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**Thermodynamics of cellular statistical inference** ALEX LANG, CHARLES FISHER, PANKAJ MEHTA, Boston University — Successful organisms must be capable of accurately sensing the surrounding environment in order to locate nutrients and evade toxins or predators. However, single cell organisms face a multitude of limitations on their accuracy of sensing. Berg and Purcell first examined the canonical example of statistical limitations to cellular learning of a diffusing chemical and established a fundamental limit to statistical accuracy. Recent work has shown that the Berg and Purcell learning limit can be exceeded using Maximum Likelihood Estimation. Here, we recast the cellular sensing problem as a statistical inference problem and discuss the relationship between the efficiency of an estimator and its thermodynamic properties. We explicitly model a single non-equilibrium receptor and examine the constraints on statistical inference imposed by noisy biochemical networks. Our work shows that cells must balance sample number, specificity, and energy consumption when performing statistical inference. These tradeoffs place significant constraints on the practical implementation of statistical estimators in a cell.

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