

Contents

List of Figures	XIX
List of Tables	XXII
Nomenclature	XXIII
Mathematical Nomenclature	XXVII
Mathematical Notation	XXVIII
I Dynamic Pricing in the Airline Industry	1
1 Introduction	3
1.1 The Passenger Airline Industry	3
1.2 The Low Cost Revolution	6
1.3 The Advent of Dynamic Pricing	11
2 Motivation and Structure	15
2.1 Relevance of the Topic	15
2.2 Focus on the Airline Industry	18
2.3 Objective and Differentiation	19
2.4 Structure of Work	20
3 Dynamic Pricing	23
3.1 Definition and Scope	23
3.1.1 Introduction to Pricing	23
3.1.2 Dynamic Pricing and Revenue Optimization	25
3.2 Literature Overview	31
3.2.1 Demand Learning Models	31
3.2.2 Non-learning Pricing Models	42
3.2.2.1 Dynamic Pricing with Myopic Customers	45

3.2.2.2	Dynamic Pricing with Strategic Customers . . .	51
3.2.2.3	Customer Choice Models	53
3.3	Limitations and Shortcomings	54
3.3.1	Dynamic Pricing Models	54
3.3.2	Demand Learning Models	56
3.4	Proposed Approach	58
 II Forecasting Latent Demand		63
Part II Objective		65
4	Self-Learning Linear Models	67
4.1	Linear Regression Models	68
4.2	Bayesian Statistics	79
4.2.1	Bayesian Probabilities	80
4.2.2	Bayesian Inference	83
4.3	Bayesian Linear Regression	85
4.3.1	Parameter Distribution	85
4.3.2	Predictive Distribution	89
4.4	Critique and Limitations	92
5	Demand in Low Cost Markets	97
5.1	Experimental Data Set	97
5.1.1	Data Collection	98
5.1.2	Data Cleansing	101
5.2	Overarching Long-term Characteristics	103
5.2.1	Log-linear Demand Structure	104
5.2.2	Macro-Seasonalities and Trends	110
5.2.3	Similarities of Adjacent Flights	113
5.3	Short-term Characteristics	115
5.3.1	Time Series Disruption Through Outliers	116
5.3.2	Patterns Based on Departure Weekdays	121
5.3.3	Micro-Seasonalities along Observation Weekdays	125
5.3.4	Cross-Effects of Departure and Observation Weekdays	128
5.4	Implications for Forecasting Model	129
6	The Demand Forecasting Model	131
6.1	Linear Basis Function Model	131
6.1.1	Indexing and Data Transformation	132
6.1.2	Driving Model Parameters	134

6.1.3	Model Specification and Re-transformation	138
6.1.4	Frequentist Coefficient Weights	140
6.2	Model Validation	141
6.2.1	Model and Coefficient Significance	142
6.2.2	Prerequisites and Assumptions	144
6.3	Bayesian Learning Mechanism	146
6.3.1	Online Demand Learning	147
6.3.2	Overarching Demand Structures and Prior Demand Knowledge	153
7	Computational Results and Evaluation	159
7.1	Performance of the Naïve Bayesian Scheme	159
7.1.1	Distribution Convergence Speed	159
7.1.2	Forecast Quality and Accuracy	164
7.2	Sensitivity of Forecast Accuracy	168
7.2.1	Improvement Through Informed Priors	169
7.2.2	Sizing of Learning window	172
7.2.3	Granularity of Forecasting Basis	178
7.2.4	Combined Effects	181
7.3	Recommended Approach	185
8	Summary and Outlook	189
III	Estimating Price Sensitivity	199
	Part III Objective	201
9	Discrete Customer Choice Analysis	203
9.1	Fundamentals of Choice Modeling	204
9.2	Elements of a Choice Decision Process	206
9.2.1	Decision Maker and its Characteristics	207
9.2.2	Choice Set	208
9.2.3	Alternative Attributes	209
9.2.4	Decision Rule	210
9.3	Individual Choice Behavior	211
9.3.1	Economic Utility-based Consumer Theory	211
9.3.2	Deterministic Choice Theory	213
9.3.3	Probabilistic Choice Theory	215
9.4	The Multinomial Logit Model	217
9.4.1	Description and Functional Form	218

9.4.2	Specific Properties and Limitations	220
9.4.3	Coefficient Estimation	224
9.4.4	Tests of Model Specifications	226
10	Choice Situation in Low-Cost Markets	233
10.1	Experimental Data Set	233
10.2	Market Overview	238
10.2.1	Market Participants and Supply	238
10.2.2	Pricing Environment and Behavior	239
10.3	Observed Demand Behavior	243
10.3.1	Price Sensitivity	243
10.3.2	Schedule Preference	247
10.3.3	Booking Day Preference	249
10.4	Implications for Choice Model	250
11	Multinomial Logit Model for Low-Cost Travel Choice	253
11.1	Modeling Constraints and Specifics	255
11.2	Model Building and Goodness of Fit	261
11.2.1	Internal Choice Drivers	262
11.2.2	Decision Maker Characteristics	268
11.2.3	External Outbound Choice Drivers	278
11.2.4	External Inbound Choice Drivers	294
12	Computational Results and Evaluation	303
12.1	Predictive Model Performance	303
12.2	Choice Elasticities of Fare Changes	311
12.3	Applications to Dynamic Airfare Pricing	316
13	Summary and Outlook	319
	Appendix	329
	Bibliography	331