Applied Asymptotics in R

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The likelihood function represents the basic ingredient of many commonly used statistical methods for estimation, testing and the calculation of confidence intervals. In practice, much application of likelihood inference relies on first order asymptotic results such as the normal approximation to the distribution of the standardized maximum likelihood estimator. The approximations can, however, be rather poor if the sample size is small or, generally, when the average information available per parameter is limited. Thanks to the great progress made over the past twenty-five years or so in the theory of likelihood inference, very accurate approximations to the distribution of statistics such as the likelihood root have been developed. These not only provide modifications to well-established approaches, which result in more accurate inferences, but also give insight on when to rely upon first order methods. We refer to these developments as *higher order asymptotics*.

The purpose of this presentation is to show the importance and range of application of higher order asymptotics in statistical practice. We will do this by presenting a selection of examples. These range from elementary one-parameter models, chosen to illustrate the potential accuracy of the procedures, to more specialized examples. All calculations are carried out using R. One intriguing feature of the theory of higher order likelihood asymptotics is that relatively simple and familiar quantities play an essential role. Furthermore, many classes of models can be treated in a modular way, so higher order quantities can be expressed using a few elementary building-blocks. These are the key to efficient numerical implementation of higher order asymptotics. An example is the `hoa` package bundle.

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