
AIMMS User's Guide - Preface

This file contains only one chapter of the book. For a free download of the complete book in pdf format, please visit www.aimms.com or order your hard-copy at www.lulu.com/aimms.

Copyright © 1993–2011 by Paragon Decision Technology B.V. All rights reserved.

Paragon Decision Technology B.V.	Paragon Decision Technology Inc.	Paragon Decision Technology Pte.
Schipholweg 1	500 108th Avenue NE	Ltd.
2034 LS Haarlem	Ste. # 1085	80 Raffles Place
The Netherlands	Bellevue, WA 98004	UOB Plaza 1, Level 36-01
Tel.: +31 23 5511512	USA	Singapore 048624
Fax: +31 23 5511517	Tel.: +1 425 458 4024	Tel.: +65 9640 4182
	Fax: +1 425 458 4025	

Email: info@aimms.com
WWW: www.aimms.com

AIMMS is a registered trademark of Paragon Decision Technology B.V. IBM ILOG CPLEX and sc CPLEX is a registered trademark of IBM Corporation. GUROBI is a registered trademark of Gurobi Optimization, Inc. KNITRO is a registered trademark of Ziena Optimization, Inc. XPRESS-MP is a registered trademark of FICO Fair Isaac Corporation. MOSEK is a registered trademark of Mosek ApS. WINDOWS and EXCEL are registered trademarks of Microsoft Corporation. $\text{T}_{\text{E}}\text{X}$, $\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$, and $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$ are trademarks of the American Mathematical Society. LUCIDA is a registered trademark of Bigelow & Holmes Inc. ACROBAT is a registered trademark of Adobe Systems Inc. Other brands and their products are trademarks of their respective holders.

Information in this document is subject to change without notice and does not represent a commitment on the part of Paragon Decision Technology B.V. The software described in this document is furnished under a license agreement and may only be used and copied in accordance with the terms of the agreement. The documentation may not, in whole or in part, be copied, photocopied, reproduced, translated, or reduced to any electronic medium or machine-readable form without prior consent, in writing, from Paragon Decision Technology B.V.

Paragon Decision Technology B.V. makes no representation or warranty with respect to the adequacy of this documentation or the programs which it describes for any particular purpose or with respect to its adequacy to produce any particular result. In no event shall Paragon Decision Technology B.V., its employees, its contractors or the authors of this documentation be liable for special, direct, indirect or consequential damages, losses, costs, charges, claims, demands, or claims for lost profits, fees or expenses of any nature or kind.

In addition to the foregoing, users should recognize that all complex software systems and their documentation contain errors and omissions. The authors, Paragon Decision Technology B.V. and its employees, and its contractors shall not be responsible under any circumstances for providing information or corrections to errors and omissions discovered at any time in this book or the software it describes, whether or not they are aware of the errors or omissions. The authors, Paragon Decision Technology B.V. and its employees, and its contractors do not recommend the use of the software described in this book for applications in which errors or omissions could threaten life, injury or significant loss.

This documentation was typeset by Paragon Decision Technology B.V. using $\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$ and the LUCIDA font family.

Preface

The printed AIMMS documentation consists of three books

Three AIMMS books

- AIMMS—*The User's Guide*,
- AIMMS—*The Language Reference*, and
- AIMMS—*Optimization Modeling*.

The first two books emphasize different aspects in the use of the AIMMS system, while the third book is a general introduction to optimization modeling. All books can be used independently.

In addition to the printed versions, these books are also available on-line in the ADOBE Portable Document Format (PDF). Although new printed versions of the documentation will become available with every new functional AIMMS release, small additions to the system and small changes in its functionality in between functional releases are always directly reflected in the online documentation, but not necessarily in the printed material. Therefore, the online versions of the AIMMS books that come with a particular version of the system should be considered as the authoritative documentation describing the functionality regarding that particular AIMMS version.

Available online

Which changes and bug fixes are included in particular AIMMS releases are described in the associated release notes.

Release notes

What is in the AIMMS documentation

The AIMMS User's Guide provides a global overview of how to use the AIMMS system itself. It is aimed at application builders, and explores AIMMS' capabilities to help you create a model-based application in an easy and maintainable manner. The guide describes the various graphical tools that the AIMMS system offers for this task. It is divided into five parts.

The User's Guide

- Part I—*Introduction to AIMMS*—what is AIMMS and how to use it.
- Part II—*Creating and Managing a Model*—how to create a new model in AIMMS or manage an existing model.
- Part III—*Creating an End-User Interface*—how to create an intuitive and interactive end-user interface around a working model formulation.

- Part IV—*Data Management*—how to work with cases and datasets.
- Part V—*Miscellaneous*—various other aspects of AIMMS which may be relevant when creating a model-based end-user application.

The AIMMS Language Reference provides a complete description of the AIMMS modeling language, its underlying data structures and advanced language constructs. It is aimed at model builders only, and provides the ultimate reference to the model constructs that you can use to get the most out of your model formulations. The guide is divided into seven parts.

The Language Reference

- Part I—*Preliminaries*—provides an introduction to, and overview of, the basic language concepts.
- Part II—*Nonprocedural Language Components*—describes AIMMS' basic data types, expressions, and evaluation structures.
- Part III—*Procedural Language Components*—describes AIMMS' capabilities to implement customized algorithms using various execution and flow control statements, as well as internal and external procedures and functions.
- Part IV—*Sparse Execution*—describes the fine details of the sparse execution engine underlying the AIMMS system.
- Part V—*Optimization Modeling Components*—describes the concepts of variables, constraints and mathematical programs required to specify an optimization model.
- Part VI—*Data Communication Components*—how to import and export data from various data sources, and create customized reports.
- Part VII—*Advanced Language Components*—describes various advanced language features, such as the use of units, modeling of time and communicating with the end-user.

The book on optimization modeling provides not only an introduction to modeling but also a suite of worked examples. It is aimed at users who are new to modeling and those who have limited modeling experience. Both basic concepts and more advanced modeling techniques are discussed. The book is divided into five parts:

Optimization Modeling

- Part I—*Introduction to Optimization Modeling*—covers what models are, where they come from, and how they are used.
- Part II—*General Optimization Modeling Tricks*—includes mathematical concepts and general modeling techniques.
- Part III—*Basic Optimization Modeling Applications*—builds on an understanding of general modeling principles and provides introductory application-specific examples of models and the modeling process.
- Part IV—*Intermediate Optimization Modeling Applications*—is similar to part III, but with examples that require more effort and analysis to construct the corresponding models.

- Part V—*Advanced Optimization Modeling Applications*—provides applications where mathematical concepts are required for the formulation and solution of the underlying models.

In addition to the three major AIMMS books, there are several separate documents describing various deployment features of the AIMMS software. They are:

Documentation of deployment features

- AIMMS—*The Function Reference*,
- AIMMS—*The COM Object User's Guide and Reference*,
- AIMMS—*The Multi Agent and Web Services User's Guide*,
- AIMMS—*The Excel Add-In User's Guide*, and
- AIMMS—*The Open Solver Interface User's Guide and Reference*.

These documents are only available in PDF format.

The AIMMS documentation is complemented with a number of help files that discuss the finer details of particular aspects of the AIMMS system. Help files are available to describe:

Help files

- the execution and solver options which you can set to globally influence the behavior of the AIMMS' execution engine,
- the finer details of working with the graphical modeling tools, and
- a complete description of the properties of end-user screens and the graphical data objects which you can use to influence the behavior and appearance of an end-user interface built around your model.

The AIMMS help files are both available as Windows help files, as well as in PDF format.

Two tutorials on AIMMS in PDF format provide you with some initial working knowledge of the system and its language. One tutorial is intended for beginning users, while the other is aimed at professional users of AIMMS.

AIMMS tutorials

As the entire AIMMS documentation is available in PDF format, you can use the search functionality of Acrobat Reader to search through all AIMMS documentation for the information you are looking for. From within the **Help** menu of the AIMMS software you can access a pre-built search index to quicken the search process.

Searching the documentation

AIMMS comes with an extensive model library, which contains a variety of examples to illustrate simple and advanced applications containing particular aspects of both the language and the graphical user interface. You can find the AIMMS model library in the Examples directory in the AIMMS installation directory. The Examples directory also contains an AIMMS project providing an index to all examples, which you can use to search for examples that illustrate specific aspects of AIMMS.

AIMMS model library

What is in the User's Guide

Part I of the User's Guide provides a basic introduction to AIMMS, its position among other technologies, and its use.

*Introduction to
AIMMS*

- Chapter 1—*AIMMS and Analytic Decision Support*—discusses the concept of Analytic Decision Support (ADS), AIMMS as an ADS development environment, as well as a comparison to other ADS tools.
- Chapter 2—*Getting Started*—explains how to create a new AIMMS application, and provides an overview of both the modeling tools available in AIMMS and the files associated with an AIMMS project.
- Chapter 3—*Organizing a Project into Libraries*—describes the facilities available in AIMMS to allow multiple developers to collaborate on a single project.

Part II discusses all aspects of the AIMMS system that are relevant for entering and maintaining the model source associated with a particular modeling application.

*Creating and
managing a
model*

- Chapter 4—*The Model Explorer*—introduces the main graphical tool available in AIMMS for accessing the model source. It discusses various aspects that are specific to the model tree, as well as the basic concepts common to all trees used in the AIMMS system.
- Chapter 5—*Identifier Declarations*—explains how you can add identifier declarations to the model tree, and how you can modify the various attributes of an identifier in its attribute window.
- Chapter 6—*Procedures and Functions*—explains how you can create procedures and functions within your model, how to add arguments to such procedures and functions, and describes the AIMMS concepts that help you to sub-divide procedure and function bodies into smaller more meaningful entities.
- Chapter 7—*Viewing Identifier Selections*—discusses the flexible identifier selector tool in AIMMS, which allows you to create and simultaneously view selections of identifiers in your model.
- Chapter 8—*Debugging and Profiling an AIMMS Model*—discusses AIMMS' debugger and profiler, which can help you to track the modeling errors in an AIMMS model, or to find and speed up time-consuming statements in your model.
- Chapter 9—*The Math Program Inspector*—introduces a graphical debugging tool for finding infeasibilities or unexpected results of a math program contained in your model.

Part III introduces the fundamental concepts and design tools available in AIMMS to create a graphical end-user interface for your modeling application, as well as AIMMS' reporting facilities.

Creating an end-user interface

- Chapter 10—*Pages and Page Objects*—introduces the AIMMS concept of end-user pages. In addition, it explains how to add graphical (data) objects to such pages, and how to link these data objects to identifiers in your model.
- Chapter 11—*Page and Page Object Properties*—discusses the options for pages and page objects that you can modify to alter the behavior and appearance of your end-user interface.
- Chapter 12—*Page Management Tools*—describes the AIMMS tools that can help you create and manage a large collection of end-user pages in an easily maintainable fashion.
- Chapter 13—*Page Resizability*—explains the basic concepts available in AIMMS to define the behavior of pages when resizing.
- Chapter 14—*Creating Printed Reports*—discusses the concept of print pages which you can use to create a printed report of your model results.
- Chapter 15—*Designing End-User Interfaces*—provides some background on designing professional end-user interfaces that are both easy to use and to maintain.
- Chapter 16—*Deploying End-User Applications*—discusses the several options that AIMMS has to offer to deploy your AIMMS applications, including the AIMMS Viewer.

Part IV focuses on the facilities within AIMMS for performing common and advanced case management tasks.

Data management

- Chapter 17—*Case Management*—describes the basic case management facilities and tools in AIMMS. It also provides you with an overview of AIMMS' capabilities to start a batch run of a model with multiple cases, and to work with multiple case data, both in the model and the end-user interface.
- Chapter 18—*Advanced Data Management*—explains the advanced concepts of case types, data categories and datasets, and their interaction with cases. In addition, this chapter discusses the security aspects of cases and datasets, as well as AIMMS' capabilities to access the tree of all cases and datasets from within the modeling language.

Part V discusses the various miscellaneous concepts that may be of interest to both AIMMS developers and/or end-users.

Miscellaneous

- Chapter 19—*User Interface Language Components*—provides a complete overview of the function library available in AIMMS for communication with the end-user through the various tools available in the AIMMS end-user interface.

- Chapter 20—*Calling AIMMS*—describes AIMMS' command line options, the restrictions with respect to end-user licenses, and the possibilities of calling an AIMMS model from within your own application.
- Chapter 21—*Project Security*—discusses various security aspects such as protecting your project through a VAR license, adding a user database to a model to provide user authentication, and case file security.
- Chapter 22—*Project Settings and Options*—describes the tools available in AIMMS to alter the execution behavior of your model, the appearance of its interface, and various other aspects concerning AIMMS itself and its solvers.
- Chapter 23—*Localization and Unicode Support*—discusses AIMMS' built-in support for localizing the end-user interface of your project (i.e. making it capable of dealing with multiple languages). It also discusses the capabilities and limitations of the AIMMS Unicode version, which, combined with the localization features, allows you to create AIMMS end-user applications for the Asian market.

The authors

Marcel Roelofs received his Ph.D. in Applied Mathematics from the Technical University of Twente in 1993 on the application of Computer Algebra in Mathematical Physics. From 1993 to 1995 he worked as a post-doc at the Centre for Mathematics and Computer Science (CWI) in Amsterdam in the area of Computer Algebra, and had a part-time position at the Research Institute for the Application of Computer Algebra. In 1995 he accepted his current position as CTO of Paragon Decision Technology B.V. His main responsibilities are the design and documentation of the AIMMS language and user interface.

Marcel Roelofs

Johannes Bisschop received his Ph.D. in Mathematical Sciences from the Johns Hopkins University in Baltimore USA in 1974. From 1975 to 1980 he worked as a Researcher in the Development Research Center of the World Bank in Washington DC, USA. In 1980 he returned to The Netherlands and accepted a position as a Research Mathematician at Shell Research in Amsterdam. After some years he also accepted a second part-time position as a full professor in the Applied Mathematics Department at the Technical University of Twente. From 1989 to 2003 he combined his part-time position at the University with managing Paragon Decision Technology B.V. and the continuing development of AIMMS. From 2003 to 2005 he held the position of president of Paragon Decision Technology B.V. His main interests are in the areas of computational optimization and modeling.

*Johannes
Bisschop*

In addition to the main authors, various current and former employees of Paragon Decision Technology B.V. and external consultants have made a contribution to the AIMMS documentation. They are (in alphabetical order):

Other contributors to AIMMS

- Pim Beers
- John Boers
- Peter Bonsma
- Mischa Bronstring
- Ximena Cerda Salzmann
- Michelle Chamalaun
- Robert Enriken
- Thorsten Gragert
- Koos Heerink
- Nico van den Hijligenberg
- Marcel Hunting
- Roel Janssen
- Gertjan Kloosterman
- Joris Koster
- Chris Kuip
- Gertjan de Lange
- Ovidiu Listes
- Bianca Makkink
- Peter Nieuwesteeg
- Giles Stacey
- Richard Stegeman
- Selvy Suwanto
- Jacques de Swart
- Martine Uyterlinde