Preface

This book is about optimizing in the presence of uncertainty. Due to uncertainty, one needs to exercise caution, and optimization must accommodate the uncertain elements that are present in the problem. A scenario is an instance of uncertainty, and a scenario program is an optimization program that incorporates a sample of scenarios. The fact that only a finite sample of scenarios is considered makes the problem tractable, while theoretical results establish rigorous ties between scenario solutions and the original uncertainty problem.

The scenario approach has been given a solid mathematical foundation in recent years, and it is rapidly evolving at the time this book is being written. Our goal here is not completeness, instead, we mean to provide the reader with easy access to the scenario methodology, leaving to the literature the task of providing more-in-depth presentations. Many pointers to the literature will be given along the way.

Scenario optimization can be applied across a variety of fields, including machine learning, quantitative finance, and control, so this book targets a vast audience. It is intended not only for practitioners, who can find here "easy-to-use recipes," but also for theoreticians, who will benefit from a rigorous treatment of the theoretical foundations of the method.

This book has a bottom-up structure. We start with a broad presentation that covers a rapid exposure to many aspects relating to the scenario approach, and then we guide the reader through various chapters that present material that is more detailed. This material covers a selected set of theoretical results, some applications, and a discussion on the interpretation of the method.

In order to keep the book focused, only a sample of fundamental proofs is presented. At times, we shall just hint at various issues, rather than fully developing them. The chapters are linked to one another according to the scheme presented in Figure 1, where an arrow indicates that the reading of a chapter is best done after the reading of the parent chapters has been completed.

This book was partly motivated by the lectures that we taught for four consecutive years, from 2012 to 2015, at Supelec—Orsay, Paris Sud—as part of the EECI International Graduate School on Control. We are gratefully indebted to Françoise Lamnabhi-Lagarrigue for her commitment towards promoting and organizing this school. Later, presentations of portions of this book were delivered at the NASA–Langley Research Center, USA, at the Politecnico di Milano, Italy, at Texas A&M University, USA, and at the University of Melbourne, Australia. We thank all the people who have contributed to improving and consolidating this material through their comments and suggestions.

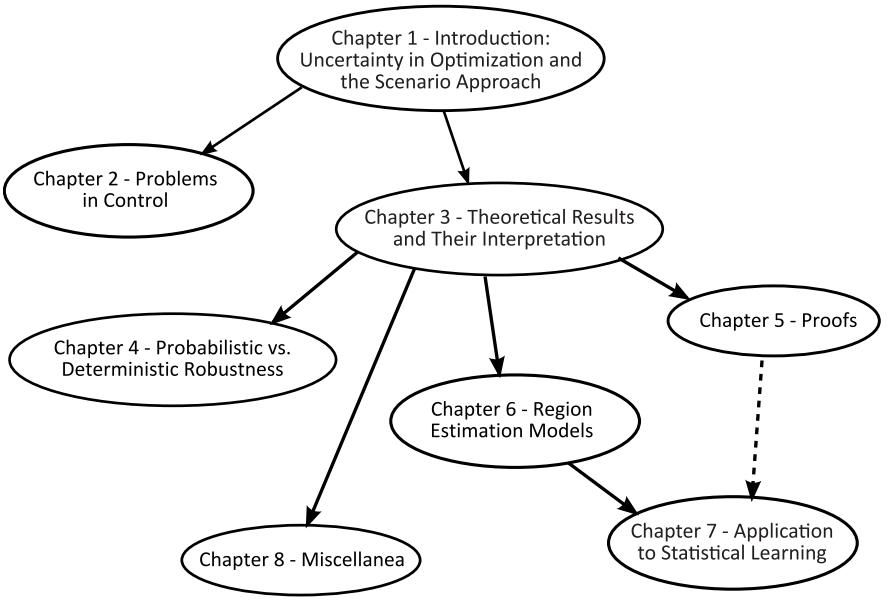

Figure 1. *The book structure.*