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## On Fiducial Inference

Abstract:

R. A. Fisher's fiducial inference has been the subject of many discussions and controversies ever since he introduced the idea during the 1930's. The idea experienced a bumpy ride, to say the least, during its early years and one can safely say that it eventually fell into disfavor among mainstream statisticians. However, it appears to have made a resurgence recently under the label of generalized inference. In this new guise fiducial inference has proved to be a useful tool for deriving statistical procedures for problems where frequentist methods with good properties were previously unavailable. Therefore we believe that the fiducial argument of R.A. Fisher deserves a fresh look from a new angle.

In this paper we first generalize Fisher's fiducial argument and obtain a fiducial recipe applicable in virtually any situation. We demonstrate this fiducial recipe on many examples of varying complexity. We also investigate, by simulation and by theoretical considerations, some properties of the statistical procedures derived by the fiducial recipe. In particular, we compare the properties of fiducial inference to the properties of Bayesian inference and observe that the two share many common strengths and weaknesses.

In addition to the theoretical considerations mentioned above we also derive the fiducial distribution and verify its viability by simulations for several examples that are of independent interest. In particular we derive fiducial distributions for the parameters of a multinomial distribution, for the means, variances, and the mixing probability of a mixture of two normal distributions, and for the variance components in a simple one-way random linear model.