1 INTRODUCTION 22

1.1 Why this book? 22

1.2 Why Bother with Forecasting? 23

1.2.1 Short-Term 23

1.2.2 Long-term Forecasting 24

1.3 Focus on Food 24

1.4 The ‘Missing Link’ 24

1.5 The Modelling Process 25

1.5.1 Objectives of a Model 25

1.5.2 Acceptability 25

2 ACME FOOD STORES PLC 27

2.1 Introduction 27

2.2 The Food Store Sector in the UK 27

2.2.1 Overall Growth 27

2.2.2 Market Shares 27

2.3 Stores and Revenue per Outlet 28

2.4 Financial Performance in Detail 30

2.5 Employees 32

2.6 Additional Issues for Acme 33

2.6.1 In Store Operations – Self Scan 33

2.6.2 Online Sales 34

2.6.3 Suppliers 34

3 ERRORS IN FORECASTING – ARE THEY INEVITABLE? 35

3.1 Chapter Overview 35

3.2 Systemic Errors 35

3.3 Technical Errors 35

3.4 Robustness of Forecasts 38

3.4.1 Ranking Factors by Robustness 38

3.4.2 Labour Costs 40

3.4.3 Labour Costs per Unit Produced 40

3.4.4 Raw Materials 40

3.4.5 Sector Demand 41

3.4.6 Company Demand 43

3.4.7 Company Revenue 43

4 CHANNEL TUNNEL– CASE STUDY 46

4.1 Overview 46

4.2 Market Volume 46

4.3 Market Shares 47

4.4 Forecasts 48

4.4.1 General Observations 48

4.4.2 Market Size 49

4.4.3 Tunnel Market Share 50

4.5 Closing Remarks 50

5 SAMPLING 51

5.1 Why Sampling is Important 51

5.2 Mean and Standard Deviation 51

5.3 Normalisation 52

5.4 Sampling, Standard Error and T Distribution 53

5.4.1 Introducing Sampling 53

5.4.2 Standard Error of the Mean (SEM) 53

5.4.3 Degrees of Freedom (DoF) 54

5.4.4 T-Distribution 54

5.4.5 Degree of confidence 56

5.5 Confidence Interval 57

5.5.1 German Stores 57

5.5.2 UK Stores 58

5.5.3 How Could These Results Change? 58

5.5.4 Sample Quality 59

5.6 Sampling: Endnotes 62

5.7 Annex on Standard Deviation and SEM 63

5.7.1 Introduction 63

5.7.2 The Problem 63

5.7.3 Method 1- Simulation 63

5.7.4 Method 2 – Direct Calculation 64

5.7.5 Back to the Owner’s Problem 65

5.7.6 Model Used to Demonstrate SEM 65

6 ANALYSING HISTORICAL DATA 68

6.1 What are we looking for in the data? 68

6.2 Correlation 68

6.2.1 Examples of Correlation Values 68

6.2.2 Correlation and Causality 69

6.2.3 Need for a Hypothesis 69

6.2.4 “False Friends” 69

6.2.5 Significance of the Correlation Coefficient 70

6.2.6 Coefficient of Determination 71

6.3 Trends 72

6.4 Seasonality 72

6.5 Lags 74

6.6 Shocks Explained 75

7 PROBABILITY AND CONTINGENCY PLANNING 77

7.1 Why Examine Probability? 77

7.2 Types of Probability 77

7.3 Quantifying Uncertainty 77

7.4 Calculating Compound Probabilities 79

7.5 Probability Distributions 80

7.6 Binomial Distribution 80

7.6.1 A Binomial Problem 80

7.6.2 Binomial Formulae 80

7.6.3 Excel Solution 81

7.7 Normal Distribution 81

7.7.1 A Normal Problem 81

7.7.2 Excel Solution 82

7.7.3 Manipulating the Normal Distribution 82

7.7.4 Poisson Distribution 83

8 QUEUING AND SIMULATION 85

8.1 Introduction 85

8.2 Queuing Behaviour 86

8.2.1 Fairness and Equity 86

8.2.2 Baulking and Reneging 86

8.3 Single Server Queue 86

8.3.1 Mathematics of a Single Queue 86

8.3.2 Varying the Rate of Arrivals 87

8.4 Single Server Queue Simulation 88

8.4.1 Simple Probability Distributions 88

8.4.2 Applying the Poisson Distribution 88

8.4.3 Random Numbers 90

8.4.4 Simulation Results 91

8.4.5 Full Simulation Results 91

8.4.6 Available Options 94

8.4.7 Improve the Service Rate 94

8.4.8 Add a Server 95

8.4.9 One Queue or Two? 96

8.5 Closing Remarks 98

9 SIMULATION: MODELLING MAJOR INCIDENTS 99

9.1 Overview 99

9.2 Example: Assessing the Impact of Power Outages 99

9.3 Notes of Caution 100

9.4 Results 100

9.5 Extensions of the Methodology 101

9.6 Closing Remarks 102

10 WORKING WITH CONSTRAINTS 103

10.1 Introduction 103

10.2 A Simple Example of Linear Programming 103

10.3 Constraints 104

10.3.1 Truck Variables 104

10.3.2 Integers and Non-Negative Responses 104

10.3.3 Demand 105

10.3.4 Truck Supply 105

10.3.5 Route-specific Constraints 105

10.3.6 Summary of Constraints 105

10.4 Defining the Objective Function 105

10.5 Excel’s Solver 106

10.6 Solution 107

10.7 Sensitivities 107

10.7.1 Changing Large Truck Supply 108

10.7.2 Removal of the Store 3 Constraint 108

10.7.3 Higher Demand at Store 3 108

10.8 Closing Remarks 110

10.9 Other Uses for Solver 110

11 BENCHMARKING 111

11.1 Background 111

11.2 Historical/Internal Benchmarking 111

11.3 Comparative Benchmarking 112

12 SCENARIOS 114

12.1 Introduction 114

12.2 Overview of Sensitivity Testing 114

12.3 “States of the World” 115

12.4 Scenario Specifics 115

12.4.1 Decision Tree – Modelling the Issues 115

12.4.2 Revenue Scenarios 116

12.4.3 Cost Scenarios 116

12.4.4 Probabilities 116

12.5 Closing Remarks 118

13 ELASTICITIES 119

13.1 What are Elasticities? 119

13.2 A Little Bit of Algebra 119

13.3 Application to Forecasting Demand 120

13.4 Application to Forecasting (GDP/Income) 120

13.5 Application to Indirect Taxation 121

13.5.1 Who pays? 121

13.5.2 Basic Supply and Demand 121

13.5.3 Introducing a Tax 122

13.5.4 Splitting the Tax Burden 123

13.6 Model Development for the Tax Burden 124

13.6.1 Overview 124

13.6.2 Supply and Demand Lines 125

13.6.3 Second Supply Line with Tax 125

13.6.4 Equilibrium Point with the New Supply Line 125

13.6.5 Finding Point B 125

13.6.6 Calculating the Tax Burden 126

13.6.7 Tax Burden on Elastic Goods 126

13.7 Closing Remarks 128

14 DRIVERS INFLUENCING FORECASTING 130

14.1 Overview of Drivers 130

14.2 Banking and Software Compared 130

15 INFLATION AND EXCHANGE RATES 132

15.1 Overview 132

15.2 Terminology 132

15.3 Inflation – Simple Example 132

15.4 Inflation - Complex Example 133

15.5 Which inflation rate? 134

15.6 Inflation Calculations in the Food and Drink Sector 135

15.7 Developing a Real Price Index 136

15.8 Conversion to Indices 137

15.9 Exchange Rates 138

15.9.1 How Inflation and Exchange Rates are Related 138

15.9.2 Exchange Rates in the Food Sector 139

16 QUANTIFIABLE MACROECONOMIC FACTORS 141

16.1 Overview 141

16.2 Demography 141

16.2.1 National population 141

16.2.2 Population by Age 141

16.2.3 Population by Lifestyle 141

16.3 National Economy 142

16.3.1 Overview 142

16.3.2 Flow of Income Explained 142

16.3.3 Wealth 145

16.3.4 Disposable Income 146

16.3.5 GDP Per Capita 148

16.3.6 Savings Ratio 151

17 NON QUANTIFIABLE MACROECONOMIC FACTORS 154

17.1 Consumer Behaviour 154

17.1.1 “In the factory we make cosmetics. In the drugstore we sell hope.” 154

17.1.2 Dynamics of Consumer Behaviour 154

17.1.3 Revealed and Stated Preference Techniques 154

17.1.4 External Influences: Culture, Demographics, Social Status 155

17.1.5 Influencers 155

17.1.6 Internal Influences: Perception, Personality, Previous Experiences 155

17.1.7 Purchase Decision 156

17.2 Technology 157

17.3 Legal/Political Drivers 159

17.4 Coping with Non-quantifiable Factors 160

17.5 Minimum Viable Value – A Worked Example 160

17.6 Closing Remarks 163

18 INDUSTRY DRIVERS 166

18.1 Understanding an Industry’s Structure 166

18.2 Current Industry State 166

18.2.1 Introduction to Industry Structures 166

18.2.2 Product and Service Differentiation 168

18.2.3 Product Life Cycle 168

18.3 Competitive Rivalry 169

18.3.1 A contrast between two industries 169

18.3.2 What Differentiates Apparel from Telecoms? 169

18.4 Trends in Industry Concentration 171

18.5 Why is Concentration Important for Firms? 172

18.6 Overview of Barriers to Entry and Exit 172

18.7 Regulatory Barriers 173

18.7.1 Types of Regulatory Barrier 173

18.7.2 Shocks to Industries Restricted by Regulation 173

18.7.3 Warning for New Entrants: Customer Inertia 173

18.8 Closing Remarks 174

19 INTERNAL DRIVERS 175

19.1 Overview of Internal Drivers 175

19.2 Stock Control Optimisation 175

19.2.1 Costs Associated with Stock Control 175

19.2.2 Introducing Economic Order Quantity (EOQ) 176

19.2.3 EOQ – Reality Check! 177

19.2.4 Impact of Stock Control Costs 177

19.3 Closing Remarks 178

20 MARKET POSITIONING 179

20.1 Introduction 179

20.2 Analysis of current and future markets 179

20.3 Market (Perceptual) Mapping 180

20.4 Closing Remarks 181

21 FIRM STRUCTURE AND CONTROL MECHANISMS 182

21.1 Introduction 182

21.2 Organisation Dimensions 182

21.2.1 Span of Control 182

21.2.2 Chain of Command 182

21.3 Functional Organisation 183

21.4 Regional/Geographical Structure 184

21.5 Strategic Business Unit (SBU) Structure 185

21.6 Matrix Structure 185

21.7 Organisational Culture - Overview 186

21.8 How does an Organisation REALLY Function? 187

21.9 Power Structure 188

21.10 Control Systems 188

21.10.1 Type of Control System 188

21.10.2 Beliefs and Objectives 189

21.10.3 Boundary Systems 189

21.10.4 Performance Control 189

21.10.5 Managing Uncertainty 189

21.11 Closing Remarks 190

22 SIMPLE REGRESSION 192

22.1 Introduction 192

22.2 Least Squares 192

22.3 Regression Using Excel 193

22.4 Regression Output 194

22.4.1 Output in Full 194

22.4.2 Regression Statistics 195

22.4.3 Intercept and Coefficients 195

22.4.4 Significance of Intercept and Coefficients 196

22.4.5 Relevant Range 196

22.5 Summary and Next Steps 197

23 MULTIPLE REGRESSION 198

23.1 Overview 198

23.2 Understanding what Drives Acme Food Sales 198

23.2.1 Hypothesis 198

23.3 Correlation Revisited 198

23.3.1 Correlation in Multiple Regression 198

23.3.2 Correlation Matrix 199

23.4 Regression Results 199

23.4.1 All variables Included 199

23.5 Omitting Ind Rev 201

23.6 Model Fit and Residual Analysis 202

24 DUMMY VARIABLES 204

24.1 Introduction 204

24.2 Dealing with One-Off Shocks 204

24.3 Dealing with Long-term Shocks 205

24.4 Use of a Single Dummy Variable 206

24.5 How to Use Dummy Variables 208

24.6 Using More Than One Dummy Variable 208

24.7 Acme Food Sales Revisited 211

24.7.1 Application of Dummies – New Information 211

24.7.2 Regression Results with Dummies 211

24.8 A Caveat 214

24.9 Real Life Application 214

24.9.1 Introducing the Problem 214

24.9.2 Results from Using the Dummy Variable 215

25 REGRESSION – MISCELLANEOUS TOPICS 217

25.1 Non-linear Models 217

25.2 A Note of Caution 221

25.3 “Real Statistics” 221

25.4 Stepwise Regression in Detail 223

25.5 Closing Remarks 225

26 TIME SERIES – INTRODUCTION 227

26.1 Why are Time Series Important? 227

26.2 When is a Time Series NOT a Time Series? 227

26.3 What We Will Do with Time Series 227

26.4 Time Series - Basic Concepts 228

26.4.1 Seasonality and Trend 228

26.4.2 Additive or Multiplicative? 229

26.5 Greek Air Traffic – Additive Model 229

26.5.1 Identifying the Trend 229

26.5.2 Calculating Seasonal Variation 230

26.5.3 Comparing Actual and Modelled Demand 232

26.6 Greek Air Traffic – Multiplicative Model 233

26.6.1 Seasonal Variation 233

26.6.2 Putting the Multiplicative Model Together 235

26.7 Quantifying Goodness of Fit 236

26.7.1 Introducing MAD and MSE 236

26.7.2 MAD and MSE for Greek Data 236

27 JAPAN AIR TRAFFIC 238

27.1 Overview 238

27.2 Identifying the Trend 238

27.3 Calculating Seasonal Variation (Additive) 238

27.4 Comparing Actual and Modelled Demand 239

27.5 Japan - Multiplicative Model 240

27.5.1 Seasonality 240

27.5.2 Putting the Multiplicative Model Together 241

27.6 How Good a Fit is the Model? 242

27.7 Testing the Models for 2018 Demand 242

27.8 Closing Remarks 243

28 SINGLE EXPONENTIAL SMOOTHING 245

28.1 Introduction 245

28.2 Selecting Alpha 245

28.2.1 Trial and Error 245

28.3 Using Solver to find Alpha 246

28.4 Forecasts 247

29 TRIPLE EXPONENTIAL SMOOTHING 248

29.1 Overview 248

29.2 Methodology and Formulae 248

29.2.1 Establishing the Coefficients 248

29.3 Narrative behind the Formulae 249

29.3.1 Base Periods (Months 1-12) 249

29.3.2 Forecast Periods (Month 13 onwards) 249

29.4 Populating the TES Model 250

29.5 Optimising Alpha, Beta and Gamma 250

29.6 Forecasting Using the TES Model 252

29.7 Triple or Single Exponential Smoothing? 253

29.8 Closing Remarks 255

30 AUTOREGRESSION 256

30.1 Overview 256

30.2 Weather in Artown 256

30.3 Regression AR1 257

30.4 Regression AR2 258

30.5 AR3 and more 260

30.5.1 How many periods should be included in the lagged model? 260

30.5.2 Reintroducing Stepwise 260

30.5.3 Reality Check 261

31 ACME FOOD STORES PLC – TIME SERIES MODEL COMPARISON 263

31.1 Introduction 263

31.2 Time Series Decomposition (Multiplicative) 263

31.3 Single Exponential Smoothing 265

31.4 Triple Exponential Smoothing 267

31.5 Autoregressive Model 268

31.6 MSE for the Acme Model 269

31.7 Aligning Short- and Long-Term Forecasts 270

31.7.1 Theory 270

31.7.2 Practice 270

32 LONG TERM FORECASTING 273

32.1 Overview 273

32.2 Strategic Issues Facing Acme 273

32.3 Relationships between Variables 273

32.3.1 Overview 273

32.4 Forecast 1 (Optimistic): Office of Budget Responsibility 275

32.4.1 Economic Forecast 275

32.4.2 Fiscal Forecast 275

32.5 Forecast 2 (Pessimistic): Brexit Downside 277

32.5.1 Introduction 277

32.5.2 GDP 277

32.5.3 Interest Rate 278

32.5.4 Unemployment 278

32.6 Closing Remarks 279

33 LONG TERM FORECASTS CTD (SCIENCE) 280

33.1 Acme Regression Model 280

33.2 Bringing the Two Scenarios Together 280

33.2.1 Macroeconomic Factors 280

33.3 Supermarket Sector Forecasting 282

33.3.1 Optimistic Scenario 282

33.3.2 Supermarket Sector Forecasting – Pessimistic Scenario 283

33.4 Acme Forecasts 284

34 LONG TERM FORECASTS CTD (ART) 286

34.1 Summary of Available Options 286

34.2 Investment Options For Acme 286

34.2.1 Funding Options 286

34.2.2 The Illusion of Competitive Advantage 286

34.2.3 Do Nothing 287

34.2.4 Alleviating Competitive Disadvantage 287

34.3 Implementation 287

35 FINANCIAL FORECASTING 289

35.1 Why Financial forecasting is Different 289

35.2 Overview of the Discount Rate 289

35.3 Introducing the Discount Rate 289

35.3.1 General Concepts 289

35.3.2 The Discount Rate in Practice 289

35.4 Net Present Value (NPV) 291

35.5 Internal Rate of Return (IRR) 291

35.6 NPV Compared to IRR: Which is Better? 292

35.7 The Investment Appraisal Problem Using Excel 293

35.7.1 Defining the Problem 293

35.8 Benefit: Cost Ratios – An Alternative Approach 297

35.9 Mitigation of Risk 298

35.9.1 Scenarios Revisited 298

35.9.2 Optimism Bias 298

35.10 What a Financial Appraisal Can Miss 300

35.11 Calculating the Discount Rate 300

35.12 Capital Asset Pricing Model (CAPM) 302

35.12.1 Three Elements of CAPM 302

35.12.2 Beta 302

35.12.3 Cost of Debt and Tax 303

35.12.4 WACC Calculation for MEG 303

35.13 Closing Remarks 303

36 HOW DID IT ALL WORK OUT? 304

36.1 Overview 304

36.2 Level 1 – Revenue and Costs 304

36.3 Level 2 – Analysis of Revenue 305

36.3.1 The Figures 305

36.3.2 Analysis of the Figures 305

36.4 Analysis of Costs (Raw Materials) 306

36.4.1 Level 2 306

36.4.2 Level 3 306

36.5 Addressing the Causes of Variance 308

36.6 Analysis of Costs (Labour) 309

36.6.1 Headline Labour Costs 309

36.6.2 Level 2 309

36.6.3 Level 3 310

36.7 Closing Remarks 311