



The University of Chicago
Department of Statistics

Ph.D. Seminar

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Robustness of Volatility Estimation

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ABSTRACT

This thesis contains three major parts. All are related to the market microstructure error and the volatility estimation.

In the first part, we consider the case when the market microstructure error is solely due to rounding. Financial prices are often discretized - to the nearest cent, for example. Thus we can say prices are observed with rounding error. Rounding errors affect the estimation of volatility and understanding them becomes important especially when we use high frequency data. We study the asymptotic behavior of the Realized Volatility (RV) which is commonly used as an estimator of the integrated volatility. We prove the convergence of the RV and scaled RV under different conditions on the rounding level and the number of observations. A bias corrected volatility estimator is proposed and an associated central limit theorem is shown. Simulation results show that improvement in statistical properties can be substantial.

In the second part, we consider microstructure as an arbitrary contamination of the underlying latent securities price, through a Markov kernel. Special cases include additive error, rounding, and combinations thereof. Our main result is that, subject to smoothness conditions, the Two Scales Realized Volatility is robust to the form of contamination. To push the limits of our result, we show what happens for some models involving rounding and see in this situation how the robustness deteriorates with decreasing smoothness. Our conclusion is that under reasonable smoothness, one does not need to consider too closely how the microstructure is formed, while if severe non-smoothness is suspected, one needs to pay attention to the precise structure and also the use to which the estimator of volatility will be put.

In the third part, we present a generalized pre-averaging approach for estimating the integrated volatility. This approach also provides consistent estimators of other powers of volatility - in particular, it gives feasible ways to consistently estimate the asymptotic variance of the estimator of the integrated volatility. This approach, which possesses an intuitive transparency, can generate rate optimal estimators (with convergence rate $n^{-1/4}$).