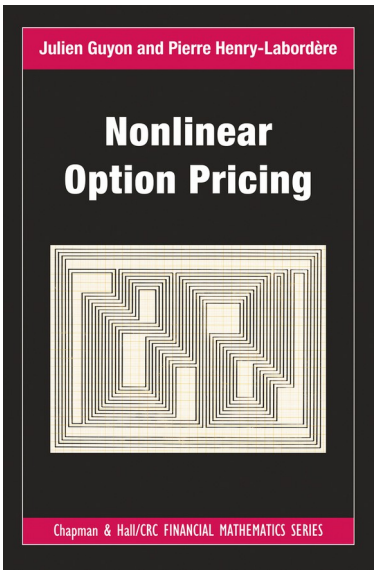
Review of the book

Nonlinear Option Pricing

by Julien Guyon and Pierre Henry-Labordère

Chapman & Hall/CRC, 2013



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As a variation on usual reviews, let me start with my conclusion: anyone with interest in quantitative finance *and* partial differential equations / continuous time stochastic analysis and will greatly enjoy the book of Guyon and Henry-Labordère.

The ambition of this book is huge as is most evident from its content: Chapter 1 is mostly a review of classical linear PDEs arising in mathematical finance, as found in many classical texts. But even here the reader will find new material, drawn from the authors industry background. Chapter 2 is a brief review on the basics of Monte Carlo, which sets the numerical stage for much of the rest of the book. In Chapter 3 the authors cover, amongst other material, utility indifference pricing, quantile hedging, and P&L variance minimization, providing a first appearance of nonlinear pricing examples (and then PDEs, in Markovian settings). Chapter 4 is a crash course on nonlinear second order parabolic PDEs, based on the viscosity approach which has proved so decisive in stochastic control. In Chapter 5 the authors present a collection of examples of nonlinear PDEs arising in quantitative finance (American-style options, the uncertain volatility model, transaction costs, illiquid markets, pricing under delta and gamma constraints ...). Chapter 6 is devoted to American-style options and, accordingly, starts with a discussion of variational inequalities. Chooser options are introduced as generalization of American options, but also multi-asset convertible bonds, passport options etc. are looked at in

detail and illustrate primal and dual methods. Chapter 7 is devoted to backward stochastic differential equations, which provide a stochastic view on certain non-linear PDEs, with a remarkable extension to fully non-linear equations, known as 2BSDEs. Chapter 8 deals with a model ("lapse and mortality") used for reinsurance deals and the authors make a link to BSDEs. In Chapter 9, the pricing of options in "uncertain volatility" is investigated, especially from a 2BSDE perspective. Chapters 10-11 deal with nonlinear (McKean-Vlasov type) SDEs and some derived interacting particle algorithms, especially aimed at calibration of generic local stochastic volatility models (a key ingredient to Henry-Labordère's Quant of the Year award in 2013), Chapter 12 is a similar-in-spirit extension to the calibration of local correlation models. Finally, Chapter 13, introduces a method based on branching diffusions for solving high-dimensional nonlinear PDEs, pricing of counterparty risk being an application.

Such a variety of topics, in one book, comes at a price. The textbook style illusion created in the first chapters, is soon replaced by the author's desire to present latest findings, with a natural tendency to be more detailed on what they have been personally involved with (especially Chapter 8, it seems, and then from 10 on). The authors are also not afraid of presenting numerical algorithms, successfully implemented, which still await their final mathematical justification.

Leaving formal criticism aside (such as several hard-to-see black-white figures, plainly multi-coloured in a previous excel life) it is time to repeat and detail the conclusion of this review: anyone with interest in quantitative finance *and* partial differential equations / continuous time stochastic analysis will not only greatly enjoy this book, he or she will find both many numerical ideas of real practical interest, as well as material for academic research, perhaps for years to come.