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Theoretical Loss and Gambling Intensity (Revisited): A Response to Braverman et al (2013)

Michael Auer

a2mlab ltd

Office 404 Albany House

324 Regent Street

London

W1B 3HH

m.auer@a2mlab.com

Mark D. Griffiths,

Professor of Gambling Studies

International Gaming Research Unit

Psychology Division

Nottingham Trent University

Burton Street

Nottingham

NG1 4BU

mark.griffiths@ntu.ac.uk

Abstract

In this paper, we provide a brief response to Braverman and colleagues' (2013) critique of our 'Theoretical Loss' metric as a measure of monetary gambling intensity (Auer & Griffiths, 2013; Auer, Schneeberger & Griffiths, 2012). We argue that 'gambling intensity' and 'gambling involvement' are essentially the same construct as descriptors of monetary gambling activity. Additionally, we acknowledge that playing duration (i.e., the amount of time – as opposed to money – actually spent gambling) is clearly another important indicator of gambling involvement – something that we have consistently noted in our previous studies including our empirical studies on gambling using behavioural tracking data. Braverman and colleagues claim that the concept of Theoretical Loss is nullified when statistical analysis focuses solely on one game type as the house edge is constant across all games. In fact, they state, the correlation between total amount wagered and Theoretical Loss is perfect. Unfortunately, this is incorrect. To disprove the claim made, we demonstrate that in sports betting (i.e., a single game type), the amount wagered does not reflect monetary gambling involvement using actual payout percentage data (based on 52,500 independent bets provided to us by an online European bookmaker). After reviewing the arguments presented by Braverman and colleagues, we are still of the view that when it comes to purely monetary measures of 'gambling intensity', the Theoretical Loss metric is a more robust and accurate measure than other financial proxy measures such as 'amount wagered' (i.e., bet size) as a measure of what players are prepared to financially risk while gambling.

Keywords: Gambling intensity; Gambling involvement; Theoretical Loss; Sports betting; House edge; Stake size; Behavioral tracking

Introduction

In two recent papers involving a simulation study of 300,000 gamblers across thirteen gambling games (Auer, Schneeberger & Griffiths, 2012), and a real study of 100,000 online gamblers across eight games (Auer & Griffiths, 2013), we introduced a new metric to help measure the monetary aspect of 'gambling intensity' in the gambling studies field. This metric is called 'Theoretical Loss' and measures the amount of money that a gambler is prepared to financially risk when playing a game. This metric takes into account each individual game's house edge and is important because different types of games offer different chances of winning. By using Theoretical Loss, the amount of money that a gambler is willing to risk can be evaluated.

The payback to players and the profits made from casino (and other) games of chance are determined by the house advantage (i.e., the 'house edge'). Over time, the house edge determines a casino's profitability. For short periods over a few games, a player's winnings or losses can be very different from what would be expected based on the types of games played and the corresponding house edges. A player might even leave the casino winning far more money than they staked. The fewer data points available, the greater the actual (win or loss) result can deviate from the expected value. Therefore, in the short-term, the financial balance of the player (as measured by what they have actually won or lost) is arguably a mediocre indicator of a player's gambling involvement. On the other hand, the Theoretical Loss eliminates these random fluctuations and provides what we would argue is a much more stable measure of monetary gambling involvement and intensity than previously used measures. We formulated the Theoretical Loss metric so that it could be used to compare players' monetary gambling intensity irrespective of the types of games played or the amount of money won or lost gambling (helping to overcome short-term financial volatility).

Gambling intensity and/or involvement: A question of definition?

Braverman, Tom and Shaffer, (2013) recently provided a critique of our Theoretical Loss metric and we are pleased to see others in the field have read and responded to what we have to say. We were also pleased to read that Braverman and colleagues believe that our concept of Theoretical Loss *"might be another useful construct that investigators can use to add to the pool of operational definitions for gambling intensity"* (p.4). Braverman, et al. (2013)

claimed that we did not define ‘gambling intensity’ clearly. However, we clearly stated that gambling intensity is defined as the amount of money that players are prepared to risk when playing and that this can be measured by our metric of Theoretical Loss. We also claimed that the Theoretical Loss is better than other proxy measures such as ‘bet size’ and ‘number of games’ as a measure of gambling involvement and intensity. These other proxy measures of gambling involvement were used in a number of previous studies of online gambling behavior (e.g., Broda, LaPlante, Nelson, LaBrie, Bosworth & Shaffer, 2008; LaBrie, Kaplan, LaPlante, Nelson & Shaffer, 2008; LaPlante, Schumann, LaBrie & Shaffer, 2008; LaPlante, Kleschinsky, LaBrie, Nelson & Shaffer, 2009; Nelson, LaPlante, Peller, Schumann, LaBrie, & Shaffer, 2008; Dragicevic et al., 2011; Braverman & Shaffer, 2012; Gray, La ante & Shaffer, 2012; Braverman, LaPlante, Nelson, & Schaffer, 2013; Gray, LaPlante, & Shaffer, 2012).

In their critique of our paper, Braverman et al. (2013) explained that the metrics they used (such as the total amount wagered) were intended to measure gambling involvement as opposed to gambling intensity. Clearly, ‘gambling involvement’ is a vague concept and we could also argue that Braverman and colleagues did not specifically define what they meant by this term. However, the real issue is whether the metrics used previously used to measure ‘gambling involvement’ are any different from our use of the term ‘gambling intensity’ as a descriptor for gambling behavior. Our view is that these two concepts are essentially the same. While we agree that previous studies have not specifically used the term ‘gambling intensity’, our reading of these papers is that the measures used were trying to get some insight into about how intensely a player was involved in gambling behavior. For instance, LaBrie et al. (2008) identified a group of “highly involved” gamblers that spent substantially more time and lost more money gambling than did other gamblers. We would argue that such a definition would ideally describe the most gambling intense players. To all intents and purposes, those players that are the most involved in gambling are the ones that are playing most intensely.

The metrics used by the Harvard-affiliated research group in their previous studies examining online gamblers clearly attempted to provide some kind of proxy measure of gambling intensity in terms of both time and money (e.g., total amount of money that players wagered, the number of games played, as well as various derived attributes from such metrics). Bravermen et al. (2013) appear to criticize us for lacking a definition of ‘gambling intensity’ when they themselves have never defined what exactly they aimed to measure in their

previously published studies of online gamblers using data collected from the *bwin* gambling website.

However, we have stated several times in our recent publications (Auer & Griffiths, 2013a; 2013b; Auer, et al. 2012) that gambling intensity is simply defined as the amount of money that a player is willing to risk (using the metric of Theoretical Loss). We admit that part of the misunderstanding probably stems from the lack of explicitly stating the monetary aspect of Theoretical Loss and we would like to emphasize here that our metric is a measure of *monetary* gambling intensity. Theoretical Loss does not intend to cover other important aspects of gambling such as time involvement. However, Theoretical Loss is quite clearly a measure of gambling involvement (albeit financial involvement). It remains to be explained by the Harvard-affiliated research group how their gambling involvement metrics (such as the total amount wagered) are on an advance (or simply some kind of equivalent) on what we have proposed. We have pointed out both theoretically and empirically that the total amount wagered is a misleading metric of gambling involvement because it does not take into account the types of game that have been played by gamblers.

Braverman et al. (2013) do at least agree with us that describing gambling activity just by using bet (stake) size (i.e., total amount wagered) for gamblers that participate in different game types can be misleading in some situations (such as when the goal is to compare different gamblers and the degree of risky gambling behavior). They explain the lack of accuracy as due to missing information about the specific games that have been played. Clearly the underlying *bwin* datasets (that can be found on http://www.thetransparencyproject.org) are not sufficiently detailed. However, this does not mean they should not strive to improve – and even re-evaluate – their results instead of criticizing other approaches that we still believe are more robust and rigorous.

The importance of multiple measures

Despite what may have been implied in Braverman and colleagues' paper, we wholeheartedly agree that gambling cannot be understood solely by looking at monetary aspects. For instance, one of us (MG) was one of the co-authors of the British Gambling Prevalence Survey (BGPS). In the most recent BGPS (Wardle, Moody, Griffiths, et al. 2011; Wardle, Moody, Spence, et al. 2011), we developed a simple 'gambling involvement' typology based on the

amount of time and money that our participants spent gambling. More specifically, regular gamblers (i.e., those who gambled once a month or more often) were categorized into one of four 'gambling involvement' groups. These were: *high-time only gamblers* (i.e., those who spent a lot of time but not a lot of money gambling); *high-spend only gamblers* (i.e., those who spent a lot money, but not a great deal of time gambling); *high-time/high-spend gamblers* (i.e., those who spent a lot of time and money gambling), and (iv) *non-high-time/non-high-spend gamblers* (i.e., those who spent little time or money gambling). Using this simple categorization, we found that high-time/high-spend gamblers showed a relative preference for betting on horse races, fixed odds betting terminals, and playing casino games. High-time/high-spend gamblers also had the most adverse socio-economic profile (i.e., they were more likely to live in areas of greatest deprivation, live in low-income households, and be unemployed). The most recent BGPS provides a demonstrable example of how we are only too aware that measures of 'gambling involvement' can also involve the amount of time spent gambling as well as the amount of money.

In regards to our own previously (jointly) published studies, in one of them on voluntary limit setting among online gamblers at the *win2day* website, we clearly emphasized the importance of playing duration as an indicator of gambling involvement/intensity (see Auer & Griffiths, 2013b). For instance, in this study, we demonstrated that for poker players, the setting of voluntary time spending limits had a much greater effect on the rake than the setting of monetary spending limits. In fact, poker players were the only group of gamblers (compared to lottery gamblers and casino gamblers) where such an effect was observed. Given that poker is a more time intensive game than almost all other forms of gambling, we argued that the setting of time spending limits (rather than monetary spending limits) was the most desirable action in facilitating responsible gambling behaviour among this group of gamblers.

To further emphasize the point that time involvement is also an important variable in relation to gambling involvement (i.e., intensity), we also introduced a procedure for the measurement of time involvement in a previous paper using our behavioral tracking data (see Auer & Griffiths, 2013b). In order to compute the playing duration for a certain time period, single playing sessions were identified. All games that had a playing duration of no longer than 30 minutes apart belonged to one playing session. Therefore, a time gap of more than 30 minutes led to the recording of a new (and therefore separate) game session. The daily play duration corresponded to the sum of all sessions on that particular day. The playing duration for a

specific time period corresponded to the sum of all daily playing durations for that time period.

On several occasions, the paper by Braverman et al. (2013) – quite rightly – emphasized the importance of measuring the amount of time played. They refer to the paper by Nelson et al. (2008) mentioning that time spent gambling can reflect gambling involvement, and that it might be as important as an indicator of gambling problems as money wagered or lost. However, it is worth noting that the Nelson et al. (2008) study did not measure playing duration directly. By examining the codebook of their publication 'Sitting at the virtual poker table: A prospective epidemiological study of actual internet poker gambling behavior' (on the website http://www.thetransparencyproject.org) it is very clear that playing duration was not part of the underlying data set. Therefore, although Braverman et al. (2013) criticize us on several occasions about not taking into consideration the playing duration, we have done so directly in our behavioral tracking studies (e.g., Auer & Griffiths, 2013b), whereas they have not. As far as we are aware, not a single study from the *bwin* behavioral tracking has ever examined gambling duration directly using a time measure (which is surprising given how important this is for examining gambling involvement/intensity among poker players).

With respect to willingness to devote time to gambling, Braverman et al. (2013) refer to two specific studies (i.e., Braverman & Shaffer, 2012; Dragicevic et al. 2011). However, neither of these studies measured playing duration as such. They used the proxy measures of total number of bets divided by the total number of days resulting in the mean average number of bets per active day. We would argue that this is an unnecessary uncertainty and might yield misleading results due to the fact that conclusions with regard to time involvement are being made when time is not measured directly. Again, looking at the codebook of Braverman and Shaffer's (2012) study 'How do gamblers start gambling: Identifying behavioral markers for high-risk internet gambling' on the website (http://www.thetransparencyproject.org) we noted that playing duration was not part of the underlying data set. It is obvious that publications based on the data provided by *bwin* to the Harvard-affiliated research group are making conclusions about gambling duration that are not reflected in any of the variables on which they have data. The data do not allow for accurate measurements of playing duration or monetary gambling intensity as they are aggregated to a level where those details cannot be extracted any more.

Is Theoretical Loss nullified when evaluating a single game type?

Another type of gambling that we have not published yet on using our behavioral tracking data – but subject to research by the Harvard-affiliated research group (e.g., Broda, et al. 2008; LaBrie et al., 2008) – is sports betting. Braverman et al. (2013) claim that the concept of Theoretical Loss is nullified when the analysis focuses solely on one game type as the house edge is constant across all games. In this case, they state, the correlation between total amount wagered and Theoretical Loss is perfect. More specifically, it is asserted that:

"Calculating bet size within a single game seems to nullify the difference between theoretical loss and bet size by definition. Indeed, theoretical loss equals the product of bet size and house advantage when the advantage is constant for any specific game. Therefore, for any single game (e.g., French roulette), a correlation between bet size and theoretical loss is perfect" (p.6).

Unfortunately this statement is incorrect. We will now describe in detail why this is the case. The previously published studies on sports betting using the *bwin* data (LaBrie et al. 2008; Broda et al. 2008) focus solely on sports betting (i.e., a single game type), and use the total amount wagered as an indicator of monetary spending. However – and especially in sports betting – the amount wagered does not reflect anything close to the amount of money a player is willing to risk – or to what they will eventually lose or win on the long run. This is due to the fact that each and every specific wager is connected to the odds of the specific bet. For example, LaBrie et al. (2008) concluded that moderate online sports betting at the population level (i.e., 2.5 bets of €4 each every fourth day) did not suggest excessive gambling among many sports bettors.

The following analysis shows that those previously reported results have to be interpreted with caution, given the metrics that have been used in those studies. In order to derive the metric for monetary gambling intensity among sports bettors, we have to start by explaining how bookmakers lay their bets. Figure 1 is taken from www.bwin.com on February 1, 2014. It shows the payback multiple for three outcomes of the English soccer game between West Bromwich Albion versus Liverpool. Throughout the rest of this paper, we will use the continental (European) way of displaying odds, which is the payout multiple of the amount

wagered. In the example shown (see Figure 1), if West Bromwich Albion (WBA) win the game the player that has bet on WBA receives 5.25 times the amount wagered. In case of a draw, players that bet on no team winning receives four times the amount wagered. If a player bets on Liverpool to win the match, they would win 1.6 times the amount wagered. In this case, the Liverpool team is clearly the favourite to win this soccer match.

Bookmakers lay odds so that the overall payback to players is less than 100% (i.e., in the same way that casino games have house edges that lead to sustained casino profit). Therefore, the odds inherently contain the house edge. Table 1 shows how one can derive the payout or attractiveness of a game based on the odds for the different outcomes. The column '1/Odds' represents the (approximate) probabilities that the bookmaker assumes for each outcome. These probabilities are all overestimated, and eventually leads to a payout of 94% (i.e. lower than 100%). The payout percentage of 94% is computed as the inverse of the sum of the reciprocal odds (1/[0.19+0.25+0.63]). So for this particular game, *bwin* has chosen the odds in a way that it can roughly expect a 5% profit from the amounts wagered. Other bookmakers' odds can vary and these variations are based on their own designated house edges. However, all bookmaking basically starts with an assumption of the probabilities of the different outcomes. Those probabilities are overestimated to a certain degree and then converted to into odds.

So what does this have to do with Theoretical Loss and monetary gambling intensity? The answer is very simple. Braverman et al. (2013) claim that a player that wagers €100 on Liverpool losing shows the same monetary involvement as a player that wagers €100 on Liverpool winning or anybody that wagers €100 on a number of bets or a single bet. Quite clearly, this is not the case. Contrary to Braverman et al.'s (2013) assumptions, sports betting is the one game type with the single highest variability in house edges.

This becomes even clearer when looking at parlay bets (that are arguably more the rule than the exception). Parlay bets are combinations of bets that result in one combined odds figure that represents this multiple betting combination (and are typically very long odds). Figure 2 displays a parlay bet with an overall payback multiple of 84 times the size of the stake wagered (on the right hand side at the lower end of the picture) that is the product of the three odds that go along with the three single bets (win for Liverpool, win for Crystal Palace, and win for Chelsea). With a wager of €25 to win all three games, the player can expect 84 times

the wager (i.e., a total of €2,100). This is precisely where the disadvantage for the player betting lies.

Table 2 explains why parlays pay out less than single bets from a theoretical point of view. In the final column of Table 2 it can be seen that the payout decreases with the number of single bets in a parlay. This is due to the multiplication rule that goes along with the independence of events in probability theory. In this example, the outcomes of all single bets are assumed to have a probability of 50%. This means that the predicted outcome will happen with probability of 50%. If players bet correctly on two games they will be correct in (0.5 times 0.5 =) 25% of the cases (and so on) until they are only correct in 0.098% of the cases (i.e., 0.5 to the power of 10). Given that the bookmaker's payout is set to 90%, the quotes for all games are (0.9/0.5) = 1.8. As seen in Table 2, the quotes for parlay bets are multiplied just like the probabilities – and in the theoretical example of Table 2, players can expect 357 times the amount wagered if they win all ten bets. But the payout column, that is the product of the cumulated odds and the cumulated probability, shows that the payout percentage steadily decreases. The odds of parlay bets do not represent the underlying probability of the events such as previously described (above) for single bets. The underlying probability is much smaller and this is because of the independence of each betting event.

This is further argument against any sole use of wagered amount as a way of measuring monetary gambling involvement. Our example clearly suggests that the odds themselves are meaningless as predictors of monetary gambling intensity for parlays that comprise several single bets. The following quote is another useful observation that we found online at *PredictEm.com*. The website stated: *"Ever wondered why bookies drive cadillacs? It's because many of their clients play parlays (aka: Accumulators). We'll admit, parlay bets are great fun but they are the quickest way to the poorhouse as your just stacking enormous odds against yourself when you wager on them."* (see text at: http://www.predictem.com/sportsbooks/parlays.php, accessed March 15, 2014).

In order to verify our theoretical assumptions we were given access to actual player betting data provided to us by a European online bookmaker. Table 3 and Table 4 are the empirical payout percentages from a total of 52,500 independent bets. Table 3 displays the payout percentage for different odds that players have chosen to bet on and it can clearly be seen that the payout percentage is quite different across different odds. From the discussion outlined

above, we would expect a negative correlation between odds and payout percentage leading to low payout percentages for higher odds. This was indeed the case. Whereas games with low odds between 1.05 and 1.03 pay out 94% of the wagers, the games with high odds between 5.1 and 9.5 only pay out 71% of the wagered amount. Sports wagering is clearly not homogenous and it is this variability that provides the attraction for many regular bettors. This leads to the conclusion that any attempts to measure monetary involvement without taking into account the odds of a game are not taking into account the whole picture.

The previous discussion about parlay bets (which are very common, and often mandatory on many betting sites) is underpinned by the empirical payout data presented in Table 4. Independent of the odds of a game, the payout percentage is negatively correlated to the number of combined bets in a parlay. The more games that are combined into a parlay bet, the lower the empirical payback percentage. This empirical observation confirms the theoretical assumptions described in Table 2. This is another underpinning of the variability of sports wagering and highlights the importance of taking the odds into account when it comes to measuring monetary gambling involvement.

In order to measure monetary involvement in sports betting or across different types of games in which sports betting happens to be one of those game types, researchers need to take into account the odds of games as well as the number of combined bets in parlays. We would argue that any attempt that neglects either of these two indicators is not measuring monetary involvement correctly. The previous studies carried out on sports betting using behavioral tracking data (i.e., Broda et al. 2008; LaBrie et al. 2008) used the total amount wagered as the primary measure of monetary gambling involvement. As we have tried to show in this paper, these studies totally neglected the nature and mechanics of how sports bettors actually gamble.

Concluding comments

In this paper, we have provided a brief response to Braverman and colleagues' (2013) critique of our paper about the concept of Theoretical Loss (Auer & Griffiths, 2013; Auer et al., 2012). Based on our observations, we believe that 'gambling intensity' and 'gambling involvement' are (in essence) the same construct as descriptors of gambling activity. Bravermen et al. (2013) appear to criticize us for lacking a definition of 'gaming intensity'.

However, a number of our papers have consistently defined what we mean by gambling intensity (Auer & Griffiths, 2013a; 2013b; Auer et al. 2012) but maybe this was simply not to a level that Braverman et al would like. In this paper, we have clarified that 'gambling intensity' specifically relates to the amount of money that a player is prepared to risk financially as measured using our metric of Theoretical Loss.

With respect to gambling involvement, playing duration (i.e., the amount of time actually spent gambling) has been emphasized as another important indicator, both by Braverman et al. (2013) and by ourselves on several occasions (e.g., Auer & Griffiths, 2013b; Delfabbro, King & Griffiths, 2012; Griffiths, 2012; Griffiths & Auer, 2011; Griffiths & Whitty, 2010). We have never said that the time spent gambling is not an important variable in gambling intensity. However, Theoretical Loss – as we have explained here – only measures *monetary* gambling intensity. We also asserted that no study from the *bwin* behavioral tracking dataset has ever examined gambling duration directly (which – as noted above – is surprising given how important this is for examining gambling involvement among some specific types of gambler such as poker players). On the other hand, we have directly measured playing duration using temporal measures in our own behavioral tracking data (e.g., Auer & Griffiths, 2013b).

In this paper we also showed that the amount wagered does not reflect monetary gambling involvement in sports betting. The total amount wagered was the 'gambling involvement' metric used across several papers based on data from the *bwin* website (e.g., LaBrie et al. 2008; Broda et al. 2008). We would argue that these published results do not reflect the true nature of sports betting as they do not take into account the odds or the number of bets in a parlay that we have outlined here as crucial parameters of sports betting using actual data from provided by a European bookmaker in this paper.

Based on what has been presented in this response paper, we are still of the view that when it comes to purely monetary measures of 'gambling intensity' (i.e., 'gambling involvement'), the Theoretical Loss is a more robust and accurate measure than other financial proxy measures such as 'amount wagered' (i.e., bet size) as a measure of what players are prepared to financially risk while gambling. Braverman et al argued that measures such as bet size show good convergent validity with Theoretical Loss and as such is a useful measure. However, convergent validity is self-evident as bet size is one of the two variables that

comprise Theoretical Loss in the first place (the other being the house edge). We acknowledge that Braverman and colleagues are unlikely to change their view as to whether some metrics of gambling intensity are 'better' than others but we are delighted they acknowledged that our Theoretical Loss metric *"an interesting and potentially useful measure of gambling intensity"* (p.7). We wholeheartedly look forward to further debate on this important topic.

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Figure 1

Odds for the English Soccer Game 'West Bromwich Albion vs. Liverpool' (February 1, 2014)

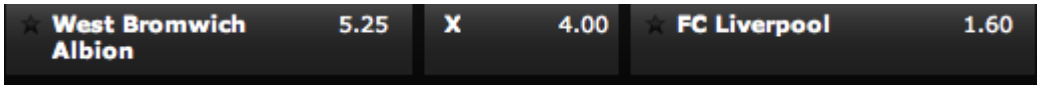

Figure 2

Parlay Bet Consisting of Three Single Bets on English Soccer Games (February 1, 2014)

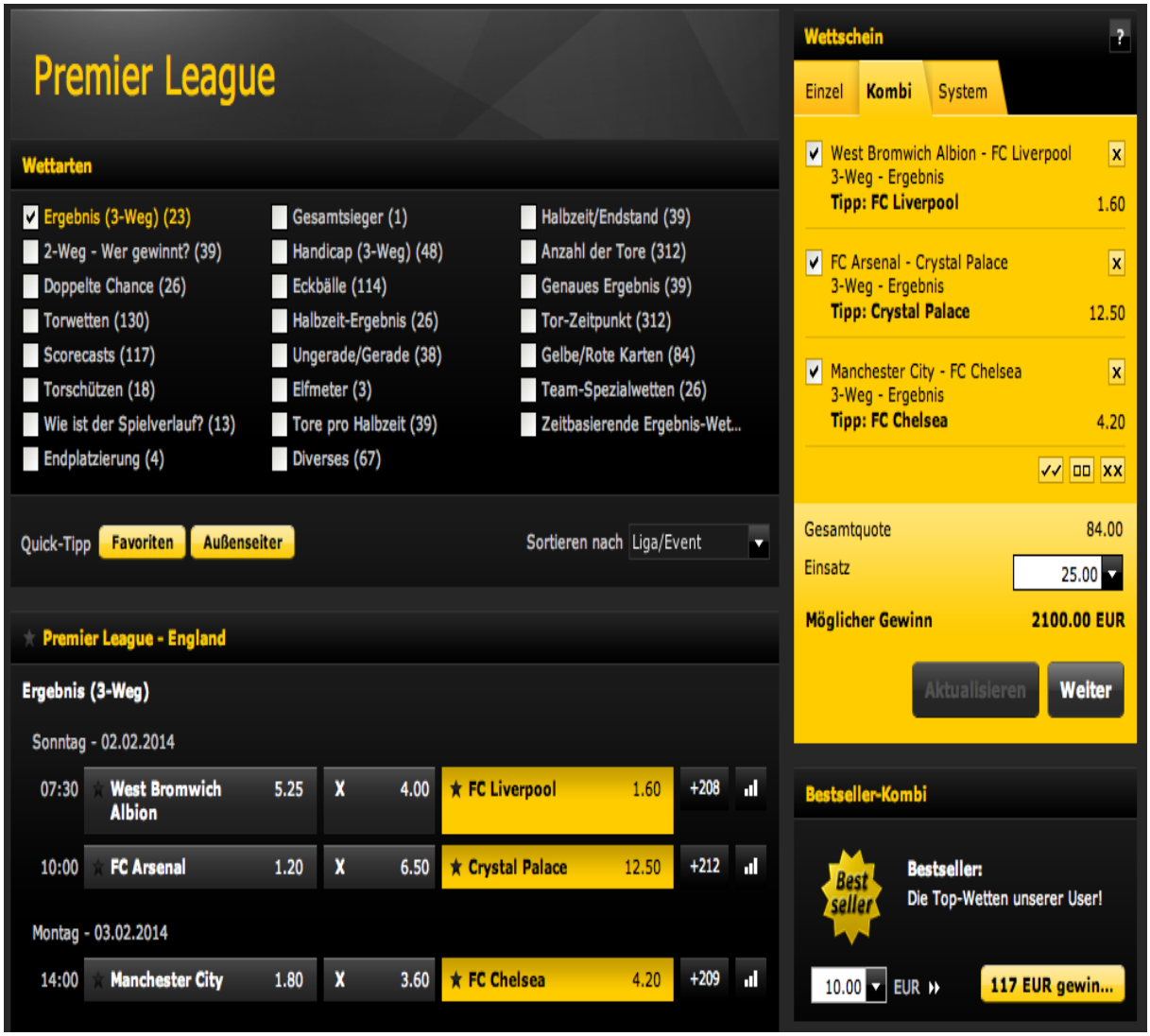

Table 1

Payout of the Soccer Game West Bromwich Albion vs. Liverpool

Outcome	Odds	1/Odds
1	5.25	19%
X	4.00	25%
2	1.60	63%
Payout		94%

Table 2

Payout of Parlay Bets

Bet	Probability	Cumulative Probability	Odds	Cumulative Odds	Payout
1	0.5	50.00%	1.8	1.8	90%
2	0.5	25.00%	1.8	3.2	81%
3	0.5	12.50%	1.8	5.8	73%
4	0.5	6.250%	1.8	10.5	66%
5	0.5	3.125%	1.8	18.9	59%
6	0.5	1.563%	1.8	34.0	53%
7	0.5	0.781%	1.8	61.2	48%
8	0.5	0.391%	1.8	110.2	43%
9	0.5	0.195%	1.8	198.4	39%
10	0.5	0.098%	1.8	357.0	35%

Table 3

Empirical Payout Percentage for Different Odds Intervals based on 52,500 sports bets

Odds	Payout %
[1.05;1.3]	94%
[1.3;1.55]	91%
[1.55;1.8]	87%
[1.8;2.05]	92%
[2.05;2.4]	91%
[2.4;3]	83%
[3;3.75]	68%
[3.75;5.1]	77%
[5.1;9.5]	71%
[9.5;max]	47%

Table 4

Empirical Payout Percentage for Different Number of Games in a Parlay based on 52,500 sports bets

No. of Bets	% Payout
1	86.30%
2	76.10%
3	65.20%
4	56.00%
5	50.40%
6	44.90%
7	42.80%
8	35.60%
9	35.40%
10	27.90%