PREFACE

My career in the electric power industry has spanned four decades during which I have seen several changes, none as drastic as the deregulation of the industry towards the end of the last century. The merits or otherwise of deregulation—if competition in the electricity industry is possible to the extent that it can bring benefits to consumers—is worthy of debate. But my concern is about the acquisition of new skills and proficiency by the professionals in the electric power industry to meet new challenges.

Optimization techniques have been around for quite some time, not to mention that the mathematical underpinnings precede such techniques by a century or more. However, the power industry, except in the field of manufacturing apparatus, has been rather conservative and phlegmatic in embracing these techniques for analyses. An example is that of optimal power flow (OPF) solution, which has been around for at least a quarter of a century. Nevertheless, practicing professionals, by and large, viewed it as the pursuit and intellectual curiosity of some academicians and researchers. Such techniques, with some rare exceptions, had no day-to-day use for decision-making in the power industry.

Suddenly, unaware as the industry was, deregulation changed it all. The market rules and economic principles to price commodities at marginal cost made it necessary to use more and more sophisticated algorithms containing optimization techniques, either for the dispatch of the power system itself or for the settlement of markets. OPF is one such technique essential for the computation of locational marginal prices (LMP) of energy in a network.

Against this backdrop, as the need for sophisticated methods and algorithms were and are being felt, software vendors are rising to the occasion. However, the

corresponding universal appreciation of such sophistications appears to be absent among the practicing professionals of the industry.

Given the refractory attitude of the past and that changes are fast, the practicing professional has had no time to catch up. It is not uncommon in meetings to hear senior staff speak of LMP and other matters related to even elementary optimization techniques making their lack of awareness transparent to those who know the field well.

In my experience of teaching university students as an adjunct professor, I have observed that the engineering curriculum in most schools does not address linear programming techniques in the undergraduate level, and on occasion in postgraduate levels as well. However, this is a fundamental requirement in most undergraduate curriculums for Economics majors!

Because of these observations, I thought that a book on optimization techniques that addressed practical applications more than the theory was needed. Additionally, such a book should enable the senior managers to study at their own leisure and privacy using the PC as an aid. Such an education might even be enjoyable and might enthrall the reader to appreciate the beauty of optimization techniques and its application not only to engineering problems, but to social sciences as well.

An in-house course on optimization, which I was privileged to teach during 2001, was organized at ISO New England Inc. This book evolved from the contents of that course. During that course, I noted that the electricity industry is recruiting many nonengineering professionals of late, particularly in departments dealing with markets and trade. During discussions in such an interdisciplinary group, I found that when attention turned to reactive power, there was considerable discomfort among professionals without engineering background. Therefore, although it appears inconsistent to include a discussion on basic principles of electricity, I thought that its inclusion would benefit nonengineers who may want to use optimization techniques to analyze markets and trade. Appendix A.1 discusses such basics culminating in the explanation of active and reactive power concepts. It neither is a rigorous treatment of the subject, nor is it directed to engineers.

The intent of this book is to help practicing engineers as well as the senior staff in the electric power industry to become aware of, if not dexterous in, optimization techniques. Of course, a student who works out all the exercises and understands the underlying programs of spreadsheets will move closer to dexterity.

As the power industry has changed, so has the availability of personal computers and algorithms. In my earlier days of profession, engineers spent several days developing algorithms to solve a problem. Today, algorithms of all types and from multiple sources are available at very reasonable prices, making it unattractive for any organization to develop its own algorithms. For example, some mathematical and statistical packages are available from NAG, IMSL, GAMS, and several other sources based on the fruits of research of the world's best engineers and mathematicians. Presumably, there are several other sources, all of which one cannot know in one's own lifetime. For example, Wall Street financial professionals routinely use linear program software packages that solve for thousands of choice variables

with several thousands of constraints. On top of that, on the ubiquitous PC, one has Excel, MATLAB, and other software, which have optimization packages that are excellent for small to even fairly large problems.

Wiley's ftp site located at ftp://ftp.wiley.com/public/sci_tech_med/electric_power/ contains the spreadsheets and solutions to the problems explained in the text. The spreadsheets are programmed to solve the problems contained therein. Therefore, it is necessary for the reader to have access to a personal computer with Microsoft Excel software. The advanced reader may prefer to use MATLAB instead of the Excel Solver to confirm the solution to examples in the book.

This book serves well as a text for postgraduate or senior undergraduate students in engineering for a one-semester course. A rigorous curriculum can extend this to a two-semester course by making exercise problems compulsory.

The part of thanking people, in most prefaces, is left until the end, as it is in this case. I must say that I would not have undertaken the travails of writing this book in the first place had it not been for the insistence and encouragement of Mr. John Lally and Dr. Alex Bykhovsky, both of whom participated in the course I gave at ISO New England. Consequently, I consider it my obligation to thank them first. Of course, this book would not have been possible without the understanding and patience of my wife, Kusum, a companion and friend for 40 years.

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