

# Evidence Marshalling

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As part of a project exploring the possibility of using cosmic ray muons to detect hidden explosives, I have done a cost-benefit comparison between an instrument that measures energy and one that measures scattering angle. I found that *Chernoff Information*[1, 2, 3] provides the relevant characterization. Relying on the central limit theorem, one might predict that the first two moments of the log likelihoods for the two instruments would be sufficient to characterize their relative performance in the limit of a large number of muons. My presentation illustrates the failure of that prediction.

I illustrate how a Bayesian analysis[4] can guide measurement selection for a small number of measurements for a contrived example. I conclude by asking how one might bridge the small sample analysis that requires priors and costs to the asymptotic analysis that provides a comparative valuation independent of priors and costs.

## References

- [1] H. Chernoff. A measure of asymptotic efficiency for tests of a hypothesis based on a sum of observations. *Ann. Math. Stat.*, 23:493–507, 1952.
- [2] I. Sanov. On the probability of large deviations of random variables. *Mat. Sbornik*, pages 11,44, 1957. Engl. Sel. Transl. Math. Statist. Probab. 1961, 1, 213–244.
- [3] T.M. Cover and J.A. Thomas. *Elements of Information Theory*. Wiley, NY, 1991.
- [4] Herman Chernoff and Lincoln E Moses. *Elementary decision theory*. John Wiley & Sons Inc., New York, 1959.

**Topic:** learning theory

**Preference:** oral