

CONTENTS OF VOLUME II

Introduction to the Series	v
Contents of the Handbook	vii
Preface to the Handbook	xi
Part 4 – TESTING	
<i>Chapter 13</i>	
Wald, Likelihood Ratio, and Lagrange Multiplier Tests in Econometrics	
ROBERT F. ENGLE	
1. Introduction	775
2. Definitions and intuitions	776
3. A general formulation of Wald, Likelihood Ratio, and Lagrange Multiplier tests	780
4. Two simple examples	785
5. The linear hypothesis in generalized least squares models	788
5.1. The problem	788
5.2. The test statistics	790
5.3. The inequality	792
5.4. A numerical example	793
5.5. Instrumental variables	794
6. Asymptotic equivalence and optimality of the test statistics	796
7. The Lagrange Multiplier test as a diagnostic	801
8. Lagrange Multiplier tests for non-spherical disturbances	802
8.1. Testing for heteroscedasticity	803
8.2. Serial correlation	805
9. Testing the specification of the mean in several complex models	808
9.1. Testing for non-linearities	809
9.2. Testing for common factor dynamics	811
9.3. Testing for exogeneity	812
9.4. Discrete choice and truncated distributions	817
10. Alternative testing procedures	819
11. Non-standard situations	822
12. Conclusion	824
References	825

*Chapter 14***Multiple Hypothesis Testing**

N. E. SAVIN	827
1. Introduction	828
2. <i>t</i> and <i>F</i> tests	830
2.1. The model	830
2.2. Tests	831
2.3. Critical values—finite induced test	833
2.4. Acceptance regions	835
3. Induced tests and simultaneous confidence intervals	843
3.1. Separate hypotheses	843
3.2. Finite induced test— ψ of primary interest	844
3.3. Infinite induced test—Scheffé test	848
3.4. Finite induced test— ψ of secondary interest	855
3.5. Simultaneous confidence intervals	857
4. The power of the Bonferroni and Scheffé tests	860
4.1. Background	860
4.2. Power contours	861
4.3. Average powers	862
4.4. The problem of multicollinearity	867
5. Large sample induced tests	871
6. Empirical examples	874
6.1. Textile example	874
6.2. Klein's Model I example	876
References	877

*Chapter 15***Approximating the Distributions of Econometric Estimators and Test Statistics**

THOMAS J. ROTHENBERG	881
1. Introduction	882
2. Alternative approximation methods	884
2.1. Preliminaries	884
2.2. Curve-fitting	886
2.3. Transformations	887
2.4. Asymptotic expansions	889
2.5. Ad hoc methods	891
3. Edgeworth approximations	892
3.1. Sums of independent random variables	893
3.2. A general expansion	896
3.3. Non-normal expansions	900
4. Second-order comparisons of estimators	902
4.1. General approach	903

4.2.	Optimality criteria	904
4.3.	Second-order efficient estimators	905
4.4.	Deficiency	907
4.5.	Generalizations	908
5.	Second-order comparisons of tests	909
5.1.	General approach	909
5.2.	Some results when $q = 1$	912
5.3.	Results for the multiparameter case	915
5.4.	Confidence intervals	917
6.	Some examples	918
6.1.	Simultaneous equations	918
6.2.	Autoregressive models	925
6.3.	Generalized least squares	929
6.4.	Departures from normality	930
7.	Conclusions	931
	References	932

Chapter 16

Monte Carlo Experimentation in Econometrics

DAVID F. HENDRY

1.	Monte Carlo experimentation	939
1.1.	Introduction	939
1.2.	Simulation experiments	942
1.3.	Experimentation versus analysis	943
2.	The econometric model	945
2.1.	The data generation process	945
2.2.	Known distributional and invariance results	946
3.	The Monte Carlo model	947
3.1.	Random numbers	947
3.2.	Efficient simulation: Reliability and validity	949
3.3.	Embedding the econometric model in the Monte Carlo model	950
4.	Reducing imprecision: Variance reduction	951
4.1.	Common random numbers	951
4.2.	Antithetic random numbers	952
4.3.	Control variates	952
5.	Reducing specificity: Response surfaces	955
5.1.	Response surface formulations	955
5.2.	Heteroscedasticity transformations	959
5.3.	Investigating validity	962
6.	An application to a simple model	963
6.1.	Formulation of the experiments	963
6.2.	Estimating $E(\hat{\alpha} \alpha, T)$	965
6.3.	Estimating $\psi_{T2}(\hat{\alpha})$	968

6.4. Estimating $V_T(\hat{\alpha})$	969
6.5. Estimating $E(\hat{\sigma}_e^2 \alpha, T)$	970
6.6. Estimating $P(Z \alpha, T, \delta)$	971
7. Some loose ends	972
7.1. Non-existent moments	972
7.2. Evaluating integrals	973
References	974

Part 5 – TIME SERIES TOPICS

Chapter 17

Time Series and Spectral Methods in Econometrics

C. W. J. GRANGER and MARK W. WATSON	979
1. Introduction	980
2. Methodology of time-series analysis	980
3. Theory of forecasting	993
4. Multiple time series and econometric models	1002
5. Differencing and integrated models	1006
6. Seasonal adjustment	1009
7. Applications	1016
8. Conclusion	1019
References	1019

Chapter 18

Dynamic Specification

DAVID F. HENDRY, ADRIAN R. PAGAN and J. DENIS SARGAN	1023
1. Introduction	1025
2. Data generation processes	1028
2.1. Conditional models	1028
2.2. Estimation, inference and diagnostic testing	1031
2.3. Interpreting conditional models	1034
2.4. The status of an equation	1035
2.5. Quasi-theoretical bases for dynamic models	1037
2.6. A typology of single dynamic equations	1040
3. Finite distributed lags	1049
3.1. A statement of the problem	1049
3.2. Exact restrictions on lag weights	1050
3.3. Choosing lag length and lag shape	1054
3.4. Weaker restrictions on lag weights	1060
3.5. Alternative estimators	1062
3.6. Reformulations to facilitate model selection	1065

4. Infinite distributed lags	1066
4.1. Rational distributed lags	1066
4.2. General error correction mechanisms	1069
4.3. Derived statistics	1072
5. Stochastic specification	1073
6. Dynamic specification in multi-equation models	1080
6.1. Identification with autoregressive errors	1080
6.2. Reduced form, final form and dynamic multipliers	1084
6.3. Unconstrained autoregressive modelling	1087
6.4. Alternative forms of disequilibrium model	1089
References	1092
<i>Chapter 19</i>	
Inference and Causality in Economic Time Series Models	
JOHN GEWEKE	1101
1. Introduction	1102
2. Causality	1103
3. Causal orderings and their implications	1108
3.1. A canonical form for wide sense stationary multiple time series	1109
3.2. The implications of unidirectional causality	1113
3.3. Extensions	1115
4. Causality and exogeneity	1117
5. Inference	1122
5.1. Alternative tests	1122
5.2. Comparison of tests	1127
6. Some practical problems for further research	1133
6.1. The parameterization problem and asymptotic distribution theory	1133
6.2. Non-autoregressive processes	1135
6.3. Deterministic processes	1138
6.4. Non-stationary processes	1139
6.5. Multivariate methods	1140
References	1142
<i>Chapter 20</i>	
Continuous Time Stochastic Models and Issues of Aggregation Over Time	
A. R. BERGSTROM	1145
1. Introduction	1146
2. Closed first-order systems of differential and integral equations	1150
2.1. Stochastic limit operations and stochastic differential equations	1150
2.2. Random measures and systems with white noise disturbances	1157
2.3. Estimation	1171
3. Higher order systems	1193
4. The treatment of exogenous variables and more general models	1202
5. Conclusion	1209
References	1210

*Chapter 21***Random and Changing Coefficient Models**

GREGORY C. CHOW	1213
1. Introduction	1214
2. Derivation of $\beta_{t,s}$ by recursive regression of β_t on y_1, \dots, y_s	1215
3. Derivations of $\beta_{t,s}$ by regression of y_1, \dots, y_s on x_1, \dots, x_s	1220
4. Maximum likelihood estimation of σ^2, V and M	1222
5. System of linear regressions with changing coefficients	1225
6. System of linear simultaneous equations	1228
7. System of non-linear simultaneous equations	1233
8. Model with stationary coefficients	1234
9. Identifiability of parameters	1237
10. Testing constancy of regression coefficients	1239
11. Problems for research	1242
References	1243

*Chapter 22***Panel Data**

GARY CHAMBERLAIN	1247
1. Introduction and summary	1248
2. Specification and identification: Linear models	1254
2.1. A production function example	1254
2.2. Fixed effects and incidental parameters	1256
2.3. Random effects and specification analysis	1257
2.4. A consumer demand example	1259
2.5. Strict exogeneity conditional on a latent variable	1262
2.6. Lagged dependent variables	1264
2.7. Serial correlation or partial adjustment?	1267
2.8. Residual covariances: Heteroskedasticity and serial correlation	1268
2.9. Measurement error	1269
3. Specification and identification: Nonlinear models	1270
3.1. A random effects probit model	1270
3.2. A fixed effects logit model: Conditional likelihood	1274
3.3. Serial correlation and lagged dependent variables	1278
3.4. Duration models	1282
4. Inference	1285
4.1. The estimation of linear predictors	1286
4.2. Imposing restrictions: The minimum distance estimator	1288
4.3. Simultaneous equations: A generalization of three-stage least squares	1292
4.4. Asymptotic efficiency: A comparison with the quasi-maximum likelihood estimator	1294
4.5. Multivariate probit models	1296
5. Empirical applications	1299
5.1. Linear models: Union wage effects	1299
5.2. Nonlinear models: Labor force participation	1304

6. Conclusion	1311
Appendix	1311
References	1313

Part 6 – SPECIAL TOPICS IN ECONOMETRICS – I

Chapter 23

Latent Variable Models in Econometrics

DENNIS J. AIGNER, CHENG HSIAO, ARIE KAPTEYN and TOM WANSBEEK

1. Introduction	1323
1.1. Background	1323
1.2. Our single-equation heritage	1324
1.3. Multiple equations	1326
1.4. Simultaneous equations	1327
1.5. The power of a dynamic specification	1328
1.6. Prologue	1329
2. Contrasts and similarities between structural and functional models	1329
2.1. ML estimation in structural and functional models	1330
2.2. Identification	1332
2.3. Efficiency	1335
2.4. The ultrastructural relations	1336
3. Single-equation models	1337
3.1. Non-normality and identification: An example	1337
3.2. Estimation in non-normal structural models	1338
3.3. A non-normal model with extraneous information	1340
3.4. Identifying restrictions in normal structural and functional models	1341
3.5. Non-linear models	1344
3.6. Should we include poor proxies?	1345
3.7. Prediction and aggregation	1346
3.8. Bounds on parameters in underidentified models	1347
3.9. Tests for measurement error	1349
3.10. Repeated observations	1350
3.11. Bayesian analysis	1352
4. Multiple equations	1353
4.1. Instrumental variables	1354
4.2. Factor analysis	1357
4.3. The MIMIC model and extensions	1359
5. Simultaneous equations	1362
5.1. The case of Ω known	1363
5.2. Identification and estimation	1363
5.3. The analysis of covariance structures	1369

6. Dynamic models	1372
6.1. Identification of single-equation models	1372
6.2. Identification of dynamic simultaneous equation models	1377
6.3. Estimation of dynamic error-shock models	1380
References	1386
 <i>Chapter 24</i>	
Econometric Analysis of Qualitative Response Models	
DANIEL L. McFADDEN	1395
1. The problem	1396
2. Binomial response models	1396
2.1. Latent variable specification	1396
2.2. Functional forms	1397
2.3. Estimation	1398
2.4. Contingency table analysis	1400
2.5. Minimum chi-square method	1400
2.6. Discriminant analysis	1401
3. Multinormal response models	1403
3.1. Foundations	1403
3.2. Statistical analysis	1406
3.3. Functional form	1410
3.4. The multinomial logit model	1411
3.5. Independence from irrelevant alternatives	1413
3.6. Limiting the number of alternatives	1415
3.7. Specification tests for the MNL model	1417
3.8. Multinomial probit	1418
3.9. Elimination models	1420
3.10 Hierarchical response models	1422
3.11 An empirical example	1428
4. Further topics	1433
4.1. Extensions	1433
4.2. Dynamic models	1433
4.3. Discrete-continuous systems	1434
4.4. Self-selection and biased samples	1436
4.5. Statistical methods	1439
5. Conclusion	1442
Appendix: Proof outlines for Theorems 1–3	1442
References	1446
Index	1459