

Comparison of the effectiveness of roulette betting strategies using Monte Carlo simulation

Marek Sarnecki*

Department of Computer Science, Lublin University of Technology, Nadbystrzycka 36B, 20-618 Lublin, Poland

Abstract

This study presents the performance of seven betting strategies in European roulette via Monte Carlo simulations across 48 scenarios. Performance metrics included mean and median net profit, win and ruin probability, maximum drawdown, VaR and CVaR. Results confirmed that all strategies have negative expected value. Progressive strategies had higher short-term win rates but incurred much heavier loss tails. Fractional Kelly and Fixed-fractional showed moderate profiles with no long-term advantage. The fixed-stake strategy proved to be the safest, effectively limiting the risk of ruin. The study can be used to modify new betting strategies and serve as a warning to casino users.

Keywords: roulette; betting strategies; Monte Carlo simulation; risk analysis; gambling systems

*Corresponding author

Email address: s96456@pollub.edu.pl (M. Sarnecki)

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1. Introduction

Online gambling has become popular in recent years thanks to the development of web platforms and mobile applications [1]. Easy access to online casinos allows users to play gambling games at any time. Among many casino games, European roulette is one of the most recognizable.

Many players are looking for betting strategies that could increase their chances of winning or limit their long-term losses. Popular systems such as Martingale or Fibonacci are often presented on websites or forums as effective methods for making money at roulette [2]. These strategies are usually based on changing the stake after previous wins or losses.

From a mathematical point of view, roulette is a game with a negative expected value for the player because the casino has a built-in advantage in the form of an additional zero field [3].

Betting strategies cannot change the probability of roulette results. However, they can change the distribution of wins and losses during the game. Some strategies may generate many small profits in the short term, but at the same time, they may increase the risk of large losses or complete loss of bankroll. Because of this, roulette strategies are an interesting research problem related to probability theory, stochastic processes and risk management.

European roulette is often analysed in probability theory [4], [5] because it has a simple and clearly defined mathematical structure. The roulette wheel contains 37 fields numbered from 0 to 36. For even-money bets, the player wins on 18 fields and loses on 19 fields. The additional zero field creates the casino advantage and causes the expected value of the game to be negative for the player.

A betting strategy can be understood as a rule that determines the size of the next stake. The stake can depend on the current bankroll, previous results or a fixed progression system. In gambling research, betting strategies

are usually divided into fixed betting systems, progressive betting systems and proportional betting systems.

Fixed betting systems are the simplest group. In this approach, the player uses the same stake in every round. Such systems do not try to recover losses by increasing the stake, so they are usually more stable and less risky than progressive systems.

Progressive betting systems are based on changing the stake after wins or losses. Popular examples are Martingale, Fibonacci, D'Alembert and Labouchere. These systems are often attractive for players because they may generate frequent small wins. However, research shows that progressive systems cannot change the expected value of roulette. Croucher showed that betting systems modify the distribution of results, but they do not remove the mathematical advantage of the casino [4]. Pflaumer also analysed the Martingale system using simulations and showed that frequent small wins are balanced by rare but large losses [5].

Proportional betting systems are based on adjusting the stake to the current bankroll. In this group, the player usually risks a selected percentage of capital. One of the best-known proportional systems is the Kelly criterion. This approach is used in gambling and investment theory to maximize long-term capital growth [6], [7]. However, this method is useful mainly when the player has a positive mathematical advantage. In European roulette, that advantage does not exist, so Kelly-based strategies cannot guarantee long-term profit.

In the analysis of betting strategies, it is not enough to compare only average profit. Some systems may have a high probability of small profit, but at the same time they may create a high risk of ruin. Therefore, risk measures are very important in this type of research.

Probability of ruin is one of the basic measures used in gambling analysis. It describes how often the player loses enough capital to continue playing. Another important measure is maximum drawdown, which shows the largest decrease in bankroll from a previous maximum value during a session.

Modern risk analysis also uses tail-risk measures such as Value at Risk (VaR) and Conditional Value at Risk (CVaR). VaR estimates the loss level that should not be exceeded with a selected probability. CVaR describes the average loss in the worst part of the distribution [8], [9]. These measures are especially useful for progressive systems, where large losses may appear rarely, but their consequences are very serious.

Monte Carlo simulation is commonly used to analyse gambling systems because it allows researchers to generate many independent game sessions and observe the distribution of results. This method is useful when analytical calculations are difficult due to changing stakes, table limits and finite bankrolls [10], [11].

Monte Carlo simulation is also widely used in modern risk management because it allows researchers to approximate the full distribution of possible outcomes, including rare but severe losses. Recent studies on VaR and CVaR show that simulation-based methods are useful when analytical formulas are difficult or when the loss distribution is asymmetric and heavy-tailed. This is important for progressive betting systems, where there are frequent small gains and rare but significant losses [12], [13].

2. Research objective, scope and hypothesis

The main objective of this study is to compare selected betting strategies used in European roulette and evaluate their effectiveness using Monte Carlo simulation. The analysis focuses on how different betting systems affect the final financial outcome, the probability of profit, and the risk of losing capital.

The study includes seven betting strategies:

- Flat betting,
- Martingale,
- Fibonacci,
- D'Alembert,
- Labouchere,
- Fixed-fractional,
- Fractional Kelly.

The study does not include psychological factors, bonuses, taxes, casino promotions or other additional rules.

The simulations were performed for different bankrolls, table limits, and session lengths. This allows strategies to be compared under different conditions. The study also included profitability measures and risk measures, because average profit alone is not enough to evaluate betting systems.

The main research hypothesis was formulated as follows:

- Betting strategies used in European roulette do not eliminate the negative expected value of the game, but they significantly influence the distribution of profits, losses, and financial risk.

3. Materials and methods

3.1. Research object and assumptions

The research focused on betting strategies used in European roulette. The analysis was limited to even-money bets, specifically the red/black type of bet.

The study assumes that every roulette spin is an independent random event with an identical probability distribution. This assumption is consistent with the theoretical model of European roulette and allows the gambling process to be treated as a stochastic process.

3.2. Analysed betting strategies

Seven betting strategies were analysed in the study:

- Flat betting was used as a reference strategy. The player placed the same stake in every round,
- Martingale doubled the stake after each loss and returned to the initial stake after a win,
- Fibonacci increased the stake according to the Fibonacci sequence after losses. After a win, the strategy moved two positions back in the sequence,
- D'Alembert increased the stake by one unit after a loss and decreased it by one unit after a win,
- Labouchere used a numerical sequence. The next stake was calculated from the first and last element of the sequence. After a loss, the stake was added to the sequence, and after a win, selected elements were removed,
- Fixed-fractional used a constant percentage of the current bankroll as the stake,
- Fractional Kelly was based on the Kelly criterion, but only a fraction of the calculated Kelly stake was used to reduce volatility.

3.3. Simulation scenarios

Monte Carlo simulation was used to compare the strategies. For every strategy and scenario, 10,000 independent sessions were simulated.

The following parameters were used:

- Initial bankroll: {100, 200, 500, 1000}
- Table limit: {32, 64, 128, 256}
- Maximum number of spins: {200, 500, 2000}
- Number of sessions per scenario: 10000

The full experiment included 48 scenarios for each strategy. In total, 3,360,000 game sessions were simulated.

The selected parameter values allowed the analysis of short and longer game sessions, lower and higher bankrolls and different table limits. The number of simulations was selected after observing that the main statistics, such as mean profit and probability of ruin, became stable.

3.4. Evaluation metrics

The analysed betting strategies were evaluated using a set of profitability and risk metrics. This approach was used because the average final result alone does not fully describe the behaviour of a betting system. Some strategies may generate a relatively high number of profitable sessions, but at the same time they may expose the player to

rare and very large losses. For this reason, expected performance and downside risk were included in the evaluation.

The basic measure used in the analysis was the final profit from a session. It was calculated as the difference between the final bankroll and the initial bankroll:

$$\Pi = B_T - B_0 \quad (1)$$

Where Π is the final profit from a session, B_T is the bankroll after T spins, and B_0 is the starting capital assigned to a given simulation scenario and T is the total number of spins in a session. Positive values of Π indicate profitable sessions, while negative values indicate losses.

For each strategy, the mean and median profit were calculated. The mean profit was used to estimate the average long-term result of the strategy. The median profit was included because the obtained distributions were often asymmetric and influenced by extreme values. In such cases, the median can better represent a typical session result than the arithmetic mean.

The probability of profit was defined as the percentage of sessions in which the final profit was greater than zero:

$$P_{profit} = \frac{N_{profit}}{N} \quad (2)$$

Where P_{profit} is probability of profit, N_{profit} is the number of profitable sessions and N is the total number of simulated sessions. This metric shows how often a given strategy ends with a positive result. It is especially important when analysing progressive systems, because they often increase the number of small winning sessions.

The probability of ruin was used as one of the main risk measures. In this study, ruin was defined as a situation in which the player was no longer able to place the minimum required stake. The probability of ruin was calculated as:

$$P_{ruin} = \frac{N_{ruin}}{N} \quad (3)$$

Where P_{ruin} is the probability of ruin, N_{ruin} is the number of sessions that ended in ruin, and N is the total number of simulated sessions. This metric is important because a strategy may produce many profitable sessions but still be dangerous if it frequently leads to the loss of the bankroll.

Another risk measure was maximum drawdown. It describes the largest decrease in bankroll value from a previous maximum during a session. It was used to evaluate how large temporary losses may occur before the session ends. This metric is important because even if the final result is not equal to ruin, a large drawdown means that the player had to accept a significant loss during gameplay.

The maximum drawdown can be defined as:

$$MDD = \max_{0 \leq n \leq T} \left(\max_{0 \leq k \leq n} B_k - B_n \right) \quad (4)$$

Where MDD is the maximum drawdown, T is the total number of spins in a session, n is selected moment of the session, k represents the previous moments up to moment n , B_k is the bankroll value at moment k and B_n is the bankroll value at moment n , $\max_{0 \leq k \leq n} B_k$ represents the highest bankroll value observed from the beginning of session up to moment n . Higher drawdown values indicate greater capital instability.

The average stake was also calculated for each strategy. This metric was used to compare the aggressiveness of betting systems. Progressive strategies usually require much higher stakes after losing streaks, while Flat betting keeps the stake constant. Therefore, the average stake helps to show how strongly a strategy increases risk during the session.

To analyse extreme losses, Value at Risk and Conditional Value at Risk were used. Value at Risk (VaR) describes the loss threshold for the worst part of the distribution. In this study, the 95% level was used, which means that VaR was calculated for the worst 5% of session results.

Conditional Value at Risk (CVaR) was used as an extension of VaR. CVaR was calculated for confidence levels of 95% and 99%. For 95% confidence level, CVaR represents the average result among the worst 5% simulated sessions, and at the 99% confidence level, it represents the average result among the worst 1% of simulated sessions. This metric is especially useful for progressive strategies because it shows how large the losses are when the strategy enters unfavourable scenarios. While VaR gives only a boundary value, CVaR provides more information about the severity of extreme losses.

3.5. Statistical analysis and implementation

The distributions obtained from simulations were not normally distributed and contained extreme values. Because of this, non-parametric methods were used [14], [15].

The D'Agostino–Pearson test was used to check normality. The Mann–Whitney U test was used to compare selected strategies with the Flat betting strategy. Bootstrap analysis was used to evaluate the stability of CVaR estimates.

The simulations were implemented in Python. The Pandas and NumPy libraries were used for data processing and numerical calculations. Matplotlib was used to prepare charts. The raw results were stored in CSV files.

4. Results

4.1. Overall comparison of strategies

The aggregated results for all scenarios are shown in Table 1. The results confirm that all analysed strategies generated negative mean profit. This means that none of the strategies was able to overcome the casino advantage.

Table 1: Aggregated results of analysed strategies

Strategy	Mean profit [u.]	Profit probability	Ruin probability
Flat betting	-24.11	23.04%	1.81%
Martingale	-67.33	39.20%	39.45%
Fibonacci	-57.98	53.34%	32.49%
D'Alembert	-161.84	31.09%	54.15%
Labouchere	-153.79	26.55%	64.56%
Fixed-fractional	-150.07	17.68%	5.14%
Fractional Kelly	-150.07	17.68%	5.14%

Flat betting achieved the lowest ruin probability, equal to 1.81%. It also had the smallest average loss. This means that the simplest strategy was the safest in terms of capital protection.

Progressive systems had a higher probability of profit than Flat betting. The highest value was achieved by Fibonacci, where 53.34% of sessions ended with profit. However, this result was connected with a high ruin probability of 32.49%. Martingale also had a relatively high profit probability, but its ruin probability was 39.45%.

The worst ruin probability was observed for Labouchere and D'Alembert. Labouchere ended in ruin in 64.56% of sessions, while D'Alembert ended in ruin in 54.15% of sessions. These results show that high short-term attractiveness of progressive systems is connected with risk.

4.2. Risk metrics

Tables 2 and 3 present the risk measures for the analysed strategies. These results show not only average profit, but also the scale of losses in unfavourable scenarios.

Table 2: Risk and volatility measures

Strategy	95%-VaR	95%-CVaR	99%-VaR	99%-CVaR
Flat betting	-100.0	-115.02	-132.0	-148.56
Martingale	-500.0	-635.67	-1000.0	-1000.0
Fibonacci	-500.0	-633.75	-1000.0	-1000.0
D'Alembert	-1000.0	-1000.0	-1000.0	-1000.0
Labouchere	-1000.0	-1000.0	-1000.0	-1000.0
Fixed-fractional	-727.52	-854.4	-919.57	-945.36
Fractional Kelly	-727.52	-854.4	-919.57	-945.36

Table 3: Aggregated results of analysed strategies

Strategy	Avg. drawdown [u.]	Avg. stake [u.]
Flat betting	45.24	1.00
Martingale	283.94	112.46
Fibonacci	213.63	64.41
D'Alembert	361.64	22.76
Labouchere	479.21	84.43
Fixed-fractional	307.09	4.99
Fractional Kelly	307.09	4.99

The results show that progressive strategies generated much higher drawdowns than Flat betting. The highest

average drawdown was observed for Labouchere. This confirms that the strategy creates high capital fluctuations and can quickly lead to large losses.

Flat betting had the lowest average drawdown and the lowest average stake. This is expected because the strategy does not increase the stake after losses. As a result, it does not create strong capital escalation.

The CVaR results also show that progressive strategies have higher tail risk. In the worst scenarios, Martingale, Fibonacci, D'Alembert and Labouchere reached very large losses. This means that even if these strategies sometimes generate frequent small profits, they are very dangerous in the most cases.

4.3. Distribution of simulation results

The distribution of simulation results was examined to compare the variability, asymmetry and extreme outcomes of the analysed strategies.

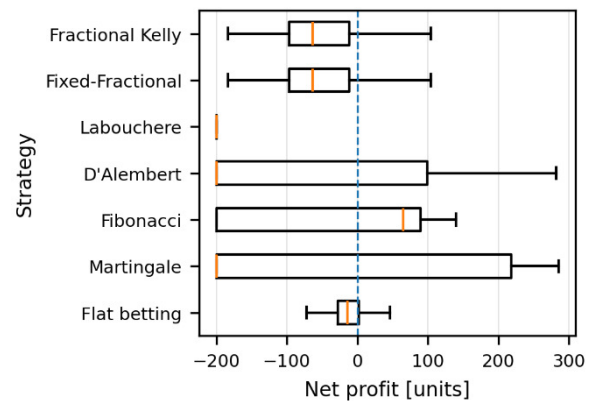


Figure 1: Boxplot of profit distribution for analysed strategies

Figure 1 shows that progressive systems have a strong concentration of results near the lower boundary, which means that many sessions ended with very large losses or ruin. Flat betting has a more stable distribution, with lower variability and smaller extreme losses.

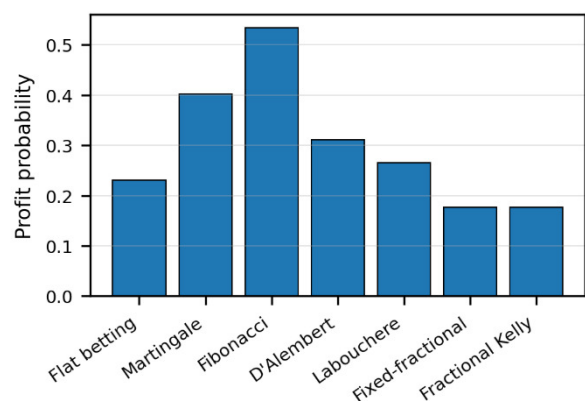


Figure 2: Probability of profitable session

The profit probability chart shows that Fibonacci achieved the highest probability of profit. Martingale also had a higher profit probability than Flat betting. However, this does not mean that these strategies are better because their risk of ruin is also much higher.

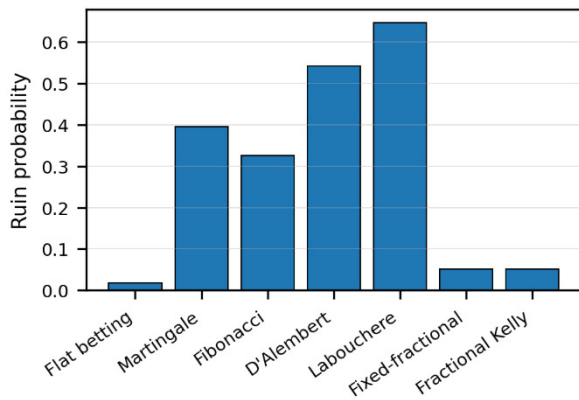


Figure 3: Probability of ruin

The ruin probability chart shows a clear difference between Flat betting and progressive systems. Flat betting had very low ruin probability, while Labouchere, D'Alembert, Martingale and Fibonacci had much higher values. This confirms that progression-based strategies increase the danger of losing the whole bankroll.

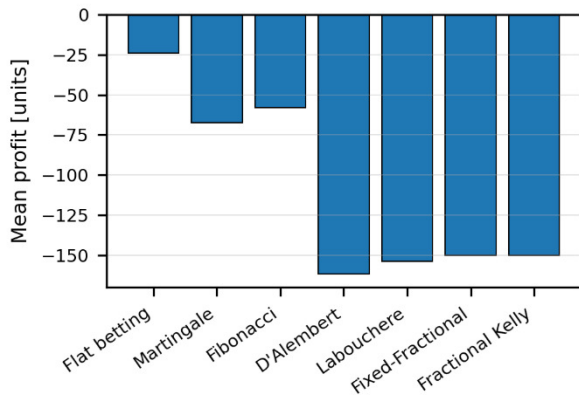


Figure 4: Mean profit by strategy

The mean profit chart confirms that all strategies generated negative average results. Flat betting had the smallest average loss, while D'Alembert and Labouchere had the largest losses. This result supports the main hypothesis that betting systems do not remove the negative expected value of roulette.

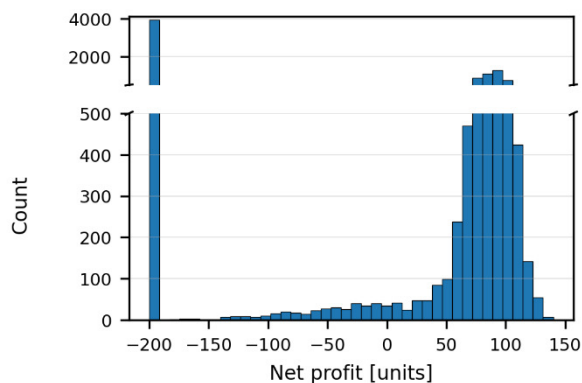


Figure 5: Profit distribution for Fibonacci

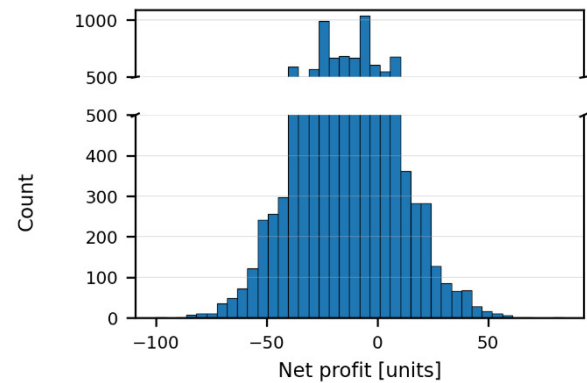


Figure 6: Profit distribution for Flat betting

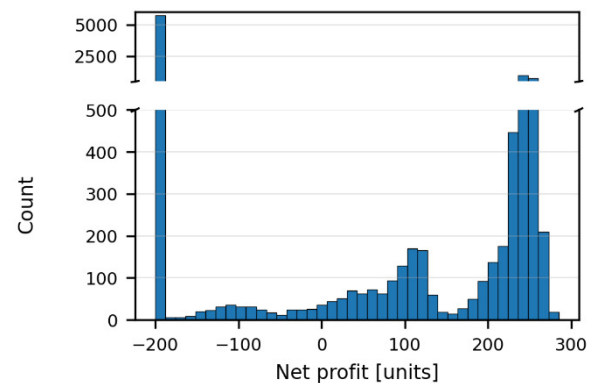


Figure 7: Profit distribution for Martingale

The histograms show that Flat betting has a more regular and stable distribution of results. In contrast, Martingale and Fibonacci produce asymmetric distributions. Many results are small profits, but there are also large losses connected with ruin. This confirms that progressive systems change the shape of the distribution instead of improving the expected value.

4.4. Statistical results

The D'Agostino-Pearson test rejected normality for all analysed strategies. This means that the obtained result distributions were not normal.

Table 4: D'Agostino-Pearson normality test

Strategy	Skew-ness	Kurtosis	p-value
Flat betting	-1.02	1.28	0
Martingale	-0.42	3.02	0
Fibonacci	-1.64	4.67	0
D'Alembert	-0.63	1.70	0
Labouchere	0.49	3.38	0
Fixed-fractional	0.21	14.80	0
Fractional Kelly	0.21	14.80	0

The Mann-Whitney U test showed statistically significant differences between Flat betting and selected progressive strategies.

Table 5: Statistical significance tests

Comparison	Test	p-value
Martingale vs Flat betting	Mann-Whitney U	< 0.001
Fibonacci vs Flat betting	Mann-Whitney U	< 0.001
Labouchere vs Flat betting	Mann-Whitney U	< 0.001

This means that the differences were not only random effects of simulation, but were connected with the structure of the strategies.

5. Discussion and conclusions

The results confirmed the main research hypothesis. None of the analysed betting strategies was able to eliminate the negative expected value of European roulette. All strategies produced negative mean profit in the long term. This result is consistent with the mathematical structure of roulette and the casino advantage created by the zero field.

This observation is also consistent with earlier analyses of roulette betting systems [4], which indicate that betting strategies may change the distribution of short-term outcomes, but they do not change the expected value of the game. The practical meaning of a betting strategy should not be interpreted as the ability to generate long-term profit, but rather as the ability to control or increase specific types of risk. Because of that, the analysed systems should be compared mainly from the perspective of bankroll protection, probability of ruin and exposure to extreme losses.

Progressive systems increased the probability of short-term profit in some scenarios. However, this effect was obtained at the cost of much higher ruin probability and higher tail risk.

From the player's perspective, this means that the percentage of profitable sessions may be misleading when used as the main criterion for strategy selection. A system such as Fibonacci or Martingale may appear attractive because it often produces small profits, but the same mechanism increases the size of the stake after losses and exposes the bankroll to rare but large losses. For this reason, a strategy with a higher probability of profit should not automatically be considered safer or more effective.

Fibonacci is a good example of this effect. It achieved the highest probability of profitable sessions in the aggregated results, but it also produced a high probability of ruin. This means that the strategy may look effective in short sessions, but it is dangerous when analysed from the risk perspective.

This result shows the importance of analysing not only how often a strategy wins, but also what happens in losing scenarios. In practical terms, Fibonacci may be acceptable only for a player who is aware that frequent small gains are balanced by the possibility of losing a large part of the bankroll.

Martingale also shows the same problem. The strategy is based on the idea of recovering previous losses by

doubling the stake. In practice, this approach is limited by the player's bankroll and the table limit. When a long losing sequence appears, the strategy may quickly lead to ruin.

Labouchere and D'Alembert were among the riskiest strategies in the experiment. They generated high average drawdown and high ruin probability. This shows that slower progression does not necessarily mean safe progression.

Flat betting achieved the most stable results. It had the lowest probability of ruin and the lowest average drawdown. It did not generate the highest number of profitable sessions, but it protected the bankroll better than the other strategies. A player who aims to reduce the probability of ruin should prefer low fixed stakes instead of progression-based recovery systems. Flat betting does not remove the casino advantage, but it limits stake escalation and makes losses easier to control. If the objective is bankroll preservation rather than maximizing the number of short-term winning sessions, Flat betting is the most rational choice among the analysed strategies.

The results for Fixed-fractional and Fractional Kelly were nearly identical. This outcome is a result of the Kelly parameters. In the simulations, the Fixed-fractional used a constant fraction of 2% bankroll. For the Fractional Kelly assumed probability estimate was 0.52 and the Kelly fraction was set to 0.5. According to the Kelly formula for even-money bets, these parameters also resulted in a stake to equal approximately 2% of bankroll. These results also illustrate an important limitation of Kelly-based staking in roulette. The Kelly criterion is designed for situations where the player has a positive edge. In European roulette, this condition is not satisfied, so proportional staking can only influence volatility, but it cannot create a positive long-term expectation. This is why Fractional Kelly should be interpreted here as a risk-control rule rather than as a profit-maximizing method.

The results also show that average profit is not enough to evaluate betting systems. Some strategies may have relatively high profit probability, but their worst-case results are very poor. Therefore, risk measures such as probability of ruin, maximum drawdown and CVaR should be used in the analysis of gambling systems.

The study has several limitations. First, the model does not include any psychological behaviour of players. In real gambling, emotions, risk aversion and irrational decisions may strongly influence results. Second, the research was limited to one type of bet, red/black. Third, the analysis did not include casino bonuses, taxes, transaction costs or different roulette rules. Finally, the study was based on simulation data, not on real casino data.

The main conclusions from the research are:

- Betting strategies do not overcome the casino advantage in European roulette. All analysed systems produced negative mean profit in the long term.
- Progressive strategies increase the probability of short-term profit, but they also significantly increase probability of ruin, maximum drawdown and tail risk.

- Flat betting was the safest strategy in the study because it generated the lowest ruin probability and the most stable bankroll changes.
- Risk measures such as CVaR and maximum draw-down are necessary for proper evaluation of betting systems, because average profit alone may be misleading.

Future research may include the analysis of other roulette bets, different table rules and real gambling data. Another possible direction is the use of Markov models, dynamic programming or reinforcement learning to analyse adaptive betting systems. It may also be useful to include behavioural models of players, because real decisions in gambling are often influenced by emotions and risk perception.

References

- [1] Gambling - Worldwide | Statista Market Forecast, Statista, <https://www.statista.com/outlook/amo/gambling/worldwide>, [09.05.2026].
- [2] 7 Most Successful Roulette Strategies A Finish Guide, Grand Hotel Son Net, <https://son-net.es/blog/2025/01/17/7-most-successful-roulette-strategies-a-finish-guide/>, [17.05.2026].
- [3] Rules of Roulette | Instructions for the Casino Classic, <https://www.mastersofgames.com/rules/roulette-rules.htm>, [17.05.2026].
- [4] J. S. Croucher, A Comparison of Strategies for Playing Even Money Bets in Roulette, *Teaching Statistics* 27(1) (2005) 20–23, <https://doi.org/10.1111/j.1467-9639.2005.00193.x>.
- [5] P. Pflaumer, A Statistical Analysis of the Roulette Martingale System: Examples, Formulas and Simulations with R, *International Conference on Gambling and Risk Taking*, 2019, https://oasis.library.unlv.edu/gambling_institute/2019/May29/8/, [14.03.2026].
- [6] S.-K. (Amang) Kim, Kelly Criterion Extension: Advanced Gambling Strategy, *Mathematics* 12(11) (2024) 1725, <https://doi.org/10.3390/math12111725>.
- [7] B. P. Jacot and P. V. Mochkovitch, Kelly criterion and fractional Kelly strategy for non-mutually exclusive bets, *Journal of Quantitative Analysis in Sports* 19(1) (2023) 37–42, <https://doi.org/10.1515/jqas-2020-0122>.
- [8] D. Duffie and J. Pan, An Overview of Value at Risk, *The Journal of Derivatives* 4(3) (1997) 7–49, <https://doi.org/10.3905/jod.1997.407971>.
- [9] R. T. Rockafellar and S. Uryasev, Optimization of conditional value-at-risk, *The Journal of Risk* 2(3) (2000) 21–41, <https://doi.org/10.21314/JOR.2000.038>.
- [10] D. P. Kroese, T. Taimre, and Z. I. Botev, *Handbook of Monte Carlo Methods*, 1st ed., Wiley, 2011, <https://doi.org/10.1002/9781118014967>.
- [11] P. Właż, *Symulacje Monte Carlo. Teoria i zastosowania*, Politechnika Lubelska, 2025, <https://doi.org/10.35784/9788379476404>.
- [12] Y. Cheng, Monte Carlo-Based VaR Estimation and Backtesting Under Basel III, *Risks* 13(8) (2025) 146, <https://doi.org/10.3390/risks13080146>.
- [13] J. Wang, S. Wang, M. Lv, and H. Jiang, Forecasting VaR and ES by using deep quantile regression, GANs-based scenario generation, and heterogeneous market hypothesis, *Financial Innovation* 10(1) (2024) 36, <https://doi.org/10.1186/s40854-023-00564-5>.
- [14] C. M. Borror, Practical Nonparametric Statistics, 3rd Ed., *Journal of Quality Technology* 33(2) (2001) 260–260, <https://doi.org/10.1080/00224065.2001.11980074>.
- [15] A. Stanis, *Przystępny kurs statystyki z zastosowaniem Statistica PL na przykładach z medycyny. T. 1: Statystyki podstawowe*, Wyd. 3 zm. i popr, StatSoft Polska, Kraków, 2006.