Soft constraint simulation results

November 3, 2022

1 Summary

The soft threshold approach seems to work very well. Conditional on getting bounds, the results are always optimal.

The times we do not get bounds is when we use a quadratic loss function for the criterion. Gurobi minimizes the criterion without issue. However, when the criterion is included into the objective function as a soft constraint, Gurobi (incorrectly) determines that the quadratic matrix is not PSD. Gurobi thus complains that the optimization problem is nonconvex and requests the user set the option `nonconvex = 2`. This problem has to do with the quadratic penalty being scaled by `criterion.tol`, When `criterion.tol` gets large, the scaled quadratic matrix violates some kind of tolerance when being checked for PSD-ness.

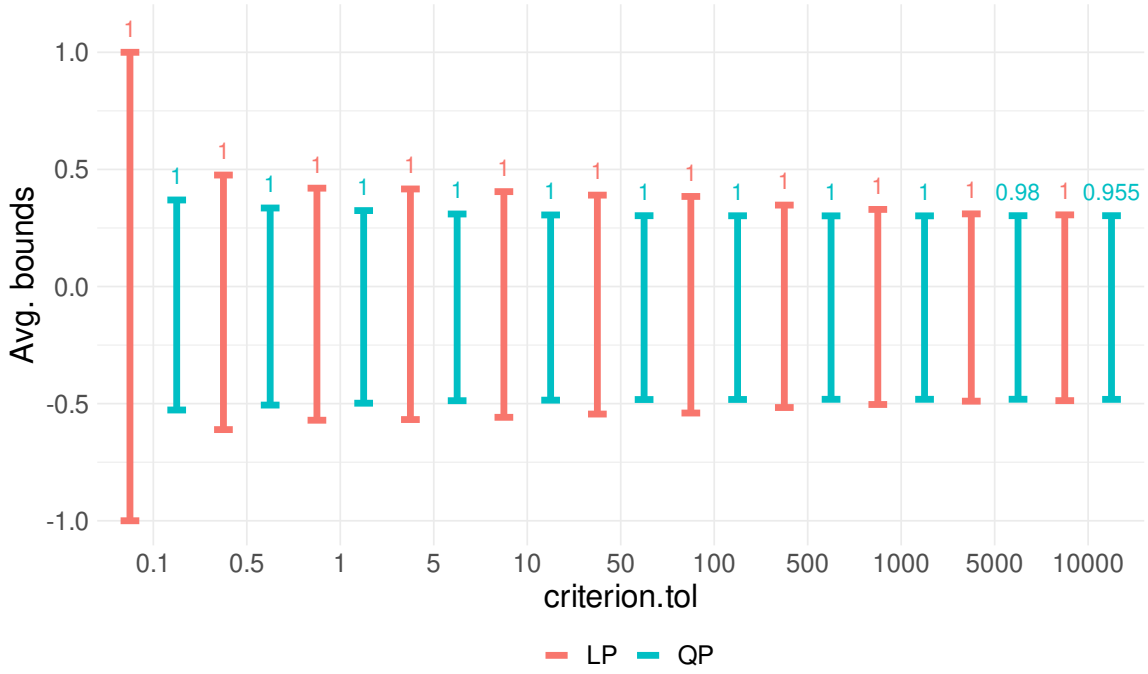
But why is there still an error when estimating the bounds when `criterion.tol = 1`, even though the criterion minimization problem can be solved (e.g., see test case 4)? This is because I actually scale the quadratic matrix by the sample size `N` as well. That is, the quadratic constraint is scaled by

$$\texttt{N} \times \texttt{criterion.tol}.$$

Recall that the quadratic constraint is originally scaled by by $\texttt{N}^{-1}$ (this was discussed in Issue 208). We did this so that the criterion would not grow with sample size. So when I construct the soft penalty, I undo this scaling. If I do not undo this scaling, we need enormous values of `criterion.tol` (e.g., 50,000) before we see the bounds shrink.

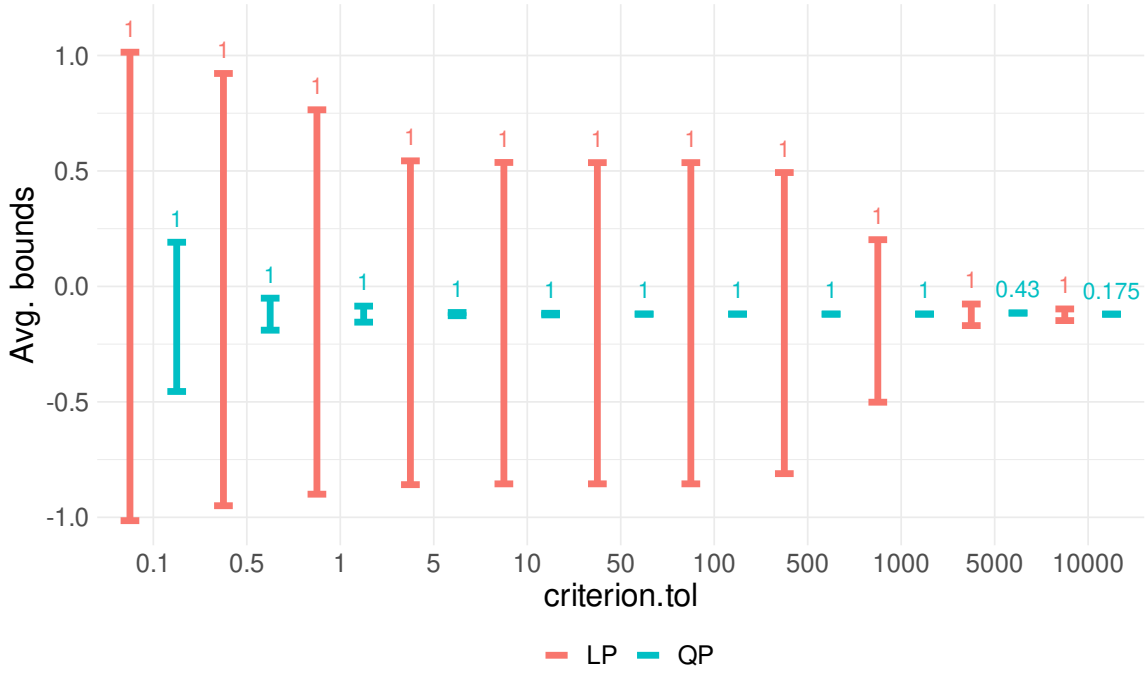
2 Simulation results

2.1 Case 1



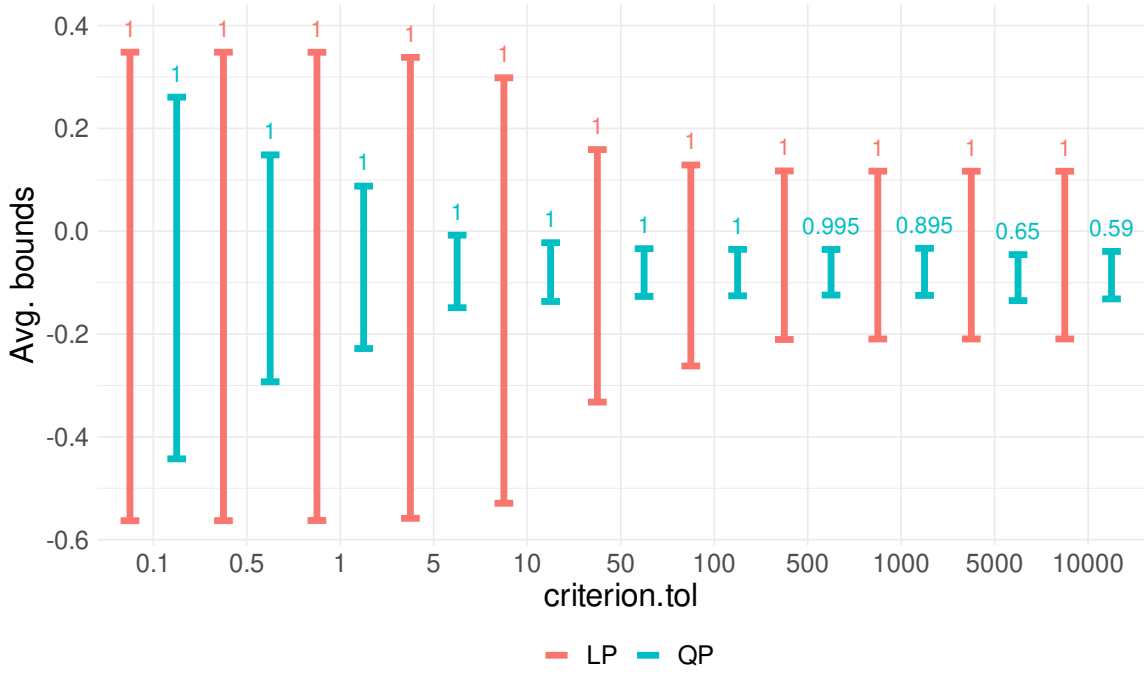
Note: The bars display the average lower and upper bounds for simulations where both bounds were optimal. The number above each bar indicates the fraction of the 200 simulations for which the both bounds were optimal.

2.2 Case 2



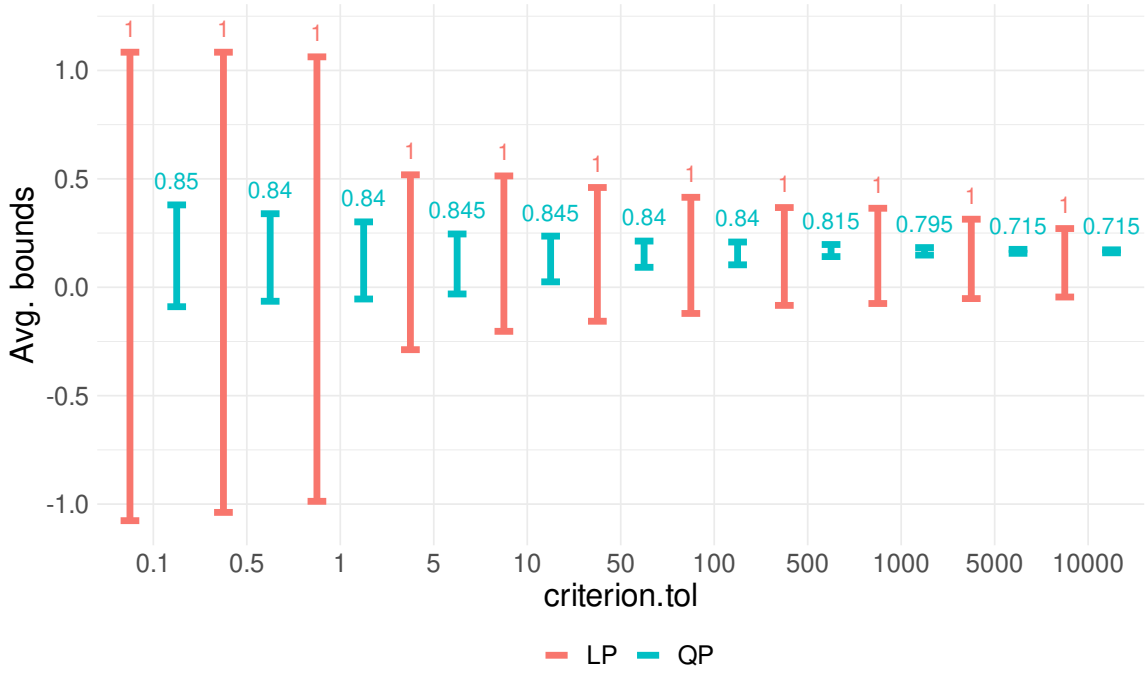
Note: The bars display the average lower and upper bounds for simulations where both bounds were optimal. The number above each bar indicates the fraction of the 200 simulations for which the both bounds were optimal.

2.3 Case 3



Note: The bars display the average lower and upper bounds for simulations where both bounds were optimal. The number above each bar indicates the fraction of the 200 simulations for which the both bounds were optimal.

2.4 Case 4



Note: The bars display the average lower and upper bounds for simulations where both bounds were optimal. The number above each bar indicates the fraction of the 200 simulations for which the both bounds were optimal.