. These values are shown in Table 3.10.

Table 3.10. Realistic profit margins for the bookmaker on home, draw and away odds, based on an odds comparison analysis

Bookmaker	**Realistic value of bookmaker's profit margin**			**Edge**		
	Home	*Draw*	*Away*	*Home*	*Draw*	*Away*
Canbet	-0.4%	14.2%	18.5%	1.004	0.875	0.844
BetInternet	7.0%	12.5%	21.9%	0.935	0.889	0.821
Centrebet	8.1%	7.5%	13.7%	0.925	0.930	0.879
Gamebookers	8.1%	9.1%	5.3%	0.925	0.916	0.950
Bet&Win	9.9%	16.0%	13.7%	0.910	0.862	0.879
Internet1x2	9.9%	12.5%	13.7%	0.910	0.889	0.879
Interwetten	9.9%	21.8%	15.3%	0.910	0.821	0.868
Paddy Power	12.9%	7.5%	13.7%	0.886	0.930	0.879
Eurobet	12.9%	12.5%	10.8%	0.886	0.889	0.903
Sportingbet	12.9%	10.8%	6.6%	0.886	0.903	0.938
Expekt	16.2%	10.8%	4.0%	0.861	0.903	0.961
Bet 365	17.7%	4.4%	6.6%	0.850	0.957	0.938

Canbet offered odds of 2.04 for a Norwich home win, or a win expectancy of 49.0%. Since the average fair estimation for this result across the 12 bookmakers was 49.2%, these odds may realistically offer a very small edge[17] to the punter. Whether or not this edge is real is dependent upon the validity of the two core assumptions used for this odds comparison

[16] Although the true chance of a sporting result can never be known exactly, it is surely reasonable to assume that the common view of a number of bookmakers will frequently provide a close approximation to this value, provided a common error in the pricing assessment has not been made.

[17] The *edge* here may be defined quantitatively as the true chance of a result divided by the bookmaker's expectancy of this result, with his profit margin built in. It provides an accessible measure of a punter's expectation to make a profit. Where the edge is over 1, the bet is a value bet and is potentially a profitable one, according to the analysis that went into determining it in the first place. An equivalent and simpler means of calculating it is to divide the bookmaker's odds by the fair odds.

analysis. If correct, and the match was played 1,000 times, a punter could reasonably expect to profit by nearly £4 from 1,000 £1 stakes. Not much, one might say, but achieved without any match analysis at all. By contrast, taking Bet365's odds at 1.727 would seem foolish. The best opportunity for betting on Crystal Palace is with Expekt, at 4.1. The odds comparison analysis informs us that whilst we have not gained an edge over the bookmaker, our disadvantage may only be 4.0% instead of the more usual 11 or 12%.

There are a number of websites that can take the time out of performing lengthy odds comparison analyses for each match a punter might want to bet on. The better ones include:

Betbrain	www.betbrain.com
Tip-ex	www.tip-ex.com
Oddschecker	www.oddschecker.com
Betbase	www.betbase.info

Betbrain and Tip-ex actually provide a list of value bets where the hypothetical edge for a bet on a particular result is over 1.00, based on an odds comparison analysis similar to that performed here. Betting with this type of analysis is sometimes called *arithmetic value betting*.

A punter might now be wondering whether there is any need to perform any match analysis at all if one need only find some "value" bets using an odds comparison website. Unfortunately, betting is never that simple, and it is worthwhile introducing a word of caution. Remember, to profit from arithmetic value betting in this way the underlying assumptions that underpin an odds comparison analysis of this nature must be valid. These assumptions were that:

a) the bookmaker's profit margin on a full book is spread proportionally across the range of possible outcomes for that book, in this case the home win, draw and away win; and
b) the average fair odds based on odds from a number of bookmakers frequently represents a close approximation to the "true" price.

Of course, since there is no real way of determining the true chance of a sporting result, the second assumption can never be entirely substantiated. However, it is probably the first assumption that will have the greater influence, at least from the perspective of trying to profit from this type of betting. Fortunately, there is a way to investigate its validity by investigating it with some real data.

From European league games played in 20 divisions during the 2000/01 season, a sample of 3,788 matches were found to have value odds with at least one bookmaker for either a home win or an away win according to a typical odds comparison analysis, taking odds from 12 online bookmakers. Draws were excluded from the analysis. Where more than one bookmaker was found to be offering “value” odds for the same game, only the bookmaker with the highest odds was kept in the sample, restricting the dataset to a total of 2,256 games. Of these games, 1,892 (or 84%) had “value” odds for the away win. The remaining 364 games had “value” home odds.

The much greater number of “value” away wins is a consequence of the greater variation across bookmakers for the away win price, or more correctly the underdog market, which of course is predominately made up of away wins. Such an observation might indicate that if some bookmakers are prepared to offer disproportionately higher odds for the highest of the three prices without additional risk to themselves, others refusing to do so may very well be locking a proportionally greater percentage of the book’s total profit margin into that price than would be predicted on the basis of the initial assumption above. A simple but plausible explanation for this might be that the bookmaker can manipulate the higher prices more easily without a punter noticing the difference.[18] If an odds comparison analysis fails to take into account a differentially weighted profit margin across home win, draw, and away win, then a punter may wrongly believe that he has found a value bet.

A level stakes profit analysis confirms the arguments presented above. The first thing to notice from Table 3.11 is that the odds comparison analysis failed to return a profit, with a loss of 6.4% from the total amount bet (2,256 points). This is considerably better than the loss of 10 or 11% that would be expected if all bets had been placed with one bookmaker,

[18] A punter might believe that a cut of evens to 8/11 is inferior to dropping from 6/1 to 5/1. In actual fact, the latter is marginally worse. Since 5/1 still represents a healthy payout for a winning bet, the punter may be convincing himself that the drop in price is relatively less important than for a move from evens to 8/11.

but hugely uninspiring, given that the analysis model had predicted a profit of +6% (since the average edge of each bet was 1.06). However, upon further inspection, we can see exactly where the problems have arisen. Breaking the sample into home wins and away wins reveals the relatively poorer performance of the away win prices. Since these make up 84% of the total sample, this has obviously dragged down the overall performance. More crucially, a breakdown according to the betting price reveals that the best performing bets are those with the lower odds. Bets (whether home or away) where the odds were less than 7/2 actually returned a profit of nearly 1%. Including additional wagers up to (but not including) odds of 6/1 restricted the loss to only 3.4%, compared to a loss of 14.3% for odds 6/1 and above. This was despite the average edge for odds 6/1 and greater being over twice as large as that for the lower odds group. Clearly, although this odds comparison model is predicting a better performance for the higher prices market, this is not actually happening. The most rational explanation for this is that bookmakers are introducing a much greater profit margin into their higher prices than could have been initially predicted on the basis of the overround for each book. Why? Partly to limit liabilities on the bigger payout, and partly because he knows the punter won't know or care. It may come as no surprise, then, that the majority of so-called value bets found by Betbrain and Tip-ex with this analysis involve fairly high prices. Many of these, clearly, will actually contain no value at all.

Table 3.11. A profit analysis for arithmetic value betting, European football league matches 2000/01

	Number of bets	% of total bets	Average odds	Average edge	Level stakes profit	Profit over turnover
Home wins	364	16%	4.05	1.05	-17.5	-4.8%
Away wins	1982	84%	6.16	1.06	-127.2	-6.7%
All bets odds <7	1636	73%	4.57	1.05	-56.0	-3.4%
All bets odds ≥7	620	27%	9.13	1.11	-88.8	-14.3%
All bets odds <3.5	308	14%	2.92	1.03	+2.8	+0.9%
All bets odds ≥3.5	1948	86%	6.28	1.07	-147.6	-7.6%
All bets	2256	100%	5.82	1.06	-144.7	-6.4%

Arbitrage

Overround value analysis offers a useful weapon in a punter's arsenal to help overcome the bookmaker's odds. Unfortunately, without more accurate information on how each bookmaker spreads his overround across the range of possible outcomes, it is unable to ensure a profitable return at minimal risk. There is, however, one way to guarantee that a profit **is** made from a fixed odds sports bet – arbitrage.

From the odds comparison analysis of football matches above, we have seen how bookmakers vary in the prices they offer for the home win, draw and away win for one football match. If the variation is great enough, a bet can be placed on each result at the best available odds using two or three bookmakers, in such a way that, with correct staking, a profit is guaranteed whatever the result of the game. This possibility arises because, by taking the best odds from different bookmakers, the punter can reduce the overround on the book to below 0%. The book for the punter is then said to be "overbroke" and the betting opportunity is known as an arbitrage, sure win or sure bet.

Consider the friendly international football match between Greece and Ireland, played on 20th November 2002. Table 3.12a shows the opening fixed odds prices from 3 Australian online bookmakers.

Table 3.12a. Opening prices for Greece v Ireland

Bookmaker	Home win	Draw	Away win
Canbet	**2.39**	3.15	2.89
Centrebet	2.3	3.1	2.85
Tattersall's	2.15	**3.25**	**3.1**

The lowest overround available to a punter with these opening prices is 4.9%, by taking Canbet's odds for Greece and Tattersall's odds for the draw and an Ireland win. By the morning of the game, Tattersall's and Canbet's odds for the home win had shortened dramatically, possibly in response to considerable punter interest. At the same time, Ireland's odds lengthened, as illustrated in Table 3.12b.

Table 3.12b. Shifted prices for Greece v Ireland

Bookmaker	Home win	Draw	Away win
Canbet	1.90	3.15	**4.23**
Centrebet	**2.3**	3.1	2.85
Tattersall's	1.85	**3.5**	3.75

Now, taking Centrebet's home win price, Tattersall's draw price and Canbet's away win price, the book had become overbroke by 4.3%. With appropriate staking, as shown in Table 3.13, a return of £100 for an outlay of £95.69 was guaranteed, or a profit for the punter of 4.5%. Stakes may be simply calculated by inverting the odds and multiplying by a preferred standard, in this case £100.

Table 3.13. Arbitrage staking to secure a guaranteed profit

Bookmaker	Home win	Draw	Away win
Best odds	2.3	3.5	4.23
Stake	£43.48	£28.57	£23.64
Profit with win	£56.52	£71.43	£76.36
Lost stakes	-£52.21	-£67.12	-£72.05
Overall profit	*£4.31*	*£4.31*	*£4.31*

Naturally, the frequency with which arbitrage opportunities arise is relatively low, since each bookmaker is careful not to ride against the general tide of opinion regarding the pricing of a sporting event. Although overrounds of only a few per cent are not uncommon, perhaps only 1 book in a 100 or fewer is overbroke and capable of yielding an arbitrage opportunity. Nevertheless, given the enormous number of sporting events available for fixed odds betting today, there are still a considerable number of sure bets to be found each and every week.

Arbitrage might seem like betting's equivalent of the Holy Grail. If the punter profits whatever the result of the sporting event, betting becomes risk-free, right? Wrong! No form of gambling is entirely risk-free, not even arbitrage. That fact that it is frequently and wrongly acclaimed as being so is perhaps partly due to the use of the term "sure win". There are numerous difficulties associated with arbitrage betting that can and do eat into the profits, sometimes with potentially disastrous consequences.

The first issue to consider with arbitrage betting is stake size. The majority of arbitrage opportunities are limited to only a few per cent at best. Consequently, stakes have to be large to secure any form of sizeable profit. In the example illustrated in Table 3.13, an outlay close to £100 was required to win £4.31. If a punter wanted £43.10 instead, total stakes would have to be nearly £1,000. In itself, this should not present a problem, provided the punter has at his disposal enough liquid cash to place the bets or make deposits with different online bookmakers. The first difficulty arises, however, if a bookmaker imposes limits on the maximum size of a stake. Since an arbitrage bettor's stakes are likely to be larger than most, this problem may occur quite frequently. A punter, for example, may successfully place his two bets on Greece and Ireland, only to discover that he cannot place a £285.70 stake with Tattersall's on the draw, which limits him to £200. He is then left to sweat on the result of the match, which if drawn will lose him £171.20. Incidentally, the match finished 0-0.

Perhaps a more significant and ongoing problem concerns the effects of deposit and withdrawal costs, and in some cases currency transaction costs as well. For certain types of deposit, and with a number of internationally based online bookmakers, these additional costs can amount to anything from 1 to 5%. Given the usually small percentage profits available, these costs can potentially wipe out any guaranteed profit that is generated through the arbitrage. Of course, a punter can limit the number of deposits and withdrawals he makes but, given the large stake sizes and the number of bookmaker accounts he will require to be able to benefit from arbitrage opportunities that arise, none but the very wealthiest of punters will be able to have the required capital locked away in online accounts. With most arbitrage opportunities offering little more than 1 or 2%, one might assume that to earn as little as £300 per month from at least one winning arbitrage each day would require up to 20 online accounts, each with perhaps £1,000 available to spend. The wealthiest punters, of course, are unlikely to be interested in earning a few extra pounds through arbitrage betting.

A further problem arises with the currency of the betting account. Most online bookmakers now allow a choice of primary currency, with pounds, US dollars and euro all available. However, some of the smaller bookmakers may only permit transactions in one currency. If the currency used to make up one bet differs from that used to make up the others, a very careful calculation of currency conversion will be required to ensure that the appropriate stakes are used to secure the arbitrage profit. Of course, currency rates fluctuate by the hour, and even small mistakes made in calculating the equivalent value of one currency in another can eat into or wipe out the “sure win” return.

Finally, there is the issue of postponed sporting events. Under certain circumstances, postponed events may be rescheduled for within a few days of the original fixture. What a bookmaker does with bets placed on these matches will then depend upon his rules as set out in the terms and conditions. Some bookmakers may decide to void all bets placed, and reopen the book for the rescheduled event. Others may feel it appropriate to leave existing bets to stand. For a football match a punter may then be left with two standing bets and one voided bet. If the new book then offers a different set of prices from the original ones, the possibility of arbitrage may disappear. Again, the punter will be left to sweat on the result.

Every once in a while, one or two bookmakers make a glaring mistake in the pricing of a sporting event. When this happens, a sizeable arbitrage opportunity may become available, perhaps offering a 5% or even 10% return. Such opportunities, however, are relatively rare. When they come along, and a punter happens to have existing accounts with the relevant bookmakers, they present a wonderful opportunity to make a bit of extra money at very low risk. However, in view of the difficulties highlighted here, only the most dedicated punter will realistically be able to benefit repeatedly from arbitrage betting with a view to securing a regular income.

Since this analysis was first written, Tattersall's Sports Betting has ceased active online betting operations. Fortunately, their customers had their account funds returned to them. Regrettably, this is not always the case. Since the majority of arbitrage opportunities arise with the lesser-known, and less-well-established bookmakers, a reader seriously contemplating large arbitrage staking may wish to reflect on the possibility of losing a substantial amount of capital due to such unfortunate circumstances.

Rating Systems for Sports Prediction

Quantitative Sports Prediction

Value betting is the key to overcoming the bookmaker's odds and securing a long-term profit. Value betting encourages the informed punter to view all odds as probabilities, and to search for opportunities where the bookmaker may have underestimated the chance of a result. Value analysis may investigate the bookmaker's odds and overround, and any opportunity for an arbitrage. It may also be used to investigate the availability of a betting edge through match analysis and quantitative forecasting techniques, or rating systems.

As we have seen, sporting events are more complex than dice, cards or roulette, and the true chance of one result or another occurring can never be determined mathematically in the same way. This is not to say, however, that mathematics cannot play a part in sports forecasting or prediction. Of course, many punters either dislike or distrust numbers, and prefer to work with qualitative information instead, like the latest injuries list, the expected weather, and other influencing factors on a forthcoming event. This is to be commended, because without an in-depth knowledge of each event in question, a punter is unlikely to succeed over the long term. However, what mathematics does offer the punter is a simple and effective means of analysing a sports event quantitatively, providing an assessment of the true chances of the possible outcomes and the identification of a betting edge.

A numerical approach to forecasting offers one perspective on fixed odds sports betting, qualitative research and judgement another. The most effective approach to sports prediction is likely to make use of both quantitative and qualitative information about each event on which a punter wishes to bet. There are numerous sports betting books available, with a few listed in the bibliography, which describe in great detail some of the more qualitative aspects of sports prediction that a punter should consider. Geoff Harvey, for example, explains how studying the weather may reveal opportunities for semi-contingent bets,[19] particularly in golf and

[19] A related contingency bet is a multiple bet where one or more of the legs have a direct effect on the outcome of another leg. Bookmakers do not permit such bets.

cricket, which are permissible by the bookmaker but provide an obvious and significant advantage to the punter. Derek McGovern takes us through some of the relevant influences to consider when betting on tennis, snooker and athletics. Consequently, there is no need to reproduce their work. This chapter instead focuses on quantitative sports prediction and the development of mathematical rating systems as a forecasting tool in value analysis to gain a betting edge.

Analysing the Past

The chance of one result occurring from n possible results, where each result is equally possible, is simply 1/n. For a 6-sided die, the chance of throwing a 6 is of course 1/6. Such a simple and exact probability function arises despite the throw of a die being essentially determined by a number of random influences, including the way in which the die is thrown and its position at that time. Over the long run, however, such random influences, sometimes called “noise”, even themselves out, and, since the key determinant of the result is the number of sides to the die, the chance of any result occurring can be known exactly. The 1/n probability function for an n-sided die could of course be empirically determined by throwing it many hundreds or thousands of times, but there would seem little point to this thankless task, given that the discipline of statistics has calculated it from first principles.

Defining a probability function for the outcome of a sporting event, however, is a completely different ball game, if you will pardon the expression, because there are so many key influencing factors that determine the end result, none of which can be determined exactly. That is not to say that a probability function does not exist, simply that the number of variables that would need to be described by it render its calculation impossible from first principles. Instead, the punter must resort to empirical observation to provide an estimate of the probability distribution of the possible results for each sporting contest, since the exact chances of each result cannot be calculated. For dice, this means counting the number of times each number is thrown. For sports, it means analysing past results. Of course, one doesn't need a degree in statistics to appreciate the importance of studying past performance in sports prediction. Every punter intuitively knows that to predict the outcome of the next event between two players or teams, it is necessary to study their past records. The relevant point in this context, however, is that such descriptive analysis can be used quantitatively to estimate the probability function that characterises each sporting event, by means of what have commonly become known as ratings systems.

Prior to their match with the All Blacks on 9th November 2002, England's Rugby Union team had only beaten the Kiwis 4 times in 23 games. Without additional information on the match, for example the strength of the squads or more recent match form, this quantitative information might still be utilised to estimate the chance of an England victory. The basic assumption here is that the probability function used to determine the likelihood of a victory is estimated by the proportion of historical England wins against New Zealand. Since England had won approximately 17% of their games against this opposition, this basic forecasting model would predict only a 17% chance for a 5th victory.

Of course, since the game was played at Twickenham, where England enjoy favourable crowd advantage, a mere 17% chance for an England win might seem a little miserly. Upon further inspection of the historical record between the two sides, it becomes apparent that of the 4 games previously won by England, 3 had been played at Twickenham, in 1993, 1983 and 1936. Since a total of 13 games had been played at this venue prior to the latest contest, the Twickenham model would predict a more favourable 23% chance of a win. Which historical statistic provides the better estimate for the chance of the next win is perhaps not so relevant. In the event, England won the match 31-28,[20] in no small part due to New Zealand actually fielding a weakened side, owing to injury, a factor that probably outweighed the influence of past results. The important point to draw from this analysis, however, is that it is possible to use past information about sporting events to quantitatively estimate the chances of a particular result occurring, and by extension the fair odds for that result. Remember, of course, that without an idea of the fair odds for an event, we can have no way of knowing whether the bookmaker's price is one worth taking.

Of course, there is no guarantee that past performance of one form or another provides a reliable estimate of future probabilities. As we have seen in the example above, the All Blacks' injury list, and probably also the

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[20] On the 14th June 2003, England beat New Zealand for a 6th time, and only the 2nd time away from home soil.

recent strength and confidence of the English side, were far more influential in determining the result than the historical head-to-head record. Nevertheless, there is ample evidence from the world of sports and sports betting to suggest that a past performance record frequently provides an excellent indicator of future events, so much so that such data form the basis of much fixed odds compilation by the bookmakers. The key to gaining an edge over the bookmaker then becomes an issue of finding better and more relevant data with which to build a more accurate forecasting model for sports prediction.

Some Examples of Rating Systems

A rating system merely provides a quantitative measure of the superiority of one player or team over their opposition in a sporting contest. Such superiority is determined by analysing and comparing one or more aspects of past performance for each of the sides. For the England–All Blacks contest, this was solely based on the number of wins each side had had over the other, clearly a rather crude and, in the event, inaccurate ratings model. Paul Steele, in his book *Profitable Football Betting*, describes 15 different forecasting models, or rating systems, for football match prediction. The rating systems differ in the way side superiority is calculated, but basically each method calculates a points difference for a forthcoming football match, by subtracting a points rating for the away side from a points rating for the home side. The home and away team points ratings are determined through a quantitative analysis of past performance involving different aspects of a team's strength. The simplest of these uses either league points, league positions or goals conceded and scored, whilst more complex ratings might be based on elaborate match statistics including shots on goal, corners, and perhaps even possession if such data are available.

For any rating system, a judgement must be made about how far back in time past performance might be considered relevant. For head-to-head records, this may involve several years, although surely England's victory over the All Blacks in 1936 can have very little to do with the match in 2002. In the 10 years preceding the 2002 contest, 7 matches had been played between the sides, 3 of them at Twickenham, with 1 victory, 1 defeat and surprisingly 1 draw. On this evidence, a more recent head-to-head ratings analysis may indicate that England had a 33% chance of victory, higher than both the original probability estimates that were based on the full head-to-head record extending back to 1905.

Of course, ratings need not be based exclusively on head-to-head performance, and most recent form ratings that extend back only a few matches are not. Where teams play week in, week out, their form may have changed completely since the last time the two sides met each other. Under these circumstances, head-to-head ratings may have little relevance. Prior to 2003, Cambridge United had played Fulham 19 times, and beaten them in 10 of these games, with Fulham victorious on only half this number of occasions. The last time the two sides met, however, was in the English 3rd Division, in May 1997. Since then Fulham have become a big-spending Premiership club, whilst Cambridge have languished in the lower echelons of the Football League. Consequently, head-to-head ratings for a match played now would have little or no bearing on the likely outcome.

For many simple rating systems, no account is made of the quality of the opposition. A recent form goal-difference football rating system, for example, simply looks at the number of goals scored and conceded by the two teams for a specified number of matches preceding the contest under examination. One goal is always worth one goal, irrespective of whether it is scored away against the mighty Reds at Anfield or at home against the lowly Baggies. Power Ratings overcome this problem by proportioning the worth of each goal scored to the strength of the opposition against whom it was scored. Similarly, goals conceded against stronger opposition count for less in the ratings computation than those conceded against weaker sides. Bolton Wanderers, for example, may have a recent record of 1 win, 3 losses and a draw, scoring 5 goals and conceding 8. A rather unimpressive recent form, one imagines, yet if those games had been against Liverpool, Manchester United, Arsenal, Chelsea and Newcastle, one might naturally expect them to perform better against West Ham in their next match than they otherwise would, had those games been against Charlton, Blackburn, Manchester City, Birmingham and West Bromwich Albion.

A useful and popular rating system, at least with some punters, is the *Rateform*. Like Power Ratings, it takes into account the quality of the opposition each side has played in games preceding the latest one. This system has its origins in Professor Elo's book *The Rating of Chessplayers*, which in turn was adapted for UK football by Tony Drapkin and Richard Forsyth in their book *The Punter's Revenge*. As football matches are played over a season, ratings are updated for each team. Following Bill Hunter in his book *Football Fortunes*, the essential features of Rateform are that:

1. each team has a points total or rating which represents its current playing form;
2. the average number of points for individual teams remains constant at 1,000;
3. for each match the home and away teams contribute points to a kitty;
4. the winning team takes the complete points kitty; and that
5. teams that draw share the kitty.

Typically the home and away teams contribute, respectively, 7% and 5% of their points total to the kitty. The difference in these percentages represents the advantage to the home team of playing on its own ground, so if the away team overcomes this disadvantage it gains extra points. For each match played, the points allocation is determined by the result. As for other ratings systems, the home team rating minus the away team rating provides a "points difference" which may be used to predict the outcome of matches.

Manchester United, with 2,165 Rateform points, might play Birmingham City, with 723 points, at Old Trafford. The points difference for this match is +1,442 points, the size of which can provide a probabilistic estimate of the likelihood of a home win, draw or away win. How this association is made is described later in the chapter, although for now the reader will intuitively appreciate that, with such superiority, Manchester United should be expected to win the game. If they do so, they will collect the kitty of 188 points, 7% multiplied by 2,165 (152 points) plus 5% multiplied by 723 (36 points). If, on the other hand, Birmingham win the game, they will collect the 188 points. If the game is drawn, they will each receive back 94 points.

There is an important point to recognise from this redistribution of points. Where a weaker side overcomes stronger opposition, their new rating will receive a proportionally greater increase, particularly if achieved away from home. Conversely, where strong opposition defeats a weak side, more especially at home, their rating will receive relatively little benefit. Manchester United's rating increases by only 36 points with a victory (188 points minus 152 points). Birmingham's rating, by contrast, increases by 152 points after a win (188 points minus 36 points). This is because Manchester United have so much more to lose than Birmingham City, since United at Old Trafford are expected to win this game. If drawn, Birmingham will still collect 58 points overall (94 points minus 36 points), whilst United will lose 58 points (94 points minus 152 points). An away draw is proportionally better than a home draw, particularly if the home side is rated more strongly. In this way, a team's rating at any point in the season provides a reflection not just of the number of games it has won, drawn or lost, but also of the strength of the opposition it has beaten, drawn with or lost to. Ratings may also be carried forward from one season to the next, allowing forecasts to be made at the beginning of each season, a feature not available in many recent form rating systems.

Ratings and Probability

Once a set of ratings for a match has been calculated, the next step is to estimate from them the chances of each result occurring, from which betting predictions can then be made. To achieve this, a match rating must in some way be translated into a probability distribution for the possible results in a sporting contest. For England's record against the All Blacks Rugby Union side, this was an obvious and simple procedure, following the assumption that the percentage of historical England wins would provide an estimate of the likelihood of the next win. For more developed rating systems, it becomes necessary to analyse an awful lot of historical data. The following paragraphs describe, for a recent goals superiority rating system, how this may be accomplished.

Goal difference provides one measure of the dominance of one football side over another in a match. The assumption for a goals superiority rating system, then, is that teams who score more goals and concede fewer over the course of a number of matches are more likely to win their next game. That is to say, their match form, in terms of scoring and conceding goals, is potentially better than those teams with a lower rating by this reckoning. The number of past matches for which a goals superiority rating may be calculated is not entirely arbitrary, requiring a judgement by the punter on what constitutes the best choice for the number of matches to describe recent form, from the perspective of determining the best forecasting model for match prediction. Of course, without running the analysis several times, the best choice can only be guessed at. To save us time, Paul Steele, in *Profitable Football Betting*, has indicated that using the 6 most recently played games to calculate a goals superiority rating may be the most suitable choice, and seemingly preferable to using the last 2, 3, 4 and 5 football matches. The reader may wish to review this for himself.

To see how a goal superiority match rating is calculated, consider the following example for a match between Tottenham and Leeds at White Hart Lane, played on 24th November 2002. The last 6 matches for both sides are shown in Table 4.1 below, with the most recent first.

Table 4.1. Recent form of Tottenham Hotspur and Leeds United

Match	Tottenham	Leeds
1	Arsenal 3:0 Tottenham	Leeds 2:4 Bolton
2	Sunderland 2:0 Tottenham	West Ham 3:4 Leeds
3	Tottenham 0:0 Chelsea	Leeds 0:1 Everton
4	Liverpool 2:1 Tottenham	Middlesbrough 2:2 Leeds
5	Tottenham 3:1 Bolton	Leeds 0:1 Liverpool
6	Blackburn 1:2 Tottenham	Aston Villa 0:0 Leeds

In their last 6 games, Tottenham have scored 6 goals and conceded 9. With only 1 league point in their last 4 games this is not entirely unsurprising. Meanwhile, Leeds have scored 8 times and conceded 11 goals, with some rather erratic performances. Tottenham's goal superiority rating for the last 6 games is -3; for Leeds it is also -3. The match rating is simply given by the home side's rating minus the away side's rating, and for this match is therefore 0. On the face of it, one might intuitively expect a draw, since there seems to be little difference in the two sides in terms of their recent goals superiority.[21]

Yet we needn't just rely on intuition. Provided we have enough suitable data, we can translate this match rating into a home-win, draw, away-win probability distribution and quantify our intuition in terms of fair odds for one or more of the 3 possible results. To begin this task we must look to see how frequently a match with a goals superiority rating of 0 finishes with a home win, a draw and an away win.

[21] Of course, it might be argued that Tottenham have faced marginally tougher opposition during their last 6 games (4 of which were played away), playing Arsenal, Liverpool and Chelsea, but without recourse to a more powerful rating system like Rateform, which takes into account the strength of the opposition, we will have to ignore this factor.

Using results data for the English Premiership and Divisions 1, 2, and 3 for seasons 1993/94 to 2000/01, goal supremacy ratings based on the most recent 6 matches played by every team were calculated. Of the 16,272 matches played during these 8 seasons, 14,002 of them were eligible for a rating calculation, with the matches played in the first 6 rounds of each season obviously unsuitable for this recent form analysis. Of these games, 46.2% finished with a home win, 28.1% with a draw, and 25.7% with an away win. It is immediately apparent that playing at home offers an undeniable advantage, with close to half of all games ending with the visitors leaving empty-handed. Such an average home-win, draw, away-win results distribution is commonly reproduced in each English division season after season.

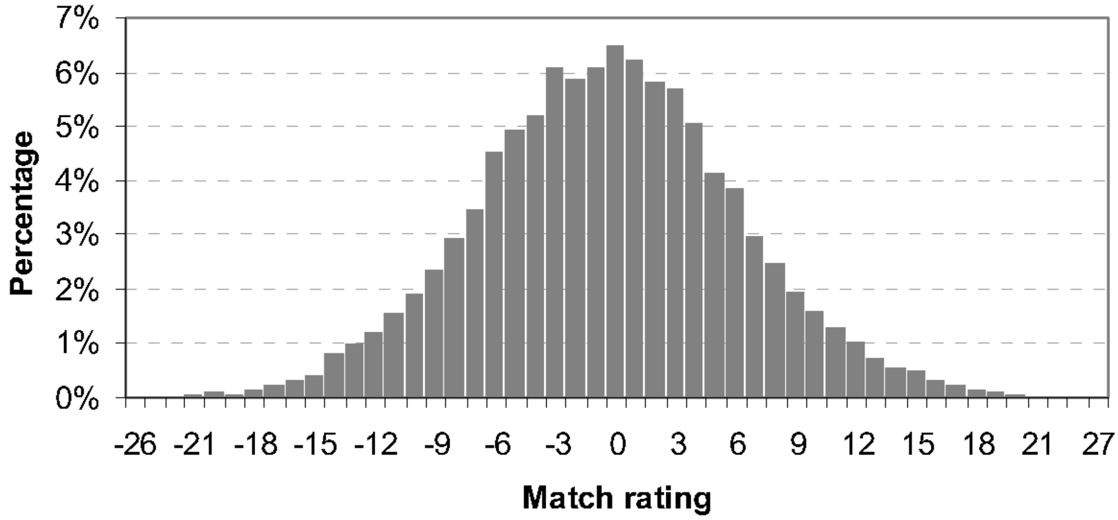
Table 4.2 shows the spread of goal supremacy match ratings for the 14,002 matches, and the number and percentage of home wins, draws and away wins for each rating figure. Of the games, 94% have a rating of between -12 and +12 and 61% between -5 and +5. Obviously, there are far fewer games with large rating values, either positive, indicating a dominant home side, or negative, where the away side is an overwhelming favourite. The precise distribution of games according to their match rating is shown in Figure 4.1. Anyone with a background in statistics will immediately recognise the shape of the histogram as an approximation of the normal distribution.

Table 4.2. Goal supremacy match ratings and historical result percentages

Match rating	No. of home wins	No. of draws	No. of away wins	% of total matches	% of home wins	% of home draws	% of away wins
-26	0	1	1	0.01%	0.0%	50.0%	50.0%
-23	0	0	2	0.01%	0.0%	0.0%	100.0%
-22	0	0	3	0.02%	0.0%	0.0%	100.0%
-21	0	2	4	0.04%	0.0%	33.3%	66.7%
-20	2	2	7	0.08%	18.2%	18.2%	63.6%
-19	1	1	3	0.04%	20.0%	20.0%	60.0%
-18	5	7	9	0.15%	23.8%	33.3%	42.9%
-17	7	9	12	0.20%	25.0%	32.1%	42.9%
-16	6	14	21	0.29%	14.6%	34.1%	51.2%
-15	25	12	19	0.40%	44.6%	21.4%	33.9%
-14	32	30	51	0.81%	28.3%	26.5%	45.1%
-13	43	38	58	0.99%	30.9%	27.3%	41.7%
-12	51	50	64	1.18%	30.9%	30.3%	38.8%

Match rating	No. of home wins	No. of draws	No. of away wins	% of total matches	% of home wins	% of home draws	% of away wins
-11	75	54	91	1.57%	34.1%	24.5%	41.4%
-10	84	94	91	1.92%	31.2%	34.9%	33.8%
-9	123	91	112	2.33%	37.7%	27.9%	34.4%
-8	171	113	124	2.91%	41.9%	27.7%	30.4%
-7	190	121	170	3.44%	39.5%	25.2%	35.3%
-6	242	202	191	4.54%	38.1%	31.8%	30.1%
-5	279	212	197	4.91%	40.6%	30.8%	28.6%
-4	293	219	215	5.19%	40.3%	30.1%	29.6%
-3	374	246	229	6.06%	44.1%	29.0%	27.0%
-2	372	233	214	5.85%	45.4%	28.4%	26.1%
-1	375	251	222	6.06%	44.2%	29.6%	26.2%
0	414	259	235	6.48%	45.6%	28.5%	25.9%
1	412	243	212	6.19%	47.5%	28.0%	24.5%
2	401	220	189	5.78%	49.5%	27.2%	23.3%
3	395	224	175	5.67%	49.7%	28.2%	22.0%
4	391	177	137	5.03%	55.5%	25.1%	19.4%
5	297	180	102	4.14%	51.3%	31.1%	17.6%
6	260	146	131	3.84%	48.4%	27.2%	24.4%
7	236	98	83	2.98%	56.6%	23.5%	19.9%
8	197	94	56	2.48%	56.8%	27.1%	16.1%
9	158	86	32	1.97%	57.2%	31.2%	11.6%
10	125	57	42	1.60%	55.8%	25.4%	18.8%
11	113	34	33	1.29%	62.8%	18.9%	18.3%
12	90	30	22	1.01%	63.4%	21.1%	15.5%
13	61	23	17	0.72%	60.4%	22.8%	16.8%
14	48	15	11	0.53%	64.9%	20.3%	14.9%
15	38	21	8	0.48%	56.7%	31.3%	11.9%
16	30	9	2	0.29%	73.2%	22.0%	4.9%
17	20	8	2	0.21%	66.7%	26.7%	6.7%
18	15	1	1	0.12%	88.2%	5.9%	5.9%
19	8	4	1	0.09%	61.5%	30.8%	7.7%
20	5	1	0	0.04%	83.3%	16.7%	0.0%
21	1	0	0	0.01%	100.0%	0.0%	0.0%
22	1	0	1	0.01%	50.0%	0.0%	50.0%
23	1	0	0	0.01%	100.0%	0.0%	0.0%
27	1	0	0	0.01%	100.0%	0.0%	0.0%
Total	*6468*	*3932*	*3602*	*100.00%*	*46.2%*	*28.1%*	*25.7%*

Figure 4.1. Percentage of games with each match rating



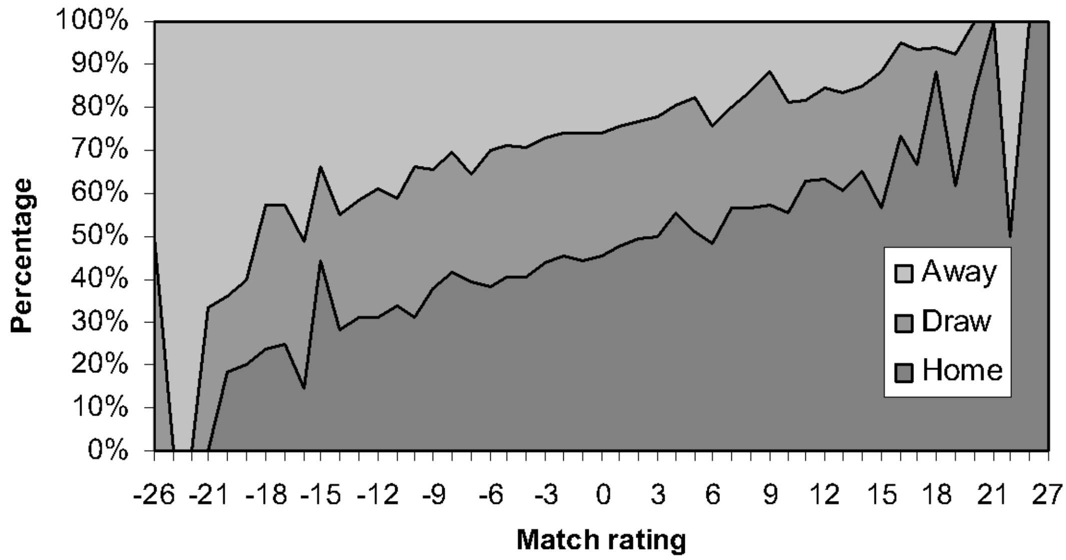
The histogram in Figure 4.1 is approximately centred on the match rating of 0, with 49% of games having a negative match rating, and 45% of games having a positive rating. The rating of 0 also contributes the greatest number of games in the overall sample, accounting for 6.5% of the total. It may come as no surprise, then, that the probability distribution of home wins, draws and away wins for this rating (45.6%, 28.5%, 25.8%), is very close to the average results distribution.

Equipped with this information, we can make a first estimate of the likelihood of any of the 3 possible results occurring for the Tottenham–Leeds game. With a match rating of 0, our forecasting model estimates Tottenham to have roughly a 46% chance of winning the game because, of the 908 matches played between 1993 and 2001 that had the same rating, 46% of them finished with a home win. The corresponding expectancy for a Leeds win is 26%, whilst that for the draw is 29%.

Since we have calculated a results probability distribution for every match rating, we can use the data from Table 4.2 to predict the most likely result for any match, provided at least 6 games have been played in the season in order to describe the recent form. According to the data, a match rating of +12, for example, would have a 63% chance of ending with a home win, whilst another game rated at -12 would give the away team a 39% expectancy of victory. It is clear from Table 4.2 that, in general, the higher the match rating, the greater the probability of a home win. Conversely, the lower the rating, the greater the chance for an away win. It is initially not obvious how the match rating influences the likelihood of a drawn game.

But what about a rating of +15? Surely one might expect the chance of a home win to be greater than that for a match rating of +12, and yet only 57% of games rated +15 finished with such a result. Similarly, only 34% of games rated -15 finished with an away success. Of course, these discrepancies arise because the relationship between the match rating and the home-win, draw, away-win probability distribution is inherently "noisy" and imperfect – we have only so much historical data with which to work. Such discrepancies become more apparent for the extreme ratings for which, owing to the limited amount of match data, one or two results have a much greater influence on the results probability distribution, as illustrated in Figure 4.2. To accommodate this variance, we need to standardise our forecasting model. By doing so, we can then make a practical attempt at defining the fair odds for a football game.

Figure 4.2. Results distribution by match rating (data from Table 4.2)



Defining the Fair Odds

The first task is to consider each result independently, and identify the "best-fit" relationship with the match ratings. The easiest way to determine this best-fit relationship is to redraw the graph in Figure 4.2 as three scatter plots, one for each result, as shown in Figures 4.3 to 4.5. For each scatter plot, the best-fit line has been superimposed on the data points, representing what would statistically be considered to be the best relationship between match rating and result probability, graphically illustrated as a fraction of 1.

Figure 4.3. Home wins distribution by match rating (data from Table 4.2)

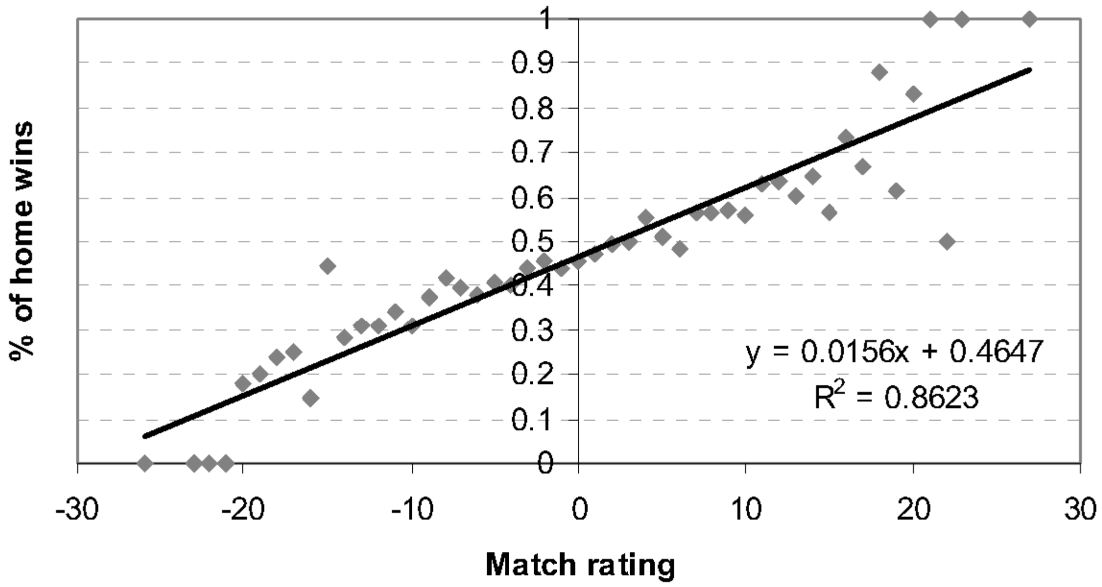


Figure 4.4. Away wins distribution by match rating (data from Table 4.2)

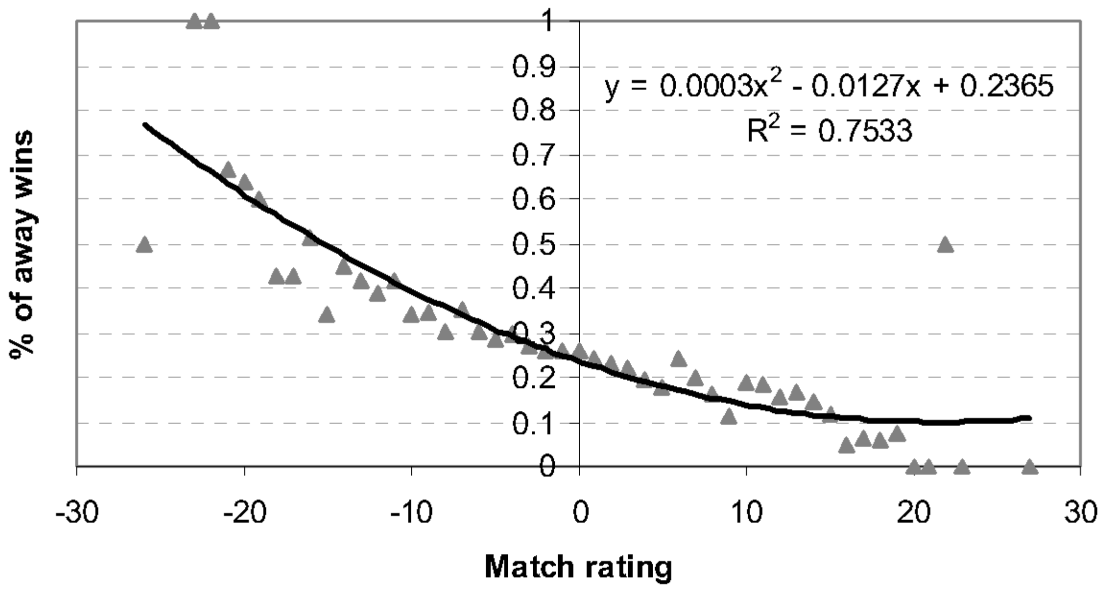
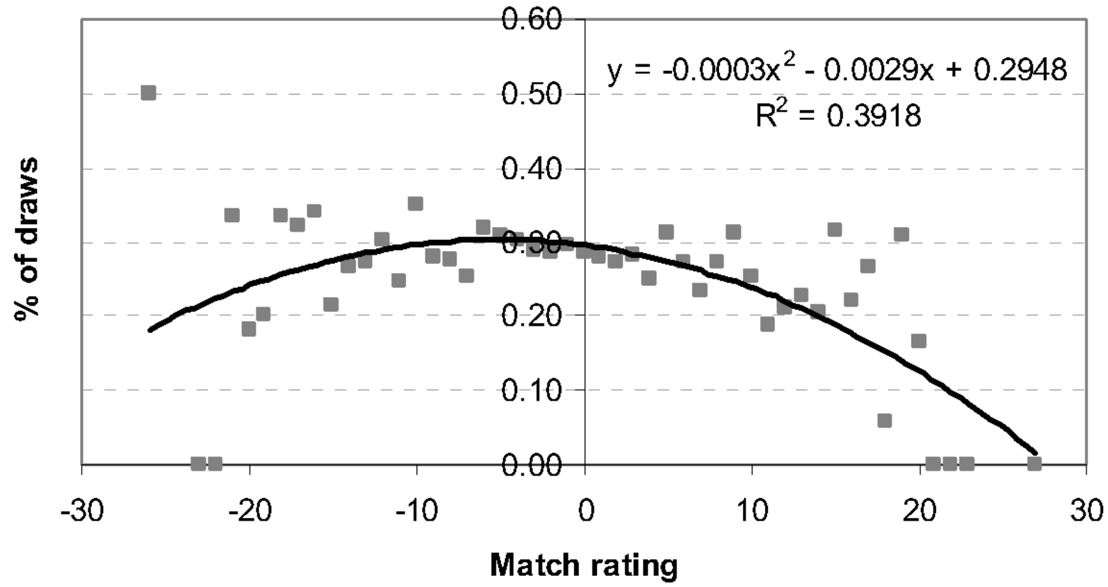


Figure 4.5. Draws distribution by match rating (data from Table 4.2)



The equation for each best-fit line can also be easily calculated with appropriate software like Microsoft Excel or SPSS, and these are shown for each figure. For each equation, y, the probability of a particular result occurring (expressed as a fraction of 1), is some function of x, the match rating. For home wins it is evident that the best relationship is a straight-line one, and the equation takes the form y = mx + c. For away wins and draws, the scatter plots reveal definite curves, and in these cases, the idealised relationship is polynomial, with an x^2 (x-squared) factor included in each equation. Readers with a background in statistics may recognise these equations as a product of regression analysis. For those who are left cold by such mathematics, the good news is that a computer can do all the work for you. In graphically determining the best-fit relationship between match rating and result probability, packages like Microsoft Excel are simply performing a statistical regression analysis and outputting the result as a trend line with accompanying equation. The value of R^2 shown for each of the 3 equations is simply a statistical measure of how closely the real data match the idealised curves or trend lines. A perfect relationship is denoted by $R^2 = 1$. Consequently, a fairly good relationship exists between the match rating and home win probability, where as much as 86% of the variation in the real data is explained by its best-fit equation. For draws, by contrast, the relationship is much weaker. As much as 62% of the variation in the draws data cannot be described by this ratings model.[22]

What are the regression equations telling us? To answer this, first consider the relationship between match rating and the likelihood of a home win. The straight-line relationship is described by the following equation:

$$y = 0.0156x + 0.4647$$

where y is the probability of a home win, expressed as a decimal fraction of 1, and x is the match rating. With this equation we can easily determine the expected probability of a home win for any match where we have calculated the goal supremacy rating. For the Tottenham–Leeds game, where the match rating was 0, the probability of a home win will be 0.4647 or 46.5% (since 0.0156 multiplied by 0 is of course 0). This is very close to the percentage of historical games with a rating of 0 finishing with a home win (see Table 4.2). Such a close match arises because the best-fit relationship provides a particularly good fit for the real data (R^2 = 0.8623). The beauty of this equation is that we no longer need to remember all the information contained in Table 4.2 to calculate the home win probability for other games with different ratings. A game with a match rating of +10, for example, has a 62.1% likelihood of ending with a home win, whilst one rated at -7 has a 35.6% chance. To calculate these percentages, all we need to do is input the match rating into the equation above.

With an estimation of the true expectancy for a home win, we can define the fair odds for a home win simply by inverting the answer. Consequently, the fair odds, according to this forecasting model for a Tottenham win, are 2.15, or 1 over 0.4647. We can define fair odds for the away win and draw in the same way, using the regression equations for away wins and draws, although their accuracy for this particular forecasting model should be questioned, since there is more variability in the historical data, particularly for draws, than there is for the home wins analysis. Many punters, in fact, never even bother to consider the draw as a betting opportunity. Thus, we can calculate the fair odds for a full book, as illustrated in Table 4.3 for a selected set of ratings. For the Tottenham–Leeds game, these are 2.15, 3.39 and 4.23 for the home win, draw and away win respectively.

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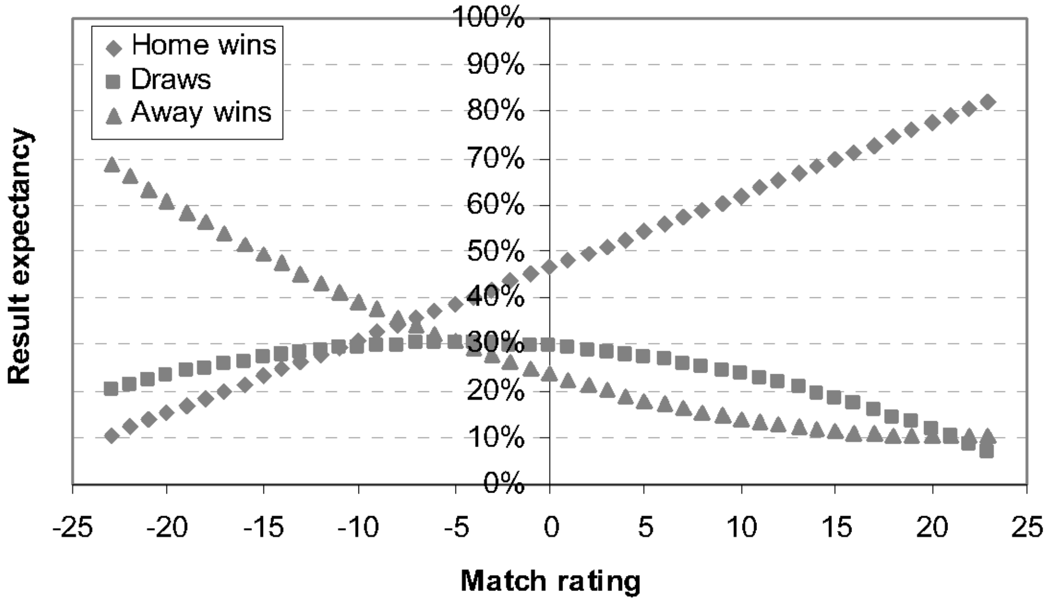
[22] Punters and bookmakers alike have always found draws notoriously hard to forecast. It is no surprise, therefore, that the pools are based entirely around their prediction.

Table 4.3. Calculation of fair odds from the ratings model

Match rating	Home expect-ancy	Draw expect-ancy	Away expect-ancy	Total	Fair home odds	Fair draw odds	Fair away odds
-16	22%	26%	52%	100%	4.65	3.78	1.94
-14	25%	28%	47%	100%	4.06	3.62	2.11
-12	28%	29%	43%	100%	3.60	3.49	2.31
-10	31%	29%	39%	100%	3.24	3.40	2.54
-8	34%	30%	36%	100%	2.94	3.35	2.80
-6	37%	30%	32%	100%	2.69	3.32	3.09
-4	40%	30%	29%	100%	2.49	3.32	3.42
-2	43%	30%	26%	100%	2.31	3.34	3.80
0	46%	29%	24%	100%	2.15	3.39	4.23
2	50%	29%	21%	100%	2.02	3.47	4.71
4	53%	28%	19%	100%	1.90	3.59	5.25
6	56%	27%	17%	100%	1.79	3.75	5.84
8	59%	25%	15%	100%	1.70	3.96	6.49
10	62%	24%	14%	100%	1.61	4.24	7.17
12	65%	22%	13%	100%	1.53	4.61	7.86
14	68%	20%	12%	100%	1.46	5.12	8.51
16	71%	17%	11%	100%	1.40	5.83	9.08

We could of course plot this information graphically, as in Figure 4.6. This only confirms the shape of the regression curves in Figures 4.3 to 4.5, as described by the 3 regression equations. The data in Table 4.3, of course, are based on those equations.

Figure 4.6. Idealised match prediction curves for goal supremacy ratings



Identifying Value Bets

Once we have identified fair odds for a match, the final step is the easiest. By comparing our fair odds to those of the bookmaker we can determine whether we have identified a value bet. Where the bookmaker's odds are superior to our fair odds, we have potentially gained an edge, provided that our ratings system furnishes an accurate forecast, or more appropriately an accurate expectancy of the result. In such a case the bookmaker has underestimated the probability of the result, and is offering, by our forecast's assessment, higher than the mathematically fair odds. Over the long term, provided the ratings analysis is accurate, one should make a profit. The distinction between result forecast and result expectancy is an important one, and is central to the principles of value betting emphasised in the last chapter. It is not enough simply to predict the most likely result. To potentially make a profit over a series of bets, we must always compare our fair odds to those of the bookmaker, and think of the outcome of a match in terms of a probability distribution rather than as simply win or lose.

Unfortunately, the majority of bookmakers are rather good at pricing football matches. Football betting is the most popular of all sports betting, particularly in the UK, where football is the national game. Consequently, the bookmakers can lay their hands on a tremendous amount of information to assist with odds pricing, and the punter will always struggle to do better. With a further 11 to 12% disadvantage in the shape of the singles overround to overcome, it may come as no surprise that the majority of bets do not offer any betting value.

Let us return again to the game between Tottenham and Leeds. Odds from 7 bookmakers are shown in Table 4.4.

Table 4.4. Odds for Tottenham v Leeds

Bookmaker	Home odds	Draw odds	Away odds
Bet365	2.1	3.25	3
Gamebookers	2.12	3.41	3.1
Interwetten	2.2	3.	2.9
Ladbrokes	2	3.2	3.2
Sporting Odds	2.1	3.25	3
Sportingbet	2.1	3.25	3
William Hill	2	3.2	3.2

Recall that our fair odds, as estimated by the goal supremacy forecast model, are 2.15, 3.39 and 4.23 for the home win, draw and away win respectively. At 2.2, Interwetten appear to be offering value for money in the home win, whilst Gamebookers have the only favourable price for the draw. In view of the reservations expressed earlier about draws prediction, a punter would be advised to leave this bet alone. Seemingly, we should also steer well clear of the away win.

At 2.2 for Tottenham, Interwetten are offering us an edge of 2.3%.[23] Assuming our model estimations are correct, we may wonder why they are offering such a good price. A possible explanation might be that Leeds have been a top 5 Premiership side for the past 5 seasons, whilst Tottenham have finished no higher than 9th. The goal supremacy model, however, rates the sides equally, and with fair odds of 4.23 for the away win, the bookmakers are overestimating the chance of Leeds taking the spoils. Conversely, Tottenham are overvalued, despite home advantage, and in Interwetten's price, we have identified a value bet. The game, as it happens, finished 2-0 to Tottenham.

Before we congratulate ourselves on a winning bet, we should remember that we had estimated the chance of Tottenham **not** winning the game to be 54%, that is, more than the expectancy of a home win. In view of this, the game could equally well have finished as either drawn or as a win for Leeds. The fact that it didn't is not in itself much of a success, although it is always a nice feeling to win a bet. The real achievement was in finding an apparent edge over Interwetten's price for Tottenham. This bet may have won or lost, but if it could be repeated 1,000 times with a £1 stake each time, the forecast analysis would predict a profit of £23 from 465 wins.

Back-Testing a Sports Prediction System

Before introducing any betting system into a betting portfolio, it should be tested. Here, the goal supremacy rating system successfully identified a value bet on Tottenham, which won. One winning bet, however, provides no measure of a profitable system. To ensure that we have one, any system should be tested over a much longer series of matches, for

[23] 2.2/2.15 (bookmaker's odds divided by fair odds) = 1.023

example over the course of a full season, and preferably before any real money is introduced.

Table 4.5 shows the results of a hypothetical betting record using the recent goal supremacy rating system to identify value home wins for English league games played during the 2001/02 season. A total of 1,746 games were given a match rating, with a team's first 6 games obviously ineligible for rating. Where an edge was found, a unit stake was placed. It might be argued that matches with extreme ratings should be avoided for betting purposes, since the very limited quantity of historical data on which their prediction rests will obviously introduce a greater degree of uncertainty. Conversely, forecasts for ratings closer to the central or median value of 0 are more reliably defined by the best-fit equation in Figure 4.3. Profit analyses contrasting the betting application of 4 different match rating ranges are therefore described. Finally, a comparison of average odds with maximum available odds from 6 different bookmakers is made.

Table 4.5. Profit analysis for the goal supremacy match ratings forecast model, home wins

	All ratings	**Ratings -10 to +10**	**Ratings -5 to +5**	**Ratings -2 to +2**	**All home wins**
Number of bets	526	459	330	171	1746
Profit from average odds	-14.48	-6.94	+2.92	+9.67	-141.76
Yield from average odds	-2.75%	-1.51%	+0.89%	+5.66%	-8.12%
Profit from best odds	+11.07	+16.32	+17.65	+17.32	-65.20
Yield from best odds	+2.10%	+3.56%	+5.35%	+10.13%	-3.73%

The reader may notice that any mention of strike rate or win percentage is omitted from Table 4.5. This is not accidental and is designed to focus the attention on the more important issue of return or yield. Value betting is all about securing better than fair odds from the bookmaker. It is not about maximising the number of wins, although there are other grounds, explored later in the book, for why one may wish to do so. The concept of yield is developed in the next chapter. For now, the reader may understand it to be the returned profit divided by the total stakes outlay, expressed as a percentage.

The first point to notice from the betting summary is that, provided we take the best odds, our rating system returns a profit. This is limited to a 2.10%

yield for all ratings, but becomes progressively higher for the more restricted ranges. For matches rated between -2 and +2, over £1.10 is returned for every £1 stake. This compares to a -3.73% return betting on every home win, and -8.12% if only the average odds are taken.

Unfortunately, the record for away wins (Table 4.6) is not as successful. In fact, it performs significantly worse than if a punter simply bet on every away win blindly, where he may expect to lose by the equivalent of the bookmaker's overround.

Table 4.6. Profit analysis for the goal supremacy match ratings forecast model, away wins

	All ratings	Ratings -10 to +10	Ratings -5 to +5	Ratings -2 to +2	All away wins
Number of bets	407	332	217	98	1746
Profit from average odds	-95.55	-109.62	-90.27	-43.77	-295.46
Yield from average odds	-23.48%	-33.02%	-41.60	-44.67%	-16.92%
Profit from best odds	-61.01	-82.47	-72.90	-38.00	-178.49
Yield from best odds	-14.99%	-24.84%	-33.59%	-38.78%	-10.22%

It is entirely plausible that the inherently greater uncertainty attributed to the away win forecasting equation may account for its failure to offer a profitable forecasting model. It should be remembered that the best-fit equation for the relationship between match rating and away win expectancy failed to account for as much as one quarter of the variability in the historical results. For the home wins relationship, this was only one eighth. Also feasible is the proposition that the away win betting record for the 2001/02 season was anomalous, and unrepresentative of a longer-term perspective. Remember, the ratings equations used to predict results from the 2001/02 season were developed from data that did not include results from that season. Of course, the converse may be true of the home wins record, which may have outperformed itself during the season under investigation. Unfortunately, this is just speculation, verifiable only by increasing the length of the betting record to 2 or even 3 seasons.

Perhaps the most likely but least palatable indication is that this rating system simply fails to offer a successful and profitable forecast model for match prediction. This is not to say that the analytical methods reviewed in this chapter are unsuitable, rather that we might actually need to find a better system of rating matches. Many rating system models, the goal supremacy forecast model included, may simply be replicating what we, and more importantly the bookmaker, already know, making it unfeasible to beat the odds on a regular basis. The key to developing a successful betting system based around the principles of value analysis is to find a forecast model that is better able to describe the variability in match results than those methods employed by the bookmaker. This is no mean task, for it essentially requires one to make the unexpected more predictable. To accomplish this, most experienced punters will complement any quantitative analysis with a more selective, qualitative and in-depth study of a forthcoming game. Only after this will they decide whether or not to place a bet.

Before closing this chapter, the reader's attention should be briefly drawn to the returns for home wins and away wins attributable to blind betting, that is, on every available match. From Tables 4.5 and 4.6 we can see that the yields are -8.12% and -16.92% for home win and away win betting respectively. These figures are equivalent to hypothetical profit margins for the bookmaker of 8.84% and 20.37%, and may be compared to the typical singles overround of 12% for a full match book. We speculated in Chapter 3 that bookmakers might generally be meaner with the higher (away win prices) than they are for their lower (home win) odds. These figures add further weight to that conviction. In the final chapter the evidence for a favourite–longshot bias will be reviewed and a case made for constructing a betting portfolio for the most part around odds-on prices. For now, we can be fairly confident that the shorter odds will generally be offering less of a disadvantage to the punter, in football at least, and provided also that a successful forecasting system can establish an edge, a potentially better opportunity of making a regular profit.

Sports Betting and Risk Management

Why Think about Risk?

Sports betting is about managing probabilities, probability is about chance, and chance is about risk. Betting, like other forms of financial investment, amounts to speculating on the future with a view to making a profit. With the exception of a few favourable arbitrage bets, however, no speculation is completely free of risk. There is always a chance that a wager can lose, and for most forms of fixed odds betting this loss is absolute, in the sense that the investment risked on the speculation is forfeited completely.

Look up the antonyms for "gamble". Most likely you will see some of the following words: invest, safeguard, plan, insure. Gambling is often considered to be a mug's game, a poor man's pastime. Investment, by contrast, is regarded as a discipline for the well-to-do. In the opening chapter of this book, however, we discovered that gambling and investing are really two sides of the same coin. Both share the same aim – to make money – and both involve an element of uncertainty. Perhaps the real difference between investors and gamblers is the way in which each thinks about risk. The majority of skilled investors consciously deal with risk all the time, managing it through investment portfolios and with professional financial advice. Many gamblers, in comparison, impetuously thrilled by each and every win, rarely give the subject a moment's thought. Although sports bettors undoubtedly face greater hurdles in seeking a profit, this division of attitude may go some way to explain why so few punters manage to beat the bookmaker on a regular basis.

Rather than criticise people for gambling, however, would it not be better to instruct them qualitatively and quantitatively about risk? Understanding more about the subject, one is better prepared to decide what to do about it. Certainly everyone understands that "taking a risk" means "taking a chance", but a risk or chance of what is often not so clear. The processes of identifying, analysing and assessing, and mitigating risk are generally characterised as risk management, for which there are 4 key questions.

1. What is the hazard?
2. If the hazard occurs, how bad will it be?
3. What is the chance of the hazard occurring?

4. Can the risk level be reduced?

From a gambling perspective, the most significant hazard a punter will face is a total loss of his betting reserves or bankroll. We may be more familiar, at least on a bet-by-bet basis, of giving consideration to the chances of a win. Instead, we should learn to think more about the probabilities of losing, perhaps even to calculate the odds of a worst-case scenario, and further, to take steps to reduce the chances of experiencing it. If we know how likely we are to lose all of our betting funds, we can choose whether to adopt a different approach. This, in a nutshell, is the process of risk management.

With that in mind, there are 3 important principles that are fundamental to answering these questions. The first of these is that one should accept no unnecessary risks. For a sports bettor, this means never risking what you want to win, but rather, only what you can afford to lose. Unlike many life-impacting decisions, sports betting should be viewed as a recreational diversion for all but the most professionally dedicated gamblers. Success should be treated as a supplementary income. Secondly, one should seek to take informed risk decisions regarding any aspect of sports betting – more about these in a moment. The following chapters of this book attempt to acquaint the reader with some of the key issues of concern and judgements to be made, in order to put together the safest strategy for fixed odds sports betting. Finally, once all the questions have been answered, a punter should choose whether to accept the risks where the benefits outweigh them. If he is unwilling to do so, then perhaps sports betting is not for him. On the other hand, if he learns to live with risk and manage his losses in an analytical fashion, sports betting can potentially be as rewarding as any other form of investment.

Aspects of Risk Management for Sports Betting

Serious fixed odds sports betting demands a lot of risk taking; not in the sense of jeopardising one's capital, but in terms of repeatedly adopting a position regarding the likelihood of the outcome of a contest. In plain English, this means placing a lot of wagers. With the exception of some Asian handicaps and a few tied match bets, a losing fixed odd bet involves a full loss of stake. Naturally, then, one would be foolish indeed to risk all of one's available bankroll on just one wager. Instead, the gambler spreads the risk across a series of bets, with each stake a small proportion of the total funds at his disposal.

For the sports bettor then, there are two central aspects to any repeated risky situation. Firstly, can you find value in the odds and create an edge for your wager? After 1,000 £1 bets, do you have more or less than £1,000? Of course, every individual fixed odds bet, leaving aside Asian handicaps and tied bets for the moment, either wins or loses. Nevertheless, for each one it is possible to identify a profit expectancy (P), expressed in terms of the bookmaker's odds (o), the size of the stake (s) and the expected or fair probability of a win (p), as in the following equation:

$$P = sp(o-1) - s(1-p)$$

Put simply, for a unit stake, the profit expectancy is the amount one expects to win multiplied by the true probability of winning, less the amount that can be lost, multiplied by the true probability of losing.[24] Try inserting figures into the equation, using decimal odds and probabilities as a fraction of 1. If the fair odds (1/p) are greater than those of the bookmaker, our profit expectancy, if we have bet, will always be negative. In this case we have overestimated the chance of a win and failed to secure an edge. On the other hand, if we have value in the bookmaker's odds, o will be greater than 1/p, and P will always be positive. When o = 1/p, P = 0.

We can simplify this equation by substituting 1/p for f, the fair odds. Now:

$$P = \{\tfrac{s}{f}(o-1)\} - \{s(1-\tfrac{1}{f})\}$$

Just as bad as before; but cleaning up the right-hand side gives:

$$P = \tfrac{so}{f} - s$$

When o > f, P is positive; when o < f, P is negative; and when o = f, P = 0.

[24] We know, of course, that the true probability of winning and losing can never be calculated exactly before an event, only estimated by a forecasting model, or evaluated retrospectively after many similar contests.

We can also express the profit expectancy instead as the return expectancy, R, where the return is just stake plus profit. Hence:

$$R = \frac{so}{f}$$

Where we have value, our return expectancy is greater than our stake; where we do not, it is less. Identifying the ratio of o/f, the bookmaker's odds against the fair odds, is the key to successful value betting. Greater than 1, and we have secured an edge; less than 1 and we will ultimately lose over the long term. As we saw in Chapter 3, the ratio of the bookmaker's odds to the true odds quantifies the punter's edge.

What has all this got to do with risk? Well, winning systems must have positive expected value, or an edge greater than unity. It is not possible to devise mathematical betting systems that will provide profits in the long run unless the average return is favourable. Attempting to recoup losses through doubling-up after losing bets, for example, will eventually fail in the long run, despite possible short-term gains, because the eventual large loss will more than wipe out the small gains along the way. The bottom line is: beat the odds or the odds will beat you.

With that in mind, the second important consideration for managing sport betting's risks is: how much should a punter wager? Chapter 7 is entirely devoted to this subject, to encourage the punter to think analytically about his staking plans from the perspective of protecting his betting reserve or bankroll. A punter may have an edge, but this does not absolve him from potential misfortune. The key to sports betting risk management, then, is really about secure money management.

Risks and Returns for Fixed Odds Betting

The Betting Bank

The aim of any punter is to make his betting bank grow. A betting bank or bankroll might be reasonably described as an amount of capital that has been set aside exclusively for the purposes of betting. This should never be more than a punter can afford to lose. To decide what is reasonable to set aside for the purposes of betting, one should pose a simple question: *If I lose my bankroll, will this impact on my ability to pay my bills*? If the answer is yes, then reduce the size of the bankroll, or in the extreme, do not gamble at all.

Every time a punter places a bet, he stakes a small proportion of his bankroll, the size of which may or may not vary, according to the punter's preferences and judgements about staking, an area that will be investigated in detail in the next chapter. Obviously, the smaller the stake as a proportion of the total bankroll, the less significant the impact after either a win or a loss. In terms of risk management, smaller stakes involve less risk of losing the bankroll entirely. For a punter with an edge, the chances of ever losing it entirely are diminished. For a punter without one, that misfortune will unfortunately be unavoidable, but it will not come around as quickly. In terms of growing the bankroll, smaller stakes will naturally contribute smaller profits, and growth, if a betting edge is accessible, will take longer.

Traditionally, the size and growth of the bankroll has been viewed as the primary measure of betting success. Frequently, claims are made by sports advisory services about the amount of profit they can generate for their members. "A guaranteed 90% profit over the course of one season", "288% during the 2001/02 season", "500% over the past 3 seasons" are just a few claims that have been made. Some claims may be fraudulent. For those that are genuine, they still provide little or no meaningful information about how such profit was achieved, how large the stakes were and consequently how great the risks were. To begin to answer these questions, two key pieces of information are required: the yield, sometimes called either the return on investment or profit over turnover, and the betting rate, or number of bets over a specified time.

Understanding and Managing Profit Growth

In finance, the yield is defined as the profit obtained from an investment, and more specifically the annual rate of return expressed as a percentage. In betting, similarly, the term may be used to describe the ratio of profit to the total amount wagered, more commonly known as the profit over turnover or sometimes return on investment. Betting yields, of course, cannot be fixed in advance as they can for dividend payments, which are paid on the investment of an initial lump sum, and will fluctuate continuously as the bettor experiences intermittent periods of success. Furthermore, a prosperous betting system should allow a punter to recycle profits already won into future wagers, ensuring that much of the initial betting capital is not actually used. For the value bettor, however, the betting yield provides a much more meaningful indicator of success, because it can be related directly to the size of his edge over the bookmaker's odds. Whether or not a punter has an edge for a bet, and if so how large it might be, can only be estimated by applying the principles of value betting and forecasting. Nevertheless, the yield from a succession of bets already settled does provide a good idea of the average advantage a punter has secured. If he returns £1,100 from one hundred £10 singles, he has, on average, gained a 10% edge over the bookmaker for each of these bets. If this return had instead been achieved from doubles, the edge for each selection, which comprises a double, will on average be close to 5%, whilst for trebles it would be a little over 3%.[25] A return of £900, on the other hand, is evidence that he is struggling to beat the odds. For many punters a 10% loss on turnover is not uncommon. It is no coincidence that this is very similar in magnitude to the bookmaker's typical profit margin expressed through the overround.

The betting yield, then, provides an objective and comparative measure of the strength of a betting system. Nevertheless, a gambler, not surprisingly, wants to identify how much money he can expect to make during a specified time. Thinking about his betting yield, however, encourages the punter to set targets, to understand and manage his profit growth and to analyse his betting strategy. A common and ambitious target is the doubling of a bankroll during the course of a year or season. Knowing his betting edge, through an examination of previous wagers, permits the gambler to estimate both the number of bets he will need to place and the

[25] Since $\sqrt{1.10} = 1.0488$ and $\sqrt[3]{1.10} = 1.0323$

size that his stakes should be in order to realise his goal. From this, it is possible to assess his risks.

The number of wagers required to double a bankroll of 100 points[26] for a series of betting yield–stake-size relationships is shown in Table 6.1. For this analysis, a stake size of a fixed magnitude, equivalent to a specified percentage of the initial starting bankroll has been assumed. Of course, by the time a bank has grown by 50%, a stake equivalent to 3% of the initial bankroll (3 points) will be only 2% of the new bankroll at this time. Percentage bank staking and other monetary management strategies will be examined in the next chapter. This staking plan is commonly referred to as level staking. Two hundred level stakes of 5 points each, for example, are needed to double a bankroll from 100 to 200 points if the punter has an average betting yield of +10% for each bet.

Table 6.1. Relationship between singles betting yield, level stake size and the number of bets required for a doubling of bankroll

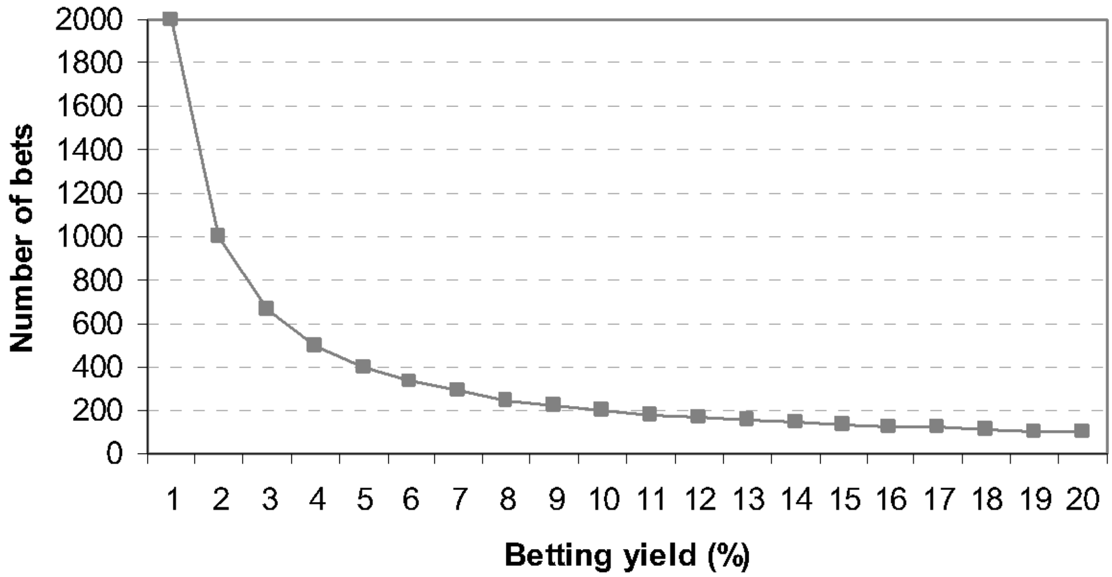
Yield	**Level stake size as a percentage of initial bank**									
%	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1	10000	5000	3333	2500	2000	1667	1429	1250	1111	1000
2	5000	2500	1667	1250	1000	833	714	625	556	500
3	3333	1667	1111	833	667	556	476	417	370	333
4	2500	1250	833	625	500	417	357	313	278	250
5	2000	1000	667	500	400	333	286	250	222	200
6	1667	833	556	417	333	278	238	208	185	167
7	1429	714	476	357	286	238	204	179	159	143
8	1250	625	417	313	250	208	179	156	139	125
9	1111	556	370	278	222	185	159	139	123	111
10	1000	500	333	250	200	167	143	125	111	100
11	909	455	303	227	182	152	130	114	101	91
12	833	417	278	208	167	139	119	104	93	83
13	769	385	256	192	154	128	110	96	85	77
14	714	357	238	179	143	119	102	89	79	71
15	667	333	222	167	133	111	95	83	74	67
16	625	313	208	156	125	104	89	78	69	63
17	588	294	196	147	118	98	84	74	65	59
18	556	278	185	139	111	93	79	69	62	56
19	526	263	175	132	105	88	75	66	58	53
20	500	250	167	125	100	83	71	63	56	50

[26] The magnitude of a point in betting can be whatever the punter chooses it to be. For some, it will be £1, for others, £10, £100 or even £1,000.

It is clear from Table 6.1 that the number of bets required to double a bankroll increases as the betting yield falls towards zero. In fact the bet number is inversely proportional to the betting yield for a particular level stake size such that, for a halving of the betting yield, double the number of bets are required to achieve the same bankroll growth. This is illustrated in Figure 6.1 for the 5-point stake series. Similarly, for a specific betting yield, the number of bets required to double a bankroll is inversely proportional to the magnitude of the level stakes. The following equation describes the simple relationship between betting yield, Y, bet number, N, stake size, S and starting bankroll, B for this level stakes model, where F denotes the final bankroll after the betting sequence and Y is expressed as a percentage.

$$F = B + (YSN/100)$$

Figure 6.1. The betting yield – bet number relationship for bankroll doubling, with 5-point stakes and initial bankroll 100



Obviously, fixed odds sports betting is never this simple. For an unsuccessful punter, the relationship is really quite meaningless, since any significant increase in bankroll size will probably never happen. A successful punter, however, will probably not secure a genuine edge for every bet, and for those wagers where he has, they will certainly not all be the same. Moreover, some bets with genuine value may still lose, whilst those that probably never had value may win. Nevertheless, this analysis does allow a successful value bettor to introduce an element of organisation and structure to his betting strategy, allowing him to predict his future profit growth, and to make informed judgements about the choice of his stake sizes, the number of bets he will place, and the time it will take to achieve his designated goals. Much as a match rating, quantified from historical data, can be beneficial in predicting the outcome of a sporting event, so knowledge of a foregoing record of bets can provide an idea of a punter's profit expectancy for his forthcoming wagers. Equipped with this information, he can begin to identify the risks his strategy will encounter.

Quantifying the Risks

Studying the data in Table 6.1, a punter might wonder what point there would be in accomplishing in 1,000 bets what can be achieved in 100, merely by increasing the stake size by a factor of 10. The justification for taking longer, of course, is minimising the risk. Put frankly, the larger the size of the stakes as a proportion of the bankroll, the greater the chance of "bankruptcy", or a total loss of initial betting resources, if things go wrong. Five consecutive losing bets at £20 each, for example, would eradicate a bank of £100. If the stakes had instead been £5, the punter could have afforded another 15 losses before bankruptcy. To most punters, this will seem intuitively obvious, yet it is surprising how many still insist on using stake sizes that a proper risk assessment would consider to be entirely unacceptable. The relationship between bankruptcy risk and stake size may be considered further by means of the following, rather unlikely, example.

A bookmaker has decided, generously, to offer odds of 11/10 for throwing tails during each flip of an unbiased coin. His challenge to Matt and Ian is for them to win £100, using a starting pot of £100, with a maximum of 1,000 flips of the coin and with a fixed stake size of their choosing for each wager. Naturally, at such odds, both Matt and Ian will back tails every time they bet. Ian is controlled and is risk-averse. Matt is impetuous and a big risk taker. Ian decides to stake £2 on every flip of the coin, with a view to winning £2.20 for every tails and losing £2 for every heads. He knows that because the odds are in his favour he can expect, on average, to gain 10 pence for each throw, and that the chances of him losing £100 must be very slim indeed. Using F = B + (YSN/100), he calculates that it will take him approximately 1,000 flips of the coin to reach the target. He will have to give up Sunday morning to accomplish the task, but for £100 he reckons it's probably worth it. He might not quite make it to £200, but prefers to fall short of the target than to risk losing his starting pot. Matt, on the other hand, can't be bothered hanging about. He wants to get down to the pub in time for the Liverpool–Manchester United game. "I'll have one flip of the coin, and stake the whole lot," he says to himself. "If it's tails, drinks are on me, if not, well, no matter, it's only money. If you can't take a chance in life, what can you do?"

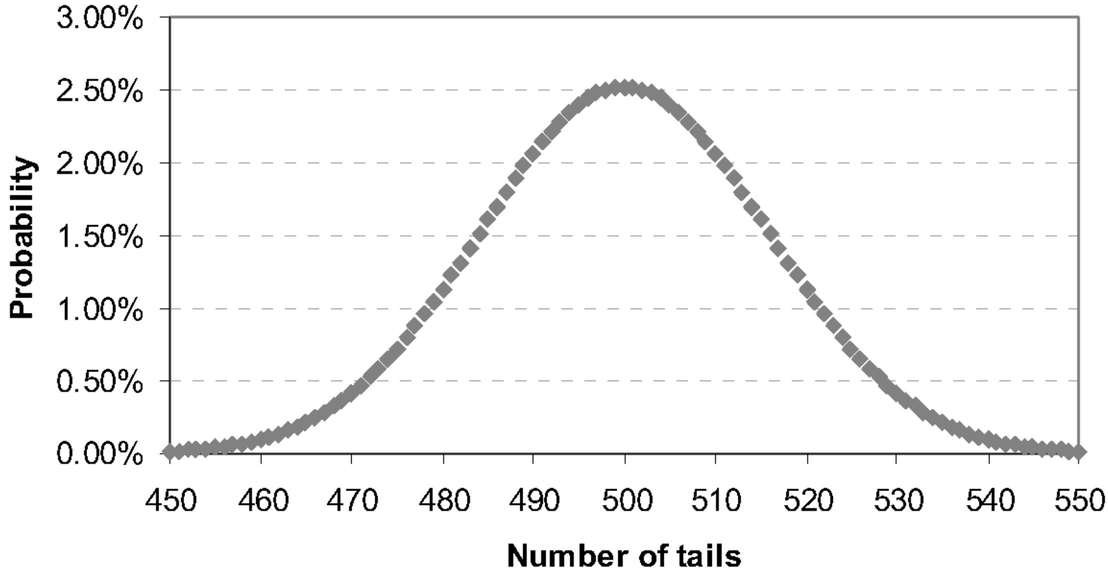
It is immediately obvious that Matt is taking a big risk here. If he throws a tails, he wins the challenge; if not, he's broke and that's it. Consequently, he has a 50% chance of losing all his initial capital, a pretty sizeable risk, even though theoretically the odds are in his favour at 11/10. Meanwhile, Ian is slowly accumulating his profit, losing approximately 50 in 100 bets but coming out ahead because he also has the 5% edge. To become bankrupt the number of heads thrown would need to significantly outnumber the tails. By how many will depend on the extent to which the bankroll had grown beforehand. Exactly how large Ian's bankroll will be after 1,000 throws cannot be known in advance, but it can be estimated by means of the binomial distribution.

The binomial distribution can be used to calculate exactly the probability of throwing a number of tails, "r", during a sequence of flips of a coin, "n", every one independent and with a constant probability of success. The prefix bi in binomial refers to the fact that there are two possible outcomes for each trial, in this case heads or tails. The calculation of binomial probabilities exploits the same mathematics that punters use to count permutation bets discussed in Chapter 2. Each binomial probability is given by:

$$({}^{n}C_{r})(p^{r})((1-p)^{n-r})$$

where ${}^{n}C_{r}$ describes the number of ways of throwing r tails from n flips of the coin, given by n!/[r!(n-r)!], and p is the probability of throwing tails during any flip of the coin, which of course is 0.5 (or 50%). To avoid a lot of unnecessary hard work, Excel's binomial distribution function can perform the calculation for us, using =BINOMDIST(r,n,p,false). The chance of throwing exactly 500 tails from 1,000 flips of the coin, and winning £100 at £2 stakes, for example, is 2.52%. This, not surprisingly, is the most likely of outcomes, as Ian had calculated, with the probability of throwing fewer or more tails less than this, as illustrated by Figure 6.2, which nicely reveals the bell shape of the binomial distribution.

Figure 6.2. Binomial probabilities for throwing r tails during 1,000 coin flips

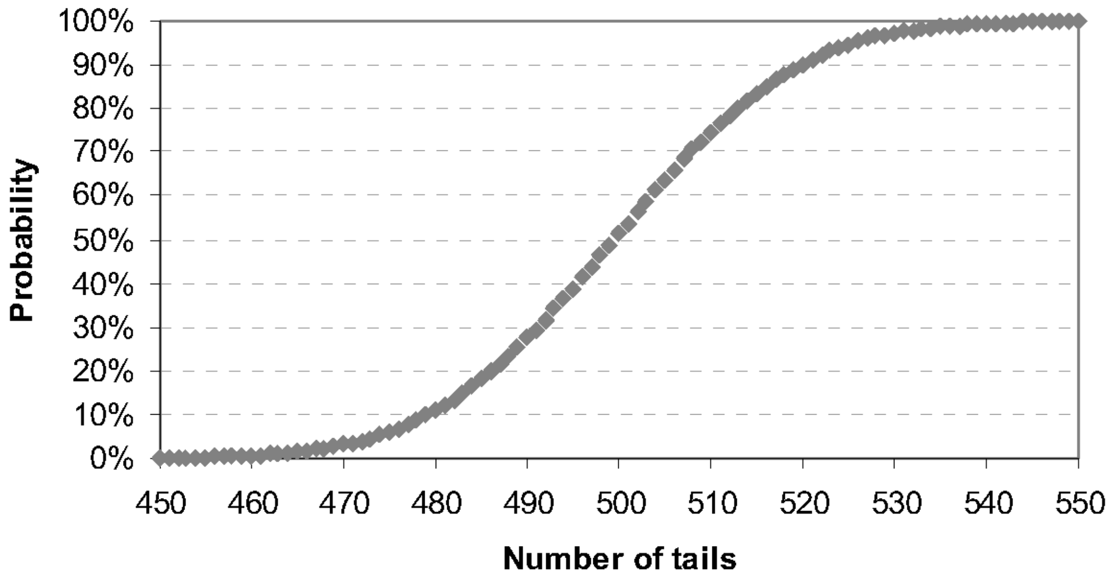


The binomial probability distribution in Figure 6.2 describes the range of all possible heads–tails combinations during 1,000 flips of a coin, from no heads and 1,000 tails through to 1,000 heads and no tails, although only the most likely combinations between 450 heads and 550 tails and 550 heads and 450 tails are shown. By extension, it describes the range of all mathematically possible bankroll sizes, from £-1,900[27] to £2,300, since for each tails the odds are fixed at 11/10. The most probable size of Ian's bankroll after 1,000 flips of the coin is £200, or a profit of £100.

Figure 6.3 shows the cumulative binomial probability distribution, which describes the probability that there have been up to and including r number of tails thrown. Again, Excel can make life easier, with =BINOMDIST(500,1000,0.5,true). The final part of the expression informs the computer to calculate the cumulative rather than the discrete binomial probability. There is a 51.26% chance of throwing 500 or tails or fewer, or a 48.74% chance of finishing with a bankroll higher than £200.

[27] Negative bankrolls are, of course, rather meaningless in a real betting context.

Figure 6.3. Cumulative binomial probability for throwing up to r tails during 1,000 coin flips



It is possible, of course, to lose the bankroll before 1,000 flips of the coin. In the event, Ian could choose to start another bankroll and continue betting, but this rather defeats the object of the exercise. Calculating the exact probability of Ian's bankruptcy using binomial probabilities, therefore, is not straightforward, because it is not initially obvious how to determine either exactly how many times the coin would have been flipped before bankruptcy occurred, and how many more times heads will have outnumbered tails during this sequence. We can see from Figure 6.3 that it is likely to be low, and unquestionably insignificant in comparison to Matt's risk of 50%. Instead, the probability of bankruptcy may be estimated though experimentation, using what is known as a Monte Carlo simulation.

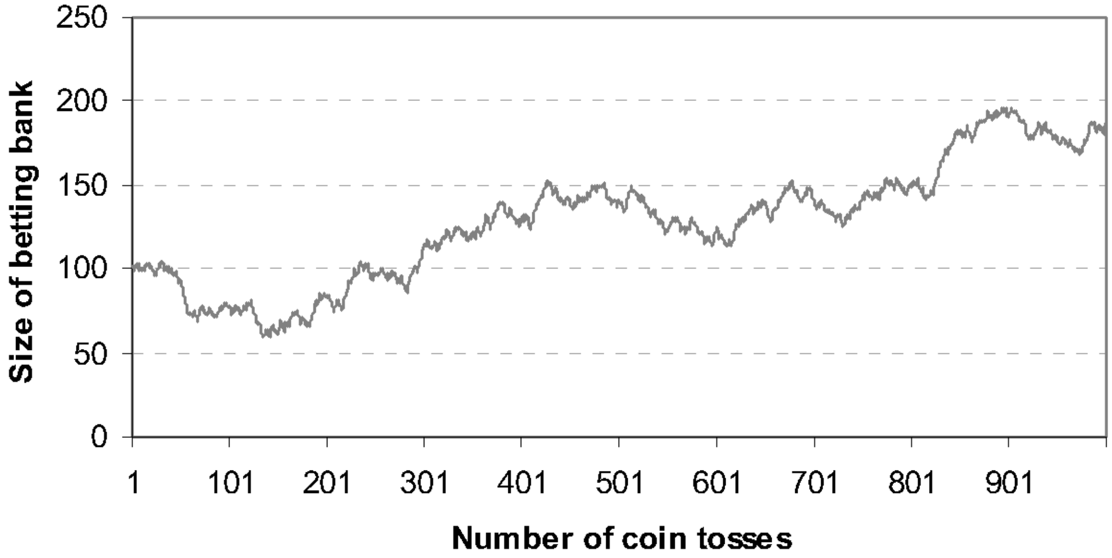
The Monte Carlo simulation derives its name from the casinos in Monte Carlo and uses random numbers to model some sort of a process or system, allowing one to estimate the probabilities of different possible outcomes, which are otherwise too complex to reproduce mathematically. This technique works particularly well when the process is one where the underlying probabilities are known but the results are more difficult to determine. It is particularly suitable for this example, because we know that the probability of throwing a tails is 50%.

There are essentially two parts to developing a Monte Carlo simulation. The first step is to write a program to describe the process or system, using the underlying probabilities to define its boundaries. For the flipping of a coin it is straightforward enough to use a spreadsheet with a random number generator to design a suitable program. In Excel, for example, the function =RAND() outputs a random number between 0 and 1. To simulate the bookmaker's coin-flipping challenge the programmer then informs the spreadsheet to pay out 11/10 multiplied by the level stake size if the random number is less than 0.5, and take away the stake if greater than or equal to 0.5. By repeating this up to 1,000 times, a full betting sequence can be modelled, and a profits growth calculated. The spreadsheet for the first 20 flips is shown in Table 6.2, whilst Figure 6.4 charts the profits growth for a typical sequence of 1,000 throws, with a starting bank of £100 and level stakes of £2.

Table 6.2. The first 20 results for a single Monte Carlo run

Coin flip	Random number	Result	Profit/loss	Bank
1	0.217997	Tails	£2.2	102.2
2	0.91423	Heads	-£2	100.2
3	0.570067	Heads	-£2	98.2
4	0.156843	Tails	£2.2	100.4
5	0.252537	Tails	£2.2	102.6
6	0.808303	Heads	-£2	100.6
7	0.033708	Tails	£2.2	102.8
8	0.839079	Heads	-£2	100.8
9	0.723895	Heads	-£2	98.8
10	0.372519	Tails	£2.2	101
11	0.579545	Heads	-£2	99
12	0.125709	Tails	£2.2	101.2
13	0.599034	Heads	-£2	99.2
14	0.32546	Tails	£2.2	101.4
15	0.250944	Tails	£2.2	103.6
16	0.554632	Heads	-£2	101.6
17	0.261543	Tails	£2.2	103.8
18	0.820935	Heads	-£2	101.8
19	0.616608	Heads	-£2	99.8
20	0.24132	Tails	£2.2	102

Figure 6.4. The progression of Ian's bankroll growth for one model run

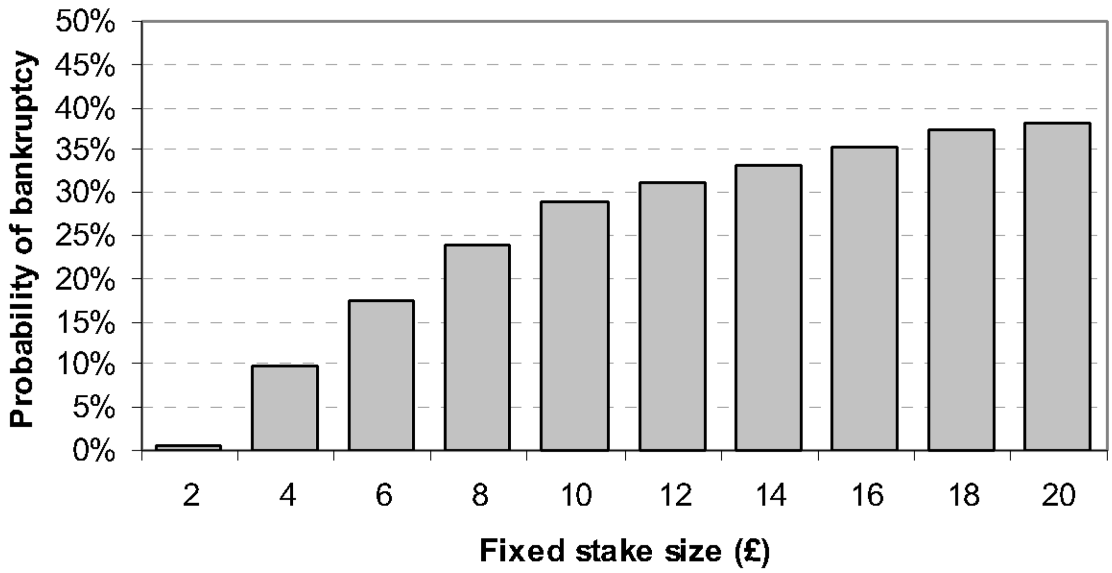


The second stage of the simulation involves running the program many times, outputting the information that we require, and thereby replicating experimentally what is too complex to be defined mathematically. Excel will auto-update any random number when required, generating a completely new profits growth according to the same underlying random conditions. A basic Excel macro can be used to reproduce the simulation as many times as is required. The larger the number of model runs, the more reliable the results will be.

For each run of the model, it is assumed that if Ian reaches £200 before he has flipped the coin 1,000 times, the run is truncated, and the bankroll secured. Similarly, if Ian loses the bankroll before he has flipped the coin 1,000 times, the run is truncated, and the bankroll is lost. For this experiment it is not possible either to recover a bankroll that has been lost or lose a bankroll that has been secured. From 1,000 model runs, there were only 6 occasions when Ian lost his betting bank. Consequently the probability of bankruptcy for Ian is estimated to be only 0.6%!

A Monte Carlo simulation can be run to model the risk analysis for any preferred stake size. Figure 6.5 shows how the probability of bankruptcy during the coin-flipping challenge rises as the level stake size increases. For each simulation, the odds for tails were 11/10 and the initial bankroll was £100. Again, where the £200 target was achieved or the bankroll lost before 1,000 throws were made, the run was truncated.

Figure 6.5. Relationship of level stake size to the probability of bankruptcy in the coin-flipping challenge



It is clear that as stake size approaches the size of the initial bankroll, 100, the probability of bankruptcy progresses, increasingly more slowly, towards 50%. Alarmingly, a punter has nearly a one-in-three chance of bankruptcy where his stake size is 10% of his initial bank. The chance of this prospect remains as high as one in ten for a level stake size of only 4 points. It is only for the relatively small stakes that the risk is reduced to acceptable levels, at least from the perspective of developing a relatively secure investment strategy. Throughout the Internet betting forums, level stakes of 5%, 10% and sometimes 20% of the initial bankroll are advised as suitable staking strategies, even where there is no evidence of yields greater than 10%. Of course, profits may be achieved more quickly but at substantially greater risk of losing one's betting capital. Far better to reduce the stake size, limit the exposure to significant losses, and look for a betting system with a higher turnover of available wagers in order to build the profits, provided of course the betting edge remains intact. Level stakes of 5% are really as high as any punter should go, before thinking about using an alternative to level staking. For an investor it is surely wiser to be in the game long term, growing the bankroll slowly, than to lose early, chasing the temptation of big payouts.

Singles versus Multiples: a Risk Assessment

Despite the greater overrounds, many punters like to increase the number of selections to a wager, attracted by the higher returns. The chances of winning a double, treble or accumulator bet, however, will always be less than for the individual selections which make them. It is not initially apparent, therefore, whether the longer-term return will be superior to singles, and perhaps more importantly, how the longer-term risks will compare. Much will depend upon the edge that a punter can on average achieve for his selections and the preferred size of his stakes.

Bill Hunter, in his book *Football Fortunes*, compares the return expectancy of singles and doubles with varying strike rates, for a series of 100 bets. The analysis is reproduced in Table 6.3. Every selection is priced at evens. Consequently, the price for each double bet must be 3/1. The stake for every single or double is 1 point.

Table 6.3. Return on singles and doubles for 100 one-point bets

Prediction success	Singles		Doubles	
	% winning bets	Profit	% winning bets	Profit
0%	0%	-100	0%	-100
10%	10%	-80	1%	-96
20%	20%	-60	4%	-84
30%	30%	-40	9%	-64
40%	40%	-20	16%	-36
50%	50%	0	25%	0
60%	60%	20	36%	44
70%	70%	40	49%	96
80%	80%	60	64%	156
90%	90%	80	81%	224
100%	100%	100	100%	300

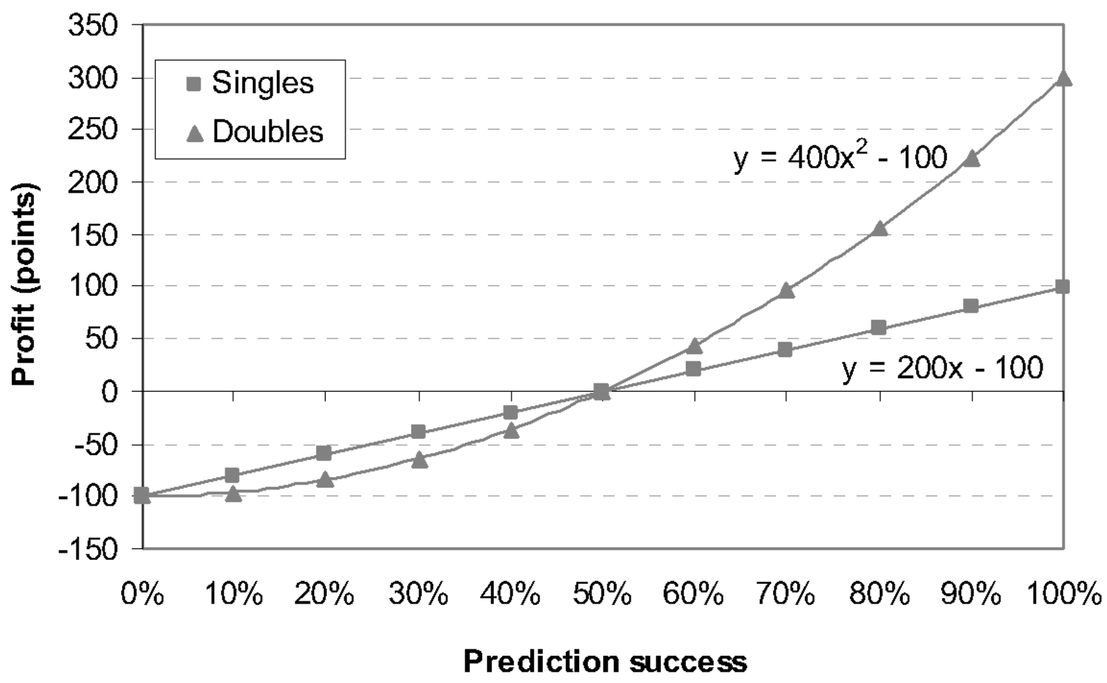
Where the punter fails to gain an edge, both singles and doubles lose money, but the doubles will always lose more, since their disadvantage is the square of that for the two singles considered separately. A prediction success rate of 30%, for example, will return 60 points, or a loss of 40. Meanwhile, the success rate for doubles is only 9% (since 0.3 x 0.3 = 0.09). A winning double returns more profit, but the number of losses is disproportionately higher than for singles, and the final return is only 36 points, or a loss of 64. For singles, the bookmaker's decimal advantage over the punter is 1.667, or 0.5/0.3. For doubles it is 2.778 ($0.5^2/0.3^2$), which is the square of 1.667.

Conversely, the performance of a punter with an edge over the bookmaker will be superior for doubles than for singles. The comparison of profits for doubles and singles is shown in Figure 6.6. For singles, profit is proportional to the margin of success, and increases linearly as the prediction rate improves. For doubles, however, profit is proportional to the **square** of prediction success, and consequently increases faster for the same improvement in prediction rate. For selections priced at evens, Figure 6.6 shows the relevant equations that describe these relationships. The profit for doubles equals the profit for singles when:

$$400x^2 - 100 = 200x - 100$$

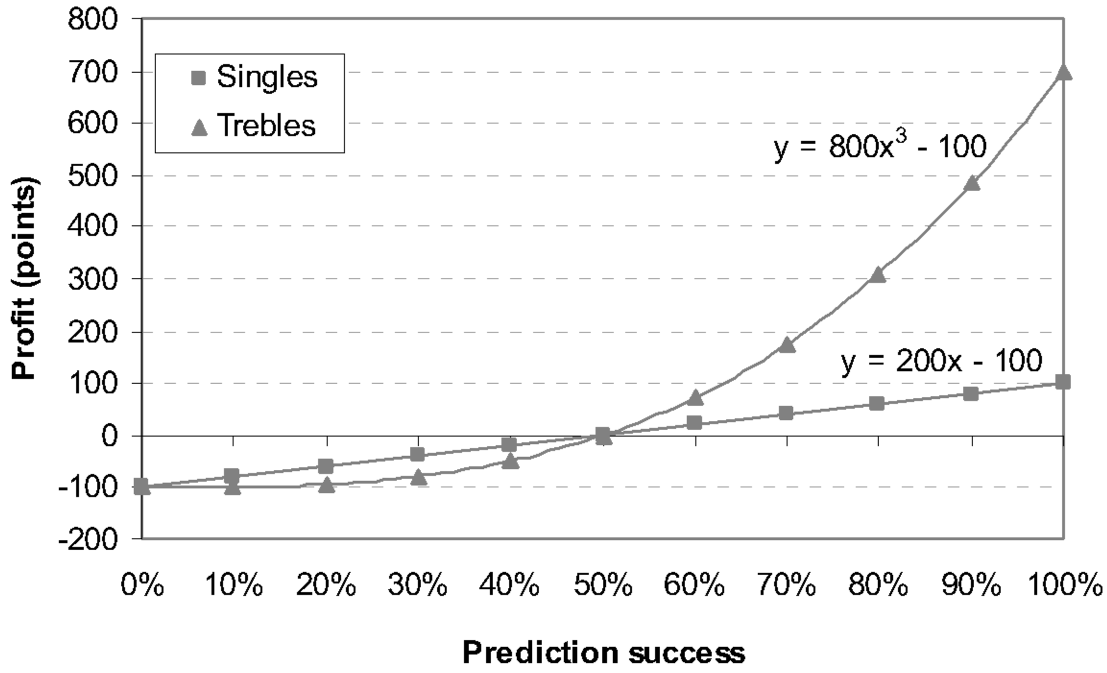
or when x, the prediction rate = 0.5 or 50%. In this case, the profit is 0 since the prediction rate equals the bookmaker's estimation. For either singles or doubles the punter will break even in the long run.

Figure 6.6. The relationship between profit and prediction success: singles versus doubles



Where a punter has considerable confidence that he has achieved an edge over the bookmaker's odds, doubles are theoretically preferable to singles. By the same token, trebles will perform better still, with profit proportional to the cube of prediction success, as illustrated in Figure 6.7. As a general rule, the size of expected betting return will be proportional to the n^{th} power of the betting edge, where n is the number of selections in an accumulator, assuming that each selection has the same edge.

Figure 6.7. The relationship between profit and prediction success: singles versus trebles



A punter should be cautious, however, before imagining that there are limitless profits to be won simply by enlarging the accumulator. Firstly, one must ensure that an edge has been secured for every part of the accumulator bet. Where this is not the case, the increased overround will begin to quickly conspire against the punter, eating into the expected return. Secondly, and more significantly, however, at greater odds, each bet is more likely to lose, regardless of the greater available returns. To be able to benefit from these superior returns, a punter must stake the same for his double, treble, or accumulator as he would for a single. The same is true for higher-priced singles – a multiple bet is really just like a single wager at longer odds, although the overround will be larger. The downside to this strategy will be a considerable increase in bankruptcy risk because of the larger and more frequent losing runs.

Table 6.4 compares the chance of bankruptcy for singles, doubles and trebles for a series of 1,000 bets, where each selection is priced at 11/10, and where the true expectancy is 50%. As for the coin-flipping challenge, the edge per selection is 5%. For this experiment, however, the punter must only terminate his sequence of betting if he loses his starting pot of 100 points. If this is avoided, the sequence continues to 1,000 bets, regardless of how large his bankroll grows. Results are based on a typical 1,000-run Monte Carlo simulation, for a series of level stake sizes from 1 to 10 points. Odds for a double and treble are 4.41 and 9.261, with true expectancies of 25% and 12.5% respectively.

Table 6.4. Risk of bankruptcy for singles, double and trebles with a 5% edge per 11/10 selection

Level stake	**Singles**			**Doubles**			**Trebles**		
	Actual bank	*Expected bank*	*% Bankruptcy*	*Actual bank*	*Expected bank*	*% Bankruptcy*	*Actual bank*	*Expected bank*	*% Bankruptcy*
1	149	150	0.0%	201	203	0.1%	254	258	1.6%
2	197	200	0.4%	296	305	5.1%	378	415	15.5%
3	242	250	3.4%	379	408	12.7%	465	573	28.4%
4	282	300	9.3%	441	510	20.9%	525	731	38.9%
5	317	350	15.2%	491	613	28.9%	571	888	46.5%
6	350	400	20.5%	528	715	35.8%	598	1046	53.2%
7	379	450	24.9%	553	818	42.4%	625	1203	58.0%
8	401	500	29.7%	575	920	47.3%	646	1361	62.2%
9	423	550	33.5%	606	1023	50.4%	674	1519	65.0%
10	445	600	36.6%	629	1125	53.5%	679	1676	68.3%

Modifying F = B + (YSN/100), we can calculate the size of the expected bankroll, that is, the size hypothetically achievable, given the boundary conditions, and assuming a limitless supply of betting capital.[28] In this case, the final expected bankroll after 1,000 bets is given by:

$$100 + \{(1000S)(1.05^n - 1)\}$$

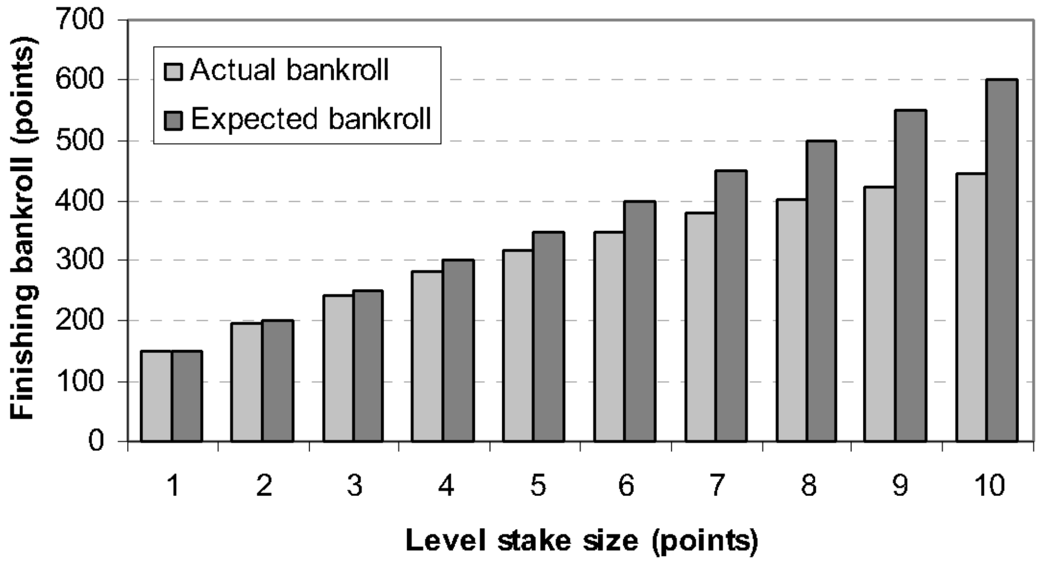
since B, the starting bankroll, is equal to 100 points, N, the number of bets, is equal to 1,000 and Y, the yield, is proportional to the n^{th} power of the

[28] In other words, the bankroll is hypothetically permitted to fall below zero.

betting edge,[29] where n is the number of selections used to make up the multiple bet. S, of course, is the stake size.

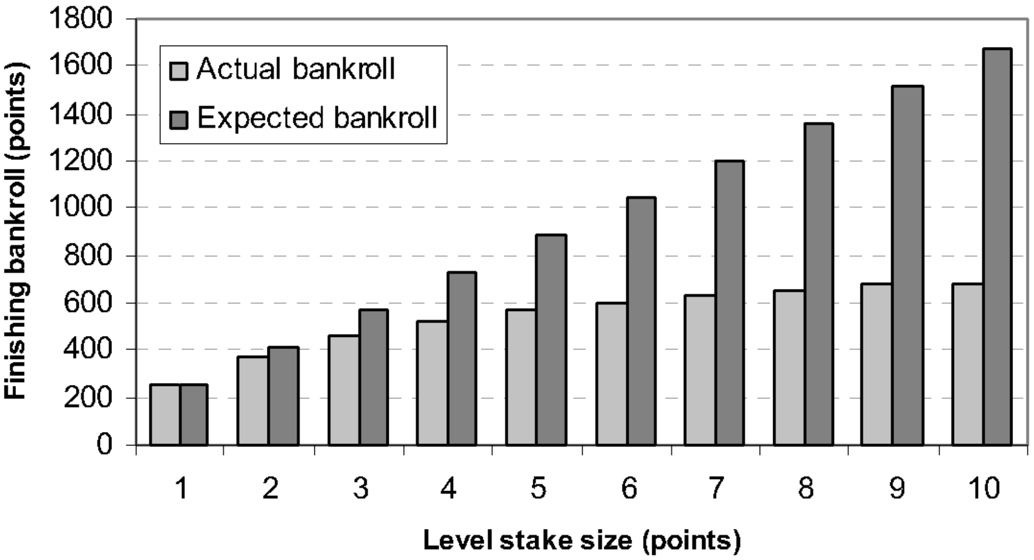
The expected or hypothetical size of the final bankroll after 1,000 bets is logically greater for doubles than for singles, and larger still for trebles, since the size of expected betting return, or yield, is proportional to the n^{th} power of the betting edge. These values should be compared to the size of the actual bankroll, that is, the average size determined by the Monte Carlo simulation. For any run where bankruptcy occurs, the final bankroll will be 0, and will be included as such in the calculation of the average, since in a real betting environment a punter is unlikely to have limitless capital at his disposal. On the contrary, if this were actually the case, a starting bankroll of 100 points would seem a little pointless. The size of the actual bankroll as determined by the simulation, therefore, provides a truer reflection of what a punter can probabilistically look forward to achieving. The more often bankruptcy occurs during 1,000 model runs, the lower the average actual bankroll will be. For singles, doubles and trebles alike, the divergence between the hypothetical bankroll and actual bankroll grows as the level stake size increases, but for the multiple bets this divergence is much greater, as confirmed by Figures 6.8 and 6.9. For 10-point trebles the actual bankroll is as little as 40% of the hypothetical bankroll after 1,000 bets, simply because the risk of losing it is so high.

Figure 6.8. Increasing stake size on average finishing bankroll: singles



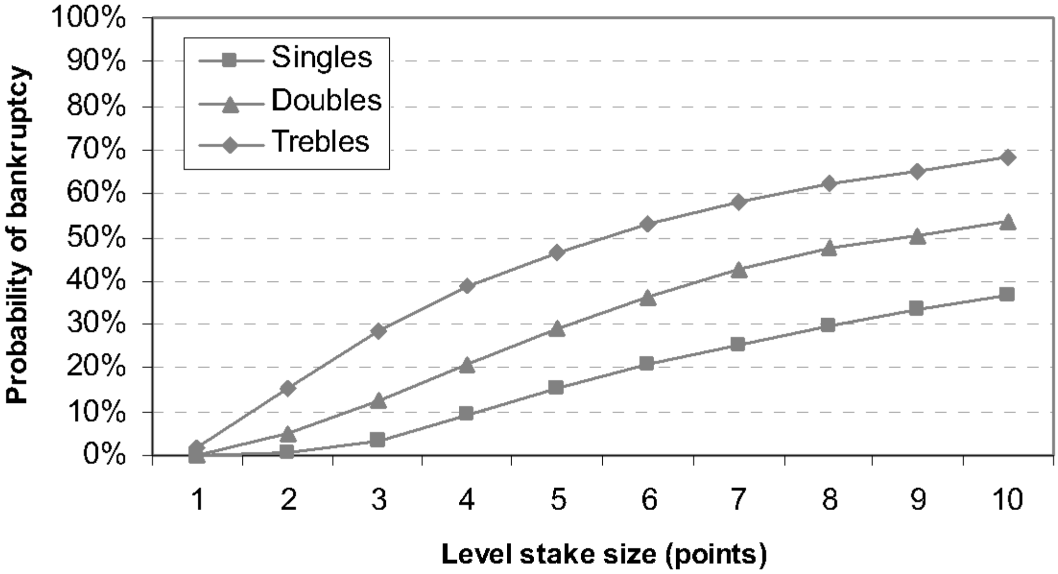
[29] The expected yield for singles is 5%, whilst that for doubles and trebles is 10.25% and 15.76% respectively.

Figure 6.9. Increasing stake size on average finishing bankroll: trebles



Unsurprisingly, the greater the divergence between the hypothetical and actual bankroll size, the higher the risk of bankruptcy during the 1,000-bet sequence. Bankruptcy risk is greater for larger stakes and for larger multiples, as illustrated in Figure 6.10. Wagering 10-point trebles implies nearly a 70% likelihood of bankruptcy for this betting scenario. One-point singles, on the other hand, are virtually as safe as houses. The risks for 3-point trebles are roughly equivalent to 5-point doubles and 8-point singles.

Figure 6.10. Risk of bankruptcy for varying stake sizes: a comparison of singles, doubles and trebles



Clearly, one way to limit risk exposure is to reduce the size of the stakes on multiple bets, or for that matter, on higher priced singles. Unfortunately, this also reduces the potential to gain at the same time. There always exists a trade-off between the impulse to achieve higher profits and the necessity to control risk. Herein lies the essence of gambling. The most important decision a **successful** punter[30] will make concerns the positioning of his betting strategy on the risk–reward scale. Risk takers will win more in the short term, but must accept the greater prospect of severe misfortune. Risk avoiders must embrace a slower rate of return, but can potentially look forward to a longer betting "career". Perhaps here exists the relevant difference between a gambler and an investor; the former accepts risk as just part of the betting experience; the latter, in contrast, seeks to control and reduce its influence through effective management. Whilst there is really no right or wrong way to bet, it may be argued that proactive risk management offers greater long-term security for a fixed odds sports bettor.

[30] A successful punter is here defined as one who has gained an edge over the bookmaker, confirmed through analysis of his long-term betting record.

Staking Strategy and Money Management

What Is Money Management?

There are really two parts to a successful betting strategy. The first is to find a method of predicting sporting events. Chapters 3 and 4 revealed how the principles of value analysis and quantitative forecasting might be used to gain an edge over the bookmaker. Without an edge, no betting system will be successful. Where a punter has achieved one, however, his second task is to plan a staking strategy in order to maximise his profits. The last chapter introduced the idea that merely increasing the stake size or the odds on a bet with a view to securing a greater return is not necessarily the safest way to achieving this goal. The downside to such a basic approach is an increase in bankruptcy risk. Instead, the punter must learn to identify, assess and mitigate the perils associated with his betting strategy through effective risk management. What this actually means in practice is a study of staking strategy and money management.

Whilst only a few per cent of punters actually profit from fixed odds sports betting over the long term, there are potentially many others who could do so, provided they paid better attention to their money management. Establishing a betting edge is a hard-enough undertaking in itself, but too many punters undo their good work by failing to give any serious consideration to this aspect of their betting strategy. Proper money management may mean different things to different people, but common elements include:

1) the application of a bankroll of known size, set aside for the purposes of betting, which if lost would not be detrimental to everyday living;
2) the identification of a suitable staking plan;
3) the maximisation of returns;
4) the reduction and control of bankruptcy risk to acceptable levels.

There exist myriad staking plans, some with very elaborate names, including Martingale, D'Alembert, Oscar's Grind, Steady Drip, Kelly, Rolling Bank and many more. All of them in some way attempt to increase the profits a punter can win above those achievable from simple level staking. In the main they are successful, but for many, with an unacceptable increase in risk.

Broadly speaking, a staking strategy is likely to fall into one of 4 different categories:

1) fixed staking;
2) variable staking;
3) percentage staking; and
4) progressive staking.

Fixed, or level, staking was introduced in the preceding chapter, in which every bet placed is assigned the same stake size, regardless of the betting odds. Level staking forms the benchmark staking strategy against which all others should be compared for profitability and risk evaluation. Many punters see weaknesses with fixed staking and prefer to vary the size of their bets according to various criteria, including their strength and their odds. A bettor, for example, may choose to standardise the amount he wins for every successful bet. Where all the odds are the same, this will amount to level staking. Where the odds differ, the stake sizes will vary. This strategy might suitably be called the fixed profits staking plan.

Percentage (bank) staking, like level staking, standardises the size of the stake, but as a percentage of the size of the current betting bank at the time the bet is placed, rather than as a fixed number of points proportional to the initial bankroll. Kelly staking, which goes further than simple percentage bank staking by seeking to optimise the stake size according the odds and the edge the punter has estimated he has over the bookmaker, is a hybrid of percentage and fixed profits staking. This interesting staking strategy will be examined later in the chapter.

Finally, progressive staking involves increasing or decreasing the stake size after each bet, according to whether it won or lost, with a view to recovering earlier losses or enhancing gains whilst on a winning run. The Martingale and Pyramid staking plans are two examples of loss chasers. There are other, more complex staking progressions, but basically they all share a common goal. This chapter introduces some of the more commonly known staking strategies, and provides a comprehensive risk assessment for each, following the techniques introduced in the previous chapter. Readers with a passion for studying money management may also wish to refer to Stuart Holland's e-book, *Successful Staking Strategies for the Gambler*,[31] upon which much of the risk analysis in this chapter builds.

A common misconception amongst less-experienced punters is that some staking strategies, in particular the progressive staking plans, can turn loss-making systems into profitable ones. This is impossible and represents a misunderstanding of the mathematical principles that underlie such strategies. It can be both mathematically proven and empirically tested, and a detailed analysis in this respect of the weakness of the Martingale plan is presented later in the chapter. In the meantime, the reader should accept that where a punter cannot gain a long-term edge and profit from level staking, he would be unable to profit from fixed odds betting at all.

Staking Plan Simulations

The problem, from a statistical perspective, is that to test any staking strategy one needs to have a reasonable number of results with which to work. To examine its exposure to risk, it is not simply good enough to analyse your own betting record, since this just represents one permutation of all possible betting histories due to the inherent randomness or noisiness in the way sporting results sequence themselves. A profitable record cannot, on its own, define the chance its underlying strategy has of failing. Similarly, a beaten system is not necessarily evidence of a flawed one, although the punter will be very tempted to give it up. To circumvent this difficulty, we must resort to a statistical analysis of the staking plan. Given the complex nature of fixed odds sports betting, with frequently varying stakes and odds, simple probability distributions like the binomial will largely be unable to help us. Instead, the Monte Carlo simulation, introduced in the preceding chapter, lends itself as the most suitable technique.

The staking plan simulations that follow in the remainder of this chapter are based on what might be considered to be a realistic collection of betting sequences. Each sequence consists of 250 win-only single bets, considered to represent a fair reflection, from observation, of the number

[31] http://homepage.ntlworld.com/fcp.online/sss.htm

of bets a typical sports bettor or advisory service might wager during the course of a year or sports season. For each staking plan simulation, information on the following variables was collected.

- The average size[32] of the finishing bankroll
- The variability (standard deviation)[33] in the finishing bankroll
- The probability of bankruptcy
- The probability of not making a profit.

For each staking plan, these variables were examined for a series of betting edges.

- 0.90 (or -10%)
- 0.95 (or -10%)
- 1.00 (or 0%)
- 1.05 (or +5%)
- 1.10 (or +10%)
- 1.15 (or +15%)
- 1.20 (or +20%).

Betting edges less than 1 (or 0%), of course, represent an advantage to the bookmaker. To make each betting sequence more realistic, it was assumed that the advantage (or disadvantage) a punter had over the bookmaker was not the same for each of the 250 bets.[34] For an average betting edge of 1.1 (or 10%), for example, the maximum edge obtained for

[32] The reader should recall that the values calculated for the finishing bankrolls for each staking plan are the result of a Monte Carlo simulation and represent the average of a whole range of possible finishing bankrolls. For such complex betting scenarios it is not possible to calculate the exact chance of each possible finishing bankroll using the binomial distribution. Of course, that is why we are running the simulation, and the values of the average finishing bankroll, as well as the probabilities of bankruptcy and no profit, are thus empirical estimates.

[33] The standard deviation is a measure of how much a set of data varies about its average value. If the spread is large, so is the standard deviation, or σ (the Greek letter sigma). If most values are close to the average, σ is small. In this case, the standard deviation provides a statistical measure of how much the range of possible finishing bankrolls varies about the average size. Its value will be intimately related to the probabilities of bankruptcy and profit making. Greater variability essentially means a riskier staking plan.

[34] The edge for each bet was determined randomly using the binomial distribution. Although the edge for an individual fixed odds sports bet can never be calculated as it can for the flip of a coin, it is reasonable to assume that some bets the punter chooses will hold more value than others (whilst some will possess no value at all), with the long-term average described by a singles level stakes yield. The punter, like the bookmaker, cannot be right all the time.

any bet was 1.36 (or 36%), whilst the minimum was 0.88 (or -12%), with 49.6% of the bets having an edge greater than 1.1. The complete betting edge data set is available in the appendix, whilst the general characteristics for each average betting edge scenario are summarised in Table 7.1.

Table 7.1. Characteristics of the betting edge scenarios used for the staking plan simulations

Average edge	**0.90**	**0.95**	**1.00**	**1.05**	**1.10**	**1.15**	**1.20**
Maximum edge	1.225	1.225	1.205	1.35	1.36	1.44	1.44
Minimum edge	0.66	0.65	0.71	0.77	0.88	0.865	0.935
% bets with value (edge > 1)	11%	26%	51%	68%	85%	91%	98%
Standard deviation	0.089	0.095	0.092	0.104	0.100	0.104	0.093

In addition to the 7 different betting edge scenarios, every staking plan simulation was run for a series of average win expectancies as defined by the bookmaker,[35] where expectancy is equal to the inverse of the bookmaker's decimal odds.

- 0.2 (or 20%)
- 0.3 (or 30%)
- 0.4 (or 40%)
- 0.5 (or 50%)
- 0.6 (or 60%).

The bookmaker's win expectancies were also varied for each bet in the same way as for the betting edges. With the exception of line betting in American sports, most punters bet on a variety of prices, although some may be more predisposed to longer odds than others. A backer of bets at 40/1 may not normally be tempted by odds-on favourites. Similarly, where a punter spends most of his time at the shorter-priced end of the market, he is unlikely to concern himself too much with longshots. These betting preferences are emphasised in Table 7.2, whilst the full data set is again shown in the appendix.

[35] A win here means a winning bet for the punter. A win expectancy of 0.4 (or 40%), for example, means the bookmaker has priced the bet at 6/4 or 2.5. Thus, if the betting edge was 1.1, the true win expectancy for the punter is 1.1 x 0.4 = 0.44 or 44%, with fair odds of 2.273.

Table 7.2. Characteristics of the bookmaker's expectancy scenarios used for the staking plan simulations

Average bookmaker's expectancy	0.2	0.3	0.4	0.5	0.6
Maximum expectancy	0.485	0.645	0.760	0.790	0.895
Minimum expectancy	0.025	0.105	0.080	0.220	0.265
Standard deviation	0.085	0.097	0.104	0.106	0.109
Average odds[36]	6.47	3.76	2.72	2.10	1.73
Maximum odds	40	9.52	12.50	4.55	3.77
Minimum odds	2.06	1.55	1.32	1.27	1.12
% bets with odds > 2.00	100%	96%	84%	50%	18%

The examination of the bookmaker's overround in Chapter 3 hinted that the bookmaker's advantage might be smaller at shorter prices. Arguably the better value is available at this end of the fixed odds market, at least in football betting. Given this, one might expect punters to gain superior edges for shorter odds, winning proportionally more profit than for higher prices. Facing a smaller disadvantage imposed by the bookmaker, however, is no guarantee that a punter will be able to find a superior betting edge overall. Indeed, at the restricted odds-on end of the market, the magnitude of any betting edge is likewise constrained. Accordingly, without more conclusive evidence from real betting histories, such a relationship is difficult to confirm. Thus, it has been assumed for the staking plan simulations that for every bet there exists no significant correlation, or relationship, between the bookmaker's defined win expectancy and the betting edge the imaginary punter was awarded over the associated price. For the very shortest of prices and the higher betting edges, this assumption may be partially invalid, since the betting edge can be no larger than the value of the price itself,[37] therefore limiting the range of possible edges for high expectancy bets. Hence, it was decided that the betting scenarios for an average bookmaker's win expectancy higher than 0.6 would be omitted from the analyses. The correlations between the betting edge and the bookmaker's expectancy are shown in Table 7.3. Values close to 0 imply little or no relationship; a value of 1 implies a perfect positive correlation. No correlation is higher than 0.14 (or 14%).

[36] It should be noted that the average odds is higher that the inverse of the average win expectancy, since it is biased towards the higher prices.

[37] An edge of 1.2 over a price of 1.1, for example, would imply a true expectancy of 109.1%, a logical impossibility.

Table 7.3. Correlation between betting edge and bookmaker's expectancy

Bookmaker's expectancy	**Betting edge**						
	0.9	*0.95*	*1*	*1.05*	*1.1*	*1.15*	*1.2*
0.2	0.026	0.051	0.067	-0.125	-0.046	-0.127	0.077
0.3	-0.057	-0.064	-0.090	-0.029	0.041	0.003	0.137
0.4	0.011	-0.096	0.079	0.045	-0.042	0.070	-0.002
0.5	-0.028	-0.019	0.002	0.067	0.010	0.052	0.009
0.6	-0.008	0.012	-0.017	0.068	-0.027	-0.074	-0.019

Each scenario was run for 6 different staking strategies.

- Level staking
- Percentage staking
- Fixed profits staking
- Martingale staking
- Pyramid staking
- Kelly staking.[38]

For each staking plan, 5 different sizes of stake were compared, the specific size of each stake dependent on the nature and characteristics of the rules of the strategy.[39] For level staking, these were 1 point, 2 points, 3 points, 5 points and 10 points, whilst for percentage bank staking, they were 1%, 2%, 3%, 5% and 10% of the betting bankroll at the time the wager was made. For every simulation, the starting bank was assumed to be 100 points. Where bankruptcy occurred before 250 bets, the simulation was truncated and the final bankroll taken to be 0 points, which was included in the average finishing bankroll calculation. In total, 930 Monte Carlo simulations were processed, each one consisting of 10,000 model runs. This is equivalent to over 2 billion simulated fixed odds wagers!

[38] Kelly staking is dependent upon the punter finding value in the odds, that is, a betting edge greater than unity. Where no value exists, Kelly staking advises no bet. Naturally, a value punter would never choose to back a valueless selection, but Kelly staking, in contrast to other staking plans, explicitly recognises this through the choice of the stake size. Consequently, simulations are theoretically only possible where the average betting edge is greater than 1, although they can be run for those less than 1 where one assumes that the punter has overestimated his advantage, in order to test this influence.

[39] Kelly staking, furthermore, identifies what the hypothetically correct stake size should be for every bet, and therefore no stake size comparisons are made for this strategy.

Level Staking

Level staking is the simplest of staking plans to use. There is only one decision a punter must make: the size of the fixed stake as a proportion of the initial bankroll. This is often quoted as a percentage, but should not be confused with percentage bank staking, which calculates the size of the stake as a proportion of the betting bank at the time the bet is placed. For novice gamblers, level staking should be the first staking plan they consider. Its chief advantage is that it requires no additional thought or calculation, since the bettor knows each time exactly how much he will wager. Its main disadvantage is that it fails to differentiate between different prices, weighting every bet the same. If, for instance, your level stake is £10, why should you have it on both an evens chance and at the same time a 50/1 longshot? How much of a disadvantage this actually represents will be revealed later in the chapter.

Table 7.4.1 to Table 7.4.4 summarises the outputs of the Monte Carlo simulations for level staking. The tabulated results, in sequential order, detail the average finishing bankroll (7.4.1), the standard deviation in finishing bankroll (7.4.2), the probability of bankruptcy (7.4.3) and the probability of not making a profit (7.4.4).

The subsequent paragraphs summarise the main conclusions that can be drawn from the results of the level staking simulation analysis, and provide supporting explanations of how these conclusions have been reached. Where appropriate, accompanying illustrative charts are also provided. The reader should keep in mind that the conclusions for level staking (and those for other staking plans examined later in the chapter) are applicable only in the context of the betting scenarios on which they are based. Every scenario comprises 250 bets and a particular range of betting prices. More or fewer bets, and a wider or narrower selection of odds, will logically influence the size of finishing bankrolls and the probability of bankruptcy. In general, however, the conclusions should offer some valuable guidance to a punter in determining the profitability and failure risk associated with his chosen betting strategy.

Table 7.4.1. Average finishing bankroll (points) after 250 level stake singles

		Bookmaker's expectancy				
Stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	75.3	75.1	75.3	75.1	75.0
	0.95	87.6	87.6	87.7	87.5	87.6
	1	100.5	100.3	100.3	100.1	100.1
	1.05	112.9	112.7	112.8	112.5	112.5
	1.1	125.6	125.2	125.3	125.0	125.0
	1.15	137.8	137.7	137.8	137.5	137.4
	1.2	150.5	150.2	150.4	150.0	149.9
2 points	*0.9*	56.5	53.2	51.9	50.8	50.3
	0.95	77.0	75.9	75.6	75.0	75.3
	1	100.2	100.4	100.6	100.2	100.2
	1.05	125.1	125.4	125.6	125.0	125.0
	1.1	150.1	150.3	150.7	150.0	150.1
	1.15	174.9	175.4	175.6	175.0	174.8
	1.2	200.6	200.3	200.8	200.0	199.9
3 points	*0.9*	47.1	40.7	36.5	33.7	31.2
	0.95	70.4	67.8	65.8	64.0	63.6
	1	98.9	100.1	100.5	100.0	100.2
	1.05	133.5	137.0	137.9	137.5	137.5
	1.1	170.1	174.2	175.8	175.0	175.1
	1.15	207.7	212.2	213.4	212.4	212.2
	1.2	247.4	250.2	251.2	249.9	249.8
5 points	*0.9*	38.2	29.3	23.1	19.1	14.9
	0.95	65.1	59.2	54.3	50.3	48.0
	1	97.2	97.9	98.2	98.7	99.2
	1.05	144.1	153.8	159.5	160.8	161.9
	1.1	194.6	211.5	221.8	223.9	225.0
	1.15	252.9	276.3	286.4	287.0	287.0
	1.2	320.8	343.6	351.2	349.8	349.6
10 points	*0.9*	32.0	22.0	14.7	10.2	6.4
	0.95	59.4	51.7	43.7	38.7	34.0
	1	93.8	93.7	92.5	93.8	93.6
	1.05	157.9	174.4	192.7	201.9	211.4
	1.1	224.3	260.8	300.8	322.7	337.9
	1.15	302.4	369.4	427.7	453.1	468.2
	1.2	420.4	506.6	575.1	591.8	598.4

Table 7.4.2. Standard deviation in finishing bankroll (points) after 250 level stake singles

		Bookmaker's expectancy				
Stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	34.9	25.2	20.1	16.5	13.7
	0.95	35.7	25.7	20.4	16.6	13.7
	1	36.7	26.3	20.6	16.7	13.6
	1.05	37.0	26.6	21.0	16.6	13.3
	1.1	37.9	27.0	21.0	16.7	13.1
	1.15	38.4	27.2	21.2	16.6	12.8
	1.2	39.5	27.7	21.4	16.5	12.4
2 points	*0.9*	59.7	45.2	37.6	31.8	26.9
	0.95	66.5	49.7	40.3	33.1	27.3
	1	72.3	52.5	41.2	33.4	27.1
	1.05	74.0	53.2	42.0	33.2	26.5
	1.1	76.9	54.0	42.1	33.4	26.2
	1.15	78.0	54.5	42.4	33.2	25.6
	1.2	79.6	55.4	42.7	33.0	24.9
3 points	*0.9*	73.0	54.6	45.3	38.2	32.6
	0.95	87.9	67.0	55.7	46.5	39.5
	1	102.0	76.7	61.5	50.3	40.8
	1.05	110.2	80.4	63.6	49.9	39.8
	1.1	117.7	82.7	63.6	50.1	39.2
	1.15	121.2	83.3	63.7	49.8	38.5
	1.2	123.5	83.9	64.1	49.6	37.3
5 points	*0.9*	90.6	64.6	50.7	40.3	31.6
	0.95	118.8	90.8	75.1	63.1	53.7
	1	147.0	115.6	96.7	81.0	67.7
	1.05	171.4	132.9	107.1	84.8	67.4
	1.1	194.3	145.7	111.7	85.6	65.8
	1.15	210.9	150.6	111.0	84.0	64.2
	1.2	221.9	149.6	108.7	83.0	62.2
10 points	*0.9*	121.4	82.5	59.6	43.4	29.1
	0.95	170.5	130.0	104.7	85.7	70.6
	1	221.7	181.3	155.3	136.2	118.2
	1.05	285.9	238.7	206.6	173.9	143.6
	1.1	344.3	289.3	243.3	195.4	150.2
	1.15	398.2	331.4	262.7	198.6	141.7
	1.2	454.9	357.0	255.8	181.8	127.2

Table 7.4.3. Probability of bankruptcy after 250 level stake singles

		Bookmaker's expectancy				
Stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	1.5%	0.2%	0.0%	0.0%	0.0%
	0.95	0.5%	0.0%	0.0%	0.0%	0.0%
	1	0.2%	0.0%	0.0%	0.0%	0.0%
	1.05	0.0%	0.0%	0.0%	0.0%	0.0%
	1.1	0.0%	0.0%	0.0%	0.0%	0.0%
	1.15	0.0%	0.0%	0.0%	0.0%	0.0%
	1.2	0.0%	0.0%	0.0%	0.0%	0.0%
2 points	*0.9*	35.8%	23.1%	14.8%	8.8%	4.6%
	0.95	24.2%	11.2%	4.6%	1.8%	0.4%
	1	16.1%	5.1%	1.2%	0.2%	0.0%
	1.05	8.1%	1.7%	0.2%	0.0%	0.0%
	1.1	4.7%	0.5%	0.0%	0.0%	0.0%
	1.15	2.5%	0.2%	0.0%	0.0%	0.0%
	1.2	1.0%	0.0%	0.0%	0.0%	0.0%
3 points	*0.9*	59.5%	50.7%	45.8%	40.2%	35.1%
	0.95	47.3%	33.1%	23.9%	16.0%	9.4%
	1	36.8%	20.7%	10.5%	5.0%	1.5%
	1.05	24.2%	9.4%	3.2%	0.8%	0.1%
	1.1	16.2%	4.3%	0.8%	0.1%	0.0%
	1.15	10.2%	1.7%	0.2%	0.0%	0.0%
	1.2	5.6%	0.6%	0.0%	0.0%	0.0%
5 points	*0.9*	79.2%	76.1%	75.9%	74.7%	74.7%
	0.95	68.6%	59.9%	53.6%	48.1%	41.2%
	1	59.9%	46.2%	35.6%	25.6%	16.6%
	1.05	46.7%	28.5%	15.7%	7.2%	2.5%
	1.1	37.0%	18.5%	7.0%	1.8%	0.2%
	1.15	27.8%	10.4%	2.5%	0.4%	0.0%
	1.2	18.7%	4.7%	0.6%	0.1%	0.0%
10 points	*0.9*	91.0%	90.7%	92.0%	92.8%	93.8%
	0.95	85.2%	81.5%	79.6%	77.2%	74.5%
	1	80.0%	72.6%	66.3%	59.4%	52.0%
	1.05	69.5%	56.1%	42.1%	30.4%	18.6%
	1.1	62.6%	45.5%	28.4%	15.8%	6.9%
	1.15	54.9%	35.0%	17.0%	7.4%	2.1%
	1.2	44.2%	23.4%	7.5%	2.0%	0.2%

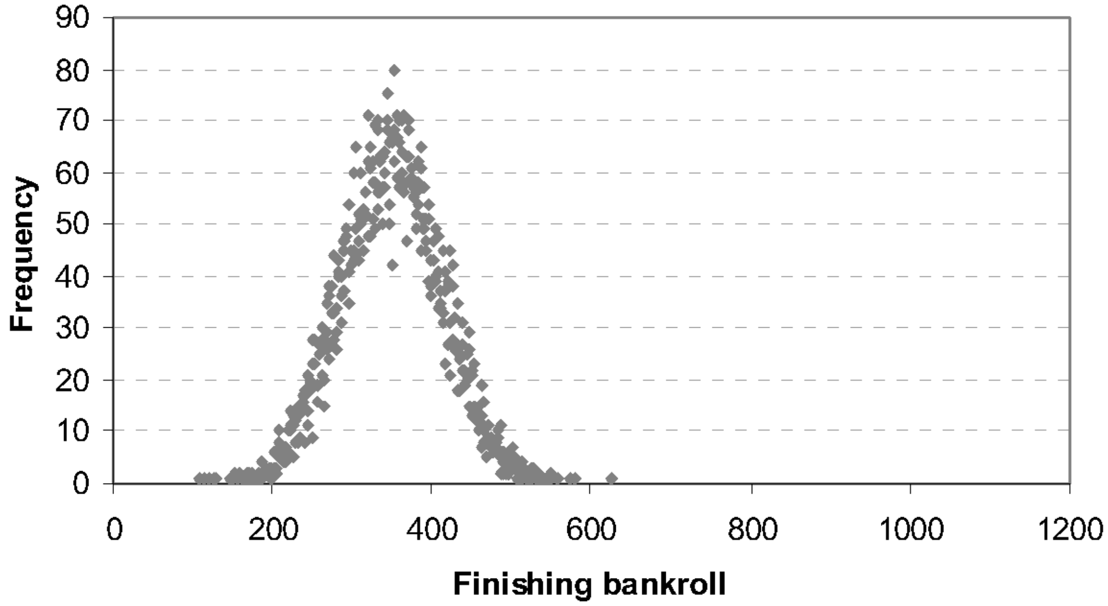
Table 7.4.4. Probability of not making a profit after 250 level stake singles

		Bookmaker's expectancy				
Stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	76.4%	83.8%	89.2%	93.1%	96.4%
	0.95	64.8%	68.9%	73.1%	77.3%	81.7%
	1	50.7%	50.6%	49.5%	50.2%	50.2%
	1.05	37.5%	31.8%	27.3%	22.4%	17.5%
	1.1	25.9%	17.4%	11.5%	6.8%	2.7%
	1.15	15.9%	8.0%	3.3%	1.1%	0.2%
	1.2	9.5%	3.1%	0.8%	0.1%	0.0%
2 points	*0.9*	76.7%	83.8%	89.2%	93.1%	96.4%
	0.95	65.1%	68.9%	73.1%	77.3%	81.7%
	1	51.2%	50.6%	49.5%	50.2%	50.2%
	1.05	37.8%	31.8%	27.3%	22.4%	17.5%
	1.1	26.1%	17.4%	11.5%	6.8%	2.7%
	1.15	16.1%	8.0%	3.3%	1.1%	0.2%
	1.2	9.6%	3.1%	0.8%	0.1%	0.0%
3 points	*0.9*	78.7%	84.0%	89.2%	93.1%	96.4%
	0.95	67.8%	69.3%	73.1%	77.3%	81.7%
	1	54.8%	51.3%	49.5%	50.2%	50.2%
	1.05	41.0%	32.3%	27.3%	22.4%	17.5%
	1.1	29.3%	17.8%	11.6%	6.8%	2.7%
	1.15	18.6%	8.3%	3.3%	1.1%	0.2%
	1.2	11.2%	3.3%	0.8%	0.1%	0.0%
5 points	*0.9*	84.6%	86.6%	90.2%	93.3%	96.4%
	0.95	75.2%	73.1%	75.1%	77.8%	81.7%
	1	65.4%	58.1%	53.3%	51.5%	50.3%
	1.05	52.5%	38.7%	29.7%	23.1%	17.6%
	1.1	41.7%	24.5%	13.7%	7.3%	2.7%
	1.15	30.8%	13.5%	4.7%	1.3%	0.2%
	1.2	20.9%	6.2%	1.1%	0.1%	0.0%
10 points	*0.9*	91.8%	92.4%	94.1%	95.4%	97.2%
	0.95	86.5%	83.8%	83.8%	83.5%	84.6%
	1	80.9%	74.8%	69.7%	64.6%	60.3%
	1.05	70.7%	58.1%	45.7%	34.9%	24.5%
	1.1	63.3%	46.8%	30.1%	17.3%	7.9%
	1.15	55.5%	35.6%	17.6%	7.6%	2.1%
	1.2	44.5%	23.6%	7.7%	2.0%	0.2%

Conclusion 1

There is a lot of noise, or variability, in the size of the finishing bankroll. This can be measured mathematically by means of the standard deviation (Table 7.4.2). The average size of the finishing bankroll for each betting scenario is shown in Table 7.4.1 but this is, of course, just one of a whole range of statistically possible finishing bankrolls. The greater the noise or variability, the greater the range of possible values. The distribution of finishing bankrolls for just one simulation is shown in Figure 7.1, for stakes of 5 points, with an average bookmaker's expectancy of 0.5, and an average edge of 1.2 (or 20%). With no bankruptcy for any of the 10,000 model runs, the variation in the finishing bankroll is closely described by the binomial, or normal[40] distribution. The average finishing bankroll for this scenario is 350 and the standard deviation is 62.

Figure 7.1. The distribution of finishing bankrolls from 10,000 model runs, for 5-point stakes, average bookmaker's expectancy 0.5, and punter's edge 1.2, for level staking

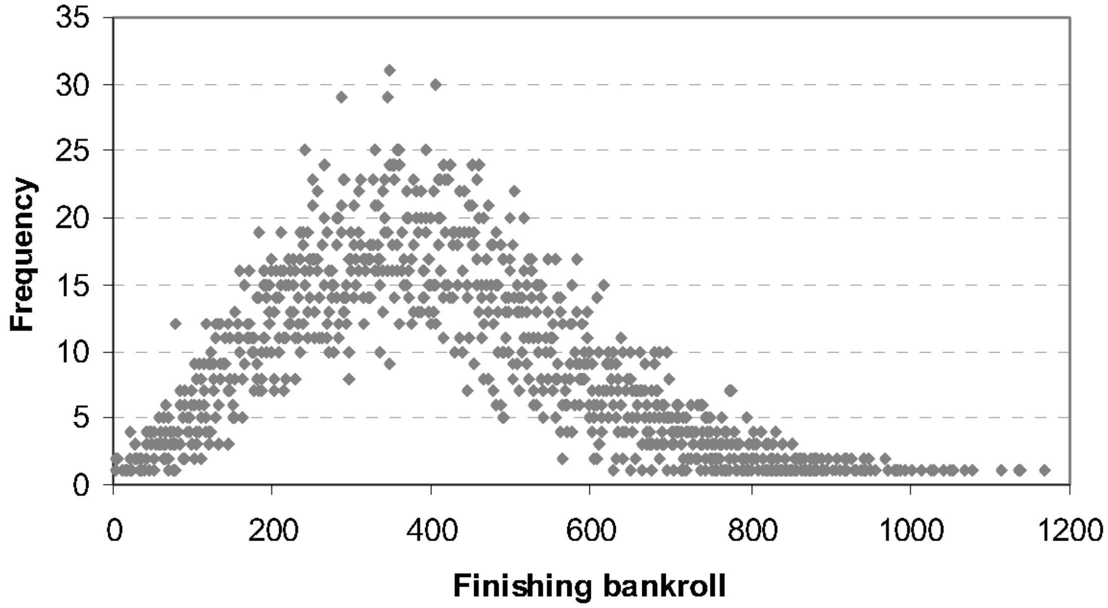


[40] For discrete data points greater than 20 (for these Monte Carlo simulations there are 10,000), the normal distribution provides a good approximation to the binomial distribution. Normal distributions are symmetric with scores more concentrated in the middle than in the tails. Normal distributions are sometimes described as bell-shaped. The reader may recall the discussion on the binomial distribution in the last chapter, and in particular the shape of its curve in Figure 6.2.

Explanation
No two finishing banks will ever be the same, simply because of the inherent randomness underlying the outcome of sporting events. No matter how good the prediction method, there will always remain an element of chance that influences the occurrence of each and every result. Betting is really all about probability, and to increase the chances of success, it pays to become familiar with some of the mathematical techniques that can describe the distribution of possible results and profits.

Conclusion 2
The variability in the finishing bank increases for increasing stake size, increasing odds and increasing edge. The higher the variability, the less confidence a punter will have in finishing close to the average finishing bank as predicted by the Monte Carlo simulation. In Figure 7.1, 58% of finishing bankrolls lie within 50 points above or below the average. For wagers with an average bookmaker's expectancy of 0.2 (at 5-point stake size and with a 20% betting edge), only 18% of finishing bankrolls lie within 50 points of the average of 321. The standard deviation for this scenario is 222, more than 3 times the variability for the shorter odds betting scenario. This greater variability is shown in Figure 7.2, which, for ease of presentation, omits the 1,900-odd cases where bankruptcy occurred, which obviously affects the nature of the true distribution.

Figure 7.2. The distribution of finishing bankrolls from 10,000 model runs, for 5-point stakes, average bookmaker's expectancy 0.2, and punter's edge 1.2, for level staking



Explanation
Variability in the finishing bankroll is naturally greater for higher odds because the punter is subjected to longer losing runs. Consequently, the way the bankroll grows or falls will be more erratic. As the edge increases, so does the variability, purely because larger profits are being made. Similarly, the standard deviation will be roughly proportional to the stake size, since more money is being wagered overall. It follows, also, that variability in the finishing bankroll will influence the chances of bankruptcy.

Conclusion 3
For any stake size and odds preference, failure to secure an edge will, on average, result in a failure to make a profit. At best, a sequence of bets will have a 50:50 chance of finishing ahead, where the punter's estimation of the fair odds matches the bookmaker's prices.

Explanation
This is the most important lesson a punter can learn. Fail to gain an edge and over the long term one cannot win. The fact that any one sequence of bets may have a 50% chance of profiting is simply the influence of chance.

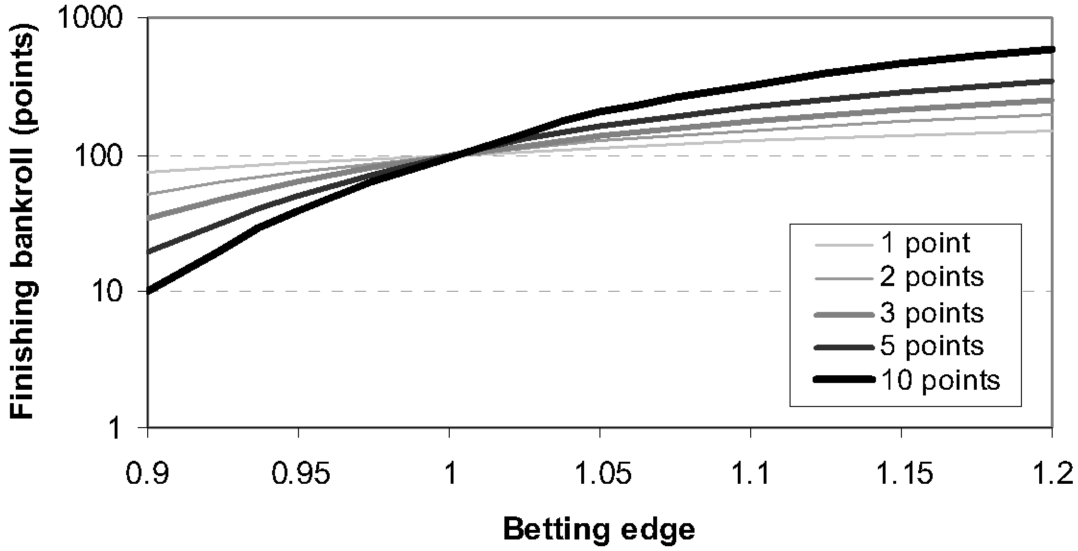
Conclusion 4
A punter without an edge will lose proportionally more of his bankroll betting larger stakes. This is illustrated by Figure 7.3, which uses a logarithmic scale to emphasise the effect of losing systems on the finishing bankroll where the edge is less than 1. For stakes above 1% of the initial bankroll, this loss increases for shorter odds. The average finishing bank for 10-point stakes, a bookmaker's expectancy of 0.6 and an edge of 0.9 is only 6 points, since so many will have experienced bankruptcy.

Explanation
The more money staked on a losing system, the more money should be lost. Betting at higher odds on a losing system may be preferable to using shorter prices, at least over the short term before bankruptcy occurs, but only because a few sizeable wins may grant a stay of execution. At shorter odds, the general decline in the bankroll will be smoother and less erratic.

Conclusion 5
Conversely, where the punter has gained an edge, he will win proportionally more as his stake size increases (see Figure 7.3), and for

stakes greater than 3 points, proportionally more for shorter prices, since bankruptcy rates decrease dramatically as the odds shorten (Table 7.4.3).

Figure 7.3. The influence of betting edge and stake size on average finishing bankroll, with average bookmaker's expectancy 0.5, for level staking



Explanation
The more money staked on a winning system, the more profit should be won. In contrast to losing systems, shorter odds are now more preferable because the profits growth is smoother and less subject to the chances of a disastrous losing sequence. With an edge of 1.1 (10%) and a stake size of 5 points, for example, the variation in the finishing bankroll is 3 times as large for a series of 11/2 shots than for 250 bets at an average price of 8/11 (Table 7.4.2). Lower prices mean higher strike rates, which, in turn, mean steadier bankroll growth.

Conclusion 6
The probability of bankruptcy is highly dependent on the availability of a punter's edge. For a stake size of 5 points, even-money bets, and an edge of 0.9, a bankroll faces a 3-in-4 chance of being lost during a sequence of 250 wagers. In contrast, where the edge is 1.2, the chance is negligible.

Explanation
This point is self-evident, and a reiteration of Conclusion 3. A punter will ultimately face bankruptcy if his system is a losing one.

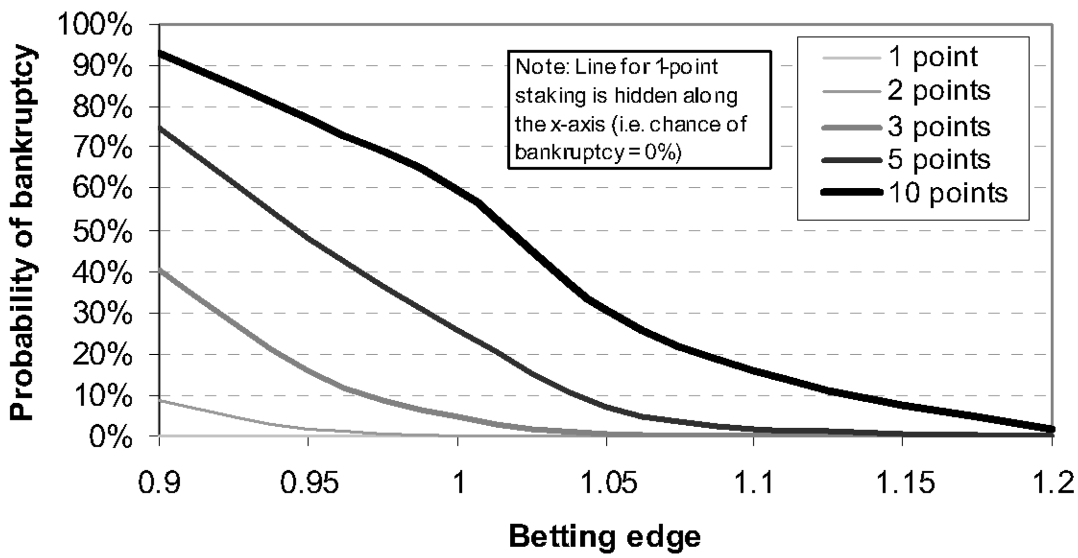
Conclusion 7

The probability of bankruptcy is dependent on the stake size. The larger the size of stake, the greater the probability of bankruptcy, regardless of the odds and the punter's edge. For 250 bets, 1-point stakes may be regarded as safe, although for losing systems betting cannot obviously continue indefinitely beyond 250 wagers. Conversely, for 10-point stakes the punter may still confront a considerable risk even if he has gained a decent edge, particularly if he favours high odds betting.

Explanation

Clearly a serious losing run has the potential to do more damage when the stakes are a larger proportion of the initial bankroll, particularly where any edge over the bookmaker is small or absent, as illustrated in Figure 7.4.

Figure 7.4. The influence of stake size and betting edge on the probability of bankruptcy, with average bookmaker's expectancy 0.5, for level staking

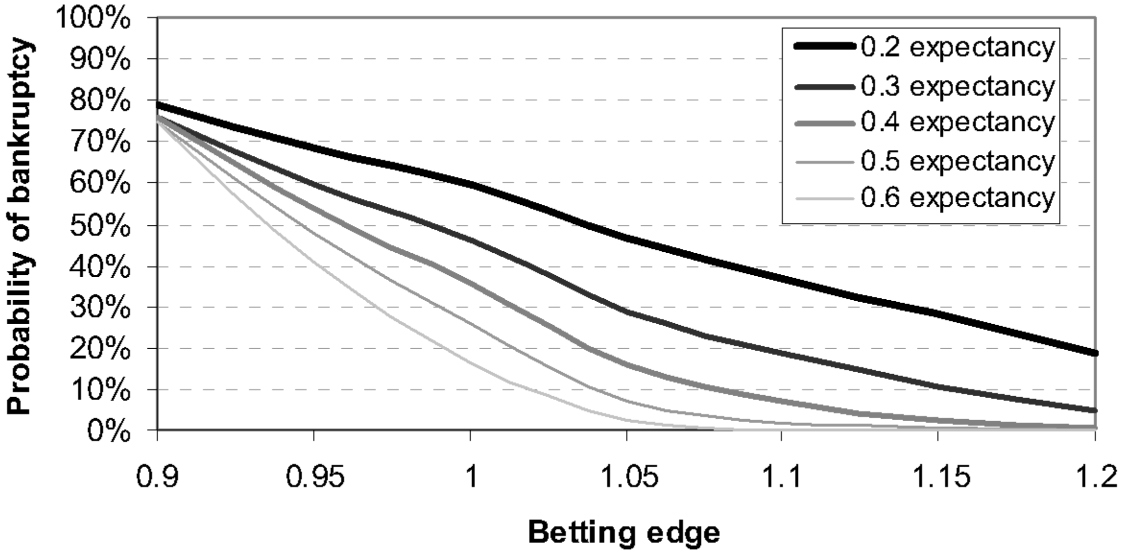


Conclusion 8

The probability of bankruptcy also increases with lengthening odds, as illustrated in Figure 7.5. For 5-point stakes and an edge of 1.05 (5%), the punter faces nearly a 1-in-2 chance of bankruptcy if most of his betting is at a bookmaker's expectancy of 0.2. If, instead, he chooses to back selections at roughly even money, his risk would be closer to 1 in 14.

Explanation
Since losing runs are more probable for higher odds betting, the risks will be greatest at this end of the fixed odds betting market.

Figure 7.5. The influence of odds and betting edge on the probability of bankruptcy, with stakes of 5 points, for level staking



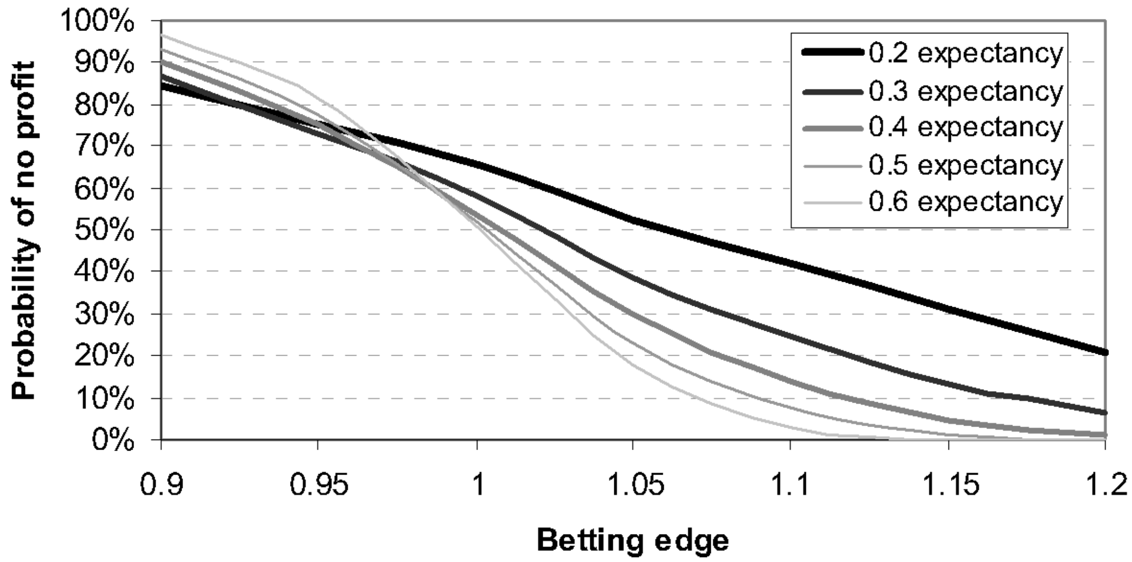
Conclusion 9
The probability of not making a profit is highly dependent on the availability of a punter's edge. Generally speaking, where the punter has an edge, he has a better-than-evens chance of finishing up at the end of the season, although for higher stakes his advantage is reduced, since the risk of bankruptcy is greater.

Explanation
This point is self-evident, and a reiteration of Conclusion 3. A punter is unlikely to profit from a losing system. Since bankruptcy is more probable for higher stakes, this increases the likelihood that a profit will not be made, even for winning systems.

Conclusion 10
For winning systems, the probability of not making a profit increases with lengthening odds. Conversely, it decreases where the punter fails to find betting value. This rather strange, but logically understandable effect is shown in Figure 7.6.

Explanation
This is a reiteration of Conclusions 4 and 5. Profitable systems show smoother bankroll growth and an increased likelihood of finishing ahead, where the odds are shorter and the strike (win) rate higher. Conversely, the lower variability in losses for losing systems makes a profit proportionally less likely to come by than for longshot betting.

Figure 7.6. The influence of odds and betting edge on the probability of failing to return a profit, for the 5-point level staking plan



Many claims about profitable systems and high yields are frequently made by punters and sports advisory services. An objective monitoring and analysis of such records does not bear witness to such assertions. Many of them do return a profit, but it is rare for a service to maintain a 20% yield over the long term. More usually it is 5 to 10%. Geoff Harvey, in *Profitable Football Betting*, confirms that his own edge is about 6%, which may be inflated a further 10% by taking the best available prices. Such returns can nonetheless be very profitable over the long term, provided that one fully considers the risks involved. Increasing the stakes will enhance the potential returns, but only at the expense of an increased likelihood of bankruptcy. A punter returning, on average, 10% profit for every 5-point even money bet may regard a bankruptcy risk of 2% during a sequence of 250 wagers as acceptable. Increasing stakes to 10 points will almost double the expected profit but will increase the risk of losing the bankroll to 16% after the same number of wagers. Whether the punter chooses to take a chance and double his stakes will very much depend on his attitudes towards gambling. Nevertheless, the informed punter is always more likely to make the correct decision appropriate to his betting preferences.

Furthermore, punters who prefer betting at longer odds, either on underdogs or for sports where the size of a field limits the availability of shorter prices, might consider reducing their stake size. Even money and odds-on bets are frequently available in football, rugby handicaps, tennis and other head-to-head match-ups. For outright betting in golf, correct score betting in football, and perhaps most commonly horse racing, higher odds are more the norm, for which the average price of a punter's betting record might be anything from 3/1 to 10/1 or even higher. For such a betting strategy, a 2% risk suddenly rises to 37% or more, simply because at such long odds the longer losing streaks have a greater potential to eliminate the betting bank. By reducing the stakes, the risk diminishes to about 5% for 250 2-point stakes and to almost nothing for 1-point stakes, although at the expense of a poorer return.

It should be clear to the reader that with level staking there is no easy way to boost profits by gambling more of the bankroll. The trade-off for greater potential gain is the increased risk of bankruptcy, and for stakes higher than 5% of the initial bankroll, its likelihood can be considerable, even within only 250 bets. To ensure a smoother profits growth from a successful betting system, the punter could be encouraged to concentrate on sporting favourites in 2-way match bets where the prices are odds-on and consequently the strikes rates higher. Unfortunately, this may go against his better judgement where he has a greater interest or knowledge of longshot betting. To accommodate this, he might wish to consider an alternative staking strategy.

Percentage Staking

There are variants to this method of staking, but the simplest involves wagering a fixed proportion of your betting bank at the time the bet is made. This may be contrasted with level stakes, where the size of the stake is a fixed proportion of the initial bankroll. For percentage bank staking then, the stake size will fluctuate with the size of the bankroll, unlike for level staking, where it remains fixed.

The advantage, in theory, of percentage bank staking is that it is not possible to lose your betting bank. In practice, a losing system will see the bankroll diminish to a point where the size of the stake becomes so small as to be hardly worth the effort of making the bet in the first place. More likely, your bookmaker will set a minimum limit for the stake size. For some this is as low as a penny, although the majority of Internet bookmakers limit this to 50p or £1.

A second advantage is that profits are gradually increased above those for level stakes, where the system is profitable. The downside to this is that where losses are made, it takes longer to recover the initial bankroll than it would for basic level staking. The professional US sports bettor, R. J. Miller,[41] is more damning of percentage bank staking. Since the precise timing of a winning streak is unknown until after it has been encountered, it makes no sense to increase a stake after a win. "If you won yesterday, you 'were' on a winning streak. But that was yesterday. If you know you will win today, why not bet it all? If you know you will lose today, you might consider not betting at all." Those employing a percentage bank staking strategy will also have to deal with the realities of placing numerous bets at the same time. The only logical approach is to assign the same stake size to each bet when several are made together.

Table 7.5.1 to Table 7.5.4 summarises the outputs of the Monte Carlo simulations for percentage bank staking: average finishing bank (7.5.1), the standard deviation in finishing bank (7.5.2), the probability of bankruptcy (7.5.3) and the probability of not making a profit (7.5.4). Comparisons made with level staking follow. When assessing the risk of bankruptcy, it has been assumed that where the bankroll falls to 1% of its initial size, this is regarded as a failure and is counted as 0 for the purposes of the analysis. Whilst most punters would probably have shelved an unsuccessful betting system long before this time, one may presume that where the starting bank is £100 with the first stake £1, the minimum size the stake may drop to is 1 pence, which should be accepted – at least by the high-street bookmaker. It has also been assumed that only one bet is placed at any one time, such that the size of the next stake will be based on the recalculated size of the bankroll.

[41] http://www.professionalgambler.com/

Table 7.5.1. Average finishing bankroll (points) after 250 percentage bank singles

		Bookmaker's expectancy				
Stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 %	*0.9*	77.7	77.6	77.6	77.8	77.8
	0.95	88.0	88.0	88.0	88.2	88.1
	1	99.7	99.6	99.8	100.0	100.0
	1.05	113.0	112.8	113.2	113.3	113.3
	1.1	127.9	127.9	128.1	128.4	128.4
	1.15	145.4	145.1	145.3	145.4	145.2
	1.2	164.4	164.3	164.5	164.8	164.6
2 %	*0.9*	60.4	60.2	60.2	60.6	60.4
	0.95	77.4	77.5	77.5	77.9	77.6
	1	99.4	99.2	99.7	100.1	99.9
	1.05	127.9	127.3	128.2	128.3	128.2
	1.1	163.5	163.8	164.0	164.8	164.7
	1.15	211.5	210.5	210.9	211.3	210.7
	1.2	269.9	269.7	270.3	271.3	270.6
3 %	*0.9*	47.0	46.7	46.6	47.1	46.9
	0.95	68.0	68.4	68.2	68.7	68.2
	1	98.8	98.9	99.5	100.3	99.7
	1.05	145.1	143.7	145.3	145.4	145.1
	1.1	209.2	210.1	210.0	211.5	211.2
	1.15	307.9	305.4	306.3	306.9	305.4
	1.2	442.5	443.0	443.6	446.4	444.2
5 %	*0.9*	28.2	28.2	27.9	28.5	28.2
	0.95	52.0	53.9	52.8	53.6	52.7
	1	95.9	98.4	99.4	100.8	99.2
	1.05	188.2	183.6	187.3	186.9	185.4
	1.1	341.6	349.2	344.3	348.6	346.1
	1.15	645.6	645.6	646.3	647.1	639.0
	1.2	1175.7	1198.8	1192.6	1205.6	1192.2
10 %	*0.9*	5.9	7.6	7.5	8.0	7.7
	0.95	21.2	32.5	27.4	28.6	27.4
	1	63.9	92.4	99.8	103.8	97.1
	1.05	311.1	327.9	366.4	350.1	335.7
	1.1	874.6	1255.9	1180.5	1214.2	1171.8
	1.15	2743.5	4001.2	4118.7	4143.2	3946.4
	1.2	9217.2	14109.1	14074.5	14272.3	13776.3

Table 7.5.2. Standard deviation in finishing bankroll (points) after 250 percentage bank singles

		Bookmaker's expectancy				
Stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 %	*0.9*	28.7	20.0	15.7	12.9	10.5
	0.95	33.0	23.2	18.2	14.7	11.9
	1	38.2	26.6	20.9	16.9	13.4
	1.05	44.3	30.5	24.0	19.1	15.0
	1.1	50.9	35.5	27.2	21.5	16.7
	1.15	59.1	40.5	31.3	24.3	18.5
	1.2	68.1	46.6	35.2	27.3	20.5
2 %	*0.9*	49.0	32.8	25.3	20.6	16.5
	0.95	64.0	43.7	33.1	26.6	21.2
	1	83.7	56.0	43.4	34.6	27.0
	1.05	113.1	73.1	56.7	44.2	34.4
	1.1	146.8	97.1	72.3	56.5	43.2
	1.15	193.7	125.2	94.4	72.1	54.0
	1.2	252.4	163.3	120.2	91.8	68.1
3 %	*0.9*	66.7	41.8	31.1	24.9	19.7
	0.95	100.5	64.7	46.3	36.6	28.6
	1	146.5	91.7	69.2	54.1	41.4
	1.05	238.1	136.7	103.0	77.9	59.4
	1.1	347.2	208.3	147.6	112.7	84.6
	1.15	511.4	302.1	218.2	162.6	119.3
	1.2	766.6	447.8	314.9	234.4	170.7
5 %	*0.9*	103.6	54.6	36.7	28.0	21.3
	0.95	224.1	120.8	71.5	53.2	39.8
	1	384.1	200.8	140.9	102.6	73.9
	1.05	971.4	393.7	274.7	186.9	134.6
	1.1	1710.0	803.0	491.3	346.9	247.0
	1.15	2897.0	1449.7	922.9	638.9	440.1
	1.2	6045.4	2858.3	1728.7	1178.2	813.4
10 %	*0.9*	118.9	56.0	35.5	23.9	17.3
	0.95	584.6	402.5	149.5	90.0	64.9
	1	1450.2	941.6	594.9	341.9	219.6
	1.05	9916.4	3090.8	2521.5	1160.8	655.7
	1.1	21730.6	14816.6	7387.9	3932.1	2427.3
	1.15	52893.6	40604.8	22368.4	13246.9	7656.7
	1.2	220612.4	217989.2	95484.8	47608.4	26938.9

Table 7.5.3. Probability of bankruptcy after 250 percentage bank singles

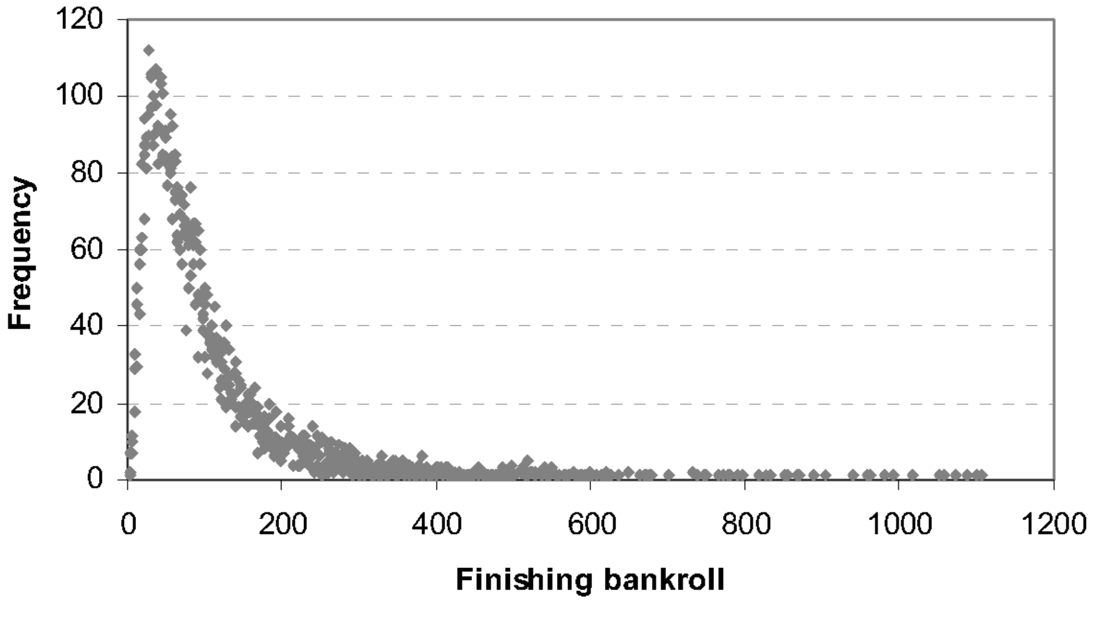
		Bookmaker's expectancy				
Stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 %	*0.9*	0.0%	0.0%	0.0%	0.0%	0.0%
	0.95	0.0%	0.0%	0.0%	0.0%	0.0%
	1	0.0%	0.0%	0.0%	0.0%	0.0%
	1.05	0.0%	0.0%	0.0%	0.0%	0.0%
	1.1	0.0%	0.0%	0.0%	0.0%	0.0%
	1.15	0.0%	0.0%	0.0%	0.0%	0.0%
	1.2	0.0%	0.0%	0.0%	0.0%	0.0%
2 %	*0.9*	0.0%	0.0%	0.0%	0.0%	0.0%
	0.95	0.0%	0.0%	0.0%	0.0%	0.0%
	1	0.0%	0.0%	0.0%	0.0%	0.0%
	1.05	0.0%	0.0%	0.0%	0.0%	0.0%
	1.1	0.0%	0.0%	0.0%	0.0%	0.0%
	1.15	0.0%	0.0%	0.0%	0.0%	0.0%
	1.2	0.0%	0.0%	0.0%	0.0%	0.0%
3 %	*0.9*	0.0%	0.0%	0.0%	0.0%	0.0%
	0.95	0.0%	0.0%	0.0%	0.0%	0.0%
	1	0.0%	0.0%	0.0%	0.0%	0.0%
	1.05	0.0%	0.0%	0.0%	0.0%	0.0%
	1.1	0.0%	0.0%	0.0%	0.0%	0.0%
	1.15	0.0%	0.0%	0.0%	0.0%	0.0%
	1.2	0.0%	0.0%	0.0%	0.0%	0.0%
5 %	*0.9*	8.8%	1.2%	0.1%	0.0%	0.0%
	0.95	4.4%	0.3%	0.1%	0.0%	0.0%
	1	2.0%	0.1%	0.0%	0.0%	0.0%
	1.05	0.7%	0.0%	0.0%	0.0%	0.0%
	1.1	0.3%	0.0%	0.0%	0.0%	0.0%
	1.15	0.1%	0.0%	0.0%	0.0%	0.0%
	1.2	0.0%	0.0%	0.0%	0.0%	0.0%
10 %	*0.9*	81.4%	64.3%	48.1%	32.7%	20.6%
	0.95	69.7%	44.2%	24.6%	10.6%	3.7%
	1	56.2%	26.3%	9.5%	2.2%	0.3%
	1.05	41.3%	12.8%	2.4%	0.3%	0.0%
	1.1	27.5%	5.3%	0.5%	0.0%	0.0%
	1.15	17.0%	1.8%	0.1%	0.0%	0.0%
	1.2	10.4%	0.6%	0.0%	0.0%	0.0%

Table 7.5.4. Probability of not making a profit after 250 percentage bank singles

		Bookmaker's expectancy				
Stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 %	*0.9*	82.0%	87.3%	91.2%	94.5%	97.5%
	0.95	71.6%	74.2%	77.5%	80.0%	84.2%
	1	59.1%	56.9%	55.0%	53.5%	52.3%
	1.05	45.7%	37.7%	31.0%	25.6%	19.0%
	1.1	31.8%	21.4%	13.7%	7.5%	3.3%
	1.15	20.9%	10.2%	4.6%	1.5%	0.2%
	1.2	13.2%	4.2%	1.0%	0.2%	0.0%
2 %	*0.9*	86.4%	90.0%	93.0%	95.2%	97.8%
	0.95	77.2%	78.0%	80.4%	82.5%	85.7%
	1	65.6%	62.2%	59.1%	56.9%	54.8%
	1.05	52.4%	42.7%	34.8%	28.5%	21.0%
	1.1	38.6%	25.4%	16.2%	8.8%	3.8%
	1.15	25.7%	12.8%	5.5%	1.7%	0.2%
	1.2	16.5%	5.6%	1.3%	0.2%	0.0%
3 %	*0.9*	89.7%	92.0%	94.2%	96.0%	98.1%
	0.95	82.0%	81.4%	83.0%	84.5%	87.4%
	1	71.5%	66.4%	63.2%	59.8%	57.7%
	1.05	58.6%	48.0%	39.1%	31.4%	22.9%
	1.1	45.1%	29.8%	18.9%	10.2%	4.4%
	1.15	31.7%	15.5%	6.9%	2.2%	0.3%
	1.2	20.8%	7.0%	1.7%	0.2%	0.0%
5 %	*0.9*	94.6%	95.0%	96.2%	97.0%	98.7%
	0.95	89.7%	87.4%	87.6%	87.8%	89.8%
	1	81.3%	75.1%	70.6%	66.2%	63.3%
	1.05	70.4%	57.7%	47.2%	37.5%	27.4%
	1.1	57.8%	38.9%	24.5%	13.5%	5.8%
	1.15	43.9%	22.2%	9.9%	3.0%	0.4%
	1.2	31.3%	10.9%	2.6%	0.4%	0.0%
10 %	*0.9*	99.2%	98.9%	98.9%	98.9%	99.5%
	0.95	97.8%	96.3%	95.0%	94.3%	95.2%
	1	95.0%	89.8%	85.1%	79.6%	75.2%
	1.05	90.1%	78.5%	66.8%	52.9%	40.1%
	1.1	82.5%	62.9%	42.4%	24.7%	10.8%
	1.15	71.8%	44.0%	21.5%	7.1%	1.2%
	1.2	59.7%	26.7%	7.5%	1.2%	0.1%

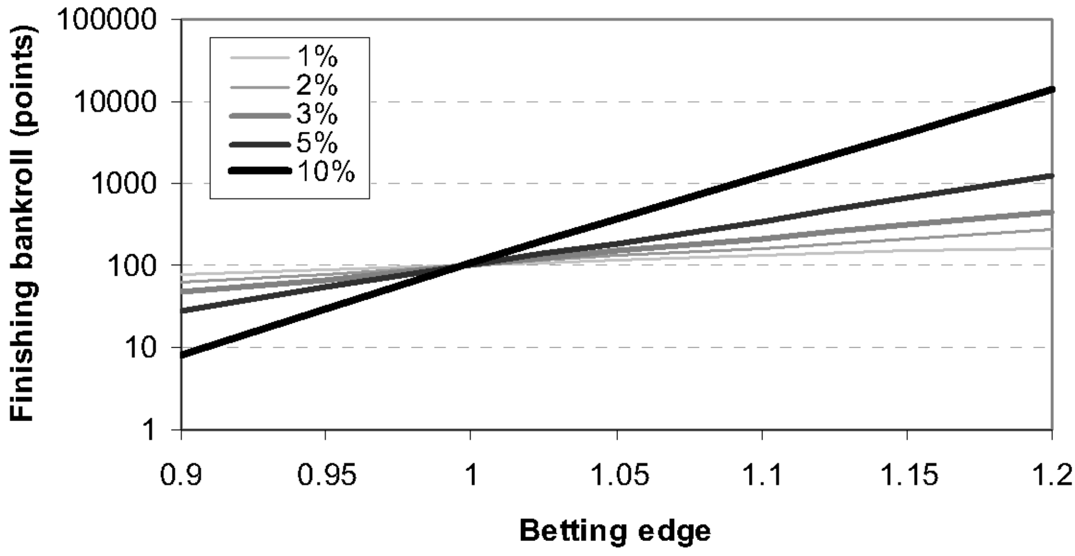
In general, profit potential and the risk of bankruptcy for percentage bank staking are once more dependent on edge, stake size and betting odds, although for profitable scenarios the variability (standard deviation) in the finishing bank can sometimes be much greater, particularly for large stakes. This is because for a series of 250 bets, the total amount wagered for a winning system will substantially exceed that for an equivalent level stakes betting scenario. Consequently, the distribution of possible finishing bankrolls is heavily skewed (Figure 7.7),[42] with a few very large finishing bankrolls, but two-thirds finishing below the average. Systems without an edge over the bookmaker again fail to return profit, although because of the characteristics of percentage staking, they are much less likely to experience bankruptcy after only 250 bets, with a significant chance of failure existing only for 10% stakes. Systems with an edge, on the other hand, are seen to outperform level staking, generating sometimes 10 times the profit if the stakes are large enough (Figure 7.8). At the same time, the risk of losing the betting bank is negligible. For even money betting with an edge of 5%, for example, 5% stakes should, on average, generate 50% more profit than for level staking. The risk of bankruptcy for the latter is nearly 6%, whilst for the former it is inconsequential!

Figure 7.7. The distribution of finishing bankrolls from 10,000 model runs, for 5%-stakes, average bookmaker's expectancy 0.5, and punter's edge 1.0, for percentage bank staking



[42] The shape of this distribution for a 5% stakes even money betting system with no significant edge clearly deviates significantly from the perfect bell-shaped curve of the normal distribution.

Figure 7.8. The influence of betting edge and stake size on average finishing bankroll, with average bookmaker's expectancy 0.5, for percentage bank staking



Is percentage bank staking, then, the answer to a punter's dreams? Not entirely, for there is one important caveat, which is hinted at in Figure 7.7. For 5% staking with a 5% edge on even money betting, the probability of level stakes finishing a 250-bet season in profit is 77%. For percentage bank staking it is only 62%. This important difference is further illustrated in Figure 7.9 for different betting expectancies, and in Figure 7.10, which emphasises the magnitude of inferiority for percentage bank staking relative to level staking, in terms of the probability of not returning a profit for even money betting. This inferiority is greater for higher odds gambling and where any advantage over the bookmaker is minimal. It is also greater for larger staking. For both highly successful and unsuccessful betting systems alike the difference is less, since the chance of bankruptcy for both staking plans is either very low or very high.

Figure 7.9. The influence of odds and betting edge on the probability of failing to return a profit, for the 5% percentage bank staking plan

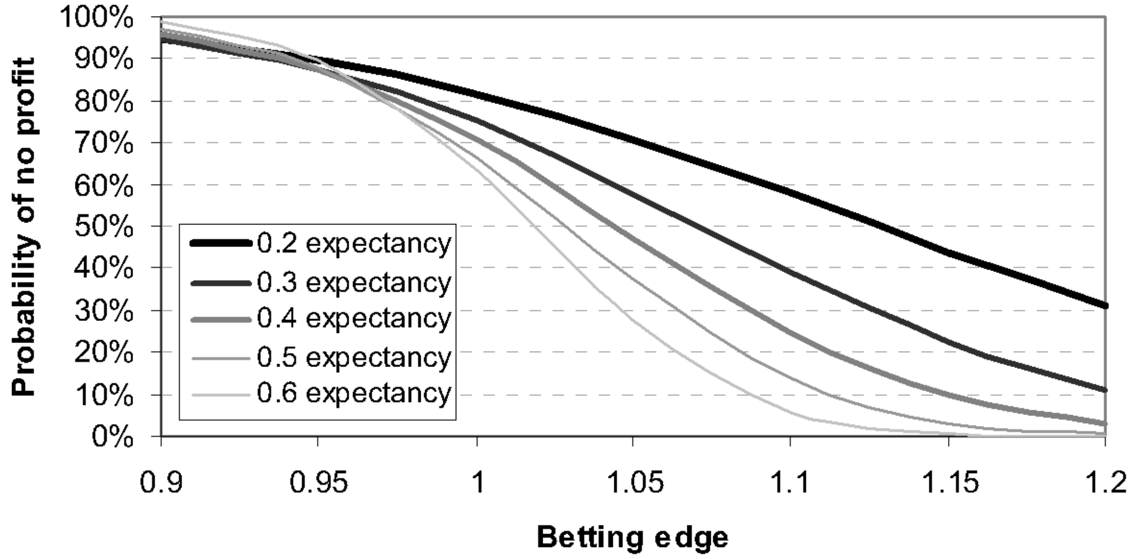
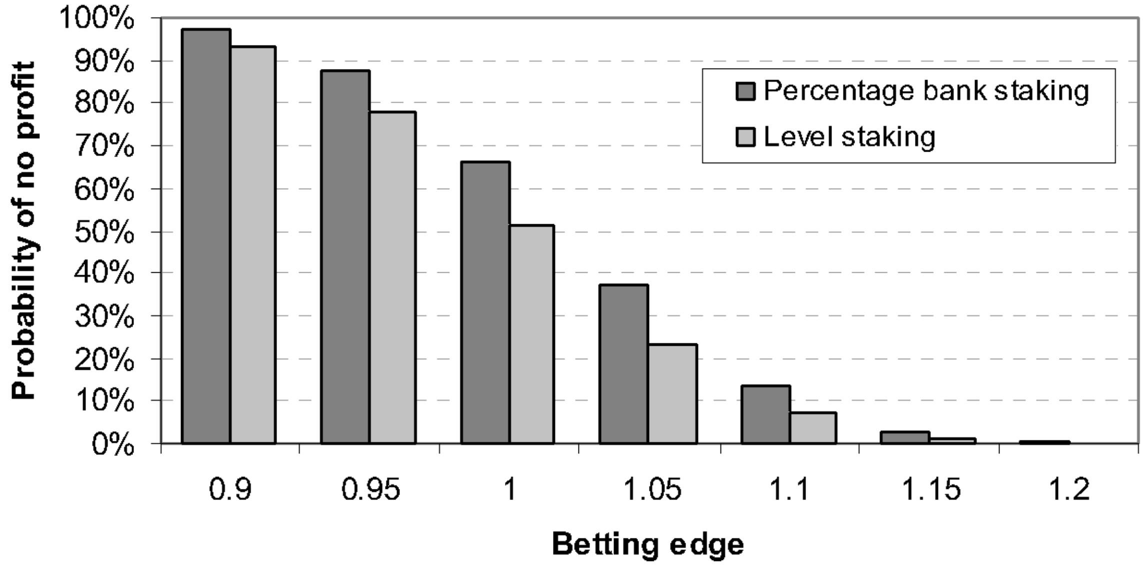


Figure 7.10. The comparison, between percentage bank staking and level staking, of the probability of failing to return a profit, for a bookmaker's expectancy of 0.5, with 5% stakes[43]



[43] For level staking this is 5% of the initial bankroll, i.e. 5 points.

Why is it, then, that the chance of securing a profit after a specified period of betting is less for percentage bank staking than for level staking, even though the anticipated profit is higher? The reason is largely because when betting banks lose capital, they take longer to recover by means of percentage bank staking, and consequently are less likely to do so within the specified betting period, in this case 250 wagers. Percentage bank staking may be potentially more profitable and theoretically safer than level staking over the longer term, but it is less likely to show you a profit in the short term. In other words, when it wins, it wins bigger, but when it loses, it takes longer to recover.

This trade-off between level and percentage staking is not merely hypothetical. Rather, it has significant implications for the psychology of real-time betting. A punter unsure of his scrupulously developed betting system may feel nervous if his bankroll takes an early tumble, abandoning his method prematurely when recovery is delayed. Furthermore, a punter aware of these implications must be prepared to wait out more seasons where profits are smaller or losses are made. Will the even money bettor with the 5% edge accept perhaps 4 losing seasons in 10 as the price to pay for seeking a larger longer-term gain, or would he rather settle for smaller but more regular seasonal returns? What if the percentage-staking punter loses 2 seasons in succession, whilst the level staker is winning? There is no simple way of deciding which money management strategy is superior. Both have their merits and their drawbacks. What is undoubtedly true, however, is that when a punter is informed of the relative risk–reward trade-offs, he will be more able to make the appropriate choices to suit his preferred approach to sports betting.

Fixed Profits Staking

Where level staking places the same-size wager on every bet, fixed profits staking seeks to win the same amount for every gamble. Where £10 is staked on an even money shot, 20 pence would be risked at a price of 50/1. A win for both bets would return a profit of £10. In this way, losses on higher odds are limited, although so too are the potential gains. Although the profit expectancy[44] for the 50/1 shot is now 50 times smaller than for a

[44] Profit expectancy is the amount one expects to win multiplied by the true probability of winning, less the amount that can be lost multiplied by the true probability of losing (see Chapter 4).

stake of £10, the risks imposed on the betting bank by the higher-priced bets are substantially reduced. The reader may recall that for both level staking and percentage bank staking, betting at longer odds introduces a substantially greater risk of bankruptcy.

Table 7.6.1 to Table 7.6.4 summarises the outputs of the Monte Carlo simulations for fixed profits staking: average finishing bankroll (7.6.1), the standard deviation in finishing bankroll (7.6.2), the probability of bankruptcy (7.6.3) and the probability of not making a profit (7.6.4). As for percentage bank staking, conclusions and comparisons with level staking are made. For the simulations it has been necessary to manipulate the size of the fixed profit such that the average stake sizes are comparable with the 1, 2, 3, 5 and 10-point scenarios for level staking. In other words, for a fair comparison of staking strategies, the total amount wagered during the 250 bets is the same for level and fixed profits staking alike. For a punter working in real-time, such retrospective analysis is theoretically impossible to carry out, although he may calculate his **average** stake size (as a fixed proportion of his initial betting bank) from an earlier betting record. The size of the potential fixed profit per wager for each betting scenario is thus summarised in Table 7.6 for reference.

Table 7.6. The size of fixed profits (points) per wager for each betting scenario

Stake size	**Bookmaker's expectancy**				
	0.2	*0.3*	*0.4*	*0.5*	*0.6*
1	3.77	2.18	1.38	0.90	0.58
2	7.54	4.35	2.76	1.81	1.16
3	11.31	6.53	4.14	2.71	1.73
5	18.84	10.88	6.89	4.52	2.89
10	37.68	21.76	13.78	9.04	5.78

Table 7.6.1. Average finishing bankroll (points) after 250 fixed profit singles

		Bookmaker's expectancy				
Average stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	73.3	74.5	75.5	75.8	76.2
	0.95	87.3	88.9	88.3	87.4	87.8
	1	99.0	101.0	100.8	99.5	100.6
	1.05	114.1	113.1	112.3	111.8	111.8
	1.1	125.6	124.2	125.2	125.3	124.5
	1.15	137.1	137.3	137.2	136.4	137.2
	1.2	149.4	148.6	149.1	149.5	148.6
2 points	*0.9*	51.6	51.4	52.0	52.1	52.5
	0.95	75.7	78.2	76.7	74.8	75.6
	1	97.7	101.9	101.6	99.1	101.2
	1.05	127.8	126.1	124.5	123.6	123.7
	1.1	150.8	148.5	150.4	150.5	148.9
	1.15	173.8	174.5	174.5	172.9	174.4
	1.2	198.7	197.3	198.3	198.9	197.1
3 points	*0.9*	40.0	37.4	36.2	33.9	32.7
	0.95	68.3	70.0	66.8	63.2	63.8
	1	95.8	102.1	102.1	98.4	101.7
	1.05	139.5	138.4	136.5	135.4	135.5
	1.1	173.1	171.9	175.5	175.8	173.4
	1.15	208.1	211.4	211.7	209.3	211.7
	1.2	246.6	245.8	247.4	248.4	245.7
5 points	*0.9*	30.1	25.2	22.2	18.0	14.5
	0.95	61.1	61.0	54.9	47.8	46.3
	1	92.2	101.9	101.7	96.2	102.1
	1.05	154.3	157.6	158.1	157.3	158.9
	1.1	204.3	211.3	222.9	225.7	222.3
	1.15	260.2	279.2	284.7	282.0	286.1
	1.2	329.3	339.4	345.4	347.2	342.8
10 points	*0.9*	22.6	17.3	13.5	8.9	5.3
	0.95	55.4	52.7	45.0	34.4	30.1
	1	89.2	99.2	98.4	90.3	99.4
	1.05	173.4	183.5	193.7	196.6	208.3
	1.1	243.4	269.7	309.0	333.5	339.8
	1.15	330.0	396.8	435.2	451.2	470.7
	1.2	463.5	525.0	574.0	591.7	585.5

Table 7.6.2. Standard deviation in finishing bankroll (points) after 250 fixed profit singles

		Bookmaker's expectancy				
Average stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	29.2	22.6	18.3	15.0	12.3
	0.95	29.8	22.8	18.5	15.0	12.1
	1	30.4	23.2	18.3	14.9	11.7
	1.05	30.7	23.3	18.5	14.7	11.5
	1.1	31.2	23.7	18.4	14.4	11.0
	1.15	31.7	23.8	18.4	14.2	10.5
	1.2	32.2	23.9	18.4	13.9	10.0
2 points	*0.9*	49.9	40.8	34.6	29.0	24.3
	0.95	56.5	44.6	36.7	29.9	24.2
	1	60.1	46.2	36.7	29.8	23.5
	1.05	62.0	46.6	37.0	29.5	23.0
	1.1	62.9	47.4	36.8	28.8	22.1
	1.15	63.9	47.5	36.8	28.4	20.9
	1.2	64.5	47.8	36.8	27.9	20.1
3 points	*0.9*	59.8	48.8	41.7	35.6	30.5
	0.95	75.3	61.5	51.4	42.7	35.4
	1	86.1	68.6	55.1	44.9	35.3
	1.05	93.3	70.6	55.9	44.4	34.5
	1.1	97.3	72.4	55.4	43.2	33.1
	1.15	99.4	72.0	55.3	42.6	31.4
	1.2	99.5	72.0	55.2	41.8	30.1
5 points	*0.9*	71.0	55.5	45.8	36.8	29.1
	0.95	101.4	84.3	70.1	57.7	48.7
	1	125.2	105.9	88.3	73.1	59.0
	1.05	151.5	118.7	94.8	76.1	58.1
	1.1	167.2	128.0	96.9	73.4	55.3
	1.15	178.7	129.1	95.3	71.7	52.3
	1.2	180.8	126.5	92.8	69.8	50.2
10 points	*0.9*	90.9	66.6	51.7	37.2	24.9
	0.95	144.6	121.4	98.2	76.3	61.7
	1	192.4	170.4	147.2	124.1	108.0
	1.05	263.7	221.4	188.5	158.6	125.1
	1.1	312.9	263.4	219.4	169.1	120.2
	1.15	360.8	294.3	229.8	166.6	108.7
	1.2	399.1	304.6	214.0	146.7	100.7

Table 7.6.3. Probability of bankruptcy after 250 fixed profit singles

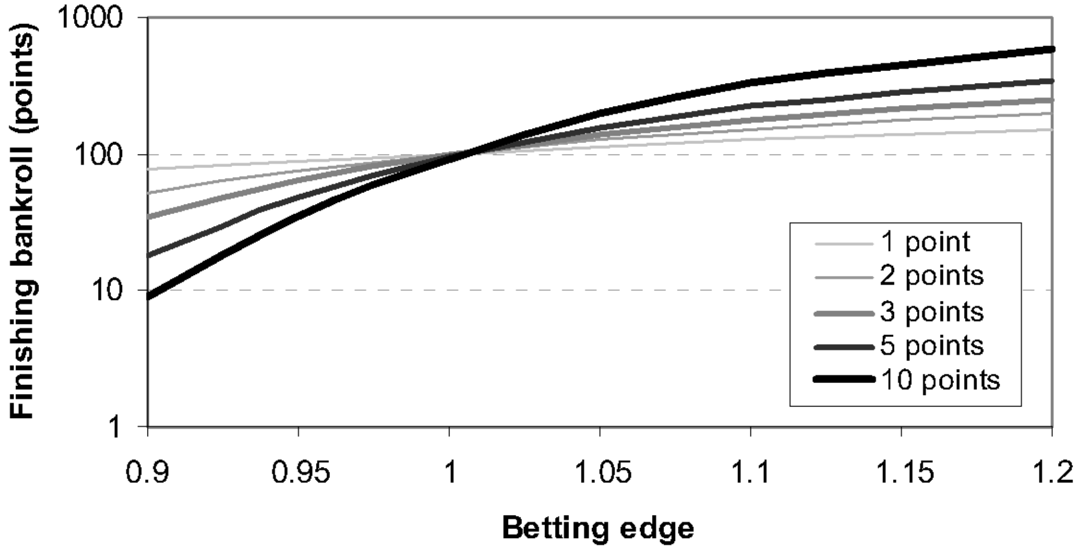
		Bookmaker's expectancy				
Average stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	0.8%	0.1%	0.0%	0.0%	0.0%
	0.95	0.2%	0.0%	0.0%	0.0%	0.0%
	1	0.1%	0.0%	0.0%	0.0%	0.0%
	1.05	0.0%	0.0%	0.0%	0.0%	0.0%
	1.1	0.0%	0.0%	0.0%	0.0%	0.0%
	1.15	0.0%	0.0%	0.0%	0.0%	0.0%
	1.2	0.0%	0.0%	0.0%	0.0%	0.0%
2 points	*0.9*	31.0%	19.9%	11.7%	5.6%	2.6%
	0.95	17.4%	7.0%	3.1%	1.0%	0.1%
	1	10.6%	2.9%	0.6%	0.1%	0.0%
	1.05	4.2%	0.7%	0.1%	0.0%	0.0%
	1.1	1.9%	0.3%	0.0%	0.0%	0.0%
	1.15	0.9%	0.1%	0.0%	0.0%	0.0%
	1.2	0.3%	0.0%	0.0%	0.0%	0.0%
3 points	*0.9*	57.9%	49.8%	41.6%	35.8%	28.5%
	0.95	40.5%	26.7%	19.3%	13.0%	6.5%
	1	29.7%	15.1%	6.9%	3.1%	0.6%
	1.05	15.0%	5.9%	1.8%	0.4%	0.0%
	1.1	9.3%	2.6%	0.3%	0.0%	0.0%
	1.15	5.4%	0.7%	0.0%	0.0%	0.0%
	1.2	2.5%	0.2%	0.0%	0.0%	0.0%
5 points	*0.9*	79.3%	76.6%	74.0%	73.1%	72.2%
	0.95	64.9%	54.3%	49.9%	45.9%	37.5%
	1	54.9%	39.4%	28.7%	21.2%	9.9%
	1.05	36.4%	21.8%	11.7%	5.6%	1.2%
	1.1	27.2%	13.6%	4.4%	0.8%	0.1%
	1.15	19.6%	6.4%	1.3%	0.2%	0.0%
	1.2	11.0%	2.5%	0.2%	0.0%	0.0%
10 points	*0.9*	92.1%	91.7%	91.4%	92.6%	94.3%
	0.95	83.0%	79.0%	77.2%	77.5%	74.2%
	1	77.4%	67.8%	61.2%	56.4%	43.4%
	1.05	62.1%	49.5%	37.4%	27.3%	14.0%
	1.1	53.9%	38.9%	23.0%	10.4%	3.0%
	1.15	45.8%	25.6%	12.6%	4.7%	0.5%
	1.2	33.0%	15.8%	4.4%	0.7%	0.0%

Table 7.6.4. Probability of not making a profit after 250 fixed profit singles

		Bookmaker's expectancy				
Average stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	82.1%	87.1%	90.7%	94.5%	97.5%
	0.95	66.9%	68.6%	73.8%	80.4%	84.2%
	1	52.1%	48.9%	48.8%	51.8%	48.1%
	1.05	33.0%	28.8%	25.3%	21.0%	15.5%
	1.1	21.0%	15.3%	8.6%	4.3%	1.5%
	1.15	12.0%	5.8%	2.1%	0.5%	0.0%
	1.2	6.1%	2.0%	0.3%	0.0%	0.0%
2 points	*0.9*	82.1%	87.1%	90.7%	94.5%	97.5%
	0.95	66.9%	68.6%	73.8%	80.4%	84.2%
	1	52.2%	48.9%	48.8%	51.8%	48.1%
	1.05	33.1%	28.8%	25.3%	21.0%	15.5%
	1.1	21.1%	15.3%	8.6%	4.3%	1.5%
	1.15	12.1%	5.8%	2.1%	0.5%	0.0%
	1.2	6.1%	2.0%	0.3%	0.0%	0.0%
3 points	*0.9*	82.8%	87.2%	90.7%	94.5%	97.5%
	0.95	67.8%	68.7%	73.8%	80.4%	84.2%
	1	53.9%	49.2%	48.8%	51.8%	48.1%
	1.05	34.4%	29.0%	25.3%	21.0%	15.5%
	1.1	22.6%	15.5%	8.6%	4.3%	1.5%
	1.15	13.3%	5.9%	2.1%	0.5%	0.0%
	1.2	6.9%	2.1%	0.3%	0.0%	0.0%
5 points	*0.9*	86.6%	88.8%	91.1%	94.5%	97.5%
	0.95	73.7%	71.4%	74.7%	80.6%	84.3%
	1	63.0%	53.7%	50.6%	52.4%	48.1%
	1.05	43.7%	33.5%	26.9%	21.5%	15.5%
	1.1	32.4%	20.2%	9.9%	4.5%	1.6%
	1.15	22.7%	9.0%	2.9%	0.6%	0.0%
	1.2	13.1%	3.7%	0.4%	0.0%	0.0%
10 points	*0.9*	93.1%	93.3%	93.9%	96.0%	98.0%
	0.95	84.5%	81.8%	81.9%	84.7%	86.1%
	1	78.5%	70.3%	65.3%	63.3%	54.9%
	1.05	63.7%	52.0%	41.1%	32.3%	20.5%
	1.1	54.8%	40.2%	24.4%	11.7%	3.7%
	1.15	46.4%	26.3%	13.1%	4.8%	0.5%
	1.2	33.4%	16.1%	4.5%	0.7%	0.0%

The relationships between stake size, odds and betting edge on the one hand and finishing bankroll on the other for fixed profits staking is broadly very similar to those for level staking, as illustrated by Figures 7.11 to 7.14. Similarly, the distribution of possible finishing bankrolls also reveals a strong resemblance to that for the equivalent level stakes scenario (see Figure 7.15). This is unsurprising, for in contrast to percentage bank staking, the total amount wagered for each fixed profits scenario is the same as for each corresponding level stakes scenario. There are, however, some very subtle, but important differences, which arise because of the lower variability in the finishing bankroll for fixed profits staking. This is illustrated in Figure 7.16 for 5-point even money betting. To investigate these more thoroughly it helps to become a little more familiar with that statistical measure of variability, the standard deviation.

Figure 7.11. The influence of betting edge and stake size[45] on average finishing bankroll, with average bookmaker's expectancy 0.5, for fixed profits staking



[45] For fixed profits staking, the points size refers to the size of the average stake, which varies according to the odds of each bet.

Figure 7.12. The influence of stake size and betting edge on the probability of bankruptcy, with average bookmaker's expectancy 0.5, for fixed profits staking.

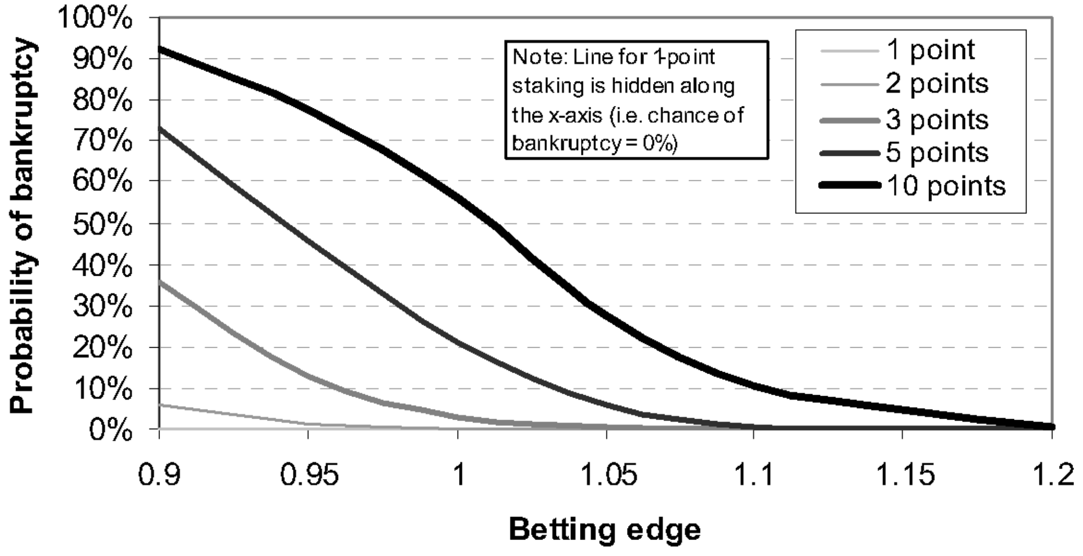


Figure 7.13. The influence of odds and betting edge on the probability of bankruptcy, for the 5-point fixed profits staking plan

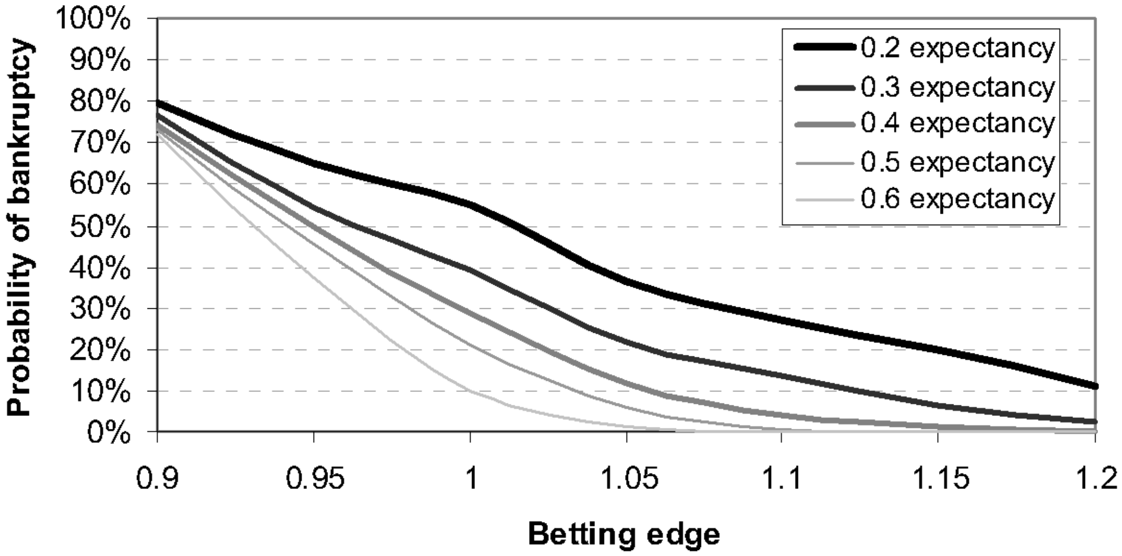


Figure 7.14. The influence of odds and betting edge on the probability of failing to return a profit, for the 5-point fixed profits staking plan

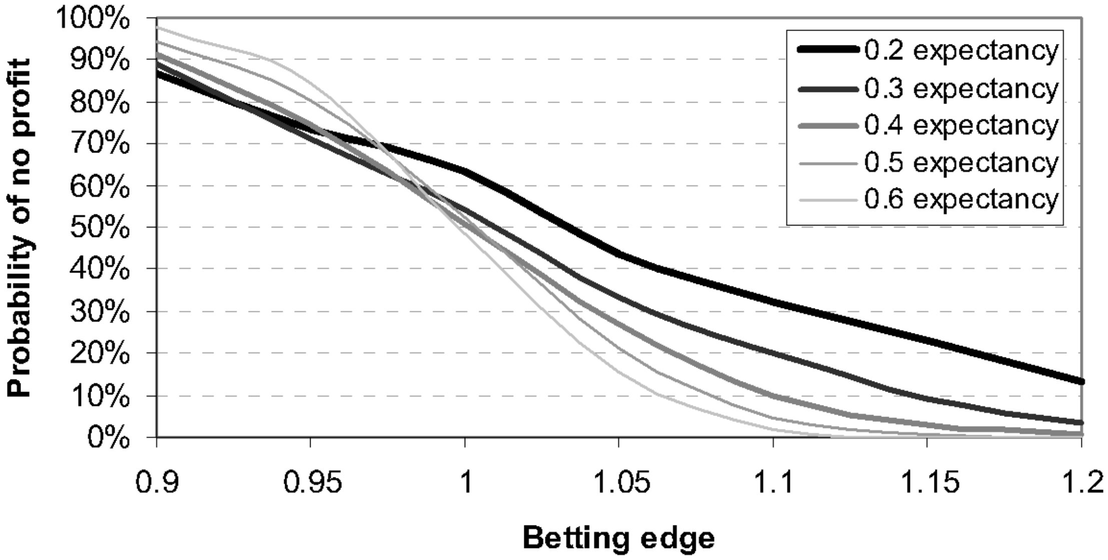
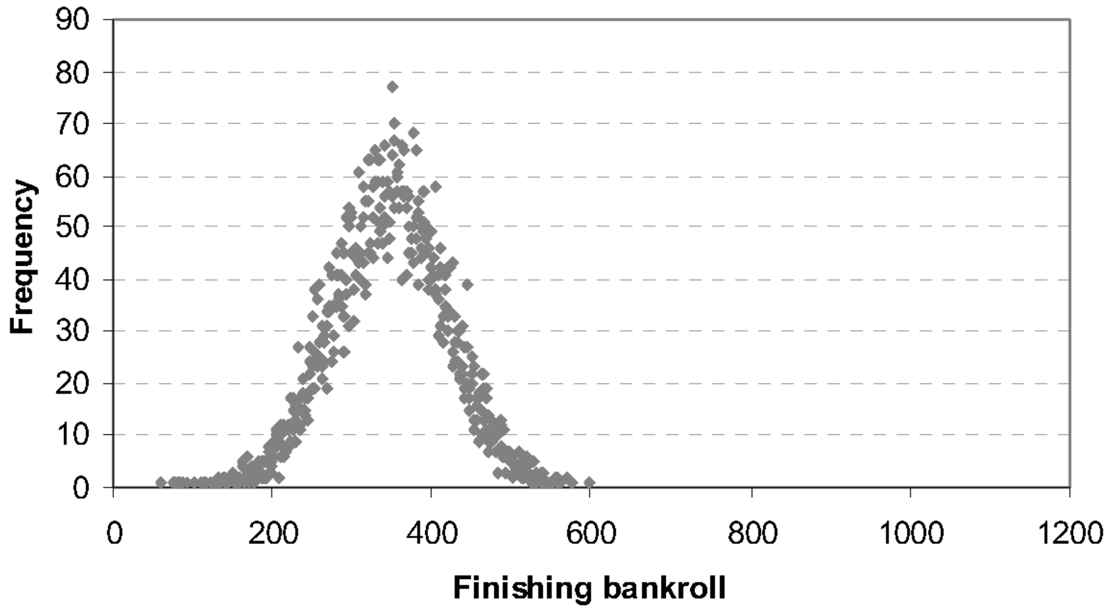
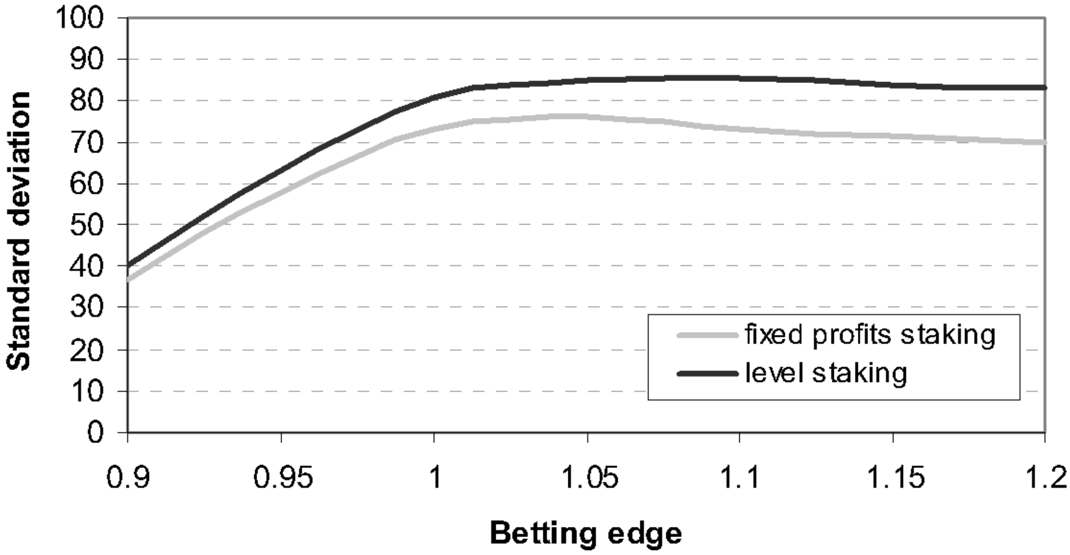


Figure 7.15. The distribution of finishing bankrolls from 10,000 model runs, for 5-point stakes,[46] average bookmaker's expectancy 0.5, and punter's edge 1.2, for fixed profits staking



[46] For fixed profits staking this is an average stake size of 5 points.

Figure 7.16. Variability (standard deviation) in finishing bankroll for fixed and level staking, for 5-point stakes and average bookmaker's expectancy 0.5



For some staking plans, the standard deviation in the finishing bankroll can be used to estimate the likelihood of finishing with a particular size of bankroll. Where the binomial, or normal, distribution provides a reasonable description of the range of possible finishing banks, it is possible to say that approximately 68% of finishing bankrolls will lie within 1 standard deviation above or below the average size, whilst about 95% will lie within 2 standard deviations.[47] This assumption should be quite reliable for winning level staking (Figure 7.1) and fixed profits staking (Figure 7.15) scenarios. It will be much less reliable for losing fixed staking plans where rates of bankruptcy are high, and for percentage and progressive staking plans, like percentage bank strategies (Figure 7.7), for which more complex statistics would be required to account for their finishing bankroll distributions.[48] The relevance of this assumption may be further illustrated by means of an example.

Bankruptcy for even money 5-point level staking with an edge of 10% is only 2%, and the variation in possible finishing bankrolls should be close to

[47] The possibility of bankruptcy in sports betting means results do not theoretically conform to any known probability distribution, which is why it was necessary to run the Monte Carlo simulations. Frequently, however, known probability distributions, like the normal distribution, offer good approximations, particularly where bankruptcy rates are very low.

[48] The lognormal distribution, for example, frequently offers a fairly good approximation for the distribution of finishing bankrolls from percentage bank staking, since the distribution of the **logarithms** of these finishing bankrolls is approximately normal.

that described by the normal distribution. With an average finishing bankroll of 224 and a standard deviation of 86, this informs us that about two-thirds of the time we can expect to finish with a bankroll of somewhere between 138 and 310. In fact, knowing the standard deviation of a normally distributed set of data can allow one to calculate the chances of obtaining any possible outcome. For this betting scenario, the size of the average bank is 1.44 standard deviations above the profit line of 100, and 2.60 standard deviations away from bankruptcy. Using a set of normal distribution (or Z) tables, or a simple computer program,[49] we can calculate that the probability of failing to make a profit is 7.5%, whilst the probability of bankruptcy is 0.5%. These values are similar to those identified by the Monte Carlo simulation, 7.3% and 1.8% respectively. The higher empirical value for the probability of bankruptcy is likely to be a consequence of the assumption that where the bankroll is lost before 250 wagers have been placed, the betting is terminated. There is no opportunity for recovery from a lost bankroll. A calculation from first principles using the normal distribution cannot take this important condition into account, which is why the Monte Carlo simulation was run.

The significant feature of Figure 7.16 is that the standard deviation in the finishing bankroll is consistently lower for fixed profits staking than it is for level staking. This is true for any range of betting odds. For even money fixed profits staking at an average of 5 points per bet and an edge of 10%, the average bank is 226, which is almost the same, unsurprisingly, as that for the equivalent level staking scenario. For the fixed profits scenario, however, the standard deviation in the finishing bank is 73, 13 less than for the equivalent level staking plan, with the average finishing bank now a larger 1.73 standard deviations above the profit line. Statistically, this converts to a probability of failing to make a profit of only 4.2%, in contrast to 7.5% for level staking. Again, this figure compares well with the experimental result from the Monte Carlo simulation of 4.5%.

For all profitable betting systems, that is, those with an edge greater than 1, fixed profits staking offers roughly the same rewards as for level staking but at a reduced risk, both of losing the betting bank (Figure 7.17) and failing to make a profit (Figure 7.18). This supplementary safety margin is not large but it is significant, and could mean the difference between profit

[49] Hyperstat Online provide a useful normal distribution applet at http://davidmlane.com/hyperstat/z_table.html. $Z_{no\ profit}$ for the example here is -1.44 whilst $Z_{bankruptcy}$ is -2.60.

or loss, bankroll preservation or bankruptcy, particularly for higher odds and larger stakes gambling, where substantial risks exist even for profitable systems with a winning edge. Its existence may be explained by the reliance, for profit making, on shorter odds, for which strike rates are higher and potential profit growth less erratic, and a minimisation of losses on longshot prices, which would otherwise introduce larger fluctuations in the size of the bankroll.

Figure 7.17. The comparison, between fixed profits staking and level staking, of the probability of bankruptcy, for a bookmaker's expectancy of 0.2, with 5-point stakes

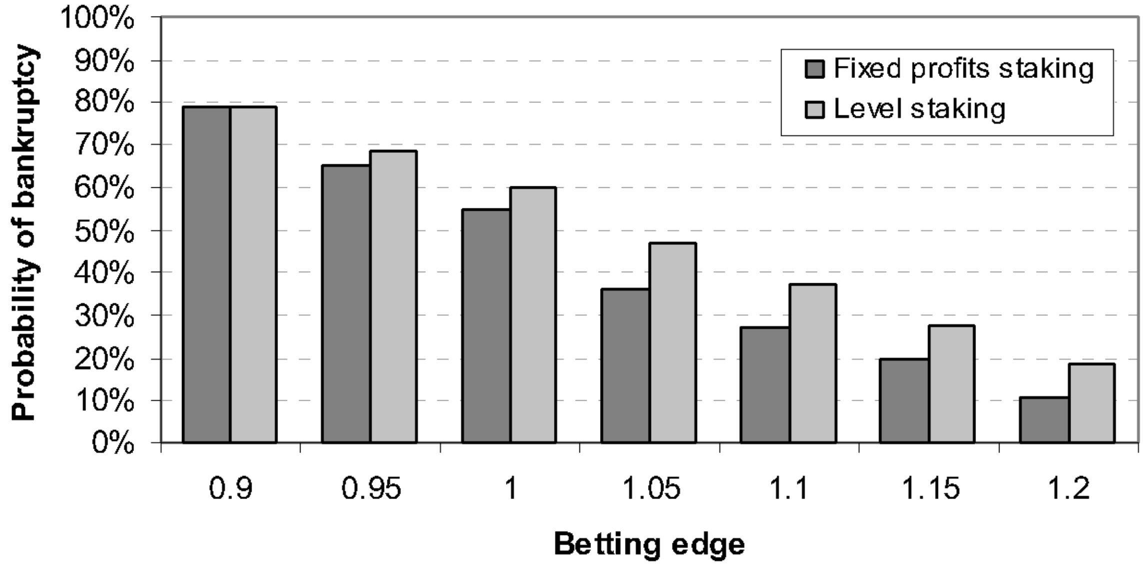
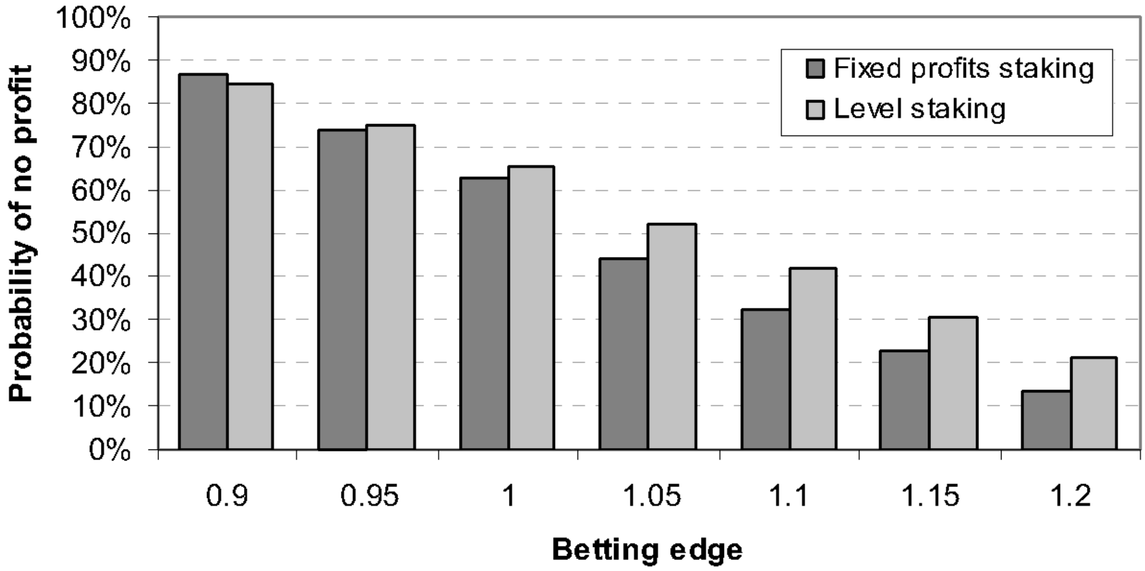


Figure 7.18. The comparison, between fixed profits staking and level staking, of the probability of failing to return a profit, for a bookmaker's expectancy of 0.2, with 5-point stakes



The Martingale

The Martingale staking plan comes from the world of casino gambling, and in particular the game of roulette. A popular game at the roulette wheel is red-black, where the gambler must decide whether the ball will land on either a red or a black number after each spin. Overlooking the influence of the house edge,[50] the odds of either result are 1/1 or evens. The idea behind Martingale is to double the stake size after each losing wager, and return to the starting stake after every win. In this way, previous losses are recovered after each successful result plus the original expected profit, as the following sequence of wheel spins reveals.

Wheel spin	Bet	Stake	Outcome	Profit	Running total
1	Red	1	Black	-1	-1
2	Red	2	Black	-2	-3
3	Red	4	Black	-4	-7
4	Red	8	Red	+8	+1
5	Red	1	Black	-1	0
6	Red	2	Red	+2	+2
7	Red	1	Red	+1	+3
8	Red	1	Black	-1	+2
9	Red	2	Black	-2	0
10	Red	4	Red	+4	+4

Martingale might seem to offer the punter a chance of profiting even where he is unable to beat the bookie fairly. Although he may lose a bet more frequently than a more skilful bettor, each win will recover his preceding losses and add a little extra each time. It must be obvious to the reader, however, that the Martingale progression is inherently a very dangerous strategy to follow, since any extended run of consecutive losses will soon increase the stake size to frighteningly high levels. 10 blacks in succession, for example, will require the 11th stake to be 1,024 units, just to win 1. Quite possibly, this stake size might be beyond the accepted limits of the house. Less commonly appreciated, but equally regrettable, is the fact that the apparent ability of Martingale to turn losses into profits is quite simply an illusion, and the reasoning which is often used to support its merits is fallacious.

[50] Where the ball lands on zero (and also double zero in American casinos), a bet on either red or black will lose, and this where the casino gains the advantage.

Stuart Holland, in *Successful Staking Strategies*, provides an excellent and thorough proof of why Martingale is unable to make something out of nothing. Following his approach, consider the first 3 wheel spins in the sequence above. The 3 consecutive losing blacks represent just 1 of 8 possible outcomes, each of which is as likely as any other. Table 7.7 shows the profit expectancy for each of these 8 permutations.

Table 7.7. Permutations and profit expectancy for red-black roulette after 3 wheel spins, for Martingale staking

Permu-tation	Bet	Outcome	Martingale stakes	Profit	Total	Chance	Profit expec.
1	R, R, R	B, B, B	1, 2, 4	-1, -2, -4	-7	0.125	-0.875
2	R, R, R	B, B, R	1, 2, 4	-1, -2, +4	+1	0.125	+0.125
3	R, R, R	B, R, B	1, 2, 1	-1, +2, -1	0	0.125	0
4	R, R, R	B, R, R	1, 2, 1	-1, +2, +1	+2	0.125	+0.25
5	R, R, R	R, B, B	1, 1, 2	+1, -1, -2	-2	0.125	-0.25
6	R, R, R	R, B, R	1, 1, 2	+1, -1, +2	+2	0.125	+0.25
7	R, R, R	R, R, B	1, 1, 1	+1, +1, -1	+1	0.125	+0.125
8	R, R, R	R, R, R	1, 1, 1	+1, +1, +1	+3	0.125	+0.375
Total			*36*		*0*	*1*	*0*

R = Red and B = Black

Overall, the profit expectancy is 0. In another words, with no edge over the roulette wheel, all we can hope for over the long term is to break even. A similar analysis for level staking returns exactly the same result – no overall expected profit (Table 7.8).

Table 7.8. Permutations and profit expectancy for red-black roulette after 3 wheel spins, for level staking

Permu-tation	Bet	Outcome	Level stakes	Profit	Total	Chance	Profit expec.
1	R, R, R	B, B, B	1, 1, 1	-1, -1, -1	-3	0.125	-0.375
2	R, R, R	B, B, R	1, 1, 1	-1, -1, +1	-1	0.125	-0.125
3	R, R, R	B, R, B	1, 1, 1	-1, +1, -1	-1	0.125	-0.125
4	R, R, R	B, R, R	1, 1, 1	-1, +1, +1	+1	0.125	+0.125
5	R, R, R	R, B, B	1, 1, 1	+1, -1, -1	-1	0.125	-0.125
6	R, R, R	R, B, R	1, 1, 1	+1, -1, +1	+1	0.125	+0.125
7	R, R, R	R, R, B	1, 1, 1	+1, +1, -1	+1	0.125	+0.125
8	R, R, R	R, R, R	1, 1, 1	+1, +1, +1	+3	0.125	+0.375
Total			*24*		*0*	*1*	*0*

All Martingale has achieved is an increase in the number of times we can expect to make a profit, in this example from 4 with level staking to 5. Unfortunately, this is at the expense of one large loss, which is essentially the source of the inherent risk associated with Martingale staking. Before it is dismissed out of hand completely, however, it is nonetheless worthwhile exploring how it compares to the other staking plans that have been examined so far.

For the purposes of the Monte Carlo simulations, a more appropriate staking progression for each betting scenario was identified than a simple doubling-up after losses, where the nature of the progression is dependent on the size of the odds, as illustrated in Table 7.9 by the following example sequence of bets.

Table 7.9. A typical Martingale stakes progression, initial stakes of 1 point

Bet	Odds	Stake	Target	Result	Profit	Running total	Running losses
1	2.38	1	1.38	Lose	-1	-1	-1
2	1.96	2.479	1.38	Lose	-2.479	-3.479	-3.479
3	2.02	4.764	1.38	Lose	-4.764	-8.243	-8.243
4	1.63	15.275	1.38	Win	+9.623	+1.38	0
5	1.96	1	0.96	Lose	-1	+0.380	-1
6	2.70	1.153	0.96	Win	+1.960	+2.340	0
7	1.79	1	0.79	Win	+0.790	+3.130	0
8	1.92	1	0.92	Lose	-1	+2.130	-1
9	1.91	2.110	0.92	Lose	-2.110	+0.02	-3.11
10	3.23	1.807	0.92	Win	+4.030	+4.050	0

For the 1-point staking plan, the first stake and each stake after every winning bet is 1. The odds of this bet set the profit target for following bet(s) if this one should lose. The aim, then, is to win back all that is lost, plus the identified target as profit, for each and every bet. The size of each stake is determined by the amount that needs to be won and the odds of the current bet, and is given by:

$$S_n = \{[L_{n-1}] + T_n\} / \{O_n - 1\}$$

where S_n is the size of the n^{th} stake, $[L_{n-1}]$ is the magnitude of the running losses up to the $(n-1)^{th}$ bet, and T_n and O_n are the profit target and (decimal) odds respectively for the n^{th} bet. For n = 1, the first bet, the running total of losses is obviously 0, and is 0 after every winning bet.

After a winning bet, a new target is set, determined by the size of the odds for the next bet, since the stake size reverts back to 1. In the sequence above, a new target is set for bets 5, 7, and 8, in addition to the first target for bet 1. It is apparent that, on occasion, the stake size of a bet after a loss may actually be less than the previous stake (as for the 10th bet), where the odds for the n^{th} bet are significantly greater than for the $(n - 1)^{th}$ bet, thus requiring less to be wagered to recover the losses and achieve the targeted profit. The reader may notice that the running total after the winning 10^{th} bet is equivalent to the sum of the 4 different targets set during the sequence, or 1.38 + 0.96 + 0.79 + 0.92. Whilst seemingly a little convoluted, this methodology offers perhaps the most appropriate means of comparison with the other staking strategies. As usual, the initial betting bank is 100. For a 5-point staking plan, for example, all stakes as calculated for the 1-point plan are multiplied by 5.

Table 7.10.1 to Table 7.10.4 summarises the outputs of the Monte Carlo simulations for Martingale staking: average finishing bankroll (7.10.1), the standard deviation in finishing bankroll (7.10.2), the probability of bankruptcy (7.10.3) and the probability of not making a profit (7.10.4). Once more, conclusions and comparisons follow the tabulated results.

Table 7.10.1. Average finishing bankroll (points) after 250 Martingale singles

		Bookmaker's expectancy				
Starting stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	48.4	49.8	46.6	41.5	38.4
	0.95	75.2	75.0	72.3	67.8	66.0
	1	96.7	100.0	101.2	97.5	100.8
	1.05	136.3	134.4	134.6	136.5	135.7
	1.1	159.9	159.5	166.0	168.8	166.7
	1.15	192.4	198.1	199.0	195.7	194.0
	1.2	231.8	227.6	230.6	229.3	214.1
2 points	*0.9*	38.2	40.4	36.1	29.8	23.9
	0.95	67.9	68.3	64.4	56.3	55.3
	1	92.3	99.2	101.1	96.1	99.7
	1.05	147.4	148.8	152.1	155.6	156.1
	1.1	179.9	187.0	203.5	209.5	212.1
	1.15	229.1	252.1	262.7	260.2	268.6
	1.2	295.4	306.5	325.4	330.4	314.3
3 points	*0.9*	33.9	34.7	29.4	23.4	18.6
	0.95	64.7	65.1	59.7	51.7	49.3
	1	91.0	97.0	100.5	94.1	98.0
	1.05	155.2	158.3	165.6	167.2	171.4
	1.1	191.7	207.1	230.5	238.1	248.5
	1.15	249.1	288.4	308.2	310.3	334.1
	1.2	336.6	367.4	399.5	419.0	406.9
5 points	*0.9*	30.4	32.3	23.8	17.3	13.7
	0.95	61.3	60.8	55.2	46.1	44.1
	1	90.6	95.8	100.5	91.5	96.6
	1.05	164.0	170.5	181.1	186.1	193.2
	1.1	208.4	234.3	269.9	284.6	305.5
	1.15	274.5	337.1	376.9	391.5	439.7
	1.2	389.7	455.7	528.6	578.5	574.9
10 points	*0.9*	25.9	27.3	18.6	12.2	8.4
	0.95	60.2	56.7	49.8	39.3	37.2
	1	88.0	94.8	97.6	87.3	93.9
	1.05	174.4	179.1	197.0	211.6	229.6
	1.1	243.3	270.1	329.4	361.3	407.4
	1.15	308.1	402.6	479.2	512.9	629.4
	1.2	481.1	583.5	750.9	873.4	933.5

Table 7.10.2. Standard deviation in finishing bankroll (points) after 250 Martingale singles

		Bookmaker's expectancy				
Starting stake size	Edge	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	120.9	105.7	92.7	81.6	71.8
	0.95	148.0	125.4	110.5	98.4	87.5
	1	165.5	140.1	123.2	109.8	96.4
	1.05	188.6	152.1	130.6	113.4	94.6
	1.1	199.3	157.4	133.1	110.2	85.7
	1.15	210.8	162.7	130.0	102.1	70.7
	1.2	218.1	159.8	119.7	83.8	54.2
2 points	*0.9*	148.2	130.2	110.4	92.3	74.2
	0.95	198.5	168.1	145.0	124.2	109.0
	1	231.3	199.3	176.8	155.4	136.2
	1.05	286.8	234.5	204.7	179.8	151.1
	1.1	312.9	255.0	223.0	191.0	151.3
	1.15	345.9	280.8	233.0	189.8	137.5
	1.2	377.1	290.2	228.2	172.7	112.9
3 points	*0.9*	170.0	146.6	119.4	97.1	76.8
	0.95	238.0	200.2	168.6	143.7	123.2
	1	283.2	243.5	216.6	189.6	166.0
	1.05	366.3	302.3	265.4	235.3	198.8
	1.1	405.3	337.0	300.6	262.6	211.2
	1.15	457.7	384.8	326.8	272.7	201.8
	1.2	515.1	410.0	335.5	261.4	172.7
5 points	*0.9*	208.1	180.4	136.3	104.2	81.7
	0.95	300.1	250.5	207.2	172.1	146.3
	1	366.8	314.8	280.2	241.5	213.3
	1.05	495.2	413.8	365.5	328.0	282.0
	1.1	558.0	476.3	436.3	386.8	322.4
	1.15	638.9	564.1	494.2	421.7	331.9
	1.2	749.2	625.7	533.8	430.8	300.2
10 points	*0.9*	271.8	233.5	168.5	121.3	85.9
	0.95	419.4	342.1	277.2	222.7	185.7
	1	512.6	446.1	394.1	332.6	296.9
	1.05	730.9	613.4	552.7	507.3	449.2
	1.1	863.3	746.9	709.5	647.7	562.2
	1.15	982.2	916.8	840.1	743.4	634.3
	1.2	1220.4	1069.9	983.8	847.3	627.1

Table 7.10.3. Probability of bankruptcy after 250 Martingale singles

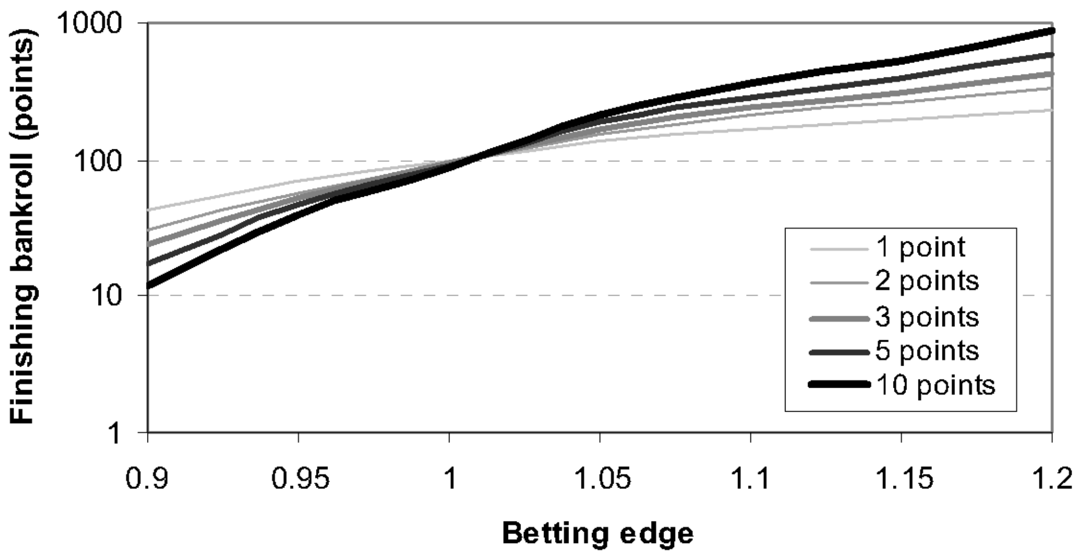
		Bookmaker's expectancy				
Starting stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	85.4%	80.7%	78.1%	77.5%	75.1%
	0.95	78.4%	72.1%	68.1%	65.4%	60.1%
	1	73.4%	64.7%	57.5%	53.3%	44.4%
	1.05	64.2%	54.4%	46.1%	38.2%	29.3%
	1.1	59.4%	47.6%	36.9%	27.5%	18.2%
	1.15	53.1%	38.7%	27.9%	19.3%	9.8%
	1.2	45.2%	31.4%	19.4%	10.2%	4.7%
2 points	*0.9*	93.3%	90.6%	89.5%	89.6%	89.4%
	0.95	88.9%	84.8%	82.4%	81.4%	77.5%
	1	85.5%	79.1%	73.9%	70.4%	62.5%
	1.05	78.0%	69.9%	62.5%	54.8%	45.4%
	1.1	74.0%	63.7%	52.4%	43.1%	31.2%
	1.15	68.3%	53.9%	42.0%	32.7%	18.8%
	1.2	60.5%	45.7%	30.8%	19.6%	9.9%
3 points	*0.9*	95.9%	94.4%	93.8%	94.0%	93.8%
	0.95	92.7%	89.8%	88.0%	87.6%	84.9%
	1	90.1%	85.6%	81.2%	79.0%	72.2%
	1.05	84.0%	77.3%	70.4%	64.5%	54.8%
	1.1	80.9%	71.4%	61.2%	52.8%	39.5%
	1.15	76.2%	62.8%	51.1%	41.7%	24.8%
	1.2	68.9%	54.2%	39.5%	26.2%	13.7%
5 points	*0.9*	97.8%	96.7%	96.8%	97.1%	97.0%
	0.95	95.8%	94.1%	92.8%	92.8%	90.8%
	1	93.9%	91.1%	87.8%	86.6%	81.6%
	1.05	89.6%	84.7%	79.0%	74.2%	66.0%
	1.1	87.2%	79.6%	70.9%	63.1%	50.6%
	1.15	83.7%	72.7%	61.8%	52.1%	34.6%
	1.2	77.8%	64.1%	48.7%	34.0%	19.7%
10 points	*0.9*	99.0%	98.6%	98.7%	98.9%	98.9%
	0.95	97.8%	97.2%	96.6%	96.7%	95.8%
	1	97.0%	95.5%	93.8%	93.1%	90.2%
	1.05	94.3%	91.7%	87.9%	84.3%	77.8%
	1.1	92.3%	87.9%	81.3%	75.1%	63.9%
	1.15	90.6%	83.2%	74.4%	66.6%	48.9%
	1.2	86.0%	76.2%	61.8%	47.1%	29.5%

Table 7.10.4. Probability of not making a profit after 250 Martingale singles

		Bookmaker's expectancy				
Starting stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	85.7%	81.5%	79.9%	79.7%	79.7%
	0.95	78.8%	73.0%	69.7%	68.0%	65.7%
	1	73.6%	65.4%	59.1%	55.6%	49.1%
	1.05	64.5%	55.1%	47.6%	40.2%	33.5%
	1.1	59.6%	48.2%	38.0%	29.0%	21.3%
	1.15	53.2%	39.1%	28.8%	20.4%	11.7%
	1.2	45.6%	31.8%	19.9%	10.9%	5.9%
2 points	*0.9*	93.4%	90.7%	89.8%	90.2%	90.5%
	0.95	88.9%	85.1%	82.7%	82.1%	79.0%
	1	85.6%	79.3%	74.3%	71.2%	64.0%
	1.05	78.1%	70.0%	63.0%	55.5%	46.9%
	1.1	74.1%	63.9%	52.8%	43.6%	32.0%
	1.15	68.3%	54.0%	42.4%	33.0%	19.3%
	1.2	60.6%	45.9%	31.1%	20.0%	10.3%
3 points	*0.9*	95.9%	94.4%	93.9%	94.2%	94.1%
	0.95	92.8%	89.9%	88.2%	87.8%	85.5%
	1	90.1%	85.7%	81.3%	79.2%	72.8%
	1.05	84.1%	77.4%	70.6%	64.8%	55.5%
	1.1	81.0%	71.5%	61.3%	53.1%	39.9%
	1.15	76.3%	62.9%	51.3%	41.9%	25.1%
	1.2	68.9%	54.2%	39.6%	26.4%	13.8%
5 points	*0.9*	97.8%	96.7%	96.8%	97.1%	97.1%
	0.95	95.8%	94.1%	92.9%	92.8%	91.0%
	1	94.0%	91.1%	87.9%	86.7%	81.8%
	1.05	89.6%	84.7%	79.1%	74.3%	66.2%
	1.1	87.2%	79.6%	71.0%	63.3%	50.7%
	1.15	83.8%	72.7%	61.8%	52.1%	34.7%
	1.2	77.9%	64.2%	48.8%	34.0%	19.8%
10 points	*0.9*	99.0%	98.6%	98.7%	98.9%	99.0%
	0.95	97.8%	97.2%	96.6%	96.7%	95.8%
	1	97.0%	95.5%	93.9%	93.1%	90.2%
	1.05	94.3%	91.7%	88.0%	84.3%	77.9%
	1.1	92.3%	87.9%	81.3%	75.2%	64.0%
	1.15	90.6%	83.2%	74.4%	66.6%	48.9%
	1.2	86.0%	76.2%	61.8%	47.1%	29.5%

What a disaster! As for other staking plans, where the punter has found an edge, a profit can potentially be made, greater for larger stakes and shorter odds, but only marginally better than for level staking and considerably worse than for percentage bank staking (Figure 7.19). For all but the safest scenarios, however, unless stakes are small enough, the odds short enough and the advantage over the bookmaker large enough, the risk of bankruptcy is considerable every time (Figures 7.20 and 7.21). Figure 7.22 illustrates just how dangerous Martingale staking can be in comparison to a comparable level staking strategy. The chances of returning a profit are equally minimal. What is more, the analysis provides adequate confirmation, if any were needed, that losing systems, that is where the edge is less than 1, are unable to turn losses into profits.

Figure 7.19. The influence of betting edge and stake size[51] on average finishing bankroll, with average bookmaker's expectancy 0.5, for Martingale staking



[51] For Martingale staking, the points size refers to the size of the first stake in every betting sequence, and the stake size after every winning bet.

Figure 7.20. The influence of stake size and betting edge on the probability of bankruptcy, with average bookmaker's expectancy 0.5, for Martingale staking

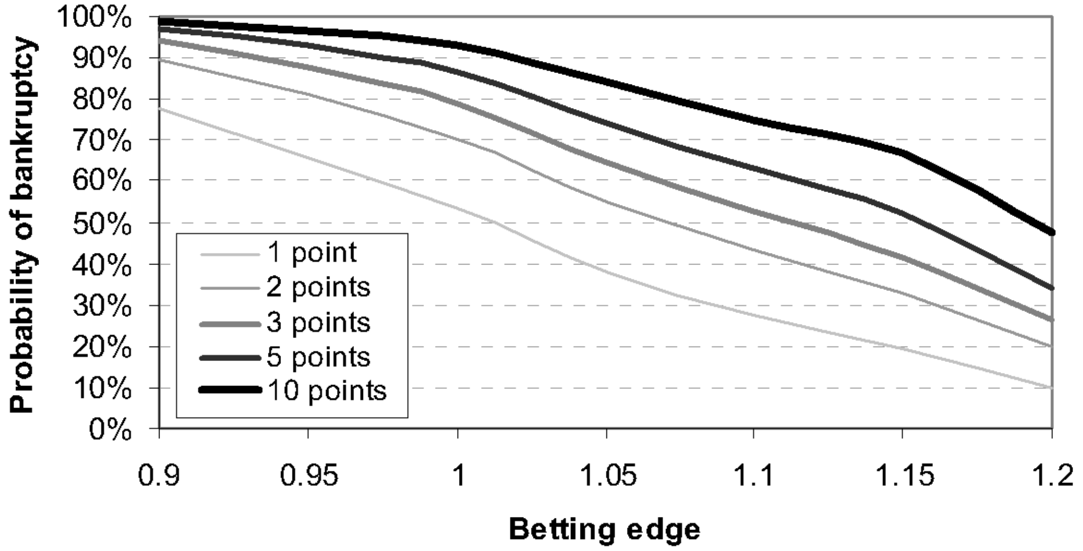


Figure 7.21. The influence of odds and betting edge on the probability of bankruptcy, for the 5-point Martingale staking plan

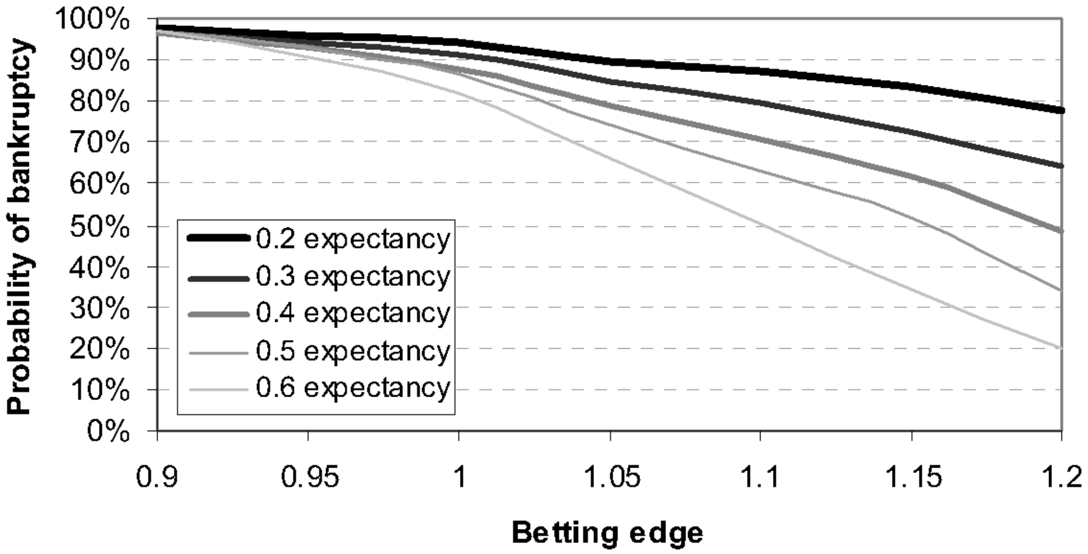
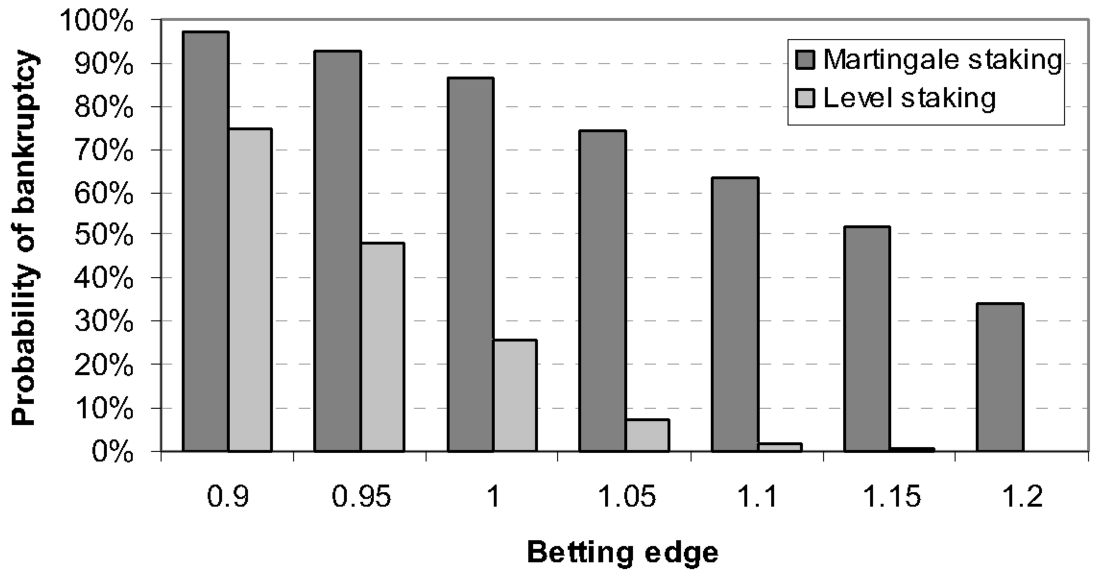


Figure 7.22. The comparison, between Martingale staking and level staking, of the probability of bankruptcy, for a bookmaker's expectancy of 0.5, with 5-point stakes



The realities of Martingale mean that when losing sequences are experienced, stake sizes and accumulated losses quickly spiral out of control. For a betting bank of only 100, starting stakes of even 1 point are not small enough to prevent only a relatively short losing run from ending in bankruptcy. Of course, one could start with a much larger betting bank, but will eventually be faced with the likelihood of having to stake maybe 1,000 points just to win 1 or 2. Even if the punter has the courage to indulge in such lunacy, it is often the case that the bookmaker's staking limits will prevent this opportunity from being taken. Alternatively, the punter could reduce the size of the starting stake to 0.1 point or even 0.01 points, but clearly this will be at the expense of the profits. Aside from the practical difficulties of making Martingale work for your betting strategy, however, we have seen how it is in fact a mathematically flawed strategy. In short, an unsuccessful punter will be unable to turn his losing system into a winning one with Martingale. A successful punter with a winning edge, meanwhile, will do just fine without it. Why worry about recovering losses when you know how to find enough winners?

The Pyramid Plan

The Martingale staking plan is perhaps the most extreme example of a progressive staking strategy. The Pyramid Plan, sometimes called the D'Alembert System,[52] is somewhat more conservative in the way that it increases the stake size after a loss. For the traditional Pyramid staking plan for 1/1 betting, stakes are increased by 1 point after a loss, and decreased by 1 point after a win, to a minimum of the starting stake. In this way, every loser has a corresponding winner with a 1-point higher stake, with the aim of recovering the loss.

Although clearly less aggressive than the Martingale progression, the idea that losses can be converted into profits over the long term again looks somewhat unconvincing. Further confirmation, if it were needed, of this fallacy is presented for Pyramid staking in Table 7.11.

Table 7.11. Permutations and profit expectancy for red-black roulette after 3 wheel spins, for Pyramid staking

Permu-tation	Bet	Outcome	Pyramid stakes	Profit	Total	Chance	Profit expec.
1	R, R, R	B, B, B	1, 2, 3	-1, -2, -3	-6	0.125	-0.75
2	R, R, R	B, B, R	1, 2, 3	-1, -2, +3	0	0.125	0
3	R, R, R	B, R, B	1, 2, 1	-1, +2, -1	0	0.125	0
4	R, R, R	B, R, R	1, 2, 1	-1, +2, +1	+2	0.125	+0.25
5	R, R, R	R, B, B	1, 1, 2	+1, -1, -2	-2	0.125	-0.25
6	R, R, R	R, B, R	1, 1, 2	+1, -1, +2	+2	0.125	+0.25
7	R, R, R	R, R, B	1, 1, 1	+1, +1, -1	+1	0.125	+0.125
8	R, R, R	R, R, R	1, 1, 1	+1, +1, +1	+3	0.125	+0.375
Total			*34*		*0*	*1*	*0*

No surprise there. As for Martingale and level staking, the profit expectancy for a system with 0% edge is of course zero.[53] Losses most definitely **cannot** be turned into profits. Nevertheless, let's look at the Monte Carlo simulations.

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[52] The D'Alembert System is named after the 18th-century French mathematician, Jean Le Rond D'Alembert, who supposedly applied his "Theory of Equilibrium" to casino gambling.

[53] The total profit expectancy for any system with an edge less than 1 is negative, and positive for an edge greater than 1. A proof of this generalisation is offered by Stuart Holland in *Successful Staking Strategies*, and is true for all staking plans, progressions included.

For the 1-point plan, stakes are increased by 1 after every loss, and reduced, to a minimum of 1 point, by an amount equivalent to the decimal odds of the winner minus 1. This scenario is exemplified by Table 7.12. Similarly, for a 5-point plan, stakes are increased by 5 after a loss, and decreased by 5 multiplied by the decimal odds minus 1 after a winner.

Table 7.12. A typical Pyramid stakes progression, initial stakes of 1 point

Bet	Odds	Stake	Result	Profit	Running total
1	2.38	1	Lose	-1	-1
2	1.96	2	Lose	-2	-3
3	2.02	3	Lose	-3	-6
4	1.63	4	Win	+2.52	-3.48
5	1.96	3.37	Lose	-3.37	-6.85
6	2.70	4.37	Win	+7.43	0.58
7	1.79	2.67	Win	+2.11	2.69
8	1.92	1.88	Lose	-1.88	0.81
9	1.91	2.88	Lose	-2.88	-2.07
10	3.23	3.88	Win	+8.65	6.58

Table 7.13.1 to Table 7.13.4 summarises the outputs of the Monte Carlo simulations for Pyramid staking: average finishing bankroll (7.13.1), the standard deviation in finishing bankroll (7.13.2), the probability of bankruptcy (7.13.3) and the probability of not making a profit (7.13.4).

Table 7.13.1. Average finishing bankroll (points) after 250 Pyramid singles

		Bookmaker's expectancy				
Starting stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	37.8	28.5	21.3	17.1	12.5
	0.95	60.8	55.4	52.3	49.5	45.1
	1	94.6	96.7	98.4	99.4	101.6
	1.05	143.8	153.8	156.6	157.4	153.2
	1.1	197.1	207.5	211.0	202.1	186.5
	1.15	262.9	273.0	260.9	235.6	203.7
	1.2	335.4	325.5	294.2	251.5	211.3
2 points	*0.9*	36.3	23.1	16.2	12.5	7.4
	0.95	62.2	53.8	45.0	41.3	36.9
	1	94.6	95.7	95.2	97.0	99.6
	1.05	160.2	170.9	177.5	185.6	183.7
	1.1	222.8	242.9	259.1	262.0	248.8
	1.15	313.6	333.9	356.1	336.0	297.2
	1.2	420.8	431.0	436.5	383.9	319.6
3 points	*0.9*	34.0	20.6	13.8	9.7	5.4
	0.95	60.1	52.0	42.0	37.1	31.8
	1	92.6	92.3	92.0	93.0	96.2
	1.05	167.4	180.7	191.1	202.7	205.7
	1.1	232.3	259.9	292.3	303.8	298.1
	1.15	341.0	377.5	423.2	413.2	378.5
	1.2	469.2	508.6	549.9	497.9	423.4
5 points	*0.9*	33.8	19.6	11.4	7.7	4.0
	0.95	58.4	46.8	38.9	33.4	28.1
	1	87.1	88.2	92.3	88.8	91.9
	1.05	172.0	186.9	203.5	224.1	234.7
	1.1	247.9	290.4	341.7	364.6	372.5
	1.15	370.2	427.6	510.2	525.3	515.1
	1.2	529.4	611.7	723.0	691.0	613.5
10 points	*0.9*	28.0	15.6	10.4	5.4	2.9
	0.95	50.4	44.2	32.2	28.4	22.8
	1	80.0	84.5	92.8	82.9	89.6
	1.05	163.9	190.3	225.6	247.6	278.9
	1.1	268.4	323.4	418.3	455.3	493.9
	1.15	385.2	492.5	631.1	698.9	752.3
	1.2	603.0	763.5	1006.0	1044.7	1011.7

Table 7.13.2. Standard deviation in finishing bankroll (points) after 250 Pyramid singles

		Bookmaker's expectancy				
Starting stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	162.2	99.9	71.6	53.9	40.4
	0.95	200.0	136.7	106.8	86.4	70.9
	1	247.3	173.8	137.7	109.4	87.5
	1.05	288.6	200.5	147.5	104.5	69.9
	1.1	327.5	216.2	143.2	87.2	44.1
	1.15	359.1	216.4	123.6	60.2	21.5
	1.2	376.9	203.1	95.1	37.0	12.7
2 points	*0.9*	223.2	123.3	82.8	60.0	39.8
	0.95	287.6	188.1	137.1	107.6	86.4
	1	354.9	247.6	195.4	157.8	129.1
	1.05	441.5	313.7	240.7	181.5	131.3
	1.1	511.7	359.6	262.4	179.5	109.2
	1.15	592.2	393.5	259.2	152.5	68.4
	1.2	652.3	405.1	226.8	110.4	40.1
3 points	*0.9*	266.7	141.6	91.7	62.6	40.2
	0.95	350.7	225.3	160.7	122.7	96.0
	1	432.6	299.8	237.0	191.8	158.5
	1.05	559.2	403.8	315.7	245.8	184.3
	1.1	653.0	474.1	362.6	263.0	172.1
	1.15	773.6	540.4	384.1	246.5	126.0
	1.2	875.6	581.2	359.4	195.8	76.9
5 points	*0.9*	347.0	176.3	106.3	70.2	42.8
	0.95	454.2	275.2	198.0	147.5	113.2
	1	547.9	380.1	308.2	243.4	202.9
	1.05	737.8	542.4	435.4	351.8	275.9
	1.1	882.5	666.3	534.7	410.1	290.9
	1.15	1069.7	782.9	604.1	426.6	249.7
	1.2	1241.5	886.0	616.0	374.8	175.3
10 points	*0.9*	438.0	219.2	141.6	80.1	49.5
	0.95	600.8	376.2	253.1	189.9	140.2
	1	749.3	528.8	439.0	335.2	285.2
	1.05	1020.7	785.2	666.3	549.8	458.2
	1.1	1316.3	1022.2	881.3	710.5	550.6
	1.15	1587.6	1245.5	1046.3	816.7	565.5
	1.2	1939.8	1499.0	1187.0	824.5	470.3

Table 7.13.3. Probability of bankruptcy after 250 Pyramid singles

		Bookmaker's expectancy				
Starting stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	93.8%	91.6%	90.7%	89.6%	89.9%
	0.95	90.1%	84.3%	78.3%	72.7%	67.9%
	1	85.5%	74.5%	63.6%	52.3%	39.7%
	1.05	77.8%	60.5%	43.6%	27.7%	14.7%
	1.1	71.0%	49.8%	28.7%	13.9%	4.3%
	1.15	62.5%	36.6%	16.2%	5.2%	0.7%
	1.2	52.8%	26.0%	7.6%	1.5%	0.1%
2 points	*0.9*	96.9%	96.1%	95.7%	95.3%	96.1%
	0.95	94.7%	91.7%	89.0%	85.8%	82.8%
	1	92.4%	86.0%	79.3%	71.1%	60.9%
	1.05	87.0%	75.5%	62.2%	46.5%	31.3%
	1.1	82.6%	67.0%	48.3%	30.3%	14.9%
	1.15	76.3%	56.6%	32.7%	16.1%	4.4%
	1.2	68.5%	45.2%	19.2%	6.8%	1.1%
3 points	*0.9*	98.1%	97.7%	97.4%	97.3%	98.0%
	0.95	96.6%	94.4%	92.8%	90.6%	89.0%
	1	95.0%	90.6%	85.8%	79.9%	71.8%
	1.05	90.8%	82.1%	71.1%	57.5%	42.3%
	1.1	87.7%	75.7%	58.7%	41.4%	23.7%
	1.15	82.4%	65.9%	43.4%	25.3%	9.3%
	1.2	76.0%	55.2%	28.0%	12.5%	2.6%
5 points	*0.9*	98.9%	98.6%	98.6%	98.7%	99.0%
	0.95	98.0%	96.8%	95.8%	94.6%	93.6%
	1	97.2%	94.4%	91.1%	87.6%	82.1%
	1.05	94.2%	88.6%	80.7%	69.7%	56.2%
	1.1	92.0%	83.2%	69.6%	54.6%	36.7%
	1.15	88.4%	76.1%	57.0%	38.9%	18.3%
	1.2	83.4%	66.6%	40.4%	21.8%	6.9%
10 points	*0.9*	99.5%	99.4%	99.4%	99.5%	99.6%
	0.95	99.2%	98.5%	98.2%	97.6%	97.2%
	1	98.7%	97.3%	95.3%	93.9%	90.6%
	1.05	97.2%	94.0%	88.9%	82.3%	71.7%
	1.1	95.6%	90.4%	80.7%	70.1%	54.4%
	1.15	93.9%	85.9%	72.4%	57.1%	35.5%
	1.2	90.5%	78.6%	56.9%	37.6%	17.1%

Table 7.13.4. Probability of not making a profit after 250 Pyramid singles

		Bookmaker's expectancy				
Starting stake size	**Edge**	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
1 point	*0.9*	94.0%	91.9%	91.6%	91.4%	93.2%
	0.95	90.4%	85.0%	80.0%	75.8%	74.6%
	1	85.7%	75.1%	64.9%	54.4%	43.8%
	1.05	78.1%	61.2%	45.3%	29.9%	17.6%
	1.1	71.2%	50.4%	30.0%	14.9%	5.0%
	1.15	62.7%	37.0%	16.9%	5.4%	0.8%
	1.2	53.0%	26.3%	8.0%	1.6%	0.1%
2 points	*0.9*	97.0%	96.2%	96.0%	95.6%	96.7%
	0.95	94.8%	91.8%	89.4%	86.5%	84.3%
	1	92.5%	86.1%	79.6%	71.5%	61.8%
	1.05	87.0%	75.6%	62.7%	47.1%	32.3%
	1.1	82.7%	67.2%	48.8%	30.6%	15.2%
	1.15	76.4%	56.7%	32.9%	16.1%	4.5%
	1.2	68.6%	45.3%	19.4%	6.8%	1.1%
3 points	*0.9*	98.1%	97.7%	97.6%	97.4%	98.2%
	0.95	96.7%	94.5%	93.0%	91.0%	89.5%
	1	95.0%	90.6%	86.0%	80.0%	72.1%
	1.05	90.8%	82.2%	71.4%	57.8%	42.8%
	1.1	87.8%	75.8%	58.9%	41.5%	23.9%
	1.15	82.4%	66.0%	43.5%	25.3%	9.3%
	1.2	76.1%	55.2%	28.1%	12.5%	2.6%
5 points	*0.9*	98.9%	98.7%	98.7%	98.7%	99.1%
	0.95	98.1%	96.9%	95.9%	94.6%	93.7%
	1	97.2%	94.5%	91.2%	87.6%	82.2%
	1.05	94.2%	88.6%	80.8%	69.8%	56.4%
	1.1	92.0%	83.2%	69.7%	54.7%	36.8%
	1.15	88.4%	76.1%	57.0%	38.9%	18.3%
	1.2	83.5%	66.6%	40.4%	21.9%	6.9%
10 points	*0.9*	99.5%	99.4%	99.4%	99.5%	99.6%
	0.95	99.2%	98.5%	98.2%	97.6%	97.2%
	1	98.7%	97.3%	95.4%	93.9%	90.6%
	1.05	97.2%	94.0%	89.0%	82.3%	71.8%
	1.1	95.6%	90.4%	80.8%	70.1%	54.5%
	1.15	94.0%	85.9%	72.4%	57.1%	35.5%
	1.2	90.5%	78.6%	56.9%	37.6%	17.1%

So much for being more conservative. Despite the less aggressive loss recovery strategy, the Pyramid staking plan performs little better than the Martingale, and for losing systems it is potentially more treacherous with a dismal average finishing bank (Figure 7.23), and a very high expectancy of bankruptcy for larger stakes (Figure 7.24) and longer odds (Figure 7.25).

Figure 7.23. The influence of betting edge and stake size[54] on average finishing bankroll, with average bookmaker's expectancy 0.5, for Pyramid staking

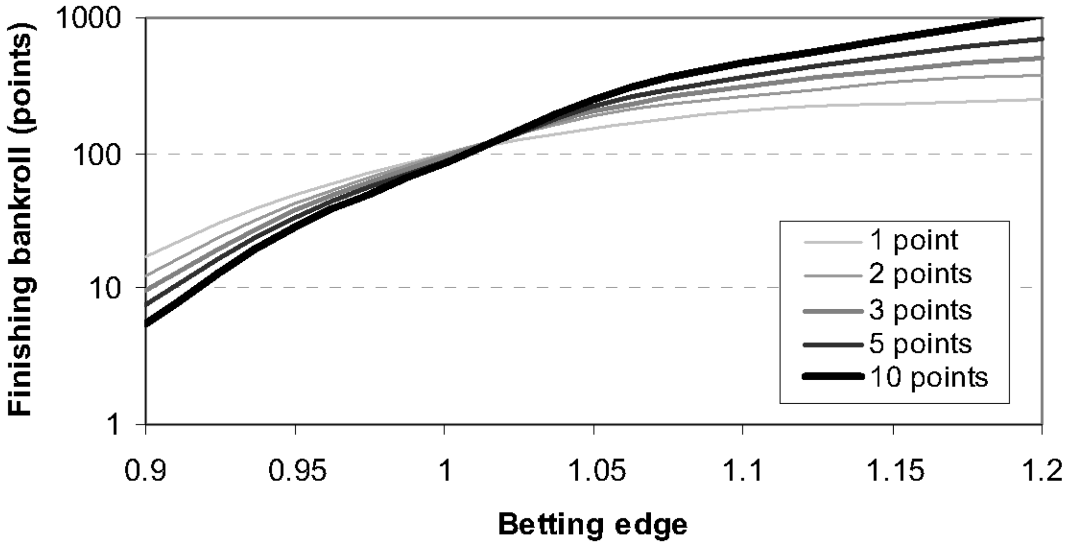
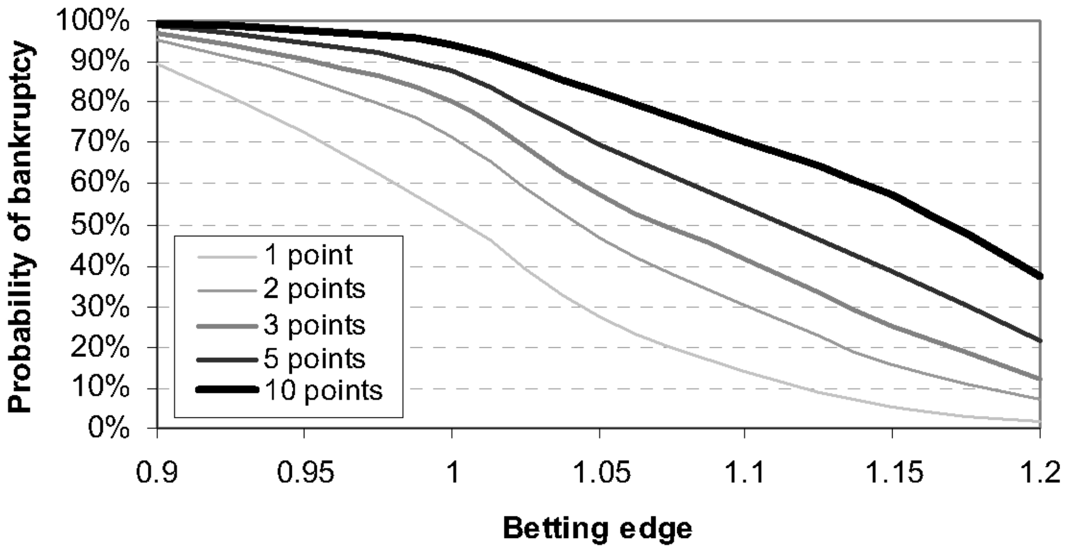


Figure 7.24. The influence of stake size and betting edge on the probability of bankruptcy, with average bookmaker's expectancy 0.5, for Pyramid staking.



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[54] For Pyramid staking the points size refers to the size of the first stake, and the size by which the stake is increased after every loss.

Figure 7.25. The influence of odds and betting edge on the probability of bankruptcy, for the 5-point Pyramid staking plan

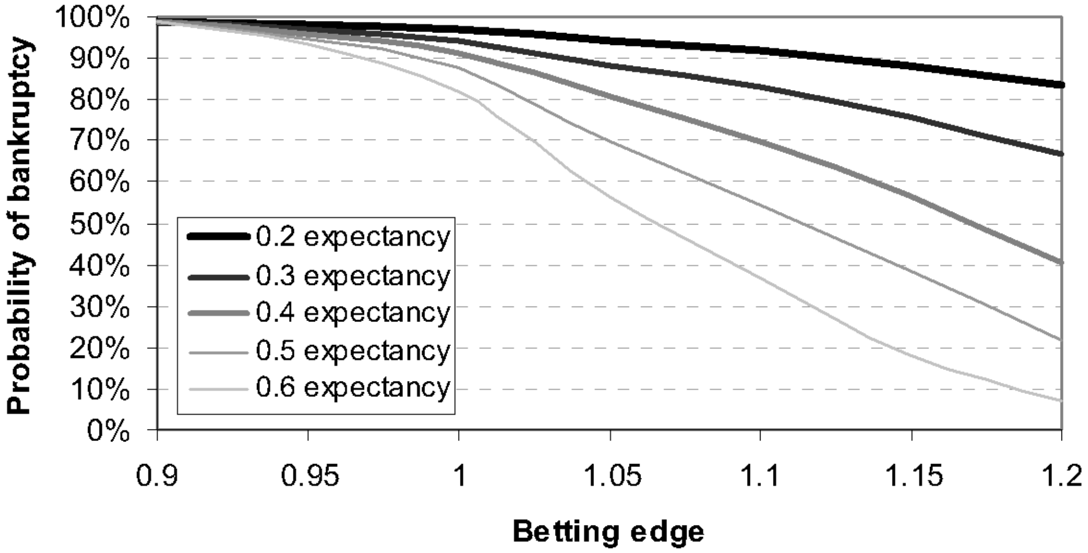
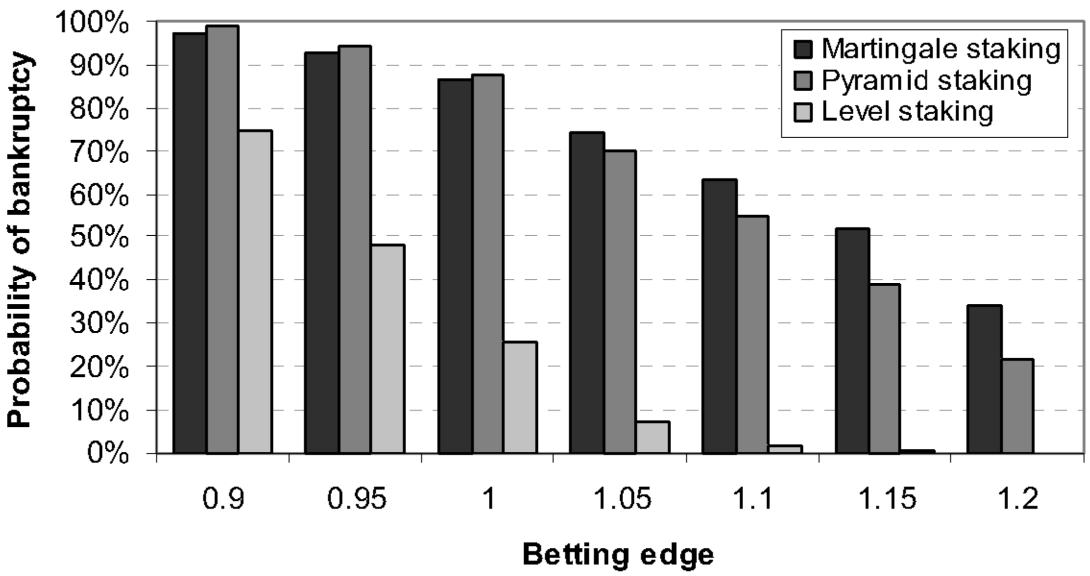


Figure 7.26 compares the risks for Pyramid, Martingale and level staking for a 5-point even money betting strategy.

Figure 7.26. The comparison, between Pyramid staking, Martingale staking and level staking, of the probability of bankruptcy, for a bookmaker's expectancy of 0.5, for the 5-point staking plan



Kelly Staking

So far, it would seem that fixed profits staking offers the safest and most consistent way of generating a profit, provided the punter has secured a real edge over the bookmaker's prices, whilst percentage bank staking, although less frequently profitable on a season-by-season basis, will present the best method of increasing the returns with the least likelihood of bankruptcy. Given these contrasting conclusions, a successful punter with an edge may wonder whether there exists a staking strategy with an optimum risk–reward trade-off, which if repeated over a period of time, will allow a betting bank to grow at the maximum rate for minimum risk. The answer to this is the Kelly Criterion. By combining both fixed profits and percentage bank approaches, one may create a money management plan known as Kelly staking.

Developed by John Kelly while working at AT&T's Bell Labs in 1956, the mathematics of the Kelly Criterion are rather complex, involving what are known as utility functions. By taking into account the expected rate of return and the risk, the Kelly utility function provides an economically justified and mathematically precise way to compute optimal bet sizes that maximise the overall growth of a bankroll, rather than profit over turnover. The original paper was published by Kelly in the Bell System Technical Journal and can be read at http://www.racing.saratoga.ny.us/kelly.pdf, whilst Stuart Holland in *Successful Staking Strategies* provides a simpler explanation. For sports betting, however, it is important only to know how to calculate the Kelly stake size. This is given by the following relationship:

$$K = (E-1)/(O-1)$$ [55]

where K is the size of the Kelly stake as a decimal percentage of the bankroll, E is the decimal edge as presented throughout this book[56] and O denotes the decimal odds.

[55] According to Kelly, this equation strictly only applies when there is a "two-horse race", although it is commonly used when there are more possible outcomes, for example in football match betting where there is the home win, draw and away win.

[56] An edge of 10%, for example, has been denoted as 1.1 throughout this book, rather than as 0.1. In this way, edges greater than 1 represent a punter's advantage over the bookmaker, with those less than 1 representing an advantage for the bookmaker over the punter.

With the Kelly Criterion, one is always betting percentages of the bankroll, so as the bankroll grows, so does the size of the stakes. Likewise, when the bankroll shrinks, the stake size will shrink too. For any particular size of bankroll, the stake size is also dependent upon both the odds, as for fixed profits staking, and crucially also the edge a punter has found. We know, of course, that estimating an edge over the bookmaker's offered odds is no easy task. A punter will always have a hunch about how wrong the bookmaker may be in pricing a particular event, but there is no substitute for analysing a previous record of bets. If these are singles, the average edge is then simply the profit yield of the record. Table 7.14 shows some examples of Kelly stakes.

Table 7.14. Some examples of Kelly stakes

Edge	Odds	Edge-1	Odds-1	Kelly stake (decimal)	Kelly stake (%)	Bankroll	Actual stake
1.1	1.5	0.1	0.5	0.2	20%	100	20
1.05	2	0.05	1	0.05	5%	200	10
1.15	3.25	0.15	2.25	0.0667	6.667%	500	33.33
1.025	5	0.025	4	0.00625	0.625%	250	1.56
1.075	10	0.075	9	0.00833	0.833%	400	3.33

With Kelly betting, it is theoretically possible to calculate the rate at which a bankroll will grow. For every bet, the growth expectancy factor by which the bankroll increases is given by:

$$F_n = K_n (E_n - 1) + 1$$

which is equivalent to:

$$F_n = \frac{(E_n - 1)^2}{O_n - 1} + 1$$

where F_n denotes the bank growth factor for the n^{th} bet. For a Kelly stake of 20% on a bet with edge 1.1, for example, the bank growth expectancy factor is 1.02. This means one can expect the bankroll to grow by 2% for such a bet. Of course, sometimes such a bet would win, other times it would lose, but with value in the odds, on average the bankroll should grow by 2%. The size of the bankroll after n bets may then be determined by the following expression:

$$B_n = B\,(F_1\ F_2\ F_3 \ldots\ldots F_n)$$

where B is the starting bankroll and B_n is the bankroll after n bets. For most types of betting, the punter either prefers to or is required to back variable odds. Some handicap bettors, however, particularly for American sports, may back the same price for most bets, usually close to evens or a little shorter due to the bookmaker's overround. In this case, assuming the edge, and therefore the Kelly stake size, is the same each time, a bettor can predetermine the expected size of his bank after any number of bets since $F_1 = F_2 = F_3 = F_n$. Consequently:

$$B_n = BF^n$$

After 100 even money bets, each with an edge of 10%, for example, a punter betting Kelly stakes could expect[57] a starting bankroll of 100 to grow to about 270.5, since $1.01^{100} = 2.705$.

It is clear from this discussion that where a punter fails to gain an edge, the significance of Kelly staking becomes rather lost, since one must have an edge over the bookmaker's odds to be able to calculate the stake size.[58] There are also inherent dangers with Kelly staking, where the punter is a poor judge of his advantage. Estimating value in the odds is never an easy task, and the punter must be careful not to overestimate what he believes to be the size of his edge, and consequently wager more than he ought. For some people, maximising the growth of the bankroll may not be the most important objective. If safety is a greater concern, a fractional Kelly approach may be used instead; for instance, betting one-

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[57] Because Kelly staking is built on percentage bank staking, for which the distribution of possible finishing bankrolls is positively skewed towards larger values (see, for example, Figure 7.7), the average finishing bankroll will be higher than the most common finishing bankrolls, its value increased by a few very large ones. For 100 even money bets with a 10% edge, the most common number of winners will be 55, and the finishing bankroll, given by $E^W \times (1-K)^L$ where E is the edge, K the Kelly stake, and W and L are the number of winners and losers respectively, will be 165. This is the median bankroll. The average bankroll of 270.5, by contrast, would require between 57 and 58 winners to achieve.

[58] In fact, classical Kelly staking sometimes does advise a bet at valueless odds, where there are more than 2 possible outcomes for a sporting event, and for which the (E-1)/(O-1) formula does not strictly apply. In horse racing, for example, a punter may bet on two (or more) horses in a single race, one of which may not represent value.

half or one-third of the suggested Kelly stakes. Such strategies will obviously have the benefit of reducing the probability of bankruptcy, although they will slow down the expected growth of the bankroll. The choice of what approach to follow will depend upon the risk attitude of the punter.

To test the success of Kelly staking using a Monte Carlo simulation, it has been assumed that the betting edge for each of the 250 bets is the same for the purposes of calculating each stake size, for each of the 4 betting edge scenarios, 1.05, 1.1, 1.15 and 1.2, for which a Kelly stake can be calculated. For the 1.05 average betting edge scenario, for example, the Kelly stake for every bet has been calculated on the basis of an edge of 1.05 (or 5%). Although specific edges, shown in the appendix, have actually been assigned for each bet for the purposes of calculating each fair win expectancy, it is felt that it would be impossible for a punter to be so accurate in estimating his advantage. Furthermore, for some of the betting edge scenarios, many of the edges are less than 1. For the 1.05 average betting edge scenario, as many as 32% of the bets have been assigned no value (see Table 7.1). Consequently, where the actual edge is less, the stake will be technically too large; where it is more, the stake will be smaller than the optimum size. Nevertheless, structured in this manner, the simulation should provide a reasonable analysis of Kelly staking in a realistic betting context.

Table 7.15.1 to Table 7.15.4 summarises the outputs of the Monte Carlo simulations for Kelly staking: average finishing bankroll (7.15.1), the standard deviation in finishing bankroll (7.15.2), the probability of bankruptcy (7.15.3) and the probability of not making a profit (7.15.4).

Table 7.15.1. Average finishing bankroll (points) after 250 Kelly stake singles

	Bookmaker's expectancy				
Edge	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
0.9	NA	NA	NA	NA	NA
0.95	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA
1.05	119.8	134.3	153.0	187.4	266.1
1.1	194.0	295.1	568.3	1487.9	6548.5
1.15	425.6	1194.9	4871.4	32880	874640
1.2	1341.1	7383.4	78588	3501464	246495068

Table 7.15.2. Standard deviation in finishing bankroll (points) after 250 Kelly stake singles

	Bookmaker's expectancy				
Edge	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
0.9	NA	NA	NA	NA	NA
0.95	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA
1.05	51.6	77.0	111.6	182.1	347.5
1.1	201.8	428.2	1079.8	4394.4	31384.4
1.15	907.6	3340.6	23037	279850	10702643
1.2	5691.8	42637	586858	79045976	3750165136

Table 7.15.3. Probability of bankruptcy after 250 Kelly stake singles

	Bookmaker's expectancy				
Edge	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
0.9	NA	NA	NA	NA	NA
0.95	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA
1.05	0.00%	0.00%	0.00%	0.00%	0.00%
1.1	0.00%	0.00%	0.00%	0.01%	0.03%
1.15	0.00%	0.02%	0.04%	0.10%	0.03%
1.2	0.00%	0.08%	0.12%	0.06%	0.01%

Table 7.15.4. Probability of not making a profit after 250 Kelly stake singles

	Bookmaker's expectancy				
Edge	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
0.9	NA	NA	NA	NA	NA
0.95	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA
1.05	41.6%	38.6%	37.6%	35.7%	32.8%
1.1	35.0%	31.2%	24.9%	19.6%	14.0%
1.15	28.6%	21.9%	15.8%	11.1%	3.9%
1.2	22.4%	16.1%	9.2%	4.1%	0.8%

There is no doubt that Kelly staking can make a punter a lot of money, provided he can both gain an edge and be fairly accurate, on average, in its assessment. Table 7.15.1 reveals that profits have the potential to be truly astronomical, although there exists an enormous amount of variability in the size of the finishing bankroll (Table 7.15.2), with the majority of finishing bankrolls lower than the average value, a feature common to all percentage staking plans (see footnote 57 earlier). Figure 7.27 reveals that profit is highly dependent on the odds, although this would be expected on account of the inverse relationship between the betting price and the size of the Kelly stake. Shorter odds will attract larger stakes, longer odds smaller bets. Despite this, however, the risk of bankruptcy is negligible for every scenario, and the chances of not returning a profit still decrease for shorter odds, despite stakes being proportionally larger (Figure 7.28).

Figure 7.27. The influence of odds and betting edge on average finishing bank, for Kelly staking

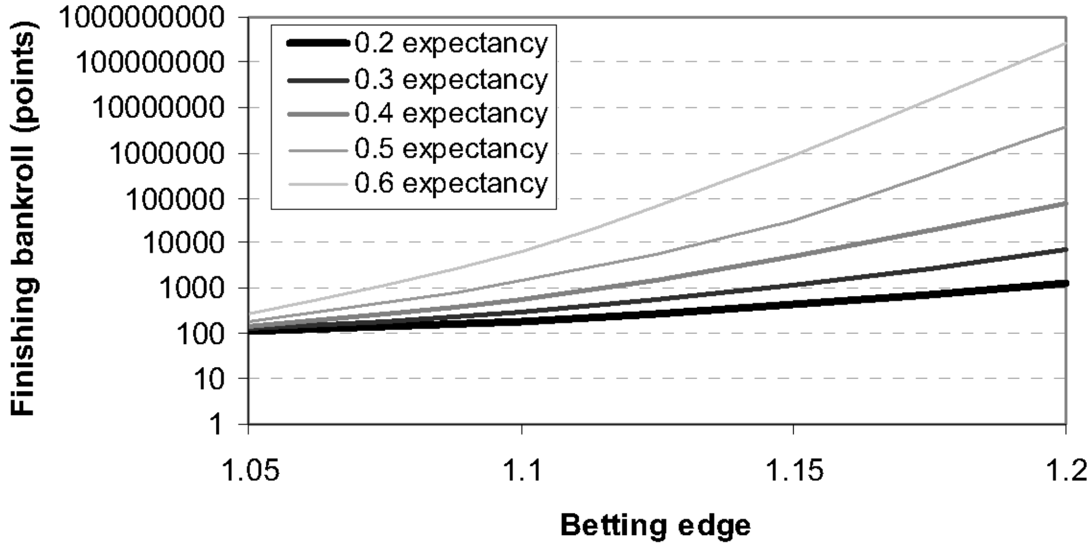
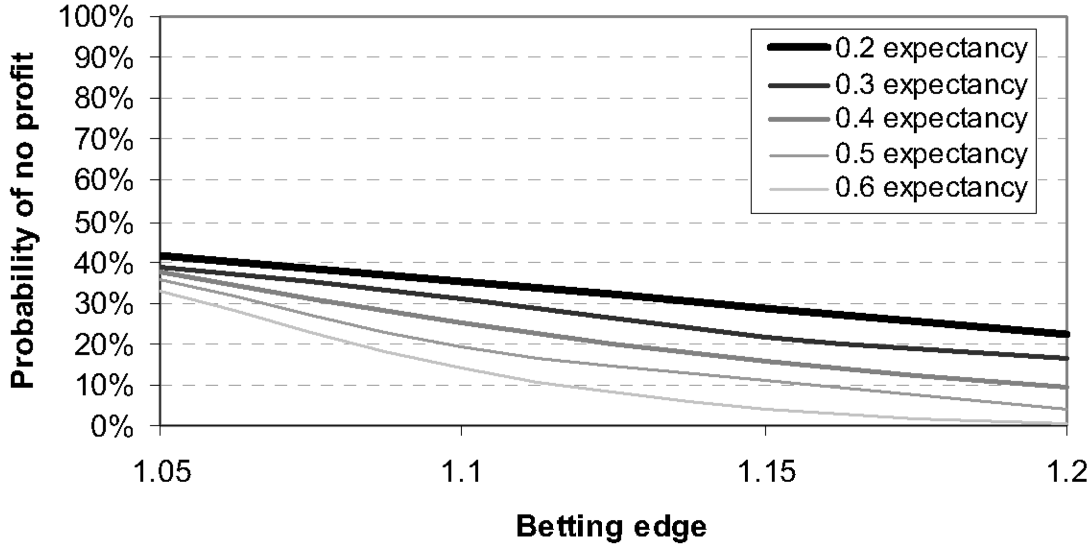


Figure 7.28. The influence of odds and betting edge on the probability of failing to return a profit, for Kelly staking



Using $B_n = B (F_1 F_2 F_3 \ldots\ldots F_{250})$, it is possible to calculate the expected[59] size of the finishing bankroll for each scenario, assuming that the betting edge for each of the 250 bets is the same. Table 7.16 shows these expected finishing bankrolls for each betting scenario according to this equation, whilst in Table 7.17 a comparison is made with the actual average finishing bankrolls. The difference between the two, for each scenario, is expressed by means of a ratio (actual/expected), and provides a measure of how well the real scenarios perform, given the punter's margin of error in the assessment of the edge for each specific bet.[60]

Table 7.16. Expected finishing bankroll (points) after 250 Kelly stake singles

	Bookmaker's expectancy				
Edge	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
0.9	NA	NA	NA	NA	NA
0.95	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA
1.05	118	133	157	199	294
1.1	194	314	608	1559	7204
1.15	442	1305	5681	45866	1329786
1.2	1395	9410	124483	4765145	1583562064

Table 7.17. Ratio of actual average finishing bankroll to expected finishing bankroll after 250 Kelly stake singles

	Bookmaker's expectancy				
Edge	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
0.9	NA	NA	NA	NA	NA
0.95	NA	NA	NA	NA	NA
1	NA	NA	NA	NA	NA
1.05	1.01	1.01	0.97	0.94	0.91
1.1	1.00	0.94	0.93	0.95	0.91
1.15	0.96	0.92	0.86	0.72	0.66
1.2	0.96	0.78	0.63	0.73	0.16

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[59] Considered here to be the average, and not the median, finishing bankroll (see footnote 57).

[60] The standard deviation in the edge for each betting scenario was about 0.1, meaning about two-thirds of the betting edges were within 0.1 either above or below the average edge for that scenario. For an average edge of 1.05, for example, the scenario assumed that 32% of bets actually failed to hold value. As argued, this feature is intended to replicate a punter's likely betting experience, and is preferable to awarding an edge of 5% for every bet, something a punter would find impossible to achieve, given the inherent uncertainties in sports prediction. Readers may wish to refer back to Table 7.1 and also the appendix.

For the majority of betting scenarios, it is surprising how close the actual average finishing bankroll is to the expected finishing bank. The discrepancy widens for increasing edge and decreasing odds, presumably because the size of the Kelly stakes is larger, and errors in the assessment of the specific edge for any bet will have a greater impact on profit growth. Nonetheless, provided a punter is, on average, a fairly good judge of his advantage, his actual profit growth should not fall far short of that predicted by the Kelly staking methodology.

Kelly staking appears, on the face of it, to represent the Holy Grail of staking plans. Provided a punter has gained an edge and is willing to ride out the potentially longer recovery periods in comparison to level staking, the profits may potentially be limitless, and, what is more, with minimal risk of bankruptcy. What happens to profits growth and risk, however, if the punter is a poor judge of his advantage, or even worse, believes he has found an edge when in fact there is none at all? Naturally, where the edge has been overestimated, the punter will be wagering more than he ought to be, and placing his bankroll at greater risk than he otherwise would. Where there is really no edge, the punter should not actually make a wager at all. For any serious value bettor, of course, this applies as much to any other staking plan as it does to Kelly betting.

Table 7.18.1 to Table 7.18.4 summarises the outputs of the Monte Carlo simulations for Kelly staking, for scenarios where the punter has inaccurately estimated his average edge. For every scenario, this is assumed to be 5% (or 1.05). For actual edges less than 5%, Kelly stakes will be too large; for those more than 5%, too small. Where the actual edge is 1.05, results are analogous to those in Tables 7.15.1 to 7.15.4.

Table 7.18.1. Average finishing bankroll (points) after 250 Kelly stake singles, for an edge estimate of 1.05

	Bookmaker's expectancy				
Edge	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
0.9	69.7	55.3	40.1	25.5	12.1
0.95	83.8	76.9	63.9	48.7	33.5
1	97.9	101.6	100.1	94.9	101.1
1.05	119.8	134.3	153.0	187.4	266.1
1.1	139.2	172.7	242.4	392.0	806.4
1.15	162.2	233.0	376.7	729.6	2394.2
1.2	191.4	301.9	580.9	1482.8	6291.5

Table 7.18.2. Standard deviation in finishing bankroll (points) after 250 Kelly stake singles, for an edge estimate of 1.05

	Bookmaker's expectancy				
Edge	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
0.9	28.6	31.3	29.2	25.0	17.7
0.95	34.7	43.4	46.8	48.9	51.7
1	41.6	57.8	72.3	92.6	143.3
1.05	51.6	77.0	111.6	182.1	347.5
1.1	61.3	99.5	174.9	365.3	1007.6
1.15	71.7	134.8	274.6	658.2	2622.6
1.2	85.8	175.9	418.2	1311.4	6455.7

Table 7.18.3. Probability of bankruptcy after 250 Kelly stake singles, for an edge estimate of 1.05

	Bookmaker's expectancy				
Edge	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
0.9	0.00%	0.00%	0.00%	0.01%	4.36%
0.95	0.00%	0.00%	0.00%	0.00%	0.37%
1	0.00%	0.00%	0.00%	0.00%	0.01%
1.05	0.00%	0.00%	0.00%	0.00%	0.00%
1.1	0.00%	0.00%	0.00%	0.00%	0.00%
1.15	0.00%	0.00%	0.00%	0.00%	0.00%
1.2	0.00%	0.00%	0.00%	0.00%	0.00%

Table 7.18.4. Probability of not making a profit after 250 Kelly stake singles, for an edge estimate of 1.05

	Bookmaker's expectancy				
Edge	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*
0.9	87.0%	92.3%	95.8%	97.9%	99.4%
0.95	74.7%	77.7%	84.1%	90.1%	94.0%
1	61.0%	59.7%	63.4%	68.1%	69.5%
1.05	41.6%	38.6%	37.6%	35.7%	32.8%
1.1	27.6%	22.5%	15.5%	9.7%	5.6%
1.15	16.9%	9.7%	4.9%	1.8%	0.2%
1.2	8.8%	3.7%	0.9%	0.1%	0.0%

Figure 7.29 illustrates clearly for Kelly staking a feature that is common to all staking plans: fail to gain an edge and a punter will be unable to return

a profit over the long term. For Kelly staking, where the punter has overestimated his advantage over the bookmaker, odds-on betting will be potentially more damaging than odds-against betting, since wagers are larger. Whilst the nature of the staking plan protects the punter against total bankruptcy for all but the most inaccurate estimations of betting edge, the probability of failing to make a profit remains considerable where there is no real advantage (Figure 7.30).

Scenarios where the punter has underestimated his true betting edge, as one might expect, underperform in comparison to accurate Kelly staking (Figure 7.31). The more conservative staking, however, makes profit taking in the short term more likely (Figure 7.32), emphasising another characteristic common to all staking strategies: cautious staking is potentially less profitable, but profitable more often. Since the size of the Kelly stake is proportional to the betting edge, underestimating its true value is equivalent to wagering fractional Kelly stakes. Given this conclusion, a punter may intentionally underestimate his betting edge or rather reduce the size of his Kelly stakes, if his priority is to secure a profit, albeit a smaller one. For an estimated edge of 1.05, the stake sizes for real betting edges of 1.1, 1.15 and 1.2 are a half, third and quarter respectively of full Kelly stakes. For half-Kelly stakes where the real edge is 10%, the potential profit may be over 4 times as small, but a punter is twice as likely to finish ahead after 250 bets. For third-Kelly stakes where the real edge is 15%, a bankroll is 6 times more likely to finish ahead.

Figure 7.29. The influence of odds and betting edge on average finishing bank, for Kelly staking with an edge estimate of 1.05

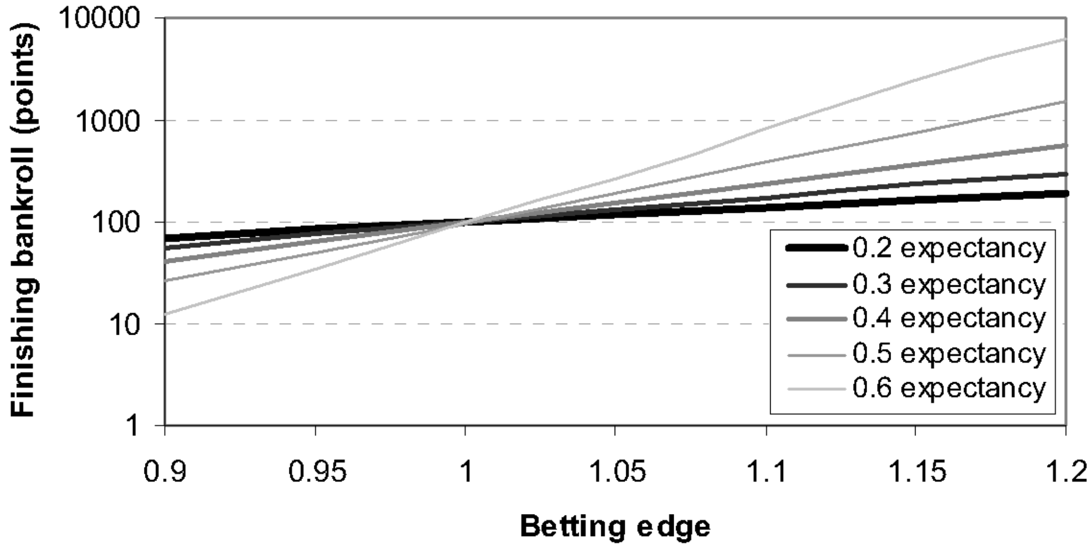


Figure 7.30. The influence of odds and betting edge on the probability of failing to return a profit, for Kelly staking with an edge estimate of 1.05

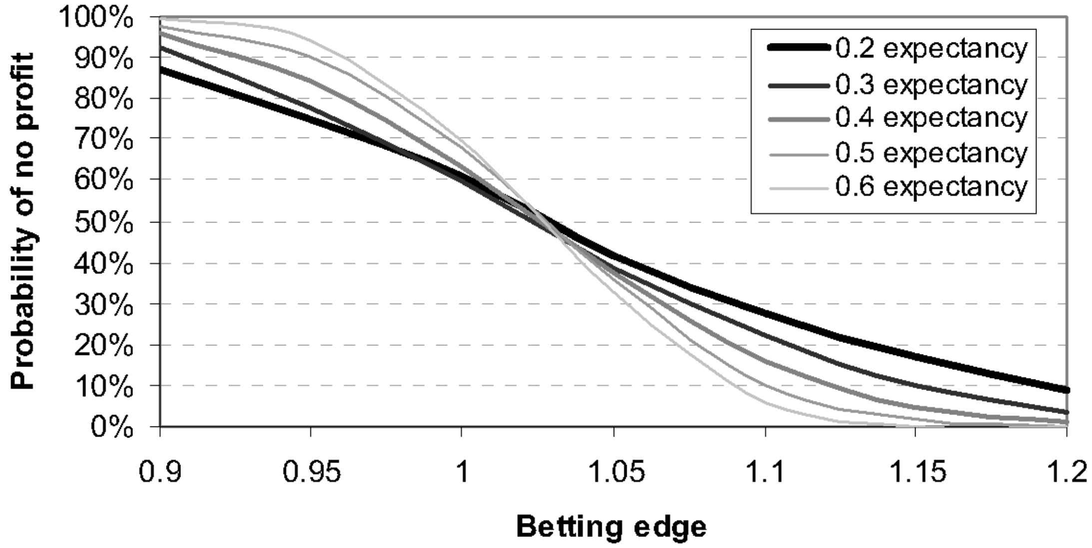
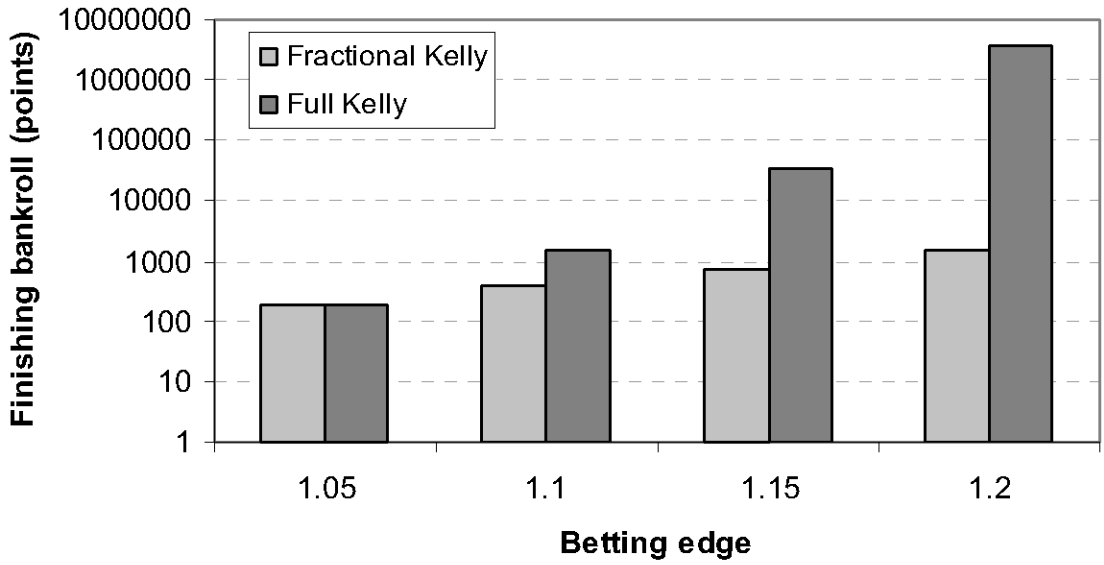
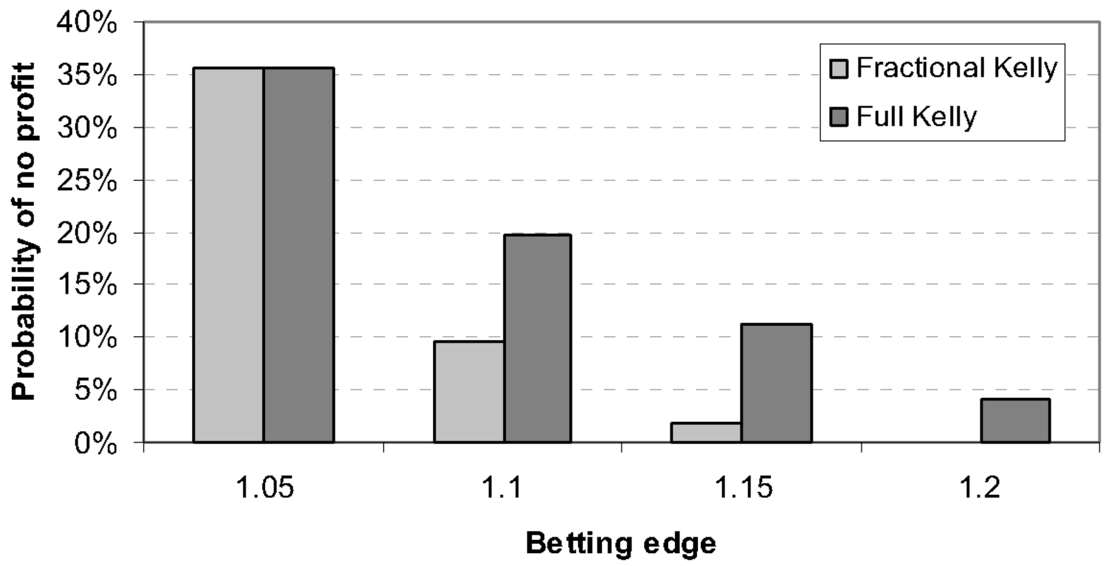


Figure 7.31. A comparison of full and fractional[61] Kelly staking for average finishing bankroll, for a bookmaker's expectancy of 0.5



[61] Betting edge estimated as 1.05.

Figure 7.32. A comparison of full and fractional Kelly staking for the probability of failing to return a profit, for a bookmaker's expectancy of 0.5



Summary

In this chapter, 6 staking plans have been analysed for their ability to return a profit and their inherent risks of underperformance and bankruptcy. From this investigation, a number of general conclusions can be drawn:

1. Increasing the stake size in proportion to the size of the bankroll increases the potential gain, but at the expense of a greater likelihood of failure, either of not returning a profit or worse still, a total loss of the bankroll.
2. Betting with shorter odds generally ensures bankroll growth is more stable and less erratic,[62] thereby reducing the risk of failure for winning systems.
3. The greater the advantage a punter has over the bookmaker, the greater the potential profit or profit expectancy.
4. Without an advantage or betting edge, **no** staking plan will turn losses into profits over the long term.
5. Percentage staking may be considerably potentially more profitable than fixed staking, but the chances of profit over a specific time frame are smaller.

[62] This is explored further in the final chapter.

6. It is preferable to wager smaller stakes where the odds are longer (e.g. fixed profits staking).
7. Progressive staking, particularly loss recovery, is not advocated as a serious betting strategy. The risk of bankruptcy is simply too large to be considered acceptable for all but the most risk-seeking gamblers.
8. Kelly staking maximises the growth of a bankroll whilst minimising the chances of failure, although being a percentage staking plan, the expectancy of profit is smaller than for fixed staking over a specified time span. A punter should, however, be able to estimate his advantage fairly accurately, at least on average, in order to benefit from this strategy.

What these conclusions mean for a bettor's preferences and attitudes to gambling will be examined in the final chapter.

A Winning System?

Developing a Successful Betting System

It is often said that as many as 95% of gamblers never make a profit in the long run. With such high levels of failure, a reader may be forgiven for thinking that there is no way to profit from sports betting. There are many reasons why success against the bookmaker is so limited, but the most important ones are overround, strategy and discipline. Some of the issues pertinent to these key influences will be examined in this final chapter.

The bookmaker's overround is the single most important disadvantage the sports bettor will face, and we have already seen in Chapter 3 quite how unfair this can sometimes be. Any successful betting system must be able to overcome this overround through the principles of value betting. Find more winners than the bookmaker believes there should be and in the long run your system should succeed. Fail to overcome the overround and the likelihood of long-term profit is slim to none, no matter what staking strategy is chosen.

Beating the bookmaker is a hard-enough task but certainly not impossible, and there are very probably more than 5% of sports bettors who can. Poor strategy and lack of discipline are the main reasons why many of these bettors do not go on to make an income from sports betting. Frequently, stake sizes are too large in an attempt to increase the profits, and losing runs, which every punter experiences from time to time, will end in tears. Many punters, furthermore, give little thought to a methodical staking strategy, particularly with a view to preserving the bankroll, instead randomly placing wagers according to the feelings of the day. Even some sports betting advisory services counsel some rather puzzling staking plans. A 20-month record from one well-known service, for example, showed a yield, or profit over turnover, of 4.6%. Simple level staking of the advised bets would have instead returned a 10% yield.

The most hazardous lack of discipline is in staking larger amounts in an attempt to recover losses from previous wagers. Loss chasing may succeed in the short term but the analysis of Martingale and Pyramid staking plans in the previous chapter should confirm that the long-term reliability of this approach is essentially of little worth, particularly if the bettor has failed to establish an edge. If a punter is to show any long-term viability with his betting, rejecting any such lack of discipline is imperative.

If there is one thing that all successful sports bettors have in common, it is the recording of all previous bets. A betting record or history, at the very least, should show details of the bet selection, including the sport and event, the price or odds, the stake size, the result of the wager and the date that it was settled. Additional useful information will include the bookmaker used to place the bet, the date it was placed, and, for value bettors, an estimation of the fair odds and expected edge over the bookmaker. Of course, the surest way of knowing whether a betting system is succeeding is to look at the bank balance. This information alone, however, cannot confirm how successful, how profitable and how safe a betting system may be. Keeping a betting history, furthermore, allows the punter to retrospectively analyse his performance according to different staking strategies, with a view to optimising profits and minimising risk. Whatever staking strategy a punter employs, he should always analyse it using level stakes. The yield from level staking provides the benchmark measure of success, since it is most readily associated with a punter’s betting edge. A positive yield indicates a potential winning system; a negative one, a likely loser.

Since profiting from fixed odds sports betting means beating the bookmaker and, in fact, beating other punters as well, whose choices to some extent influence the bookmakers' prices, it makes sense for a punter to concentrate on a sport or sports with which he is familiar, preferably where he has access to more or better information than the bookmaker. Football is without doubt the most popular medium for fixed odds sports betting, but with the amount of data on team form now at the bookmaker’s disposal, it is somewhat questionable whether it offers the most reliable long-term investment strategy. At the very least, to succeed in this field a punter will need to reduce the bookmaker's disadvantage by as much as possible, by selecting the most appropriate betting markets with minimal overrounds, and by extensive comparison of bookmakers' prices. With overrounds of 140% or more for correct score and scorecast betting, it is no surprise that these markets are heavily promoted by the high-street bookmaker. There can be only a handful of punters, however, who will be able to make this form of fixed odds betting pay regularly. With high odds for even the most likely scores, furthermore, the risks for any staking strategy will be higher,[63] since losing runs will be more commonplace. Any punter choosing to focus on correct score football betting would be wise to keep his stake size to a minimum. In contrast, 2-way betting opportunities, as we learned in Chapter 2, offer a more realistic avenue for success, whether through Asian handicap betting in football, match betting in tennis, darts or snooker, head-to-head betting in golf, skiing or ski jumping and over/under betting on goals or points totals in most sports. Typically the overround is below 110%, since there are only 2 possible outcomes to an event.

It is similarly prudent to wager mainly singles or, at most, lower-priced doubles and trebles. Whilst it may be accepted that a winning edge can be enhanced through accumulator bets, the punter should be reminded of the influence that betting at consistently longer odds has on the bankroll. Of course profits can be increased, but so too can the risk of bankruptcy without reducing the stake size. How prudent a punter chooses to be will, of course, depend on his underlying attitudes to betting risk and its management.

Backing Favourites

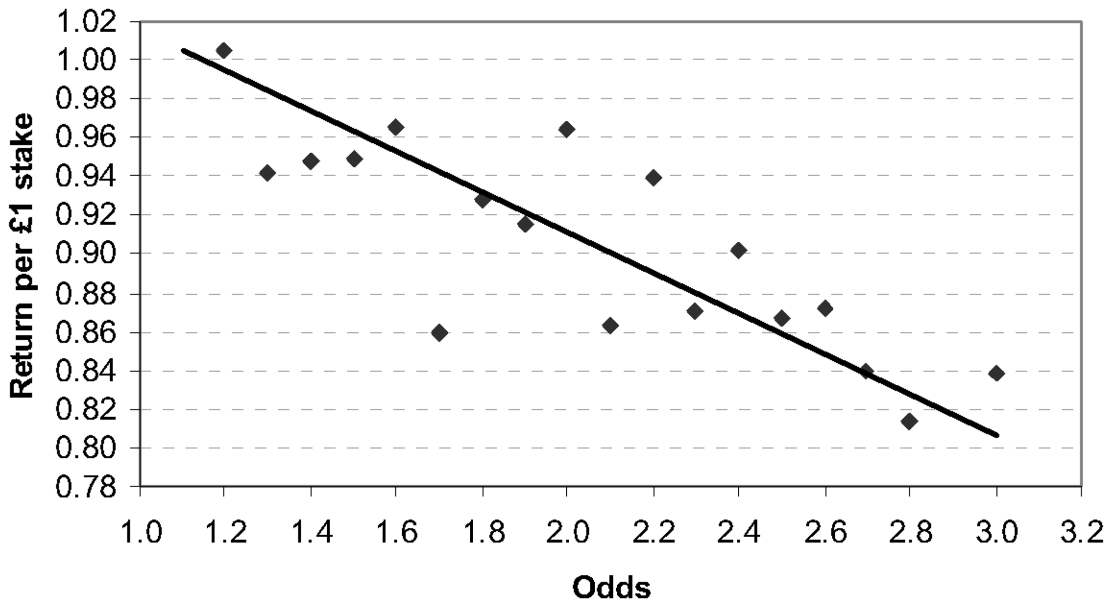
A frequent argument amongst punters is whether to concentrate on a favourite or an underdog. In recent years, many betting experts have claimed that so-called underdogs teams are vastly overpriced and that betting on such "longshots" will secure a great return on your investment in the long run, provided that you have the necessary patience to wait for the surprising results to occur. The explanation often proposed for this argument is that since the majority of punters like to back the favourite in a contest, the bookmaker must lower their odds to manage the added liability. In reality, however, both theory and evidence point to the complete opposite.

In Chapters 3 and 4, the idea was presented that the bookmaker's profit margin is not proportionally spread across the range of possible outcomes, but is concentrated on the higher odds. With superior value in the shorter prices, the potential for gaining an edge, if not additional profit, may very well be greater, since the disadvantage to be overcome is smaller. A

[63] The reader may wish to refer back to some of the staking plan analyses presented in the previous chapter.

typical bookmaker's overround for a football match bet is about 112% to 116%, depending on the league. A detailed analysis of nearly 12,000 games from 19 European football divisions for the 2000/01 and 2001/02 seasons confirms that backing every outcome would have returned, on average, £0.87 (or 1/1.15) for every £1 staked. By contrast, backing all home and away prices greater than 2/1 would have returned only £0.82 for every unit stake, whereas betting on all teams with an odds-on price would have returned as much as £0.93. Backing teams at shorter than 1/2 would have lost only 4 pence for every £1. Since the home team in football is frequently the favourite, it is no coincidence that the proportional loss from backing all home teams to win during the analysis period (10.5 pence per £1 stake) was considerably smaller than if backing the away wins (15.6p per £1 stake). A more precise breakdown for odds up to 2/1 is shown in Figure 8.1.

Figure 8.1.Relationship between odds and returns from blind betting for odds up to 2/1 (odds data from William Hill online for 19 European football leagues during 2000/01 and 2001/02)



The idea that the price for a favourite will be lowered in response to customer demand is not in itself a mistaken one. Fixed odds with Internet bookmakers fluctuate, sometimes quite considerably for popular contests, and very frequently it is the case that the price for a favourite shortens as the start of the event approaches. For an underdog to become overpriced, relative to the favourite as a consequence of such price movement, however, the assumption must be that both favourite and underdog were priced with no bias to begin with, that is, with the same measure of bookmaker's profit margin built into both. Clearly the evidence indicates that this is not the case, since a punter backing every favourite will perform proportionally less worse to level stakes than he will backing all underdogs. Furthermore, for the analysis of European football matches presented above, the online betting odds chosen were the last available before kick-off, with any price movements against the favourite taken into account.

For many sports bettors, this discovery may go against all intuition. With hordes of customers from the Far East backing Manchester United every week to win in the Premiership, for example, the idea that there may be more value in the Red Devils at 2/9 than there is in West Ham at 9/1 is surely ludicrous. Unfortunately the evidence speaks for itself. What is more, there is convincing theoretical reasoning that such a favourite–longshot bias does not simply arise randomly or intermittently, but is a fundamental property of bookmakers' fixed odds, at least for football.

A number of academic papers[64] have been written during the last decade or so which empirically confirm the existence of a favourite–longshot bias in horse racing pool (or tote) betting. The following explanation for this phenomenon has been provided. Since a £1 bet on a horse at 3/1 exposes the bookmaker to a smaller potential loss than a £1 bet on a horse at 30/1, the bookmaker will require a greater risk premium to insure himself against the possibility of inside information on a longshot. This is achieved by reducing the odds in respect of the longshot. Furthermore, the more horses in the race, the longer the odds on each, and thus the bigger the bookmaker’s overall margin. Whilst the influence of inside information plays no significant role in the majority of sports betting, a bookmaker’s exposure to risk may be essentially managed in a similar fashion. Consequently, it might be reasonable to assume that fixed odds bookmakers introduce a similar favourite–longshot bias with respect to sports betting.

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[64] For example, Fingleton, J & Waldron, P. (revised 2001). Optimal Determination of Bookmakers’ Betting Odds: Theory and Tests. Trinity Economic Paper Series Technical Paper No. 96/9 JEL Classification: D82, G13; Vaughan Williams, L. and Paton, D. (1998). Why are some favourite–longshot biases positive and others negative? *Applied Economics*, **30** (11), 1505 - 1510; Cain, M., Law, D. & Peel, D. (2000) The favourite–longshot bias and market efficiency in UK football betting, *Scottish Journal of Political Economy*, **47** (1), 25-36.

Consider an imaginary bookmaker offering odds for Michael Schumacher versus the rest of the field to win the Formula 1 motor racing world championship. It is assumed that the true expectancy of Michael Schumacher walking away with yet another title is 75%, whilst for any other winner it is 25%. Consequently the fair odds for a Schumacher win/no-win are 1.33 and 4 respectively. To investigate how the bookmaker will price this 2-way book, let us contemplate 3 alternative scenarios for which the full overround is 110%:

- no pricing bias;
- overpriced underdog;
- overpriced favourite.

Table 8.1 shows the bookmaker's result expectancies for each scenario, together with the betting prices. It is immediately obvious that overpricing the underdog exposes the bookmaker to considerably greater risk than for overpricing the favourite by an equivalent margin. Reducing the result expectancy for the favourite by 2.5% reduces the expected profit margin in the price from 10% to 6.7%. An analogous reduction in result expectancy for the underdog reduces it to 0%!

Table 8.1. The influence of pricing biasing on a bookmaker's liabilities

	Overpriced underdog	**No pricing bias**	**Overpriced favourite**
Schumacher win expectancy	0.850	0.825	0.800
Schumacher no-win expectancy	0.250	0.275	0.300
Sum of expectancies	1.100	1.100	1.100
Overround	110%	110%	110%
Bookmaker's expectancy/ true expectancy (Schumacher win)	1.133	1.100	1.067
Bookmaker's expectancy/ true expectancy (Schumacher no-win)	1.000	1.100	1.200
Odds (Schumacher win)	1.18	1.21	1.25
Odds (Schumacher no-win)	4	3.64	3.33

Now let us suppose that the bookmaker has made an error of judgement in the assessment of the true result expectancies. Instead, the true expectancies for Schumacher win and no-win might be 70% and 30%. Alternatively, they could be 80% and 20%. How each error of judgement will affect the bookmaker's exposure to risk is illustrated in Tables 8.2a and 8.2b.

Table 8.2a. A bookmaker's expected profit margin (shaded) for variation in pricing bias and fair expectancy for a Schumacher win

			Bookmaker		
			Overpriced underdog	*No pricing bias*	*Overpriced favourite*
		Expectancies	*0.850*	*0.825*	*0.800*
	Expectancies	*Odds*	*1.18*	*1.21*	*1.25*
Fair	*0.70*	*1.43*	21.4%	17.9%	14.3%
	0.75	*1.33*	13.3%	10.0%	6.7%
	0.80	*1.25*	6.3%	3.1%	0%

Table 8.2b. A bookmaker's expected profit margin (shaded) for variation in pricing bias and fair expectancy for a Schumacher no-win

			Bookmaker		
			Overpriced underdog	*No pricing bias*	*Overpriced favourite*
		Expectancies	*0.250*	*0.275*	*0.300*
	Expectancies	*Odds*	*4*	*3.64*	*3.33*
Fair	*0.30*	*3.33*	-16.7%	-8.3%	0%
	0.25	*4*	0%	10.0%	20%
	0.20	*5*	25%	37.5%	50%

For an overpriced favourite, even where the bookmaker has underestimated its true expectancy, he has still managed to avoid a potential loss of revenue for wagers placed on the favourite. Where the true expectancy is overestimated, expected profits taken on this selection are increased to 14.3%. This is at the expense of a reduction in profit taken from underdog wagers, but crucially, once again a potential loss is avoided. By contrast, where the bookmaker has overpriced the underdog or even left the value of the odds unbiased, any margin of error in his assessment of the fair odds could expose him to considerable risk on the underdog price. Of course, where the underdog is overpriced but underestimated, profits will be increased on money taken from wagers on the favourite. Nevertheless, bookmakers are notoriously risk-averse creatures, and prefer to avoid any possibility of loss on any available sporting outcome. For the scenarios presented above, the only way to achieve this level of risk management is to overprice the favourite.[65]

For the punter, then, backing the favourite, which has proportionally greater value, or rather less “no-value”, on average, than the underdog, will take him nearer to the winning margin. This does not imply that the punter should win more over the long term backing favourites, only that he may find it easier to get across the winning line in the first place. Moreover, events with more than 2 possible outcomes are likely to have proportionally longer odds for each possible result. Since a bookmaker is risk-averse towards the longshot price, this will account for the substantially greater overround for events where the number of possible outcomes is high. With 14 teams in the 2003 Cricket World Cup, the overround for the outright winner market was anywhere from 120% to 130%, in contrast to 110% to 115% for the VB One Day Series between Australia, England and Sri Lanka. It is no surprise, then, that 2-way markets undoubtedly offer the most favourable betting opportunities, at least from the point of view of minimising the bookmaker's hypothesised advantage.

The favourite–longshot bias, in football at least, provides a reasonable explanation why securing a profit via a comparison of bookmakers’ odds and arithmetic value betting as examined in Chapter 3 is not as straightforward as it first seems. The reader will recall that a standard odds comparison analysis failed to find profitable returns from the majority of supposedly value bets. Of course, the majority of these were greater than 5/2, and as such the bookmaker’s profit margin on these may have been substantially higher than that predicted by the full overround for each book. The analysis, unfortunately, had assumed that the bookmaker’s overround was spread proportionally across each result.

A further incentive for concentrating on favourites in a sporting contest is that by doing so, this frequently lowers the probability that a bankroll may be entirely lost. The relationship between betting odds and risks was explored in the previous chapter on staking. For a level staking plan, the

[65] Obviously, a major influence on a bookmaker’s price is the amount of interest shown in it by his customers, and what staking they employ. Increased interest will usually result in a lowering of a price to limit liabilities. Whilst this factor has not been considered in the analysis here, the fundamental rationale behind a favourite–longshot bias will remain essentially unchanged.

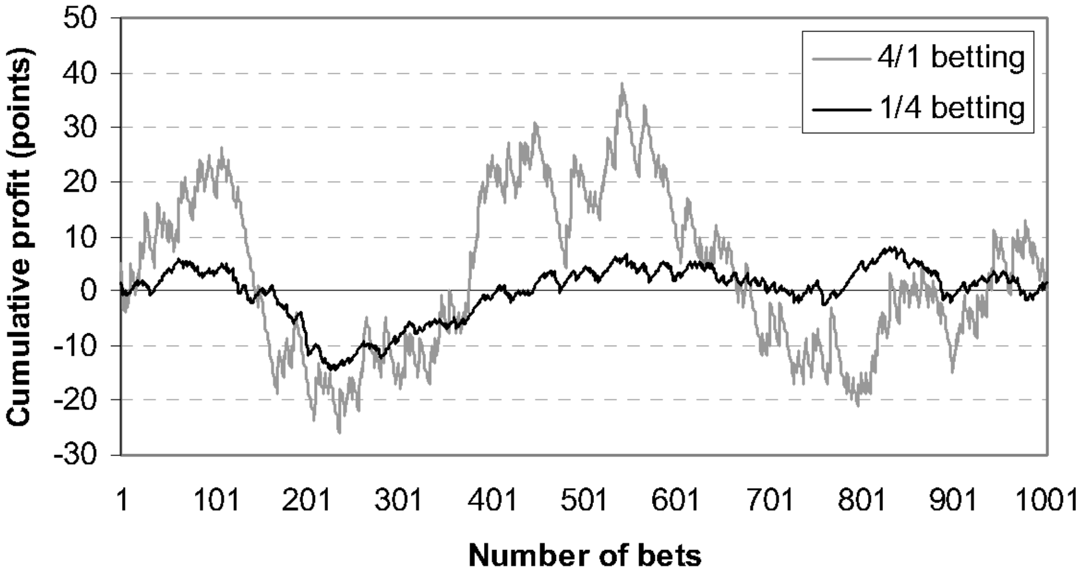
longer the odds, the "noisier" or less predictable the returns, as illustrated in Table 8.3.

Table 8.3. Profits and losses for various unit level stakes, break-even betting scenarios

Bet	Odds						
	5.00	*4.00*	*3.00*	*2.00*	*1.50*	*1.33*	*1.25*
1	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	0.25
2	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
3	-1.00	-1.00	-1.00	1.00	0.50	0.33	0.25
4	-1.00	-1.00	-1.00	-1.00	-1.00	0.33	0.25
5	4.00	3.00	2.00	1.00	0.50	0.33	0.25
6	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
7	-1.00	-1.00	-1.00	-1.00	-1.00	0.33	0.25
8	-1.00	-1.00	2.00	1.00	0.50	0.33	0.25
9	4.00	3.00	2.00	1.00	0.50	0.33	0.25
10	4.00	3.00	2.00	1.00	0.50	0.33	0.25
11	-1.00	-1.00	2.00	1.00	0.50	0.33	0.25
12	-1.00	-1.00	-1.00	1.00	0.50	0.33	0.25
13	-1.00	-1.00	2.00	1.00	0.50	0.33	0.25
14	-1.00	-1.00	-1.00	-1.00	0.50	0.33	0.25
15	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	0.25
16	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	0.25
17	4.00	3.00	2.00	1.00	0.50	0.33	0.25
18	-1.00	-1.00	-1.00	-1.00	0.50	0.33	0.25
19	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
20	4.00	3.00	2.00	1.00	0.50	0.33	0.25

The sequences for 4/1 odds-against and 1/4 odds-on betting have been extended in Figure 8.2 to 1,000 wagers, for which the cumulative profit after each bet is shown by means of a time series. Larger fluctuations in the shape of the profits time series are a consequence of the larger returns for a win at longer odds and the lengthier losing runs that separate them. A noisier profits time series places the bankroll at a greater risk of a more significant downturn, with an increased probability of bankruptcy.

Figure 8.2. A comparison of odds-on (1/4) and odds-against (4/1) profits time series for unit level staking, break-even betting.[66]



Variability in the returns can be measured by means of the standard deviation, the equation for which is shown below: the shorter the betting odds, the smaller the standard deviation in the returns.

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n}}$$

where x_i is the profit of the i^{th} bet, $\bar{x}$ is the average profit and n is the total number of bets. To non-mathematicians this looks horrendous, but for unit level staking where the odds for every bet are the same, this simplifies to:

$$\sqrt{e(o-e)}$$

where e is the decimal edge and o is the decimal odds. Where the punter is just breaking even with his betting, the edge is 1.00, and the expression reduces further to:

$$\sqrt{(o-1)}$$

[66] For a stake of 1 unit, the profit from a winning 4/1 bet is 4, whilst for a 1/4 bet it is 0.25. The profits time series generated for Figure 8.2 represent just one possible scenario.

For common stake size s, the standard deviation will be given by:

$$s\sqrt{e(o-e)}$$

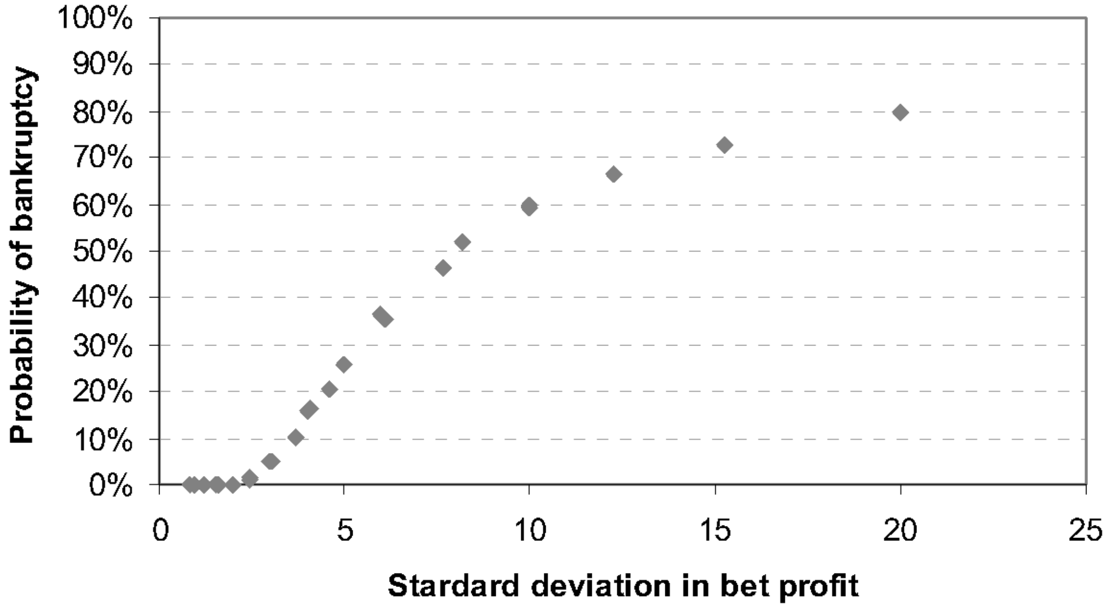
For a greater stake size, the standard deviation, and therefore variability in returns, will be larger, and consequently, so too will be the risk of bankruptcy for the same betting system and betting edge.

Table 8.4. Standard deviation in returns for break-even, unit level stake betting

Odds	√(odds-1)	Standard deviation in bet profit
5	√4	2
4	√3	1.732051
3	√2	1.414214
2	√1	1
1.5	√0.5	0.707107
1.3333	√0.3333	0.57735
1.25	√0.25	0.5

Of course we didn't need to calculate the standard deviation to find out what we can learn visually from Figure 8.2. Nevertheless, knowing its value for a particular betting scenario is useful, since it will be intimately related to the risk of bankruptcy. This relationship between the noisiness in the profits time series and the risk of bankruptcy is shown in Figure 8.3. The probabilities of bankruptcy have been taken from the results of the Monte Carlo simulations for level staking in the previous chapter (for stakes sizes 1, 2, 3, 5, and 10 units), where the reader will recall that each scenario involved a maximum sequence of 250 bets.

Figure 8.3. The relationship between standard deviation in bet profit and the probability of bankruptcy after 250 bets, for break-even betting



Crucially the potential long-term profits are no greater for longshot betting than they are for odds-on wagers, for the same staking and betting edge. Consequently, for level staking it really does make sense from the point of view of bankroll risk management to concentrate on the favourites.

One way to accommodate longer odds betting is to employ a variable staking plan, which takes into account the size of the odds. The fixed profits staking plan seeks to win the same amount for each wager made: the longer the odds, the smaller the stake, and vice versa. This reduces the risk experienced by the bankroll, in actual fact to a level a little bit lower than that for equivalent level staking (see Chapter 7). The Kelly staking plan, likewise, will take into account the price of each wager in calculating the appropriate stake size. One might wonder, however, if the majority of profit is being generated by the shorter prices, whether there is any need to focus on longshot betting at all.

The Pitfalls of Forecasting

Essentially there are 4 parts to the development of a mathematical forecasting system or ratings model.

1. Select a suitable method of prediction.
2. Define a relationship between ratings figures and forecasting rates.
3. Identify value bets.
4. Test the model.

The success, or otherwise, of a forecasting system will hinge most significantly on the first part. If the factor or factors being investigated do not provide a reliable gauge of a sporting outcome, the user is unlikely to be able to profit from the model's implementation. Simple models may only consider one factor, for example the number of goals scored and conceded, and as such may be too crude to adequately represent the spread of actual results. From the examination in Chapter 4 it is clear enough that a recent goals model may not, on its own, yield secure and replicable returns, at least for away wins. Incorporating further predictive factors, like the number of shots on goal, may reinforce any general relationship between ratings and forecasting rates, but will not necessarily reduce uncertainty in actual prediction. The slope of the line in Figure 8.4b, for example, is steeper than that in Figure 8.4a, indicating a stronger relationship between ratings and the result probability. Nevertheless, the second model accounts for less of the variation in actual results, with 78%, compared to 97% in the first.

Figure 8.4a. A more reliable prediction model

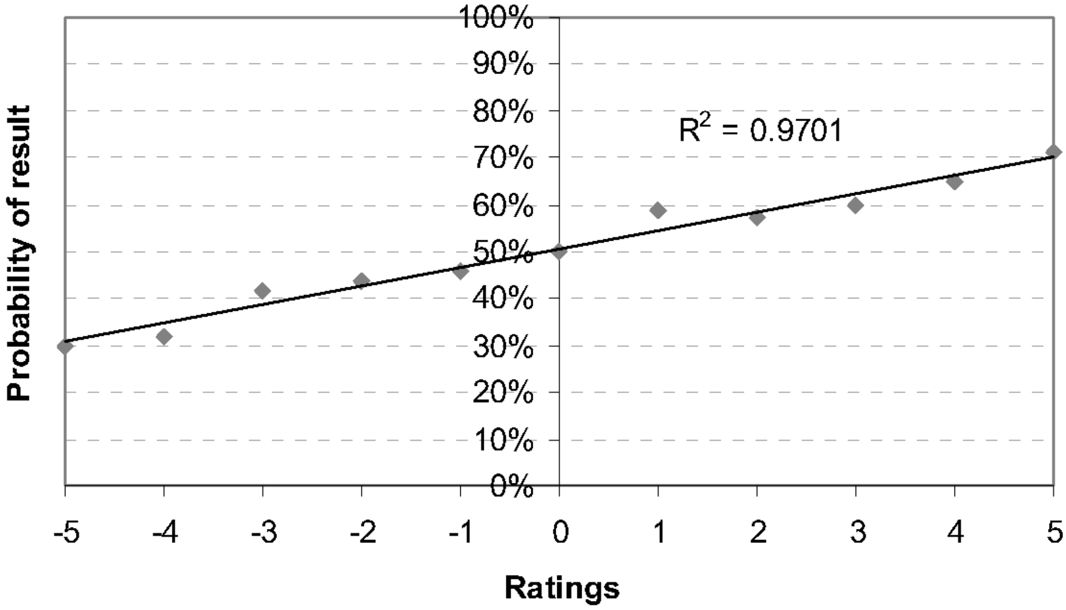
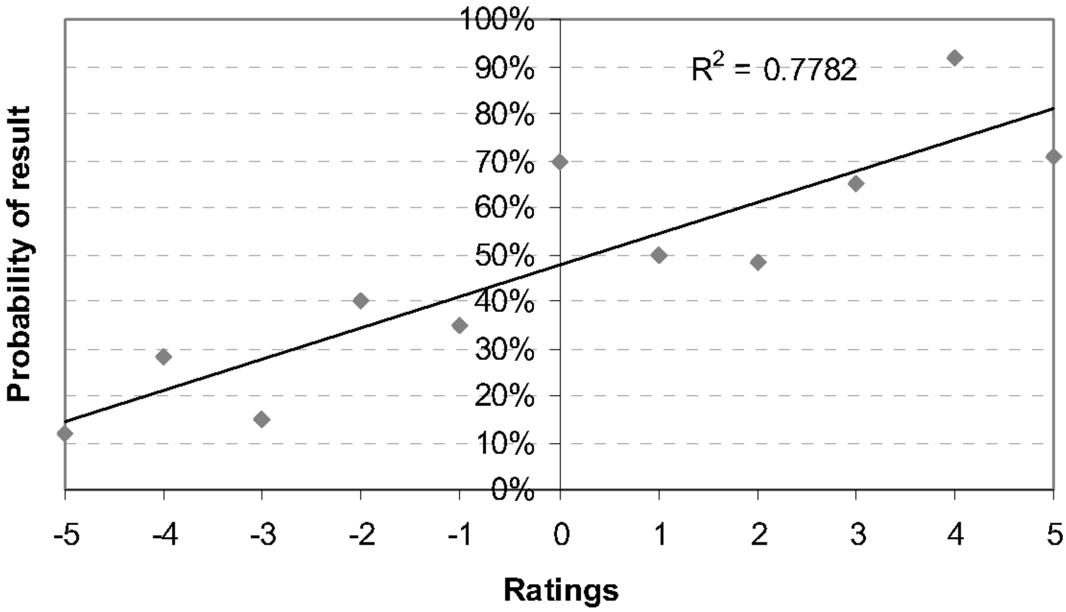


Figure 8.4b. A less reliable prediction model



From the point of view of finding value in the bookmaker's odds, it is better to reduce uncertainty. Of course, any forecasting system, whether based on mathematically modelling, subjective interpretation of relevant sporting information or a combination of the two, cannot successfully predict the outcome of an event all of the time. There are simply too many random factors that have an influence, and there will always exist a certain amount of uncertainty in any forecast. The job of the forecaster is to attempt to account for those influences that he thinks have most relevance, thereby minimising the amount of uncertainty in any prediction.

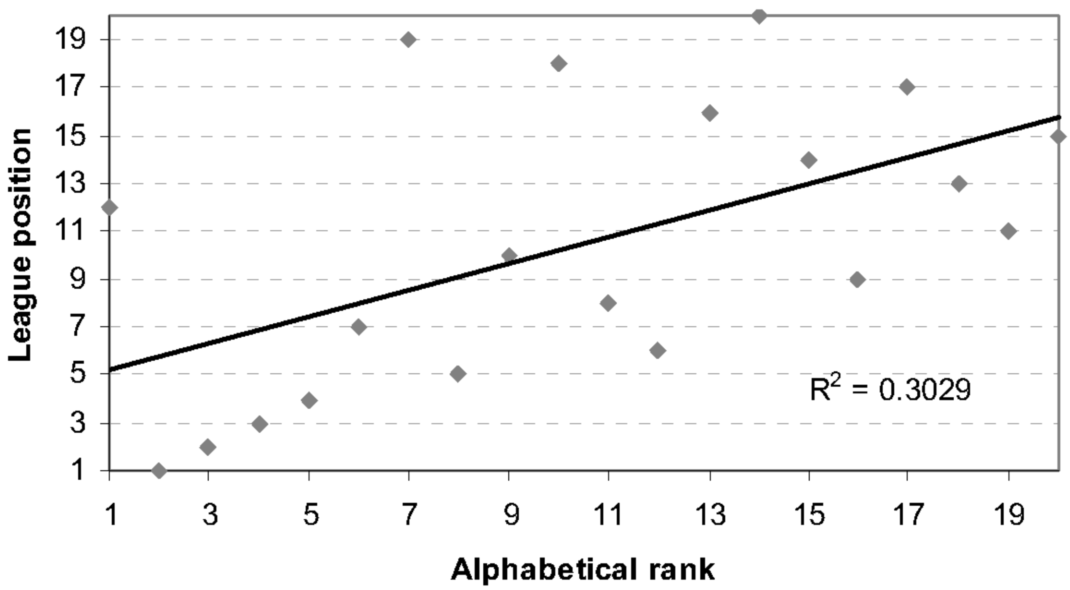
A further pitfall associated with numerical forecasting concerns the difference between causation and association. A significant association existed between a Premiership club's finishing position in the 2002/03 season and the initial of the Christian name of their manager. Ranking names in alphabetical order, Figure 8.5 reveals that almost a third of the variation in league position may be explained by the ranking of the manager's name. If these initials are assigned numbers according to their position in the alphabet, with A being 1 and Z equivalent to 26, amazingly the managers of the top 10 teams in the Premiership have an average value of 5 (roughly the letter E), whilst for the top 4 it is as low as 1.75 (between A and B). By contrast, for the bottom 10 clubs the figure is 11.7 (approximately K). This difference is statistically significant. Clearly, of course, it would take a leap of faith to believe that the first name of a manager could in any way influence the ability of the Premiership club.

Could one reasonably expect Alan Curbishly's Charlton Athletic to defeat Steve Bruce's Birmingham City on this basis?

Table 8.4. English Premiership clubs and their managers (2002/03)

Club	Manager	League position (May 2003)	Alphabetical rank (Christian name)
Manchester United	Alex Ferguson (Sir)	1	2
Arsenal	Arsene Wenger	2	3
Newcastle United	Bobby Robson (Sir)	3	4
Chelsea	Claudio Ranieri	4	5
Liverpool	Gerard Houllier	5	8
Blackburn Rovers	Graeme Souness	6	12
Everton	David Moyes	7	6
Southampton	Gordon Strachan	8	11
Manchester City	Kevin Keegan	9	16
Tottenham Hotspur	Glen Hoddle	10	9
Middlesbrough	Steve McClaren	11	19
Charlton Athletic	Alan Curbishly	12	1
Birmingham City	Steve Bruce	13	18
Fulham	Jean Tigana	14	15
Leeds United	Terry Venables	15	20
Aston Villa	Graham Taylor	16	13
Bolton Wanderers	Sam Allardyce	17	17
West Ham United	Glenn Roeder	18	10
WBA	Gary Megson	19	7
Sunderland	Howard Wilkinson	20	14

Figure 8.5. Association between manager's Christian name and a Premiership club's finishing position in the 2002/03 season



Whilst somewhat far-fetched, this example nonetheless highlights the dangers of attributing a statistically significant association between 2 sets of variables (the predictor and the predicted) to an underlying causal mechanism behind the relationship. This is of particular relevance for punters who trawl through sports data in search of a meaningful trend.

An analysis of results from Division 3 of the English Nationwide football league results from the 2001/02 season reveals that only 18% of games finished as a draw when one of the competing teams had drawn their 2 previous games. Since, on average, almost 28% of English league games played between August 1993 and May 2002 have finished in a draw, such a finding might be of use in a betting context, since it would appear to make sense to back either the home or away result for these matches. Furthermore, for the number of games involved (12 draws from 65 games), this difference has statistically less than a 1-in-10 chance of having arisen by chance.[67] Unfortunately, there are 2 serious flaws to this analysis. The first involves what statisticians term a spurious correlation. The second concerns a more fundamental misinterpretation of probability and chance.

Many punters might initially find it reasonable to assume that if a team has been involved in 2 preceding draws, it would be less likely to encounter another in the next game. After all, draws are not that common, and to have 2 in a row must be unlikely, but to have 3 must surely be rare indeed. The data from the English 3rd division during 2001/02 certainly seem to add weight to this idea. To test whether this relationship for Division 3 matches during 2001/02 might be meaningful, it is necessary to test for the association again from another sample of data. If it still exists, test it again and again until you are sure beyond any reasonable doubt that it is real. This has been done in Table 8.5 for seasons 1993/94 to 2000/01.

The bad news is that the results from the 2001/02 season seem to represent an aberration. For almost all other years, the percentage of drawn games clusters closely around the long-term average of 27 to 28% for the English football league. For the full sample of results spanning the nine seasons, nearly 27% of games which fitted the forecast criterion finished with a draw. In view of the bookmaker's overround, there will be no potential to profit from this forecast model whatsoever.

[67] Strictly speaking, statisticians would not consider this finding to be entirely statistically significant, requiring as little as a 5% probability or less that it had arisen by chance.

Table 8.5. Percentage of drawn games for matches involving at least one team with two draws in the two preceding games

Season	Percentage of draws	Number of matches
1993/94	24.14%	58
1994/95	22.22%	63
1995/96	31.00%	100
1996/97	25.32%	79
1997/98	34.02%	97
1998/99	25.64%	78
1999/00	24.29%	70
2000/01	30.49%	82
2001/02	18.46%	65
Overall	*26.88%*	*692*

The most likely explanation for the relationship arising in 2001/02 is that it represents a spurious correlation. A spurious correlation involves an association in which measures of 2 or more variables are statistically related, but are not in fact causally linked, usually because the statistical relation is caused by a third variable. A common illustration of this is the positive correlation between firemen and fire damage – more firemen, more fire damage. Naturally one might expect more firemen to attend a larger fire, but this is far removed from saying that the firemen are causing the fire damage. For the draws analysis above, there is probably some other factor lurking in the 65 games in 2001/02 which caused the low number of draws. What this might have been can only be speculated upon and would need a further inspection of the data to determine a possible explanation. The reason that this relationship arose in the first instance is linked to what Professor Vaughan Williams in his book *Betting To Win* calls data-mining: the idea that if one mines a set of data long and hard enough for a relationship, meaningful or not, one will eventually be found.

More critically, the idea that the probability of a draw occurring is decreased when such an outcome has occurred twice in the 2 preceding games is a serious misconception known as the Gambler's Fallacy. The Gambler's Fallacy is the mistaken notion that the odds for something with a fixed probability increase or decrease depending upon recent occurrences. The Gambler's Fallacy frequently crops up in roulette circles, where naïve gamblers believe that if they sit out a sequence of consecutive blacks, they are more likely to win betting on red. Suppose there has been a sequence of 10 consecutive blacks. What is the chance of the next being red? More likely than black? Well, of course not, it's still the same chance as it was for all the preceding wheel spins, and is equal to the chance of the 11^{th} spin being black again. It is the belief that a red spin is due that is the fallacy, since the probability of each outcome is independent of all the others.

Of course, in football, and other sports, the results of a team are not strictly independent, although the occurrence of a football draw seems to be about as a random an event in sport as one can find, as evidenced by the relatively narrow range of odds offered on them by the bookmakers. Nevertheless, it is also possible to commit the Gambler's Fallacy. For example, suppose that a boxer has won 50% of his fights over the past 5 years. Suppose this year he has lost his last 5 fights and he has 5 left. If a person believed that he would win his next 5 fights because he has used up his losses and is due for a victory, then he would have committed the Gambler's Fallacy. Furthermore, the person would be ignoring the fact that the results of one match can influence the results of the next one. In all probability, a boxer who has lost his last five matches is showing particularly bad form and is more likely to lose the next match.

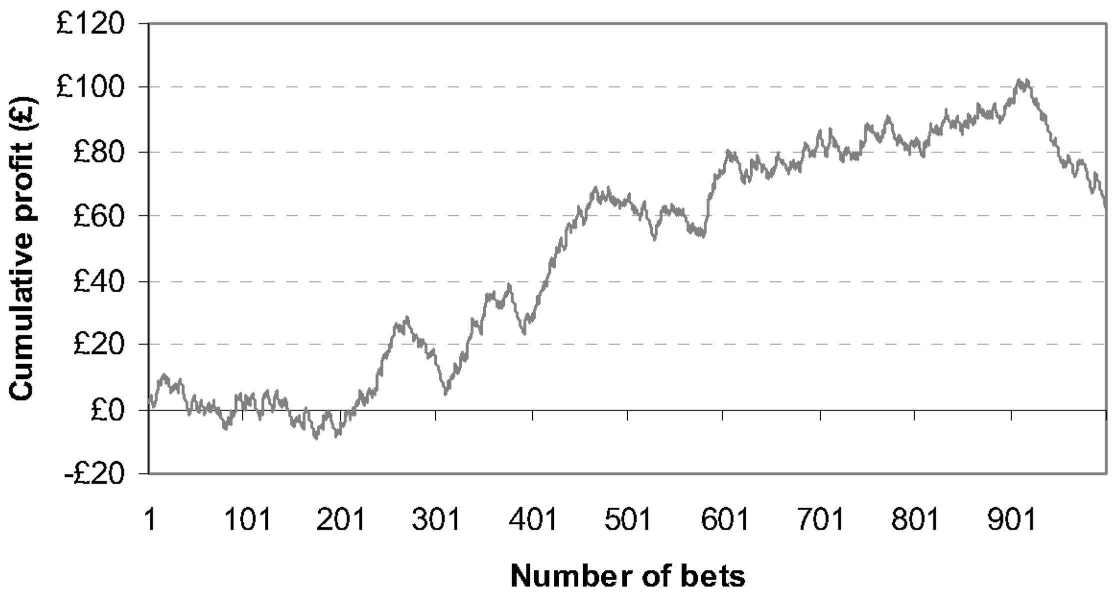
It should be noted that not all predictions about what is likely to occur are fallacious in this way. If a person has good evidence for his predictions, then they will be reasonable to accept. The "zero-to-hero" system, for example, looks for teams or players that have suffered a poor losing run, but that are more likely to gain victory in their next contest. Initially, this smacks of the Gambler's Fallacy, but if one has valid reasons for believing that a victory is due, for example squad members returning from injury or motivation by a new coach or manager, then the odds on offer for this bet may seem quite attractive.

When can someone be sure that a genuine cause exists for a significant relationship, uncontaminated by extraneous variables? Testing and retesting any association is obviously necessary to help arrive at a conclusion, but eventually the forecaster will need to make a subjective judgement as to whether a pattern he has discovered will be both meaningful and profitable in the future. To highlight this difficulty, and illustrate the potential dangers of data-mining, consider the following simple forecasting system designed to predict draws in English football league matches. The criterion for prediction is basic: a team that has won 3 or more of its last 4 away games is predicted to draw its next away game, a reasonable assumption given that a) the away team is showing decent away form and b) the away side frequently accepts a point from their travels as a decent return. The back-tested betting returns for this forecast model are shown in Table 8.6, and charted to level stakes in Figure 8.6. Without information about the actual betting prices for much of this sequence, it has been assumed that every wager was available at odds of 9/4 (3.25), since that is a typical draw price on offer with many bookmakers for English league games.

Table 8.6. Level staking betting returns for an English football league draw forecast model

Season	Percentage of draws	Number of matches	Level stakes (£1) profit	Yield (%)
1993/94	31.8%	110	£3.75	3.41%
1994/95	28.3%	92	-£7.50	-8.15%
1995/96	37.9%	95	£22.00	23.16%
1996/97	34.8%	112	£14.75	13.17%
1997/98	41.1%	95	£31.75	33.42%
1998/99	34.5%	110	£13.50	12.27%
1999/00	30.6%	121	-£0.75	-0.62%
2000/01	34.6%	133	£16.50	12.41%
2001/02	23.5%	132	-£31.25	-23.67%
Overall	32.7%	1000	£62.75	6.28%

Figure 8.6. Level staking profits time series for an English football league draw forecast model



Initially, the results look very encouraging. Seven of the 10 seasons analysed revealed a level stakes profit, and a return on investment of over 6% is fairly reasonable. With 1,000 matches selected from 18,000 games played, a return of 327 draws compared to an expected 270 would be considered highly significant by standard statistical testing. Profits growth over the 9 years is fairly steady, although experiencing a notable decline in the last season. Nevertheless, a number of points need to be addressed before genuine confidence could be placed in this prediction model.

- Does the downturn in 2001/02 represent a short-term fluctuation in an otherwise profitable betting system, or a more fundamental failure?
- Can these results be reproduced for other leagues or is this a feature specific to English football?
- Do other similar forecasting models demonstrate a commensurate level of success?

The first concern might very well be addressed by looking at how the model has performed in 2002/03. During this season, 141 games matched the model criterion, with 42 of them, or 30%, finishing with a draw. At odds of 9/4, the level stakes profit is -4.5 and the yield -3.19%. Not terribly impressive, but until the last 2 weeks of the season, the record was showing a profit.[68] What about other football leagues? Results for the Spanish La Liga first division and German Bundesliga first division for seasons 1993/94 to 2002/03 are shown in Table 8.7 and charted in Figures 8.7 and 8.8. These two divisions have been chosen because they have a similar percentage of games finishing with a draw to the English league, with odds from the bookmakers similarly, if a little less, generous. For this analysis, each selected game was assigned draw odds of 11/5.

Table 8.7. Level staking betting returns for the draw forecast model for the Spanish La Liga first division and German Bundesliga first division, 1993/94 to 2002/03

League	% of draws	Number of matches	Long-term % of draws	Level stakes (£1) profit	Yield (%)
Spanish La Liga 1	33.6%	143	27.5%	£10.6	7.41%
German Bundesliga 1	23.8%	160	26.9%	-£35.2	-22.00%

[68] Of course, this analysis has used draw prices of 3.25. In fact, taking the best available prices for the selected games actually yielded a small profit.

Figure 8.7. Level staking profits time series for a draw forecast model: Spanish La Liga 1

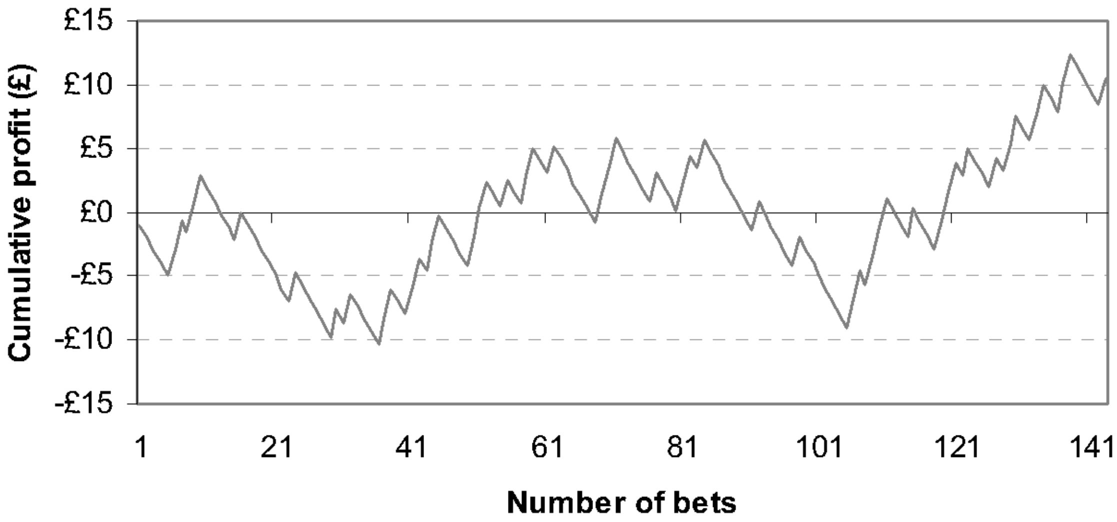
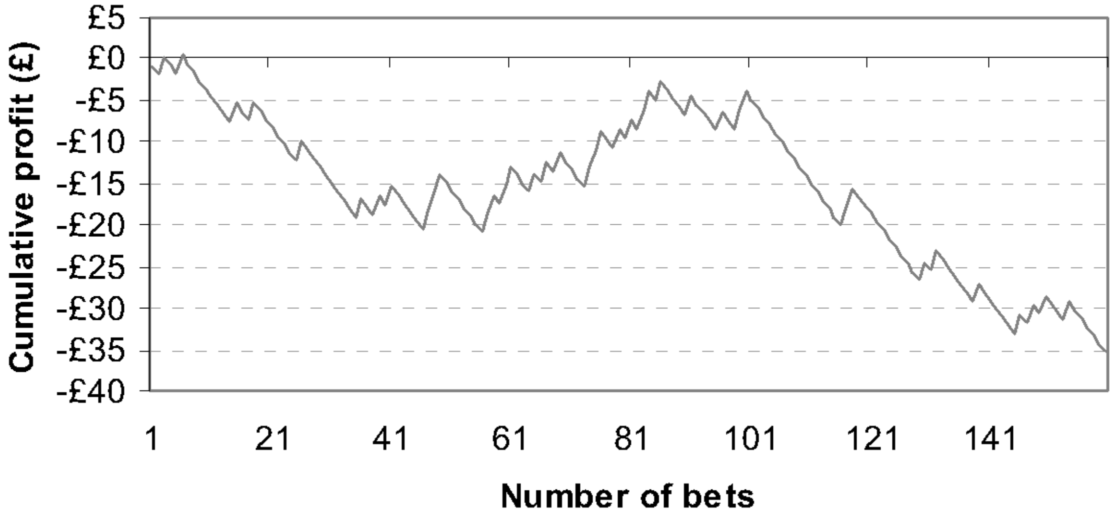


Figure 8.8. Level staking profits time series for a draw forecast model: German Bundesliga 1



Whilst a 10-season profit was achieved from Spain's La Liga 1, much of this time was spent running at a loss. It is questionable whether any punter employing this betting system would have the confidence to persist with such a marginal record. It might be argued that the number of games matching the forecasting criterion is statistically unrepresentative, in comparison to the much larger data record compiled for the 4 English divisions. Certainly with only 143 selected games, a strike rate of 34%, compared to the long-term league average of 27%, is not quite what most statisticians would accept as statistically significant. Furthermore, the profits chart for the English league analysis also reveals many similar periods of so-called treading water, where the bankroll fails to grow significantly. Unfortunately, the results for Germany's Bundesliga 1 are far less promising, with the number of forecasted draws actually less than the long-term league average, although not significantly so for the small data sample.

Whilst evidence from Spanish and German football is unconvincing, it is of course quite conceivable that such a draws forecast model is applicable only in England. One reason for believing this may lie in the generally greater competitiveness of English football compared to other European leagues. With one or two teams dominating many European divisions, not only will they make up a disproportionate number of matches that fit the model criterion, but one might also expect them to be more likely to win their next away game, rather than settle for the draw. Taking Manchester United out of the model, who may be regarded as the dominant Premiership side during the 1990s, and who accounted for 5% of the total number of selected games, improves the 9-season yield to over 7%.

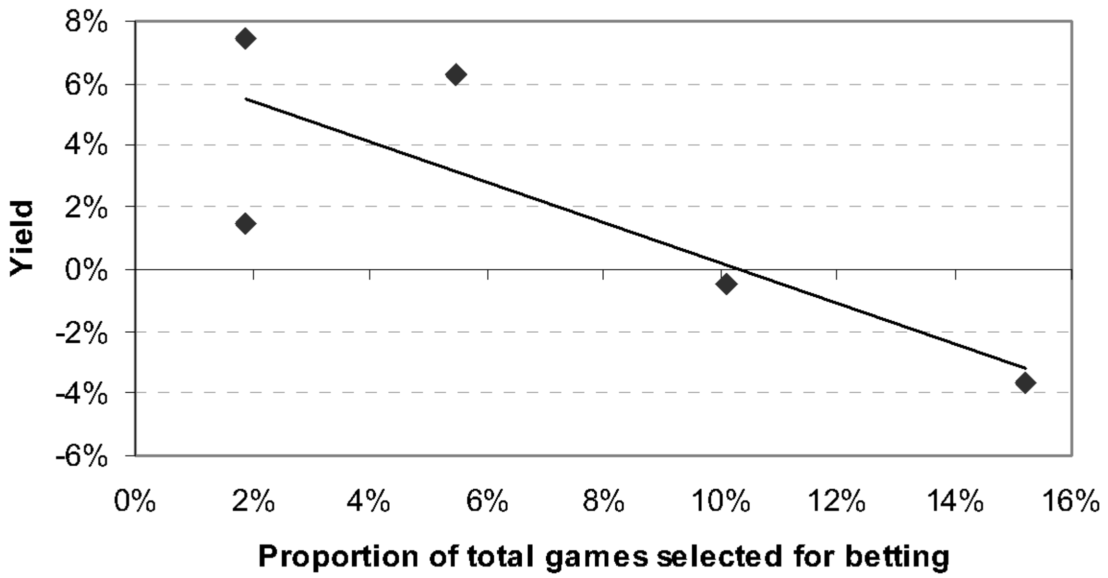
In terms of establishing a causal explanation for these results, particularly for England, the question of course remains: what is significant about the choice of 4 preceding away games? And why 3 or more away wins? The plain truth of the matter is that it was these determinants that yielded a profitable return, raising the spectre of whether mining the data for this relationship has produced a seemingly winning betting system, but within which lie hidden unaccountable factors that might provide a better explanation for this profitable trend. Unexplained influences are not inherently a bad thing, provided they remain consistent and the system remains profitable. If it works, why meddle with it? Nevertheless, the forecaster should understand these shortcomings and accept the possibility that future profit taking may be limited. To investigate this further, it is prudent to test other forecast criteria. After all, if away victories in the preceding 4 away games make a good draw predictor, one might also expect to achieve some success with 3 and 5 matches alike. The results for these forecast criteria are presented in Table 8.8 for the English football league data. Again, betting odds of 9/4 have been assumed throughout.

Table 8.8. Betting returns for an English Football League draw forecast model for four different criteria, seasons 1993/94 to 2001/02

Forecast criterion	Number of matches	Proportion of total	Level stakes (£1) profit	Yield (%)
Last 5 away games, 3 or more away wins	1849	10.1%	-£9.50	-0.51%
Last 5 away games, 4 or more away wins	349	1.9%	£5.25	1.50%
Last 3 away games, 2 or more away wins	2780	15.2%	-£102.00	-3.67%
Last 3 away games, 3 away wins	354	1.9%	£26.25	7.42%
Last 4 away games, 3 or more away wins	1000	5.5%	£62.75	6.28%

All forecast criteria perform better than one might expect, given the bookmaker's overround. The best performing, and therefore profitable, forecast criteria are those where the proportion of recent away wins is greater. Given the original model hypothesis, this is probably not an unexpected finding, although with far fewer matches selected for betting, the significance of the success will be lower. Clearly, there exists a relationship between the proportion of games selected by the forecast model from the total population of matches and the model's profitability, as illustrated in Figure 8.9. Backing all 18,308 games would have lost a punter about 12% on total investment. Backing 2,780, or 15% of all games, using the last 3 away games, 2 or more away wins criterion would have reduced this loss to less than 4%. For the last 3 away games, 3 away wins criterion, the proportion of games selected drops to only 2% but the profit rises to over 7%. The greater the number of selected matches as a proportion of the total available pool, the less likely that a profitable return will be secured. However, the smaller this proportion, the potentially less significant and reliable any success will be. The aim of the forecaster, then, is to develop a model that maximises both the statistical significance of its profitability, as well as the profitability itself. Based on these draw prediction models, the maximum possible match proportion value, that is, the proportion of matches selected for betting to ensure profitability, appears to be close to 10%. Unfortunately, this proportion is roughly what might objectively be considered to represent the minimum acceptable to safeguard statistical significance and reliability on a season-by-season basis.

Figure 8.9. Relationship between profitability and the proportion of games selected by the forecast model



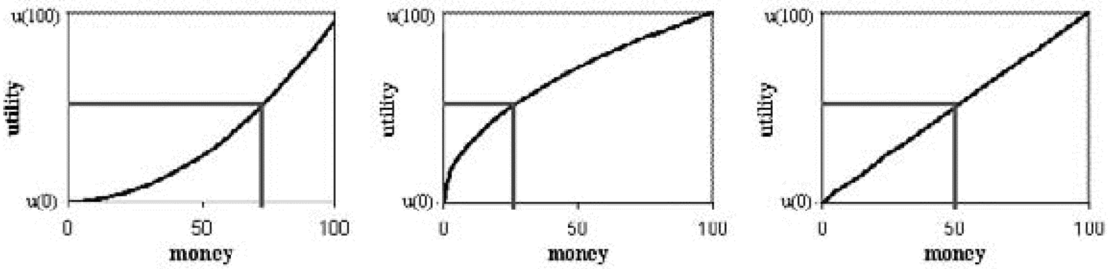
In conclusion, backing away teams in the English football league to draw that have won at least 3 of the preceding 4 away games **may** offer a potential profitable betting return. Nevertheless, the reader should be aware of the uncertainty that success will continue, given the issues of data-mining and potential spurious correlation on the one hand, and limited replicability and statistical reliability on the other.

Thinking about Risk

A primary aim of this book has been to encourage the reader to think more about the money management of his betting strategy. Too frequently, little attention is paid to this issue, whether because of an unstructured staking strategy or because there exists no concept of failure in the mind of the punter. The painful, but obvious truth of fixed odds sports betting is that we cannot win all the time. Fortunately, we do not need to, provided we can adhere to the principles of value betting. So long as we win more often than the bookmaker would like us to, the potential for profit will exist. Nevertheless, even the best sports bettors will experience damaging losing runs at some point or another. The key to successful fixed odds sports betting, then, is learning how to manage these losses: in effect, learning how to lose. To do so, it is necessary to think more about risk, and the following paragraphs which examine this subject in further detail are reproduced by kind permission of Mike Shor from Gametheory.net.

People differ in how much they are willing to take risks, and what kind of stakes are worth taking a risk for. Economists often express one's willingness to take risks through a utility function of money, and more specifically what are known as certainty equivalents. A certainty equivalent represents the maximum amount of money we are willing to pay for some gamble. Alternately, a certainty equivalent is the minimum premium we are willing to pay to insure us against some risk. Imagine that I offer you the following bet: I will flip a coin and if it lands heads you win nothing, but if it lands tails I award you $100. How much would you be willing to pay for this chance? If I set up shop on a street corner and offer passer-bys this gamble for $10, it is likely that most would take it (wouldn't you?). As I increase the price to $20 and then $30 and $40, fewer and fewer people would accept. To see why, consider the 3 utility functions below [in Figure 8.10].

Figure 8.10. Certainty equivalents for coin flip gambling



The first is a risk-seeker, the second is risk-averse, and the third is risk-neutral. In each case, the utility of winning $0 and the utility of winning $100 is denoted on the vertical axis. Since each outcome (heads and tails) is equally likely, I am just as likely to get the (un)happiness of $0 as I am to gain the happiness of $100. My expected utility, or the happiness I expect to earn from this gamble on average is halfway between my utility from winning $100 and my utility from winning $0, since each is equally likely. The horizontal line in each figure represents the utility that this gamble will bring me, on average. The interesting question, however, is not how happy this gamble makes me, but how much I am willing to pay for it [denoted by the vertical line].

Notice that for the first person, the gamble between $0 and $100 is worth about $75. This means that the person would be willing to pay me up to $75 for the right to win $100, based on a coin flip. Certainly, this is a "bad bet" since the average winnings are only $50. However, just like some are willing to make bad bets by playing the lottery or entering a casino, this person likes to take risks.

The second person would not be willing to pay anything over $25. Even though the coin toss, on average, pays $50, the extra risk is not worth it. This can be understood in the form of insurance. Consider a person with $100,000 net worth. Some accident, which has a 50% chance of happening, could cost the person his entire net worth. Therefore, this individual could end the year with a net worth of either $0 or $100,000. Because ending the year without any money is too great a risk, the person purchases insurance against the risk at a cost of $75,000. This way, he is certain to end the year at a net worth of $25,000, regardless of whether or not the accident occurs.

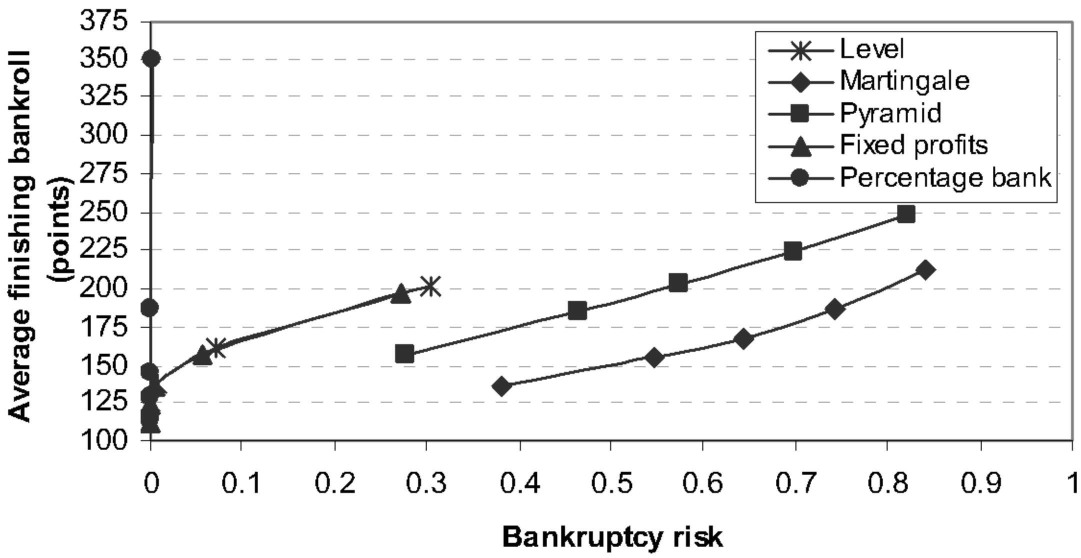
The third person is risk-neutral. Since the expected value of the bet is $50 (1/2 chance at 0, 1/2 chance at 100), the person is willing to pay up to $50 for the bet. This defines risk-neutrality – one is concerned only with the actual expected value. These numbers ($75, $25, and $50) are called certainty equivalents. A certainty equivalent is the minimum amount of money I would rather have for certain, instead of taking some risk. The more risk-averse a person is, the lower his certainty equivalent.

Any value bettor, by definition, will be risk-averse on a bet-by-bet basis. In order for him to secure a positive profit expectancy, he will only wager where he has estimated that the true chance of winning a bet is greater than that predicted by the odds offered by the bookmaker. His certainty equivalent or maximum stake, then, will always be less than 1 divided by the fair (decimal) odds for a unit return (his stake plus profit), which represents the position of risk neutrality. Of course, without value in the betting odds there can be no chance of any long-term success.

Exactly how risky and how rewarding a staking strategy might be is perhaps a more interesting question. The examination of various staking plans in the preceding chapter highlighted the divergent positions a bettor can choose to adopt, with regard to a risk–reward trade-off. In general, as one might expect, the greater the stake size as a proportion of the bankroll, the greater the likelihood of either failure to profit or bankruptcy. A certainty equivalent analysis, however, can help to reveal how risk-averse or risk-seeking a punter might be adopting each strategy.

Figure 8.11 charts the association between the average size of the bankroll after 250 single bets at an average price of even money and with an average betting edge of 5%, and the probability of bankruptcy for 5 of the staking plans examined in this book. The data are taken from the results of the staking plan simulations, with the 5 data points for each plan representing one of the stake size scenarios (1, 2, 3, 5 or 10 points) specific to that plan. Larger stakes increase profitability, but also the risk of bankruptcy for each plan. The significant feature of the chart, however, is the slope and position of each curve, which provides a visual summary of the riskiness of the staking strategy.

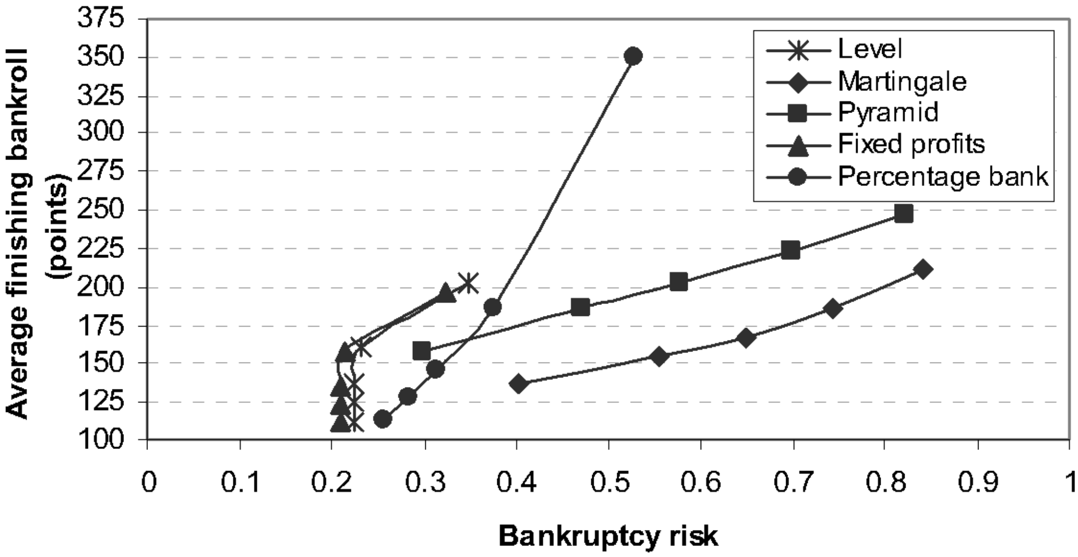
Figure 8.11. Bankruptcy risk–reward curves for 5 staking strategies (even money bets with a 5% edge)



Clearly, a bettor using a progressive staking strategy like the Martingale or Pyramid plan is particularly risk-seeking, since he seems happy to accept a dramatic increase in the risk of losing his bankroll for little extra profit expectancy as the unit stake size is increased. What is puzzling about such gamblers, however, is that it is quite apparent that greater potential profit can be achieved at almost no risk of losing the entire bankroll through percentage bank staking. Level staking and fixed profits staking might be regarded as somewhat risk-neutral by comparison, with the risk of bankruptcy only increasing significantly when the stake size climbs to 10% of the initial bankroll.

By contrast, percentage bank staking is somewhat more risk-seeking than level and fixed profits staking when one is considering the probability of not making a profit instead (Figure 8.12). Remember, when betting a proportion of the existing bankroll, it will take longer to recover from initial losses than if betting a fixed size of stake. Indeed, for stakes sizes of 5 points and lower, with an initial bankroll of 100 points, both level and fixed profits staking are suited for very risk-averse bettors who wish to secure a profit after 250 bets, even though it might be smaller than that achievable through percentage bank staking. Once again, however, the progressive staking plans seem to accept too much chance of failure, given that the increase in expected profitability is marginal.

Figure 8.12. No profit risk–reward curves for 5 staking strategies (even money bets with a 5% edge)



Whilst the significant disadvantages of progressive staking have been highlighted, qualitatively there is no best staking strategy or stake size, since different plans have different aims and distinct consequences suited to different risk attitudes. Nevertheless, many punters steadfastly refuse to accept that progressive staking is a relatively dangerous and theoretically impossible way of attempting to guarantee a profitable return from fixed odds sports betting. With any luck, the risk–reward curves presented in Figures 8.11 and 8.12 may have gone some way at least to convince the more risk-averse bettors that they might need to rethink the use of such misleading strategies.

The most suitable staking strategy for a punter will depend extensively on his attitude to profit making and risk taking. A short-term gambler may prefer to stake large and risk more in an attempt to make a quick and sizeable profit. Conversely, a long-term fixed odds "investor" will prefer to limit the stake size by means of a level stakes or fixed profits strategy, where staying in the game is more important than making fast money. The feel-good factor of actually making a profit is equally significant. Percentage staking, including the use of the Kelly strategy, offers potentially great rewards, but they are harder to come by since recovery from losses takes longer. A punter who acknowledges and understands the uncertainties inherent in fixed odds sports betting, however, will be better able to choose a strategy best suited to his risk–reward preferences.

Using Sports Advisory Services

There is perhaps as much argument amongst bettors, regarding the use of sports advisory services, as there is about the merits of favourite versus longshot betting. The usual theme of those against paying for betting advice is that if the tipping agency offering the advice was any good, they would not need to offer the advice in the first place. Furthermore, it is often suggested that backing someone else's tips takes the fun out of sports betting, in which much of the excitement is believing that you have used your skill and judgement to beat the bookmaker. This is a perfectly acceptable prerogative, but there are reasons why the use of a sports advisory service should not entirely be dismissed out-of-hand.

Ninety-five per cent of gamblers fail to make a profit over the long term. For many of these, particularly the more risk-seeking gamblers, the overall loss is not so important as the feel-good factor of each win. Nevertheless, for others, the prime objective is to actually make some money. If the punter is unable to do this himself, and, of course, this is no easy undertaking, perhaps the purchase of some advice will improve matters. Frequently in life, people find themselves procuring expertise to complete a task that they would otherwise be unable to, or at best, not very proficient at completing themselves. Naturally, part of the excitement of researching your own bets has been lost, but the punter can, and indeed should, maintain interest through effective money management. Tipping agencies do advise stake sizes, and sometimes even a staking plan, but rarely do they seek to inform the punter on how to manage their betting risks.

From the punter's perspective, a professionally organised advisory service should be regarded as a business. Yes, it is true that a successful bettor does not need to sell his knowledge, since he can profit quite happily by backing his own selections. From the tipster's perspective, however, earning revenue via the sale of his information is a sensible policy. His tips will not perform all the time, and if income from sports betting is not simply a luxury, then shortfalls in cash flow could be potentially detrimental. If, instead, his members support his income through regular monthly payments, the mortgage and bills can be paid.

Purchasing advice is one thing. Purchasing **good** advice is quite another. What assurances are there that tipping agencies offering their services can actually deliver the goods? Professor Vaughan Williams has researched a number of horse racing advisory services with mixed success.[69] Whilst he found all of them to be profitable to the advised staking and at starting prices, in no case were the profits large enough to be considered significant using standard statistical testing. Evidence from the proofing service Football-Data.co.uk clouds the picture even further, with the number of sports advisory services showing losses outweighing those showing profits over a 12-month analysis period. Furthermore, whilst staking plans differ from service to service, in no case could a doubling of bankroll have been achieved over this time frame by employing a level staking strategy with 1-point stakes[70] and an initial bankroll of 100.

On a brighter note, however, the fact that a greater proportion of tipsters seem able to return a profit than is the case for the gambling community at large may be regarded as encouraging. Nevertheless, anyone seeking to purchase advice should ensure that he has thoroughly researched the betting record of an advisory service. If there isn't one, don't use it. If one exists, make sure that it has been independently proven, and that the results can be verified. Furthermore, do not be fooled by excessive claims of profits, which in almost every case are a misrepresentation of what has

[69] Vaughan Williams, L. (2000) Can forecasters forecast successfully? Evidence from UK betting markets, *Journal of Forecasting*, **19**, 505-513.

[70] The reader will acknowledge that this represents a very risk-averse staking strategy.

actually been achieved. A “300% profit in one season” means nothing without information about the money management strategy. Instead, find out what the yield, or profit over turnover, of a betting record actually is, and decide whether the number of bets the service advises will be suitable for a reasonable growth of the bankroll without excessive risk.

In addition, the punter should also consider the following issues with regard to the practicality of an advisory service. Firstly, will it always be possible to obtain the advised betting price? If the advisory service has a large number of clients, excessive attention on a particular bet will often lead to a price shortening before the start of the event. If you are late on the bet, the price at which you take it may no longer represent value. A professional service should recognise this feature, and accommodate accordingly by limiting the size of its membership to perhaps no more than 100. If it doesn’t, consider looking elsewhere for advice. Secondly, will it always be possible to bet at the advised stake, or at the stake which you have determined is necessary for your money management strategy? For heavily backed selections, bookmakers, particularly the online firms, will frequently seek to limit their liabilities by reducing the size of the maximum allowable stake. For single bets, this is not so often a problem, but for doubles and larger multiples, stakes sizes are sometimes limited to under £50. If your usual stake size is £100 or more, this may introduce problems for the control of the staking strategy. Thirdly, is the advisory service using recognised bookmakers or obscure offshore firms with limited available currency types and higher deposit and withdrawal costs? Prices with the less familiar firms are generally higher to attract custom, but the punter may be compromising on reliability. It is not unknown for some online bookmakers to become insolvent, with punters losing all the funds in their accounts. Finally, how much does the advisory service cost, or more significantly, what proportion of profits is lost through membership fees? A typical sports advisory service costs in the region of £25 per month or £250 per year. If your stakes are £100, the yield is 10%, and there have been 250 bets during the season, this expense will make up only 10% of your profits. If, on the other hand, your stakes are only £10, you might want to consider a cheaper alternative.

Ultimately, there is no principal reason not to compliment your own betting selections with those from an advisory service if you feel this is warranted. Some punters may even prefer to have someone else do the hard work, gaining pleasure only from the knowledge that they are winning money.

Others simply may have no time to spend analysing and forecasting sporting events, but in order to maintain an interest will happily purchase some advice. Whatever you choose to do, whether to back your own selections, someone else's, or a combination of the two, it will always pay to risk-manage your strategy, and analyse your record.

Analysing Your Betting Record

During this chapter, frequent reference has been made of the statistical significance of a forecasting or betting record. When statisticians find an unusual set of data or an abnormal relationship, they like to determine how likely this has arisen by chance. What, for example, is the probability of there being 327 draws in 1,000 English football league matches occurring by chance, when the expected number would be nearer 270? Statisticians use statistical tests to identify this probability of chance occurrence. The more statistically significant a finding or a relationship is, the less likely that it has arisen by chance. Of course, proving that an association is statistically meaningful does not necessarily identify the cause behind it. The punter should always be reminded of the dangers of interpreting an association in terms of the hypothesised cause, without further investigation into the possibility of spurious correlations.

Of paramount interest to a successful bettor will be the significance of his betting record and profitability. Winning a few bets is a nice feeling, but how can the punter be sure that this does not just represent a short-lived success? How can he determine confidence in his betting system? There are really 3 ways to examine the significance of a betting record. The first is to investigate the strike rate, or ratio of winning bets to losing ones. The second seeks to statistically analyse the level of actual profit. The third approach is to run a Monte Carlo simulation.

Table 8.9 shows a successful level stakes betting history of 100 single wagers where the majority (83%) are at odds-on prices. After 100 bets, the cumulative profit is 14.45 units from a total of 100 staked, or a 14.45% yield. For each bet, the bookmaker's result expectancy is shown, calculated by the inverse of the decimal odds.

Table 8.9. A profitable level stakes betting record

Bet	Odds	Stake	Win	Profit	Cumulative profit	Bookmaker's expectancy
1	2.1	1	Lost	-1	-1.00	47.6%
2	1.33	1	Won	0.33	-0.67	75.2%
3	1.72	1	Lost	-1	-1.67	58.1%
4	1.92	1	Lost	-1	-2.67	52.1%
5	2	1	Won	1	-1.67	50.0%
6	1.84	1	Lost	-1	-2.67	54.3%
7	1.53	1	Won	0.53	-2.14	65.4%
8	2.2	1	Won	1.2	-0.94	45.5%
9	2.09	1	Lost	-1	-1.94	47.8%
10	1.85	1	Lost	-1	-2.94	54.1%
11	2.4	1	Won	1.4	-1.54	41.7%
12	1.72	1	Won	0.72	-0.82	58.1%
13	2.1	1	Won	1.1	0.28	47.6%
14	1.85	1	Won	0.85	1.13	54.1%
15	1.91	1	Won	0.91	2.04	52.4%
16	1.72	1	Lost	-1	1.04	58.1%
17	1.2	1	Won	0.2	1.24	83.3%
18	1.9	1	Won	0.9	2.14	52.6%
19	1.6	1	Won	0.6	2.74	62.5%
20	1.56	1	Won	0.56	3.30	64.1%
21	1.33	1	Won	0.33	3.63	75.2%
22	2	1	Won	1	4.63	50.0%
23	1.83	1	Won	0.83	5.46	54.6%
24	1.75	1	Won	0.75	6.21	57.1%
25	1.36	1	Won	0.36	6.57	73.5%
26	1.72	1	Won	0.72	7.29	58.1%
27	1.44	1	Lost	-1	6.29	69.4%
28	1.62	1	Won	0.62	6.91	61.7%
29	1.9	1	Lost	-1	5.91	52.6%
30	2.1	1	Lost	-1	4.91	47.6%
31	1.9	1	Lost	-1	3.91	52.6%
32	1.66	1	Won	0.66	4.57	60.2%
33	1.61	1	Won	0.61	5.18	62.1%
34	1.66	1	Won	0.66	5.84	60.2%
35	1.83	1	Lost	-1	4.84	54.6%
36	1.44	1	Won	0.44	5.28	69.4%
37	1.9	1	Won	0.9	6.18	52.6%
38	1.4	1	Won	0.4	6.58	71.4%

Bet	Odds	Stake	Win	Profit	Cumulative profit	Bookmaker's expectancy
39	1.69	1	Won	0.69	7.27	59.2%
40	1.7	1	Lost	-1	6.27	58.8%
41	1.6	1	Lost	-1	5.27	62.5%
42	2.5	1	Won	1.5	6.77	40.0%
43	1.66	1	Lost	-1	5.77	60.2%
44	1.82	1	Won	0.82	6.59	54.9%
45	1.72	1	Won	0.72	7.31	58.1%
46	1.63	1	Won	0.63	7.94	61.3%
47	2.16	1	Won	1.16	9.10	46.3%
48	1.87	1	Lost	-1	8.10	53.5%
49	1.83	1	Won	0.83	8.93	54.6%
50	1.83	1	Won	0.83	9.76	54.6%
51	1.67	1	Won	0.67	10.43	59.9%
52	1.57	1	Won	0.57	11.00	63.7%
53	1.77	1	Lost	-1	10.00	56.5%
54	2.37	1	Lost	-1	9.00	42.2%
55	1.34	1	Lost	-1	8.00	74.6%
56	1.7	1	Won	0.7	8.70	58.8%
57	2.1	1	Lost	-1	7.70	47.6%
58	1.7	1	Won	0.7	8.40	58.8%
59	1.67	1	Won	0.67	9.07	59.9%
60	1.75	1	Lost	-1	8.07	57.1%
61	1.4	1	Won	0.4	8.47	71.4%
62	1.4	1	Won	0.4	8.87	71.4%
63	1.9	1	Won	0.9	9.77	52.6%
64	1.85	1	Lost	-1	8.77	54.1%
65	1.75	1	Lost	-1	7.77	57.1%
66	1.3	1	Won	0.3	8.07	76.9%
67	1.36	1	Won	0.36	8.43	73.5%
68	1.75	1	Lost	-1	7.43	57.1%
69	1.77	1	Lost	-1	6.43	56.5%
70	1.8	1	Lost	-1	5.43	55.6%
71	1.48	1	Won	0.48	5.91	67.6%
72	1.57	1	Lost	-1	4.91	63.7%
73	1.8	1	Lost	-1	3.91	55.6%
74	1.53	1	Won	0.53	4.44	65.4%
75	1.8	1	Won	0.8	5.24	55.6%
76	1.66	1	Won	0.66	5.90	60.2%
77	1.4	1	Won	0.4	6.30	71.4%
78	1.83	1	Lost	-1	5.30	54.6%

Bet	Odds	Stake	Win	Profit	Cumulative profit	Bookmaker's expectancy
79	1.65	1	Won	0.65	5.95	60.6%
80	1.85	1	Won	0.85	6.80	54.1%
81	1.6	1	Won	0.6	7.40	62.5%
82	2.96	1	Won	1.96	9.36	33.8%
83	2.8	1	Won	1.8	11.16	35.7%
84	1.87	1	Lost	-1	10.16	53.5%
85	1.4	1	Won	0.4	10.56	71.4%
86	1.72	1	Won	0.72	11.28	58.1%
87	1.44	1	Won	0.44	11.72	69.4%
88	1.5	1	Won	0.5	12.22	66.7%
89	1.73	1	Lost	-1	11.22	57.8%
90	1.6	1	Lost	-1	10.22	62.5%
91	1.6	1	Won	0.6	10.82	62.5%
92	1.9	1	Won	0.9	11.72	52.6%
93	1.5	1	Won	0.5	12.22	66.7%
94	2	1	Won	1	13.22	50.0%
95	2.1	1	Lost	-1	12.22	47.6%
96	1.32	1	Won	0.32	12.54	75.8%
97	1.83	1	Lost	-1	11.54	54.6%
98	2.45	1	Won	1.45	12.99	40.8%
99	1.8	1	Won	0.8	13.79	55.6%
100	1.66	1	Won	0.66	14.45	60.2%

With a 14.45% profit on investment, there have clearly been more winners than the bookmaker would have budgeted for. After 100 bets, there were 66 winners and 34 losers. How does this compare to the strike rate that the bookmaker has predicted according to his odds? The value of the bookmaker's result expectancy for each bet represents his opinion about the probability of the winning result occurring, after his profit margin has been factored in. The average, across 100 bets, is 58.2%. According to the bookmaker's analysis, for any punter to break even after 100 wagers, he would, on average, need to win roughly 58 of them. The bookmaker, of course, does not expect the punter to break even, but instead anticipates that he will lose by a margin dictated by the overround. Exactly what level of profit margin, however, has been built into each price is very much open to debate. There will be two main influences, both of which concern the betting price itself. Firstly, we have seen that shorter odds may very well attract a lower bookmaker's profit margin than which might be predicted solely by the overround because of the favourite–longshot bias. For an average price of 1.76, this may be 108% or even lower as illustrated earlier in the chapter by Figure 8.1.

Secondly, moreover, a punter will normally compare prices from different bookmakers to obtain the best one available for each chosen bet. A bet of 1.76 with the most generous bookmaker may only be available at 1.66 from most others. Following the odds comparison analysis presented in Chapter 3, this may reduce the effective disadvantage even further, and on rare occasions eliminate it altogether. A conservative estimate of the real average bookmaker's profit margin for such best-priced odds-on bets, then, might be about 105%, or 1.05, but may very well be lower on many occasions. If we then divide 58.2% by 1.05, we have what could be considered to be the opinion of a collection of bookmakers for the estimate for the true or fair average win expectancy for this series of 100 bets: 55.47%. Theoretically, it would be more accurate to estimate a specific bookmaker's profit margin for each bet to calculate their opinion of the true win expectancy, before calculating the average across all bets, given that for many records the odds may vary quite considerably. In practice the punter may regard the extra computational workload as excessive and unjustified, given that what bookmakers' consensus opinion is of a fair price for a bet can only be estimated.

What is this information telling us? Well, given that most bets in this record are odds-on and that the punter has searched for the best available odds, without skill or better judgement through forecasting and prediction, he could expect on average to have about 55 or 56 winners, with 44 or 45 losers. In fact, he has had 66 winners and 34 losers, the difference he believes due to his ability to spot bookmaker's pricing errors and find real value in the odds. Would he be right in this assessment?

To test whether his strike rate after 100 bets is significantly better than that predicted by the betting odds, the punter can make use of what statisticians call the Chi-Square Goodness of Fit Test. This statistical test is used to determine if observed counts or frequencies are different from what we would expect to find. In general, the Chi-Square test statistic (χ^2) is of the form:

$$\chi^2 = \Sigma \frac{(\text{Observed - Expected})^2}{\text{Expected}}$$

In plain English, if it can be expressed plainly, χ^2 is the sum of the square of the deviations of observed frequencies from the expected frequency divided by the expected frequency. In this betting context, the observed frequency of wins was 66, whilst the observed frequency of losses was 34. By contrast, the expected frequency of wins and losses is 55.47 and 44.53 respectively. Consequently, χ^2 = 4.49, as illustrated below.

	Observed	Expected	$\frac{(\text{Observed - Expected})^2}{\text{Expected}}$
Winners	66	55.47	2.00
Losers	34	44.53	2.49
Total	100	100	4.49

The value of χ^2 provides information about the probability that the observed ratio of wins to losses is significantly different to what would be expected without a punter's skill and judgement. For a simple bimodal win/loss analysis, the probability that a betting record is statistically significant may be estimated by reference to the Chi-Square probability table shown in Table 8.10.

Table 8.10. Critical values for the Chi-Square distribution[71]

Probability record is result of chance	50.0%	25.0%	10.0%	5.0%	2.5%	1.0%	0.5%
Chi-Square	0.455	1.323	2.706	3.841	5.024	6.635	7.879

For our betting record, a χ^2 value of 4.49 would indicate that the strike rate of winners has between a 2.5% and 5% probability of having arisen by chance. Generally speaking, statisticians would look for this probability to be less than 5%, and sometimes 1%, before considering such a record to be statistically meaningful, that is, the result of the bettor's forecasting skill.

Readers with access to Microsoft Excel can input the observed and expected strike rates to calculate the probability value associated with the χ^2 statistic directly, using the following function:

=CHITEST(a1:b1,a2:b2)

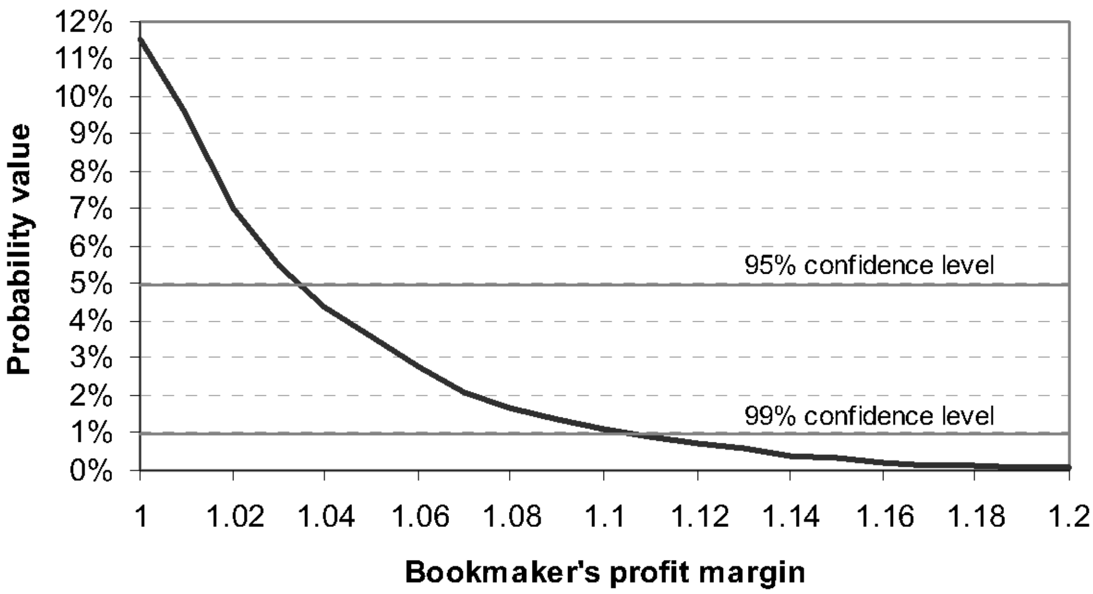
[71] Readers with a statistical background may like to note that the critical values in Table 8.8 are for a one-tailed Chi distribution with one degree of freedom.

where a1, b1, a2, and b2 represent the column-row cell locators for the observed frequency of winners, observed frequency of losers, expected frequency of winners and expected frequency of losers respectively. For this betting record, the CHITEST function confirms that the probability value is 3.41%, indeed between 2.5% and 5%, meaning that the betting record is probably the result of the bettor's prediction ability.

When computing χ^2 and its probability value, the biggest source of error will be in the estimation of the expected frequency of winners and losers, which in turn is dependent upon the choice of the bookmaker's profit margin for the calculation. The reader will recall from the analysis above that this is not necessarily simply the value of the overround; a value of 1.05 for the bookmaker's profit margin was used here, since most of the bets were odds-on and they generally represented the best available prices. If a profit margin of 1.12 is chosen instead, a margin equivalent simply to the overround, the value of χ^2 is 7.85 whilst the probability value is 0.51%, indicating a much greater degree of statistical significance in the betting record. Of course, it has been argued here that merely using the value of the overround to calculate the expected frequencies of wins and losses may sometimes be inappropriate, particularly where prices are short and represent the best available. Consequently, failure to take into account the influence of these additional factors could lead the punter to believe that his betting record is more statistically significant than it actually is. In such a case, the punter may be taking more credit than is due, when in fact the above-average prices, as well as the pricing bias, were doing much of the work for him.

Similarly, if 1.05 actually represents an overestimate of the true bookmaker's estimated profit margin on a price, then the significance of the record will likewise be overrated. Figure 8.13 demonstrates the effect on the probability value, and statistical significance, as the size of the bookmaker's profit margin used to calculate the expected win/loss frequencies is varied for this record. The greater the margin, the more significant the record, since there will be a greater difference between the observed strike rate and the expected strike rate as calculated, equivalent to a superior ability on the part of the punter to beat the bookmaker's odds. The horizontal lines in Figure 8.13 signify the 5% and 1% probability values, sometimes called the 95% and 99% confidence levels, in this case the confidence one would have that the betting record is the result of the punter's skill and not chance. For this record, an estimated bookmaker's profit margin of less than about 1.035 would mean that the record could not traditionally be considered to be statistically significant.

Figure 8.13. Variation of statistical significance (Chi-Square) with the value of bookmaker's profit margin



Of course, where the punter is betting largely at long odds, any pricing bias may very well be working against him. Although taking the best prices will reduce the bookmaker's imposed disadvantage, the true bookmaker's profit margin for such bets may still actually be greater than the value of the overround. Such considerations should be evaluated on a record-by-record basis when attempting to estimate the expected strike rate and determine the significance of any betting record.

As one might expect, the longer a profitable betting record is, the larger the value of χ^2 becomes, since it is directly proportional to the number of bets. Consequently, the significance and, potentially, the reliability of the record increase. This is intuitively obvious, since one would reasonably place more faith in a 2-year profitable betting history than in a 2-month record, even perhaps if the yield for the latter were greater. For a punter seeking a reliable sports advisory service from whom to purchase advice, this point is particularly relevant. Much better to rely on a proven record of, say, 1,000 bets with a 10% yield than on a relatively unverified record of 25 bets, where the return on investment might be 50%. Table 8.11 demonstrates how χ^2 and the significance of a betting record grow as the number of bets in it increases, all other things being equal.

Table 8.11. The influence of the size of a betting record on its statistical significance

Bets	Observed winners	Observed losers	Expected winners	Expected losers	χ^2	Probability value
20	11	9	10	10	0.2	65.47%
40	22	18	20	20	0.4	52.71%
80	44	36	40	40	0.8	37.11%
160	88	72	80	80	1.6	20.59%
320	176	144	160	160	3.2	7.36%
640	352	288	320	320	6.4	1.14%
1280	704	576	640	640	12.8	0.03%
2560	1408	1152	1280	1280	25.6	0.00%

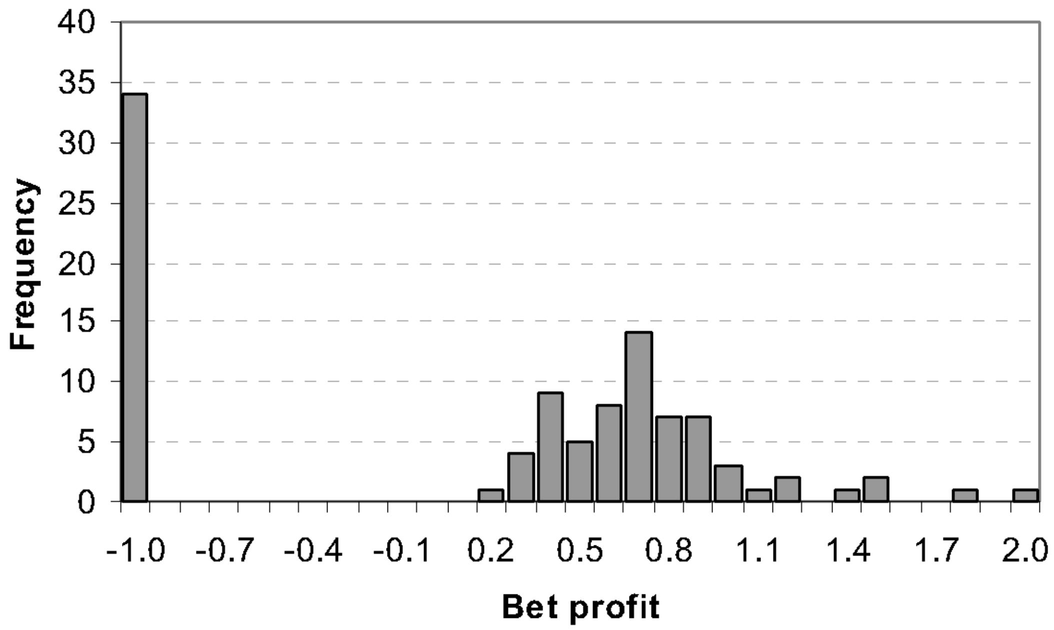
The Chi-Square statistical test investigates frequencies of wins and losses. As such, it assumes that the value of each win or loss is equal to any other. For level stakes this is quite reasonable, but for a variable staking strategy it might be more appropriate to weight the size of each win and loss accordingly. This can be simply, if somewhat imperfectly, achieved by means of what is known as the t-statistic. Instead of comparing observed win/loss frequencies to expected ones, the t-statistic investigates the probability that the size of your profit, or more accurately the average profit per bet, is significantly different to what the bookmaker would expect it to be. Naturally, bookmakers expect their customers to lose over the long term, so any profit the punter makes instead might be construed as a success. From a statistician's perspective, however, it is important to determine how significant such a profit really is. The greater the significance, the more certain the punter can be that his success will continue into the future.

The t-statistic is based upon Student's t-distribution. It is very similar to the normal distribution, which, readers will recall from Chapter 6, looks very much like a bell-shaped curve. Suppose we have a simple random sample of size n drawn from a normally distributed population with mean μ and standard deviation σ. Let $\bar{x}$ (pronounced x-bar) denote the sample mean and s, the sample standard deviation. Then the quantity, t, is given by:

$$t = \frac{\sqrt{n}(\bar{x} - \mu)}{s}$$

The t-statistic, like the Chi-Square statistic, provides a measure of how extreme a statistical estimate is, and in this example may be used to determine whether a profit over turnover of 14.45% is significant. For the t-statistic to offer a reliable measure of statistical significance in this context, the data should be normally distributed, with more values close to the average, and fewer at the extremities. For a typical betting record, this assumption is clearly invalidated, since a profit from a single fixed odds bet (excluding Asian handicap wagers) is either negative (the lost stake) or positive (the stake multiplied by the fractional odds). Figure 8.14 illustrates the spread of bet profits for this particular betting record.

Figure 8.14. Distribution of bet profits from Table 8.9



Fortunately the t-distribution is fairly robust against violations of the normality assumption for large n, when it approximates the normal distribution. When the samples become very large (above n = 100), then the sample means will approximate the normal distribution, even if the respective variable is not normally distributed in the population.

Following the earlier Chi-Square analysis, we might reasonably assume that for the chosen betting odds in Table 8.9, the real disadvantage faced by the punter in the value of the betting price will be 105%. Consequently the value of μ for a unit level staking plan will be -0.05. Using a spreadsheet to calculate the mean and standard deviation[72] of the 100 bet profits returns a t-statistic for this profit record of 2.23.

μ	-0.05
$\bar{x}$	+0.1445
n	100
s	0.871
t	**2.234**

When we speak of a specific t-distribution, we have to specify the degrees of freedom, given by the value n - 1. In this example it is 99. Probability tables, as for the Chi-Square distribution, exist also for the t-distribution, allowing one to determine the probability of a chance occurrence. With t = 2.23 and 99 degrees of freedom, the probability that the profit record has arisen by chance lies between 1% and 2.5%.

Table 8.12. Critical values for the t-distribution[73]

Degrees of freedom	Probability profit record is result of chance						
	25.0%	10.0%	5.0%	2.5%	1.0%	0.5%	0.1%
10	0.69981	1.37218	1.81246	2.22814	2.76377	3.16926	4.14366
25	0.68443	1.31635	1.70814	2.05954	2.48510	2.78744	3.45019
50	0.67943	1.29871	1.67591	2.00856	2.40327	2.67779	3.26138
100	0.67695	1.29008	1.66023	1.98397	2.36421	2.62589	3.17377
250	0.67547	1.28495	1.65097	1.96950	2.34136	2.59564	3.12313
500	0.67498	1.28325	1.64791	1.96472	2.33383	2.58569	3.10662
1000	0.67473	1.28240	1.64638	1.96234	2.33008	2.58075	3.09839

In Microsoft Excel, the TDIST(t,dof,tails) function can be used to calculate the probability value associated with the t-statistic directly, where t is the value of the t-statistic, dof is the degrees of freedom and tails is either 1 (for the one-tailed distribution) or 2 (for the two-tailed distribution). Since we are not really concerned with testing for a significantly unprofitable record at the same time, we would in this case use the one-tailed distribution. Consequently TDIST(2.234,99,1) returns a value of 1.39%,

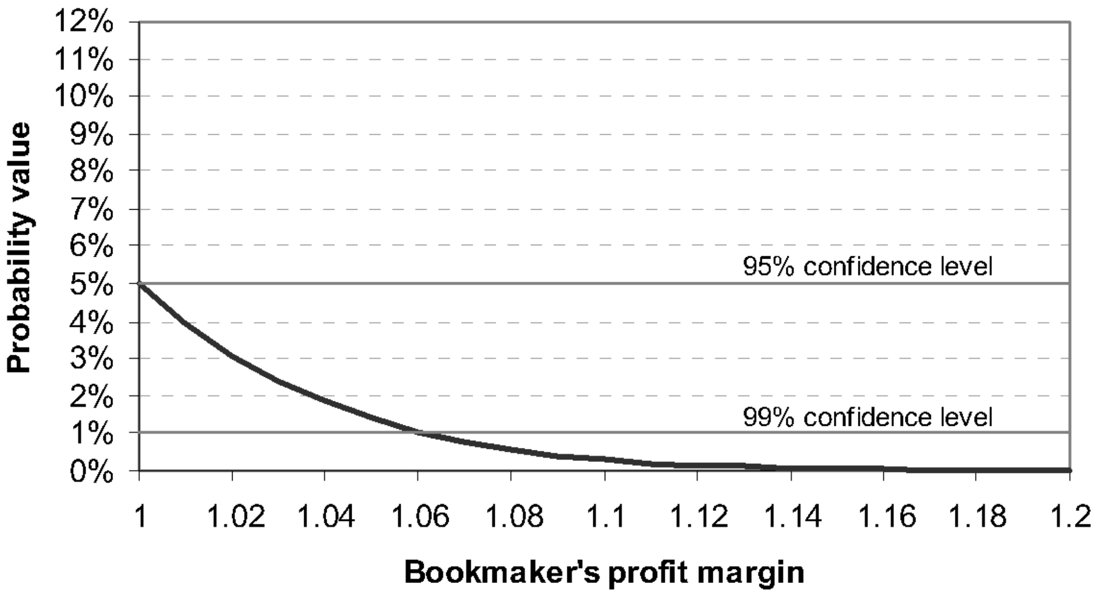
[72] The formula for the standard deviation of a set of data was shown earlier in this chapter.

[73] As the number of degrees of freedom approaches infinity, the critical value of t for each probability level tends towards a limit defined by the normal distribution. These critical values are for the one-tailed t-distribution. The reader may also like to refer to a critical value applet calculator available online at http://duke.usask.ca/~rbaker/Tables.html.

not wholly dissimilar to the probability value obtained via the Chi-Square testing (3.41%).

Figure 8.15 reproduces Figure 8.13 for the variation of statistical significance with the chosen value of the bookmaker's profit margin, this time for the t-statistic. Again, the greater the bookmaker's profit margin used to calculate the t-statistic, the greater the level of significance, since there will be a greater difference between the observed average bet profit and that expected on the basis of the chosen value of the bookmaker's profit margin. Clearly, a punter analysing the meaningfulness of his profit record must keep this issue in mind if he is to avoid reaching a misleading conclusion. The generally greater level of statistical significance attributed to this betting history by the t-statistic, however, may have arisen as a result of the violation of the assumption of normality. As such, the validity of these results might need to be questioned.

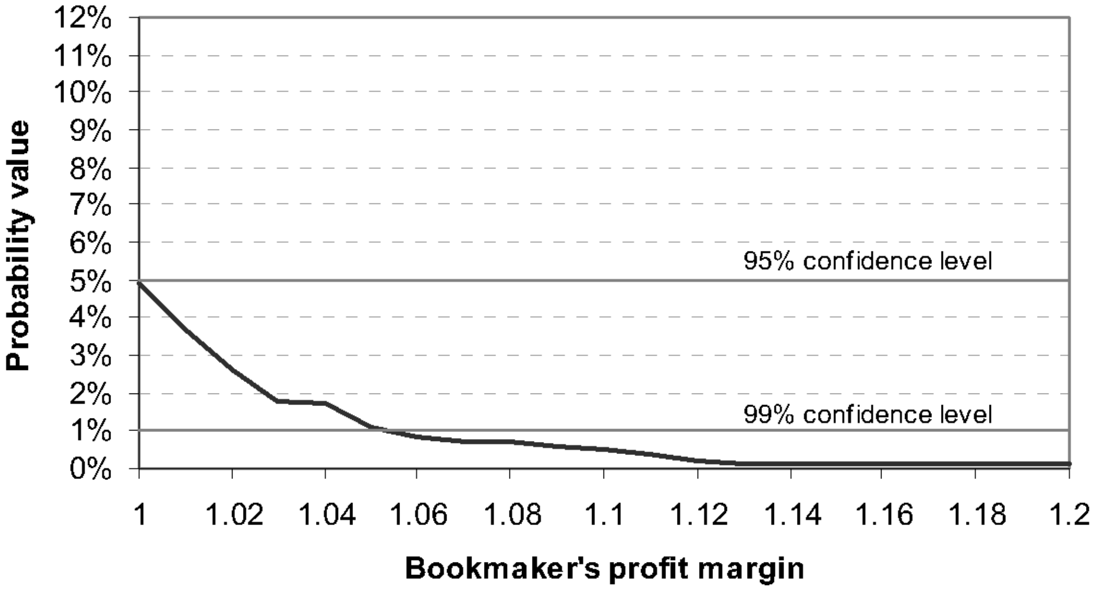
Figure 8.15. Variation of statistical significance (t-statistic) with the value of bookmaker's profit margin



Perhaps the most accurate method of estimating the statistical significance of a profit record is to run a Monte Carlo simulation, like those used to analyse the staking plans in the previous chapter. Such a simulation, which can generate a random set of winners and losers according to specified information about the bookmaker's expected profit margin on each price, will reveal how often, on average, the punter could expect to achieve or perform better than his actual profit record simply by chance.

For the betting record in question, a simulation was run, with 1,000 repetitions, for each of the specified values for the bookmaker's profit margin, from 1.00 to 1.20 at 0.01 intervals. For every bet, the same average value for the bookmaker's expected profit margin was assumed, although the punter could choose, if he wished, to estimate the specific value for each odds, which, as argued previously, will vary according to the strength of the favourite–longshot bias and their size relative to other bookmakers' prices. Results from the simulation are shown in Figure 8.16. The match with Figure 8.15 is remarkable, confirming that the t-statistic does actually provide a reliable indicator of the statistical significance of a betting record, despite the reservations about the violation of the normality assumption.

Figure 8.16. Variation of statistical significance (Monte Carlo simulation) with the value of bookmaker's profit margin



On the basis of the 3 different approaches to investigating the significance of these betting returns, we may reasonably conclude that a level stakes yield of over 14% after 100 largely odds-on single bets is more probably the result of the bettor's ability to predict sporting outcomes, rather than simply down to chance, even though some of the work was done by taking the best available prices, and focusing on favourites. Furthermore, on the basis of such analysis, we may expect to see such profit taking continue into the long-term future, **PROVIDED** the level of forecasting success remains unchanged. This is a crucial caveat – the fact that a profit record is statistically significant after 100 bets does **NOT** prove that it will be after

1,000. Certainly, where the bettor is utilising a numerical forecasting approach, that is, a rating system, the statistical significance of a limited record cannot alone refute the existence of a spurious relationship that might be accounting for the short-term or short-lived success. Consequently, it is always preferable to err on the side of caution and treat nothing, in a betting context, as statistically meaningful or robust until there is less than a 1% or perhaps even a 0.1% probability that it has arisen by chance. This may require a season of betting or more, perhaps 250 bets, perhaps 500, maybe even 1,000. The only certainty with significance testing of a betting record, however, is that the longer it is, the greater the likelihood that any profits it has accrued have been earned by a real and timeless ability to beat the bookmaker.

Before turning to the closing paragraphs of this book, it is worth reminding the reader that if his betting record contains doubles and higher multiple bets, he will need to adjust the size of the bookmaker's profit margin used in each of the 3 statistical analyses accordingly. Chapter 3 examined how a bookmaker's overround increases, as more selections are included into a bet. For 2 selections, where the bookmaker's theoretical profit margin for each is 1.05, the margin for the double will be 1.1025. For 3 selections it would be 1.1576. In general, the larger the multiple, the greater the bookmaker's profit margin built into the odds, or rather the advantage that he believes he has built in. Consequently, any similarly profitable record based on multiple betting will be more statistically significant than an equivalent level of profit for singles betting alone. Of course, with bigger overrounds for larger multiples, the realistic chances of succeeding will be relatively diminished unless the punter can demonstrate a high degree of accuracy in his assessment of value in the betting odds.

Summing Up

Fixed odds sports betting is certainly not for the faint-hearted. Evidence suggests that few actually beat the bookmaker to make a profit over the long term. Nevertheless, the fact that even a few punters are successful verifies that gaining a betting edge is not simply a pipe dream. Provided one learns how to gain this edge, and more importantly adheres to a sensible risk management of his betting strategy, fixed odds sports betting offers a potential investment opportunity to those seeking a little more excitement than merely collecting an annual low interest return from their savings.

The theme of this book has been to encourage the fixed odds sports bettor to think more analytically about his betting strategy, about the markets he invests in, about the type of wagers he makes, about betting value and numerical approaches to finding it, about ways of gaining a head start, and most importantly of all perhaps, about money management and an examination of risk. It is only through such clear thinking and critical appraisal that a bettor can hope to maximise his chances of success. Without this, the bookmaker will always maintain the upper hand. Consequently, this book concludes with a synopsis of what could be regarded as the principal axioms for any serious fixed odds investment strategy. Readers will agree or disagree to a greater or lesser extent with some of the points. In the main, however, the recognition of such principles will, at the very least, ensure that where a punter was losing money beforehand, he should be less likely to do so in the future.

1. Set aside a betting bankroll

Without a proven record of long-term success, any punter should avoid betting more than he can afford to lose. The most sensible approach to safeguard against this is to set aside a bankroll for the purposes of betting, the size of which should not encroach on the need to pay the bills. If this is lost, the punter should consider the possibility that fixed odds sports betting will not, for him at least, offer a suitable investment opportunity.

2. Research your sport and be selective

There are literally thousands of fixed odds sports betting opportunities to be found every week, and for every one the bookmaker has hoped to stack the odds against you. To improve your chances of overcoming this disadvantage, it is prudent to concentrate on one or perhaps two key sporting markets. Research these thoroughly. For the smaller, less popular markets, like darts, volleyball, cycling, ski jumping or biathlon, the bookmakers will often know less about the events than a regular follower of such sports, and may only have one or two odds compilers studying them. Be selective and don't bet because you have to, but only when you feel you have identified an edge. After all, the worst you can do by not betting at all is break even.

3. Keep accurate records

For all your betting, keep accurate records of the selections backed and their prices, the amounts wagered, and the profits or losses incurred. Keeping a truthful betting history will help you to analyse your strengths and weaknesses, to assess your profitability and, most fundamentally of all, to reveal whether you have the talent to gain an edge. For advisory services, keeping and publishing an honest record goes without saying. Without one, customers have no idea how meaningful any profit claims will actually be.

4. Value-bet or don't bet at all

Winning bets are the only ones that make money. True, but you can't win all the time. Without winning more often than the bookmaker has priced you to do so, the losers will ensure that your betting bank will remain in the red. Seek to identify and measure value in the odds, through a comparison of bookmakers' prices, quantitative and qualitative forecasting techniques and a professional's "feel" for its availability. Find the value and the winners will take care of themselves.

5. Test your forecasting systems

Punters adopt different approaches to forecasting and prediction. Some prefer to study subjectively, reading up on the news about each event, and making betting judgements on the basis of information about injuries, morale, motivation and so on. Others prefer to quantify information about form, and develop rating systems to predict the outcome of the next contest. For either approach, but more specifically for numerical forecasting, test and retest your systems, and identify significance. Be wary of spurious relationships, which may misrepresent the meaningfulness of any significant association between hypothesised predictors and the actual outcome of events. Remember that if one looks long and hard enough at a set of data, a relationship of one form or another, whether meaningful or not, can usually be found. Very few will ultimately turn out to be profitable in the long run.

6. Identify favourable betting markets

There are all sorts of wagers, from match bets to ante post, scorecast to handicaps. Every punter will have his favourite type of betting market, but it is shrewd to focus on those where the bookmaker has limited his overround. These include bets where the number of possible outcomes is a minimum – 2 – and include Asian handicap betting in football, American sports wagers and 2-way betting in many other fields. The imposed disadvantage the punter will face is lower, both because the bookmakers can afford it to be so, and because there is little room for them to manoeuvre behind less generous prices.

7. Bet singles

For decades, bookmakers imposed preposterous restrictions on the availability of single bets, where the punter needs only to back the outcome of one event. Since the explosion of the offshore and Internet fixed odds betting industry, these restrictions have thankfully all but disappeared. Unfortunately, punters fed on the lure of the bigger payouts from multiples and perms still place these unfavourable bets *en masse*. For highly successful bettors, it is true that profits can be enhanced, but the risks in seeking them, through the larger overrounds and lower strike rates, will always be greater. Singles on their own can offer quite reasonable rewards without the undue worry of losing the betting bankroll early. A punter's greed is so often his downfall. Why try to run before you can walk?

8. Back favourites or short prices

Contentious but undeniably apparent, at least in football betting, is the presence of a favourite–longshot bias. Demonstrated empirically beyond question in the European football fixed odds market, it potentially owes its existence to the risk-averse tendencies of most bookmakers, who would sooner overprice an odds-on selection than expose themselves to excessive liability by offering value in the longshot. Backing only short prices will not be enough on its own to secure a betting edge, but for those who choose to do so, the imposed average disadvantage is significantly smaller to start with. Backing shorter prices also means you will win more often and expose your bankroll to less risk if betting level stakes. Don't, however, back a favourite just because it is a favourite. Back it because you believe it contains real value, and that the bookmaker has made a mistake.

9. Compare bookmakers' prices

Really this goes without saying. If one bookmaker offers 1/1 whilst another offers 6/5, it would make little sense to take the less generous price. Perhaps a new betting account may need to be opened to take advantage of the opportunity, but provided the bookmaker's reputation is sound and the transaction costs, if any, are small, this should not create an unnecessary distraction. Also consider the betting exchanges, where you can bet against other punters rather than against a traditional bookmaker. Despite commission payable on winnings – usually 5% – the odds available with exchanges are frequently more favourable since there is technically no overround to overcome. Remember, however: do not simply bet because your bookmaker offers the highest price. Make sure the odds contain value.

10. Identify your risk preferences

Are you a risk seeker or a risk avoider? The answer to this question will shape your entire staking strategy and money management. Risk seekers are happy to back high odds and large multiples, preferring the thrill of big-win gambling to the mundane grind of "win some, lose some" betting. Furthermore, some gamblers are prepared to chase lost capital through ratcheting up the stakes after each losing bet. Be warned: this policy will **NOT** guarantee profits, whilst the risks of failure are considerable. If you prefer to play it safe, a simple level staking plan will suffice, or perhaps a policy of staking to win a fixed profit each time you bet. Betting a percentage of your bankroll through simple percentage bank staking or more advanced Kelly staking can yield significant rewards for the proven bettor, but he must be prepared to wait out potentially longer periods of loss making in order to secure a greater payday at the end of the line.

11. Always analyse your betting record

Money in the bank from winning bets is a wonderful feeling, particularly if you believe your skill and judgement has earned you that money. Avoid becoming complacent, however, and investigate whether your profits could simply have arisen by chance. If this is the case, they may not come so easily in the future. Even where you have established significance in a betting history, beware of unexplained factors that may be accounting for your level of success.

12. Learn how to lose

Perhaps the most important lesson a fixed odds sports bettor should learn is how to lose. Strange as this may sound, it is actually understanding how to manage losses and cope with losing runs that is so often the key to this business. Having the patience to outlast such deleterious sequences, and the willpower to resist chasing the losses, is the hardest part of gambling. Succeed here, and your chances of avoiding outright failure are greatly enhanced. Simply staying in the game is half the battle. If you aren’t in it, you can’t win it, regardless of any ability you have at beating the fixed odds bookmaker.

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Appendix

The following table contains the data used to construct the Monte Carlo staking plan simulations in Chapter 7. Information for each of the 250 bets for every betting scenario includes the bookmaker's result expectancy, the corresponding odds for that result expectancy, and the size of the betting edge awarded for the bet. The values in row 2 (repeated at the top of each subsequent page) refer to the average expectancies and betting edges across a 250-bet sequence. With 5 expectancy scenarios and 7 betting edge scenarios, there were a total of 35 betting scenarios for each stake size examined and for each staking methodology (with the exception of Kelly staking).

	Bookmaker's result expectancies and their odds										Betting edges						
Bet	*0.2*		*0.3*		*0.4*		*0.5*		*0.6*		*0.9*	*0.95*	*1*	*1.05*	*1.1*	*1.15*	*1.2*
1	0.235	4.255	0.235	4.255	0.3	3.333	0.42	2.381	0.44	2.273	0.815	0.985	0.71	1.015	1.2	1.245	1.325
2	0.045	22.22	0.265	3.774	0.275	3.636	0.51	1.961	0.71	1.408	0.695	0.985	1.13	1.12	1.195	1	1.215
3	0.205	4.878	0.3	3.333	0.35	2.857	0.495	2.02	0.515	1.942	0.97	0.91	1.105	1.04	1.24	1.125	1.27
4	0.13	7.692	0.31	3.226	0.41	2.439	0.615	1.626	0.495	2.02	0.84	0.915	0.855	0.885	1.16	1.15	1.285
5	0.25	4	0.31	3.226	0.61	1.639	0.51	1.961	0.53	1.887	0.805	0.995	1.055	1.085	1.19	0.955	1.17
6	0.17	5.882	0.33	3.03	0.36	2.778	0.37	2.703	0.575	1.739	1.08	1.055	1.05	1.155	1.025	1.11	1.22
7	0.485	2.062	0.21	4.762	0.54	1.852	0.56	1.786	0.635	1.575	0.755	0.915	0.905	1.085	1.045	1.015	1.265
8	0.18	5.556	0.24	4.167	0.405	2.469	0.52	1.923	0.78	1.282	0.925	0.835	1.08	1.065	1.065	1.21	1.135
9	0.445	2.247	0.335	2.985	0.38	2.632	0.525	1.905	0.695	1.439	0.935	0.98	1.03	1.075	1.055	1.22	1.34
10	0.06	16.67	0.22	4.545	0.38	2.632	0.31	3.226	0.6	1.667	0.915	0.955	0.87	1.14	1.155	1.22	1.345
11	0.135	7.407	0.16	6.25	0.515	1.942	0.475	2.105	0.62	1.613	0.82	0.935	0.93	0.96	1.195	1.12	1.275
12	0.155	6.452	0.25	4	0.47	2.128	0.47	2.128	0.795	1.258	1.08	0.975	1.085	1.01	1.105	1.11	1.155
13	0.24	4.167	0.195	5.128	0.415	2.41	0.505	1.98	0.57	1.754	0.775	1	0.835	1.07	1.22	1.135	1.06
14	0.17	5.882	0.335	2.985	0.415	2.41	0.475	2.105	0.52	1.923	0.995	0.945	0.885	1.115	1.115	1.125	1.15
15	0.155	6.452	0.395	2.532	0.255	3.922	0.455	2.198	0.485	2.062	0.855	0.845	0.96	1.01	0.88	1.175	1.195
16	0.27	3.704	0.105	9.524	0.42	2.381	0.325	3.077	0.595	1.681	0.7	1.015	0.91	1.08	1.025	1.215	1.21
17	0.155	6.452	0.3	3.333	0.405	2.469	0.565	1.77	0.55	1.818	0.785	0.65	0.925	1.16	1.055	0.965	0.99
18	0.375	2.667	0.265	3.774	0.235	4.255	0.535	1.869	0.67	1.493	0.855	1.105	1.11	1.045	1.33	1.155	1.23
19	0.32	3.125	0.355	2.817	0.54	1.852	0.6	1.667	0.38	2.632	0.91	0.975	1.04	1.115	1.05	1.235	1.205
20	0.33	3.03	0.345	2.899	0.44	2.273	0.51	1.961	0.695	1.439	0.91	1.065	0.985	1.045	1.23	1.16	1.14
21	0.3	3.333	0.44	2.273	0.375	2.667	0.63	1.587	0.74	1.351	1.09	0.975	1.01	1.105	1.1	1.275	1.175
22	0.11	9.091	0.175	5.714	0.37	2.703	0.405	2.469	0.6	1.667	0.875	0.93	1.025	1.235	0.98	1.25	1.33
23	0.075	13.33	0.25	4	0.32	3.125	0.495	2.02	0.465	2.151	0.94	1.02	1.025	1.205	0.915	1.095	1.215
24	0.125	8	0.2	5	0.455	2.198	0.51	1.961	0.66	1.515	1.035	0.98	0.83	1.01	1.13	1.03	1.2
25	0.225	4.444	0.29	3.448	0.44	2.273	0.48	2.083	0.535	1.869	0.84	0.815	0.86	1.165	1.1	1.125	1.165
26	0.47	2.128	0.43	2.326	0.44	2.273	0.48	2.083	0.72	1.389	0.85	0.99	0.93	0.975	1.015	0.985	1.01
27	0.035	28.57	0.17	5.882	0.34	2.941	0.445	2.247	0.625	1.6	0.96	0.92	0.88	0.775	1.145	0.91	1.135
28	0.24	4.167	0.35	2.857	0.385	2.597	0.26	3.846	0.5	2	0.815	0.945	0.99	1.085	0.93	1.285	1.105
29	0.16	6.25	0.115	8.696	0.475	2.105	0.485	2.062	0.465	2.151	0.96	0.97	1.08	1.185	0.96	1.125	1.39
30	0.195	5.128	0.175	5.714	0.49	2.041	0.63	1.587	0.305	3.279	0.885	0.975	0.93	1.135	1.035	1.03	1.215
31	0.125	8	0.355	2.817	0.45	2.222	0.505	1.98	0.745	1.342	0.97	1.055	1.03	1.235	1.085	1.23	1.25
32	0.27	3.704	0.355	2.817	0.455	2.198	0.335	2.985	0.635	1.575	0.79	0.81	1.055	1.095	1.105	1.06	1.04
33	0.175	5.714	0.365	2.74	0.595	1.681	0.33	3.03	0.465	2.151	1.02	1.06	1.065	1.075	1.055	1.28	1.2
34	0.125	8	0.275	3.636	0.47	2.128	0.65	1.538	0.645	1.55	0.81	1.075	1.05	0.965	1.085	0.965	1.3

	Bookmaker's result expectancies and their odds										Betting edges						
Bet	*0.2*		*0.3*		*0.4*		*0.5*		*0.6*		*0.9*	*0.95*	*1*	*1.05*	*1.1*	*1.15*	*1.2*
35	0.375	2.667	0.645	1.55	0.465	2.151	0.38	2.632	0.755	1.325	0.66	1.14	0.985	1.02	0.965	1.055	1.25
36	0.195	5.128	0.26	3.846	0.76	1.316	0.615	1.626	0.75	1.333	0.93	0.95	1.085	0.925	1.095	1.155	1.195
37	0.105	9.524	0.345	2.899	0.375	2.667	0.41	2.439	0.545	1.835	0.92	0.95	0.9	1.105	1.15	1.21	1.175
38	0.11	9.091	0.37	2.703	0.225	4.444	0.37	2.703	0.525	1.905	0.935	0.965	0.995	0.955	1.135	1.125	1.135
39	0.175	5.714	0.295	3.39	0.3	3.333	0.575	1.739	0.54	1.852	0.99	0.905	1.01	0.85	0.895	1.345	1.44
40	0.255	3.922	0.345	2.899	0.33	3.03	0.345	2.899	0.755	1.325	0.8	0.94	1.145	1.01	1.145	1.175	1.15
41	0.22	4.545	0.24	4.167	0.425	2.353	0.6	1.667	0.505	1.98	0.885	0.94	1.04	1.035	1.11	1.1	1.125
42	0.165	6.061	0.245	4.082	0.39	2.564	0.615	1.626	0.645	1.55	0.81	0.95	1.065	0.965	1.1	1.125	1.1
43	0.225	4.444	0.285	3.509	0.525	1.905	0.36	2.778	0.625	1.6	0.985	1.2	0.97	1.05	1.03	1.08	1.195
44	0.39	2.564	0.16	6.25	0.325	3.077	0.535	1.869	0.545	1.835	0.9	0.895	0.795	0.975	1.065	1.11	1.115
45	0.2	5	0.26	3.846	0.445	2.247	0.69	1.449	0.695	1.439	0.885	0.96	0.895	1.135	1.03	0.985	1.4
46	0.2	5	0.27	3.704	0.35	2.857	0.455	2.198	0.47	2.128	0.79	0.98	0.86	0.96	1.025	1.23	1.205
47	0.06	16.67	0.22	4.545	0.43	2.326	0.455	2.198	0.615	1.626	1.055	1.045	0.985	0.98	0.96	1.175	1.135
48	0.135	7.407	0.42	2.381	0.475	2.105	0.52	1.923	0.46	2.174	0.925	0.885	0.905	1.095	1.135	1.18	1.14
49	0.26	3.846	0.205	4.878	0.365	2.74	0.64	1.563	0.645	1.55	0.845	1.045	0.925	0.915	1.08	1.095	1.255
50	0.195	5.128	0.34	2.941	0.45	2.222	0.465	2.151	0.64	1.563	0.86	0.755	1.05	1.085	0.88	0.96	1.055
51	0.29	3.448	0.45	2.222	0.48	2.083	0.48	2.083	0.565	1.77	0.91	1.115	1.02	1.045	1.025	1.105	1.115
52	0.335	2.985	0.41	2.439	0.305	3.279	0.525	1.905	0.265	3.774	0.9	0.79	1.08	0.985	1.08	1.11	1.22
53	0.11	9.091	0.25	4	0.285	3.509	0.505	1.98	0.645	1.55	0.755	0.92	0.92	0.925	0.885	1.2	1.33
54	0.345	2.899	0.215	4.651	0.42	2.381	0.58	1.724	0.475	2.105	0.76	0.82	0.99	1.13	1.025	1.035	1.27
55	0.16	6.25	0.26	3.846	0.59	1.695	0.455	2.198	0.63	1.587	1.07	0.89	1.015	1.05	1.11	1.235	1.185
56	0.43	2.326	0.28	3.571	0.37	2.703	0.375	2.667	0.62	1.613	0.925	0.795	0.84	1.1	1.09	1.02	1.25
57	0.175	5.714	0.19	5.263	0.155	6.452	0.385	2.597	0.765	1.307	0.94	0.96	1.02	1.175	1.115	1.285	1.285
58	0.32	3.125	0.405	2.469	0.52	1.923	0.535	1.869	0.52	1.923	0.96	0.955	0.98	1.3	1.24	1.24	1.175
59	0.14	7.143	0.405	2.469	0.33	3.03	0.68	1.471	0.695	1.439	0.91	0.97	0.785	0.89	1.19	1.145	1.265
60	0.065	15.38	0.22	4.545	0.395	2.532	0.465	2.151	0.59	1.695	0.995	0.97	0.94	1.05	1.005	1.235	1.35
61	0.185	5.405	0.175	5.714	0.26	3.846	0.48	2.083	0.72	1.389	0.96	0.855	0.955	1.085	1.25	1.32	1.055
62	0.21	4.762	0.34	2.941	0.355	2.817	0.5	2	0.575	1.739	0.935	0.835	0.885	1.03	1.19	1.125	1.255
63	0.235	4.255	0.25	4	0.34	2.941	0.635	1.575	0.585	1.709	1.04	0.955	0.88	0.95	1.23	0.97	1.245
64	0.2	5	0.5	2	0.355	2.817	0.48	2.083	0.335	2.985	0.765	1.105	1.14	1.28	1.185	1.245	1.155
65	0.175	5.714	0.2	5	0.32	3.125	0.52	1.923	0.7	1.429	0.84	1.065	1.075	1.245	1.015	1.345	1.165
66	0.325	3.077	0.33	3.03	0.415	2.41	0.76	1.316	0.625	1.6	1.005	0.97	0.955	0.94	1.065	1.24	1.2
67	0.35	2.857	0.115	8.696	0.43	2.326	0.47	2.128	0.735	1.361	0.77	0.78	0.915	0.86	0.99	1.285	1.16
68	0.195	5.128	0.295	3.39	0.495	2.02	0.405	2.469	0.48	2.083	0.975	0.815	1.095	1.04	1.025	1.43	1.115
69	0.08	12.5	0.225	4.444	0.4	2.5	0.425	2.353	0.56	1.786	0.955	1.09	0.905	1.13	1.175	1.045	1.245
70	0.305	3.279	0.285	3.509	0.535	1.869	0.365	2.74	0.335	2.985	1.225	1.005	0.89	1.27	1.02	1.2	1.35
71	0.3	3.333	0.275	3.636	0.53	1.887	0.5	2	0.575	1.739	0.85	0.82	1.065	1.05	1.165	1.245	1.285
72	0.3	3.333	0.25	4	0.28	3.571	0.475	2.105	0.69	1.449	0.89	1.08	0.985	0.91	1.34	1.115	1.075
73	0.205	4.878	0.205	4.878	0.255	3.922	0.585	1.709	0.49	2.041	0.84	0.98	1.155	1.2	1.305	1.115	1.24
74	0.135	7.407	0.43	2.326	0.39	2.564	0.325	3.077	0.525	1.905	0.805	1.02	0.99	0.95	1.075	1.275	1.39
75	0.23	4.348	0.255	3.922	0.28	3.571	0.53	1.887	0.655	1.527	0.93	1.02	1.1	1.07	1.1	1.155	1.215
76	0.035	28.57	0.55	1.818	0.43	2.326	0.575	1.739	0.47	2.128	0.875	0.815	1.03	0.98	1.02	0.955	1.16
77	0.205	4.878	0.505	1.98	0.395	2.532	0.53	1.887	0.59	1.695	0.795	1.025	1.11	1	1.085	1.19	1.16
78	0.39	2.564	0.155	6.452	0.325	3.077	0.66	1.515	0.565	1.77	0.825	0.915	1.065	1.115	1.215	0.91	1.195
79	0.31	3.226	0.21	4.762	0.41	2.439	0.5	2	0.78	1.282	0.925	0.875	1.015	1.11	1	1.145	1.2
80	0.105	9.524	0.405	2.469	0.425	2.353	0.445	2.247	0.605	1.653	0.91	0.885	1.005	0.975	1.09	1.28	1.11
81	0.135	7.407	0.455	2.198	0.355	2.817	0.66	1.515	0.53	1.887	0.835	0.96	1.085	0.93	1.105	1.275	1.155
82	0.3	3.333	0.23	4.348	0.315	3.175	0.79	1.266	0.42	2.381	0.915	0.89	1.05	1.035	1.13	1.06	1.01
83	0.21	4.762	0.285	3.509	0.275	3.636	0.4	2.5	0.56	1.786	0.78	0.88	0.95	0.91	1.115	1.26	1.255
84	0.245	4.082	0.35	2.857	0.45	2.222	0.435	2.299	0.64	1.563	0.84	0.965	1.035	0.845	1.09	1.245	1.325
85	0.05	20	0.25	4	0.495	2.02	0.52	1.923	0.465	2.151	0.885	0.985	0.99	0.91	0.885	1.28	1.275
86	0.13	7.692	0.105	9.524	0.45	2.222	0.605	1.653	0.665	1.504	0.92	1.005	0.92	1.04	1.155	1.13	1.19
87	0.155	6.452	0.34	2.941	0.545	1.835	0.515	1.942	0.475	2.105	1.045	0.995	1.1	1.095	1.35	1.065	0.935
88	0.18	5.556	0.335	2.985	0.395	2.532	0.59	1.695	0.65	1.538	0.81	0.92	0.885	1.05	0.93	1.285	1.26
89	0.135	7.407	0.175	5.714	0.22	4.545	0.535	1.869	0.7	1.429	0.9	0.95	1.12	1.075	1.015	1.185	1.205
90	0.29	3.448	0.39	2.564	0.45	2.222	0.59	1.695	0.535	1.869	0.905	1.065	0.865	1.175	1.36	1.28	1.245
91	0.26	3.846	0.385	2.597	0.46	2.174	0.235	4.255	0.79	1.266	0.87	0.97	1.025	1.07	1.265	1.01	1.145

	Bookmaker's result expectancies and their odds										**Betting edges**						
Bet	*0.2*		*0.3*		*0.4*		*0.5*		*0.6*		*0.9*	*0.95*	*1*	*1.05*	*1.1*	*1.15*	*1.2*
92	0.17	5.882	0.3	3.333	0.345	2.899	0.495	2.02	0.7	1.429	0.88	0.855	1.015	1.05	1.03	1.08	1.3
93	0.09	11.11	0.48	2.083	0.39	2.564	0.415	2.41	0.64	1.563	0.68	0.975	1.12	0.97	1.01	1.07	1.065
94	0.235	4.255	0.365	2.74	0.495	2.02	0.485	2.062	0.7	1.429	1.155	0.95	1.05	1.09	1.095	1.325	1.215
95	0.115	8.696	0.4	2.5	0.27	3.704	0.465	2.151	0.625	1.6	0.99	0.865	0.97	0.905	1.13	1.095	1.255
96	0.235	4.255	0.42	2.381	0.305	3.279	0.45	2.222	0.59	1.695	0.85	0.93	0.97	1.205	1.135	1.105	1.315
97	0.235	4.255	0.22	4.545	0.335	2.985	0.7	1.429	0.62	1.613	0.815	0.81	0.965	1.115	1.095	1.14	1.2
98	0.15	6.667	0.165	6.061	0.51	1.961	0.65	1.538	0.685	1.46	0.935	1.01	0.945	0.955	0.975	0.95	1.365
99	0.185	5.405	0.315	3.175	0.225	4.444	0.22	4.545	0.75	1.333	0.985	1.03	1.165	1.175	1.055	1.195	1.185
100	0.215	4.651	0.225	4.444	0.585	1.709	0.545	1.835	0.64	1.563	0.9	0.945	1.16	1.125	1.07	1.14	1.215
101	0.275	3.636	0.315	3.175	0.375	2.667	0.415	2.41	0.485	2.062	0.915	1.155	1.035	0.87	1.015	1.11	1.25
102	0.125	8	0.11	9.091	0.405	2.469	0.55	1.818	0.655	1.527	0.84	0.945	0.905	1.2	1.055	1.11	1.2
103	0.29	3.448	0.24	4.167	0.345	2.899	0.505	1.98	0.555	1.802	0.695	0.94	0.975	1.035	1.065	1.195	1.24
104	0.295	3.39	0.25	4	0.415	2.41	0.395	2.532	0.67	1.493	0.805	0.885	1.065	1.13	1.18	1.095	1.23
105	0.025	40	0.11	9.091	0.37	2.703	0.575	1.739	0.585	1.709	0.975	1.04	1.025	1.005	1.215	1.135	1.23
106	0.16	6.25	0.175	5.714	0.54	1.852	0.59	1.695	0.565	1.77	0.985	0.93	0.905	0.95	1.155	1.015	1.18
107	0.18	5.556	0.37	2.703	0.38	2.632	0.775	1.29	0.715	1.399	1.085	0.98	0.885	1.005	1.01	1.15	1.185
108	0.12	8.333	0.21	4.762	0.46	2.174	0.595	1.681	0.68	1.471	0.97	0.965	0.975	0.815	1.195	1.285	1.215
109	0.27	3.704	0.515	1.942	0.4	2.5	0.54	1.852	0.615	1.626	1.095	1.065	0.87	1.05	1.005	1.2	1.2
110	0.08	12.5	0.16	6.25	0.32	3.125	0.455	2.198	0.6	1.667	0.99	0.98	1.07	1.06	1.09	1.27	1.265
111	0.105	9.524	0.375	2.667	0.385	2.597	0.425	2.353	0.375	2.667	0.905	1.035	0.87	1.09	1.135	1.105	1.345
112	0.06	16.67	0.13	7.692	0.46	2.174	0.635	1.575	0.35	2.857	0.865	0.93	0.945	0.89	0.96	0.89	1
113	0.145	6.897	0.385	2.597	0.315	3.175	0.385	2.597	0.58	1.724	0.93	0.93	0.9	1.05	1.125	1.16	1.195
114	0.235	4.255	0.275	3.636	0.4	2.5	0.565	1.77	0.545	1.835	0.87	0.875	1	1.055	1.025	1.23	1.3
115	0.225	4.444	0.33	3.03	0.45	2.222	0.56	1.786	0.56	1.786	0.86	0.76	0.94	0.78	1.005	1.105	1.135
116	0.235	4.255	0.245	4.082	0.32	3.125	0.58	1.724	0.685	1.46	0.91	0.945	0.83	1.065	1.135	1.02	1.3
117	0.195	5.128	0.365	2.74	0.355	2.817	0.6	1.667	0.52	1.923	0.81	0.945	0.98	1.03	1.085	1.06	1.21
118	0.145	6.897	0.255	3.922	0.22	4.545	0.53	1.887	0.63	1.587	0.875	0.875	1.09	1.175	1.19	1.145	1.23
119	0.145	6.897	0.215	4.651	0.325	3.077	0.555	1.802	0.735	1.361	0.965	0.95	1.115	0.89	1.115	1.11	1.08
120	0.28	3.571	0.52	1.923	0.46	2.174	0.57	1.754	0.655	1.527	0.88	0.91	0.905	0.965	1.065	1.03	1.075
121	0.16	6.25	0.415	2.41	0.45	2.222	0.465	2.151	0.45	2.222	0.94	1.225	1.015	0.915	1.15	1.03	1.16
122	0.19	5.263	0.315	3.175	0.41	2.439	0.42	2.381	0.68	1.471	0.855	0.91	1.09	1	1.09	1.305	1.4
123	0.3	3.333	0.415	2.41	0.415	2.41	0.61	1.639	0.47	2.128	0.885	0.87	0.985	1.19	0.99	1.075	1.24
124	0.065	15.38	0.505	1.98	0.375	2.667	0.51	1.961	0.575	1.739	0.915	1.15	1.115	1.195	1.005	1.285	1.25
125	0.195	5.128	0.31	3.226	0.415	2.41	0.485	2.062	0.57	1.754	0.995	1.115	0.82	0.925	1.17	1.075	1.13
126	0.17	5.882	0.355	2.817	0.35	2.857	0.59	1.695	0.65	1.538	0.98	0.925	0.98	1.015	0.96	1.07	1.12
127	0.155	6.452	0.3	3.333	0.29	3.448	0.67	1.493	0.555	1.802	0.98	0.98	0.9	0.995	1.045	1.215	1.2
128	0.215	4.651	0.17	5.882	0.41	2.439	0.395	2.532	0.54	1.852	0.805	0.965	0.885	1.06	1.005	1.2	1.06
129	0.16	6.25	0.215	4.651	0.375	2.667	0.355	2.817	0.64	1.563	1.115	0.95	1.05	1.115	1.31	1.225	1.255
130	0.15	6.667	0.25	4	0.32	3.125	0.7	1.429	0.645	1.55	0.95	0.905	0.955	1.165	1.16	1.005	1.225
131	0.25	4	0.26	3.846	0.375	2.667	0.465	2.151	0.79	1.266	0.95	0.935	1.05	1.025	1.185	1.235	1.22
132	0.14	7.143	0.32	3.125	0.44	2.273	0.485	2.062	0.685	1.46	0.905	0.93	0.99	1.35	1.19	1.185	1.185
133	0.07	14.29	0.535	1.869	0.535	1.869	0.525	1.905	0.72	1.389	0.745	1.065	1.12	1.165	1.095	1.09	1.13
134	0.105	9.524	0.34	2.941	0.175	5.714	0.51	1.961	0.895	1.117	1.05	0.96	0.92	0.945	0.92	1.085	1.035
135	0.195	5.128	0.37	2.703	0.19	5.263	0.46	2.174	0.455	2.198	0.945	0.985	1.08	1.105	1.135	1.235	1.25
136	0.165	6.061	0.145	6.897	0.44	2.273	0.625	1.6	0.775	1.29	0.83	0.855	1.15	0.965	1.115	1.285	1.21
137	0.135	7.407	0.19	5.263	0.485	2.062	0.555	1.802	0.64	1.563	0.77	0.935	1.035	1.06	1.095	1.125	1.415
138	0.15	6.667	0.27	3.704	0.31	3.226	0.425	2.353	0.575	1.739	0.84	0.99	0.845	1.1	1.235	0.97	1.305
139	0.185	5.405	0.32	3.125	0.5	2	0.645	1.55	0.52	1.923	1.02	0.92	1.115	1.05	1.21	1.195	1.31
140	0.175	5.714	0.275	3.636	0.445	2.247	0.355	2.817	0.46	2.174	0.98	0.99	1.05	1.03	0.96	1.18	1.31
141	0.25	4	0.255	3.922	0.45	2.222	0.335	2.985	0.665	1.504	0.98	0.935	0.88	1.19	1.3	1.155	1.355
142	0.21	4.762	0.36	2.778	0.42	2.381	0.45	2.222	0.7	1.429	1.02	1.035	0.995	0.975	1.15	1.18	1.21
143	0.25	4	0.255	3.922	0.465	2.151	0.31	3.226	0.42	2.381	0.785	0.96	0.89	1.015	1.11	1.145	1.205
144	0.12	8.333	0.345	2.899	0.265	3.774	0.515	1.942	0.77	1.299	0.79	0.865	0.995	1.19	0.895	1.125	1.185
145	0.195	5.128	0.24	4.167	0.52	1.923	0.4	2.5	0.565	1.77	0.895	0.905	0.975	1.035	1.085	1.125	1.295
146	0.155	6.452	0.41	2.439	0.335	2.985	0.65	1.538	0.75	1.333	1.025	0.93	1.205	1.04	1.13	1.125	1.195
147	0.335	2.985	0.325	3.077	0.385	2.597	0.345	2.899	0.74	1.351	0.795	0.695	0.71	1.085	0.95	1.005	1.18
148	0.175	5.714	0.29	3.448	0.22	4.545	0.43	2.326	0.45	2.222	0.825	0.835	1.02	1.29	0.975	1.145	1.14

	Bookmaker's result expectancies and their odds										Betting edges						
Bet	*0.2*		*0.3*		*0.4*		*0.5*		*0.6*		*0.9*	*0.95*	*1*	*1.05*	*1.1*	*1.15*	*1.2*
149	0.065	15.38	0.285	3.509	0.33	3.03	0.515	1.942	0.57	1.754	0.71	0.865	1.02	0.89	1.075	0.96	1.315
150	0.285	3.509	0.375	2.667	0.39	2.564	0.545	1.835	0.75	1.333	0.78	0.805	1.155	1.05	1.13	1.15	1.17
151	0.15	6.667	0.24	4.167	0.55	1.818	0.455	2.198	0.67	1.493	0.955	0.98	1.08	1.105	1.035	1.3	1.205
152	0.125	8	0.435	2.299	0.405	2.469	0.42	2.381	0.56	1.786	0.945	0.94	0.87	0.94	1.075	0.99	1.015
153	0.33	3.03	0.285	3.509	0.53	1.887	0.425	2.353	0.695	1.439	0.87	1	0.875	0.925	1.03	1.08	1.07
154	0.16	6.25	0.24	4.167	0.49	2.041	0.575	1.739	0.655	1.527	0.915	0.815	0.98	0.985	1.275	1.14	1.26
155	0.115	8.696	0.38	2.632	0.685	1.46	0.44	2.273	0.59	1.695	0.92	0.87	0.93	0.99	1.12	1.175	1.205
156	0.2	5	0.36	2.778	0.39	2.564	0.39	2.564	0.69	1.449	1.06	1.105	0.945	1	1.12	0.955	1.21
157	0.175	5.714	0.41	2.439	0.44	2.273	0.49	2.041	0.59	1.695	0.9	0.915	1.08	1.185	1.03	1.18	1.235
158	0.22	4.545	0.385	2.597	0.36	2.778	0.335	2.985	0.51	1.961	0.93	0.965	1.035	1.295	1.04	1.15	1.135
159	0.2	5	0.385	2.597	0.29	3.448	0.51	1.961	0.55	1.818	0.85	1.1	1.095	1.155	1.04	1.12	1.15
160	0.165	6.061	0.28	3.571	0.365	2.74	0.44	2.273	0.71	1.408	0.875	0.87	0.92	0.835	1.115	1.075	1.24
161	0.19	5.263	0.415	2.41	0.6	1.667	0.405	2.469	0.505	1.98	0.885	1.12	1.085	1.055	1.115	1.12	1.19
162	0.285	3.509	0.215	4.651	0.43	2.326	0.485	2.062	0.755	1.325	0.795	0.93	1	1.185	1.135	1.29	1.26
163	0.16	6.25	0.465	2.151	0.355	2.817	0.465	2.151	0.49	2.041	1.04	0.82	1.01	1.185	0.98	0.945	1.15
164	0.12	8.333	0.185	5.405	0.305	3.279	0.39	2.564	0.595	1.681	0.945	1.05	0.93	1.025	0.955	1.22	1.37
165	0.105	9.524	0.435	2.299	0.25	4	0.585	1.709	0.45	2.222	1.04	1.1	1.03	1.13	1.12	1.32	1.215
166	0.07	14.29	0.295	3.39	0.515	1.942	0.74	1.351	0.6	1.667	0.99	0.82	1	1	1.12	1.345	1.245
167	0.275	3.636	0.375	2.667	0.325	3.077	0.545	1.835	0.555	1.802	0.835	0.88	1.1	1.055	1.145	1.215	1.2
168	0.245	4.082	0.54	1.852	0.285	3.509	0.4	2.5	0.655	1.527	0.86	0.72	0.935	1.18	1.195	1.25	1.3
169	0.185	5.405	0.24	4.167	0.55	1.818	0.435	2.299	0.545	1.835	0.915	0.95	1.175	0.945	1.08	1.27	1.29
170	0.22	4.545	0.325	3.077	0.44	2.273	0.605	1.653	0.845	1.183	0.86	0.98	1.03	0.99	0.98	1.05	1.045
171	0.175	5.714	0.275	3.636	0.43	2.326	0.49	2.041	0.435	2.299	0.775	1.01	1.125	1.13	1.19	1.27	1.2
172	0.25	4	0.155	6.452	0.46	2.174	0.58	1.724	0.61	1.639	0.94	0.99	0.96	1.095	1.09	1.29	1.35
173	0.175	5.714	0.155	6.452	0.41	2.439	0.55	1.818	0.405	2.469	0.835	0.88	1.03	0.975	1.175	0.865	1.06
174	0.215	4.651	0.225	4.444	0.6	1.667	0.59	1.695	0.59	1.695	0.94	1.09	0.89	1.24	1.22	1.235	1.18
175	0.2	5	0.29	3.448	0.405	2.469	0.465	2.151	0.845	1.183	1.005	1.02	0.975	1.065	1.115	1.045	1.08
176	0.18	5.556	0.205	4.878	0.6	1.667	0.535	1.869	0.65	1.538	0.88	1.035	1.005	1.055	0.895	1.22	1.29
177	0.205	4.878	0.275	3.636	0.275	3.636	0.665	1.504	0.525	1.905	0.835	1.045	1.02	1.14	1.195	0.965	1.19
178	0.115	8.696	0.35	2.857	0.31	3.226	0.36	2.778	0.69	1.449	0.775	0.925	0.96	1.195	1.18	1.285	1.3
179	0.24	4.167	0.255	3.922	0.45	2.222	0.455	2.198	0.67	1.493	1.02	1.01	0.925	0.985	1.09	1.145	1.31
180	0.23	4.348	0.34	2.941	0.435	2.299	0.54	1.852	0.655	1.527	0.735	0.82	0.965	1.1	1.135	1.125	1.095
181	0.25	4	0.265	3.774	0.42	2.381	0.71	1.408	0.56	1.786	0.98	0.865	1.105	0.925	1.225	1.185	1.19
182	0.065	15.38	0.44	2.273	0.275	3.636	0.395	2.532	0.63	1.587	0.925	0.87	0.985	0.96	1.27	1.015	1.175
183	0.14	7.143	0.285	3.509	0.435	2.299	0.37	2.703	0.485	2.062	0.85	0.925	0.955	0.86	1.215	1.135	1.21
184	0.13	7.692	0.48	2.083	0.75	1.333	0.55	1.818	0.575	1.739	0.895	0.79	1.11	1.085	1.03	1.09	1.06
185	0.145	6.897	0.28	3.571	0.44	2.273	0.45	2.222	0.7	1.429	0.86	1.15	1.115	0.89	0.9	1.195	1.1
186	0.3	3.333	0.305	3.279	0.45	2.222	0.435	2.299	0.565	1.77	0.91	0.895	0.855	1.135	1.1	1.265	0.995
187	0.195	5.128	0.145	6.897	0.4	2.5	0.595	1.681	0.565	1.77	0.86	0.88	1.125	1.145	1.12	1.27	1.19
188	0.185	5.405	0.295	3.39	0.34	2.941	0.47	2.128	0.505	1.98	0.85	0.995	0.985	1.04	1.115	1.32	1.2
189	0.115	8.696	0.465	2.151	0.395	2.532	0.495	2.02	0.625	1.6	0.775	1.03	1	1.02	1.195	1.155	1.32
190	0.25	4	0.21	4.762	0.5	2	0.315	3.175	0.56	1.786	0.875	0.87	0.97	1.045	1.09	1.205	1.185
191	0.37	2.703	0.29	3.448	0.32	3.125	0.395	2.532	0.695	1.439	0.825	0.995	0.99	1.195	1.13	1.13	1.225
192	0.23	4.348	0.43	2.326	0.345	2.899	0.66	1.515	0.615	1.626	0.89	1.15	1.065	1.025	1.27	1.24	1.25
193	0.14	7.143	0.31	3.226	0.355	2.817	0.605	1.653	0.555	1.802	0.935	1.03	1.05	0.99	1.21	1.215	1.165
194	0.255	3.922	0.155	6.452	0.3	3.333	0.49	2.041	0.63	1.587	0.94	0.84	1.025	1.195	1.195	1.3	1.23
195	0.055	18.18	0.345	2.899	0.465	2.151	0.475	2.105	0.58	1.724	0.835	1.005	1.08	1.09	0.955	1.19	1.135
196	0.11	9.091	0.205	4.878	0.25	4	0.595	1.681	0.465	2.151	0.99	0.77	1.035	1.05	1.195	1.105	1.285
197	0.265	3.774	0.36	2.778	0.26	3.846	0.33	3.03	0.685	1.46	0.985	0.995	1.185	1.045	1.19	1.045	1.225
198	0.29	3.448	0.3	3.333	0.41	2.439	0.4	2.5	0.59	1.695	1.005	1.07	1.08	1.075	1.075	1.06	1.205
199	0.2	5	0.3	3.333	0.32	3.125	0.26	3.846	0.575	1.739	0.875	0.895	0.9	1.055	1.19	1.21	1.16
200	0.325	3.077	0.38	2.632	0.39	2.564	0.58	1.724	0.515	1.942	0.91	0.755	0.98	0.975	1.01	1.075	1.22
201	0.33	3.03	0.375	2.667	0.325	3.077	0.62	1.613	0.72	1.389	0.815	0.995	0.98	1.025	1.04	1.145	1.235
202	0.24	4.167	0.16	6.25	0.39	2.564	0.28	3.571	0.45	2.222	0.94	0.965	1.03	1.04	1.16	1.125	1.155
203	0.16	6.25	0.33	3.03	0.385	2.597	0.455	2.198	0.62	1.613	1	0.945	0.885	1.13	1.085	1.29	1.29
204	0.175	5.714	0.225	4.444	0.325	3.077	0.565	1.77	0.83	1.205	0.92	0.95	1.06	0.97	1.195	1.015	1.09
205	0.17	5.882	0.215	4.651	0.29	3.448	0.225	4.444	0.785	1.274	0.955	0.86	1.05	0.995	1.235	1.15	1.045

	Bookmaker's result expectancies and their odds										**Betting edges**						
Bet	*0.2*		*0.3*		*0.4*		*0.5*		*0.6*		*0.9*	*0.95*	*1*	*1.05*	*1.1*	*1.15*	*1.2*
206	0.24	4.167	0.355	2.817	0.3	3.333	0.45	2.222	0.535	1.869	0.935	0.94	1.035	1.05	0.925	1.15	1.11
207	0.07	14.29	0.17	5.882	0.48	2.083	0.58	1.724	0.595	1.681	0.91	0.87	0.935	1.005	0.945	1.1	1.195
208	0.15	6.667	0.155	6.452	0.47	2.128	0.595	1.681	0.635	1.575	0.875	0.89	1	1.07	1.19	1.195	1.34
209	0.065	15.38	0.375	2.667	0.545	1.835	0.525	1.905	0.445	2.247	0.965	0.86	1.025	0.935	1.075	1.145	1.125
210	0.195	5.128	0.285	3.509	0.51	1.961	0.75	1.333	0.375	2.667	0.925	1.025	0.805	1.08	0.915	0.95	1.025
211	0.155	6.452	0.3	3.333	0.34	2.941	0.525	1.905	0.65	1.538	0.985	0.99	1.09	0.91	1.14	1.235	1.055
212	0.15	6.667	0.485	2.062	0.385	2.597	0.42	2.381	0.545	1.835	1.01	0.895	0.9	1.005	1.075	1.15	1.12
213	0.11	9.091	0.27	3.704	0.51	1.961	0.35	2.857	0.55	1.818	0.83	0.78	1.025	1.15	1.095	1.125	1.05
214	0.18	5.556	0.225	4.444	0.425	2.353	0.275	3.636	0.55	1.818	0.815	0.855	1.03	1.04	1.085	1.085	1.305
215	0.265	3.774	0.315	3.175	0.54	1.852	0.555	1.802	0.5	2	0.79	0.955	1.14	1.17	1.18	0.98	1.2
216	0.125	8	0.415	2.41	0.535	1.869	0.455	2.198	0.645	1.55	0.835	0.855	0.995	0.875	1.27	1.185	1.22
217	0.23	4.348	0.405	2.469	0.29	3.448	0.715	1.399	0.59	1.695	0.92	1.045	0.9	1.35	1.17	1.34	1.17
218	0.195	5.128	0.25	4	0.37	2.703	0.43	2.326	0.565	1.77	0.84	0.87	0.89	1.23	1.05	1.16	1.235
219	0.025	40	0.475	2.105	0.5	2	0.44	2.273	0.555	1.802	0.815	1.05	1.15	1.08	1.145	1.005	1.4
220	0.23	4.348	0.345	2.899	0.52	1.923	0.55	1.818	0.53	1.887	0.855	1	0.995	1.055	1.115	1.08	0.99
221	0.21	4.762	0.4	2.5	0.38	2.632	0.475	2.105	0.775	1.29	0.925	1.095	0.745	1.045	1.1	1.18	1.25
222	0.2	5	0.46	2.174	0.165	6.061	0.37	2.703	0.745	1.342	0.83	0.82	1.005	0.995	1.195	1.2	1.18
223	0.225	4.444	0.305	3.279	0.23	4.348	0.635	1.575	0.685	1.46	0.91	1.035	1.075	0.95	1.105	1.055	1.055
224	0.285	3.509	0.325	3.077	0.435	2.299	0.415	2.41	0.685	1.46	0.83	0.89	1.095	1.05	1.13	1	1.16
225	0.29	3.448	0.155	6.452	0.58	1.724	0.6	1.667	0.41	2.439	0.795	1.085	0.985	1.17	1.29	1.13	1.33
226	0.25	4	0.325	3.077	0.58	1.724	0.44	2.273	0.76	1.316	0.91	0.955	1.065	1.085	1.165	1.195	1.025
227	0.345	2.899	0.33	3.03	0.495	2.02	0.485	2.062	0.515	1.942	0.805	1.065	1.125	1.125	1.12	1.28	1.16
228	0.11	9.091	0.33	3.03	0.585	1.709	0.585	1.709	0.6	1.667	0.98	1.125	1.02	0.915	1.225	1.3	1.085
229	0.17	5.882	0.42	2.381	0.565	1.77	0.485	2.062	0.56	1.786	0.99	1.02	0.99	1.13	1.24	1.19	1.03
230	0.255	3.922	0.34	2.941	0.39	2.564	0.585	1.709	0.82	1.22	0.965	1.1	0.985	1.13	0.97	1.025	1.185
231	0.115	8.696	0.285	3.509	0.49	2.041	0.38	2.632	0.53	1.887	0.835	0.87	1.2	1	1.145	1.015	1.3
232	0.22	4.545	0.22	4.545	0.455	2.198	0.505	1.98	0.7	1.429	0.915	0.97	1.035	0.995	1.02	1.19	1.2
233	0.395	2.532	0.29	3.448	0.5	2	0.685	1.46	0.65	1.538	0.805	0.905	1.065	1.21	1.1	1.335	1.315
234	0.29	3.448	0.29	3.448	0.48	2.083	0.51	1.961	0.73	1.37	0.94	1.005	0.875	1.045	1.055	1.1	1.18
235	0.195	5.128	0.275	3.636	0.315	3.175	0.52	1.923	0.465	2.151	0.835	0.95	1.05	0.77	1.06	1.175	1.155
236	0.275	3.636	0.33	3.03	0.15	6.667	0.56	1.786	0.76	1.316	0.99	0.935	1.075	1.14	1.28	1.11	1.21
237	0.25	4	0.395	2.532	0.24	4.167	0.475	2.105	0.56	1.786	0.835	0.9	1.11	0.925	0.925	1.185	1.275
238	0.3	3.333	0.21	4.762	0.465	2.151	0.38	2.632	0.49	2.041	0.93	0.935	1.065	0.88	1.11	1.105	1.215
239	0.24	4.167	0.265	3.774	0.295	3.39	0.39	2.564	0.68	1.471	0.85	0.78	1.08	0.97	0.925	1.29	1.235
240	0.37	2.703	0.165	6.061	0.405	2.469	0.55	1.818	0.505	1.98	0.955	0.915	1.08	1.13	1.12	1.12	1.09
241	0.25	4	0.295	3.39	0.29	3.448	0.535	1.869	0.7	1.429	0.845	0.87	0.95	1.07	1.155	1.205	1.35
242	0.19	5.263	0.26	3.846	0.45	2.222	0.48	2.083	0.41	2.439	1.025	0.865	1.08	0.975	1.295	1.13	1.08
243	0.205	4.878	0.34	2.941	0.29	3.448	0.46	2.174	0.61	1.639	0.935	0.855	1.125	0.965	1	1.215	1.145
244	0.165	6.061	0.205	4.878	0.335	2.985	0.415	2.41	0.47	2.128	0.935	1.065	1.1	1.01	1.015	1.155	1.285
245	0.165	6.061	0.295	3.39	0.29	3.448	0.63	1.587	0.72	1.389	0.99	0.945	1.005	1.095	0.97	1.29	1.265
246	0.335	2.985	0.17	5.882	0.51	1.961	0.575	1.739	0.62	1.613	0.84	1.135	0.995	0.995	1.19	1.44	1.21
247	0.155	6.452	0.36	2.778	0.08	12.5	0.565	1.77	0.61	1.639	0.89	0.835	1.035	1.055	0.895	1.245	1.175
248	0.1	10	0.3	3.333	0.42	2.381	0.475	2.105	0.745	1.342	0.99	0.995	1.155	1.1	1.145	1.26	1.19
249	0.175	5.714	0.26	3.846	0.2	5	0.64	1.563	0.45	2.222	0.93	1.085	1.12	1.09	1.135	1.16	0.95
250	0.185	5.405	0.105	9.524	0.4	2.5	0.68	1.471	0.555	1.802	0.905	0.825	0.95	0.98	1.235	1.195	1.35
Avg	0.2	6.472	0.3	3.762	0.4	2.72	0.5	2.105	0.6	1.73	0.9	0.95	1	1.05	1.1	1.15	1.2