We study a simple diffusive process in which the diffusivity is discontinuous across an interface interior to the domain. In many situations, the location of the interface is measured at a small number of locations and these measurements contain error. Thus the location of the interface and the solution itself are subject to uncertainty. A Monte Carlo approach is employed which requires solving a large number of sample problems, each with a different interface location. An efficient adjoint-based a posteriori technique is used to estimate the error in a quantity of interest for each sample problem. This error has a component due to the numerical approximation of the diffusive process and a component arising from the uncertainty in the interface location. A recognition of these separate sources of error is necessary in order to construct effective adaptivity strategies. (Received August 18, 2015)