Preface

A wide variety of decision problems in operations research are defined on temporal networks, that is, workflows of time-consuming tasks whose processing order is constrained by precedence relations. For example, temporal networks are used to formalize the management of projects, the execution of computer applications, the design of digital circuits and the scheduling of production processes. Optimization problems arise in temporal networks when a decision maker wishes to determine a temporal arrangement of the tasks and/or a resource assignment that optimizes some network characteristic such as the network's makespan (i.e., the time required to complete all tasks) or its net present value.

Optimization problems in temporal networks have been investigated intensively since the early days of operations research. To date, the majority of contributions focus on deterministic formulations where all problem parameters are known. This is surprising since parameters such as the task durations, the network structure, the availability of resources and the cash flows are typically unknown at the time the decision problem arises. The tacit understanding in the literature is that the decision maker replaces these uncertain parameters with their most likely or expected values to obtain a deterministic optimization problem. It is well documented in theory and practice that this approach can lead to severely suboptimal decisions.

The objective of this monograph is to survey state-of-the-art solution techniques for optimization problems in temporal networks that explicitly account for parameter uncertainty. Apart from theoretical and computational challenges, a key difficulty is that the decision maker may not be aware of the precise nature of the uncertainty. We therefore study several formulations, each of which requires different information about the probability distribution of the uncertain problem parameters. We discuss models that maximize the network's net present value, problems that minimize the network's makespan and multi-objective formulations that account for the costs associated with the temporal network. Throughout this book, emphasis is placed on tractable techniques that scale to industrial-size problems.

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