Implementing Monte Carlo Simulations to Exotic Options: A Learning Journey

This project was aimed at studying –

- Monte Carlo Simulations
- Financial Mathematics
- Exotic Options
- Optimization Problems
- Statistical Visualization

Learning Outcomes

- Black – Scholes Model Implementation
- Analysis of Brownian Motion of Options
- Lagrange Multiplier (Penalty-based Optimization)

Barrier Options:

- **Knock-Out Option Price: $7,853.64** - Significantly higher due to the "insurance premium" for barrier protection
- **Knock-In Option Price: $684.57** - Substantially lower, reflecting the conditional activation nature
- **Barrier Hit Rate: 74.5%** - High probability of barrier breach given the parameters

Lookback Options:

- **Minimum Price Distribution**: Clustered around 87.70, showing consistent downside potential
- **Maximum Price Distribution**: Wider spread around 119.22, indicating volatility asymmetry
- **Path Behaviour**: Significant divergence between best- and worst-case scenarios

Barrier vs Lookback:

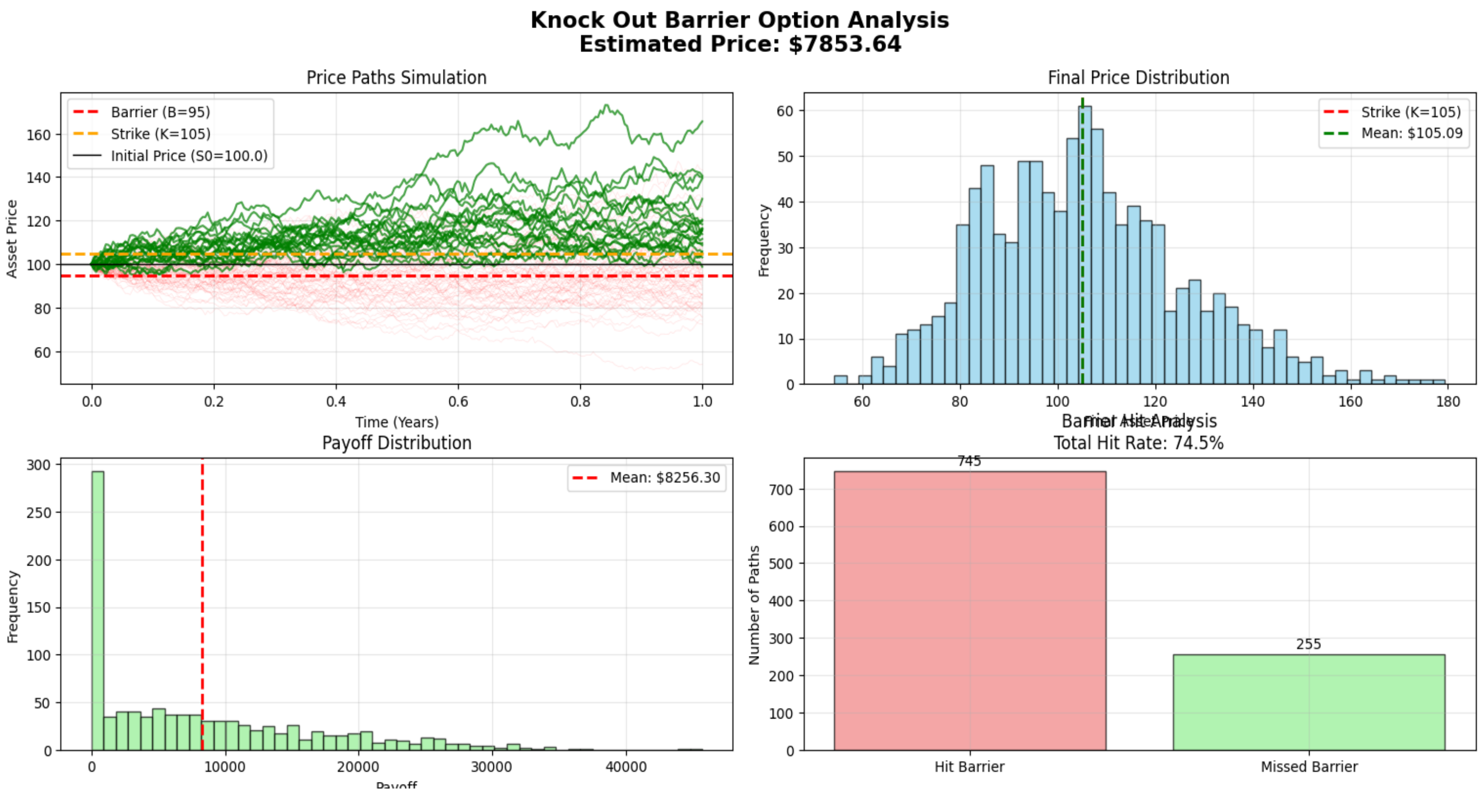
- BARRIER: Binary outcome (barrier hit/miss)
- LOOKBACK: Continuous optimization (always get best price)
- Risk Profile: Lookbacks eliminate timing risk entirely
- Cost Structure: Lookbacks more expensive due to guaranteed optimization

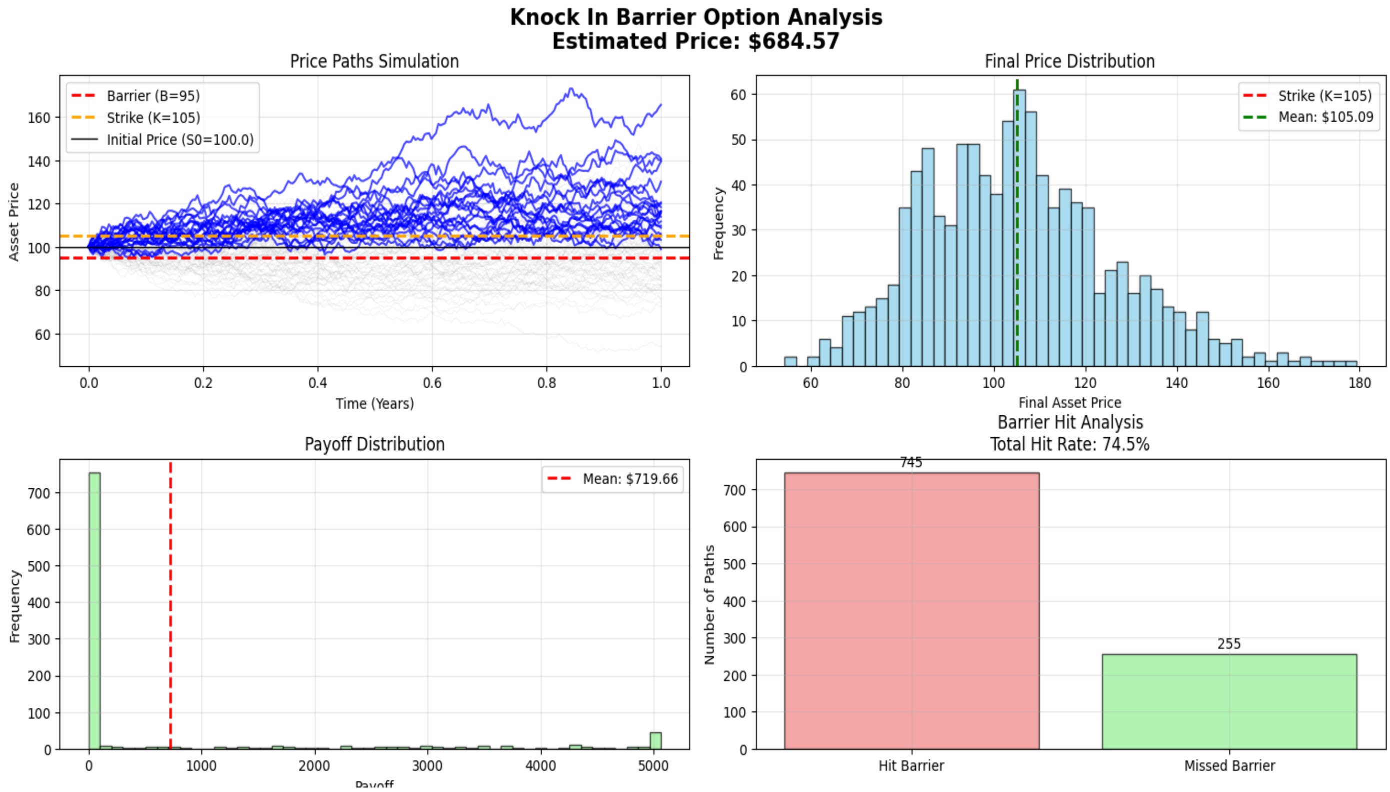
Conclusion:

Through this project, I learned that barrier options provide cost-effective protection when specific price levels are breached, while lookback options offer guaranteed optimal pricing at a higher cost. The comparison reveale d how exotic derivatives create flexible risk management strategies by balancing probability-based triggers against certainty-based premiums.

Visualizations:

Barrier Options -





LookBack Options -