

Solution Pluralism, Deliberation, and Metaheuristics

Extracting More Value from Optimization Models
Part 2: Engineering and Scientific Challenges.

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Outline

- 1 How to get Sol samples?
- 2 How best to sample the Sols?
- 3 Processing Sols
- 4 Robustness under Risk

Sampling in our examples of part 1

- Philly redistricting project. See cited papers. Basically, OR (IP) heuristic models for initial contiguous solutions, then innovative GA to find high-quality new solutions.
- TSP. Well-known heuristic, Lin 2-opt, with multiple starting points. Lots of obvious alternatives.
- GAP. FI-2Pop GA. Especially good at finding lols [Kimbrough et al., 2008, Kimbrough et al., 2009].
- VRPs. RJR (homegrown, “rotate, jiggle, repair”) on top of TSP. Affords multiple solutions.
- 2-sided matching. GAs in multiple cases. ABM in one case [Kimbrough and Kuo, 2010, Kimbrough, 2012].

Sampling the Sols

- Evolutionary computation is a natural place to look first.
- In general, population-based approaches
 - Particle swarm optimization, many forms of EC, ant colony optimization, artificial immune systems, ...
- NB: Interacts with constraint handling.
 - Again, the FI-2Pop GA has been especially good at finding lols [Kimbrough et al., 2008, Kimbrough et al., 2009].

Points arising

- Very little is known about which methods of sampling (particularly which metaheuristics) are most effective.
- Conducting local search in the neighborhood of a known (e.g., conventionally discovered) solution is an obvious tactic (but is largely unexplored for these purposes).
- In experiments with GAPS, we found that the Sols (both Fols and Iols) were quite dense [Kimbrough et al., 2010].
- Do different sampling methods find very different samples?

How to process large numbers of sampled Sols?

- Reduce by DEA, Pareto dominance.
- DSS. Prototype for GAP-like problems.

Robust optimization

- Standardly: under uncertainty.
- Solution pluralism affords under-risk analyses [Kimbrough et al., 2011].



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