

Bootstrap methods and their application

A. C. Davison

*Professor of Statistics, Department of Mathematics,
Swiss Federal Institute of Technology, Lausanne*

D. V. Hinkley

*Professor of Statistics, Department of Statistics and Applied Probability,
University of California, Santa Barbara*



Contents

<i>Preface</i>	ix
1 Introduction	1
2 The Basic Bootstraps	11
2.1 Introduction	11
2.2 Parametric Simulation	15
2.3 Nonparametric Simulation	22
2.4 Simple Confidence Intervals	27
2.5 Reducing Error	31
2.6 Statistical Issues	37
2.7 Nonparametric Approximations for Variance and Bias	45
2.8 Subsampling Methods	55
2.9 Bibliographic Notes	59
2.10 Problems	60
2.11 Practicals	66
3 Further Ideas	70
3.1 Introduction	70
3.2 Several Samples	71
3.3 Semiparametric Models	77
3.4 Smooth Estimates of F	79
3.5 Censoring	82
3.6 Missing Data	88
3.7 Finite Population Sampling	92
3.8 Hierarchical Data	100
3.9 Bootstrapping the Bootstrap	103

3.10	Bootstrap Diagnostics	113
3.11	Choice of Estimator from the Data	120
3.12	Bibliographic Notes	123
3.13	Problems	126
3.14	Practicals	131
4	Tests	136
4.1	Introduction	136
4.2	Resampling for Parametric Tests	140
4.3	Nonparametric Permutation Tests	156
4.4	Nonparametric Bootstrap Tests	161
4.5	Adjusted P-values	175
4.6	Estimating Properties of Tests	180
4.7	Bibliographic Notes	183
4.8	Problems	184
4.9	Practicals	187
5	Confidence Intervals	191
5.1	Introduction	191
5.2	Basic Confidence Limit Methods	193
5.3	Percentile Methods	202
5.4	Theoretical Comparison of Methods	211
5.5	Inversion of Significance Tests	220
5.6	Double Bootstrap Methods	223
5.7	Empirical Comparison of Bootstrap Methods	230
5.8	Multiparameter Methods	231
5.9	Conditional Confidence Regions	238
5.10	Prediction	243
5.11	Bibliographic Notes	246
5.12	Problems	247
5.13	Practicals	251
6	Linear Regression	256
6.1	Introduction	256
6.2	Least Squares Linear Regression	257
6.3	Multiple Linear Regression	273
6.4	Aggregate Prediction Error and Variable Selection	290
6.5	Robust Regression	307
6.6	Bibliographic Notes	315
6.7	Problems	316
6.8	Practicals	321

7	Further Topics in Regression	326
7.1	Introduction	326
7.2	Generalized Linear Models	327
7.3	Survival Data	346
7.4	Other Nonlinear Models	353
7.5	Misclassification Error	358
7.6	Nonparametric Regression	362
7.7	Bibliographic Notes	374
7.8	Problems	376
7.9	Practicals	378
8	Complex Dependence	385
8.1	Introduction	385
8.2	Time Series	385
8.3	Point Processes	415
8.4	Bibliographic Notes	426
8.5	Problems	428
8.6	Practicals	432
9	Improved Calculation	437
9.1	Introduction	437
9.2	Balanced Bootstraps	438
9.3	Control Methods	446
9.4	Importance Resampling	450
9.5	Saddlepoint Approximation	466
9.6	Bibliographic Notes	485
9.7	Problems	487
9.8	Practicals	494
10	Semiparametric Likelihood Inference	499
10.1	Likelihood	499
10.2	Multinomial-Based Likelihoods	500
10.3	Bootstrap Likelihood	507
10.4	Likelihood Based on Confidence Sets	509
10.5	Bayesian Bootstraps	512
10.6	Bibliographic Notes	514
10.7	Problems	516
10.8	Practicals	519

11 Computer Implementation	522
11.1 Introduction	522
11.2 Basic Bootstraps	525
11.3 Further Ideas	531
11.4 Tests	534
11.5 Confidence Intervals	536
11.6 Linear Regression	537
11.7 Further Topics in Regression	540
11.8 Time Series	543
11.9 Improved Simulation	545
11.10 Semiparametric Likelihoods	549
Appendix A. Cumulant Calculations	551
<i>Bibliography</i>	555
<i>Name Index</i>	568
<i>Example index</i>	572
<i>Subject index</i>	575