SG–Portfolio Test Problems for Stochastic Multistage Linear Programming

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Barycentric Approximation is a solution technique for stochastic multistage programs where the joint probability distribution of the underlying multidimensional stochastic discrete-time process is approximated by a sequence of distinguished scenario trees. These scenario trees define a corresponding sequence of multistage programs with error bounds for the approximate solutions. This way, barycentric approximation provides the user with scenarios and approximate policies. In the convex case, the goodness of the scenarios and the accuracy of the associated policies can be quantified; further information on how significant improvements are can be elicited via duality analysis.

It has turned out that the numerical effort of the barycentric approximation scheme heavily depends on the efficiency of the optimization algorithm invoked for solving the highly sparse multistage programs. Currently, CPlex is used for solving these multistage programs (on SUN SPARCSystem20; 512 MByte RAM, Solaris 2.3). In a next step, the idea is to invoke sophisticated decomposition techniques. For this purpose, a set of n-stage linear minimization programs in SMPS-format[1] is made available on public domain,

[1]For a description of the SMPS format see: *John R. Birge, Michael A. Dempster, Horand I. Gassmann, E.A. Gunn, Alan J. King* and *Stein Wallace*: A STANDARD INPUT FORMAT FOR MULTIPERIOD STOCHASTIC LINEAR PROGRAMS, *COAL (Mathematical Programming Society, Committee on Algorithms) Newsletter* **17** (1988)

to exchange experiences with currents codes of various decomposition techniques within stochastic programming.

Portfolio test problems, called SGPF3Yn and SGPF5Yn, are considered, where n represents stages ($n = 3, 4, 5, 6, 7$). Some current portfolio is given as input; the decisions at stage $1, 2, 3, \ldots, n$ will be seen as revisions or rebalancing activities.

The barycentric scenario trees associated with portfolio problems SGPF3Y n and SGPF5Yn basically consist of 4 stochastic rates of return (in the objective) and one stochastic cash flow component (in the RHS) per period. Per period and per scenario, SGPF3Yn and SGPF5Yn have 51 and 77 state and control variables, respectively.

Problems SGPF3Yn and SGPF5Yn are available in SMPS-Format and in MPS-Format for $n = 3, 4, \ldots, 7$ stages. In a first step, the portfolio problems for $n = 3, 4, \ldots, 6$ stages will be made available only in SMPS-Format on a public domain (see instruction below). Because of storage capacity, data for the 7−stage problems (SGPF3Y7 and SGPF5Y7) will be made available on request, as well as data for all test problems in MPS-Format.

The problems SGPF5Y3, SGPF5Y4, SGPF5Y5, SGPF5Y6, SGPF3Y3, SGPF3Y4, SGPF3Y5, and SGPF3Y6 were generated as minimization problems in scenario format within SMPS. The corresponding files are named SGPF*.COR, SGPF*.TIM, and SGPF*.SCE. The characteristics of the SG–Portfolio Test Problems are described in the table on the last page.

A format description of those portfolio test problems is in preparation and will be distributed on request via e–mail as soon as it is available.

CAUTION: As mentioned above, the portfolio problems have been generated twice, in MPS format and in SMPS format. Up to now, we were able to check only for small problems (i.e. less or equal than 3 stages) whether the problem formulation in MPS format and in SMPS format really coincide. Therefore, currently we cannot guarantee that no inconsistencies occur for n $\geq$ 4. We could not do a final check, because we neither have a routine that converts problems in SMPS format back to MPS format nor a decomposi-

tion code which uses the SMPS format as input. Making our test problems available on public domain, should help not only to verify that final check, but also to compare performance and accuracy of existing decomposition techniques within Stochastic Programming.

Please send your results and experiences with linear SG–Portfolio Test Problems to:

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The SG–Portfolio Test Problems are via ftp available at:

Node:	alpha.unisg.ch (130.82.1.12)
User:	anonymous
Password:	<your name>
Directory:	SMPS (1DUA1:SPEZ.XFR.SMPS])

Characteristics of the SG–Portfolio Test Problems:

Problem	SGPF5Y3	SGPF5Y4	SGPF5Y5	SGPF5Y6
#Stages	3	4	5	6
#Scenarios	25	125	625	3125
Obj. value	3027.6	4023.9	5180.8	6403.3
Size of the problem in MPS format				
Rows	1972	9861	49303	246178
Columns	2474	12372	61858	308733
Numerical effort solving the problem with Cplex				
Eliminated rows	1282	5657	24407	102532
Eliminated columns	1342	5726	24476	102601
Reduced rows	124	749	3874	19499
Reduced columns	620	3236	16361	81986
Nonzeros	1441	8432	46557	252807
Iterations	103	521	1544	4927
Solution time [s]	0.40	3.03	25.86	428.87

Problem	SGPF3Y3	SGPF3Y4	SGPF3Y5	SGPF3Y6
#Stages	3	4	5	6
#Scenarios	25	125	625	3125
Obj. value	2967.9	3991.3	5152.6	6369.0
Size of the problem in MPS format				
Rows	1220	6097	30487	152434
Columns	1595	7974	39868	199341
Numerical effort solving the problem with Cplex				
Eliminated rows	710	3085	13085	53710
Eliminated columns	746	3130	13130	53915
Reduced rows	124	749	3874	19539
Reduced columns	496	2612	13237	66242
Nonzeros	1085	6326	34451	184371
Iterations	106	493	1610	7246
Solution time [s]	0.26	1.94	22.14	625.27