

Preface

Location Theory and Decision Analysis is tailored toward upperclass and graduate-level courses that include location decision making. It includes the fundamental theories and analysis procedures of that process. With these fundamentals carefully and comprehensively compiled, it is amply suited for courses such as management science, operations research, economics, civil and environmental engineering, industrial engineering, geography, urban and regional planning and policy sciences. The book also serves as an overview of the relationship between location, transport, and land use decisions. As such it introduces more advanced topics as documented in Chan (2005) and Easa and Chan (2000).

This book is unique in that it integrates existing practical and theoretical works on facility location and land use. Instead of dealing with individual facility location or the resulting land use pattern alone, it provides the underlying principles that are behind both types of models. Of particular interest is the emphasis on counter-intuitive decisions, which are often overlooked unless deliberate steps of analysis are taken. Being oriented toward the fundamental principles of infrastructure management, the book transcends the traditional engineering and planning disciplines, where the main concerns are often exclusively physical design, fiscal, socioeconomic, or political considerations.

Employing contemporary quantitative models and case studies, the book discusses the siting of such facilities as transportation terminals, warehouses, nuclear power plants, military bases, landfills, emergency shelters, state parks, and industrial plants. The book also demonstrates the use of satellite imagery, computer-based data-retrieval technologies (such as geographic information systems), and statistical tools for forecasting and analyzing implications of land use decisions. The idea is that land use shown on a map is necessarily a consequence of individual, and often conflicting, siting decisions.

The analytical community has made significant progress in recent years in the basic building blocks of spatial analysis. Current models have captured accurately many of the bases of facility-siting decision making—proximity to demand, competition among existing facilities, and the availability of utilities and other institutional supports. Throughout this text, accessibility (as afforded by transportation) and infrastructure support (as provided by utilities and sewers) are used as determinants of location decisions. Competitive and statistical determinants that are not based on accessibility alone are also covered.

However, a novel feature of *Location Theory and Decision Analysis* is the recognition that in today's service economy, the traditional concepts of accessibility need to be broadly interpreted. Evidence indicates, for example, that half of the shopping currently done is by mail, telephone, or the Internet. Thus the definition of "a trip to the shopping mall," and hence the conventional judgment in

siting a retail facility, need to accommodate such a change. “Global reach” redefines the concept of accessibility and distance in all sectors of the economy, including E-commerce, international corporations, and even the defense community. Half the globe away now means a few hours of flight time or seconds of telecommunication time. Conversely, congested streets can make cross-town travel almost impossible, and thus encourage telecommuting. Again a redefinition of accessibility and hence the conventional wisdom in office site selection is required. The theme of change carries throughout the book, serving to unify many of the spatial location models discussed.

The advances in remote sensing imagery and geographic information systems today facilitate much of spatial analysis. Electronic devices, such as satellites, sensors, computers, and telecommunications technology, make the collection and processing of data much faster, which in turn assists in the problem solving process. The book discusses how information can be stored in such a way that it can be directly translated to a format for real-time decision making. This means simple and transparent models that are database compatible and require minimal data manipulation in the solution process. These models become the tools for analysis and decision making. *Location Theory and Decision Analysis* gives the reader a comprehensive insight into the use of these tools—identifying, assembling and utilizing the important information for problem solving, rather than prescribing verbatim software instructions.

ORGANIZATION OF THE BOOK

As mentioned, this book contains a comprehensive review of the fundamental principles. Questions such as why facilities locate where they do and why population and employment activities distribute on the map as they do are answered. The first few chapters include the underlying determinants of facility location and land use, as well as the techniques that are essential to analyze these location decisions. In addition, these chapters discuss databases from remote sensing and geographic information systems (GIS), statistical tools for data analysis and forecasting, optimization procedures for choosing the desirable course of action, and multicriteria decision-making techniques to tie the entire analysis procedure together. Key concepts in economics, one of the most important disciplines in explaining the organization in space, are also reviewed.

The first five chapters—which include economics, descriptive and prescriptive techniques, and multicriteria decision making—constitute an excellent quantitatively oriented survey course in this field. If needed, the appendices provide for a review of the mathematical tools. Where there is room in the curriculum, a more advanced treatment will include the “Remote Sensing and GIS” chapter. While the first five chapters redefine location by such concepts as telecommuting, Chapter 6 drives it home. In this last chapter, new ways to store, organize, process, and transmit spatial data are reviewed.

Location Theory and Decision Analysis purposefully accommodates the different technical backgrounds and career objectives of its readers. For example, spatial economics principles are introduced in Chapter 2, allowing the non-economists to acquire the basic economic concepts that underlie much of the location literature. It serves as an excellent overview of the entire book. As another example, multicriteria

decision making is reviewed in Chapter 5, with an emphasis on how it assists in location decisions. It includes discussion of state-of-the-art concepts and technology that may not be familiar to those outside the fields of management science and operations research. For example, I illustrate how an obnoxious facility, such as a noisy airport, can be located by taking into consideration all the stakeholders concerns. Most importantly, liberal numerical examples and graphics are used to get the point across. My diverse background, which spans technical consulting firms, government, academia, and the defense community, enables me to communicate with different audiences in terms of a common language. Beyond the classroom, professionals who seek an update on the fundamentals on location decisions will find this book helpful. The professional audience will find the crosscutting discussion of technical concepts in Appendix 5 particularly helpful, since it unifies the findings from different disciplines.

Exercises and case studies are used throughout the book. Rather than a set of mechanical calculations, the exercises and case studies are designed to extend many of the concepts covered in the book. They also play an important role in integrating the many diverse principles advanced in the text. One objective of the exercises is to challenge the readers creatively to use the data sets and computer software that come with *Location Theory and Decision Analysis*. While the basic exercises are well structured, readers are often asked to perform their own case studies, using the data sets if desired, and arrive at open-ended results. For the sake of synergy, all the exercises are placed together at the end of the book, rather than included separately at the end of individual chapters. To assist both instructors and students, answers to the exercises are available on my web site. Please contact me by email at ychan@alum.MIT.edu for information about the web site. Students and professionals should enter in the Subject line: REQUEST FOR SAMPLE SOLUTIONS, and instructors should enter: REQUEST FOR INSTRUCTOR'S GUIDE.

SOFTWARE

A CD-ROM provided with the text provides sample software. The main purpose of the CD is to supplement the basic ideas covered in the text. Aside from extensive databases, it contains software to implement some of the basic concepts presented. It also challenges the reader to investigate further through hands-on experiences with case studies. In view of the rapid progress in information technologies and to avoid obsolescence, the book is not specifically tied to a single generation of information technology. Rather, the book is problem-oriented and provides a set of procedures and a set of data for analysis that can transcend the technological evolution. Hands-on experiences are discussed with respect to the basic models employed, rather than the particular software or hardware.

One software program used for processing remote sensing images (courtesy of Dr. T. S. Kelso) illustrates some of the spatial statistical concepts and GIS. The remainder are software implementations of some of the facility-location and land-use concepts discussed in this book. While the book introduces the various analytical techniques in a pedagogic fashion, the software provides practical implementations. The programs are therefore not purely for the classroom; they have real potential for everyday, operational use.

1. All files on the CD are ASCII-text files. Where possible, both source codes and executable codes are given—mainly for the ease of execution and modification by the users. Program documentation is included as README files.
2. While references are made to supporting software for extended use of some of the programs, all programs are self-contained, and they have been developed or refined by the author and his associates. The programs do not require supporting software or language compilers.

As mentioned, sample data sets are provided to allow demonstration of the software. Most of the data are drawn from real-world case studies.

The programs have been extensively tested, but still there can be no absolute guarantee of faultlessness. It is impossible for me to provide any programming support for the software, but I am keenly interested in and would appreciate any feedback from users regarding their experiences with the programs or the book. To provide your comments, simply contact me by email at ychan@alum.MIT.edu and include in the subject line: SUGGESTIONS FOR THE BOOK.

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YUPO CHAN

ABOUT THE COVER

This radar image shows the massive urbanization of Los Angeles, California. The complete image extends from the Santa Monica Bay at the left to the San Gabriel Mountains at the right. Downtown Los Angeles is on the right side of the textbook's cover. The complex freeway system is visible as dark lines throughout the image. Some city areas, such as Santa Monica in the upper left, appear red due to the alignment of streets and buildings to the incoming radar beam.

The image was acquired by the Spaceborne Imaging Radar-C/X-band Synthetic Aperture Radar (SIR-C/X-SAR) onboard the space shuttle Endeavour on October 3, 1994. SIR-C/X-SAR, a joint mission of the German, Italian and U. S. space agencies, is part of NASA's Mission to Planet Earth. The radar images illuminate earth with microwaves allowing detailed observations at any time, regardless of weather or sunlight conditions. The multi-frequency data will be used by the international scientific community to better understand the global environment and how it is changing. The SIR-C/X-SAR data, complemented by aircraft and ground studies, will give scientists clearer insights into those environmental changes that are caused by nature and those changes that are induced by human activity.

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