HYPOTHESIS TESTING AND INFORMATION THEORY

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Abstract. This talk will describe the main connections between hypothesis testing and information theory. In particular, we will introduce an identity between the error probability of Bayesian M-ary hypothesis testing and non-Bayesian binary hypothesis testing in the Neyman-Pearson setting.

Statistical hypothesis testing is one of the main problems in statistics and finds applications in areas as diverse as information theory, image processing, computer science, signal processing, social sciences or biology. Hypothesis testing is the problem of deciding one of M possible known statistical hypotheses after processing some observation data. Hypothesis testing problems are typically classified as binary or non-binary, depending on the number of hypotheses, and Bayesian or non-Bayesian, depending on whether or not priors on the hypotheses are known.

In this talk, we will study the error probability of M-ary hypothesis testing. In particular, we show that the error probability of Bayesian M-ary hypothesis testing is equal to the error probability of a suitably optimized non-Bayesian binary hypothesis test. We will discuss an alternative identity in terms of information spectrum [1], i.e., the tail probability of an information random variable. The extension to the case where the hypothesis test outputs a list of candidate hypotheses instead of a single one will also be discussed.

This is joint work with Gonzalo Vázquez-Vilar, Adrià Tauste, Alfonso Martinez [2] and Ehsan Asadi Kangarshahi [3].

References

[1] T.-S. Han *Information-spectrum methods in information theory.* (2003) Springer.

[2] G. Vazquez-Vilar, A. Tauste Campo, A. Guillén i Fàbregas and A. Martinez. Bayesian M-ary Hypothesis Testing: The Meta-Converse and Verdú-Han Bounds are Tight. *IEEE Trans. Inf. Theory*, (2016), vol. 62, no. 5, pp. 2324-2333.

[3] E. Asadi Kangarshahi and A. Guillén i Fàbregas. Minimum Probability of Error of List M-ary Hypothesis Testing. `https://arxiv.org/abs/2110.14608.`

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