THE BOOTSTRAP IN ECONOMETRICS

Economics 481-1
Fall 2016

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COURSE DESCRIPTION

The bootstrap is a method for estimating the distribution of an estimator or test statistic by resampling one’s data or a model estimated from the data. It amounts to treating the data as if they were the population for the purpose of evaluating the distribution of interest. Under conditions that hold in a wide variety of econometric applications, the bootstrap provides approximations to distributions of statistics, coverage probabilities of confidence intervals, and rejection probabilities of hypothesis tests that are more accurate than the approximations of ordinary asymptotic distribution theory (e.g., asymptotic normal and chi-square approximations). The reductions in the differences between true and nominal coverage and rejection probabilities can be very large. Therefore, the bootstrap greatly improves the reliability of finite-sample inference in econometrics. In addition, the bootstrap can be used to carry out non-asymptotic inference under certain conditions. The bootstrap is a practical technique that is widely used in applications. This course explains and illustrates the usefulness and limitations of the bootstrap and why it matters in applied econometrics. The course covers the theory of the bootstrap, provides numerical examples of its performance, and illustrates its uses in applied research. The course also explains how the bootstrap can be applied to time-series data. There will be simple instructions on how to implement the bootstrap in applications. There will be occasional problem sets. Every student must write a one-page memo each week summarizing what was done in class that week. In addition, each student must write a paper and make a presentation of some course material to the class. There will be no examinations. The text for the course is my chapter in the Handbook of Econometrics, Vol. 5. It can be downloaded from Elsevier through the Northwestern library system or from the class web page, http://sites.northwestern.edu/jlh951/course-481-1-the-bootstrap/. There will also be readings assigned from the statistics and econometrics literature on the bootstrap.

EVALUATION:

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<th>Component</th>
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<tr>
<td>Problem Sets</td>
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<td>Weekly memos</td>
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<td>Presentation</td>
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<td>Paper</td>
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The tentative course outline follows.

I. The Bootstrap Sampling Procedure and Its Consistency

A. The problem to be solved (Horowitz, Sec. 2.1)
B. Consistency of the bootstrap (Horowitz, Sec. 2.1; Mammen (1991), Sec. 1.2; Bickel and Freedman (1981))

C. Alternative resampling procedures (Horowitz, Sec. 2.2; Politis et al., Politis and Romano (1994); Bertail et al. (1999), Sakov and Bickel (2000), Delgado et. al. (2001))

II. Asymptotic Refinements

A. Bias reduction (Horowitz, Sec. 3.1; Hall (1992a), Ch. 1)

B. Edgeworth expansions (Horowitz, Sec. 3.2; Hall (1992a), Ch. 2)

C. Bootstrap critical values for hypothesis tests (Horowitz, Sec. 3.3; Hall (1992a), Ch. 3)

D. Confidence intervals (Horowitz, Sec. 3.4; Hall (1992a), Ch. 3)

E. Alternative sampling procedures
   1. Parametric bootstrap (Horowitz, Sec. 3.6)
   2. The wild bootstrap (Mammen (1991), Sec. 8.3; Mammen (1993); Davidson and Flachaire 2008))
   3. Recentering (Horowitz, Sec. 3.7; Bickel and Freedman (1981); Brown and Newey (2002))

F. Prepivoting and bootstrap iteration (Horowitz, Sec. 4.4; Beran (1987, 1988); Hall (1992a), Ch. 3)

III. Nonparametric Density and Mean-Regression Estimators

A. Nonparametric density estimation  (Horowitz, Sec. 4.2.1; Hall (1992a), Ch. 4)

B. Asymptotic bias (Horowitz, Sec. 4.2.2; Hall (1992b))

C. Asymptotic refinements for density estimators (Horowitz, Sec. 4.2.3; Hall (1992a), Ch. 4)

D. Nonparametric mean-regression (Horowitz, Sec. 4.2.4; Hall (1992a), Ch. 4)

IV. Non-Smooth Statistics and Partially Identified Parameters

A. The population median  (Janas (1993))

B. The LAD estimator (De Angelis et al. (1993); Horowitz (1998a), Whang (2006))

C. Non-smooth semiparametric estimators (Chen, Linton and Van Keilegom (2003)).
D. Partially identified models (Bugni (2011), Freyberger and Horowitz (2012))

E. Penalized least squares estimation of high-dimensional models (Chatterjee and Lahiri (2011)).

V. Time-Series Data (Härdle et al. (2002))

A. ARMA models (Horowitz, Sec. 4.1.1; Bose (1988, 1990))

B. Sieve bootstrap for linear processes (Bühlmann 1997; Choi and Hall (2000))

C. The block bootstrap (Horowitz, Sec. 3.1.1; Hall et al. (1995), Hall and Horowitz (1996), Andrews (2002, 2004); Politis and White (2004); Patton, Politis, and White (2009).

1. Correction factors (Hall and Horowitz (1996))

2. Rate of convergence of errors (Hall et al. (1995); Zvingelis (2001))

D. Bootstrap for Markov processes (Rajarshi (1990); Datta and McCormick (1995); Horowitz (2003))

E. The dependent wild bootstrap (Shao 2010; Davidson 2013, Section 7)

VI Non-Asymptotic Inference

REFERENCES

Books are available in the library. Most journal articles can be obtained electronically through JSTOR or journal web sites. Unpublished working papers and papers that are hard to get for other reasons are on the course web page.


