Exploring

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Abstract

This document explores the Object-Oriented Programming (OOP) structure in finance using Python. We will discuss the code in the following repo

1 Introduction

In this document, we will examine the Object-Oriented Programming (OOP) structure of financial models implemented in Python. The primary classes involved are `VolatilitySurface`, `Model`, and `Asset`.

2 Volatility Surface Class

The `VolatilitySurface` class is responsible for developing the SVI (Stochastic Volatility Inspired) volatility surface. This process involves the following steps:

1. Data Retrieval: First, we collect data from publicly available tickers. This data includes options prices, implied volatilities, and other relevant information.
2. Data Transformation: We transform the collected data to suit our needs. This transformation includes recoding variables and introducing new ones. For example, we calculate the time to maturity (`ttm`), moneyness, and the market volatility
3. **SVI Calibration**: With the transformed data, we calibrate the SVI model using the following equation:
$$w(k, \chi_*) = a + b\left\{\rho_{svi}(k-m) + \sqrt{(k-m)^2 + (\sigma_{svi})^2}\right\}.$$
Here, $w(k, \chi_*)$ represents the SVI implied volatility, and a, b, ρ_{svi}, m, and σ_{svi} are calibration parameters.
4. Table Generation: The `VolatilitySurface` class generates a table that contains the calibrated SVI parameters for all dates in the dataset. This table allows us to analyze how the parameters evolve over time and make informed decisions in financial modeling.

3 Model Class

The `Model` class serves as the base class for various financial models, including Black-Scholes (BS), Heston, Stochastic Volatility Jump (SVJ), and Stochastic Volatility Compound Jump (SVCJ). It contains abstract methods for put-call pricing, delta, gamma, implied volatility calculation, path simulation, and Fast Fourier Transform (FFT) pricing.

This class defines essential methods and attributes shared by all models. The primary goal is to calibrate each model to the market volatility, leveraging the data from the `VolatilitySurface` class.

4 Asset Class

The `Asset` class is responsible for managing financial assets and generating CSV files. It includes methods for writing data to CSV files and plotting relevant financial graphs.