Warp-speed bootstrap in Monte Carlo experiments

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Monte Carlo experiments are a fundamental tool for evaluating the performance of statistical procedures, particularly bootstrap methods. However, their computational cost can be prohibitive since each Monte Carlo replication requires drawing many bootstrap samples, resulting in a multiplicative explosion of calculations. This limitation is especially acute in applications involving complex statistics or resampling schemes for dependent data. The "warp-speed" approach, pioneered by White (2000) and later formalized by Giacomini et al. (2013), proposes a radical simplification: using only one bootstrap resample per Monte Carlo replication. Surprisingly, this yields valid approximations under broad conditions while reducing computation by orders of magnitude. The warp-speed bootstrap provides asymptotically correct coverage for confidence intervals when the bootstrap itself is valid.

The proposed thesis will review the mathematical and statistical foundations of the warp-speed bootstrap, and perform illustrative numerical studies to compare the warp-speed and standard bootstrap methods in Monte Carlo simulations, both in terms of accuracy and computational effort. The numerical experiments will explore the coverage and length of bootstrap confidence intervals, and the powers of bootstrap-based tests, for the warp-speed and standard bootstraps.

References

Giacomini, R., Politis, D. N., & White, H. (2013). A warp-speed method for conducting Monte Carlo experiments involving bootstrap estimators. *Econometric Theory*, *29*(3), 567–589. https://doi.org/10.1017/S0266466612000655

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