

Title:**E-values and e-processes: Theory and applications in combining p-values, selective inference, risk backtesting, and online LLM detection****Abstract:**

E-values and e-processes have gained attention as potential alternatives to p-values as measures of uncertainty, significance and evidence. It has statistical advantages over p-values, such as sequential anytime validity, post-hoc decision validity, and robustness to dependence. We first briefly introduce the theory of e-values and e-processes, and then

a) Combining dependent p-values: Any admissible procedures for combining dependent p-values must go through e-values, and e-values offer powerful methods for combining exchangeable p-values.

b) Selective inference procedures: An e-value-based analog of the Benjamini-Hochberg (BH) procedure for false discovery rate (FDR) control is called the e-BH procedure, which is under arbitrary dependence structures. Indeed, all FDR procedures are, in some disguises, e-BH applied to some compound e-values.

c) Backtesting risk measures: Via e-processes we design nonparametric backtesting procedures for standard risk measures VaR and ES in banking regulation, providing a model-free solution to a long-standing challenging problem in financial risk management.

d) Online large language models (LLM) watermark detection: Through LLM watermarks, e-processes can be built to detect the use of LLM in generating texts, and it gives guidelines on theoretical optimality of watermarking schemes.

The talk is based on several joint papers with many co-authors and a book draft (with A. Ramdas) on this topic, available at <https://arxiv.org/abs/2410.23614>.

Ruodu Wang