

## 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.