



Pricing Exotic Options Using the Binomial Model

AMERICAN BARRIER OPTION

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Introduction

What Are Exotic Options?

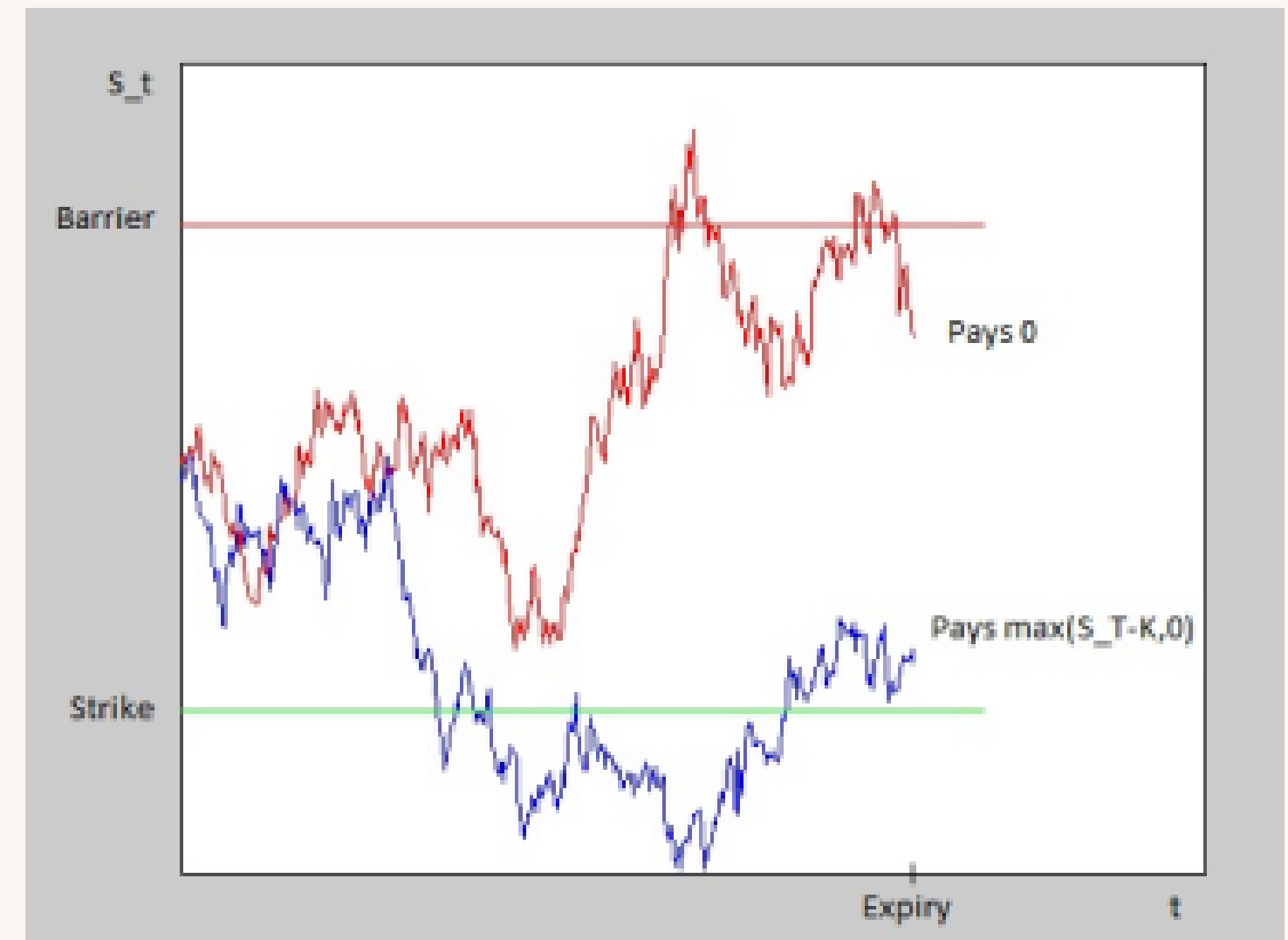
- Exotic options have complex features beyond standard options (e.g., barriers, multiple strike prices).
- Widely used in risk management, hedging, and speculative strategies.



Introduction

Barrier Option

- A barrier option's payoff depends on whether the underlying asset crosses a specific price level.



American Barrier Options

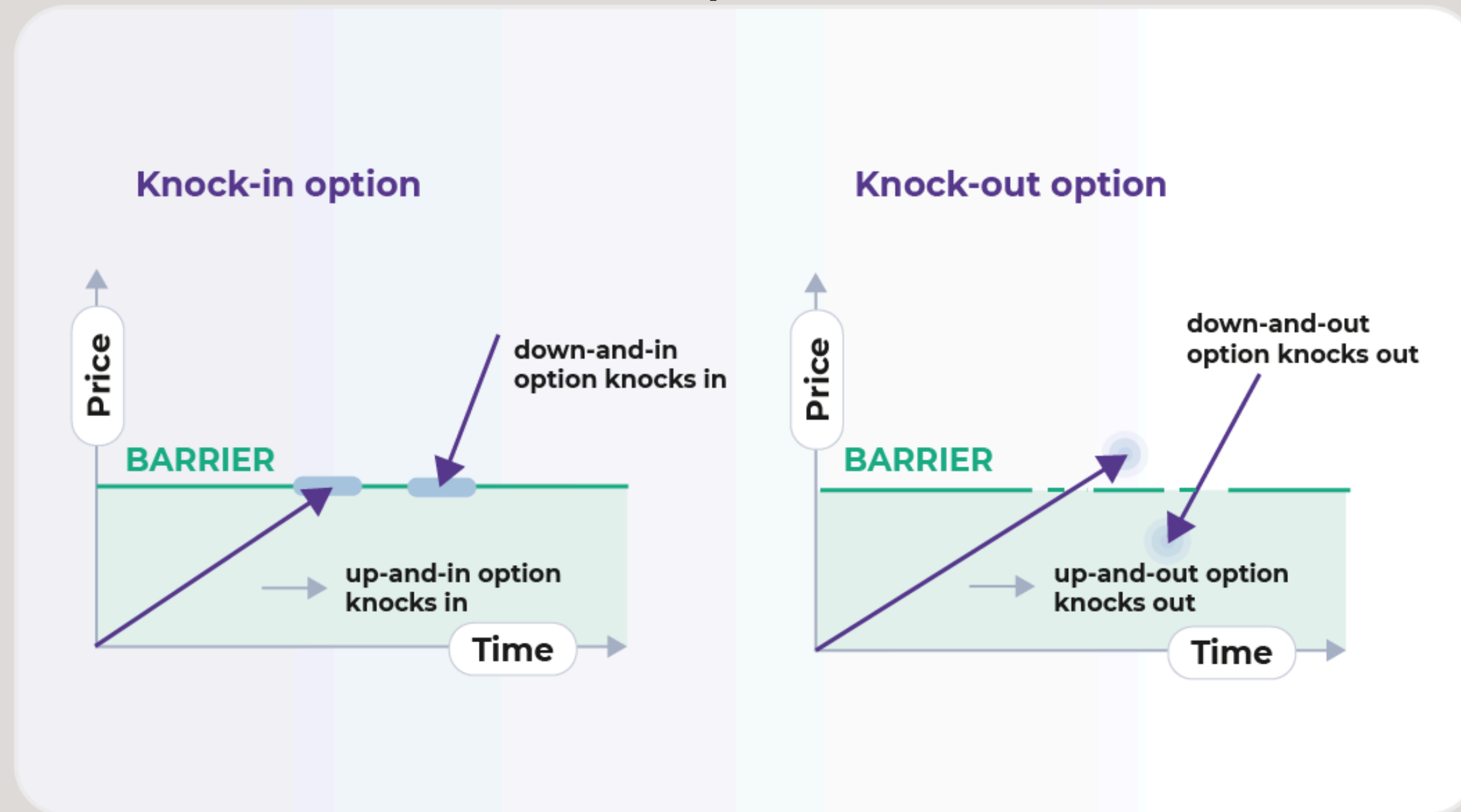
Combines features of **American options** (early exercise allowed) and **barrier options** (price dependency on a threshold).

Types:

- *Up-and-out*: Deactivated if the stock price goes above the barrier.
- *Down-and-out*: Deactivated if the stock price goes below the barrier.

Pricing is computationally challenging due to these combined features.

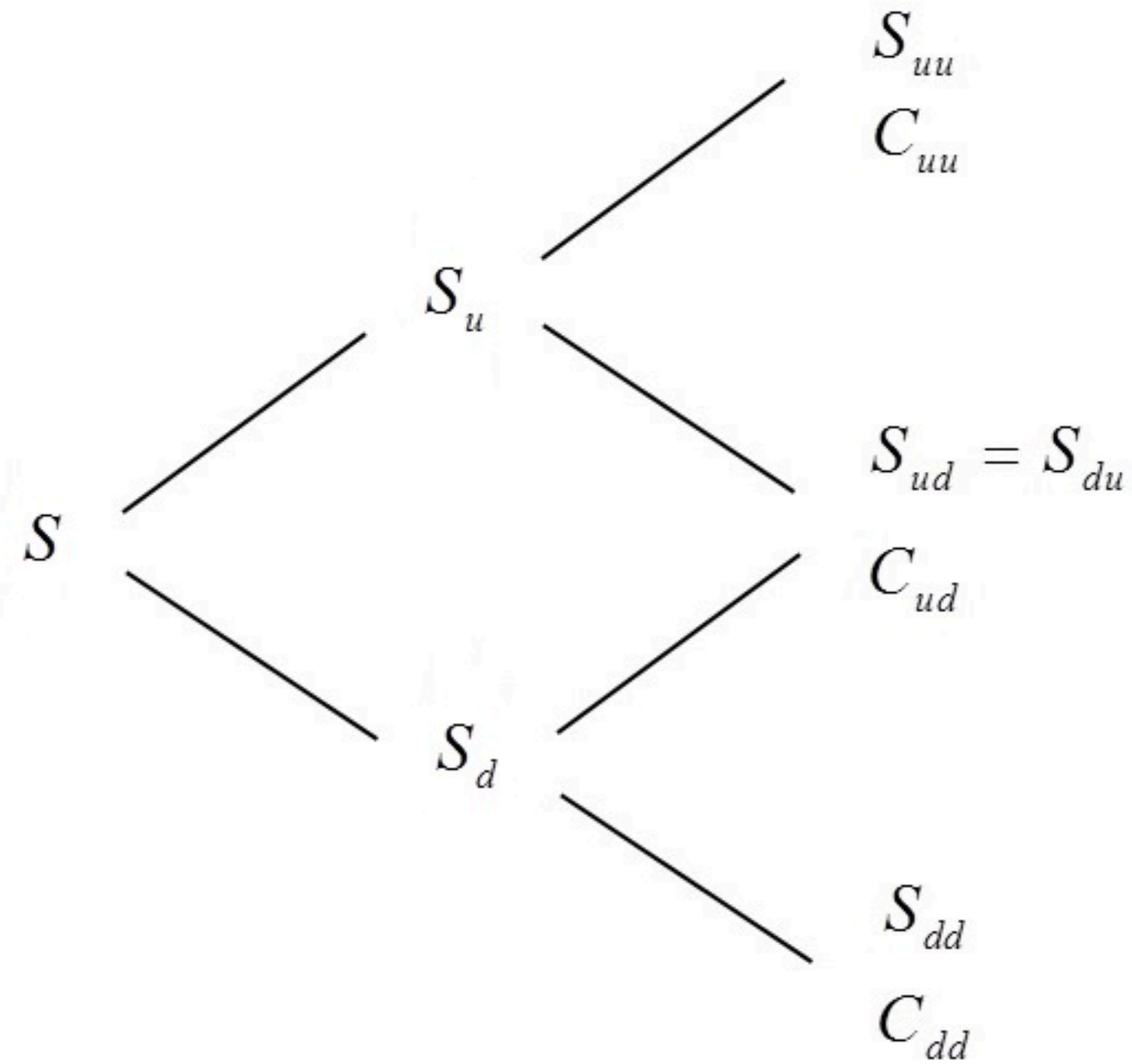
American Barrier Options



The Binomial Model

- A tree-based method to model stock prices in discrete time steps.
 - Stock prices evolve as up or down per step.
 - Factors:
 - Risk-neutral probability (p):** Assumes no arbitrage.
 - Discount factor:** Accounts for the time value of money.
 - Capable of handling early exercise and complex barriers.
-

The Binomial Model



Methodology – Build the Stock Price Tree

- Tree structure evolves from the initial stock price **(S₀)**.
- Stock prices at each node are calculated:

Up: S^*u

Down: S^*d

- Barrier applied at each node:
If stock crosses the barrier, the node becomes invalid.

Methodology – Option Value Calculation

Option values are computed backward:

- Maturity nodes: *Intrinsic value* = $\max(S - K, 0)$.
- Earlier nodes: $\max(\text{Continuation Value}, \text{Intrinsic Value})$.

If a node violates the barrier, the option value at that node is set to 0.

Implementation

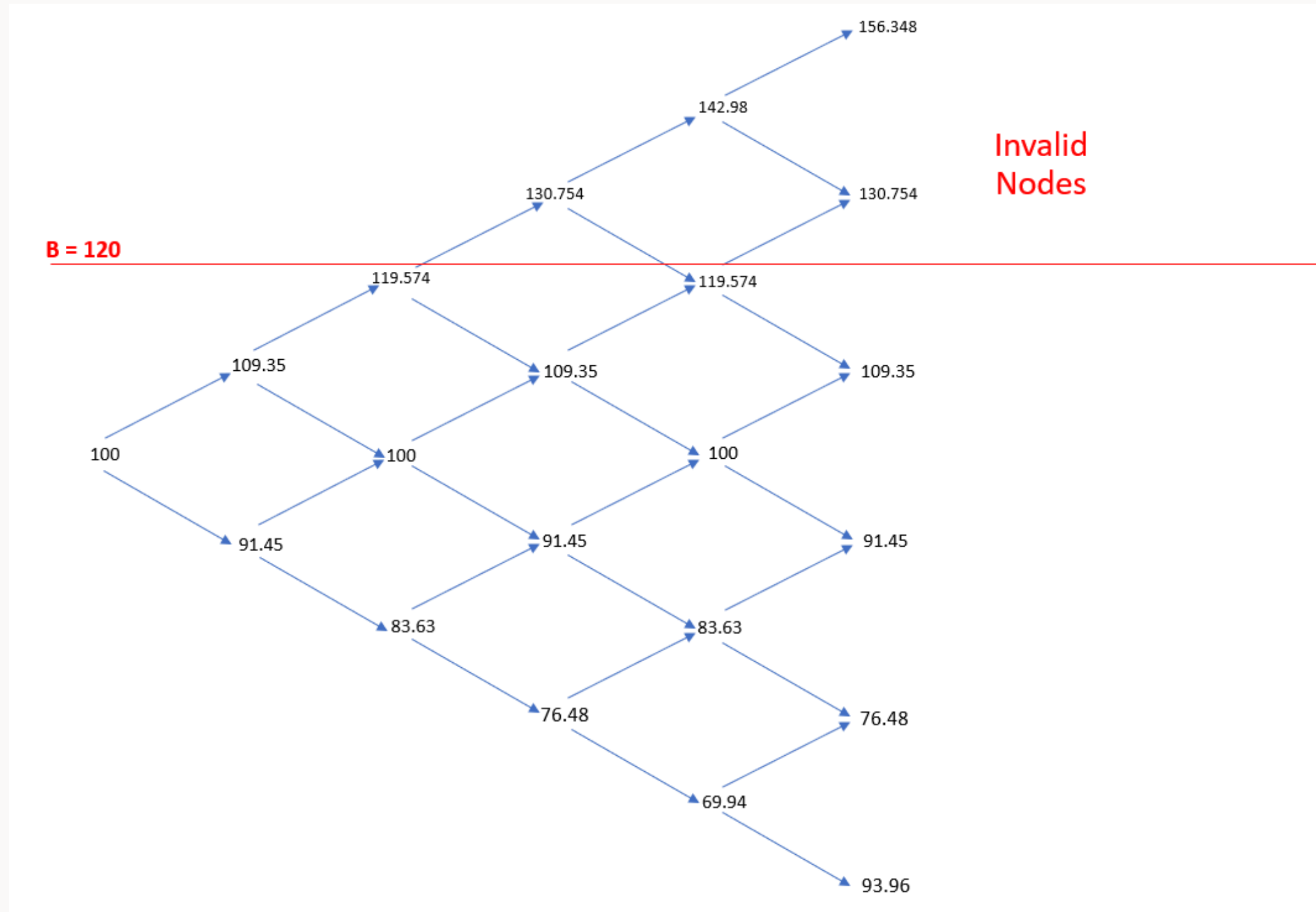


The code was implemented in **Python**, utilizing libraries for numerical computations.

Testing & Validation:

- Case 1: Standard call option, validating early exercise payoff calculation.
- Case 2: Up-and-Out Barrier Option, incorporating invalidation if the price exceeded

Results²



Conclusion

- Successfully priced an American barrier option using the binomial model.
 - The barrier condition adds complexity but can be modeled effectively.
 - The binomial model is robust and provides a good foundation for further refinement.
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Future Work

- Use finer grids for increased accuracy (higher N).
- Apply other numerical techniques (e.g., Monte Carlo, finite difference).
- Explore exotic options with multiple barriers or other complexities.

Thank you for
your attention!
