Quasi-Monte Carlo Approximations of Two-stage Stochastic Programs

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Recent developments of Quasi-Monte Carlo theory provided the optimal convergence rate $O(n^{-1+\delta})$, $\delta \in (0, 0.5]$, with constant not depending on the dimension, for certain randomized lattice rules if the integrand belongs to weighted tensor product Sobolev spaces. Two-stage integrands are piecewise smooth, but do not belong to such tensor product Sobolev spaces. We show, however, that all terms of their ANOVA decomposition except the one of highest order are even infinitely differentiable if the underlying densities are smooth enough and a weak geometric condition on the second stage problem is satisfied. We argue that this result justifies the use of randomized lattice rules for linear two-stage stochastic programs. Our numerical experience shows that indeed such methods are superior compared to Monte Carlo methods and that convergence rates close to the optimal rate can be achieved if suitable dimension reduction techniques are employed.