THE ROLE OF ALGORITHMS AND ARTIFICIAL INTELLIGENCE IN MODERN SPORTS BETTING

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ABSTRACT

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THE ROLE OF ALGORITHMS AND ARTIFICIAL INTELLIGENCE IN MODERN SPORTS BETTING

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This bachelor's thesis analyses the gradual changes in the sports betting industry over the years. The focus is on highlighting the growing role of algorithms and artificial intelligence in sports betting. The study examines how these technologies have transformed betting systems and reshaped the experiences of both bettors and betting companies. The primary goal of the thesis is to evaluate which party primarily benefits from these technological advancements.

TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

LUT Teknis-luonnontieteellinen

Tietotekniikan koulutusohjelma

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ALGORITMIEN JA TEKOÄLYN ROOLI NYKYAJAN URHEILUVEDONLYÖNNISSÄ

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Tämä kandidaatintyö analysoi urheiluvedonlyöntialan muutoksia vuosien varrella. Työn painopiste on korostaa algoritmien ja tekoälyn kasvavaa roolia vedonlyönnissä. Tutkimuksessa tarkastellaan, miten nämä teknologiat ovat muuttaneet vedonlyöntijärjestelmiä ja muokanneet sekä vedonlyöjien että vedonlyöntiyhtiöiden kokemuksia. Lisäksi selvitetään, kumpi osapuoli on isompi hyötyjä näistä toimialan muutoksista.

SYMBOLS AND ABBREVIATIONS

AI	artificial intelligence
ML	machine learning
CNN	convolutional neural network
RNN	recurrent neural network
ASI	artificial swarm intelligence
NFL	National Football League
NLP	natural language processing
ITK	in the known
LightGBM	light gradient boosting machine
AdaBoost	adaptive boosting

TABLE OF CONTENTS

ABSTRACT
TIIVISTELMÄ
SYMBOLS AND ABBREVIATIONS

1 INTRODUCTION 5
1.1 Background 5
1.2 Objectives 6
2 DEVELOPMENT OF SPORTS BETTING 7
2.1 Sports betting 7
2.1.1 What is sports betting? 7
2.1.2 Sports betting before 7
2.2 AI and Algorithms 8
2.2.1 What are algorithms? 8
2.2.2 What is artificial intelligence? 8
2.2.3 AI and Algorithms in sports betting 8
2.3 Current state of sports betting 9
3 ANALYTICAL SPORTS BETTING 11
3.1 AI-driven sports betting 11
3.2 AI-driven betting 12
3.3 AI in risk management 13
3.4 Arbitrage betting 14
3.5 Insider betting 15
4 ANALYSIS 17
4.1 Industry disruption 17
4.1.1 Market efficiency 17
4.1.2 Betting fundamentals 18
4.2 Ethical dimensions 19
4.3 Summary 19
5 CONCLUSIONS 21
REFERENCES 22

1 INTRODUCTION

1.1 Background

Sports betting has existed for a long time, dating back to ancient civilizations where wagers were placed on competitions. For centuries, sports betting was based on human judgment. Bookmakers used their knowledge to set odds, while bettors trusted their instincts and a small sample size of statistics. This system created a market balance, often benefiting the bookmakers the most. [1]

In recent years, the betting industry was disrupted by computerised systems, which began to manage bet placement and tracking. Bookmakers started to employ statistics more systematically, and professional bettors developed increasingly sophisticated analytical frameworks. Despite these advancements, the industry continued to operate primarily on human judgment until recently.

The advancement of machine learning and the discovery of AI have made these technologies a central part of the sports betting ecosystem. Bookmakers leverage advanced systems through analysing vast amounts of data, trying to gain the edge. These systems create opportunities for bettors by developing advanced solvers to find line discrepancies in market odds.

These technological advancements also raise important questions about fairness, ethics, and market dynamics, as algorithms and AI take on a more dominant role in the betting industry. This shift challenges the balance between human judgment and automated systems, creating both opportunities and risks for all parties. This thesis explores the ramifications of these technologies on the industry, how they have reshaped the landscape of sports betting, and what this means for its future.

1.2 Objectives

The aim of this thesis is to explore the transformative impact of artificial intelligence (AI) and algorithms on the sports betting industry. The topic is narrowed down through the following research questions:

1) How have artificial intelligence and algorithms disrupted the sports betting industry?
2) Who benefits more from AI in sports betting: bettors or betting companies?
3) Is it possible to become profitable in sports betting?

The thesis begins with an introduction that presents the background behind the subject and opens the problem, followed by chapter two, which defines key terms such as sports betting, algorithms, and artificial intelligence, briefly covering their basics, how they interact, and the past and present state of the industry. Chapter three analyses these advanced models more in-depth from the perspectives of bettors and betting companies, examining how different strategies are utilised, their effectiveness, and how the other party can counter them. The last chapter analyses these findings and answers the research questions based on the results, followed by a sharp conclusion chapter that concludes the thesis.

2 DEVELOPMENT OF SPORTS BETTING

Section two goes into detail about sports betting and algorithms, exploring how they interact together. It analyses the current state of sports betting and how it has evolved recently. The Section also goes deeper into more advanced algorithms and how each party leverages them to make money.

2.1 Sports betting

2.1.1 What is sports betting?

Sports betting is a form of gambling, where individuals place wagers on specific actions to happen during a match. Bettors predict specific game results, and bookmakers set the odds, which determines the payout multiplier for a successful bet. The betting market is a speculative market, where contracts on some future cash flows are traded. Although the odds may change over time, the bettor's bet is tied to the initially taken odds.

2.1.2 Sports betting before

Before data analytics and modern technologies, sports betting relied mainly on manual processes and human expertise. Bookmakers set odds based on their personal expertise and rudimentary statistical records, if they were to have one accessible. These "experts" adjusted odds subjectively to balance the betting action, so maintaining a profit margin relied mostly on human instinct [1].

Bettors participated in sports betting by placing wagers through personal interactions with bookmakers, often in local settings across various regions. Generally, they relied on whatever information was at hand, which could be their own observations or basic public knowledge. This meant that the old fashion of sports betting was inherently uncertain, with outcomes shaped more by human judgement. Bettors faced risks not only from unpredictable

results but also from the possibility that bookmakers might not always honour large payouts, a challenge noted in early gambling practices [1].

2.2 AI and Algorithms

2.2.1 What are algorithms?

An algorithm is a step-by-step procedure that follows a defined set of rules to perform a task. In computing, algorithms process input data to generate an output. They are capable of handling large amounts of data, far beyond human capacity. In contrast to human intuition, algorithms operate solely on the given parameters and rules provided. [2]

2.2.2 What is artificial intelligence?

Artificial intelligence (AI) refers to advanced technologies designed to replicate human decision-making capabilities. In the context of sports betting, AI is commonly employed to automate processes, for example adjusting odds or analysing betting patterns. Machine learning (ML) is a subset of artificial intelligence, that is extensively examined in this thesis. ML involves algorithms that improve their predictive accuracy over time from data learning. For the purposes of this thesis, artificial intelligence is understood as encompassing broader technological systems, while machine learning specifically denotes data-driven models that enhance prediction and analysis. [3]

2.2.3 AI and Algorithms in sports betting

Algorithms play a crucial role in modern sports betting, particularly in the development of predictive models for match outcomes and the optimisation of betting odds. One of the most advanced applications of algorithms in sports betting is the use of machine learning models that analyse historical match data to predict future outcomes. Algorithms process the input data without emotions and biases, which is one of the main reasons bettors lose money

in the long term. Models assess key performance indicators to generate more accurate probability estimates [4].

The biggest challenge in developing these advanced models is deciding between accuracy and calibration. Some models prioritize accuracy, aiming to maximize correct predictions, while others focus on calibration to ensure that predicted probabilities align closely with actual outcomes. Studies have shown that balancing these two factors is essential for developing profitable betting strategies [5].

AI-driven betting strategies are also becoming increasingly popular from bettors' perspective. Software continuously scans the market for betting opportunities, with adjusted stakes, minimising human error in the process. A way bettors seek to take advantage is by using automated betting bots to identify arbitrage opportunities. Cases where bettors find odds discrepancies between different bookmakers, allowing bettors to place guaranteed profitable bets [6].

However, as artificial intelligence and machine learning become more dominant in sports betting, concerns about fairness and market manipulation have emerged. Bookmakers now use artificial intelligence to counteract professional bettors' strategies, adjusting odds dynamically to reduce potential losses. This has led to a constant battle between bettors and bookmakers, where both sides leverage advanced algorithms to gain an edge.

2.3 Current state of sports betting

The he sports betting industry is heavily reliant on data analytics and AI-driven algorithms nowadays. Betting companies utilise these advanced automated systems to maximise their operating margins. Modern algorithms can assess market trends in real-time, adjusting odds dynamically based on betting activity. This has resulted in a more competitive betting landscape, where bettors and bookmakers alike rely on artificial intelligence for decision-making [6]. One of the main advancements of artificial intelligence is the improvement in the accuracy of odds setting and betting predictions. Algorithms process large amounts of historical data, player performance metrics, and external factors to refine odds or identify profitable betting opportunities [5].

These technological changes have enabled betting platforms to expand their services online, making betting more accessible. However, online betting also presents vulnerabilities that can be exploited maliciously. Corporations use artificial intelligence for fraud detection and identifying suspicious betting patterns to prevent match-fixing and illegal gambling activities from occurring. Accounts are flagged based on abnormal behaviour, while algorithms determine whether the account has violated guidelines and restricting betting activities. [6]

3 ANALYTICAL SPORTS BETTING

Section three examines how and in what context machine learning models are utilised in betting by different parties. This part examines if algorithms are more accurate than human analysis and whether bettors have a possibility to become profitable in sports betting against betting companies.

3.1 AI-driven sports betting

Sports betting has changed significantly in recent years due to the development of artificial intelligence and algorithms. Algorithms react to market fluctuations almost immediately, which has created an even more dynamic betting environment. This has led to a really efficient odds setting, compared to previously set by human analysis. Faster odds calculation has made live betting markets more common, where odds change continuously throughout an ongoing match. [5]

Mandadapu's study [5] shows that machine learning models calculate odds far more accurately than humans predict. Based on the results, machine learning models achieved an accuracy of approximately 59% compared odds set by human expertise and basic statistics at around 51%. While humans can only handle a handful of variables in their analysis, machine learning applies numerous variables and incorporates context into odds formation. Humans also tend to let opinions and biases unconsciously negatively influence their decision making [5]. This computerised odds-setting has lead sports betting too be tougher for casual bettors.

Tammouch et al. [7] reinforce these findings in their study. They measure modern neural networks and deep learning techniques at predicting football match outcomes. Their study examined English Premier League data from the 2021-2022 season, focusing on predicting fixture outcomes using previous matches' statistics. They compared machine learning models convolutional neural networks (CNNs) and recurrent neural networks (RNNs)

against traditional statistical methods like logistic regression and Poisson models. The results showed that deep learning models, particularly CNN achieved around 60-65% accuracy in correctly predicting match outcomes, compared to the traditional methods' 50-55% accuracy. This 10% improvement highlights the improvement advanced models have in comparison to old methods. [7]

3.2 AI-driven betting

The betting markets being very strongly optimised from the bookmakers' perspective raises questions whether the market is fair for bettors and if it is possible to be profitable in betting. Although AI-based methods have made profitability challenging, they have created opportunities to be leveraged by bettors. Several studies have shown that with machine learning-based models, it is possible under certain conditions to beat the bookmakers, but long-term profitability is difficult due to the adaptability of the markets.

Rosenberg and Willcox [8] examine how well an Artificial Swarm Intelligence (ASI) system competes against professional bettors in NFL predictions. Their study analysed a broad dataset of NFL matches across multiple seasons. They compared the ASI hybrid model that blends real-time human predictions with algorithmic processing, to Vegas oddsmakers with deep game knowledge and market expertise. The AI-based models achieved an average accuracy 6% higher than these experts, reaching 60-62% accurate predictions compared to the professionals' 54-56%. Outperforming individual human experts and Vegas odds in certain weeks [8].

The difference was particularly evident in predicting complex game situations and extraordinary match events. As algorithmic models heavily rely on historical data, which is why the models struggled to adapt to sudden anomalies like a sudden performance spike by teams. However, the study notes that bookmakers adjust lines dynamically based on betting patterns, limiting the window for exploiting such advantages [8].

The study by Wang et al. [9] examines inefficiencies in betting markets and the ability of artificial intelligence-based models to exploit them. The markets are often assumed to be efficient, meaning the odds reflect the true probabilities of matches without significant deviations. Wang et al., however, showed that systematic errors exist in the bookmakers' odds, which machine learning models were able to identify. In the study conducted by Wang et al., data from European football leagues from the years 2008–2016 was analysed. It was observed that certain machine learning models, particularly LightGBM and AdaBoost, were able to detect under- and overvalued teams. [9]

This means that the betting markets do not fully account for all variables, but rather predictable distortions occur in them. In the simulation analysis, the most advanced models were able to exploit these inefficiencies and achieve a 3% positive profit margin, which suggests that the markets are not entirely random or impenetrable. However, according to the study, exploiting these inefficiencies is time- and resource-intensive, and their impact may diminish over time. When artificial intelligence models find new profitable strategies, bookmakers adapt and adjust their odds, whereby the efficiency of the markets increases. [9]

This concept is called value betting, where bettors seek out line discrepancies in the market. Bettors utilise their algorithms for differences in odds across bookmakers or mispricing relative to true probabilities. It is one of the most common analytical approaches for betting that places wagers strategically to maximize long-term gains. An important aspect of value betting is also the precise use of stakes in units, which is a common metric used in sports betting. A unit is a percentage of the betting bankroll rather than a fixed sum of money, typically ranging from one to five percentages. Unit sizes are often determined based on the risk-to-reward ratio of the bet and how much value it offers. This method ensures discipline, preventing erratic or emotional over-betting after losses, and aligns the stake with the perceived edge in the odds. The likelihood of making a profit when focusing on statistically advantageous bets is smarter than chasing every opportunity [10].

3.3 AI in risk management

Philander [11] examines in their study the bookmakers' methods to identify high-risk players. Betting companies collect and process extensive data of their customers' behaviour

using machine learning models. Especially how they identify regularly winning players, if there are suspicious trends to detect potential fraud. Models classify players based on their behaviour patterns to assist companies in making decisions of restricting customer betting or even account closures. Artificial neural networks proved the most reliable classification methods, but even they did not identify every problem gambler. The study emphasizes the importance of holdout testing and highlights that mere variables such as betting intensity, variance, frequency, and development trends are not sufficient to classify problem gamblers with reasonable accuracy [11].

Betting companies use advanced data mining techniques to safeguard their operations from risks that could undermine their profitability and integrity. These firms monitor customer activities by wagers, deposits and withdrawals to class behavioural profiles to users. By analysing the user data with supervised learning algorithms, companies can detect patterns indicative of fraudulent behaviour, such as unusual betting trends or exploiting methods. Beyond technical measures, betting operators integrate responsible gambling frameworks to bolster their defences [11]. This is a general level how companies operate against fraud prevention, while in Section 3.4 and 3.5 examines couple of exploitation methods.

3.4 Arbitrage betting

Arbitrage betting, often referred to as "sure betting," is a strategy where bettors capitalize on discrepancies in odds to guarantee a profit. The concept of arbitrage betting relies on identifying situations where the combined odds of all possible outcomes create a guaranteed profit regardless of event’s result. These prospects occur, as different bookmakers have different algorithms adjusting the odds, odds, resulting in varying prices for the same event. Levins [12] explains that such opportunities emerge when a bettor can buy into a bet at one bookmaker’s odds and "sell" it, either by betting on complementary outcomes at another bookmaker or via an exchange market. To achieve this, stakes must be allocated precisely across all outcomes, forming a hedged bet where the payout remains constant regardless of the event result [12].

Bookmakers typically embed a negative margin to ensure their own profitability, with below market value odds. Arbitrageurs aim to turn these differences to their advantage by utilises odds from different bookmakers. Differences in lines occur, as there are differences between the algorithms, set different prices for the same event [12]. This is common practice on over and under bets, where combined odds surpass the initially staked wager on both sides of the bet from different brokers. For instance, one bookmaker offers a 2.15 rate for over 2.5 goals scored and another bookmaker at 1.91 for under 2.5 goals scored, a bettor can wager a precisely calculated stake that returns a guaranteed profit margin of around 1%.

$$\frac{1}{\frac{1}{2.15} + \frac{1}{1.91}} = 1.0114532$$

Figure 1. Implied Probability Sum Inverse Equation

Arbitrage betting is completely legal betting strategy, though it raises ethical questions regarding the approach. Bettors exploit these opportunities using software that employs machine learning models to find arbitrage prospects. Betting companies are aware of this and take measures to protect their profits by deploying counter-models and quickly suspend accounts deemed suspicious. This behaviour raises ethical questions about whether there is concrete evidence of "cheating" to justify such actions [12]. Bettors also employ similar techniques to identify the best single bets in the market from a value perspective, known as line shopping which is more common and ethical approach.

3.5 Insider betting

Insider betting refers to the practice where individuals with access to non-public information place bets with unfair market value. Unlike arbitrage betting, which relies on market inefficiencies, insider betting leverages private information to skew in favour of the informed bettor. This poses a significant threat to the integrity of sports betting markets, forcing betting companies to develop sophisticated models in defence. Although often it is

impossible to prepare for information that is completely private. Information source is from inside workers of an organization known as In The Know (ITK) person. Information leaks are either discovered through internet or straight from an ITK, usually for financial compensation. Despite it is illegal to utilise insider information for a profit, information still gets spread online nowadays by workers and agents.

Journalists play a significant role in the insider betting landscape by disseminating information that can be exploited before it becomes widely known. A report on a potential player transfer will prompt rapid betting activity on platforms offering transfer bets. Betting companies needed to apply a real-time news analysis, often using natural language processing (NLP) to monitor breaking news and social media for news, events and rumours. Artificial intelligence usage for textual possessing common for betting companies to process news real-time and dynamically adjust odds. While it raises ethical concerns, as Philander and Fiedler [11] note, that such systems can produce false positives, unfairly penalizing legitimate bettors.

Rapid spread of unverified leaks online exacerbates the existing challenge. For instance, in April 2024, Manchester City manager Pep Guardiola responded to rumours about Phil Foden starting against Luton, saying, “A lot of leaks incorrect” in a post-match interview [13]. Despite numerous leaks circulating online about Foden starting the match against Luton, he ended up being an un used substitute for the entire game. Foden was named Premier League Player of the Year that very season, so his absence from the lineup adjusted odds, such as winning odds and those of other players.

Leaks constantly complicate betting, whether true or not. Odds shift constantly based on such rumours, raising doubts about whether bettors are offered fair value odds. When leaks prove inaccurate, it’s hard to tell if betting companies consistently undervalue certain bets. This is why algorithm usage is such valuable to benchmark real probability to offered odds. By leveraging algorithms, bettors can identify market discrepancies and place bets with better value.

4 ANALYSIS

Section four evaluates the impact of artificial intelligence (AI) and algorithms on the sports betting industry, drawing on insights from previous chapters. It evaluates how these technologies have disrupted market dynamics and introduced ethical challenges. Furthermore, this section addresses the thesis's research questions:

(1) How have AI and algorithms disrupted the industry?

(2) Who benefits more from this shift—bettors or betting companies?

(3) Is it possible for a bettor to achieve profitability in sports betting using algorithms?

4.1 Industry disruption

The integration of artificial intelligence and algorithms has fundamentally altered the sports betting industry, as highlighted in Sections two and three. This subsection explores two key areas of disruption: market efficiency and betting practises, while ethical considerations are explored separately in Subsection. Together, these aspects provide a comprehensive view of how the industry has been reshaped.

4.1.1 Market efficiency

The adoption of AI-driven algorithms significantly enhanced the efficiency of the sports betting market, as outlined in Sections 2.2.3 and 3.1. Past methods, such as bookmakers relying on human expertise and rudimentary data to set odds, were not the most optimal. One of the biggest reliefs for betting companies is continuously getting consistent odds, achieved by advanced models with a negative margin to ensure their profitability. Therefore, it can be concluded that market is often not fair for those aiming to sports bettors.

Algorithms have made sports betting far more consistent. While the odds of achieving profitability are mainly set in the bookmakers' favour, market efficiency could be seen as a

positive thing for the bettors too. Historically, uncertainty in the industry harmed bettors as well. In earlier conditions, bookmakers operated with unreliable profit margins and less accurate odds calculations. Though no public data confirms this, it might have led to bookmakers undershooting the odds they offered. The stability provided by these advancements ensures a steadier cash flow today, which could enable companies to offer more generous odds. Matheson [1] emphasizes the persistent uncertainty in old-fashioned betting markets, highlighting the speculative nature of odds-setting back then.

4.1.2 Betting fundamentals

Artificial intelligence and algorithms have opened pathways for smarter betting to challenge the odds and pursue profitability. Historically, outsmarting bookmakers relied on intuition or limited statistical edges, but modern methods have proven more systematic, though often not sustainable in the long term. Although the evidence suggests that only around 3% of sports bettors achieve consistent profits, a figure estimated due to the absence of definitive public data [15]. It is evident, that most of the sports bettors are set for a failure.

Analytical sports betting is mostly about utilising technology to find value opportunities in the market. As we proved earlier in Section 3, machine-based calculating significantly outperforms human analysis in efficiency. For maximizing the chances of succeeding, AI-based models adjust wagers and the bets you take for bettor. The aim is not to achieve a 100% winrate, rather maximizing the chances and beating bookies by a small margin. Every method will get predictions wrong, but sticking with the strategy over emotionally chasing lost wagers is a step closer to smarter betting.

The NerdWallet survey conducted in December 2024 [15] with over 2,000 U.S. adults shows that the majority of sports bettors engage in betting primarily for entertainment. While most people lose money betting and often wager on their favourite teams playing on Saturday night, it is evident that they don’t fully utilise these advanced technologies. This casual approach contrasts sharply with the industry’s economic scale, where global sports betting

generates billions annually, largely captured by companies leverage using artificial intelligence [1].

4.2 Ethical dimensions

Although the sports betting industry is heavily constrained by laws and regulations, it has always raised ethical questions. As a form of gambling, it is rooted in its speculative nature and knowing that some betting companies operate with questionable practices. The rise of artificial intelligence and algorithms introduce new dilemmas tied to technology's power, adding to these concerns. It is evident that automated systems can exploit bettor vulnerabilities, but such raises questions about transparency and consent in data use.

With billions generated annually [1], it is questionable whether bettors face a fair playing field or an engineered disadvantage. As noted in Section 3.3, betting companies often restrict users with consistent winning streaks, using machine learning models to classify accounts based on behaviour [9]. Should they require concrete evidence to justify such actions? Legally, these companies hold the right to select their customer base. Operation like this seems a little bit counterintuitive to penalize players for succeeding at the game they offer, as if winning was not permitted. Only in cases with clear evidence of cheating, such as insider betting or fraud, do they arguably deserve the authority to restrict or close accounts. Without such proof, this practice raises doubts about fairness, suggesting the system could be skewed.

4.3 Summary

The goal of the work was to get concrete answers on questions who benefits more from these changes, bettors or betting companies and whether profitability is achievable for bettors.

Based on the findings from the examination, it is evident that betting companies get the upper hand from these industry changes. Their income stream is now more predictable than ever, while they improve profit margins for their bets. As we concluded, most of their customers are betting for entertaining purposes with only a minority making a profit. Therefore, we can evidently conclude that majority of the bettors do not utilise these technologies to their full potential, if statistics are used at all. Consequently, it is logical that one side, the betting companies, utilise these models for almost everything, whereas most of the other side does not. This reflects on the effectiveness of these models compared to human instincts. AI-driven market efficiency further solidifies this advantage, reducing uncertainty and stabilizing odds in favor of companies.

Bettors, meanwhile, face a tougher landscape. Although artificial intelligence offers tools like value betting against betting companies. The opportunities are not as luxurious as betting companies have it. Profitability with good utilisation of models and betting strategies is still a possibility for bettors. That said, profitability in sports betting is possible with using AI-based models, though challenging as we concluded multiple methods for smarter sports betting.

Bettors, meanwhile, face a tougher landscape. Although artificial intelligence offers tools for analytical and smarter decision making, the opportunities are not as luxurious as betting companies have it. Profitability with good utilisation of models and betting strategies is still a possibility for bettors. That said, profitability in sports betting is possible when using AI-based models, though challenging as we concluded multiple methods for smarter sports betting. Yet, ethical practices, such as restricting consistently winning bettors exacerbate this challenge, skewing the system against bettors further. This imbalance underscores that while AI disrupts the industry profoundly, its benefits primarily contribute to companies' revenue.

5 CONCLUSIONS

The primary goal of this study was to evaluate the influence of algorithms and artificial intelligence on the sports betting industry. The study reveals that AI significantly changed the betting ecosystems, with one side clearly benefiting of the change. The research contributes practical insights for bettors seeking profitability, underscoring the need for ethical oversight in AI-driven gambling. While prior studies have explored AI's predictive capabilities in betting, this thesis focuses on bettor behaviour in sports betting

This novel approach focuses on understanding not only how AI reshapes betting markets, but how it is utilised in sports betting. The findings demonstrate that despite the technological advantages held by betting companies, informed bettors who employ disciplined strategies and leverage AI tools can still find opportunities in the market. As the industry continues to evolve, the balance between technological innovation and fair market practices will remain a critical concern for all parties. The ultimate aim of this thesis is to educate bettors to start practicing smarter betting approaches.

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