# GLOBAL OPTIMIZATION AND OPTIMIZATION UNDER UNCERTAINTY EXERCISES FOR PASI COURSE

**Nick Sahinidis, *nikos@uiuc.edu***

## Exercise 1: Local search with GAMS/BARON

Consider the following pooling problem (Haverly, 1978):

$$
\begin{aligned}
\min \quad & -9x_5 - 15x_9 + 6x_1 + 16x_2 + 10x_6 \\
\text{s.t.} \quad & x_1 + x_2 = x_3 + x_4 \\
& x_3 + x_7 = x_5 \\
& x_4 + x_8 = x_9 \\
& x_7 + x_8 = x_6 \\
& x_{10}x_3 + 2x_7 \le 2.5x_5 \\
& x_{10}x_4 + 2x_8 \le 1.5x_9 \\
& 3x_1 + x_2 = x_{10}(x_3 + x_4) \\
& (0,0,0,0,0,0,0,0,0,1) \le \mathbf{x} \\
& \mathbf{x} \le (300,300,100,200,100,300,100,200,200,3)
\end{aligned}
$$

Use GAMS/BARON to run 1000 local searches from randomly generated starting points (using suitable values for the *numloc* and *maxiter* options). Upon completion, plot a histogram of frequency vs. objective function values found (*hint:* use the *locres* option). Repeat the run of 1000 local searches after turning off range reduction (with the *prelpdo, tdo, mdo, lbttdo,* and *obttdo* options) so that the local search solver gets no benefit from BARON's range reduction tools. Compare the results from the two runs.

## Exercise 2: Global optimization with GAMS/BARON

Copy the following *globallib/minlplib* problems from the GAMS web site:

ex6_2_14, gtm, himmel16, sambal
du-opt, fac2, ravem, spectra2

Use GAMS/BARON to solve these problems. Experiment with the following algorithmic options (corresponding BARON options are shown in parentheses):

- branching strategy (*brvarstra, brptstra, modbrpt*)
- local search (*numloc, dolocal*)
- probing (*prelpdo, pdo*)
- reduction level (*maxredpass, maxnodepass, tdo, lbttdo*)
- termination tolerance (*epsa, epsr*).

Tabulate your results and discuss the relative importance of these algorithmic options.

## Exercise 3: Optimization under uncertainty

Refer to the following paper:

Liu, M. L. and N. V. Sahinidis, Optimization in process planning under uncertainty, Industrial & Engineering Chemistry Research, 35(11), 4154-4165, 1996.

Consider the example in section 6.2 (right column of p. 4162). Write a GAMS code and reproduce the results described in the second and third paragraph of p. 4163.