Homework 5 – Stochastic Programming

Due: 1:30 pm, April 23, 2025

1. Using the Dakota example in Higle (2005) with the **modified data in Table 1**,

TABLE 1. Dakota Production/Resource Data (Modified)

Resource	Cost ($)	Desk	Table	Chair
Lumber (bd. ft.)	2	8	6	1
Finishing (hrs.)	4	4	2	1.5
Carpentry (hrs.)	5.2	2	1.5	0.5
Demand		$\tilde{d}_d$	$\tilde{d}_t$	$\tilde{d}_c$

where $\tilde{d}_d$, $\tilde{d}_t$, and $\tilde{d}_c$ are independent random variables, and their probability mass functions are

$$p_{\tilde{d}_d}(d_d) = \begin{cases} 0.50, & d_d = 95, \\ 0.40, & d_d = 190, \\ 0.10, & d_d = 265, \end{cases}$$

$$p_{\tilde{d}_t}(d_t) = \begin{cases} 0.30, & d_t = 40, \\ 0.60, & d_t = 150, \\ 0.10, & d_t = 230, \end{cases}$$

and

$$p_{\tilde{d}_c}(d_c) = \begin{cases} 0.15, & d_c = 140, \\ 0.25, & d_c = 210, \\ 0.30, & d_c = 365, \\ 0.30, & d_c = 390, \end{cases}$$

complete the following tasks.

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

2) Solve the Mean Value Problem (MVP).

3) Solve one scenario problem.

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

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

5) 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.

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

Notes:

1) Please formulate the Dakota example as a linear program (LP); use *continuous* rather than *integral* variables when constructing the Gurobi model.

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

Reference:

✧ Higle, J. L. (2005). Stochastic programming: Optimization when uncertainty matters. INFORMS TutORials in Operations Research (*Emerging Theory, Methods, and Applications*) null(null): 30-53.

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_05_赵磊.zip*."