SEMINAR

Combining p-values, with applications to uncertainty quantification

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Combining p-values is a classic problem, and the usual assumption of independence is often violated or unverifiable. Many well-known rules combine arbitrarily dependent p-values into a single valid one. We show that essentially all of them can be strictly improved when the p-values are exchangeable, when external randomization is allowed, or both. The improvements follow a simple recipe: calibrate p-values to e-values, average them, and apply recent extensions of Markov's inequality. These results have direct applications in uncertainty quantification. In particular, they can be used to improve the statistical efficiency of cross-conformal prediction, yielding smaller prediction sets with the same coverage guarantee.