Quantum coherence is a fundamental common trait of quantum phenomena, from the interference of matter waves to quantum degeneracy of identical particles. Despite its importance, estimating and measuring quantum coherence in generic, mixed many-body quantum states remains a formidable challenge, with fundamental implications in areas as broad as quantum condensed matter, quantum information, quantum metrology and quantum biology. Here we provide a quantitative definition of the variance of quantum coherent fluctuations (the quantum variance) of any observable on generic quantum states. The quantum variance generalizes the concept of thermal de Broglie wavelength (for the position of a free quantum particle) to the space of eigenvalues of any observable, quantifying the degree of coherent delocalization in that space. The quantum variance is generically measurable and computable as the difference between the static fluctuations and the static susceptibility of the observable; despite its simplicity, it is found to provide a tight lower bound to most widely accepted estimators of "quantumness" of observables (both as a feature as well as a resource), such as the Wigner-Yanase skew information and the quantum Fisher information. When considering bipartite fluctuations in an extended quantum system, the quantum variance expresses genuine quantum correlations (of discord type) among the two parts. In the case of many-body systems it is found to obey an area law at finite temperature, extending therefore area laws of entanglement and quantum fluctuations of pure states to the mixed-state context. Hence the quantum variance opens the way to the measurement of macroscopic quantum coherence and quantum correlations in most complex quantum systems.