1 MC_w_barrier_activation.py

Purpose

Simulates multiple price paths for an underlying asset and checks whether a **barrier condition** (knock-in or knock-out) is triggered during the option's life.

Learning focus

- **Knock-in option**: Only becomes active if the barrier is hit during the life of the option.
- **Knock-out option**: Stops existing if the barrier is hit.
- Barrier monitoring is path-dependent — the *entire* price path matters, not just the final spot.

Key intuition

This script visually distinguishes:

- **Valid paths** (green) where the barrier was untouched.
- **Triggered paths** (red) where the barrier was hit.
  For risk managers, this shows why barrier options are cheaper: many simulated paths will never pay out because they never meet the barrier condition.

Experiment

Change barrier_level from 80 to 95 and see how the proportion of triggered paths jumps. This illustrates how a "close" barrier makes activation or knockout far more likely.

2 Payoff_vanilla_knockin_knockout.py

Purpose

Compares the payoff profiles at expiry for:

- Vanilla European call
- Down-and-In call (knock-in)
- Down-and-Out call (knock-out)

Learning focus

- In a **down-and-in call**, payoff is identical to a vanilla call *if* the barrier is touched; otherwise, it expires worthless.
- In a **down-and-out call**, payoff is identical to a vanilla call *only if* the barrier is **never** touched; if touched, it becomes worthless.
- Both structures typically cost less than vanilla calls because they carry the "barrier condition" that reduces the probability of payout.

Key intuition

Barrier options let traders tailor exposure. For example:

- A knock-in call is cheaper but only protects if the market first drops — useful for hedging after adverse moves.
- A knock-out call gives upside exposure but removes it if prices fall past a certain threshold, lowering premium costs.

Experiment

In the script, run $plot\_option\_payoffs(min\_price = 75)$ vs $plot\_option\_payoffs(min\_price = 85)$ to see how barrier activation completely changes the payoff shape.