1 MC_barrier_simulation.py: Monte Carlo Barrier Option Simulation

Purpose

Simulates **up-and-out barrier call options** to show how crossing a barrier cancels the payoff.

Learning focus

- Paths generated via **Geometric Brownian Motion** (GBM).
- Any path touching/exceeding the barrier results in **zero payoff** (knock-out feature).
- Highlights the role of path dependency: two paths with the same final price can have different payoffs depending on whether they touched the barrier.

Trading intuition

Barrier options are cheaper than vanilla because the knock-out condition reduces payoff probability.
Near the barrier, Vega and Gamma can spike as small moves may trigger or avoid the barrier.

Experiment

Lower the barrier from 125 to 110 and observe how more paths are knocked out.

2 Structured_payoff_diagram.py: Structured Product Payoffs

Purpose

Plots payoff profiles for three common structured products:

1. **Reverse Convertible** — fixed coupon but principal at risk below barrier.
2. **Autocallable** — periodic observation triggers early redemption with coupon payment.
3. **Capital Protected Note** — partial downside protection, participation in upside.

Learning focus

- Shows how payoff shapes differ from simple options.
- Explains the use of barriers, coupons, and participation rates in tailoring client risk–return.

Trading intuition

Structured products combine derivatives to match investor risk appetite. Knowing their payoff diagrams helps traders structure and hedge them.

Experiment

Change coupon or barrier levels to see risk/return trade-offs.

3 Swap_valuation_sensitivity.py: Interest Rate Swap Sensitivity

Purpose

Shows how fixed and floating legs' PVs evolve under different interest rate scenarios.

Learning focus

- Swap value = PV(fixed leg) – PV(floating leg).
- Yield curve shape and shifts affect each leg differently.
- Demonstrates **mark-to-market** concept and rate risk.

Trading intuition

Swaps are used to exchange fixed and floating rate exposures. Rate shifts can create gains or losses even if the swap started at zero value.

Experiment

Switch the yield curve from normal to inverted and see how fixed vs floating PVs invert.

4 Vega_exposure_near_barrier.py: Barrier Effects on Vega and Gamma

Purpose

Shows how Vega and Gamma behave near a barrier using a simple adjustment to the Black–Scholes sensitivities.

Learning focus

- Vega increases when close to a barrier due to heightened uncertainty about knock-out.
- Gamma also rises but to a lesser extent.
- Introduces concept of **barrier zone risk** for hedging.

Trading intuition

Traders monitor Greeks near barriers closely; a knock-out event can cause large position shifts in hedging needs.

Experiment

Widen the barrier zone (±5) to see a more gradual Vega/Gamma change.