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We estimate the persistent homology of sublevel sets of a function on a compact Riemannian manifold, from a finite noisy sample. The Stability Theorem of Cohen-Steiner, Edelsbrunner and Harer bounds the distance between the persistent homologies of the sublevel sets of two functions by the supremum norm of the difference between the two functions. This allows us to convert our topological problem to the statistical nonparametric regression problem on a compact manifold under the sup-norm loss. We calculate the sharp asymptotic minimax bound. Furthermore, the construction of the estimator in the proof is well-suited to calculations of the persistent homology of its sublevel sets. (Received September 12, 2008)