SOFR PRICING TOOLKIT — README

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Overview

This toolkit provides Python building blocks for pricing and risk of SOFR-linked products: • SOFR 3M futures (CME SR3 contracts) and Black-76 options on those futures • OIS (SOFR) swaps • Caps/Floors (sum of Black caplets) It produces Greeks (Delta, Gamma, Vega), DV01s, carry/roll-down, IMM pack/bundle risk, and tidy reports (CSV + Excel).

What the Toolkit Computes

The library is organized into modular functions, each of which can be imported independently. Highlights include: • **Discount Curves:** Classes for flat and piecewise-flat zero curves. These expose P(t), forward rates, and can be bumped for sensitivity analysis. • **Futures:** Functions to derive forward rates from discount curves and convert them to CME SOFR futures prices (100 – rate%). For futures options, Black-76 pricing is implemented, returning not just the price but also analytic Delta, Gamma, and Vega. • **Swaps:** Generators to create payment schedules, par-rate solvers, PV and DV01 calculators. Includes key-rate DV01 reports (bump each node of the bootstrapped curve), IMM pack/bundle DV01 aggregators, and theta/carry explainers that split daily PnL into fixed accrual, float accrual, and roll-down components. • **Caps/Floors:** Caplets priced with the Black model. Each caplet exposes Delta to the forward, Gamma (second derivative), and Vega. The toolkit rolls these up into bucketed vega reports to show exposure by maturity. • **Reports:** Helper scripts combine these primitives to produce CSVs and an Excel workbook with consistent column names. This includes: - Key-rate PV01s per swap per tenor - IMM pack and bundle DV01s for curve hedging with futures - Swap theta/carry breakdown (1 business day roll) - Cap vega term-buckets - Validation recomputes for futures, options, swaps, and caplets By keeping the functions small and composable, you can slot in new instruments (e.g., swaptions, basis swaps) or new models (e.g., SABR vol surfaces) without rewriting the existing code.

General CME SOFR Futures and Options Knowledge

CME SOFR futures (SR3) reference the compounded SOFR rate over a 3■month accrual window starting on IMM dates. The quoted price is 100 – (implied average SOFR %). Options on SOFR futures are European■style, expiring on the IMM start date, and Black■76 is the standard model. Delta, Gamma, and Vega describe the option’s sensitivity to forward rate, curvature, and volatility, respectively.

Cap/Floors, Futures, Options, and Swaps in Hedging

Swaps provide long■dated fixed vs. floating exposure. Futures are liquid short■end hedges. Options on futures manage volatility and convexity. Caps/floors provide asymmetric tail protection. In practice, dealers combine these: futures to hedge swap DV01s, futures options to cover convexity or vol exposure, and caps/floors for asymmetric balance sheet protection.

Conventions & Notes

Day-counts (ACT/360, ACT/365F, 30/360), curve bootstrap via par OIS, frozen-curve carry assumption, and NYSE/NY Fed style calendars are built in. Volatility is lognormal (Black). Futures convexity adjustment is approximate. Replace or extend with your house models as needed.

Next Steps

Replace the simulated CSVs with real market quotes and trades. Extend the toolkit with swaptions, SABR smiles, and integrate into PnL explain workflows.