Homework 6 – Stochastic Programming

Due: 1:30 pm, May 7, 2025

1. Self-study the modeling examples CEP1 and PGP2 in Section 1.1.1 and Section 1.1.2 in Higle and Sen (1996). Write down the two-stage stochastic programming (TS-SP) model of CEP1.

   Reference:

   ✧ Higle, J. L. and S. Sen (1996). Stochastic Decomposition: A Statistical Method for Large Scale Stochastic Linear Programming. Springer.

2. Based on the SMPS instance files of CEP1 (.cor, .tim, and .sto), complete the following tasks:

   1) Write down the corresponding relationships between the columns and rows in the SMPS instance files and the decision variables and constraints, respectively, in the TS-SP model of CEP1 in problem 2. For example, columns $\texttt{COL1\_1}, \dots, \texttt{COL1\_4}$ correspond to the first-stage decision variables $x_1, \dots, x_4$, and rows $\texttt{ROL1\_1}, \dots, \texttt{ROL1\_4}$ correspond to the operation time constraints for machine $1, \dots, 4$ in the first stage master problem.

   2) Define the scenario set Ω, and describe how to calculate the probability p_ω for each scenario $\omega \in \Omega$.

   3) Solve the Mean Value Problem (MVP).

   4) Solve one scenario problem.

      Note: There are hundreds of scenarios. You only need to select any one of them.

   5) Formulate the Deterministic Equivalent Problem (DEP) to solve the recourse problem.

   6) Evaluate the expected profit of the MVP solution, the scenario solution in 4), and the optimal solution to the recourse problem (DEP) under the stochastic setting.

   7) Evaluate the bounds on the optimal objective value (expected profit) of the recourse problem as in equation (15) on page 15 in Higle (2005).

   8) Calculate the Expected Value of Perfect Information (EVPI) and the Value of the Stochastic Solution (VSS).

   Hint:

   1) Follow the tutorial *SMPS & PySMPS for TS-SLP* to familiarize yourself with SMPS format.

   2) Follow the tutorial *Formulate and Solve the MVP in Python* to study how to load instance data from SMSP instance files, formulate the MVP, and solve it using Gurobi in Python.

   Note: The homework grade will be deducted 50% if the outcomes of your submitted package are inconsistent with your homework results.

Submission requirements:

1. For each (sub)problem, name the solution file as "*problem_x.ext*," where "*x*" represents the (sub)problem number (x = 1, 2, 3 or x = 1a, 1b, 1c) and the file extension "*ext*" depends on the file type (Word, Excel, PDF, etc.). If the solution to a (sub)problem contains multiple files (e.g., a Python package), organize the file(s) into a folder and name the folder as "*problem_x*."

2. Note that your Python files must be able to be executed directly. So use relative paths instead of absolute paths. If necessary, you may provide a short "user manual" of instructions on how to execute your codes.

   Warning: If the TAs have to manipulate your Python package to verify your solutions, you will be deducted points from your grade.

3. Pack all the "(sub)problem" folders in a zip file and name the zipped file "*hw_##_Chinese name.zip*," where "##" (two digits) represents the homework number, for example, "*hw_06_赵磊.zip*."