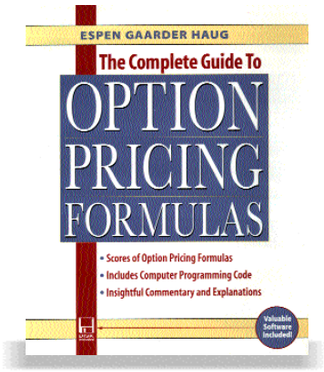
Book reviews

Alireza Javaheri considers the Keith Richards of quantitative finance, amongst other things



The Complete Guide to Option Pricing Formulas

Espen G. Haug 1997

McGraw Hill Professional

The Rolling Stones are on tour again. I always thought that Keith Richards was the single most under-appreciated guitarist of our times. Sure, everyone loves him. Everyone thinks he is a character and is funny. But few are those who recognize him as one of the greatest rock guitarists ever. Everybody says "Clapton is God" or "Hendrix was the Greatest" … I've never heard something similar about Richards. I guess sometimes image gets in the way of true value.

I'd like to think of Espen Haug as the Keith Richards of the quantitative finance world. With his famous nickname "The Collector" and his unique sense of humor, he has become quite a celebrity. Plus, every quant I know has a copy of *The Complete Guide to Option Pricing Formulas* on their desk.

And yet most people don't realize that in addition to his Terminator-like looks and his having collected a bunch of formulae in the form of a book, the man is a brilliant trader and a brilliant quant.

How do I know this? I was fortunate to work with him and Paul Wilmott on a paper last year. Espen brought up a lot of interesting points that only an experienced trader could have known about. At the same time he was able to play with the formulae as well as any math-wiz I'd ever seen.

At first sight it might appear an easy task to collect a number of well known financial equations. You might think that anyone can do that, and the only reason he became famous was that he was the first one.

Big mistake! The book, *The Complete Guide to Option Pricing Formulas* contains not only a thorough description of every major financial model, but also very insightful and astute interpretations and comments.

From Black-Scholes to Derman-Kani, from Binomial Trees to Monte Carlos, from Equity Derivatives to Fixed Income Derivatives … nothing is left out. Not to mention detailed numeric examples, which help us truly understand the abstract concepts. And for those who don't feel like doing any work, he also provides the software to price these exotics. You have to admit; it can't get any better than this!

Let us take an example. The Derman-Kani technique. On the 125th page of the book, in the middle of the chapter on "Numerical Methods in Option Pricing" you see "Recent Developments" where he first explains (in detail and with references) the construction of the implied binomial tree. He then gives an explicit numeric example of this technique. Further, a new paragraph is dedicated to implied trinomial trees and yet another detailed numeric example is provided. Finally an actual computer algorithm for implied trinomial trees is given.

What I am trying to say is this. True, you don't have to read this book to learn about implied trees. True, you can go and read the original Goldman Sachs Quantitative Research papers on the same subject. Only, it will take you ten times longer! Just think of this as an executive summary. It's good for your ego. Trust me.

The truth of the matter is that if I am being so positive about this book, it's because I know for a fact that it has saved lives more than once.

Imagine that you are a nice desk-quant having an ordinary workday, drinking your coffee innocently and browsing the Wilmott Forum … all of a sudden an angry trader comes to you and wants to price such and such exotic product immediately. You then realize that you don't have a model ready for that specific product and you're not sure how to build one fast. You have two choices: Tell the trader you have to think about it and it will take a while (but then you might get bazooka-ed out of the trading-floor) or, you say no problem and rush to your *Complete Guide to Option Pricing Formulas*, find the model, code it up and look like a hero.

By the way, just in case you still have not realized where the nickname comes from, here is a paragraph from the Introduction of the book:

"Some people collect stamps; others collect coins, matchboxes, butterflies or cars. I collect options pricing formulas. The book you have before you is a copy of this collection. As opposed to cars, one can easily share a collection of options pricing formulas with others. A collection like this would naturally not have been possible if it weren't for all the excellent researchers both in academia and in the industry who willingly share their knowledge in various publications.''

A new edition of the book will be coming out next year. Espen himself always says that the title of the book is the *The Complete Guide to Option Pricing Formulas* but it will never be really complete.

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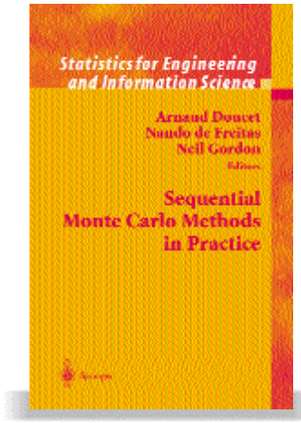

Sequential Monte Carlo Methods in Practice

Arnaud Doucet, Nando de Freitas, Neil Gordon (Editors) 2001

Springer Verlag

Like most immature individuals, I've always wondered, what is the best way to impress people on the street? Of course it depends on the people.

Showing off your wealth always works. And it's easy too, if you have it. Just how many will turn to look at your Ferrari or at your Rolls-Royce? Not that I've ever had a chance to do this myself, but growing up on the French Riviera, I have turned to look more than once.

Another way to impress people would be to show off your knowledge. Now this is a little subtler. To me, unless you have a Nobel Prize and carry it on you, as Myron Scholes does, the next best thing is to a yellow Springer book and pretend you have read and understood most of it.

Well this is your lucky day: The book I am talking about is a Springer. Only, it is an Engineering book and therefore it's practical and useful as well.

Being a regular and serious reader of *Wilmott*, I am sure you know that last time I talked about the Kalman Filter and its importance in Time Series Analysis. I also mentioned its limitations and need for improvement. Well, here you are. This book presents exactly the state-of-the-art improvements that you need for a better calibration. It is a compilation of recent articles by many theorists and practitioners. The most important part of the book is "Part I" where the actual concepts of Sequential Monte Carlo technique and Particle Filtering are explained.

Now I know you remember this well, but just in case, I am going to quickly repeat what I had said last time:

"Imagine that you have a model where an observed entity $z[t]$ is a function of an unobserved state variable $x[t]$ where t indicates time as usual. The purpose is to determine as closely as possible the distribution of $x[t]$ given our observation $z[t]$. Calling the corresponding probability density function $p(x[t]|z[t])$ the idea therefore is to estimate this function iteratively.

In order to do that we need to proceed in two steps: first we determine $p(x[t]||z[t-1])$ from $p(x[t-1]||z[t-1])$ by applying the Chapman-Kolmogorov equation, and then we deduce $p(x[t]||z[t])$ from $p(x[t]||z[t-1])$ by applying Bayes theorem. The first step is called a Time Update and the second one a Measurement Update."

Nine times out of ten, people assume Gaussian noise and therefore determine the distribution via its mean and variance. As we saw, the Kalman Filter and its non-linear extensions do that quite well.

In this book, however, dozens and dozens of brilliant and famous researchers present a case for a Monte Carlo based filter that would generalize the above to the non-Gaussian case.

We all know that in order to estimate an integral with a Monte Carlo technique we need to sample from the state distribution. There is a well-known technique called Importance Sampling where a simple proposal distribution is chosen to sample from. We would then introduce weights in the sum, in order to compute the original integral. The sampled points are called particles.

OK, Nothing really new so far. Importance Sampling has been done and redone. The novelty here is the concept of Sequential Importance Sampling:

We make an assumption about the chosen proposal distribution. The assumption being that it has the Markov property. From this simple but fundamental assumption a whole new world of sexy equations offers itself to us. Indeed, we will be able to compute the importance sampling weights iteratively and update the state estimates at each time step.

As if this was not enough, the authors then go on and describe the problems of this technique, among which is a degeneracy issue, meaning that after a few iterations all but a few particles will have a negligible weight. They then suggest a solution to this: The Resampling technique, where we eliminate the particles with too small a weight and repeat the other ones. They even underline a possible problem with this Resampling algorithm, which is called Sample Impoverishment, and they suggest a solution to this issue as well...

So don't you say they haven't done anything for you!

But it's not all theory. Best thing is, there are a lot of cool applications thoroughly explained in the book: From aeronautics to image recognition, to our own beloved stochastic volatility. .. And since we are all part of the respectable quantitative finance community, let us take the example of the latter.

Chapter ten of the book, entitled "Combined Parameter and State Estimation in Simulation-Based Filtering" written by Jane Liu and Mike West, first gives the framework for the filtering of the state variable. Then it describes an algorithm for the model parameter treatment. The example the authors choose is the Factor Stochastic Volatility where the hidden state and the model parameters are estimated and filtered simultaneously. They then use various Exchange Rate Time Series for illustration purposes ...

With all this stuff I gave you, you have enough material to impress a whole bus full of people. If not, something is fundamentally wrong with your fellow passengers. You might be in Juan-les-Pins or something.