

Preface

Population increase and socioeconomic rise of developing countries in many parts of the world has escalated the water demand for various uses including agriculture, municipal, recreational, and industrial demands. The increased demands in the past few decades have put severe stresses on the available water resources across the world particularly in arid and semi-arid regions. Hence, optimal management of water resources is a crucial issue and it is imperative to adopt realistic policies to ensure that water is used more efficiently in various sectors. In this book, we present the latest tools and methods to assist the students, researchers, engineers, and water managers to properly conceptualize and formulate the resource allocation problems, and deal appropriately with the complexity of constraints in water demand and available supplies. Although existing references supply total information relevant to the optimization analysis in water resources engineering, providing a book for undergraduate and graduate students and newcomers to this field is a requirement. In other words, what is needed is to present concepts more simply on the basics of optimization theories, get directly to the principal points, and apply simple examples in preparation for the use of more advanced texts.

In this book, the basics of linear and nonlinear optimization analysis for both single and multiobjective problems in conjunction with several examples with various levels of complexity in different fields of water resources engineering are presented. The main advantages of the current book rather than existing publications briefly are:

1. The authors' idea is to use simple examples and solve them step by step as the best way to introduce the materials in the book, and also to provide useful information to better understand the implementation of theoretical concepts. Hence, each chapter of the book contains some examples related to the basic principles of linear and nonlinear optimization analysis for both single and multiobjective problems ([Chaps. 2–4](#)).
2. As EXCEL, LINGO, and MATLAB are three of the well-known computer programs used today in optimization analysis, the process of solving optimization problems using those programs are presented in details as an alternative. This characteristic teaches the application of the noted computer programs in optimization analysis and makes analyzing, organizing, interpreting, and presenting results quick and easy ([Chap. 5](#)).

3. Real case studies are important resources for students to apply theoretical formulas, and computer programs to analyze real events. Hence, three real case studies as a valuable source for students, practitioners, and researchers are presented in the last chapters of book to show how the optimization concepts and theoretical formulas are used in analyzing real world problems (Chaps. 6–8). The case studies in brief are;
 - Reservoir Optimization and Simulation Modeling,
 - Reservoir Operation Management by Optimization and Stochastic Simulation, and
 - Water supply optimization in central Florida (simulation-optimization using integrated surface and groundwater modeling to allocate groundwater pumping that is protective of the natural ecosystem while meeting water supply demands of over two million people using a mix of surface water, groundwater, and desalinated water).
4. Finally, complete lists of most optimization studies on hydrosystem engineering (1963–2013) are presented in the Appendix of the book in table format. These tables include authors' names, dates of study, and a brief description of their work. With the help of these tables, readers can easily find all previous studies related to hydrosystem optimization analyses that may of particular interest to them.

To sum up, the main purpose of this book is to serve as a guide for conducting and incorporating optimization analyses in water resource planning processes. This book's main theme is to improve the understanding of the quantity and quality of information we have, and the importance of information we do not have, for the take only out purpose of improving decision making. The principal audiences of this book are undergraduate and graduate students of water engineering and all new researchers who are interested in academic research associate with optimization analysis as well as practitioners in the field of water resources management. Furthermore, this book can be used as reference for teaching in various fields of water engineering including: hydrology, hydraulic, water resources analysis, water quality analysis, etc. This book is also a useful reference for practicing engineers/professionals as well as students and individual researchers. They can apply optimization analysis as a useful tool to make best informed decisions when designing for unaccounted loads.

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