

Adaptive Business Intelligence

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To Adam, Ewa, and Arthur.
Z. M.

*To Ana, my family and my friends:
May Love, Knowledge and Good Luck guide your way!*
M. S.

To my parents, children, and loving wife Luiza.
M. M.

To my parents and my wife Larisa.
C. C.

Preface

“My name is Sherlock Holmes. It is my business to know what other people do not know.”

The Adventure of the Blue Carbuncle

“What do you think of it, Watson?”

“A masterpiece. You have never risen to a greater height.”

The Adventure of the Bruce-Partington Plans

Since the computer age dawned on mankind, one of the most important areas in information technology has been that of “decision support.” Today, this area is more important than ever. Working in dynamic and ever-changing environments, modern-day managers are responsible for an assortment of far-reaching decisions: *Should the company increase or decrease its workforce? Enter new markets? Develop new products? Invest in research and development?* The list goes on. But despite the inherent complexity of these issues and the ever-increasing load of information that business managers must deal with, all these decisions boil down to two fundamental questions:

- What is likely to happen in the future?
- What is the best decision right now?

Whether we realize it or not, these two questions pervade our everyday lives – both on a personal and professional level. When driving to work, for instance, we have to make a traffic prediction before we can choose the quickest driving route. At work, we need to predict the demand for our product before we can decide how much to produce. And before investing in a foreign market, we need to predict future exchange rates and economic variables. It seems that regardless of the decision being made or its complexity, we first need to make a prediction of what is likely to happen in the future, and then make the best decision based on that prediction. This fundamental process underpins the basic premise of *Adaptive Business Intelligence*.

Simply put, Adaptive Business Intelligence is the discipline of combining prediction, optimization, and adaptability into a system capable of answering these two fundamental questions: *What is likely to happen in the future?* and *What is the best decision right now?* To build such a system, we first need to understand the methods and techniques that enable prediction, optimization, and adaptability. At first blush, this subject matter is nothing new, as hundreds of books have already been written on business intelligence, data mining and prediction methods, optimization techniques,

and so forth. However, none of these books has explained how to combine these various technologies into a software system that is capable of predicting, optimizing, and adapting. This text is the first on the subject.

When we set out to write *Adaptive Business Intelligence*, we had three important objectives in mind: First of all, we wanted to explain why the future of the business intelligence industry lies in systems that can make decisions, rather than tools that produce detailed reports. As most business managers now realize, there is a world of difference between having good knowledge and detailed reports, and making smart decisions. Michael Kahn, a technology reporter for Reuters in San Francisco, makes a valid point in the January 16, 2006 story entitled “Business intelligence software looks to future”:

“But analysts say applications that actually answer questions rather than just present mounds of data is the key driver of a market set to grow 10 per cent in 2006 or about twice the rate of the business software industry in general.

‘Increasingly you are seeing applications being developed that will result in some sort of action,’ said Brendan Barnacle, an analyst at Pacific Crest Equities. ‘It is a relatively small part now, but it is clearly where the future is. That is the next stage of business intelligence.’”

We could not agree more.

Second, we wanted to explain the principles behind many prediction methods and optimization techniques in simple terms, so that any business manager could grasp them. Even though most business managers have a limited technology background, they should not be intimidated by terms such as “artificial neural networks,” “fuzzy logic,” “evolutionary algorithms,” “ant systems,” or “agent-based modeling.” They should understand the strengths and weaknesses of these methods and techniques, their operating principles, and applicability. Armed with such knowledge, business managers will be in a better position to control the application of these methods and techniques in their respective organizations.

And, third, we wanted to underscore the enormous applicability of Adaptive Business Intelligence to many real-world business problems, ranging from demand forecasting and scheduling, to fraud detection and investment strategies. From a high-level perspective, most of these business problems have similar characteristics, and the application of Adaptive Business Intelligence can provide significant benefits and savings.

To facilitate the discussion in this book, we have divided the chapters into three parts that correspond to the three objectives listed above. In Part I, we present the fundamental ideas behind Adaptive Business Intelligence, and explain the different roles that prediction, optimization, and adaptability play in producing near-optimal decisions. We also discuss the characteristics that many business problems have in common, and why these characteristics increase the complexity of the problem-solving exercise. Furthermore, we introduce a particular distribution problem that is used throughout the text as a running example. Given that the prediction and optimization issues in this example are common to most business problems, it should be relatively easy for the reader to extrapolate this example to many other business domains.

Because countless texts have already been written on the subject of database technologies, data warehousing, online analytical processing, reporting, and the like, we saw little point in rehashing the tools and techniques that are routinely used to access, view, and manipulate organizational data. Instead, Part II of the book discusses the various prediction methods and optimization techniques that can be used to develop an Adaptive Business Intelligence system. The distribution example is continued throughout these chapters, effectively highlighting the strengths and weaknesses of each method and technique. Each chapter in Part II is concluded by a *Recommended Reading* section that provides suggestions for readers who want to learn more about particular methods or techniques.

Part III begins with a chapter on hybrid systems and adaptability, explaining how to “combine” the various methods and techniques discussed in Part II, and how the component of adaptability can be added to the final design. In the remaining chapters of the book, we discuss the definitive solution to the distribution problem that was used throughout the text, as well as the application of Adaptive Business Intelligence to several other complex business problems.

Without a doubt, we believe that business managers of all levels would benefit from this text. Anyone who makes operational and strategic decisions – whether on the factory floor or in the boardroom – will find this book invaluable for understanding the science and technology behind better predictions and decisions. We hope that readers will enjoy reading the book as much as we enjoyed writing it, and that they will profit from it.

We would like to thank everyone who made this book possible, and who took the time to share their thoughts and comments on the subject of Adaptive Business Intelligence. In particular, we would like to express our gratitude to SolveIT Software’s scientific advisory board, which includes Hussein Abbass, Valerio Aimale, Jürgen Branke, Mike Brooks, Carlos Coello, Ernesto Costa, Kalyanmoy Deb, Gusz Eiben, Fred Glover, Philip Hingston, Jong-Hwan Kim, Bob McKay, Marek Michalewicz, Masoud Mohammadian, Pablo Moscato, Michael Rumsewicz, Marc Schoenauer, Alice Smith, Russel Stonier, Lyndon While, Xin Yao, and Jacek Zurada. Our special appreciation also goes to two anonymous reviewers who provided us with many insights and useful suggestions, and to Ronan Nugent, who did a wonderful job of editing this book and helping us make the entire project a success.

Lastly, we would like to thank the most famous fictional detective of all time, Sherlock Holmes, for providing us with the entertaining quotes at the beginning of each chapter. Mr. Holmes remains one of the most famous problem-solvers of all time, and his methodology is based on prediction (“*It is a capital mistake to theorize before you have all the evidence*”), optimization (“*... I had best proceed on my own lines, and then clear the whole matter up once and for all*”), and adaptability (“*I have devised seven separate explanations ... But which of these is correct can only be determined by the fresh information, which we shall no doubt find waiting for us*”). Needless to say, his methodology bears a striking resemblance to Adaptive Business Intelligence! Enjoy.

Contents

Part I: Complex Business Problems

1	Introduction	3
2	Characteristics of Complex Business Problems.....	9
2.1	Number of Possible Solutions.....	10
2.2	Time-Changing Environment	12
2.3	Problem-Specific Constraints	13
2.4	Multi-objective Problems	14
2.5	Modeling the Problem	16
2.6	A Real-World Example	19
3	An Extended Example: Car Distribution	25
3.1	Basic Terminology	25
3.2	Off-lease Cars	27
3.3	The Problem	28
3.4	Transportation	30
3.5	Volume Effect.....	32
3.6	Price Depreciation and Inventory.....	33
3.7	Dynamic Market Changes	33
3.8	The Solution	34
4	Adaptive Business Intelligence.....	37
4.1	Data Mining.....	38
4.2	Prediction.....	41
4.3	Optimization	43
4.4	Adaptability	44
4.5	The Structure of an Adaptive Business Intelligence System.....	45

Part II: Prediction and Optimization

5	Prediction Methods and Models	49
5.1	Data Preparation.....	51
5.2	Different Prediction Methods	56
5.2.1	Mathematical Methods	56
5.2.2	Distance Methods.....	62

5.2.3	Logic Methods	64
5.2.4	Modern Heuristic Methods	68
5.2.5	Additional Considerations	69
5.3	Evaluation of Models	69
5.4	Recommended Reading	74
6	Modern Optimization Techniques.....	75
6.1	Overview	75
6.2	Local Optimization Techniques	82
6.3	Stochastic Hill Climber	87
6.4	Simulated Annealing.....	90
6.5	Tabu Search	96
6.6	Evolutionary Algorithms.....	101
6.7	Constraint Handling	108
6.8	Additional Issues.....	112
6.9	Recommended Reading	114
7	Fuzzy Logic	117
7.1	Overview	119
7.2	Fuzzifier	119
7.3	Inference System.....	123
7.4	Defuzzifier	127
7.5	Tuning the Membership Functions and Rule Base.....	128
7.6	Recommended Reading	129
8	Artificial Neural Networks	131
8.1	Overview	132
8.2	Node Input and Output	134
8.3	Different Types of Networks	136
8.3.1	Feed-Forward Neural Networks.....	137
8.3.2	Recurrent Neural Networks	140
8.4	Learning Methods	142
8.4.1	Supervised Learning.....	142
8.4.2	Unsupervised Learning.....	146
8.5	Data Representation	147
8.6	Recommended Reading	148
9	Other Methods and Techniques.....	151
9.1	Genetic Programming.....	151
9.2	Ant Systems and Swarm Intelligence.....	158
9.3	Agent-Based Modeling.....	163
9.4	Co-evolution	169
9.5	Recommended Reading	173

Part III: Adaptive Business Intelligence

10	Hybrid Systems and Adaptability.....	177
10.1	Hybrid Systems for Prediction.....	178
10.2	Hybrid Systems for Optimization	183
10.3	Adaptability	187
11	Car Distribution System	191
11.1	Overview	192
11.2	Graphical User Interface.....	194
11.2.1	Constraint Handling	195
11.2.2	Reporting	201
11.3	Prediction Module.....	203
11.4	Optimization Module	206
11.5	Adaptability Module	208
11.6	Validation	211
12	Applying Adaptive Business Intelligence.....	215
12.1	Marketing Campaigns	215
12.2	Manufacturing.....	221
12.3	Investment Strategies	224
12.4	Emergency Response Services.....	228
12.5	Credit Card Fraud.....	232
13	Conclusion.....	239
	Index	243

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