# Blackjack: Martingale vs Fixed Fractional Betting

Context:

All bankrolls started at £10,000

All bets are 5% of bankroll (£500)

Simulations are ran 1000 times (1,000,000 total games)

10 rounds = 1000 simulations

Mean Sharpe Ratio, Mean Ruin Probability and Mean Max Drawdowns are calculated after 10 rounds to improve accuracy and reduce random error.

| Rounds | Metrics | Martingale | Fractional Betting |
|---|---|---|---|
| 1 | Win rate (%) | 40.7 | 40.5 |
| | Loss rate (%) | 40.5 | 40.7 |
| | EV per 100 hands (£) | -7500 | -453 |
| | Std dev of returns (£) | 9100 | 4910 |
| | Sharpe ratio | -0.824 | -0.0923 |
| | Ruin probability (%) | 69.6 | 0.00 |
| | Max drawdown (%) | 100 | 94.9 |
| | | | |
| 2 | Win rate (%) | 40.6 | 40.6 |
| | Loss rate (%) | 40.7 | 40.5 |
| | EV per 100 hands (£) | -2500 | -500 |
| | Std dev of returns (£) | 9080 | 4930 |
| | Sharpe ratio | -0.275 | -0.101 |
| | Ruin probability (%) | 70.5 | 0.00 |
| | Max drawdown (%) | 100 | 94.6 |
| | | | |
| 3 | Win rate (%) | 40.9 | 40.5 |
| | Loss rate (%) | 40.3 | 40.8 |
| | EV per 100 hands (£) | 11500 | -548 |
| | Std dev of returns (£) | 9390 | 4710 |
| | Sharpe ratio | 1.22 | -0.116 |
| | Ruin probability (%) | 66.5 | 0.00 |
| | Max drawdown (%) | 100 | 94.7 |
| | | | |
| 4 | Win rate (%) | 40.7 | 40.5 |
| | Loss rate (%) | 40.5 | 40.8 |
| | EV per 100 hands (£) | -7500 | -3980 |
| | Std dev of returns (£) | 9340 | 4810 |
| | Sharpe ratio | -0.803 | -0.828 |
| | Ruin probability (%) | 65.2 | 0.00 |
| | Max drawdown (%) | 100 | 95.5 |
| | | | |
| 5 | Win rate (%) | 40.9 | 40.7 |
| | Loss rate (%) | 40.6 | 40.6 |
| | EV per 100 hands (£) | -4000 | 5630 |
| | Std dev of returns (£) | 9150 | 4690 |
| | Sharpe ratio | -0.437 | 1.20 |
| | Ruin probability (%) | 68.1 | 0.00 |
| | Max drawdown (%) | 100 | 95.9 |
| | | | |
| 6 | Win rate (%) | 40.9 | 40.6 |
| | Loss rate (%) | 40.4 | 40.6 |
| | EV per 100 hands (£) | 14500 | -3940 |
| | Std dev of returns (£) | 9240 | 4970 |

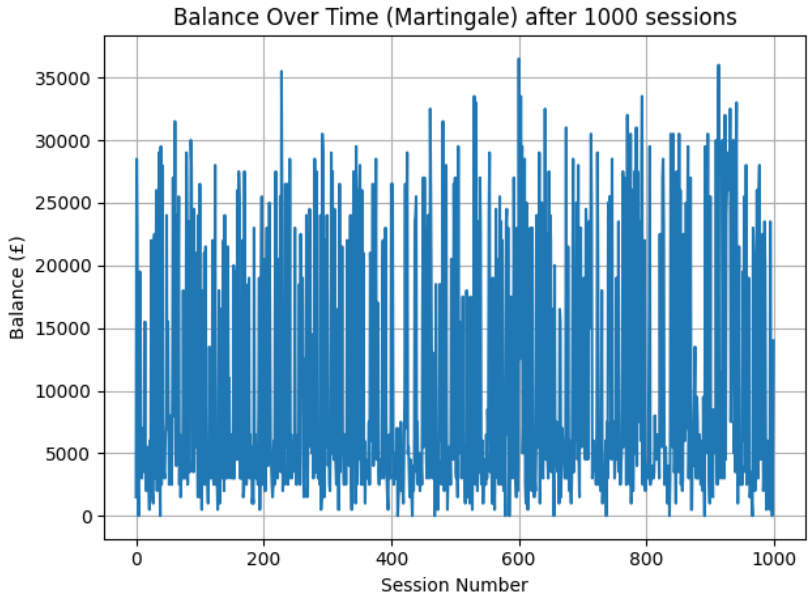
| | | | |
|---|---|---|---|
| | Sharpe ratio | 1.57 | -0.792 |
| | Ruin probability (%) | 68.6 | 0.00 |
| | Max drawdown (%) | 100 | 95.2 |
| | | | |
| 7 | Win rate (%) | 41.0 | 40.6 |
| | Loss rate (%) | 40.2 | 40.7 |
| | EV per 100 hands (£) | -6000 | -2180 |
| | Std dev of returns (£) | 9260 | 4580 |
| | Sharpe ratio | -0.648 | -0.477 |
| | Ruin probability (%) | 67.7 | 0.00 |
| | Max drawdown (%) | 100 | 95.2 |
| | | | |
| 8 | Win rate (%) | 40.7 | 40.7 |
| | Loss rate (%) | 40.6 | 40.4 |
| | EV per 100 hands (£) | -3000 | -1810 |
| | Std dev of returns (£) | 9060 | 4780 |
| | Sharpe ratio | -0.331 | -0.380 |
| | Ruin probability (%) | 69.4 | 0.00 |
| | Max drawdown (%) | 100 | 93.7 |
| | | | |
| 9 | Win rate (%) | 40.8 | 40.8 |
| | Loss rate (%) | 40.5 | 40.4 |
| | EV per 100 hands (£) | -7000 | -5270 |
| | Std dev of returns (£) | 9280 | 5170 |
| | Sharpe ratio | -0.754 | -1.02 |
| | Ruin probability (%) | 66.7 | 0.00 |
| | Max drawdown (%) | 100 | 96.0 |
| | | | |
| 10 | Win rate (%) | 40.4 | 40.7 |
| | Loss rate (%) | 40.8 | 40.5 |
| | EV per 100 hands (£) | 7000 | 15800 |
| | Std dev of returns (£) | 9030 | 4720 |
| | Sharpe ratio | 0.775 | 3.34 (outlier) |
| | Ruin probability (%) | 69.1 | 0.00 |
| | Max drawdown (%) | 100 | 96.4 |

| Mean Metrics after 10 Rounds | Martingale | Fractional Betting |
|---|---|---|
| EV per 10 hands (£) | -450 | +275 |
| Std dev of returns (£) | 9190 | 4830 |
| Sharpe ratio | -0.0507 | +0.0734 |
| Ruin probability (%) | 68.1 | 0.00 |
| Max drawdown (%) | 100 | 95.2 |

Mean win rate = 40.8%

Mean loss rate = 40.5%

**Martingale:**


Balance Over Time (Martingale) after 1000 sessions
Balance (£)
Session Number
0
5000
10000
15000
20000
25000
30000
35000
0
200
400
600
800
1000

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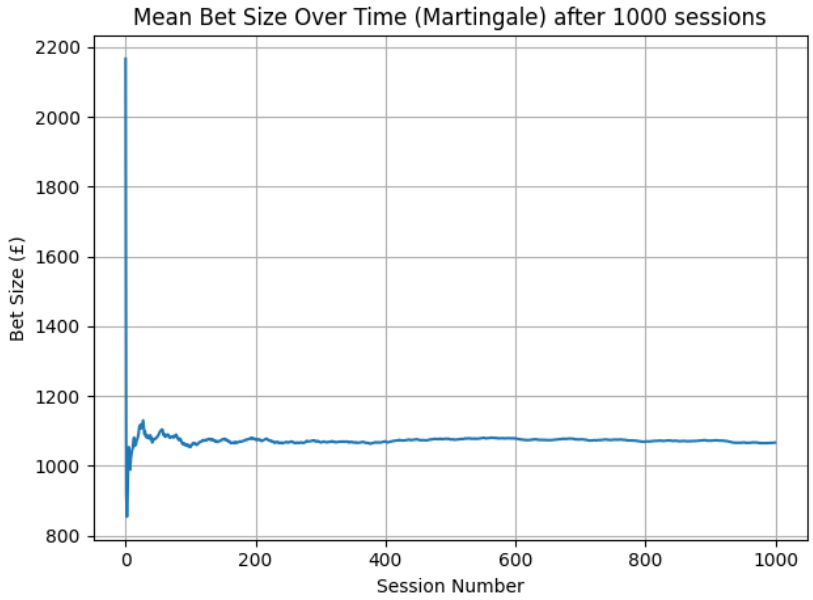
Mean Bet Size Over Time (Martingale) after 1000 sessions
Bet Size (£)
Session Number
800
1000
1200
1400
1600
1800
2000
2200
0
200
400
600
800
1000

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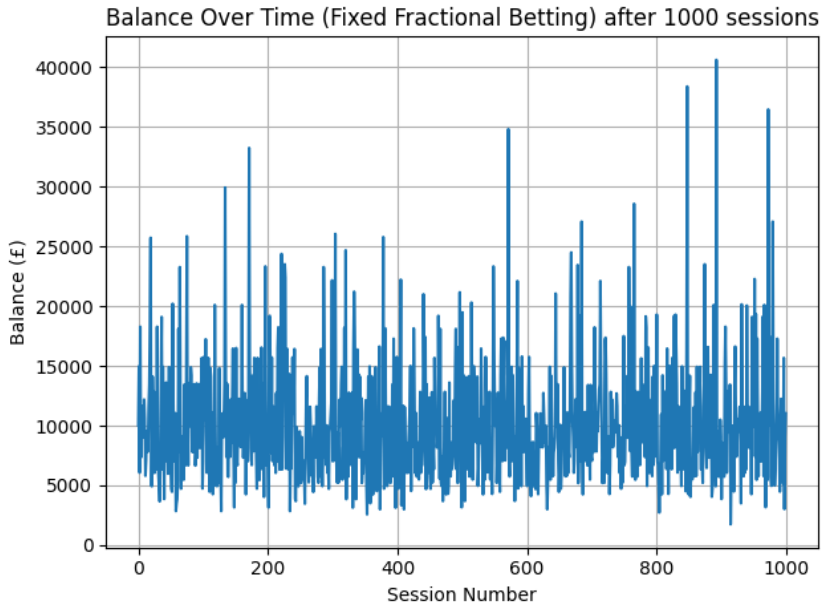
## Fixed Fractional Betting:

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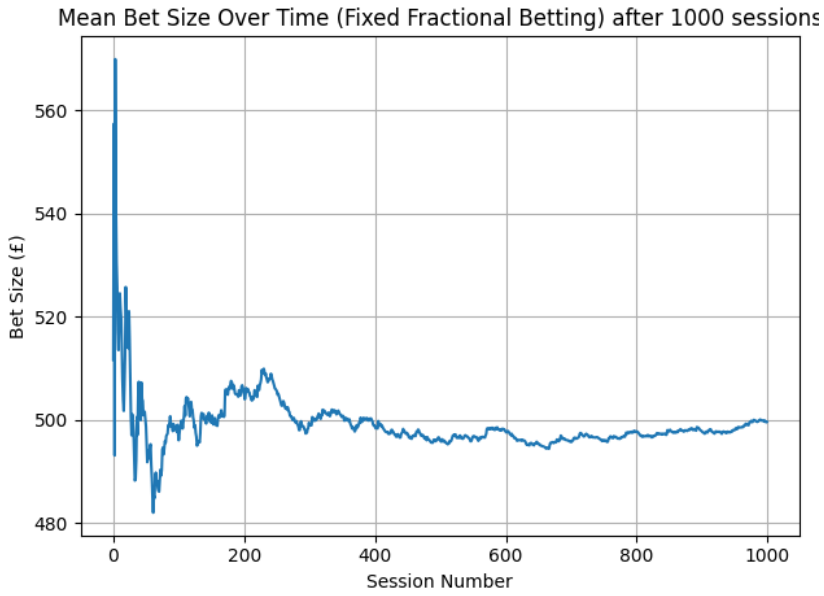


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## Conclusion

This simulation compared Martingale and Fixed Fractional betting strategies over 100,000 blackjack hands using Monte Carlo methods. While Martingale occasionally yielded gains, it displayed a high average ruin probability (68.1%) and consistent 100% drawdowns, highlighting its extreme fragility under realistic bankroll constraints. In contrast, Fixed Fractional betting avoided ruin entirely, delivered more stable performance, and achieved a slightly positive average return with lower volatility, demonstrating stronger risk-adjusted efficiency.

The generally low Sharpe ratios stem from the low average win rate of 40.8%, which reflects the simplified gameplay logic of hitting until reaching 17. A basic strategy table would likely raise the win rate by around 5%, but this study aimed to isolate the impact of betting strategy alone. Ultimately, the results demonstrate how aggressive recovery systems like Martingale fail under practical constraints, whereas conservative sizing strategies offer greater long-term viability.