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The Netherlands

Safe anytime-valid inference: from theory to implementation in psychiatry research

Turner, R.J.

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Classical statistical methods, such as p-value hypothesis testing, are difficult for researchers to apply correctly. The prevailing methods taught to applied researchers are actually not suitable for performing research in a modern environment, especially when working in a dynamic manner with lots of collaborations. They for example do not allow for real-time analysis and deciding to draw conclusions from a study early, or for extending a study with extra research groups that want to make their data available later. Sadly, in practice this often leads to faulty application of statistics and subsequent invalidity of experiment conclusions.

Partly as a consequence of the above, recently, interest in sequential testing and particularly safe, anytime-valid inference (SAVI) with e-values has emerged. This framework potentially offers the same functionality as the classical statistics and in addition provides researchers with plenty of flexibility, for example through enabling early stopping and effect estimation at any time, extending a study in hindsight, and analyzing data located across multiple hospitals.

In this thesis, this theory is further developed for performing SAVI in scenarios applicable to healthcare, specifically for several use-cases in psychiatry. It is explored how one could actually set up real-time psychiatry research in practice in an automated manner, combining text mining with network analysis techniques for data preparation and exploration and then confirming hypotheses with SAVI. Through this, the work in this thesis contributes to an environment where continuous learning from routinely collected healthcare data for better personalized recommendations is the new standard.

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