# BUSINESS FLUCTUATIONS

### FORECASTING TECHNIQUES AND

# APPLICATIONS

Dale G. Bails Memphis State University

Larry C. Peppers Creighton University

che Hoch chgeblet 1 listik und Ökonor

Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632

## Contents

Preface	xi
PART I OVERVIEW OF FORECASTING AND	
BUSINESS CYCLES	1
Chapter 1 Business Forecasting:	
Economy, Region, Industry, and Company	3
Introduction 3	
Decision Makers: The Need for Forecast Information 4	
The Business Cycle: Past and Present 6	
Measuring Economic Activity From Peak to Trough 7	
Absolute vs. Relative Measures of Economic Activity 9	
Disaggregation: Economy, Region, Industry, and Company 12	
Disaggregation by Industry 14	
The Automotive Industry: Domestic vs. Foreign Production 15	
The Beer Industry and Product Proliferation 16	
The Rail Freight Industry and Regional Disaggregation 17	

The Air Passenger Transportation Industry: Disaggregation by Customer and Region 19 The Steel Industry and Disaggregation by End Use 20

Interdependence 22 Commercial Forecast Vendors 23 Is the Economy Near a Turning Point? 25 Preparing the Forecast 29 Questions for Discussion and Analysis 30

#### Chapter 2 Macroeconomic Forces: Shaping the Environment of the Business Sector

Introduction 32 Economic Forces at Work in the Business Sector 33 The Business Cycle: An Overview 34 The Anatomy of the 1970–75 Cycle 39 Statistical Measurement: The National Bureau of Economic Research 47 The National Bureau of Economic Research 47 Indicators, Diffusion Indices, and Turning Points 48 Indicators: Theoretical Underpinning and Empirical Reliability 50 Integrating Technical Indicators: Developing an Outlook 54

The 1980 Downturn: Confirmation or Rejection of the Indicator Approach 59 Questions for Discussion and Analysis 63

#### Chapter 3 The Great Recession of 1974–75: Monitoring Econometric Forecasts

Introduction 66

Ex Post Forecast Analysis: Evaluating Changing Economic Scenarios 67 Alternative Macroeconomic Forecasting Techniques 68 Macroeconomic Models: Introduction 68 Macroeconometric Models: Equation Formulation 72 A Monetarist Model of the Economy 73 An Overview of the Great Recession: The Economy From 1973 to 1975 76 Setting the Stage 76 The Forecast Assessment at the Outset of 1974 77 Diagnosing the Great Recession: A Monthly Chronicle 81 Introduction 81 "Roundup's" Optimism: No More Cycles? 82 "Roundup's" Caution: Recognizing a Recession 85 "Roundup" Catches Up With the Great Recession 85 DRI's Ex Post Analysis of the Great Recession 86 DRI's Outlook 86 The Great Recession: Legacy for the Forecaster 90 Econometric Modeling: Adaption to Structural Change 92 The Great Recession's Legacy: Microeconomic Forecast Implications 94 Implications 94 Questions for Discussion and Analysis 95

66

32

PART II CLASSICAL TIME-SERIES DECOMPOSITION	99
Chapter 4 Forecasting, Time-Series Data Analysis, and Forecast Evaluation	101
Introduction 101 Forecasting and Forecasting Techniques 102 Objectives of Forecasting Models 102 Classification of Forecasting Techniques 102 Technique Selection 104	
Time-Series Analysis 107 Seasonal Adjustment 109 Trend Isolation 115 Cyclical Fluctuations 123 Census Method of Decomposition 125 Forecasts and Forecast Accuracy 126 Concept of a Forecast 126 Simple Forecasting Techniques 127 Error Analysis 130 Example 4-1: Airline Revenue Passenger Miles 130	
Models and Forecasting 136 Questions for Discussion and Analysis 137	
PART III THE TWO-VARIABLE REGRESSION MODEL	139
Chapter 5 Simple Linear Regression	141
Introduction 141 Linear-Regression Model 142 Statistical Formulation 142 Statistical Estimation 147	
Mathematical Model 149 Properties of the Least-Squares Model 149 Statistical Properties 152	
Statistical Validation 153 Hypothesis Testing 153 Point and Interval Estimates 156 Standard Error of the Estimate 157 Analysis of Variance 158 Coefficients of Determination and Correlation 161 Concluding Commentary 162 Example 5-1: Air-Miles Traveled 162 Example 5-2: Retail Sales of New Passenger Cars 165	
Forecasting with Simple Linear-Regression Models 168 Types of Forecasts 168 Forecast Evaluation 172 Example 5-3: Air-Miles Traveled, Continued 175 Example 5-4: Retail Sales of Automobiles, Continued 177	
Questions for Discussion and Analysis 178	

#### PART IV THE MULTIPLE REGRESSION MODEL

183

Chapter 6 Multiple Regression Models	185
Introduction 185 Multiple Regression 186 The Multiple Regression Model 186 Interpretation of the Model 190 Multiple and Partial Correlation 191 Beta Coefficients and Elasticities 192 Forecasting and Explanatory Equations 193 Example 6-1: Automobile Sales Revisited 194 Example 6-2: Installment-Loan Demand in Memphis 200	
<ul> <li>Validation of the Model 203 Introduction 203 Multicollinearity 204 Heteroscedasticity 208 Autocorrelation 210 Example 6-3: Unit Sales of Automobiles; Correction for Autocorrelation 221 Conclusion 223 Appendix 6.1 224</li> <li>Questions for Discussion and Analysis 228</li> </ul>	
Chapter 7 Advanced Topics in Regression Analysis	231
Introduction 231 Proxy and Dummy Variables 232 Proxy Variables 232 Dummy Variables 233	
Linear Transformations 239 Logarithmic Transformations 239 Reciprocal Transformations 240 Comments on Transformation Issues 241 Example 7-1: Sales Tax Revenue Elasticity 241	
Finding the Best Set of Independent Variables 243 Introduction 243 All Possible Regressions 243 Stepwise Regression 244 Forward Stepwise Selection 245 Backward Stepwise Elimination 245 Comments on Search Procedures 245 Example 7-2: Unit Sales of Automobiles, Stepwise Analysis 246	
Lagged Independent Variables 257 Simple Lagged Relationships 257 Example 7-3: Estimation of Sales via Lagged Relationships 259 Distrubuted Lags 260 Example 7-4: Capital Expenditures and Polynomial Distributed Lags 262	
Two-Stage Least Squares and the Identification Problem 263 Introduction 263 The Identification Problem 264	

Two-Stages Least Squares (2SLS) 267

275

OLS vs. 2SLS: An Overview 268 Multiple Equation Models 268 Introduction 268 Simultaneous Equation Systems 268 Recursive Models 269 Example 7-5: Testing the Structural Stability of Regression Models: The Chow Test 270 Questions for Discussion and Analysis 273

#### Chapter 8 Case Studies of Multiple Regression Models

Introduction 275
A Quarterly Model of Rail Freight Ton-Miles 276 The Historical Setting 276
Time-Series Analysis of Raw Data 277 Developing a Rail Regression Model 283 Correcting the Rail-Ton-Mile Model for Autocorrelation 287 Preparation of a Forecast for Rail Ton-Miles 293
Capital Planning for a Locomotive Builder 295
Exogenous Safety Shocks: Forecasting in the Trailer Sector 296 Historical Background: Truck Safety Guidelines 298 Forecast Evaluation of Exogenous Shocks 298 Quantifying SS 121's Effect on Trailer Demand 300

Demand Analysis: Developing Ad Hoc Models 303 Quantifying the Secondary Effects of SS 121 306 Simulating Economic Activity with a Monetarist Model The Monetarist Approach 307

Empirical Analysis with a Monetarist Model 315 Using a Recursive Monetarist Model 320

Summary 327 Questions for Discussion and Analysis 328

#### PART V TIME-SERIES MODELS

#### Chapter 9 Time-Series Models

Introduction 333 Moving-Average Models 334 Simple Moving Averages 334 Weighted Moving Averages 337 Double Moving Averages 338

Exponential Smoothing 339 Single Exponential Smoothing 339 Brown's Linear Exponential Smoothing 345 Triple Exponential Smoothing 349 Evaluation of Smoothing Techniques 351 Example 9-1: Planning Flight-Attendant Requirements 352 Example 9-2: Combining Time-Series and Regression Models 356 Example 9-3: Turning-Point Evaluations of Time-Series Models 359

Questions for Discussion and Analysis 363

331

307

333

#### Chapter 10 Advanced Time-Series Models

Introduction 365
Winters's Seasonal Exponential Smoothing 365
Adaptive-Response-Rate Exponential Smoothing 371
Holt's Two-Parameter Exponential Smoothing 375
Confidence Intervals for Exponential-Smoothing Forecasts 377
Box-Jenkins Methodology 380
Comparision of Regression and Autoregressive Techniques 385
Example 10-1: Forecasting Sales Tax Receipts: Box-Jenkins and Regression Models 386
Conclusion 391
Questions for Discussion and Analysis 391

#### PART VI TRANSLATING THE FORECAST FOR MANAGEMENT

#### Chapter 11 Communicating Forecasts to Management 395

Introduction 395

Determining Management's Forecast Needs 396

Quantifying Manpower Requirements: Support-Staff Projections for Personnel 397

Operating a Railroad: Ton-Mile Projections 402

Formulating the Budget: The Role of the Forecaster 409 Introduction 409 Stage One: Synthesizing Top-Down and Bottom-Up Projections 412 Monitoring the Budget and Forecast 416

Reasessing the Budget 419

The Politics of Forecasting 422 Forecast Communication: Summary and Overview 424 Questions for Discussion and Analysis 425

#### LIST OF APPENDICES

Appendix ACensus X-11Seasonal Adjustment Program Applied<br/>to Memphis Retail Sales427Appendix BStudent t Distribution429Appendix CCritical Values for the F Distribution439

- Appendix D Data for Air-Miles Traveled and Retail Sales of New Automobiles 444
- Appendix E Data for Auto Sales and Installment Loans 448
- Appendix F The Durbin-Watson d Statistic 454
- Appendix G Unit Sales of Automobiles: Sample Data 457
- Appendix H Clothing Sales: Sample Data 460
- Appendix I Smoothed Statistics 463

INDICES

### 427

393