Roulette Strategy Simulation Summary-Made by Adityavardhan Iyengar

Overview

This document outlines and analyzes several commonly used betting strategies for **European Roulette**, simulated over a series of games. The objective is to understand the theoretical foundation, mathematical expectations, and practical implications of each betting method.

European roulette has 37 numbers: 18 red, 18 black, and 1 green (zero). This gives the house a built-in edge. Each spin is independent, and the payout for an even-money bet (like red/black) is 1:1.

1. Flat Betting Strategy

**Definition:** - You bet the **same fixed amount** on each spin, regardless of wins or losses.

Theoretical Features: - **Low variance** strategy. - **No compounding risk.** - Easy to implement and budget-friendly.

Expectation: Let: - Win probability ($p = 18/37$) - Loss probability ($q = 1 - p = 0.514$) - Payout per win = 1 unit - Bet per game = 1 unit

Then expected value per game: [$EV = (p) + (q) = 0.486 - 0.514 = -0.028$]

Conclusion: - Over 10,000 spins, the average loss is expected to be ~280 units. - **Safe but guaranteed long-term loss** due to house edge.

Ruin Probability Over Time

Distribution of Final Bankrolls (Flat Betting x1000)
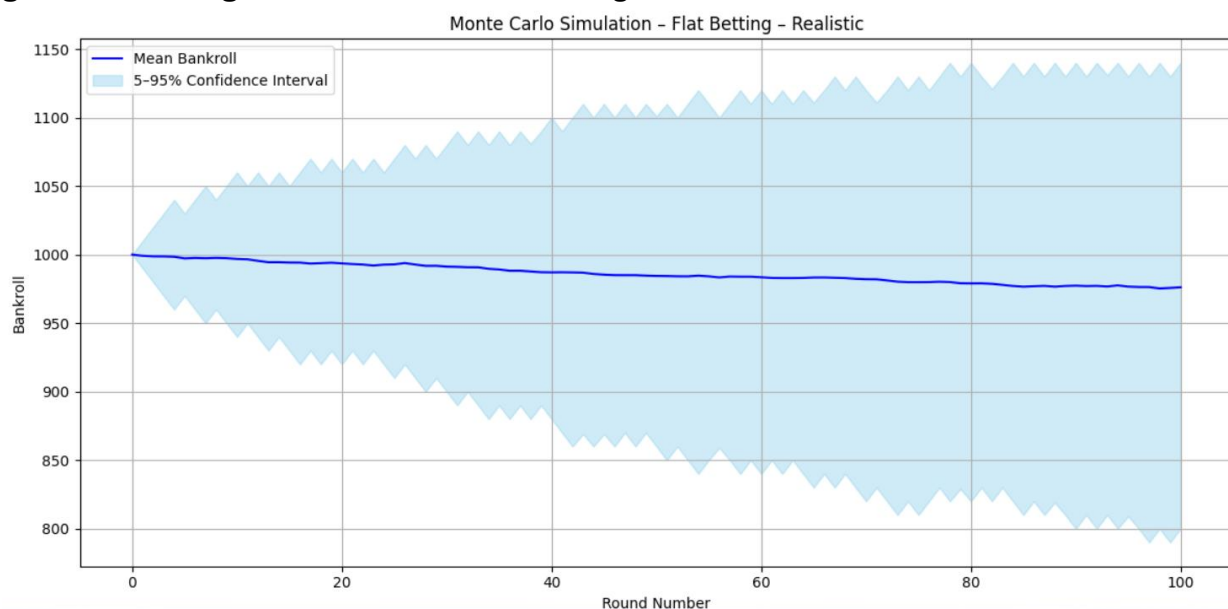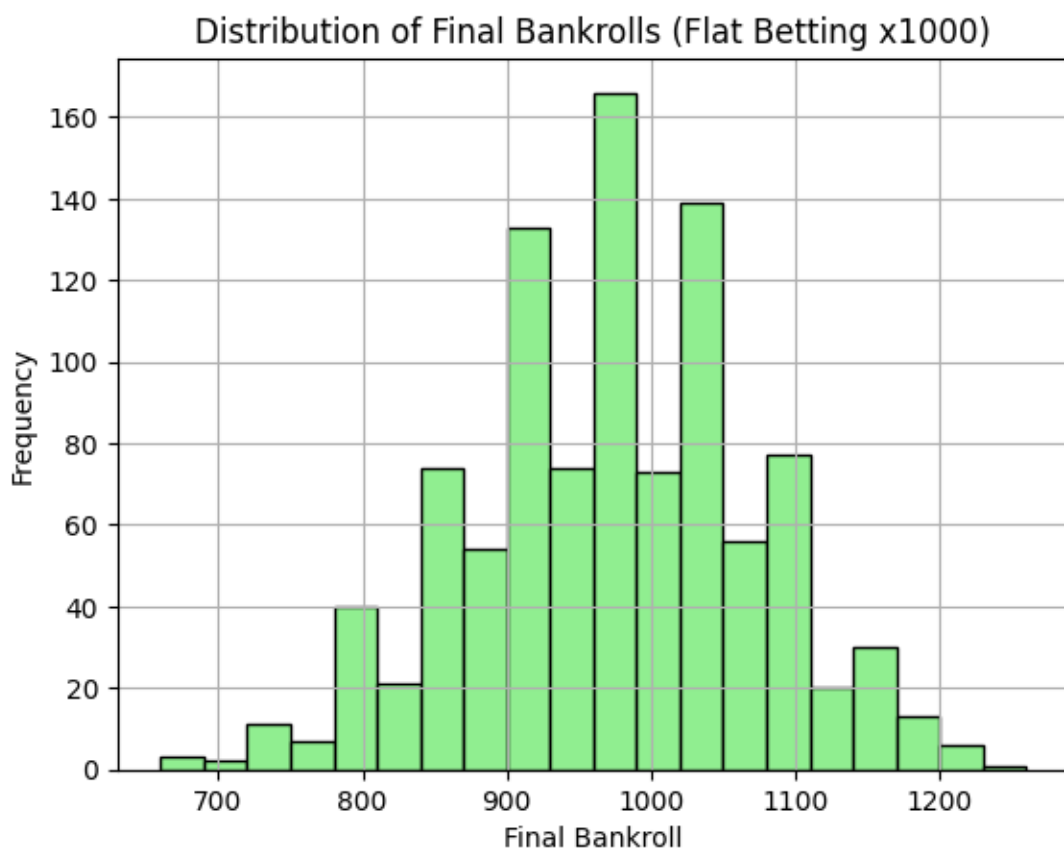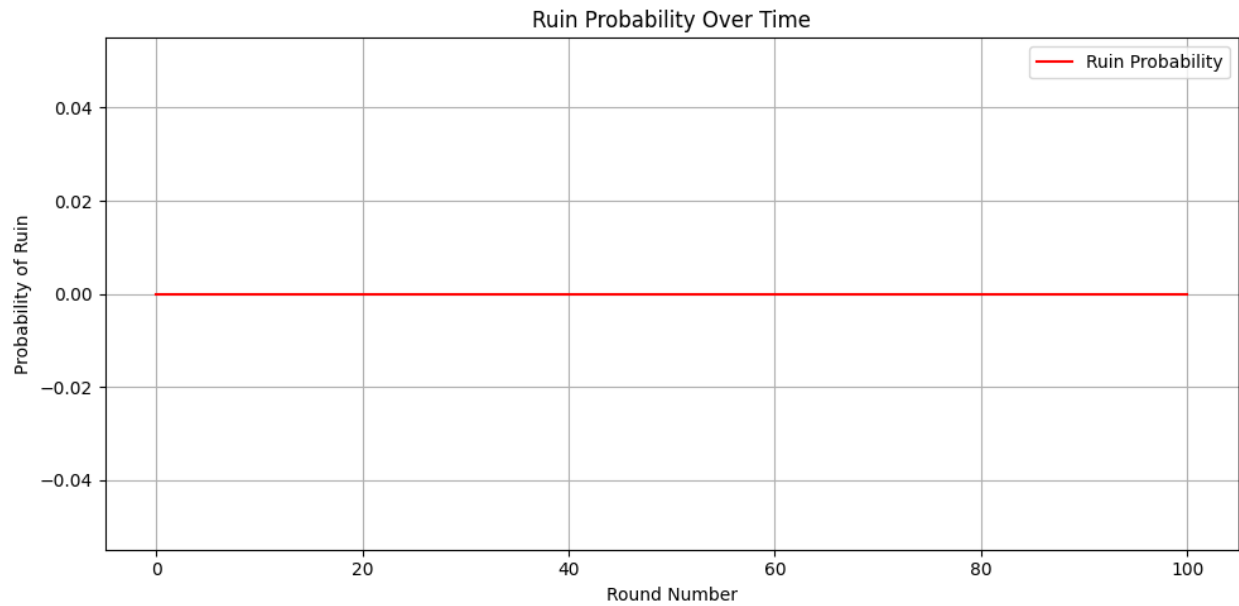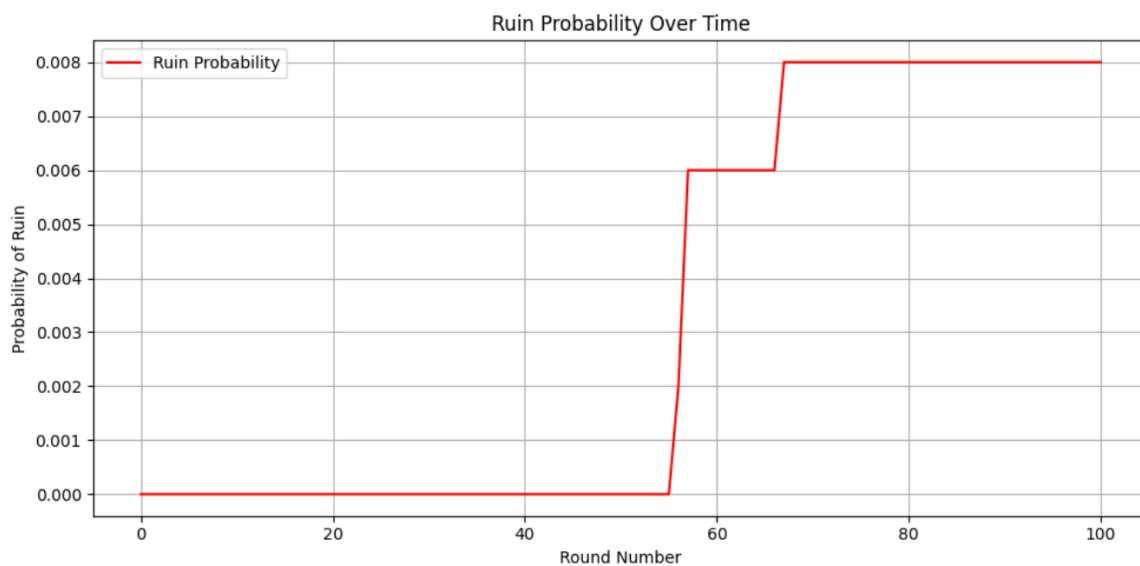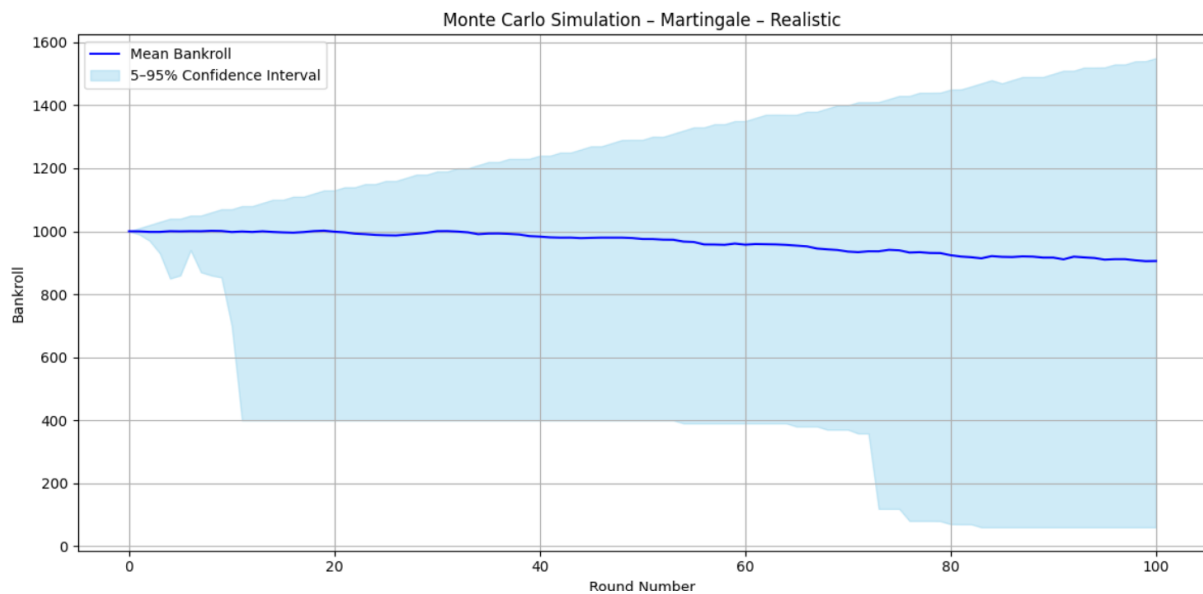
2. Martingale Strategy

Definition: - Double your bet after every **loss**, return to base bet after a win.
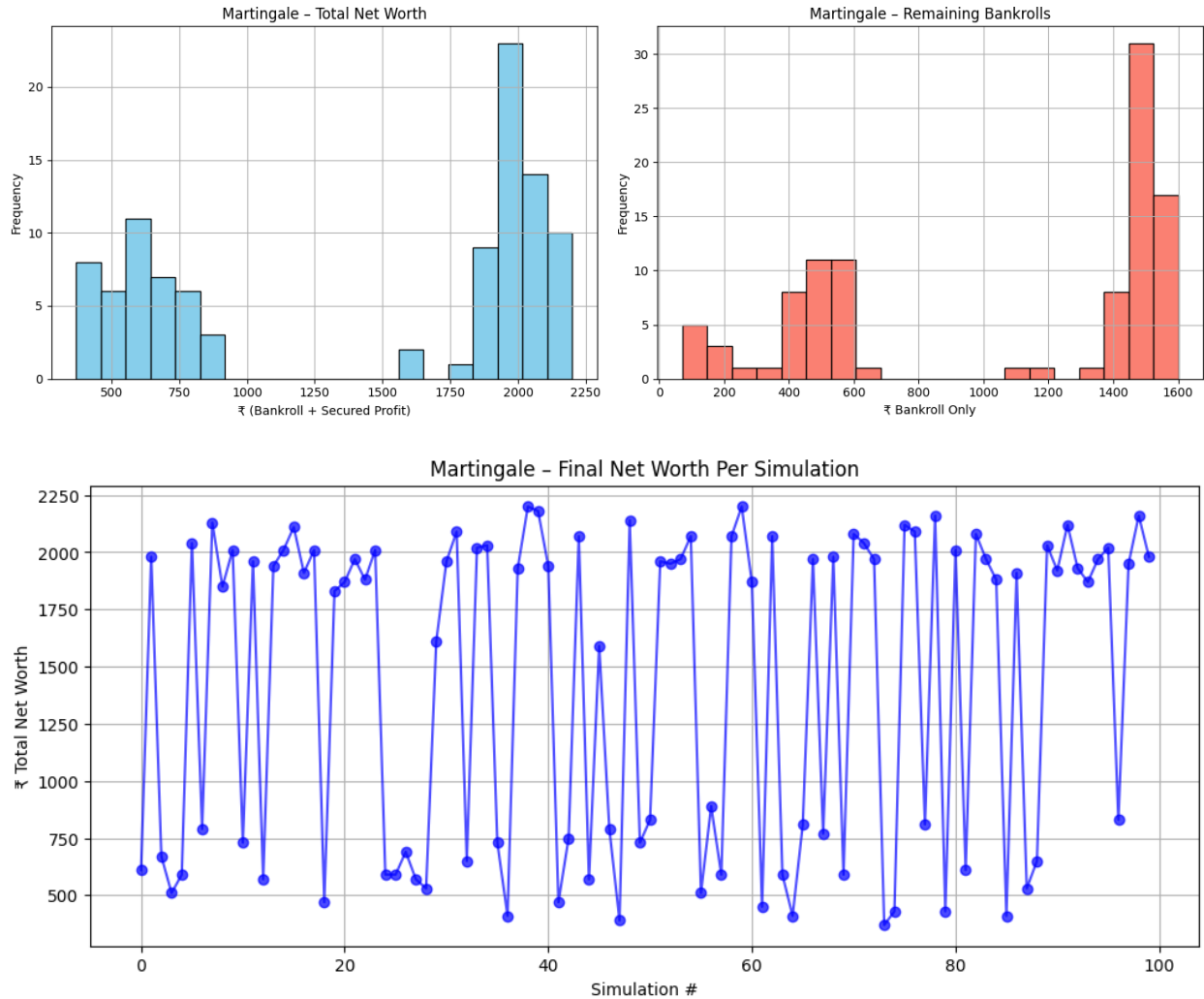
Theoretical Justification: - Designed so that the **first win recovers all prior losses + 1 unit profit**.

Mathematics: - After (n) consecutive losses, the total loss is: [L = _{k=0}^{n-1} 2^k = 2^n - 1] - On the (n)-th round, the bet is (2^{n-1}), and if won: [= 2^{n-1} - (2^n - 1) = 1]

Problems: - **Exponential growth in bets.** - Risk of hitting table limits or running out of bankroll.

Conclusion: - Can appear successful short-term. - **Very high long-term risk**, prone to **bankruptcy** after long losing streaks.

Martingale – Total Net Worth

Martingale – Remaining Bankrolls

Martingale – Final Net Worth Per Simulation
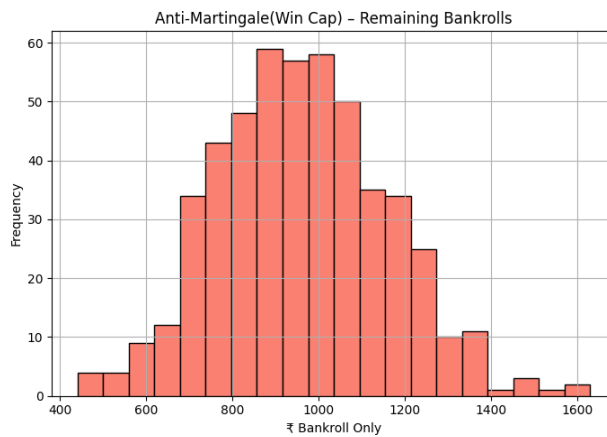
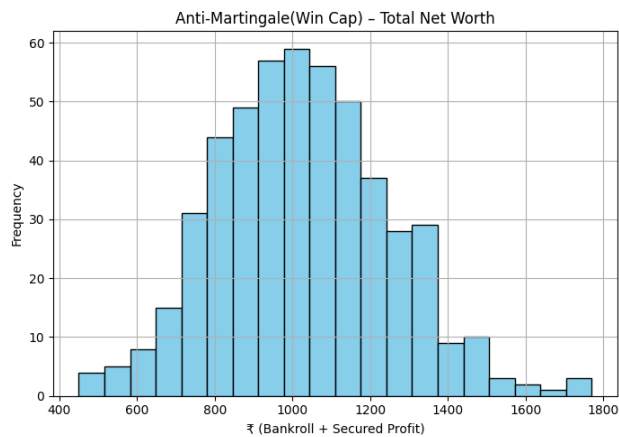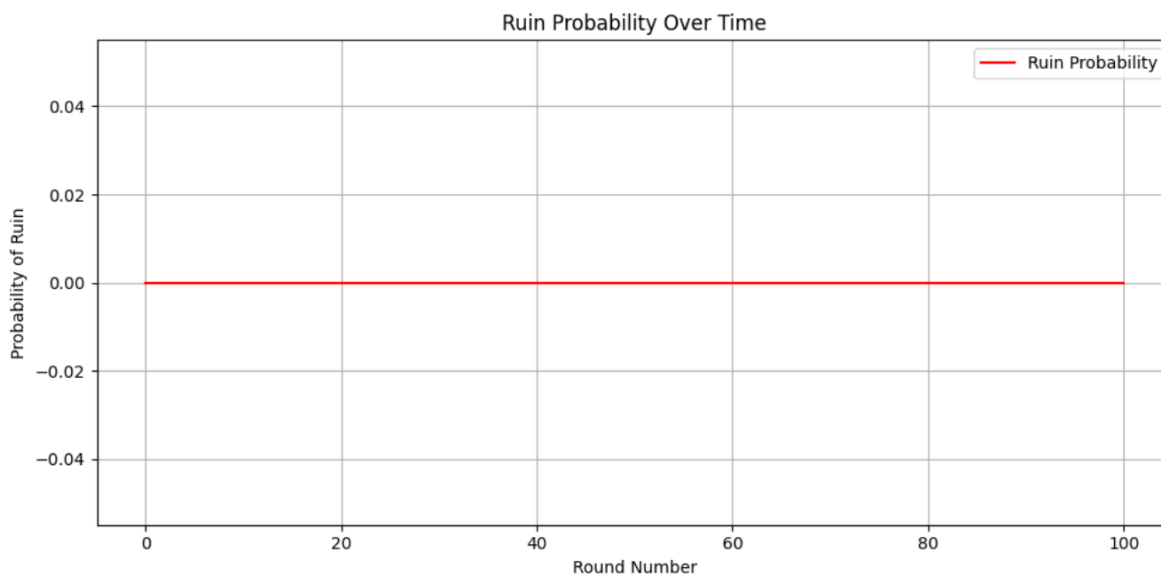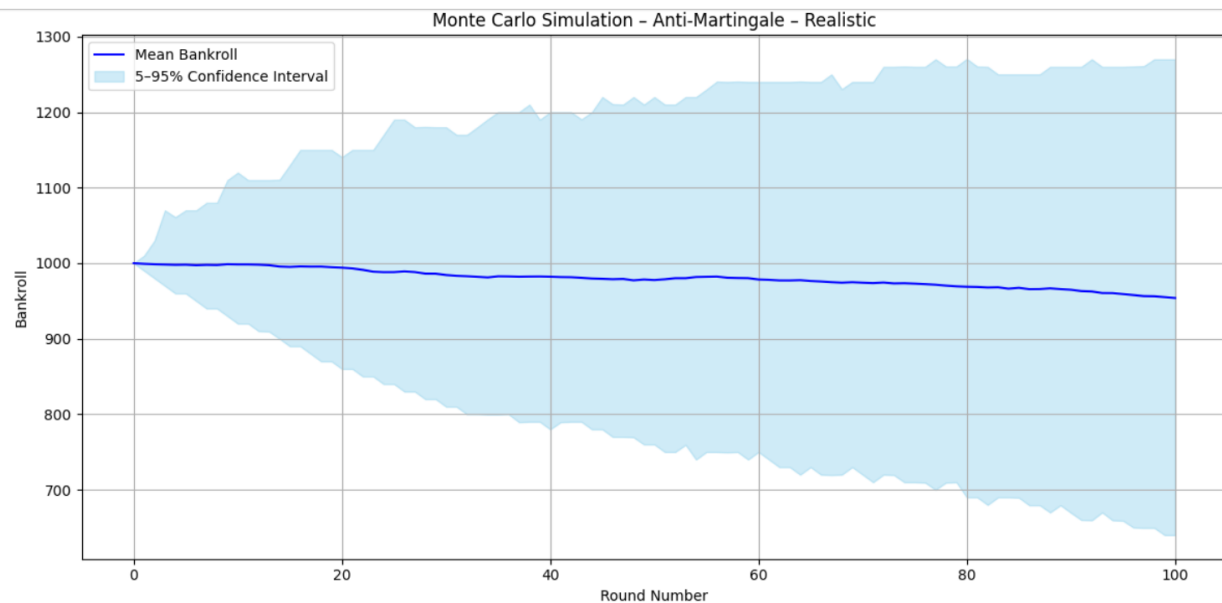# 3. Anti-Martingale Strategy (Reverse Martingale)

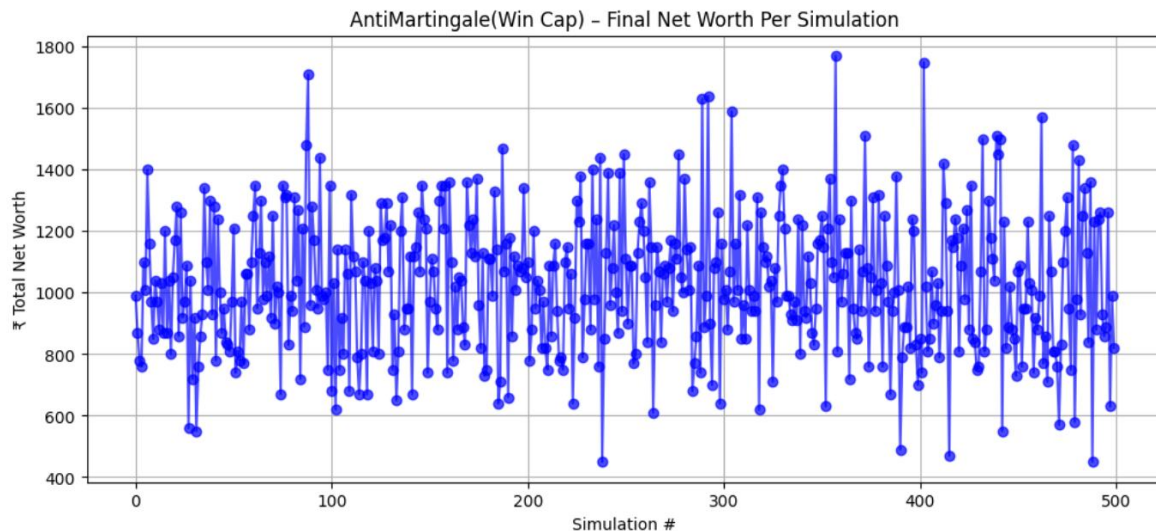**Definition:** - **Double your bet after a win**, reset to base bet after a loss.

Conceptual Motivation: - Emphasizes **riding winning streaks**, and cutting losses early.

Benefits: - Maximum loss per session = base bet. - Potential for high profit if winning streaks occur.

Cautions: - Still a negative EV game. - Requires profit-locking mechanism to be effective.

Conclusion: - **Better risk control than Martingale**. - Useful for short-term bursts with profit targets.

Monte Carlo Simulation – Anti-Martingale – Realistic

Ruin Probability Over Time

Anti-Martingale(Win Cap) – Total Net Worth

Anti-Martingale(Win Cap) – Remaining Bankrolls

AntiMartingale(Win Cap) – Final Net Worth Per Simulation

4. Kelly Criterion

Definition: - Bet a **mathematically optimal fraction** of your bankroll each turn to maximize long-term growth.

Formula: [f =] Where: - (f): fraction of bankroll to bet - (b): net odds received on bet (1 for roulette) - (p): probability of winning - (q = 1 - p): probability of losing

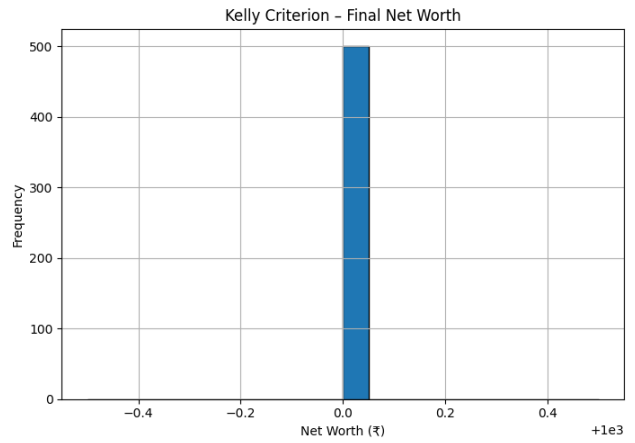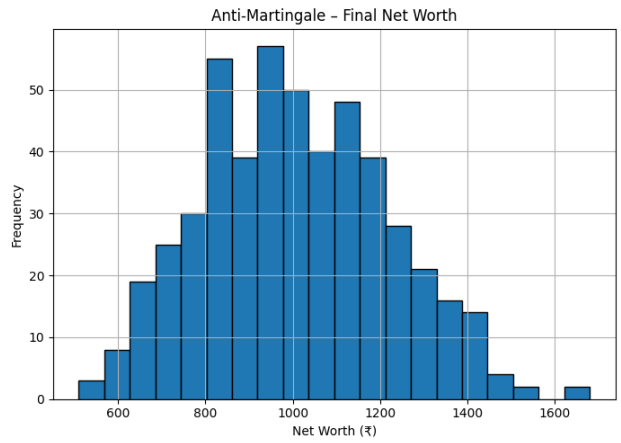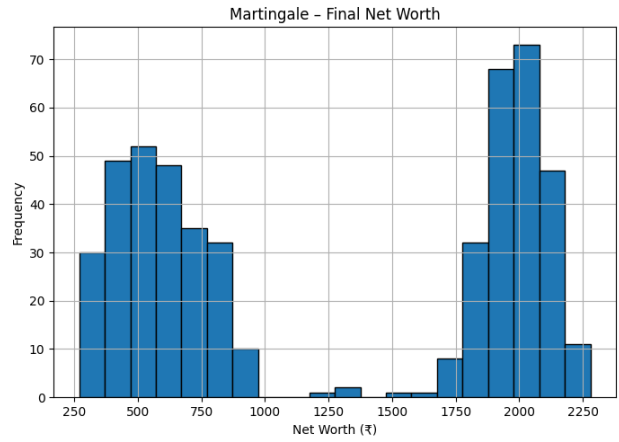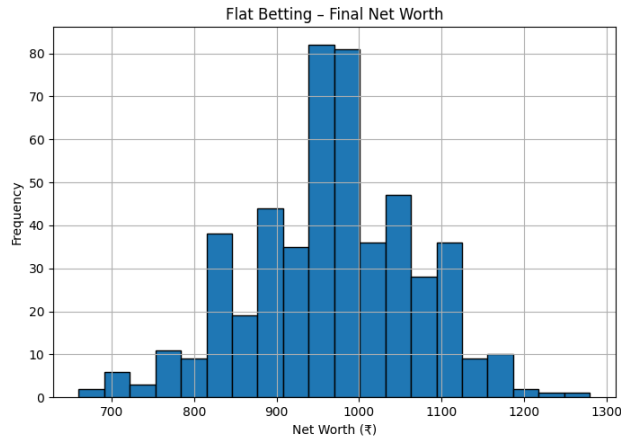**For European Roulette:** [p = , q = 0.514, b = 1] [f = = -0.028]

Interpretation: - **Negative Kelly fraction** ⇒ Don't bet - Kelly advises against any betting when expected value is negative.

Conclusion: - **Mathematically sound**, but confirms that: - **All roulette bets have negative EV**, so Kelly advises no betting.

Final Thoughts

- **Flat betting** is simple but slowly loses money.
- **Martingale** can win early but collapses under pressure.
- **Anti-Martingale** provides better loss control and works best with exit plans.
- **Kelly Criterion** highlights that **roulette is always a losing game** in the long run.

Roulette is fundamentally a game of chance with a **built-in house edge**. Betting systems may control **volatility**, but they **cannot eliminate the mathematical disadvantage**.

Flat Betting – Final Net Worth

Martingale – Final Net Worth

Anti-Martingale – Final Net Worth

Kelly Criterion – Final Net Worth

End of Report