Cash-Out Sports Betting, Expected Utility and National Sentiment: Can Bookmakers 'Cash-In' By Understanding Bettors Better?

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Abstract

Sports betting markets have been studied extensively due to their capacity as simplified financial markets. Of interest are the applications of utility theory and national sentiment to this market which have been used to better understand bettor behaviour. This study is novel in its focus on a new technology within sports betting markets – 'cash-out betting'. This is a feature which allows bettors to terminate their bets whilst the event is happening in order to make a profit (or reduce their losses). Despite the popularity of this feature for bettors, it has yet to be studied with regard to utility theory and national sentiment.

An online survey was conducted whereby 128 respondents were asked a series of standard gamble questions in order to elicit indifference points between monetary values. They were also posed a total of 18 cash-out scenario questions, 9 for their preferred national football team, and a further 9 for non-preferred club football teams. The responses to the standard gamble questions were used to estimate a constant absolute risk aversion utility function for each respondent using non-linear least squares. Under expected utility theory, respondents' utility functions were used to calculate their certainty equivalents for the cash-out questions to see if this was a good predictor for their observed cash-out values. On average, frequent bettors denoted cash-out values £3.24 higher than non-bettors, significant at the 1% level. These results hold implications for bookmakers as it could allow them to personalise cash-out values for sports bets on a bettor-by-bettor basis, particularly between frequent bettors and new bettors (assumed to be previous non-bettors) due significant difference in mean cash-out values denoted by these groups.

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1. Introduction

This year, the Gambling Commission (2021) reported that from April 2019 – March 2020, the gross gambling yield for Great Britain was a staggering £14.2Bn. Within this figure, 40% of the gross yield was sourced from online betting, an 8.1% year-on-year increase. A proponent to this increase in online betting yield is the relatively recent introduction of new betting technologies, most notably the in-play and cash-out features of bookmakers. In short, the in-play feature allows bettors to place new bets during sports events and the cash-out feature provides bettors with the option to terminate their bet early for a profit (or a loss) depending on the current situation in the match (Betfair, 2020a, 2020b). These features have been enabled by the shift of a large proportion of sports gambling from in-store to online.

Sports betting markets have been studied extensively, with applications of utility theory and risk aversion at the forefront of the field (Griffith, 1949; Weitzman, 1965; Ali, 1977). With direct reference to the cash-out feature of sports betting markets, research is scarce, presumably due to the recency of the feature to come to market. The existing literature on in-play and cash-out betting consists of qualitative studies into why bettors partake in in-play betting (Deans et al., 2016; Killick & Griffiths, 2021) and also studies into the effects and implications of these new features on current, and problem gamblers (Lopez-Gonzalez & Griffiths, 2017; Killick & Griffiths, 2019; Parke & Parke, 2019; Lopez-Gonzalez et al., 2020). More recent analysis of sports betting markets has considered their efficiency, and the biases which potentially challenge this efficiency. Most relevant to this study is 'national sentiment', the idea that bettors are not rational and instead direct a disproportionate amount of their bets to sports teams/players that they have sentimental attachment to (Franck et al., 2011). This has been applied to fixed-odds betting markets across a whole range of sports including: football (across many National leagues), American football, and basketball (Dare & Macdonald, 1996; Forrest & Simmons, 2008; Humphreys, 2010; Braun & Kvasnicka, 2013; Feddersen et al., 2016).

Whilst utility theory and national sentiment have been applied to betting markets extensively, their applications to cash-out markets are lacking. This study looks to build on the literature with an original investigation into the prediction of bettor cash-out values employing expected utility theory, and a test for the effect of national sentiment on bettor cash-out values. The 'prediction' of bettor cash out values is enabled by the similarities between a bettor's cash-out value and the economic concept of a certainty equivalent for a lottery or gamble. An individual's certainty equivalent is the monetary value for which they are indifferent to receiving as opposed to partaking in a gamble (Luce & Fishburn, 1995). Therefore, a bettor's certainty equivalent for a sports bet would be the cash-out value for which they are indifferent between cashing-out the bet, or not. As a result, a bettor's 'minimum cash-out' value would be just over this indifference point[1]. Under the assumption that respondents were expected utility maximisers, this study utilised a series of standard gamble questions to elicit respondents' indifference points between monetary values and utility, using a procedure adapted from Wakker and Deneffe (1996). After these indifference points were elicited, utility functions were estimated for each respondent. Under expected utility theory, these utility functions were used to calculate respondents' certainty equivalents for an array of lottery style sports betting scenarios, and these calculations were compared to the cash-out values which respondents denoted in response to these scenarios. In addition to this, respondents' observed cash-out values for the national team betting scenarios were compared to the values for the club football team scenarios in order to see if bettors cash-out values were different for their favourite teams, and hence effected by national sentiment. Consequently, the research question for this study is as follows:

[1] The term 'minimum cash-out value' was used within the survey as it was believed to aid respondents' understanding of the questions.

Under expected utility theory, are individuals' certainty equivalents for sports betting scenarios equal to their minimum-cash out values, and how does national sentiment effect bettor's minimum cash-out values?

The prediction of bettors' cash-out values is a unique aspect of this study, surprisingly so due to the ramifications this could have for bookmakers in sports betting markets. The current system involves the bookmaker offering the bettor a cash-out value based upon the probability of their selected bet to be successful. The bettor then has two choices, they can either accept the offered cash-out amount, on continue with their bet. However, there is a missing link within this process, when the bookmakers observe a bettor cashing-out, they cannot be sure whether the cash-out value they offered exceeds the minimum-value that a bettor would have settled for. In situations where this is the case, the bookmakers are making inefficient cash-out offers and hence are not profit maximizing. Therefore, if an equivalence was to be found between bettors observed cash-out values for sports bets and their certainty equivalents for these bets under expected utility theory, this would be beneficial for bookmakers to estimate the cash-out values that bettors would settle for.

National sentiment may also have a bearing on the cash-out values the bettors settle for. Braun and Kvasnicka (2013) found national sentiment to cause bettors to overrate the chances of their favourite national team to win a game. In addition to this, they also suggest that loyal bettors will not place a sports bet against the team they support. With respected to this, if sports fans overrate the chance of their team winning a game, they'll be likely to require a higher cash-out values for a bet to consider cashing-out. The topic of interest is whether bettors' cash-out behaviour is different for their preferred national team in comparison to a non-preferred club team. This would again have implications for bookmakers, and if national sentiment did in fact effect cash-out behaviour, this is knowledge which they could use to their advantage and profit from. Within this study, the presence of national sentiment in cash-out betting was tested by posing respondents cash-out scenario questions for their favourite national team, and for non-favourite football clubs. The stakes, returns and probability of a team winning were identical between the national football and club football cash-out scenarios, and so a significant difference between these cash-out values would support the presence of national sentiment in cash-out sports betting. This was analysed using a linear regression model with respondents denoted cash-out values as the dependent variable and dummy variable to distinguish between national and club football questions. Whilst national sentiment has been researched in depth for fixed odds markets, to my knowledge it has not yet been applied to in-play or cash-out betting and so therein lies the novelty of this approach. It was apparent that despite its prevalence in fixed odds markets, within the sample from this study, national sentiment was not in effect in for cash-out markets.

In addition to testing whether cash-out values were higher for respondents' preferred national teams due to national sentiment, the effect of being a frequent bettor, or a student was analysed with regard to cash-out values. These were dummy variables also used in the aforementioned linear regression model, with frequent bettors having on average, higher cash-out values by £3.24 in comparison to non-bettors.

Section 2 of this report corroborates the existing literature on sports betting and the use of utility theory and national sentiment in this field. It also includes a worked explanation of cash-out betting as this is an integral theme throughout this study. Section 3 presents the methodology of the research, section 4 the results, and section 5 the discussion before finishing with section 6, the concluding remarks.

2. Literature Review

2.1 A Brief History of Utility Theory and Sports Betting

Much of the early literature on gambling/wagering in sports betting markets is centred around horse racing and the measurement of bettors' risk attitudes (Griffith, 1949; Weitzman, 1965; Ali, 1977). Horse racing was studied for two key reasons: firstly, because the betting market was commonly run in 'pari-mutuel' fashion, where winnings are paid from the prize pool of all bets placed after commission deduction (Lotha, 2010). Secondly, horse racing was particularly popular due to the frequency of racing meets (and the frequency of races throughout a given day), so existed a large data pool for analysis.

Griffith (1949, p.293) analysed data from 1,386 races and proffered early ideas that "too much money is wagered on long-odded horses" – now more formally known as the 'favourite-longshot bias', which has been reviewed in depth by Snowberg & Wolfers (2010). Expected utility theory is commonly used in the measurement and modelling of risk preferences within betting. Weitzman (1965) used the results from 12,000 races over a 10-year period to estimate the probability of a horse winning a race as a function of return paid on a bet on that horse. He then derived the average bettor's utility function for money assuming that he is an expected utility maximiser. Lastly, Ali (1977) analysed the difference between the objective and subjective probabilities of a horse winning in 20,247 races. Assuming that the representative bettor is an expected utility maximiser, he then estimated a utility function and found that the representative bettor is risk loving. More recent studies have used racetrack data to estimate expected utility, rank-dependent utility, and cumulative prospect theory models for behaviour at the aggregate level (Jullien & Salanié, 2000). Within the realm of expected utility, they estimated constant absolute risk aversion (CARA) utility functions and found it to perform equally well as rank-dependent expected utility.

There has also been much research into the efficiency of betting markets which again has been most frequently applied again to horse racing, but also football betting markets. Thaler and Ziemba (1988) set market efficiency conditions for pari-mutuel racetrack betting; they posit that these conditions are often violated, but that bettors have high expertise as the probability of a horse winning a race is well predicted by the markets odds. Despite this, there is also evidence to suggest that profits can be made due to market inefficiencies if bettors use publicly available information in their predictions (Asch et al., 1984).

The pari-mutuel format of sports betting has now been superseded by fixed-odds betting markets, even within the scope of horse racing where it originated. A decisive reason for this change of betting market structure is due to a hindrance of the pari-mutuel system, that odds aren't determined ex-ante (Franck et al., 2011). Therefore, within this system, bettors were unable to calculate the potential returns on a bet they had placed until the betting on that event had closed, and the total volume of wagers was finalised. The fixed-odds market remedies this issue, by as the name suggests, fixing the odds once the bet has been placed. The benefit for the bettor is that once they have selected the stake which they wish to risk and the event to place the bet on, they have well defined outcomes in terms of the amount they could potentially lose/win depending on the outcome of the event. Bookmakers' have the ability to change these fixed odds for new bettors on the event in order to provide better value on some betting selections, incentivising these bets to balance the volume of bets on a certain event. This relates to the (in)efficiency and will be detailed in due course.

2.2 The Introduction of Cash-Out Sports Betting

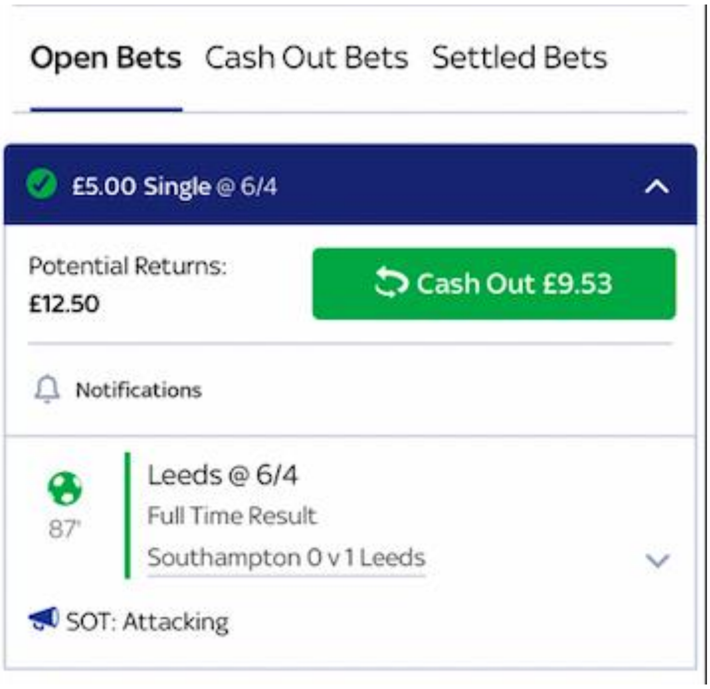
As mentioned above, sports betting has been commonly used alongside economic theory for the measurement of risk aversion and bettors' risk attitudes. Given that the focus of this research looks at a particular niche of sports betting, the 'cash-out' feature, this will be described in more detail to provide clarity. The concept of cash-out betting was first introduced online by the bookmaker William Hill in December 2012 (Lopez-Gonzalez & Griffiths, 2017). Cash-out betting is a method of getting money back from a previously placed bet on an event, before the event is over. This is normally offered on in-play betting (also known as in-running, or live betting) as to allow bettors to end their bets early (Gambling Commission, 2020). The cash-out feature gives bettors a clear (continuous) visual overview of the profit or loss they would make on their bet if it were to be 'unwound' at that point in time (Brown & Yang, 2017). The purpose of this was to boost bookmakers' revenue streams and profit margins. This has been successful for some bookmakers, with Bet365 reporting that 80% of their sports betting revenues came from in-play betting alone (Jackson, 2015).

With the rise of in-play and cash-out betting, the concept has come under criticism for its effects on the vulnerable, young, and problem gamblers. The cash-out feature has made sports betting a "potentially continuous gambling activity" (Lopez-Gonzalez & Griffiths, 2017) and has also made it possible to wager on, and view a sports match simultaneously. It has been noted that in-play markets have increased the volume and frequency of available events for a bettor to place a wager, whilst the cash-out option extends the duration of betting sessions (Parke & Parke, 2019). This continuous aspect of these recent sports betting technologies limits the time between bets being placed, thus restricting the emotional respite for bettors (Parke & Parke, 2019; Lopez-Gonzalez et al., 2020). The evolution of sports betting to an online platform increases the emotional attachment for bettors, a theme which will be explored later for cash-out betting with respect to particularly susceptible groups, students and frequent bettors.

To truly understand the concept of cash out betting, see figure 1. This is a screenshot of an online bet placed with bookmaker 'Sky Bet'. It shows a £5 stake placed at odds of 6/4 on Leeds United to beat Southampton in a Premier League football fixture. The odds of 6/4 indicate that every £1 placed will return £2.50 (£1.50 plus the £1 stake returned) if the bet is to be successful, this is shown by the 'potential returns' of the bet listed as £12.50. As highlighted in green, the cash out value of the bet is currently £9.53 in the 87th minute of the game. As Leeds are currently winning 1-0, the bettor could cash out their bet for this value, sacrificing the additional £2.47 if Leeds were to win the game, the bettor would benefit from a certain pay-out which would leave them in profit of £4.53. This information is displayed differently with different bookmakers, but fundamentally the offering is the same, with bookmakers looking to capitalise on bettors cashing-out their winnings early.

Figure 1

Sky Bet Cash-Out Screenshot



2.3 Utility Theory and Cash-Out Betting

Having described the concept of cash-out betting, the similarities between the cash-out value of a sports bet, and the economic concept of a certainty equivalent will be drawn upon. Luce and Fishburn (1995) note that an individual's certainty equivalent, CE(g) of a gamble 'g', is defined as the monetary amount indifferent to 'g':

$$CE(g) \sim g, \text{ where } CE(g) \text{ is an amount of money.}$$

Comparatively, in a sports betting scenario, the in-play bet which has been placed (the gamble) will also have a cash-out value for which an individual is indifferent between keeping the bet, or cashing-out the bet – this is equivalent to their certainty equivalent of the gamble. To refer back to figure 1, £9.53 may make the bettor indifferent between cashing the bet for this value, or leaving the bet with the potential to win £12.50, but also for the bet to lose. This cash-out value can therefore be established as a conceptual equivalence to the economic concept of a certainty equivalent. This conceptual equivalence will be used in turn to 'predict' respondents' cash-out values for sports betting scenarios by calculating their certainty equivalents for these bets using expected utility theory and respondents' estimated utility functions. By comparing these values to respondents' observed cash-out values, it will be evident whether under expected utility theory, the certainty equivalents of sports gambles are equal to respondents' observed cash-out values.

Having now summarised the applications of utility theory to sports betting markets, and defined the concept of cash-out betting, the first hypothesis of this research can be formed:

Hypothesis 1: Under expected utility theory, respondents' calculated certainty equivalents for betting scenarios are equal to their minimum cash-out values.

This hypothesis concerns the estimation of individual respondents' utility functions, which can then be used to make a prediction of their cash-out value for a bet. If these predictions were successful, this information would be of particular interest for bookmakers. In practice, when bookmakers offer a cash-out to bettor it is based off the probability of that bet to win (minus a margin), but if the bookmakers were privy to information regarding the utility functions of their bettors, they could use this to ensure not to offer a value above a bettors' minimum cash-out value.

2.4 Sentiment: Investor and National

The concept of investor sentiment originates from the behaviour of investors in financial markets. De Long et al. (1990) refer to 'noise traders' as investors who, on average, overestimate returns or underestimate risk and therefore their investment decisions are not entirely rational. Investor sentiment has a bearing on these investment decisions and can destabilize asset prices. The concept has been broadened as to define investor sentiment as "any non-maximizing trading pattern among noise traders that can be attributed to a particular exogenous motivation" (Avery & Chevalier, 1999, p.493). Baker and Wurgler (2009, p.130) highlight key factors which make stocks particularly sensitive to investor sentiment, these include: "stocks of low capitalization, younger, unprofitable, high-volatility, non-dividend paying, growth companies or stocks of firms in financial distress". Sauer (1998) notes that wagering markets are highly simplified financial markets, where the pricing problem is removed, and with the benefit of fixed timing for bets being placed and payoffs being received. As a result, investor sentiment is applicable to sports betting markets and there is a wealth of literature which searches for sentiment bias (in the form of national sentiment) in markets, or analyses the effect of this on bookmaker pricing.

Braun and Kvasnicka (2013) postulate that national sentiment has an effect on bettor behaviour regarding to the support of their national team in the form of 'perception' and 'loyalty' biases. Perception bias is concerned with the fact that individuals overrate the chance of their national team winning a game. This is paired with the loyalty bias whereby bettors do not bet against their own team even when the odds are favourable. Placing a bet on one's favourite team to lose would be labelled as an act of disloyalty to the club and the fanbase. In relation to football betting, perception bias has previously been referred to as 'wishful thinking' – the effect of preferences on expectations (Babad & Katz, 1991). They tested this concept of 'wishful thinking' by surveying 980 Israeli football match attendees. The most interesting of their findings was that for the team who was objectively the underdog, none of their 'diehard' supporters predicted their team to lose. This shows the faith (irrational may it be) that football fans have in the team they support, an error in perception which bookmakers are aware of, and can exploit in their pricing of betting markets.

Dare and Macdonald (1996) analysed the efficiency of the National Football League (NFL) point spread betting markets, finding that the 14 fixtures played on neutral territory (i.e. the Superbowl) have less efficient betting markets than the regular season fixtures. They hypothesise that the Superbowl fixtures attract bets from unsophisticated bettors who are more likely to use emotion when placing their bets, and hence the bookmakers have to bias their betting markets for these events in order to balance their books. The effects of bettor emotion and sentiment in the placing of wagers can evidently distort markets and create inefficiencies for bookmakers.

Evidence has been found across English, Spanish and Scottish top division football that bookmakers are aware of sentiment bias, and price the odds on these markets accordingly to increase their profit margins (Forrest & Simmons, 2008; Franck et al., 2011; Feddersen et al., 2016). Football teams with a greater following naturally attract more sentiment bets due to their popularity with bettors (Franck et al., 2011). Avery and Chevalier (1999) also find the success of a football team, and the frequency of which the team is mentioned in the media to be drivers of sentiment betting. Feddersen et al. (2017) used Facebook 'likes' as a proxy for team popularity and found that every 1 percentage point difference in 'likes' favouring the home team increased the probability of the home team winning by 0.6 percentage points. This implies that the bookmakers would reduce the odds accordingly as a result of this sentiment bias. The aforementioned pari-mutuel betting system made factors like sentiment clearly detectable in the market as the prize of a bet was determined by the volume of bets placed on that outcome, thus creating a mechanism where the payout per bettor was reduced in line with the volume of betting on a particular horse.

Kuypers (2000) created a model of bookmaker behaviour whereby he suggested that if bettors have biased expectations, that is, their subjective probability of their favourite team winning a game is different to the bookmakers probability, then the bookmaker can maximize profits by setting inefficient odds. Loyalty to a particular sports team is given as a factor which may cause a bettor to have biased expectations and therefore the bookmakers would reduce the odds on the favourite team to win, hence reducing the pay-out of the bet. As bookmakers exploit this bias by changing their price (market odds) to profit, a sophisticated bettor can also do so (Levitt, 2004). Whilst the change of price exploits the bettors prone to bias, these sophisticated bettors can take advantage of the distorted pricing. Humphreys (2010) analysed the NBA point spread betting market and his findings contradict Levitt's (2004). Whilst Levitt finds that bookmakers change the odds pricing to balance the bets in the market, Humphreys finds that the NBA point spread wagering market is unbalanced in terms of bet volume and pricing.

Whilst the general consensus is that sentiment causes bettors to direct more of their wagering towards their favourite team, there is also a reversal of this phenomena where bettors bet against their favourite team (Agha & Tyler, 2017). This contradicts Braun and Kvasnicka's (2013) loyalty bias which states that bettors don't bet against their own team, even if the odds are favourable. Agha and Tyler (2017) categorise bettors who bet against their favourite team into two groups. 'Hedgers' bet against their own team so that in the event that their team loses, they are financially rewarded and so experience a positive emotion whether their team wins or loses. Whereas 'gamblers' recognise when the odds to bet against their team are favourable, hence they bet against their favourite team for financial gain. This is not to say that these fans do not want their favourite team to win, they are still strong supporters of their team, they just seek value in betting against them. This provides an interesting perspective as a counter argument to the body of literature on (national) sentiment betting.

Conversely, this study will not look at how the bookmakers price these markets but whether consumer cash-out behaviour is affected by national sentiment. Although, this would have implications for bookmakers as it can be used in the determination of their pricing for these markets. With regard to the effect of sentiment on cash-out betting, the formerly mentioned perception bias (Braun & Kvasnicka, 2013) is most relevant as it should in theory lead to upward bias in subjective probability of the team winning and therefore it is expected that the bettor will require a higher minimum cash-out value to consider 'cashing-out' their bet. It is also possible that for cash-out betting there is a similar effect to loyalty bias, but this manifests itself as an individual's reluctancy to cash-out a bet on their favourite team as this represents a lack of faith in their team to win. This is a reversal of the loyalty bias but follows the same concept. In light of the literature regarding the presence of sentiment in betting markets, the second hypothesis is formed:

Hypothesis 2: National sentiment will increase individuals' minimum cash-out values when they are betting on their preferred national team to win.

It is expected that individuals will require a higher cash-out value for a bet on their preferred national team in comparison to the same bet for a club they have no preference for. A finding such as this would have wider implications for bettors and bookmakers alike. Bettors should be made aware of their flawed judgement, and if their aim of gambling is purely to make a profit, they should aim to act without emotion and sentiment when considering cashing-out a bet. Similarly, if the national team cash-out values did happen to be higher compared to club football, bookmakers should systematically adjust the cash-out values on national team football for the national team of each country as to maximise profits.

2.5 Frequent Bettors, Students, and Cash-Out

As mentioned, many social issues have emanated from the introduction of in-play and cash-out into sports betting markets. The issues are mostly founded in concern for the effect of cash-out and in-play on problem gamblers (Deans et al., 2016; Hing et al., 2016; Lopez-Gonazalez et al., 2020). Whilst this study is not focused on problem gamblers, it can be presumed that in-play and cash-out betting has the same effects on bettors in comparison to non-bettors, just at a lower magnitude. Killick and Griffiths (2021) highlight 3 key factors which motivate bettors to gamble in-play: increased excitement, increased intensity of the game, and the fact that in-play betting allows the use of their skills/knowledge. These factors are more likely to be apparent in frequent bettors in comparison to non-bettors, as a result, the difference between the cash out values bettors and non-bettors will be analysed in the latter part of this study. Due to the excitement and increased intensity of the game when a bettor has an in-play bet placed, it is expected that this will increase the minimum cash-out value which a bettor requires to cash-out a bet. The feeling of excitement derived from having an in-play bet placed is an emotion which frequent bettors will resonate with (more so than non-bettors) and therefore if they cash-out a bet, then they no longer have a bet placed and lose the feeling of excitement which they had prior.

A second group of interest is students, and whether in comparison to non-students, their cash-out behaviour differs. Qualitative research into in-play betting behaviour and the associated risk factors pinpoints pubs, and alcohol consumption as strong influences on gambling (Deans et al., 2016; Killick & Griffiths, 2021). Deans et al. (2016, p.117) continue by suggesting that the "collision" of pubs, alcohol consumption and gambling culture create a high-risk gambling environment. They reference young men specifically, implying that the environment "impairs risk decision making", a factor which could have knock-on effects for cash-out behaviour. Furthermore, Hing et al. (2016) indicate that students are particularly susceptible to high risk gambling and with a UK student lifestyle often associated with pub visits and alcohol consumption (high risk gambling environments), this provides motivation for this sub-group to be analysed. Within the UK, the National Union of Students survey found that 59% of students gambled in the past year, 8% used their student loan to gamble, and 13% wagered more than they could afford to lose (Busby, 2019). It is evident that risky gambling practices are present within UK students and so in addition to comparing the behaviour of bettors and non-bettors, students and non-students will also be compared. Given that students have been identified as being more susceptible to high risk gambling, and also visit high-risk gambling environments, it is expected that students will exercise riskier betting practices and require higher minimum cash-out values (in comparison to non-students) to consider cashing-out a bet. This leads to the final hypotheses:

Hypothesis 3a: Frequent bettors minimum cash-out values for club football will be higher than non-bettors.

Hypothesis 3b: Students minimum cash-out values for club football will be higher than non-students.

3. Methodology

The research included the collection of data to estimate an individuals' utility function, whilst also exposing respondents to sports betting scenarios where they were asked to elicit minimum cash-out values. Both national team football and club football were used within the sports betting scenarios as to test for national sentiment. Respondents were asked a total of 28 questions within 3 stages.

3.1 Experimental Design

The data collection consisted of the distribution of an online survey in Qualtrics which was split into 3 stages, and a post-experimental survey to collect demographic information. The experimental design will be described in turn for each stage of the survey.

3.1.1 Stage 1

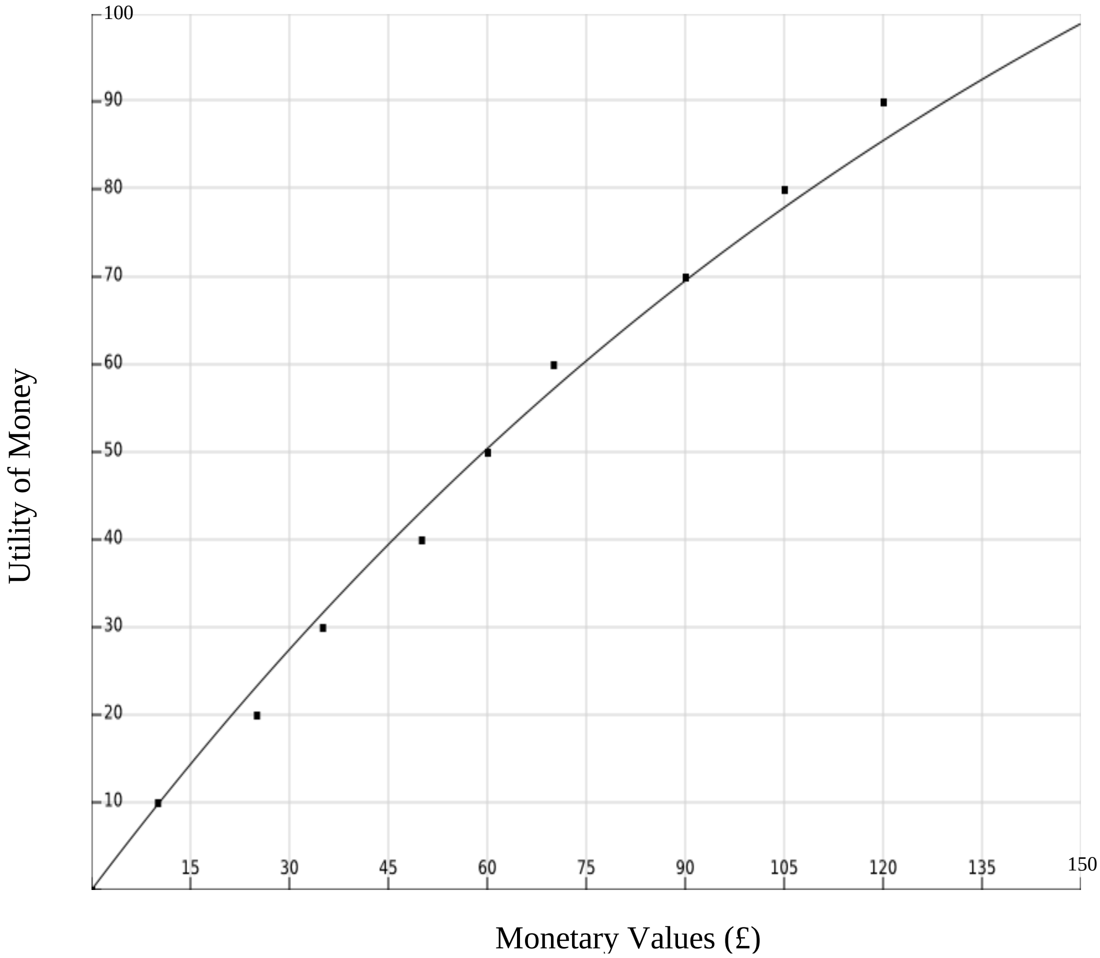
The first stage of the survey posed 9 standard gamble questions to respondents in order to elicit indifference points between monetary values and utility. This would result in 11 data points per respondent. This was deemed a sufficient number of data points for utility function estimation across range of £0-150 based upon previous studies. Fishburn and Kochenburger (1979) used between 3-13 data points for each subject to estimate subjects' utility curves for monetary values > 0, whilst Hildreth and Knowles (1982) used between 13-26 data points for each subject to estimate the utility curves for farmers across a far larger range of values. The procedure was adapted from Wakker and Deneffe (1996) for the range of monetary values of interest (up to £150). This value was chosen as a maximum as this is the largest betting return which is used in the latter stages and therefore the highest monetary value that utility will need to be calculated for in the analysis. For an example, the first of the 9 questions read as follows:

> "You are faced with a lottery which has a 10% chance of winning £150 and 90% of winning £0. Please state the minimum fixed prize for which you would prefer over playing the lottery".

The subsequent questions increased the chance of winning £150 by 10% and reduced the chance of winning £0 by 10% incrementally (the full list of questions can be seen in appendix A). The questions were asked in a fixed order, from lowest expected value to highest. For each question, a direct matching procedure was employed whereby respondents were asked to declare the minimum amount of money that if offered for certain, they would prefer instead of playing the standard gamble. The purpose of the data collected in this stage of the experiment was to enable the estimation of each respondents' utility function using non-linear least squares, an example of which can be seen below in figure 2. This shows the respondents' plotted certainty equivalents for the standard gamble questions, and their estimated utility function using these certainty equivalent indifference points. This is necessary in order to calculate each respondents' certainty equivalents (using expected utility theory) for the cash-out questions in stage 2 and test whether they are good predictors of respondents' observed cash-out values.

Figure 2

Scatterplot of a Respondent's Denoted Certainty Equivalents With Fitted Estimated Utility Function



Note: the scattered points show the certainty equivalents denoted in response to stage 1 of the survey. The fitted function is the estimated CARA utility function in the form:

U(X) = $\frac{(1-e^{-ax})}{a}$, with the parameter $a \approx 0.006$. This data is for respondent 5.

3.1.2 Stage 2

The second stage of the experiment consisted of 9 club football sports betting scenarios which were constructed from real-life football fixtures and bookmaker odds from the week commencing 3rd May 2021. The scenarios were constructed from a pool of 40 fixtures across

4 of the 5 ‘big leagues’ (French, German, Italian and Spanish – excluding the English league). Care was taken to the exclude the English league from the questions pool as to eliminate favourite team bias from this stage of the experiment, given that the survey was distributed to UK residents only. The 9 sports betting questions were comprised of 3 different stake levels: £10, £20 and £50, and for each question information such as the odds of the bet, the return of the bet and the probability of a given team winning were provided. The probability of the team winning was calculated prior to the construction of the questions by converting the half-time odds into odds-implied probabilities. Based off the information provided in these scenarios, respondents were asked to provide the minimum value for which they would consider ‘cashing-out’ a bet for. An example question can be seen below:

> You placed a £10 bet on Freiburg to beat FC Koln at odds of 13/5 (£10 returns £36). At half time, the score is 2-0 to Freiburg. The HT odds suggest that Freiburg have an 87.5% chance of winning the game. What is the minimum amount you would cash your bet out for?

A full list of these questions can be seen in appendix B.

3.1.3 Stage 3

The final stage of the online survey was very similar to stage 2, insofar as respondents were presented with 9 football betting scenarios, but these were now related to international football. Prior to these questions, respondents were asked to denote the home nation that they support in football (possible answers included: England, Scotland, Wales, Northern Ireland, or none of the above). The 9 football match scenario questions which followed used the country name of the preferred nation that the respondent selected. These questions were constructed to be identical to the previous 9 questions from stage 2. Again, respondents were asked to denote the minimum value of money for which they would ‘cash-out’ a given bet for. These questions were in the same format as the previous example, but with the club name switched for the respondents' international team of choice (a full list of the questions can be seen in appendix C). This is the variable of interest from the questions in stage 2 and 3, and its purpose is two-fold. Firstly, the observed minimum-cash out values will be compared to calculated certainty equivalents for each cash-out question, making use of the utility function which can be estimated from stage 1. Secondly, these observed cash-out values will be compared within-subject between the football club and international team questions, and also between subject for demographic information such whether the respondent has engaged in betting previously, or whether they are currently a student.

3.2 Randomisation and Pilot Survey

The order in which stages 2 and 3 appeared in the survey were randomised as to account for any order effects. Aside from this, the order of the survey was the same for all respondents, they were always presented with the 9 standard gamble questions as the first stage of the survey.

The survey was piloted by 2 respondents (a frequent bettor and a non-bettor) prior to distribution and minor adaptations were made to the original survey. Neither the bettor, nor the non-bettor had issues understanding the cash-out questions, meaning the explanation of cash-out was clear enough. The feedback was that the standard gamble questions were difficult to understand and hence caused confusion, so this section was altered to make it clearer. It was suggested that a multiple price list would aid the accessibility of this stage of the survey, but a direct matching approach was still preferred to this as it is a less laborious process and thus more time efficient.

3.3 Respondents

As mentioned, the survey was distributed to UK residents only. Social media platforms such as LinkedIn and Facebook were used as a distribution method in addition to circulating the online survey amongst personal contacts. Due to the presence of sports betting in the survey, respondents needed to be 18 or over to participate. However, despite the presence of sports betting, no prior knowledge of this subject was needed in order to participate. The survey took a maximum of 10 minutes for respondents to complete and was unincentivized.

In total, 128 respondents provided completed responses to the survey. This sample had an average age of 36 years (SD = 15.5), 88.4% of which were male. In addition to this, 46.5% of the sample were identified as frequent bettors, and 32.6% are currently students. 'Frequent bettors' were identified as those who place at least one sports bet per month. Some respondents were excluded from parts of the analysis, this will be detailed in due course.

3.4 Analysis

3.4.1 Utility Curve Estimation

In stage 1 of the online survey, respondents were asked for denote their certainty equivalents for 9 standard gamble questions, resulting in 11 data points per respondent (including the assumed points of U(0) = 0 and U(150) = 100)[2]. Under the assumption that all respondents were expected utility maximisers, their denoted certainty equivalents were transformed into indifference points using the following method:

$$U(0) = 0 \ \& \ U(150) = 100$$

$$U(CE) = p \cdot U(150) + (1 - p) \cdot U(0)$$

$$U(CE) = p$$

Where 'p' is the probability attached to an outcome in the standard gamble.

[2] The original plan to use U(150) = 1, but these values were scaled up by factor of 100 to provide a better fit for the utility function.

These data points were then used to estimate each respondents' utility curve using non-linear least squares. A CARA specification was assumed, as used in Jullien & Salanié (2000), specifying the utility of a monetary value, X as the following:

$$U(X) = \begin{cases} \dfrac{(1 - e^{-ax})}{a}, & a \neq 0 \\ X \quad , & a = 0 \end{cases}$$

Where 'a' was the parameter of interest to be estimated.

3.4.2 Cash-Out Value Prediction

The estimated CARA utility functions were then used to estimate respondents' certainty equivalents for the sports betting scenarios using expected utility theory. A respondents' minimum cash-out[3] value for the wagers that were presented are essentially certainty equivalents for those bets, and therefore were calculated as follows.

For example, in question 1, the cash-out question involved a gamble with a £10 stake (x), £36 return (y), and an 87.5% chance of winning (p). Therefore, the wager (W) in the question can be presented as follows and the cash-out value was predicted such that:

$$W \sim [p{:}\,x, (1-p){:}\,y] \;\equiv W \sim (87.5\%{:}\,£36, 12.5\% : -£10)$$

$$\text{U(Minimum Cashout)} = U[p \cdot U(x) + (1-p) \cdot U(y)]$$

$$\text{U(Minimum Cashout)} = U^{-1}[0.875 \cdot U(36) + 0.125 \cdot U(-10)]$$

[3] The term cash-out is used frequently in this study, in some cases 'minimum' has been omitted for brevity. With reference to the respondents' 'cash-out' values, this should be assumed that these are minimum cash-out values, i.e. they would cash-out a bet for any value greater or equal to this minimum value.

$$\text{Minimum Cashout} = U^{-1}\left[0.875 \cdot \frac{(1 - e^{-36a})}{a} + 0.125 \cdot \frac{(1 - e^{10a})}{a}\right]$$

This procedure was repeated to predict a certainty equivalent (minimum cash-out value) for the 9 cash-out questions based on each respondents' estimated utility curve. The cash-out values were analysed on a question-by-question basis, with the mean predicted cash-out value being compared to the mean observed cash-out value using paired t-tests and Wilcoxon signed rank tests.

3.4.3 National Sentiment, Frequent Bettors, and Students

Other aspects of interest were national sentiment, and whether respondents were frequent bettors, or if they were students. The effect of these factors on respondents' cash-out values was analysed using a linear regression model with the dependent variable as the pooled observed cash-out values (N = 2,124) and 3 binary independent variables. The descriptions of these 3 binary independent variables can be seen in table 1:

Table 1

Description of Regression Variables

Dummy Variable	Description
National	Whether the cash-out value was from national football (favourite nation) or club football (non-favourite club).
Bettor	Whether the cash-out value was denoted by a bettor or non-bettor.
Student	Whether the cash-out value was denoted by a student or non-student.

Note: each dummy variable takes a value of 1 if the cash-out value was from national football, a bettor, or a student, and 0 if from club football, a non-bettor, or non-student (respectively).

Within the regression model, a significant positive (negative) coefficient for any of the variables would indicate that on average, national sentiment, being a frequent bettor, or being a student increases (decreases) the cash-out values of respondents.

4. Results

4.1 Estimated Utility Curves

From the original 128 completed responses, a proportion of respondents were excluded from the utility curve estimation and prediction of cash-out values. There were some outliers in respondents' cash-out answers, with 2 respondents providing answers of £0 to all 18 cash-out questions, and 4 respondents provided answers equivalent to the maximum return of each cash-out question. Based upon informal feedback received from the survey, it is clear that some of these respondents answered in this way because they were of the disposition that once they place a bet, they would never cash-out as they would always 'let the bet run'. These 6 respondents were excluded from this part of the analysis leaving a sample size of 122. These outliers will be referred to later in the discussion section. In addition to this, it was also evident that some respondents did not understand the standard gamble questions by the certainty equivalents that they denoted. This refers to 13 respondents who or those who violated monotonicity and denoted certainty equivalents which decreased as the probability of winning the standard gamble increased, thus demonstrating their lack of understanding of the task. These 13 respondents were therefore excluded, their responses to the utility elicitation task can be seen in appendix D. This resulted in a total sample of 109 respondents.

The original data points for utility were scaled up by 100 in order to provide an improved fit for the CARA specification. This approach is logical for the small range of monetary values used, as Wakker and Deneffe (1996) note that utility is almost linear over small intervals. The result being that the parameter estimates were very close to zero meaning utility was close to linear for most respondents.

Withing the 109 estimated CARA utility functions, there were 19 respondents (17.4%) whose estimated 'a' parameter was insignificantly different to zero (at the 5% level). The value of the significant parameter ranged from 0.0032 – 0.014 and these parameter estimates results can be seen in appendix C.

4.2 Calculated Certainty Equivalents (Cash-Out Values) for Sports Betting Questions

Using the procedure outlined in the methodology, respondents' certainty equivalents were calculated for each sports betting scenario using their estimated utility curves. These are also referred to as their 'predicted cash-out values' can be seen in appendix E. The predicted and observed cash-out values were pooled and then compared on a question-by-question basis across all respondents. Paired t-tests were conducted to compare the mean value of the predicted cash-out to the mean value of the observed cash-out for questions 1-9 for club football (a full list of these questions can be seen in appendix B). The Wilcoxon signed-rank test was also conducted for each question as a robustness check. There were 109 observations per question, and these results of which can be seen in table 1 below:

Table 2

Paired T-Tests Between Predicted and Observed Cash-out Values Per Question

Cash-Out Question	Predicted Cash-Out	Observed Cash-Out	Paired T-Test *t*-stat *p*-value	Wilcoxon Signed-Rank Test *z*-stat *p*-value
1	M = 29.44 SD = 0.47	M = 29.04 SD = 4.45	t = 0.92 p = .36	z = -1.08 p = .28
2	M = 10.52 SD = 0.28	M = 14.63 SD = 2.01	t = -21.2 p ≈ 0	z = -9.0 p ≈ 0
3	M = 13.87 SD = 1.19	M = 24.51 SD = 6.42	t = -17.1 p ≈ 0	z = -8.8 p ≈ 0
4	M = 21.29 SD = 1.61	M = 31.38 SD = 4.9	t = -19.5 p ≈ 0	z = -8.8 p ≈ 0
5	M = 27.67 SD = 3.56	M = 43.69 SD = 8.88	t = -17.1 p ≈ 0	z = -8.8 p ≈ 0
6	M = 43.38 SD = 3.26	M = 54.54 SD = 10.22	t = -10.47 p ≈ 0	z = -7.5 p ≈ 0
7	M = 34.56 SD = 9.93	M = 73.93 SD = 10.72	t = -27.1 p ≈ 0	z = -9.0 p ≈ 0
8	M = 30.34 SD = 15.89	M = 87.69 SD = 17.8	t = -24.6 p ≈ 0	z = -9.0 p ≈ 0
9	M = 73.06 SD = 22.16	M = 84.56 SD = 9.18	t = -4.87 p ≈ 0	z = -4.2 p ≈ 0

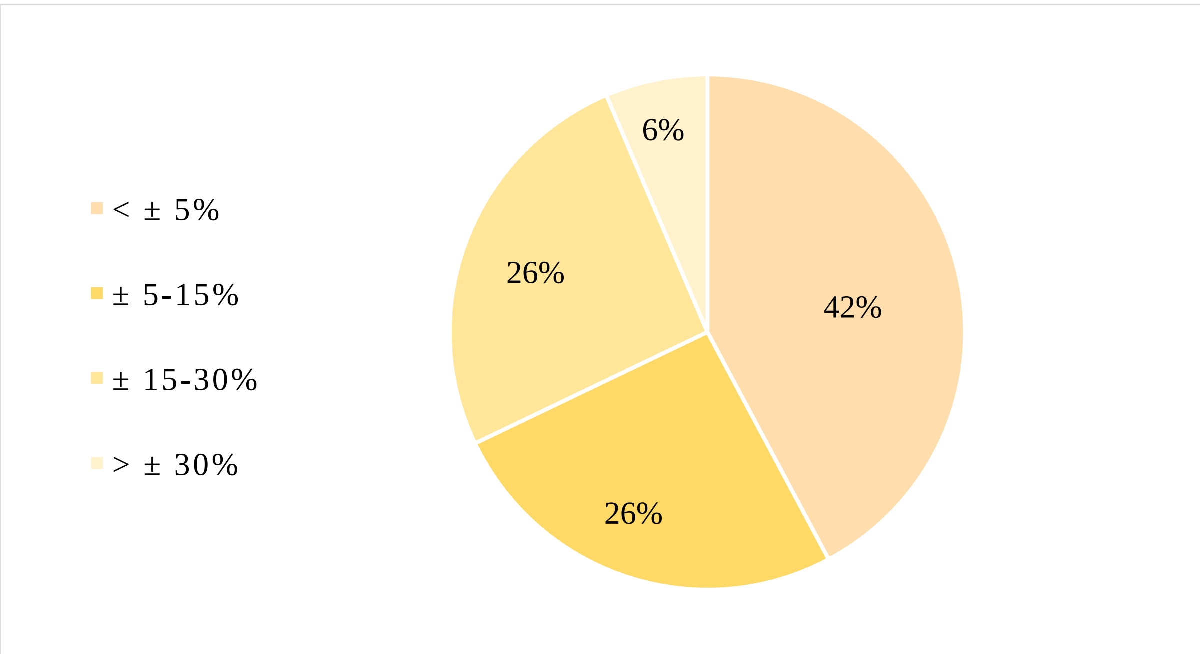
These results show that on a question-by-question basis, bar cash-out question 1, the mean of the observed cash-out values is statistically different from the mean of the predicted cash-out values. Within questions 2 to 9, the mean predicted cash-out value for questions 7 and

8 were 53% and 65% (respectively) lower than their corresponding mean observed cash-out value. These were the cash-out questions with the greatest percentage difference between the predicted and observed mean cash-out value, whilst question 9 had the lowest difference, just 14%. Although significant non-zero differences were ascertained between the mean predicted and observed cash-out values for questions 2 to 9, some of the predicted cash-out values were not too dissimilar to the observed values, a point which will be revisited in due course.

With particular focus on the sports betting question 1, the calculated certainty equivalents were relatively accurate - figure 3 below shows the proximity of the calculated certainty equivalents (minimum cash-out values) relative to the observed cash-out values for this question. As highlighted earlier, this was the only question for which there was an insignificant difference between the mean of the predicted cash-out values and the mean of the observed cash out values.

Figure 3

The Proximity of Calculated Certainty Equivalents (Minimum Cash-Out Values) to Observed Cash-Out Values for Question 1 (N=109)



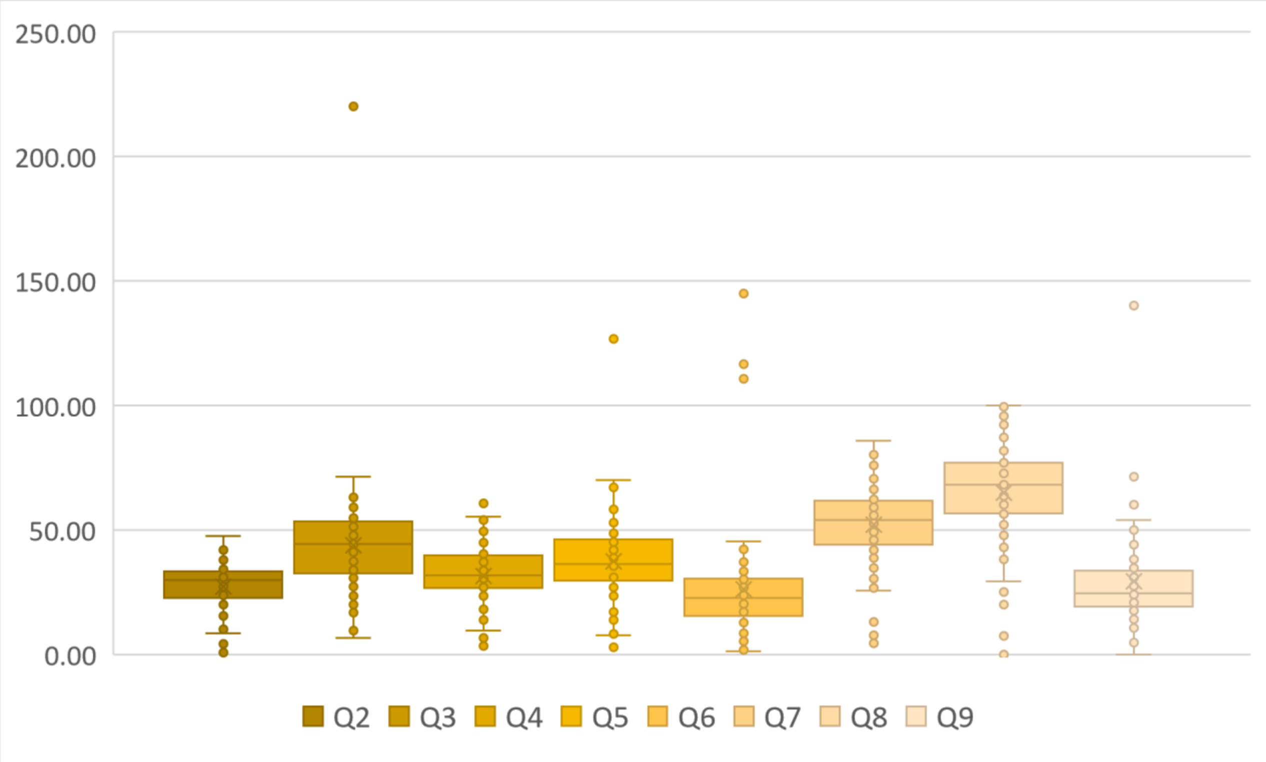
Note: < ± 5% refers to the predicted cash-out value being within a 5% range of the observed value. ± 5-15% refers to the predicted value being greater than ± 5% from the observed value, but less than ± 15% away, *et cetera*.

It can be seen that 42% of the predicted cash-out were within ± 5% of the observed cash-out value, signifying the accuracy of this prediction for a proportion of respondents. A further 26% of predicted values resided between 5-15% above or below the observed cash-out value, and only 6% of predicted values were over 30% above or below the observed value.

Another aspect to note is that for questions 2 through 9, the mean predicted value is lower than the mean observed value, and for questions 7 and 8 in particular, the mean is severely lower. Table 1 showed that there were significant differences between the mean cash-out values for questions 2 through 9, however some predicted cash-out values were reasonably close to the observed values. Figure 4 shows the distribution of the percentage difference between respondents' predicted cash-out values and observed cash-out values for questions 2 through 9. The majority of predicted cash-out values undershot the observed cash-out values denoted by respondents, but some did also overshoot. The percentage differences are in absolute terms for the purpose of the box plot.

Figure 4

A Box and Whisker Plot Showing the Distribution of the Absolute Percentage Difference Between Predicted and Observed Cash-Out Values Per Question



The box plot shows that cash-out questions 6 and 9 were relatively accurate compared to the other questions, with the lowest medians of 22.7% and 24.4% of predicted cash-out values (respectively). Therefore, for questions 6 and 9 the predicted cash-out values were within 22.7% and 24.4% for half of respondents. Moreover, the lower quartiles for these questions were 15.5% and 19.3% (respectively) and so the predicted cash-out values were within 15.5% and 19.3% of observed cash-out values for a quarter of respondents. Conversely, the predicted cash-out values for questions 7 and 8 were inaccurate in comparison to the observed cash out values, with the box plot showing these questions to have medians of 52% and 68.2% respectively. This shows that for half of respondents, in questions 7 and 8 their predicted cash-out values were greater than 52% and 68.2% (respectively) different from their observed cash-out values.

It is unclear as to why the cash-out predictions for question 1 were relatively accurate, and the other questions not, but some speculation will be made. Question 1 had the lowest stake level (£10) and within the 3 questions at this stake, it had the median return with questions 1, 2 and 3 having payoffs of £36, £18 and £42 (respectively). Whilst the level of stake could be a factor which improved the accuracy of the cash-out values for question 1 in comparison to other questions, it would then be hard to explain the undershoot in cash-out predictions for question 3 which had the same stake and slightly higher return (£42). It could be the case that the predictions for question 1 were accurate due to the probability of the team winning which was presented in the question, as this was a factor which varied between questions. This was stated as 87.5% for question 1, and 85% in question 9, but the cash-out predictions for this question were significantly lower than the observed cash-out values. This undershoot could be attributed to the higher stake level in this question, but as there are multiple factors at play, it is difficult to pinpoint the probability of the team wining as the factor which made the calculated certainty equivalents relatively accurate compared to the observed cash-out values for this question.

A final factor to consider is the fact that question 1 was answered first by all respondents as the order of the club cash-out questions was not randomised. Therefore, respondents may have exercised more concentration and mental effort for question 1, making a more considered judgement of their cash-out value. This of course could have repercussions for the observed cash-out values, thus affecting the accuracy of cash-out values predictions. This I believe is the most likely reason for the accuracy of the cash-out value predictions for question 1, as factors such as the stake level, or the probability of the team winning were not unique to this question and yet the predicted cash-out values for other questions were not as accurate.

4.3 National Sentiment, Bettors and Students

This section is concerned with testing hypothesis 2 and 3 – whether national sentiment increases respondents' minimum required cash-out values for in-play sports bets, and if being a frequent bettor, or student, also increases cash-out values. In order to test for the presence of national sentiment in cash-out sports betting, a linear regression was conducted. From the original sample size of 128, the 6 respondents who denoted cash-out values equal to £0, or equal to the maximum return of each gamble were again excluded from the analysis. In addition to this, there were 4 respondents who did not have a preferred national football team and as a result they were also excluded – this left a full sample of 118 respondents.

Despite the previous exclusion of 13 respondents for their inconsistent certainty equivalent answers to stage 1 of the survey, these were not excluded from this part of the analysis as it was not evident that their denoted cash-out values had been affected. The football cash-out scenario question data had no clear outliers, presumably for the following two reasons. Firstly, the questions were contextual which I believe aided understanding (even for non-bettors) and also the questions stated the amount of money at stake, and the amount that the bet could return, thus clearly defining the boundaries for which a respondents' cash-out value should lie between.

All the cash-out values from the 118 respondents were pooled, and given each respondent provided 9 cash-out values for national football and 9 for club football, there were 2,124 total observations.

The dummy variables for bettors and students were also included to test whether being a bettor or a student increased respondents' cash-out values for the sports betting scenarios. The estimated linear regression took the following form:

$$Y_i = \beta_0 + \beta_1 national_i + \beta_2 bettor_i + \beta_3 student_i$$

Where Y_i is the dependent variable for the respondents cash-out value for each betting scenario, 'national' is a dummy variable (equalling 1 if the cash-out value is for a favourite national team, or 0 if from a club football team). This variable will show whether cash-out values are higher for respondents when they bet on their favourite national team in comparison to betting on a non-favourite club football team. The variable 'bettor' is another dummy (equalling 1 if the cash-out value if from a frequent bettor, or zero if it is from a non-bettor), this will show whether frequent bettors denote higher cash-out values than non-bettors. Finally, 'student' is the last dummy variable (equalling 1 if the cash-out value is from a student, or 0 for a non-student), to show whether there is a significant increase of student cash-out values in comparison to non-students. Table 3 show the results from this regression:

Table 3

Linear Regression Results

Dependent Variable: Cash-Out Value	Coefficient (Standard Error)	T-Statistic	P-Value
National	-0.38 (1.20)	-0.32	.750
Bettor	3.24 (1.22)	2.65	.008
Student	-0.57 (1.28)	-0.45	.656
Constant	48.14 (1.08)	44.38	≈ 0
N = 2,124			
Adjusted R-Squared = .0027			

As the table shows, the dummy variable 'bettor' has a coefficient of 3.24 and was significant at the 1% level. As a result, it can be inferred that on average, bettors' cash-out values were £3.24 higher in comparison to the cash-out values of non-bettors', *ceteris paribus*.

Aside from this, it should be noted that the other dummy variables, 'national' and 'student' both had negative (and insignificant) coefficients. This suggests that with in the sample, on average the cash-out values were actually lower for the national team questions (in comparison to the club football questions) and lower for students (in comparison to non-students), however both coefficients were insignificantly different from 0.

A second linear regression was conducted, identical to the prior, but with the inclusion of an interaction term between the dummy variables 'national' and 'bettor'. The purpose of which was to determine whether there were higher cash out-values for the national team questions compared to the club football questions for bettors in comparison to non-bettors. It would be reasonable to expect bettors' cash-out values to be more effected by national sentiment in comparison to non-bettors as they have betting experience and may be influenced by the thrill of betting on the national team that they support.

Table 4

Linear Regression Results With Interaction Term Between 'National' and 'Bettor' Variables

Dependent Variable: Cash-Out Value	Coefficient (Standard Error)	T-Statistic	P-Value
National	-0.71 (1.66)	-0.42	.671
Bettor	2.90 (1.72)	1.69	.092
Student	-0.57 (1.28)	-0.45	.656
National*Bettor	0.68 (2.41)	0.28	.779
Constant	48.31 (1.23)	39.38	≈ 0
N = 2,124			
Adjusted R-Squared = .0015			

This second linear regression showed that the effect of the interaction term between the dummy variables 'national' and 'bettor' was insignificantly different from zero. That is, the cash-out values denoted by frequent bettors were no higher for the national football questions (in comparison to the club football questions) than the cash-out values denoted non-bettors. It should also be noted that with the addition of this interaction term (in comparison to the first regression), on average, the increase of being a frequent bettor in comparison to a non-bettor is reduced to £2.90, *ceteris paribus*, now significant at the 10% level (previously significant at the 1%).

It was expected that the interaction term between the 'national' and 'bettor' variable would be significant, indicating that bettors are more influenced by national sentiment when cashing-out bets in comparison to non-bettors, however this is not the case. Despite this, both regression models do indicate that frequent bettors on average denote significantly higher cash-out values compared to non-bettors. In comparison to non-bettors, bettors must be influenced differently in order to denote higher cash-out values. This could be as a result of bettors deriving enjoyment from a bet being placed (albeit the sports betting scenarios were hypothetical. It could also be the case that bettors with experience have a greater understanding of how the cash-out feature works for bookmakers, and how they offer actuarily unfair cash-out values, thus causing bettors to denote higher minimum cash-out values to counteract this. This is an interesting finding, especially given that being a 'frequent bettor' was defined as just placing at least one sports bet per month. This was the only measure of whether a respondent had betting experience or not, but this opens up possibilities to explore whether cash-out values for sports betting scenarios increase with the frequency of sports betting in respondents.

5. Discussion

The main aims of this study were threefold. Firstly, respondents utility indifference points were elicited for which their utility functions were estimated, and these in turn were used alongside expected utility theory in an attempt to predict respondents' minimum cash-out values for different sports betting scenarios. Secondly, this research looked into the concept national sentiment, which is well researched in the field of sports betting, but yet to be applied to cash-out betting in particular. Finally, interest was also taken into whether being a frequent bettor, or a student, would have an effect on respondents' observed cash-out values.

5.1 Overview of Results

The key findings from the results were that when respondents' estimated utility curves were used with expected utility theory to calculate certainty equivalents for the sports betting scenarios, these were an accurate measure for respondents observed cash-out values in the first sports betting question, but the certainty equivalents were significantly different to the observed cash-out values for the other 8 questions. Despite this significant difference, respondents' certainty equivalents for the sports betting questions 6 and 9 were relatively accurate when compared to their observed cash-out values, but only for a proportion of respondents. Meanwhile respondents' cash-out values for questions 7 and 8 (both with a £50 stake) were poorly predicted by the calculated certainty equivalents for these sports gambles. In addition to this, national sentiment found to not significantly increase respondents' cash-out values. One promising finding was that those who indicated that they were frequent bettors required statistically higher cash-out values to consider cashing out a sports bet in relation to non-bettors, £3.24 average. However, students were found to denote cash-out values insignificantly different from non-students.

5.2 Utility Function Elicitation and Estimation

The first stage of the online survey posed 9 standard gamble questions to respondents in order to elicit indifference points between the values of £0 and £150. The survey was piloted by 2 respondents prior to distribution and one of these respondents provided feedback that these standard gamble questions were difficult to interpret. Due care was taken to simplify this stage of the survey given its importance in estimating respondents' utility curves, but it is clear that a large proportion of respondents also had issue with these questions. Appendix D shows the certainty equivalents denoted by the 13 respondents who were later excluded from the utility function estimation. The certainty equivalents denoted by these respondents highlights the lack of understanding of the first stage of the survey. Due to the fact that the standard gamble questions were presented with the probability of winning the prize (£150) increasing each time, by denoting certainty equivalents which decreased in value, respondents were violating monotonicity. During the construction of the survey, the use of a multiple price list[4] was considered as an alternative to the direct matching procedure which was used to elicit certainty equivalents from respondents. Albeit this may have aided respondents understanding of this stage of the survey, it was deemed to be too time consuming, especially given it would have been repeated for 9 questions. The use of a multiple price list in this stage of the survey would have been at the expense of the breadth of data collected on cash-out values in the latter part of the survey, as the survey was already nearly 10 minutes in length.

In addition to this, it was mentioned that the range of values which indifference points were elicited for were between the values of £0-£150, yet when the utility functions were employed to predict cash-out values, the values of -£10, -£20 and -£50 were used. This was a considered decision made prior to the distribution of the survey, but with the intent of making the standard gamble questions as simple as possible, it was decided to only elicit utility

[4] *See* Andersen et al., 2009 examples of multiple price lists in practice.

indifference points within the positive monetary value range. With the benefit of hindsight, I believe this was the correct decision as a result of the issues respondents had understanding this part of the survey – even just with positive values.

5.3 Expected Utility Theory and Cash-Out Value Prediction

A key takeaway from table 2 in the results is that the mean predicted cash out values were significantly different to the mean observed values for 8 of 9 cash-out scenarios, and in each case, the predicted mean was lower than the observed mean. This at least shows some consistency of respondents' estimated utility functions and expected utility theory to under predict cash-out values. Of these 8 questions however, there were differences in the proximity of the certainty equivalents to respondents' observed cash-out values. For example, as mentioned in the results section, the certainty equivalents for questions 6 and 9 were relatively accurate compared to the observed cash-out values, but they were relatively inaccurate for questions 7 and 8. The consistent undershoot of the mean certainty equivalents for questions 2 to 8 could be related to the fact that when respondents are placed in a sports betting scenario, they derive some enjoyment from placing the bet itself.

Both Fishburn (1980) and Conlisk (1993) advocated for the extension of the expected utility model in application to gambling, whereby there is an additional component to represent the utility derived for participating in gambling. This 'utility of gambling' is included when comparing a risky prospect to a riskless alternative and can be used to explain the behaviour of individuals who partake in very small gambles (Sauer, 1998). A similar approach is taken by Diecidue et al. (2004) where a term is added to an expected utility model for the utility lost in the absence of gambling. This links to the scenarios of cash-out betting where the decision made by an individual when cashing-out a bet involves a risky prospect (the bet) versus the cash-out value of the bet (riskless alternative).

It appears there would be the foundation to add this utility of gambling into the cash-out prediction, which would help to bridge the stark gap between the predicted and observed cash-out values in this study. With specific reference to cash-out/in-play betting, Lopez-Gonzalez et al. (2020, p.17) conclude that this betting format causes bettors to be more impulsive, when there is "high emotional involvement" – most commonly experienced with bettors watching (and betting on) live sport. This provides support for the utility derived from gambling itself and provides rationale for the gap between the predicted and observed cash-out values[5].

It may be argued that a different descriptive model should have been used to calculate respondents' certainty equivalents for the sports gambles in order to 'predict' their cash-out values more accurately. Harrison and Rustöm (2009, p.134) have described expected utility theory and prospect theory as "two front runners" in a metaphorical horse race for theories explaining choice under risk and uncertainty. The basic tenets of prospect theory (Kahnemann & Tversky, 1979) involve a value function whereby gains and losses are defined relative to a reference point, with the function mostly concave for gains and convex for losses, whilst also being steeper for losses in comparison to gains. Another important aspect of prospect theory is the transformation of probabilities into decision weights. Tversky and Kahnemann (1992) proposed an 'inverse S-shaped' one-parameter weighting function for which their experimental data supported the qualitative properties of. Associated with this is that decision weights are often lower than stated probabilities, apart from low probabilities which are overweighted. With these precepts of prospect theory briefly explained, they will be applied to the certainty

[5] A short, informal tangent to this point regards the behaviour of bettors when watching sporting events that do not interest them. Bettors have been known to bet on these events with the purpose of making them interesting by seeking the thrill of winning money.

equivalents calculated using expected utility in this study, and the deviation of these from respondents' observed cash-out values.

With respect to the calculation of respondents' certainty equivalents (predicted cash-out) for the sports gamble scenarios using their estimated utility curves and expected utility theory, as mentioned for 8 of the 9 scenarios, the mean certainty equivalent undershot the observed cash-out values. Within these 8 scenarios, the probability of winning the bet stated in the sports gamble scenario ranged between 50-85%, and the probability of losing these bets between 15-50%. If the proposed 'inverse S-shaped' weighting function was applied to calculate the certainty equivalents for the sports gamble scenarios, I do not believe it would improve upon expected utility theory by bridging the gap between the predicted cash-out and observed cash-out values. The transformation of the probabilities of the gambles into decision weights would in most cases result in the overweighting of the lower probabilities (the chance of losing the bet) and underweighting of the higher probabilities (the chance of winning the best). When paired with a value function which is concave for gains and convex for losses, whilst also being steeper for losses than gains, I believe this would actually increase the undershoot of the calculated certainty equivalents (predicted cash-out values) from the observed cash-out values, hence not improving on the predictions made using expected utility theory. Of course, this is based on the assumption of all individuals having an 'inverse S-shaped' weighting function, and a value function which is steeper for losses than gains, whereas these value and weighting functions would differ between individuals. The difficulty therein lies in the estimation of these two separate functions. Tversky and Kahnemann (1992, p.311) note that "if the functions associated with the theory are not constrained, the number of estimated parameters is too large". As a result, a parametric form must be assumed for both the value function and the weighting function, which then only tests the theory to the extent of these assumptions. As such the estimation of a complex theory like prospect theory is challenging and limited to the assumed specification of the value and weighting functions.

5.4 National Sentiment

It was expected that national sentiment would have an upward bias on bettors' perceptions of their national team winning a game and hence they would require a higher minimum cash-out value for the given football betting scenarios. In reality, there was no significant difference between the cash-out values for club football and national football, hence defying expectations. It is difficult to establish a benchmark for the expected effect of national sentiment on cash-out values due to the fact that this is the first known study to apply national sentiment to cash-out betting. Previous studies (Dare & Macdonald, 1996; Kuypers, 2000; Levitt, 2004; Forrest & Simmons, 2008; Franck et al., 2011; Feddersen et al., 2016) have researched sentiment within betting markets and the effect is has on increasing the volume of betting on a particular team. However, these studies are all also more focused on the response of the bookmaker to these unexpected changes in betting volume, so whilst they confirm the presence of sentiment betting, they provide little insight for the effect of sentiment on cash-out values[6].

Aside from this, it is still surprising that there was no presence of national sentiment in cash-out markets. Research by both Babad and Katz (1999) and Braun and Kvasnicka (2013) suggests that bettors overrate the chance of their favourite team winning a game, therefore in betting terms, one would expect a bettor to cash-out for a higher value to reflect this overrated subjective probability of a team winning. Perhaps more could have been done within the survey to evoke respondents' feeling of national sentiment. Respondents were merely asked to denote the national team that they support, a very simple question which takes little thought. In future research, respondents could be shown images of their national team playing sport or asked to

[6] Especially given that cash-out and in-play markets are a relatively new concept.

think of memories of their national team winning a match, both of which may evoke more national sentiment from respondents. For example, Babad and Katz (1999) found evidence for the effect of sentiment for a supports favourite football team, but their methodology involved surveying attendees of football matches, thus likely encouraging these feelings of sentiment. It is clearly difficult to create a very powerful feeling of national sentiment through an online survey, but it would be an interesting line of enquiry to see if national sentiment is present in cash-out values when additional questions are asked to evoke this emotion.

5.5 Bettor and Non-Bettor Behaviour

An interesting finding from the results was that the mean cash-out values for bettors were on average £3.24 higher than the values denoted by non-bettors. There could be a culmination of factors which result in bettors 'cashing-out' for higher values than non-bettors, the most important of which will be mentioned now.

Firstly, the fact that bettors require higher cash-outs than non-bettors may provide supporting evidence for the utility of gambling in the market. When faced with a bet and with knowledge of the potential returns from the bet, a bettor may also lose out on the thrill of gambling by terminating the bet early. Albeit they secure themselves a guaranteed monetary payoff, as seen in Fishburn (1980), Conlisk (1993) or Diecidue (2004), these gamblers may lose utility from not having a bet placed. Therefore, they require a minimum higher cash-out value to terminate a bet, because there is another aspect to the bet than just the stake and returns, they value the bet as a source of enjoyment.

Secondly, in comparison to non-bettors, bettors may be more aware of how the concept of cash-out works, and why bookmakers introduced it, hence making them wary of the facility to cash-out. In short, it is common knowledge for bettors than the bookmakers price the odds of events with a margin so that it is a profitable practice for them. The cash-out markets are priced in the same manner, with a margin built-in, and so bettors may know that cashing-out benefits the bookmakers and also reduces the payoff for the bettor. The outliers in the data set (those who gave cash out values equal to zero, or equal to the maximum return for every question) were denoted by those who suggested they would never cash-out a bet. This is a fixed rule which could be motivated by past experience as a result of cashing-out a bet too early and missing out on the full payoff. In the same vein, it could be argued that cashing-out a winning bet can feel like a like conceding to the bookmaker, as the bettor misses out on their full payoff, saving the bookmaker money. For some bettors, refusing to cash-out a bet once it has been placed is just a personal rule, but for others it may be the case that they know they are losing value to the bookmaker as soon as they cash out their bet.

This in turn holds some practical implications for bookmakers in terms of the cash-out values that they offer to bettors. For simplicity, assume that a bookmaker classes all new online customers as previous non-bettors. With the knoweldege that non-bettors systematically cash-out their bets for lower values than bettors, they could implement a blanket rule whereby bookmakers in turn systematically reduce the cash-out offers to new online bettors. The implication of which should in theory increase the margin they make, by closing the gap between the cash-out value they offer, and a bettors minimum cash-out value for a given sports bet. This of course is over-simplified, but the general concept has substance. At a more granular level, if a suitable model for the prediction of individuals' minimum cash-out values was found, this would be of even more use for bookmakers, and they could offer different cash-out values on bettor-by-bettor basis. The legality of such a system is unclear, and although it may be less likely to be used on mainstream bets, due to the high level of customisation that can be applied to a bet nowadays, cash-out values could be tailored to unique bets which have been placed.

A final aspect to note is that the cash-out scenarios presented in the online survey were constructed purely with the survey in mind. In order to construct the cash-out scenarios as gambles, the half-time odds of each game were transformed into implied probabilities so that respondents had accurate information for the likelihood of the outcomes of the football match. In practice, when a bettor is faced with the decision to cash-out a bet, the information they receive is slightly different to the scenarios shown to respondents in the survey. Whilst in real life a bettor could take the time to calculate these implied probabilities, when most cash-out decisions are made in a very short time frame due to the fast-changing nature of a football match, they are more likely to rely on 'gut instinct' or their subjective evaluation of the outcomes of the match. As a result, although the cash-out scenarios were a good recreation of a bettors actual cash-out decision, they were not completely representative of the cash-out market. The inclusion of probabilities may well have affected the cash-out values denoted by respondents, presumably by reducing the variance of cash-out values as the probability of winning and losing was well defined. As mentioned, in real life this would not be the case and so the bettors' subjective probabilities of a team winning or losing may vary significantly, thus altering the amount they would be willing to cash-out a bet for. This is of particular relevance for the measurement of national sentiment in cash-out betting, the effect of which is to bias a bettors' subjective probability of their team winning a game (Babad & Katz, 1999; Braun and Kvasnicka, 2013). This may be the case when the probabilities are not clear for bettors, but in the case of the survey cash-out scenarios, this national sentiment effect may have been lessened due to the presentation of probabilities.

5.6 Suggestions for future research

Some suggestions for future research have been offered throughout this study, but I will conclude this section with a final remark. In order to truly understand bettor cash-out behaviour for club and national football, or even for different sports for that matter, access to cash-out data from a bookmaker would be of great use. Three large UK bookmakers (Betfair, Paddy Power and Kwiff) were approached prior to this study with the attempt of using their cash-out data, but naturally were very protective of this information. Using actual data as such may reveal findings which are not present within the hypothetical cash-out scenarios analysed within this study.

If this study was conducted using real life sports betting scenarios, and hence real incentives, the results could differ. This is particularly relevant to the sports betting cash-out scenarios as the questions had 3 varying stake levels, £10, £20 and £50. Holt and Laury (2002) found that in hypothetical scenarios, subjects' risk attitudes do not change significantly across stake levels, but with real payoffs, risk aversion increase as stake levels increase by factors of 20, 50 and 90. Kachelmeier and Shehata's (1992) also found that when using real monetary payoffs, subjects became less risk seeking when prize levels were increased 10 fold, but found no such difference when using hypothetical payoffs. Whilst the stake levels in this study did not increase by such a high factor as in Holt and Laury (2002), the highest payoff in the sports betting scenarios was over 8 times greater than the lowest, and so it could be the case that with real monetary payoffs subjects may become less risk seeking.

In addition to this, the hypothetical sports betting scenarios presented in the survey of this study are likely to be absent of the thrill that bettors receive from real life gambling. Whilst the scenarios where designed to imitate cash-out scenarios, they do not replicate the scenario of placing a sports bet and then preceding to watch the game that the bet was placed on, whereby the bettor derive a thrill if their bet was winning, or perhaps distain if their bet were losing. These emotions could be factors which effect an individuals' willingness to cash-out a bet, but they are impossible to replicate in a hypothetical setting.

In order to reduce the impact of the experiments hypothetical nature, I believe a natural experiment would be best suited in order to truly understand individuals' cash-out behaviour. This would require the access to the cash-out betting data of a current bookmaker, which as mentioned, is not an easy feat. Nevertheless, this would be an ideal solution to the flaw of using hypothetical scenarios.

Alternatively, this study could be replicated with a much smaller sample, but with a more in-depth approach to the measurement of respondents' utility of money. This would be aided by in-person interviews which would provide clarity as to whether respondents understand the utility elicitation exercise, a factor which proved an issue with the online survey.

6. Conclusion

Cash-out betting is a fascinating research topic and yet the existing literature does not do it justice. The most notable finding from this study is the fact that bettors systematically denote higher minimum cash-out values than non-bettors. The arguments for this difference are speculation but include the fact that frequent bettors have more of an attachment to sports games and therefore derive utility from betting on matches, increasing their minimum cash-out values. Bettors may also be driven by the fact that they envisage betting as a battle against the bookmaker, hence making them more stubborn in holding out for a higher cash-out value. Regardless of the reasons for the difference, within the data set it was significant, and so this also holds practical implications for bookmakers.

A further finding was that the certainty equivalents calculated for respondents' using their estimated utility functions in conjunction with expected utility theory were consistently lower than their observed cash-out values. This finding invites further research into a model suitable for the prediction of individuals' cash-out values for sports betting scenarios. In relation to the practical implications, bookmakers can use the insight of bettors having higher cash-out values to their benefit. They could employ a strategy of discriminating between frequent bettors and new bettors (assumed non-bettors) and offer different cash-out values accordingly, or potentially even offering different cash-out values on an individual level. Both of these implications revolve around customising cash-out values to a particular bettor, or group of bettors, hence allowing bookmakers to increase the margin they make on cashed-out bets.

Aside from this, national sentiment was found to have no significant effect on respondents' denoted cash-out values and therefore no resulting implications could be offered. However, suggestions were made with regard to how feelings of national sentiment could be evoked from respondents, as it was believed that the setting of an online survey was insufficient to provoke an emotional response.

This study has laid a foundation for which improvements can be made on the methodology, but it does have promising findings which should be pursued in more depth.

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Appendices

Appendix A

Standard Gamble Questions To Elicit Certainty Equivalents

1) You are faced with a lottery which has a 10% chance of winning £150 and 90% of winning £0. Please state the minimum fixed prize for which you would prefer over playing the lottery.

2) You are faced with a lottery which has a 20% chance of winning £150 and 80% of winning £0. Please state the minimum fixed prize for which you would prefer over playing the lottery.

3) You are faced with a lottery which has a 30% chance of winning £150 and 70% of winning £0. Please state the minimum fixed prize for which you would prefer over playing the lottery.

4) You are faced with a lottery which has a 40% chance of winning £150 and 60% of winning £0. Please state the minimum fixed prize for which you would prefer over playing the lottery.

5) You are faced with a lottery which has a 50% chance of winning £150 and 50% of winning £0. Please state the minimum fixed prize for which you would prefer over playing the lottery.

6) You are faced with a lottery which has a 60% chance of winning £150 and 40% of winning £0. Please state the minimum fixed prize for which you would prefer over playing the lottery.

7) You are faced with a lottery which has a 70% chance of winning £150 and 30% of winning £0. Please state the minimum fixed prize for which you would prefer over playing the lottery.

8) You are faced with a lottery which has an 80% chance of winning £150 and 20% of winning £0. Please state the minimum fixed prize for which you would prefer over playing the lottery.

9) You are faced with a lottery which has a 10% chance of winning £150 and 10% of winning £0. Please state the minimum fixed prize for which you would prefer over playing the lottery.

Appendix B

Club and National Football Cash-out Questions

Club Football

1) You placed a **£10** bet on Freiburg to beat FC Koln at odds of **13/5 (£10 returns £36)**. At half time, the score is 2-0 to Freiburg. The HT odds suggest that Freiburg have an **87.5%** chance of winning the game. What is the minimum amount you would cash your bet out for?

2) You placed a **£10** bet on Angers SCO to beat Dijon FCO at odds of **4/5 (£10 returns £18)**. At half time, the score is 1-0 to Angers SCO. The HT odds suggest that Angers SCO have an **75%** chance of winning the game. What is the minimum amount you would cash your bet out for?

3) You placed a **£10** bet on Mainz to beat Eintracht Frankfurt at odds of **16/5 (£10 returns £42)**. At half time, the score is 1-0 to Mainz. The HT odds suggest that Mainz have an **50%** chance of winning the game. What is the minimum amount you would cash your bet out for?

4) You placed a **£20** bet on Sassuolo to beat Genoa at odds of **23/20 (£20 returns £43)**. At half time, the score is 1-0 to Sassuolo. The HT odds suggest that Sassuolo have an **70%** chance of winning the game. What is the minimum amount you would cash your bet out for?

5) You placed a **£20** bet on Levante to beat Deportivo Alaves at odds of **5/2 (£20 returns £70)**. At half time, the score is 2-1 to Levante. The HT odds suggest that Levante have an **60%** chance of winning the game. What is the minimum amount you would cash your bet out for?

6) You placed a **£20** bet on Celta Vigo to beat Villareal at odds of **13/5 (£20 returns £72)**. At half time, the score is 3-1 to Celta Vigo. The HT odds suggest that Freiburg have an **75%** chance of winning the game. What is the minimum amount you would cash your bet out for?

7) You placed a **£50** bet on Valencia to beat Valladoid at odds of **21/20 (£50 returns £102.50)**. At half time, the score is 1-0 to Valencia. The HT odds suggest that Valencia have an **67%** chance of winning the game. What is the minimum amount you would cash your bet out for?

8) You placed a **£50** bet on Brest to beat Nice at odds of **2/1 (£50 returns £150)**. At half time, the score is 2-1 to Brest. The HT odds suggest that Brest have an **55%** chance of winning the game. What is the minimum amount you would cash your bet out for?

9) You placed a **£50** bet on Hertha Berlin to beat Freiburg at odds of **1/1 (£50 returns £100)**. At half time, the score is 2-0 to Hertha Berlin. The HT odds suggest that Hertha Berlin have an **85%** chance of winning the game. What is the minimum amount you would cash your bet out for?

National Football

1) You placed a **£10** bet on England to beat Croatia at odds of **4/5 (£10 returns £18)**. At half time, the score is 1-0 to England. The HT odds suggest that England have an **75%** chance of winning the game. What is the minimum amount you would cash your bet out for?

2) You placed a **£10** bet on England to beat Belgium at odds of **13/5 (£10 returns £36).** At half time, the score is 2-0 to England. The HT odds suggest that England have an **87.5%** chance of winning the game. What is the minimum amount you would cash your bet out for?

3) You placed a **£10** bet on England to beat France at odds of **16/5 (£10 returns £42)**. At half time, the score is 1-0 to England. The HT odds suggest that England have an **50%** chance of winning the game. What is the minimum amount you would cash your bet out for?

4) You placed a **£20** bet on England to beat Portugal at odds of **5/2 (£20 returns £70).** At half time, the score is 2-1 to England. The HT odds suggest that England have an **60%** chance of winning the game. What is the minimum amount you would cash your bet out for?

5) You placed a **£20** bet on England to beat Italy at odds of **23/20 (£20 returns £43)**. At half time, the score is 1-0 to England. The HT odds suggest that England have an **70%** chance of winning the game. What is the minimum amount you would cash your bet out for?

6) You placed a **£20** bet on England to beat Spain at odds of **13/5 (£20 returns £72).** At half time, the score is 2-1 to England. The HT odds suggest that England have an **75%** chance of winning the game. What is the minimum amount you would cash your bet out for?

7) You placed a **£50** bet on England to beat Germany at odds of **2/1 (£50 returns £150)**. At half time, the score is 2-1 to England. The HT odds suggest that England have an **55%** chance of winning the game. What is the minimum amount you would cash your bet out for?

8) You placed a **£50** bet on England to beat Sweden at odds of **21/20 (£50 returns £102.50)**. At half time, the score is 1-0 to England. The HT odds suggest that England have an **67%** chance of winning the game. What is the minimum amount you would cash your bet out for?

9) You placed a **£50** bet on England to beat Denmark at odds of **1/1 (£50 returns £100).** At half time, the score is 2-0 to England. The HT odds suggest that England have an **85%** chance of winning the game. What is the minimum amount you would cash your bet out for?

Appendix C

Table C1

Non-linear Least Squares CARA Utility Function 'a' Parameter Estimates (N=109)

Respondent	'a' Parameter Coefficient (Standard Error)	P-value	Respondent	'a' Parameter Coefficient (Standard Error)	P-value
2	0.012* (0.002)	p ≈ 0	68	0.005 (0.006)	p = 0.437
3	0.01* (0.001)	p ≈ 0	69	0.004* (0.001)	p = .001
4	0.011* (0.001)	p ≈ 0	70	0.007* (0.001)	p ≈ 0
5	0.006* (0)	p ≈ 0	73	0.013* (0.003)	p = .002
6	0.009* (0.001)	p ≈ 0	75	0.006* (0.001)	p ≈ 0
7	0.007* (0.001)	p ≈ 0	76	0.007* (0.001)	p ≈ 0
8	0.009* (0.001)	p ≈ 0	77	0.007* (0.001)	p ≈ 0
9	0.01* (0.002)	p = .001	78	0.011* (0.001)	p ≈ 0
10	0.007* (0.001)	p ≈ 0	79	0.007* (0.001)	p ≈ 0
11	0.007* (0.001)	p ≈ 0	80	0.008* (0.002)	p = .001
13	0.014* (0.003)	p = 0.001	81	0.006* (0.001)	p = .001
14	0.009* (0.002)	p = 0.001	82	0.012* (0.002)	p ≈ 0
16	0.007* (0.001)	p ≈ 0	83	0.007* (0.001)	p ≈ 0
17	0.004 (0.005)	p = .403	84	0.004 (0.005)	p = .394
18	0.007* (0.001)	p ≈ 0	85	0.007* (0.001)	p ≈ 0
19	0.008* (0.001)	p ≈ 0	86	0.006* (0.001)	p ≈ 0
20	0.007* (0.001)	p ≈ 0	88	0.005* (0.002)	p = .01
22	0.009* (0.001)	p ≈ 0	89	0.005 (0.005)	p = .419
23	0.011* (0.002)	p ≈ 0	90	0.009* (0.001)	p ≈ 0

24	0.007* (0.001)	p ≈ 0	91	0.007* (0.001)	p ≈ 0
25	0.009* (0.001)	p ≈ 0	92	0.009* (0.002)	p = .002
27	0.007* (0.001)	p ≈ 0	93	0.008* (0.001)	p ≈ 0
28	0.007* (0.001)	p ≈ 0	94	0.005 (0.005)	p = .401
29	0.005* (0.001)	p ≈ 0	95	0.003 (0.002)	p = .183
30	0.014* (0.003)	p = .001	96	0.007* (0.001)	p ≈ 0
31	0.004 (0.002)	p = .107	97	0.005* (0.001)	p ≈ 0
32	0.006* (0.001)	p ≈ 0	98	0.006 (0.007)	p = .463
33	0.006* (0.001)	p ≈ 0	100	0.009* (0.001)	p ≈ 0
34	0.006* (0)	p ≈ 0	101	0.005* (0.001)	p ≈ 0
35	0.006* (0.001)	p ≈ 0	102	0.004 (0.005)	p = .43
36	0.003 (0.002)	p = .187	103	0.009* (0.001)	p ≈ 0
37	0.006 (0.007)	p = .046	104	0.008* (0.001)	p ≈ 0
38	0.007* (0.001)	p ≈ 0	105	0.009* (0.002)	p = .003
39	0.006* (0.001)	p ≈ 0	106	0.005 (0.006)	p = .437
41	0.009* (0.001)	p ≈ 0	107	0.004* (0.001)	p = .001
43	0.006* (0.001)	p ≈ 0	108	0.006* (0)	p ≈ 0
44	0.011* (0.002)	p ≈ 0	109	0.004 (0.002)	p = .044
45	0.003 (0.002)	p = .108	110	0.004 (0.002)	p = .063
46	0.007* (0.001)	p ≈ 0	111	0.005* (0)	p ≈ 0
47	0.007* (0.001)	p ≈ 0	112	0.003 (0.002)	p = .084
48	0.008* (0.002)	p ≈ 0	113	0.007* (0.001)	p ≈ 0
50	0.004 (0.005)	p = .43	114	0.006* (0.001)	p ≈ 0
51	0.013 (0.003)	p = .001	115	0.003 (0.002)	p = .063

52	0.005* (0.001)	p ≈ 0	117	0.007* (0.002)	p = .005
53	0.009* (0.001)	p ≈ 0	118	0.004* (0.001)	p = .008
54	0.013* (0.003)	p = .001	119	0.007* (0.001)	p ≈ 0
56	0.008* (0.001)	p ≈ 0	120	0.008* (0.001)	p ≈ 0
58	0.007* (0.001)	p ≈ 0	122	0.008* (0.001)	p ≈ 0
59	0.004* (0.001)	p = .003	123	0.004 (0.003)	p = .116
60	0.004 (0.002)	p = .105	124	0.007* (0.001)	p ≈ 0
61	0.006* (0.001)	p ≈ 0	125	0.007* (0.001)	p ≈ 0
63	0.008* (0.001)	p ≈ 0	126	0.007* (0.001)	p ≈ 0
65	0.006* (0.001)	p ≈ 0	127	0.006* (0)	p ≈ 0
66	0.006* (0.001)	p ≈ 0	128	0.011* (0.002)	p ≈ 0
67	0.005* (0.002)	p = .014			

Note: all numbers are rounded to 3 decimal places. * denotes significance at the 5% level.

Appendix D

Table D1

Certainty Equivalents Denoted to the Standard Gamble Questions (Appendix A) For the Respondents Excluded from Cash-out Prediction

	Certainty Equivalents Denoted For Standard Gamble Questions								
Respondent	CE(1)	CE(2)	CE(3)	CE(4)	CE(5)	CE(6)	CE(7)	CE(8)	CE(9)
12	0	20	40	40	70	60	50	60	45
15	20	30	50	30	60	100	120	130	150
21	10	5	5	40	50	80	110	120	130
26	100	75	50	50	75	100	100	125	125
40	140	130	120	120	100	100	100	80	50
42	15	10	5	30	60	80	90	100	110
49	10	20	30	10	0	0	70	90	100
55	50	50	50	30	100	100	100	100	100
64	150	150	150	90	75	60	150	150	150
72	100	75	100	100	100	100	100	100	100
74	100	70	60	55	50	40	100	60	30
87	20	15	15	15	10	10	10	5	1
116	150	130	120	100	75	70	150	150	150
121	140	130	120	100	75	60	50	50	50

Note: the headings CE(1-9) refer to respondents elicited certainty equivalents for the following 9 standard gamble questions.

CE(1): (10%: £150, 90%: £0)
CE(2): (20%: £150, 80%: £0)
CE(3): (30%: £150, 70%: £0)
CE(4): (40%: £150, 60%: £0)
CE(5): (50%: £150, 50%: £0)
CE(6): (60%: £150, 40%: £0)
CE(7): (70%: £150, 30%: £0)
CE(8): (80%: £150, 20%: £0)
CE(9): (90%: £150, 10%: £0)

Appendix E

Table E1

Respondents' Certainty Equivalents/Predicted Cash-out Values (£): Questions 1-9

	Cash-Out Question								
Respondent	1	2	3	4	5	6	7	8	9
2	28.69	10.08	12.07	18.76	22.22	38.17	19.37	8.35	53.47
3	28.96	10.23	12.67	19.64	24.04	40.01	24.35	14.65	58.05
4	28.84	10.17	12.39	19.25	23.21	39.18	22.06	11.69	56.00
5	29.56	10.58	14.11	21.66	28.43	44.19	36.74	32.65	67.82
6	29.07	10.30	12.92	20.01	24.81	40.78	26.50	17.52	59.90
7	29.34	10.45	13.57	20.92	26.78	42.67	32.05	25.43	64.37
8	29.09	10.31	12.96	20.07	24.95	40.91	26.88	18.04	60.22
9	28.88	10.19	12.50	19.40	23.54	39.51	22.96	12.84	56.81
10	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
11	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
13	28.42	9.94	11.51	17.94	20.56	36.42	14.95	3.18	49.05
14	29.07	10.30	12.93	20.02	24.85	40.81	26.61	17.67	59.99
16	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
17	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
18	29.33	10.44	13.54	20.88	26.70	42.59	31.82	25.08	64.19
19	29.24	10.39	13.32	20.57	26.02	41.95	29.92	22.30	62.70
20	29.39	10.48	13.69	21.08	27.13	43.00	33.06	26.94	65.13
22	29.14	10.33	13.08	20.23	25.30	41.25	27.87	19.41	61.05
23	28.86	10.18	12.44	19.31	23.36	39.33	22.46	12.19	56.36
24	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
25	29.09	10.31	12.96	20.06	24.93	40.89	26.84	17.98	60.19
27	29.32	10.44	13.51	20.84	26.60	42.50	31.55	24.68	63.98
28	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
29	29.67	10.64	14.39	22.04	29.27	44.95	39.13	36.55	69.48
30	28.28	9.87	11.23	17.50	19.71	35.50	12.74	0.73	46.71
31	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
32	29.45	10.51	13.84	21.29	27.61	43.44	34.41	28.99	66.14
33	29.51	10.55	14.00	21.51	28.09	43.88	35.77	31.11	67.13
34	29.49	10.54	13.93	21.42	27.88	43.69	35.18	30.18	66.70
35	29.52	10.55	14.01	21.52	28.11	43.90	35.84	31.23	67.18
36	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00

37	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
38	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
39	29.46	10.52	13.87	21.33	27.70	43.52	34.66	29.38	66.32
41	29.12	10.32	13.04	20.17	25.16	41.12	27.49	18.87	60.73
43	29.53	10.56	14.03	21.55	28.17	43.96	36.01	31.50	67.30
44	28.86	10.18	12.46	19.34	23.40	39.37	22.58	12.35	56.47
45	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
46	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
47	29.32	10.44	13.53	20.86	26.66	42.56	31.73	24.94	64.12
48	29.26	10.41	13.38	20.66	26.21	42.13	30.44	23.06	63.12
50	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
51	28.56	10.02	11.80	18.37	21.43	37.34	17.23	5.80	51.37
52	29.58	10.59	14.17	21.73	28.59	44.34	37.19	33.38	68.14
53	29.10	10.31	13.00	20.12	25.05	41.01	27.17	18.44	60.46
54	28.58	10.03	11.84	18.43	21.56	37.47	17.57	6.21	51.72
56	29.25	10.40	13.35	20.62	26.13	42.05	30.21	22.72	62.93
58	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
59	29.76	10.70	14.63	22.36	29.98	45.59	41.15	39.94	70.83
60	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
61	29.45	10.51	13.83	21.28	27.57	43.40	34.30	28.82	66.05
63	29.19	10.36	13.20	20.40	25.65	41.59	28.86	20.79	61.85
65	29.52	10.55	14.00	21.51	28.10	43.89	35.80	31.16	67.15
66	29.50	10.55	13.97	21.47	28.01	43.81	35.54	30.76	66.96
67	29.64	10.63	14.32	21.94	29.06	44.76	38.52	35.54	69.06
68	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
69	29.73	10.68	14.56	22.27	29.78	45.41	40.58	38.96	70.45
70	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
73	28.50	9.99	11.68	18.19	21.06	36.95	16.25	4.66	50.39
75	29.49	10.54	13.93	21.42	27.88	43.69	35.19	30.20	66.71
76	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
77	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
78	28.80	10.15	12.32	19.13	22.98	38.95	21.43	10.89	55.41
79	29.34	10.45	13.56	20.91	26.77	42.66	32.02	25.38	64.35
80	29.21	10.38	13.25	20.47	25.82	41.75	29.33	21.46	62.23
81	29.45	10.51	13.84	21.29	27.61	43.44	34.41	28.99	66.13
82	28.66	10.07	12.00	18.67	22.02	37.96	18.83	7.70	52.95
83	29.31	10.44	13.51	20.83	26.59	42.49	31.52	24.63	63.95
84	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
85	29.39	10.48	13.70	21.10	27.17	43.03	33.16	27.09	65.21
86	29.45	10.52	13.85	21.30	27.63	43.46	34.46	29.08	66.18
88	29.62	10.61	14.27	21.88	28.91	44.63	38.10	34.85	68.77

89	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
90	29.16	10.35	13.14	20.31	25.47	41.41	28.34	20.06	61.43
91	29.41	10.49	13.75	21.16	27.32	43.17	33.59	27.73	65.53
92	29.04	10.28	12.86	19.92	24.64	40.60	26.01	16.86	59.48
93	29.21	10.38	13.25	20.48	25.82	41.76	29.34	21.48	62.24
94	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
95	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
96	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
97	29.66	10.64	14.38	22.02	29.23	44.92	39.03	36.38	69.41
98	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
100	29.04	10.28	12.86	19.93	24.64	40.61	26.02	16.87	59.49
101	29.60	10.60	14.21	21.79	28.71	44.45	37.55	33.95	68.39
102	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
103	29.09	10.31	12.98	20.09	25.00	40.96	27.03	18.24	60.35
104	29.21	10.37	13.25	20.47	25.81	41.74	29.31	21.43	62.22
105	29.05	10.29	12.88	19.95	24.70	40.66	26.18	17.08	59.63
106	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
107	29.79	10.71	14.71	22.46	30.21	45.79	41.79	41.02	71.24
108	29.51	10.55	13.98	21.48	28.03	43.83	35.61	30.86	67.01
109	29.81	10.72	14.76	22.52	30.35	45.91	42.19	41.72	71.51
110	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120
111	29.67	10.64	14.39	22.03	29.26	44.94	39.10	36.49	69.45
112	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
113	29.39	10.48	13.69	21.09	27.16	43.02	33.12	27.03	65.18
114	29.56	10.58	14.12	21.68	28.46	44.22	36.83	32.81	67.89
115	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
117	29.43	10.50	13.80	21.23	27.47	43.31	34.01	28.39	65.85
118	29.79	10.72	14.72	22.48	30.26	45.83	41.92	41.26	71.33
119	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
120	29.19	10.37	13.21	20.42	25.69	41.63	28.97	20.94	61.94
122	29.19	10.37	13.22	20.42	25.71	41.65	29.03	21.03	61.99
123	30.25	11.00	16.00	24.10	34.00	49.00	52.18	60.00	120.00
124	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
125	29.34	10.45	13.57	20.92	26.78	42.67	32.06	25.43	64.37
126	29.36	10.46	13.61	20.98	26.91	42.79	32.43	25.98	64.65
127	29.48	10.53	13.92	21.40	27.84	43.66	35.08	30.04	66.63
128	28.82	10.16	12.37	19.21	23.14	39.10	21.85	11.43	55.80