Stochastic Optimization

Assignment

Edoardo Fadda
Dip. di Scienze Matematiche – Politecnico di Torino
e-mail: edoardo.fadda@polito.it

Version: December 4, 2024

Whenever you need a scenario tree, always use the `ScenarioTree` class, available here (from the 9th of December). Bug reports are highly appreciated.

For all problems, you are free to define any unspecified details (e.g., the distribution of the random variable, etc.).

ScenRed Propose a heuristic method to cluster similar scenarios by implementing it as part of the `ScenarioTree` class. Test its efficiency on the nesw-vendor problem and another two-stage stochastic program of your choice. Repeat the process using a heuristic that reduces the number of scenarios based on the Wasserstein distance. Finally, compare the results obtained.

WelchAlt Instead of using the Welch algorithm, consider the following alternative methods:

- Schruben (1982) 'Detecting Initialization Bias in Simulation Output'
- Schruben, L.W., H. Singh, and L. Tierney: Optimal Tests for Initialization Bias in Simulation Output, Operations Res., 31: 1167–1178 (1983).
- Goldsman, D., L.W. Schruben, and J.J. Swain: Tests for Transient Means in Simulated Times Series, Naval Research Logistics, 41: 171–187 (1994).

Read the papers and develop a Jupyter Notebook in which you test these algorithm on a simulation example of your choice.

IhtcGA Apply genetic algorithms to the problem presented here.

IhtcALNS Apply Adaptive Large Neighborhood Search to the problem presented here.

IhtcRVNS Apply Reduced Variable Neighborhood Search to the problem presented here.

IhtcTS Apply Tabù Search or Reduced Variable Neighborhood Search to the problem presented here.

IhtcGRASP Apply Greedy Randomized Adaptive Search Procedure to the problem presented here.

Sched Consider the deterministic scheduling model described here. In certain contexts, operations may fail and need to be repeated, leading to a two-stage model where we first decide the schedule and then observe if some operations require repetition.

- Schedule the jobs using the Earliest Due Date (EDD) precedence rule and estimate the average value of the objective function.

- Repeat this procedure with all the decision rules outlined here.

- Investigate whether a well-designed scenario generation method can produce similar results while generating fewer scenarios.

ATOPrice In the ATO model, price and demand are independent. Consider a stochastic model that link prices and the demands, and optimize the price by using

surface response method. In other words, you have to consider the ATO model as a black box that, given the prices of the items, provide you the revenue. Solve the problem with two products so that it is possible to have a graphical representation. Then, increase the number of items. Important: Ensure that the number of scenarios used for the ATO problem is sufficient to guarantee stability in the results.

IhtcDyn: Consider the problem presented here. Instead of addressing the entire dataset, focus only on the patients who can be operated on at a given time t

- Define two different look-ahead policies to optimize the problem.
- Compare the performance of these policies using the provided instances.

AirVI: You are tasked with managing ticket sales for an airline over discrete time steps $[0, 1, \ldots, T]$. Customer arrivals follow a Poisson process, and each customer has a perceived value for the flight, θ, which is distributed according to a beta(a, b) distribution. A customer will purchase a ticket if their perceived value satisfies $\theta > p$, where p is the ticket price. Apply value iteration to solve the problem, optimizing ticket pricing and inventory management over the given time horizon.