Example problems

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Consider a stochastic linear program

$$
\begin{aligned}
&min 2x_1 + 3x_2 + E[7y_1(\xi) + 12y_2(\xi)] \\
&s.t. x_1 + x_2 \leq 100 \\
&\quad (2+\xi_1)x_1 + 6x_2 + y_1(\xi) \geq 180 + \xi_2 \\
&\quad 3x_1 + (3.4 - \xi_3)x_2 + y_2(\xi) \geq 162 + \xi_4 \\
&\quad x_1, x_2 \geq 0, y_1(\xi), y_2(\xi) \geq 0,
\end{aligned}
$$

where $\xi = (\xi_1, \xi_2, \xi_3, \xi_4)$. Suppose $\xi_1, \xi_2, \xi_3, \xi_4$ are independent random variables, and

- $\xi_1 \sim U(-0.8, 0.8)$
- $\xi_2 \sim N(0, 12)$
- $\xi_3 \sim exponential(2.5)$
- $\xi_4 \sim N(0, 9)$

Solve the problem by using the following methods:
1. L-shaped method, single-cut version;
2. L-shaped method, multi-cut version;
3. Level decomposition;
4. Partition-based approach;
5. Monte Carlo sampling in Sample Average Approximation (SAA) with sample size $N = 10, 50, 100, 200, 500, 1000$ for ξ to get the lower bound and using relative large sample size $N' = 100,000$ to get upper bounds. Replicate each experiment for 10 times for each sample size.