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Distribution-free testing: for Markov chains and for regression models

Consider an empirical process, in any one of statistical contexts, and then appliy unitary operator to this processes. Can one say what good could come out of this, and why will it be useful? The answer is that probably one can, as it leads us to a new point of view on distribution-free testing of probabilistic models.

The specific answer in the case of parametric families of discrete distributions was described in 2013. For parametric empirical processes in $\mathbb{R}^d$ the approach was described in 2016. In this talk we will show two further examples: how can we have a theory of distribution-free tests for transition matrices of Markov chains, and how can we test regression model in the way, which does not depend on covariates.

We will see that empirical process, or rather a family of empirical processes indexed by departure states x, constructed to test the parametric family $P_\theta(\cdot|x)$ can be mapped into empirical process for testing any other family $Q_\theta(\cdot|x)$ of transition probabilities within a class of equivalent families. The equivalence classes are broad and yet, only one family in any given equivalence class is needed. The equivalence classes "often" include families $Q_\theta(\cdot)$ which do not depend on departure states at all, thus making the problem of testing Markovianity equivalent to testing independence.

We will start, however, with more traditional statistical problem of parametric regression. We will see that regression empirical process, asymptotic distribution of which depends on behaviour of the regressors, can be mapped by appropriate unitary operator into regression empirical process where there are no covariates at all.

References

E. Khmaladze (2013), Note on distribution free testing for discrete distributions, AS, 41, 2979-2993

E. Khmaladze (2016), Unitary transformations, empirical processes and distribution free testing, Bernoulli, 22, 563-599

E. Khmaladze (2019), Testing hypothesis on transition matrix of a Markov chain, under submission

E. Khmaladze (2019), Distribution free testing for parametric regression in $\mathbb{R}^p$, under

submission.