SO methods

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1 Introduction

How we categorise simulation optimisation (SO) methods:

- decision variable discrete or continuous. In the discrete case:
  - Finite or infinite number of feasible solutions
  - Ordered or unordered feasible solutions
  - Random search used or not
- how the problem may be constrained:
  - unconstrained, partially constrained, fully constrained
  - stochastic constraints, deterministic constraints, box constraints
- dimensionality of the problem
- local or global solutions found
- convergence guarentee

The problem we face in the housing waiting-list problem has the following corresponding characteristics:

- In reality the decision variables (numbers of units of housing/shelter to build) are discrete, however we may work with a continuous approximation of the system. In the discrete case:
  - We have a finite but large number of feasible solutions
  - Within each dimension of the solution space, solutions are ordered, however ordering across dimensions is not obvious
- The problem we currently have in mind is:
  - fully constrained
  - deterministic constraints

- There is potentially a medium number (approx. 10) of dimensions (how much of housing/shelter to build each year over some reasonable time horizon for planning
- We would like a global solution, however we may still be interested in locally convergent methods provide we can add an element of random searching to escape any local optimum if necessary.

2 Discrete decision variables

"A Guide to Sample-Average Approximation" - Kim, Ragu, Shane Henderson Multi-dimensional newsvendor problem analysis shows that differentiability and expectation are interchangeable. The true function and the sample problem have the same nice properties of smoothness and concavity. So then - sufficiently large N -¿ effectively concave and deterministic opt can be used to find optimum.

We can say that SAA is appropriate for a problem if there is a structure to the sample average function which allows a nice deterministic optimisation solver to be used, and that the true function can be said to share that same structure.

It is also noted here

3 Integer ordered decision vars

"Simulation-based optimization over discrete setswith noisy constraints" YAO LUO and EUNJI LIM

Ragu et al - RSpline

"CONSTRAINED OPTIMIZATION OVER DISCRETE SETS VIA SPSA WITH APPLICATION TO NON-SEPARABLE RESOURCE ALLOCATION" Witney et al.

Other references from Ragu et al. - COMPASS and DSA (Discrete Stochastic Approx.)

4 Continuous decision varialbes