THE BOOTSTRAP

Professor Russell Davidson
McGill University
http://russell-davidson.arts.mcgill.ca/

Tuesday 24 February
Building 2610, room 530 (S)

10:00 – 11:30 Lecture 1

Lunch break

13:00 – 14:30 Lecture 2

Wednesday 25 February
Building 2628, room 101 (M)

10:00 – 11:30 Lecture 3

This lecture is followed by students of Ulrich Hounyo.

AARHUS
UNIVERSITY

The Bootstrap

The bootstrap is a statistical technique used more and more widely in econometrics. Although the principle of the bootstrap does not depend on simulation, in practice simulation is almost always necessary for its implementation. Bootstrapping always involves setting up a bootstrap data-generating process (DGP). The main types of bootstrap DGP in current use will be discussed in the course, with examples of their use in econometrics.

I intend to follow a set of notes in the form of slides as the main support for the course. These will be made available in a PDF file, as will some papers that have not yet appeared in journals.

The following is an approximate outline of the course material.

1 Definitions and notation for the bootstrap; the bootstrap principle.
2 Monte Carlo tests
3 The parametric bootstrap.
4 Resampling and the nonparametric bootstrap.
5 The Golden Rules of Bootstrapping
6 Confidence intervals: asymptotic and bootstrap confidence intervals.
7 The bootstrap discrepancy and bootstrap refinements.
8 Estimating the bootstrap discrepancy and the fast approximation.
9 Heteroskedasticity and dependent data
10 Bootstrap iteration

If time permits, I will also discuss some particular applications of the bootstrap: nonlinear models, multivariate and simultaneous-equation models, weak instruments, inequality indices.

The bibliography that follows is mostly for reference. I don't intend to go through any of the articles listed specifically, but I will refer to some of them while giving the course.

Bibliography

Andrews, D. W. K., 2004. "The block-block bootstrap: Improved asymptotic refinements", *Econometrica*, **72**, 673–700.

Beran, R. (1988). "Prepivoting test statistics: A bootstrap view of asymptotic refinements", *Journal of the American Statistical Association* **83**, 687–697.

Davidson, R. (2007). "Bootstrapping Econometric Models", *Quantile*, **3**, 13–36 (in Russian). Discussion paper version in English.

Davidson, R. (2010). "Size Distortion of Bootstrap Tests: Application to a Unit Root Test", *Review of Economic Analysis*, **2**, 169–193.

Davidson, R. (2012). "Statistical Inference in the Presence of Heavy Tails", *Econometrics Journal*, **15**, C31–C53.

Davidson, R. and A. Cornea (2013). "A Parametric Bootstrap for Heavy Tailed Distributions", *Econometric Theory*, forthcoming.

Davidson, R. and E. Flachaire (2008). "The Wild Bootstrap, Tamed at Last", *Journal of Econometrics*, **146**, 162–169.

Davidson, R. and J. G. MacKinnon (2001). "Bootstrap J Tests of Nonnested Linear Regression Models," *Journal of Econometrics*, **109**, 167-193.

Davidson, R. and J. G. MacKinnon (2002). "Fast Double Bootstrap Tests of Nonnested Linear Regression Models", *Econometric Reviews*, **21**, 419-429.

Davidson, R. and J. G. MacKinnon (1999). "Bootstrap testing in nonlinear models". *International Economic Review 40*, 487–508.

Davidson, R. and J. G. MacKinnon (2004). *Econometric Theory and Methods*, Oxford University Press, New York.

Davidson, R. and J. G. MacKinnon(2006). "The Power of Asymptotic and Bootstrap Tests", *Journal of Econometrics*, **133**, 421–441.

Davidson R. and J. G. MacKinnon (2006). "Bootstrap methods in econometrics", Chapter 23 of *Palgrave Handbook of Econometrics*, Volume 1, *Econometric Theory*, eds T. C. Mills and K. Patterson, Palgrave-Macmillan, London.

Davidson, R. and J. G. MacKinnon (2007). "Improving the Reliability of Bootstrap Tests with the Fast Double Bootstrap," *Computational Statistics and Data Analysis*, **51**, 3259–3281.

Davidson, R. and J. G. MacKinnon (2008). "Bootstrap Inference in a Linear Equation Estimated by Instrumental Variables", *Econometrics Journal*, **11**, 443–477.

Davidson, R. and J. G. MacKinnon (2012). "Bootstrap Confidence Sets with Weak Instruments", *Econometric Reviews*, DOI: 10.1080/07474938.2013.825177.

Dufour, J.-M. and L. Khalaf (2001). "Monte Carlo test methods in econometrics", Ch. 23 in *A Companion to Econometric Theory*, ed. B. Baltagi, Oxford, Blackwell Publishers, 494–519.

Dwass, M. (1957). "Modified randomization tests for nonparametric hypotheses", *Annals of Mathematical Statistics*, **28**, 181–187.

Efron, B. (1979). "Bootstrap methods: Another look at the jackknife", *Annals of Statistics*, **7**, 1–26.

Gonçalves, S., Kilian, L., 2004. "Bootstrapping autoregressions with conditional heteroskedasticity of unknown form", *Journal of Econometrics*, **123**, 89–120.

Hall, P. (1992). *The Bootstrap and Edgeworth Expansion*, Springer-Verlag, New York.

Horowitz, J. L. (2001). "The bootstrap", Ch. 52 in *Handbook of Econometrics* Vol. 5, eds. J. J. Heckman and E. E. Leamer, North-Holland, Amsterdam, 3159–3228.

Horowitz, J. L. (2003). "The bootstrap in econometrics", *Statistical Science*, **18**, 211–218.

Mammen, E. (1993). "Bootstrap and wild bootstrap for high dimensional linear models", *Annals of Statistics*, **21**, 255–285.