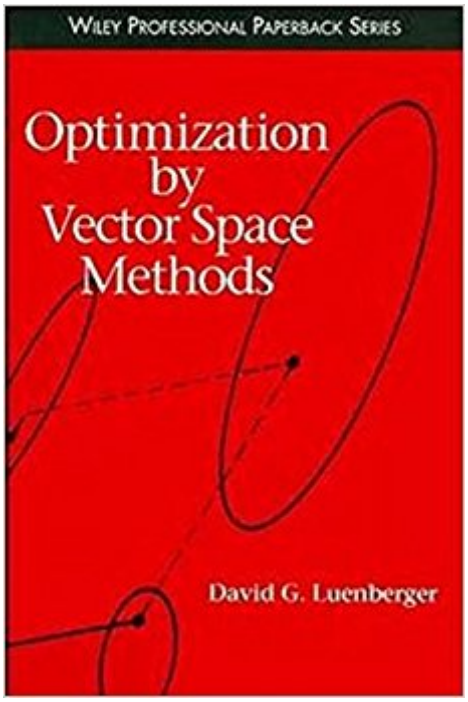
Optimization By Vector Space Methods



Synopsis

Engineers must make decisions regarding the distribution of expensive resources in a manner that will be economically beneficial. This problem can be realistically formulated and logically analyzed with optimization theory. This book shows engineers how to use optimization theory to solve complex problems. Unifies the large field of optimization with a few geometric principles. Covers functional analysis with a minimum of mathematics. Contains problems that relate to the applications in the book.

Book Information

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Customer Reviews

Unifies the field of optimization with a few geometric principles. The number of books that can legitimately be called classics in their fields is small indeed, but David Luenberger's Optimization by Vector Space Methods certainly qualifies. Not only does Luenberger clearly demonstrate that a large segment of the field of optimization can be effectively unified by a few geometric principles of linear vector space theory, but his methods have found applications quite removed from the engineering problems to which they were first applied. Nearly 30 years after its initial publication, this book is still among the most frequently cited sources in books and articles on financial optimization. The book uses functional analysis --the study of linear vector spaces --to impose simple, intuitive interpretations on complex, infinite-dimensional problems. The early chapters offer an introduction to functional analysis, with applications to optimization. Topics addressed include linear space, Hilbert space, least-squares estimation, dual spaces, and linear operators and adjoints. Later chapters deal explicitly with optimization theory, discussing * Optimization of

functionals * Global theory of constrained optimization * Local theory of constrained optimization * Iterative methods of optimization. End-of-chapter problems constitute a major component of this book and come in two basic varieties. The first consists of miscellaneous mathematical problems and proofs that extend and supplement the theoretical material in the text; the second, optimization problems, illustrates further areas of application and helps the reader formulate and solve practical problems. For professionals and graduate students in engineering, mathematics, operations research, economics, and business and finance, Optimization by Vector Space Methods is an indispensable source of problem-solving tools.

DAVID G. LUENBERGER is a professor in the School of Engineering at Stanford University. He has published four textbooks and over 70 technical papers. Professor Luenberger is a Fellow of the Institute of Electrical and Electronics Engineers and recipient of the 1990 Bode Lecture Award. His current research is mainly in investment science, economics, and planning.

I have used this book since it first appeared. I first went through it in seminar when I was a graduate student in 1970 and have since used it in many different courses. I require my gradaute students to read and understand it. It is very easy to read and give the best picture of optimization that I know of. I expect that this book will be required in most economics and engineering programs for the next 40 years. Luenberger is a master expositor--it is to bad that more books are not written in this style.

The exposition is pretty clear and the book has a good number of worked non-trivial examples. At $40 this would be a great book, but $100 for a PAPERBACK book written 30 years ago is a bit ridiculous. The first 1/4 of the book is also a (very) basic introduction to functional analysis which, if you have had any contact with this subject before, you will probably skip making the book quite short.

Optimization by Vector Space Methods, by David Luenberger, is one of the finest math texts I have ever read, and I’ve read hundreds. Many years ago this book sparked my interest in optimization and convinced me that the abstract mathematics I had been immersed in actually would be applicable to real problems. Since then, Luenberger’s book has inspired several of my graduate students. I merely lent them my copy, and Luenberger did the rest; he drew them in by carefully laying the foundation for an elegant theory, with just the right mix of formalism and intuition, and opened their eyes to the beauty and practicality of abstract mathematics. Anyone with an interest in

higher-level mathematics (beyond multi-variable calculus, say) would benefit from exposure to this finely-crafted book. I daresay, the rampant math anxiety that is so prevalent in the West would be substantially reduced if more authors would take such meticulous care in presenting their material.The format of Luenberger's book is also extremely appealing in a way that I cannot quite put my finger on. The typography and illustrations are inherently crisp and inviting; they draw you in. There is nothing at all superfluous or gratuitous in this book. It is utterly to-the-point, methodical, and above all, clear. The techniques are developed starting from an elementary treatment of vector spaces, then proceeding on to Banach spaces and Hilbert spaces. Along the way, Luenberger introduces convexity, cones, basic topology, random variables, minimum-variance estimators, and least squares, among many other things. There is a recurring theme of duality, which can be used in a way analogous to the inner product of a Hilbert space. In particular, the familiar projection theorems of Hilbert spaces can be echoed in simpler normed linear spaces using duality, which Luenberger motivates and covers beautifully.The book also covers some of the standard fare of functional analysis, such as the Han-Banach theorem, strong and weak convergence, and the Banach inverse theorem. However, Luenberger never wanders too far off into abstract nonsense; around every corner lay tantalizing application of these ideas to optimization. Luenberger first explores optimization of functionals then covers constrained optimization, which builds upon concepts such as positive cones and Lagrange multipliers. The optimization methods themselves have endless applications in fields such as computer vision, computer graphics, economics, and physics. Indeed, the list is effectively endless as optimization techniques pervade math and science.I'm certain that the appeal of this book is helped immeasurably by the inherent beauty of the subject matter. Hilbert-space methods are lovely in themselves--they possess a structure that engages one's geometric intuition while at the same time admitting convenient algebraic properties. Once you are in the habit of phrasing problems in abstract settings such as Hilbert spaces, it forever changes how you look at things; you cannot help but look past the clutter to the essence of a problem (or, at least try very hard to do so). While this material is not nearly as abstract as, say, category theory, it nevertheless hits a high point in mathematics--a point more people ought to experience.If you've had some exposure to optimization methods, or need to apply them in the context of computer vision, graphics, or finance, to mention just a few areas, then I urge you to take a look at Luenberger's fine book. It too hits a high point in clarity of mathematical writing. Combine beautiful theory with endless applications and lucid writing, and you have a winner of a book.

A few years ago, when I was a student first coming into contact with Hilbert spaces, linear

operators, etc., I was absolutely confused by conventional textbooks. Hopelessly lost, an old friend from Cornell let me in on a little secret: Luenberger. Apparently, every student at his department was "secretly" reading this book on the side in order to get that elusive commodity -- "clear understanding" -- at which Luenberger is an absolute master.I took my friend up on his suggestion, and it was a revelation. I was amazed. I was also furious at the fact that my professor had not assigned this book to us. After confronting him with it, he admitted that not only was he very familiar with it, it had also been instrumental for him when HE was a student. It seems Luenberger has been a "secret" text that students have been using for a generation or so.Recently, when speaking with a confused and discouraged student, I let him in on it: "Luenberger. Forget everything else for now, and just work through Luenberger". A few days later, he came back and furiously confronted me as to why I did not recommend this to him beforehand...etc...and the legacy continues.Dr Luenberger, thank you very, very much!

This is a true classic in the field of optimization, a timeless and definitive book that is hard to match in terms of quality and effectiveness of exposition. It shows that a large segment of the field can be effectively unified by a few geometric principles of linear vector space theory. It helps serious students of optimization to appreciate the unifying power of sophisticated mathematics, and it also provides an accessible and highly motivating vehicle for studying these mathematics. A measure of the quality of this book is that despite its success, it has not been emulated by any other book.

Professor Luenberger unites many areas of optimization using a few principles from functional analysis. The explanations are clear and the proofs are compact and elegant. This book is your tool for understanding the deep connection between linear programming, convex optimization, game theory, optimal control and series approximation (e.g. Fourier series).Luenberger’s book has over 4517 citations as of March 2012. In my opinion, the material in this book is essential for any graduate student or professional who intends to contribute to the literature in optimization or optimal control.

When I decided to change my career path from B-school to mathematics, I know that only with taking calculus and linear algebra courses is definitely not enough for me to get into a decent math graduate program. I spent an afternoon in a local bookstore to find a book for functional analysis and Hilbert space which is comprehensible for me at that time. I found Luenberger. I was obsessed with its clarity and simplicity without sacrificing too much rigor. Especially for those finance student

who want to learn some advanced math for quant finance but may not have enough background to deal with, Luenberger's book is a really good starting point!

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