
Preface

Financial mathematics has recently undergone a considerable development, due mainly to new financial instruments that have been introduced in order to limit the risk in financial operations. The study of problems related to such instruments requires mathematical techniques that occasionally may be rather sophisticated and are to a great extent related to Probability.

Consequently, the financial institutions now offer job opportunities not only to economists, but also to experts in scientific-technical disciplines, in particular in mathematics. With the Bologna Accords the so-called 3+2+3 (bachelor-master-doctor) curriculum has been introduced in various countries with the intention that students may enter the job market already at the bachelor level. It thus turns out to be appropriate to have a financial mathematics course already at the bachelor level. Most mathematical techniques in use in financial mathematics are related to continuous time models and require therefore notions from stochastic analysis that are in general not familiar not only to economists but neither to mathematicians at the bachelor level. It is thus desirable to be able to transmit to bachelor students the basic notions and methodologies in use in financial mathematics without the technicalities from stochastic analysis that are inherent in continuous time models. This can be achieved by using discrete time (multi-period) models instead. On one hand they generalize to a dynamic context the one-period models that are still in wide use by economists, on the other hand they can also be seen as possible approximations to continuous time models. Multi period models have however also a genuine interest in their own and this also in view of possible practical applications.

The present volume is intended as a possible textbook for a course as described above and is the result of the teaching experience of the authors in the area of financial mathematics. For multi-period models there do not exist many textbooks (one of the best known is [18]) and so one of the purposes of the present volume is to fill in this gap. Although conceived mainly for a bachelor-level course in mathematics, the volume should also be appropriate for quantitative finance courses for economics students.

Evidently, we could not take into account in this book all possible topics in financial mathematics and so we have confined ourselves to those that one may consider as basic ones. The structure of the book originates from the idea of teaching by examples and counterexamples. It has been expanded beyond the examples to become a complete textbook that includes also the necessary theory. Consequently, and differently from other textbooks, this one includes many examples and solved problems. In this context we want to mention also [21] that contains examples for the specific binomial model and [19] that includes problems both from discrete as well as continuous time models.

The majority of the solution methods for multi-period models is based on recursive algorithms, for which the computational complexity increases considerably with the number of periods. In practice one has therefore to use computer programs to implement the algorithms. For problems in classrooms and at exam sessions it is therefore appropriate to limit oneself to situations where calculation can be performed “by hand”. For this reason, in the examples and problems suggested in the book we consider small numbers of periods and numerical data that may not correspond to realistic situations but allow for easier calculations.

The book is divided into four chapters, in which we treat the following topics:

- pricing and hedging of European derivatives;
- portfolio optimization (dynamic programming and “martingale method”);
- pricing, optimal exercise and hedging of American derivatives;
- multi-period models for the term structure of interest rates.

Each of the four chapters consists of two parts: a theoretical section and a problem section. In the latter section we describe in detail the solution for many possible problems.

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Financial Mathematics

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