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Quantum systems as embarrassed colleagues: what do tax evasion and state tomography have in common? CHRIS FERRIE, Institute for Quantum Computing, University of Waterloo, ROBIN BLUME-KOHOUT, Theoretical Division, Los Alamos National Laboratory — Quantum state estimation (a.k.a. "tomography") plays a key role in designing quantum information processors. As a problem, it resembles probability estimation – e.g. for classical coins or dice – but with some subtle and important discrepancies. We demonstrate an improved classical analogue that captures many of these differences: the "noisy coin." Observations on noisy coins are unreliable – much like soliciting sensitive information such as ones tax preparation habits. So, like a quantum system, it cannot be sampled directly. Unlike standard coins or dice, whose worst-case estimation *risk* scales as $1/N$ for all states, noisy coins (and quantum states) have a worst-case risk that scales as $1/\sqrt{N}$ and is overwhelmingly dominated by nearly-pure states. The resulting optimal estimation strategies for noisy coins are surprising and counterintuitive. We demonstrate some important consequences for quantum state estimation – in particular, that adaptive tomography can recover the $1/N$ risk scaling of classical probability estimation.

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