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Title: ROCs, Dual ROCs and Symmetric ROCs

Abstract: It has long been appreciated that the data from different experimental procedures can be related via a common theoretical framework provided by the theory of signal detectability. We examine in detail three of the most common experimental procedures: yes/no detection, forced choice, and rating methods, and provide a common “non-parametric” account of each of them. We show that (ideal) data from any one of these three procedures can be used to faithfully predict the corresponding data from the others. Two famous results from probability theory arise naturally in our investigations, namely the de Finetti representation of exchangeable binary-valued random variables and the Hausdorff moment theorem.

Ideal data from the yes/no procedure are summarized in the form of a so-called “receiver operating characteristic” or ROC. The notion of a dual ROC is introduced and this leads to a concise generalization of the well-known “area theorem” of standard signal detection theory. ROCs that are self-dual are called symmetric, and an explicit representation for symmetric ROCs is constructed.

The notions of “invariance” and “symmetry” occur throughout our developments.