Randomly-shifted lattice rules for unbounded integrands

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We study the problem of multivariate integration over $\mathbb{R}^d$ with integrands of the form $f(x)\rho(x)$ where ρ is a probability density function. Our study is motivated by problems in mathematical finance, where unbounded integrands over $[0,1]^d$ can arise as a result of using transformations to map the integral to the unit cube. We assume that the functions f belong to some weighted Hilbert space. We carry out a worst-case analysis in this space and show that good randomly-shifted lattice rules can be constructed component-by-component to achieve a worst-case error of order $O(n^{-1/2})$.