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SIPLIB 2.0

Stochastic Integer Programming Library version 2.0

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Abstract We present a collection of stochastic integer programming problem instances.

Keywords Stochastic Integer Programming · Problem Instances

1 Introduction

- What SIP is?
  Stochastic integer programming (SIP) is ... The main difficulty in solving stochastic integer programs is that the second-stage value function is not necessarily convex, but only lower semicontinuous (l.s.c.). Thus, the standard decomposition approaches that work nicely for stochastic *linear* programs, break down when second stage integer variables are present (Ahmed and Garcia, 2004). In this research study, we focus our emphasis on 2-stage SIP.
- SIPLIB?
  - MIPLIBv5 (last modified 2017): http://miplib.zib.de/
  - Shabbir's SIPLIB (last modified 2015): https://www2.isye.gatech.edu/ sahmed/siplib/
  - Felt et al's SLPlib (last modified 2001): https://www4.uwsp.edu/math/afelt/slpinput/download.html
  - Holmes's POSTS (the most recent reference 1994): http://users.iems.northwestern.edu/ jrbirge/html/dholmes/post.html

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- Motivation for SIPLIBv2
  We need more..
- Power of Julia language for large-scale optimization problems
- Contribution
  By SIPLIB 2.0, we mainly provide 1) richer collection of test problems for computational and algorithmic research in 2-stage SIP with benchmark experimental results, 2) not only SMPS files but also *Julia* files formatted in *StructJuMP* that are easily readable/modifiable.

2 Stochastic Integer Programming

The form of SIP is varying

2.1 Formulation

2.1.1 2-Stage Recourse Programs

2.2 Algorithms

2.2.1 Stage-wise Decomposition Algorithm

2.2.2 Scenario-wise Decompostion Algorithm

Benders, dual, ...

2.3 Software Libraries

2.3.1 Modeling Languages

2.3.2 Solvers

3 Test Sets Description

We introduce the set of problem instances. The instances are available in SMPS and Julia (StructJuMP) file format. characteristics, categorization

3.1 Mutli-Path Traveling Salesman Problem with Stochastic Travel Times (MPTSPS)

3.1.1 Problem Class

	1^{st} stage	2^{nd} stage
Variables	Bin	Bin
Constraints		

3.1.2 Notation

Table 1 Notations corresponding to problem

Index sets	
T	index set of time slots ($t = 1, \dots, \vert T\vert$)
A	index set of applications ($i = 1, \dots, \vert A\vert$)
S	index set of servers ($j = 1, \dots, \vert S\vert$)
F_j	index set of frequency options of server $j \in S$ ($f = 0, \dots, \vert F_j\vert$)
Parameters	
λ_{it}	average workload of application $i \in A$ that arrives in time interval $t \in T$
U_j	maximum number of applications installable to server $j \in S$
C_{jf}	processing capacity of server $j \in S$ under frequency $f \in F_j$
β_{jft}	cost incurred when server $j \in S$ runs at frequency $f \in F_j$ in time interval $t \in T$
ρ	target load for all servers (surrogate for quality of service)
Decision variables	
a_{ij} (virtualization)	1 if application $i \in A$ is installed to server $j \in S$, 0 otherwise
x_{jft} (server provisioning)	1 if server $j \in S$ runs at frequency $f \in F_j$ during time interval $t \in T$, 0 otherwise
r_{ijt} (routing)	fraction of workloads of application $i \in A$ assigned to server $j \in S$ in time interval $t \in T$

3.1.3 Formulation

$$(\text{MIP}_O) : \text{minimize} \sum_{j\in S}\sum_{f\in F_j}\sum_{t\in T}\beta_{jft}x_{jft}, \tag{1}$$

subject to

$$\sum_{i\in A} a_{ij} \le U_j, \quad \forall j \in S, \tag{2}$$

$$\sum_{j\in S} r_{ijt} = 1, \quad \forall i \in A, \forall t \in T, \tag{3}$$

$$r_{ijt} \le a_{ij}, \quad \forall i \in A, \forall j \in S, \forall t \in T, \tag{4}$$

$$\sum_{i\in A} \lambda_{it} r_{ijt} \le \rho \sum_{f\in F_j} C_{jf} x_{jft}, \quad \forall j \in S, \forall t \in T, \tag{5}$$

$$\sum_{f\in F_j} x_{jft} = 1, \quad \forall j \in S, \forall t \in T, \tag{6}$$

$$\sum_{i\in S} r_{ijt} \le U_j(1 - x_{j0t}), \quad \forall j \in S, \forall t \in T, \tag{7}$$

$$a_{ij}, x_{jft} \in \{0,1\}, \quad \forall j \in S, \forall f \in F_j, \forall t \in T \tag{8}$$

$$0 \le r_{ijt} \le 1, \quad \forall j \in S, \forall t \in T \tag{9}$$

4 Implementation of SMPS Writer

We describe our Julia implementation, how to model SIP and generate SMPS files..

5 Solution Report

6 Concluding Remarks

References

1. Author1 and Author2, paper paper paper paper, Journal Title 68 (2011), 1207–1221.