

Stochastic Decomposition for Two-stage Stochastic Linear Programs with Random Cost Coefficients

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Stochastic decomposition (SD) has been a computationally effective approach to solve large-scale stochastic programming (SP) problems arising in practical applications. By using incremental sampling, this approach is designed to discover an appropriate sample size for a given SP instance, thus precluding the need for either scenario reduction or arbitrary sample sizes to create sample average approximations (SAA). SD provides solutions of similar quality in far less computational time using ordinarily available computational resources. However, previous versions of SD did not allow randomness to appear in the second-stage cost coefficients. In this paper, we extend its capabilities by relaxing this assumption on cost coefficients in the second-stage. In addition to the algorithmic enhancements necessary to achieve this, we also present the details of implementing these extensions which preserve the computational edge of SD. Finally, we demonstrate the results obtained from the latest implementation of SD on a variety of test instances generated for problems from the literature. We compare these results with those obtained from the regularized L-shaped method applied to the SAA function with different sample sizes.

Key words: Stochastic programming, stochastic decomposition, sample average approximation, two-stage models with random cost coefficients, sequential sampling.

History:

1. Introduction

The two-stage stochastic linear programming problem (2-SLP) can be stated as:

$$\begin{aligned} \min \quad & f(x) := c^\top x + \mathbb{E}[h(x, \omega)] \\ \text{s.t.} \quad & x \in \mathcal{X} := \{x \mid Ax \leq b\} \subseteq \mathbb{R}^n \end{aligned} \tag{1a}$$

where, the recourse function is defined as follows:

$$\begin{aligned} h(x, \omega) &:= \min \quad d(\omega)^\top y \\ \text{s.t.} \quad & D(\omega)y = \xi(\omega) - C(\omega)x \\ & y \geq 0, y \in \mathbb{R}^{n_2}, \end{aligned} \tag{1b}$$

Stochastic Decomposition

**F. Ceragioli, A. Dontchev, H. Furuta, K.
Marti, L. Pandolfi**



Stochastic Decomposition:

Stochastic Decomposition Julia L. Hingle, S. Sen, 2013-11-27 Motivation Stochastic Linear Programming with recourse represents one of the more widely applicable models for incorporating uncertainty within in which the SLP optimization models. There are several arenas model is appropriate and such models have found applications in air line yield management capacity planning electric power generation planning financial planning logistics telecommunications network planning and many more. In some of these applications modelers represent uncertainty in terms of only a few scenarios and formulate a large scale linear program which is then solved using LP software. However there are many applications such as the telecommunications planning problem discussed in this book where a handful of scenarios do not capture variability well enough to provide a reasonable model of the actual decision making problem. Problems of this type easily exceed the capabilities of LP software by several orders of magnitude. Their solution requires the use of algorithmic methods that exploit the structure of the SLP model in a manner that will accommodate large scale applications. **Stochastic Decomposition**

Julia L. Hingle, S. Sen, 2014-09-01 **Two-stage Stochastic Linear Programming: Stochastic Decomposition**

Approaches (PHD). Diana Schadl Yakowitz, 1991

Encyclopedia of Optimization Christodoulos A. Floudas, Panos M. Pardalos, 2008-09-04 The goal of the Encyclopedia of Optimization is to introduce the reader to a complete set of topics that show the spectrum of research the richness of ideas and the breadth of applications that has come from this field. The second edition builds on the success of the former edition with more than 150 completely new entries designed to ensure that the reference addresses recent areas where optimization theories and techniques have advanced. Particularly heavy attention resulted in health science and transportation with entries such as Algorithms for Genomics Optimization and Radiotherapy Treatment Design and Crew Scheduling. *Stability, Approximation, and Decomposition in Two- and Multistage Stochastic Programming* Christian Küchler, 2010-05-30 Christian Küchler studies various aspects of the stability of stochastic

optimization problems as well as approximation and decomposition methods in stochastic programming. In particular the author presents an extension of the Nested Benders decomposition algorithm related to the concept of recombining scenario trees. *Vacation Queueing Models* Naishuo Tian, Zhe George Zhang, 2006-10-11 This book discusses systematically the many variations of vacation policy. The book discusses a variety of typical vacation model applications. The presentation style is unique compared with the books published in the same field: a theorem and proof format is used. Also this is the first time G1/M/1 multi server vacation models both continuous and discrete and the optimization and control issues have been presented in book form. **System Modeling and Optimization** F. Ceragioli, A. Dontchev, H. Furuta, K. Marti, L.

Pandolfi, 2006-06-07 We publish in this volume the plenary talks and a selection of the papers on numerics optimization and their applications presented at the 22nd Conference on System Modeling and Optimization held at the Politecnico di Torino in July 2005. The conference has been organized by the Mathematical Department of the Politecnico di Torino. IFIP is a

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Exploration of stochastic decomposition algorithms for stochastic linear programs with recourse (PHD). Wing Wah Lowe, 1994

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