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# STOCHASTIC FACILITY LOCATION PROBLEM WITH OUTSOURCING COSTS

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Stochastic facility location problems with outsourcing costs (SFLPOC) optimize facility placement and customer assignment under demand uncertainty. Excess demand beyond the capacity of a facility incurs outsourcing costs. This work addresses SFLPOC, aiming to minimize overall expected costs (placement, service and outsourcing). We model SFLPOC as a two-stage stochastic program. While prior work focused on specific assumptions or small scenario sets, we present methods suitable for general probability distributions. For discrete scenario sets, we improve upon classic Benders decomposition by exploiting the second-stage subproblem's structure. To handle general distributions, we partition the probability space based on incumbent integer solutions. Coupled with Benders cuts, this provides an exact solution method for common distributions (e.g. Bernoulli, Exponential, Poisson, Gaussian). Additionally, we introduce a compact formulation specifically for i.i.d. demand distributions, allowing us to solve even continuous distribution problems to optimality. Computational experiments on established benchmarks demonstrate that our compact formulation consistently finds optimal solutions, while the Benders approach provides strong solutions with proven optimality gaps for general distributions, outperforming sample average approximations.

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