A (PO)rtable (S)tochastic programming (T)est (S)et (POSTS)

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What is POSTS?

POSTS is a small test set of stochastic programming recourse problems (SLP) designed to highlight different qualities of general linear recourse problems. This test set is meant as a common test bed for reporting the computational characteristics of state-of-the-art SLP algorithms and their implementations. The problems are generally extendible to an arbitrary number of periods and scenarios. Each is given in standard SMPS format (Birge, at. al.). Go Back to Contents

How to get POSTS

The POSTS test set is available as a zip file, posts.zip, or a compressed tar file posts.tar.Z. To uncompress the files, type (from a UNIX prompt) either

```
unzip posts.zip
```

for the zip file or

```
zcat posts.tar.Z | tar -xvf -
```

Instructions and solution values are in README files in each package. Go Back to Contents

How should the problems be solved?

To further "standardize" any computational results that may be reported using POSTS, we suggest using the following guidelines:

- Tolerances and solutions
  - All stages should be solved to a relative tolerance of 10^(-6), i.e. if UB and LB are upper and lower bounds on the recourse objective in any given stage, (UB-LB)/(|LB|+0.1) <= 10^(-6). Interior point codes should use the same tolerance, but are not required to provide a basic solution.
  - Primal and dual solutions should be given for all nodes in the solution tree. (If not, at least primal solutions should be given, and the absence of dual solutions should be reported.)
- Reporting
  - Complete descriptions of the hardware and software used should be given, including machines make, model, memory, and speed (if applicable). If parallel codes are used, some indication of processor-processor bandwidth and message latency should be reported. (Ideally, the guidelines presented in Section 7 of Barr and Hickman should be followed.) If external routines are used (e.g. LP solvers), they should be cited.
  - Both algorithmic solution times and total times should be reported. Algorithmic solution times exclude input, problem set-up, and output. System times should be used if uniprocessor codes are used. If a parallel code is being used, the best and average wall clock times over a group of tests should be used. Using machines loaded with other processes should be avoided, if possible.

Any suggestions or comments would be GREATLY appreciated, and can be forwarded to jrbirge@northwestern.edu . Go Back to Contents

Problem Descriptions

Here is a summary of the problems in the set. For more detailed descriptions, (and descriptions of more problems) Click here!.
• Costs and RHS stochastic, time dependent scenarios. The only problems not arbitrarily created from those with only RHS stochasticity are the SGPF problems submitted courtesy of Prof. Karl Frauendorfer. The SGPF problems arise from a portfolio management application approximated with his discrete barycentric approximation system. (Frauendorfer, 1992). There is a set of small size problems and a set of large size problems publicly available. Due to their excessive size, only the smaller set will be used. The problems in the set and their filenames are given in the table below.

```
  Stages   Scenarios     Cor            Time        STOCH
 ---------------------------------------------------------------
```

```
        3          25      sgpf3y3.cor  sgpf3y3.tim  sgpf3y3.sce
        4         125      sgpf3y4.cor  sgpf3y4.tim  sgpf3y4.sce
        5         625      sgpf3y5.cor  sgpf3y5.tim  sgpf3y5.sce
        6        3125      sgpf3y6.cor  sgpf3y6.tim  sgpf3y6.sce
```

- RHS random: Finding feasibility The most tightly constrained problem in the test set is SCFXM1, which is tightly coupled in at least the first few stages. (See note below) The problem first appeared in Ho and Loute. There are 2,3, and 4 stage versions of this problem, and 2 and 16 scenarios per stage STOCH versions. The problems and their descriptions are given below

```
     Stages  Scens/stage    Cor      Time      STOCH
   ---------------------------------------------------

        2          6       fxm.cor  fxm2.tim  fxm2_6.sto
                  16                          fxm2_16.sto

        3          6       fxm.cor  fxm3.tim  fxm3_6.sto
                  16                          fxm3_16.sto

        4          6       fxm.cor  fxm4.tim  fxm4_6.sto
                  16                          fxm4_16.sto
```

Note: The period partitions in the core file are different from those originally used in Gassman 1988. The original fxm file from the netlib test set was partitioned so as to have roughly equal size blocks.

- RHS random: A moderate number of optimal bases. A problem with a relatively few number of optimal second stage bases is the PLTEXP problem (Sims), which is the linear relaxation of a stochastic capacity expansion problem. The problem is extendable to an arbitrary number of stages and an arbitrary number of scenarios.
- Thick tree version. This test set has either 6 or 16 scenarios per stage. The associated file names are shown below

```
  Stages  Scens/stage    Cor             Time       STOCH
 --------------------------------------------------------------

     2         6       pltexpA2.cor  pltexpA2.tim  pltexpA2_6.sto
              16                                   pltexpA2_16.sto

     3         6       pltexpA3.cor  pltexpA3.tim  pltexpA3_6.sto
              16                                   pltexpA3_16.sto

     4         6       pltexpA4.cor  pltexpA4.tim  pltexpA4_6.sto
              16                                   pltexpA4_16.sto

     5         6       pltexpA5.cor  pltexpA5.tim  pltexpA5_6.sto
              16                                   pltexpA5_16.sto

     6         6       pltexpA6.cor  pltexpA6.tim  pltexpA6_6.sto
```

- Thin tree version. This test set has 6 scenarios in the first stage, and two scenarios per stage thereafter. These problems are provided as a contrast with those in (4.1), and may show results less dependent on subproblem solution.

```
  Stages  Scens in Stg 2   Cor             Time       STOCH
 --------------------------------------------------------------

     3         6       pltexpA3.cor  pltexpA3.tim  pltexpB3_6.sto

     4         6       pltexpA4.cor  pltexpA4.tim  pltexpB4_6.sto

     5         6       pltexpA5.cor  pltexpA5.tim  pltexpB5_6.sto
```

- RHS random: Huge number of optimal bases. Due to its size and the high dimension of its support, STORM (Mulvey and Ruszczy/'{n}ski, 1992) is a problem well known for its difficulty. The problem as originally received was a very large two-stage only problem, with dim (Supp) = 118. Prof. H.I. Gassmann modified the model by enforcing some dependence among the RHSs. These instantiations form the basis of this test set. However, in the spirit of the original model, the smaller two-stage model has extended to include up to 1000 scenarios.

```
     Stages   Scenarios    Cor         Time          STOCH
   ------------------------------------------------------------

        2          8    stormG2.cor  stormG2.tim   stormG2_8.sto
                  27                               stormG2_27.sto
                 125                               stormG2_125.sto
                1000                               stormG2_1000.sto
```

References (please excuse the varied styles)

- J. R. Birge, M.A.H. Dempster, H. I. Gassman, E. A. Gunn, A. J. King, and S. W. Wallace, 1987. ``A Standard forinput format for multiperiod stochastic linear programs," *COAL newsletter*, 17, pp. 1-20.

- K. Frauendorfer, Lecture Notes in Economics and Mathematical Systems No 392, **Stochastic Two-Stage Programming** (Springer-Verlag, Berlin, 1993).
- H. I. Gassman, 1990. ``MSLiP: A computer code for the multistage stochastic linear programming problem.'' *Mathematical Programming*, 47, pp. 407-423.
- J. K. Ho, 1975. ``Optimal Design of Multistage Structures: A Nested Decomposition Approach,'' *Computers and Structures*, Vol. 5, pp 249-255.
- M. J. Sims, 1992. ``Use of a stochastic capacity planning model to find the optimal level of flexibility for a manufacturing system,'' Senior Design Project, Department of Industrial and Operations Engineering, University of Michigan, Ann Arbor, MI 48109.
- J. M. Mulvey, and A. Ruszczynski, 1992. ``A New Scenario Decomposition Method for Large Scale Stochastic Optimization,'' Technical Report SOR-91-19, Dept. of Civil Engineering and Operations Research, Princeton Univ. Princeton, N.J. 08544

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Problem sizes and solutions

This table describes the characteristics of the stochasticity for each problem, as well as the size of the Deterministic Equivalent and the optimal objective value.

Problem	Stages	Scen/Stage	Det. Equiv. Rows	Det. Equiv. Columns	Total Scen.	Opt. Obj. Value
PLTEXP						
pltexpA2_6	2	6	686	1856	6	-9.479354
pltexpA2_16	2	16	1726	4636	16	-9.663308
pltexpA3_6	3	6	4430	11864	36	-13.969368
pltexpA3_16	3	16	28350	75804	256	-14.267458
pltexpA4_6	4	6	26894	71912	216	-19.599417
pltexpA4_16	4	16	454334	1214492	4096	-18.849337
pltexpA5_6	5	6	161678	432200	1296	-23.214073
pltexpA6_6	5	6	970382	2593928	7776	-28.134408
pltexpB3_6	3	6+1+1			6	-13.643226
pltexpB4_6	3	6+1+1+1			6	-17.928191
pltexpB5_6	3	6+1+1+1+1			6	-23.846166
SCFXM						
fxm2.6	2	6	780	1047	6	18416.686
fxm2.16	2	16	1680	2227	16	18416.655
fxm3.6	3	6	4020	5295	36	18615.932
fxm3.16	3	16	24720	32435	256	18438.891
fxm4.6	4	6	23460	30783	216	18616.224
fxm4.16	4	16	393360	515763	4096	18438.891
STORM						
stormG2.8	2	8	2985	11456	8	15535231.897
stormG2.27	2	27	9635	37809	27	15508982.306
stormG2.125	2	125	43935	173735	125	15512090.180
stormG2.1000	2	1000	350185	1387360	1000	15802589.698
SGPF						
sgpf3y3	3	5	1220	1595	25	-2967.917
sgpf3y4	4	5	6097	7974	125	-3994.198
sgpf3y5	5	5	30487	39868	625	-5172.165
sgpf3y6	6	5	152434	199341	3125	-6463.323
sgpf5y3	3	5	1282	1342	25	-3027.706
sgpf5y4	4	5	5657	5726	125	-4031.391
sgpf5y5	5	5	24407	24476	625	-5201.282
sgpf5y6	6	5	246077	308733	3125	-6479.614

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