

## Title: On Nonparametric Estimation of the CTE

**Nariankadu D. Shyamalkumar**, The University of Iowa

**Abstract:** The Conditional Tail Expectation (CTE) is gaining an increasing level of attention as a measure of risk. It is known that the empirical CTE is negatively biased as an estimator of the CTE, and that this bias can be practically significant for small sample sizes. This talk will present results relating to this phenomenon. First, we show that unbiased estimation is not possible for most nonparametric class of distributions of interest. Second, we show that the bias of the empirical CTE can be of order  $n^{-1/2}$  or exponential when the underlying distribution is discrete, and is of order  $1/n$  when it is continuous. And we also identify distributions at which this bias is maximized. Third, in the continuous case we derive a closed form expression for the first order bias, and this opens up alternatives to Bootstrap as a method for bias correction. Finally, we show that the Bootstrap method for bias correction is not asymptotically optimal for distributions of interest, while other kernel based methods are optimal. These results are derived from co-works with Prof. Bangwon Ko and Prof. Ralph P. Russo, and a part of this research is supported by CKER.