Soft constraint simulation results

December 1, 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.

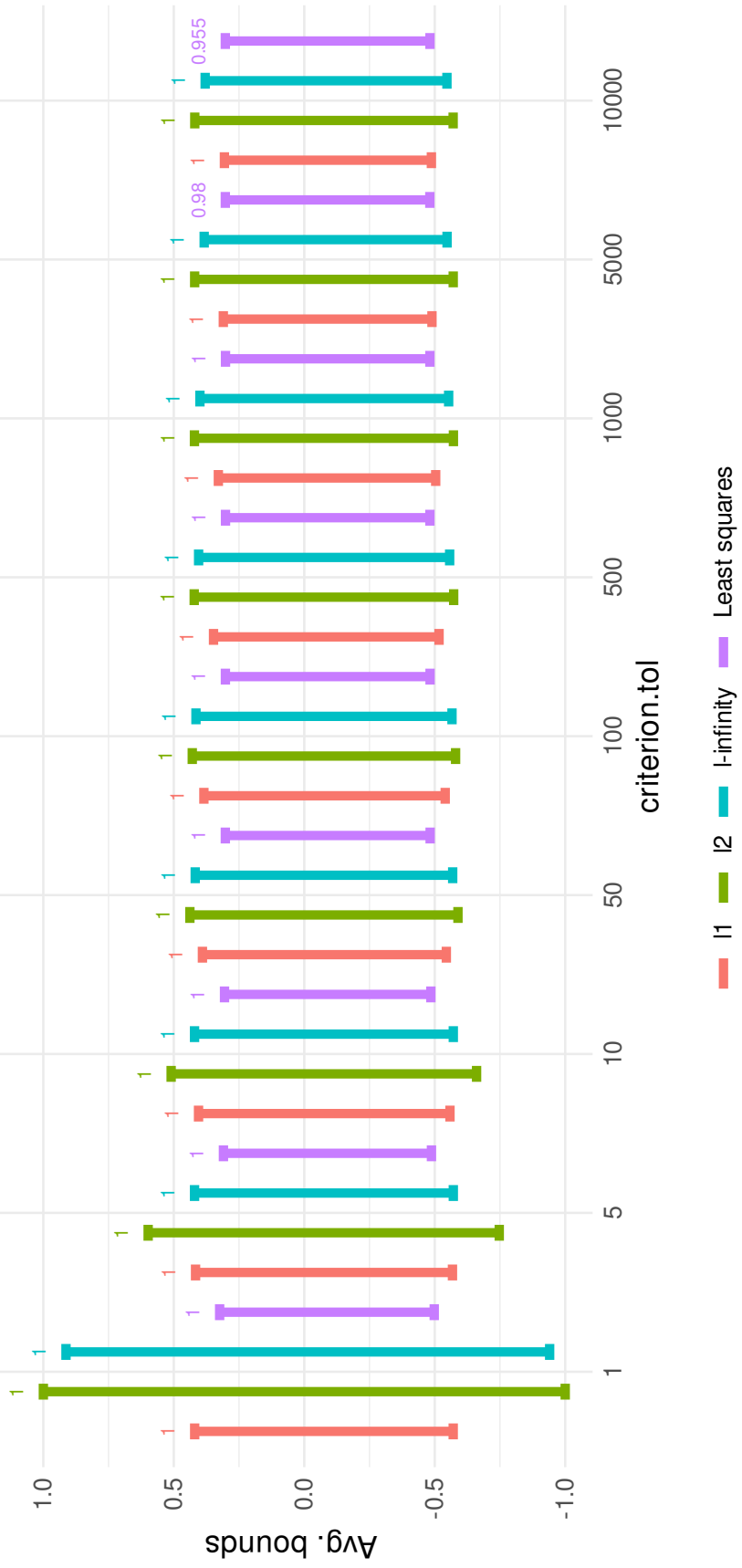
2 Simulation results

The `ivmte` package allows for four different types of criteria, $\widehat{Q}(\theta)$.

1. ℓ_1: $\widehat{Q}(\theta) = \left\| \frac{1}{n} \sum_{i=1}^{n} (Y_i B_i - B_i B_i' \theta) \right\|_1$
2. ℓ_2: $\widehat{Q}(\theta) = \left\| \frac{1}{n} \sum_{i=1}^{n} (Y_i B_i - B_i B_i' \theta) \right\|_2$
3. ℓ_∞: $\widehat{Q}(\theta) = \left\| \frac{1}{n} \sum_{i=1}^{n} (Y_i B_i - B_i B_i' \theta) \right\|_\infty$
4. Least squares: $\widehat{Q}(\theta) = \frac{1}{n} \sum_{i=1}^{n} (Y_i - \theta' B_i)^2$

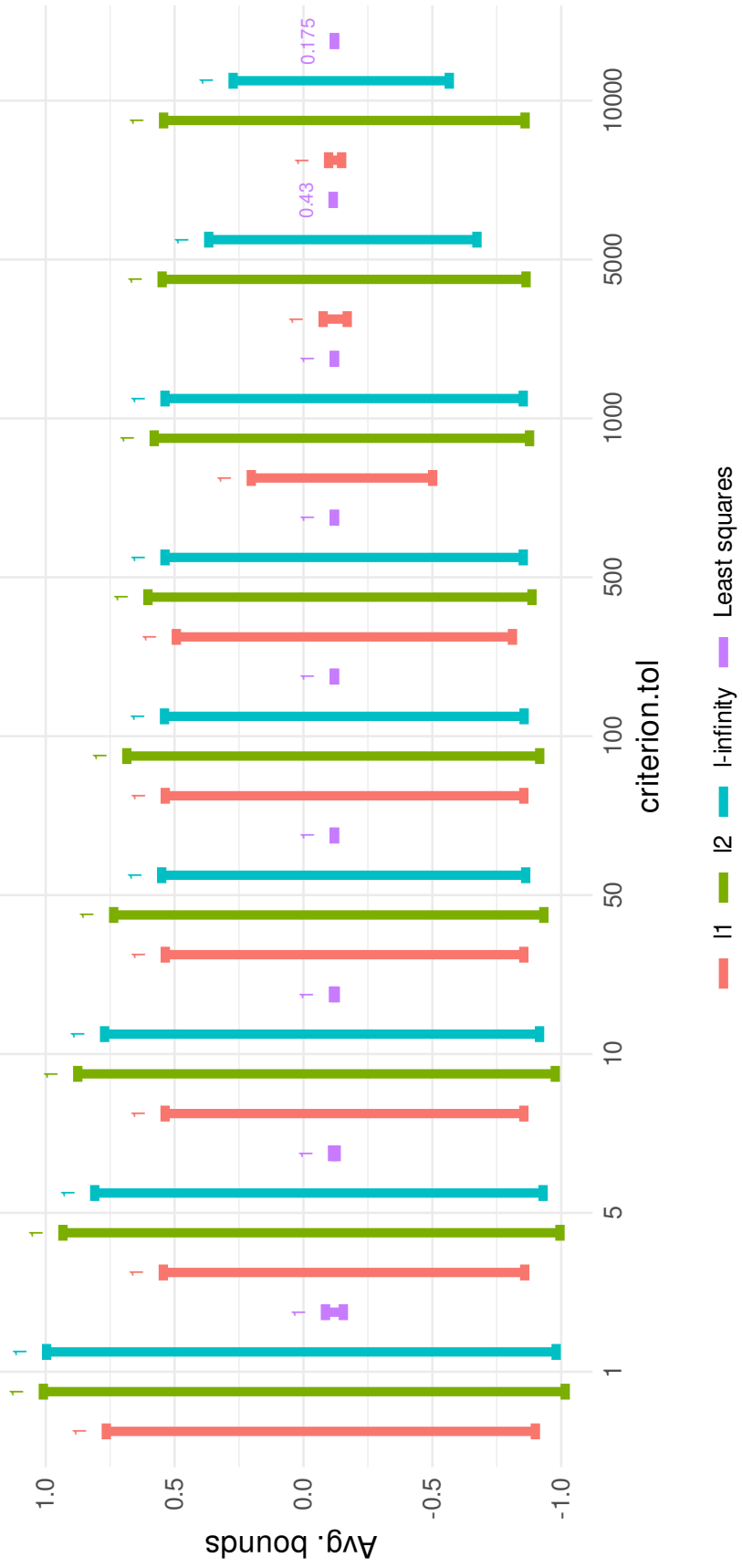
The figures below show the average lower and upper bounds obtained using each criterion under various simulations, as well as how frequently both bounds are calculated optimally.

Figure 1: Test Case 1



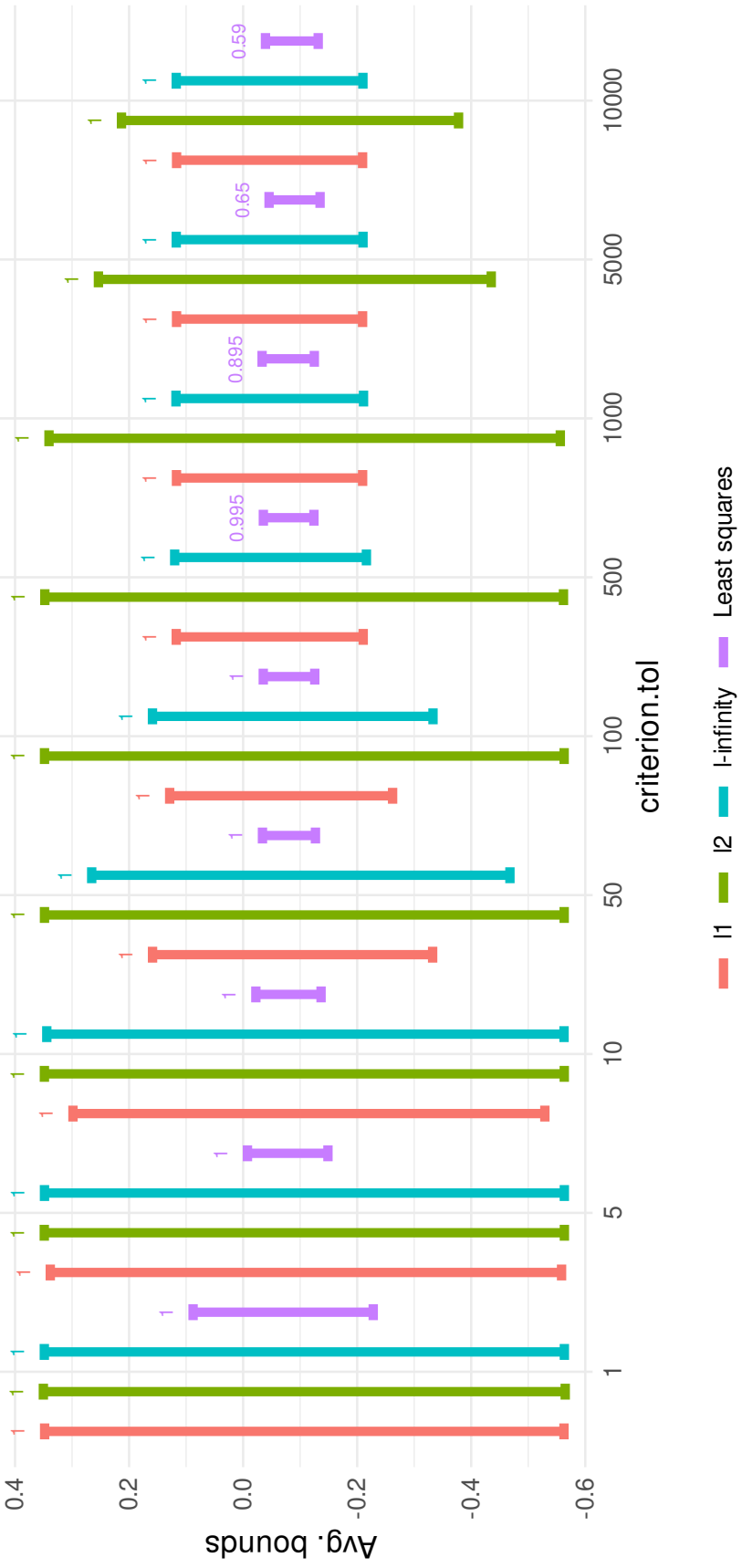
Note: The bars display the average lower and upper bounds for simulations where both bounds were optimal. The number above each bar indicates the fraction of the 200 simulations for which the both bounds were optimal.

Figure 2: Test 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.

Figure 3: Test 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.

Figure 4: Test 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.