

Introduction

These are notes on the theory of fixed income derivative pricing, running from the construction of the Itô integral to how a swaption book is quoted, hedged and risk-managed. They aim to be self-contained at graduate level: where a step needs an argument, the argument is given, and where a piece of mathematics is needed — functional analysis, Lie algebras, spectral theory — it is introduced rather than gestured at. They began as my own notes, written while learning interest rate modelling and collected over years from books, papers and colleagues; I make no claim to originality.

What they try to add is organisation. The industry's ideas are scattered across a literature written for other purposes. A reader — a junior quant, or anyone who has to work with interest rate derivatives — after finishing these notes should be able to do more than recite what the models say: choose one for a problem, extend it when it does not fit, know which of its assumptions are load-bearing, and see where the mathematics and the history came from. What they are not is an implementation manual; the accompanying code exists to check the notes' claims rather than to serve as a template for a production system. The modelling choices are the subject.

That emphasis is deliberate. Derivative pricing has accumulated a zoo of models that are not competitors in a contest one of them wins — each was designed under constraints, often how little compute was available at the time, and a model's form is a record of them. So the skill worth building is navigating that zoo: why a model has the shape it has, what it can and cannot be made to fit, what breaks when it is extended, how to test whether it does what one believes, and what its compromises cost on a desk. The same questions recur throughout — where solvability is genuinely needed and where modern numerics has removed it, which old compromises are still necessary, and what a model's failures look like in a profit and loss report rather than a norm. Chapter 25 collects the answers.

Every quantitative claim in the prose — every rate, ratio and comparison — is computed by the Rust crate published alongside the notes and pinned by a test, with closed forms cross-checked against an independent route that shares none of their algebra. Figures come from the same crate. The notes are revised often — chapters are added, split and reordered — so the revision date on the title page is the one to trust. They are also a work in progress rather than a finished text, and the latest version is always at <https://www.sarthakbagaria.com/notes/derivativepricing/>.

These notes are a personal project, not affiliated with, endorsed by, or the responsibility of any employer, past or present. They have also been extended and revised with AI assistance — several chapters, the figures and the accompanying code were written that way — but every figure is drawn by published code with tests beside it, so the numbers can be checked rather than taken on trust. The errors that remain are mine, and I would be glad to hear about any that are found.