Josef Kallrath
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GAMS Courses 2026

– B&A: Modeling and Optimization with GAMS –

In 2026 we offer the **physical** basic (B261) and advanced (A261) courses:
B261 21.-23.09.2026 (see page 2) A261 24.-25.09.2026 (see page 6)

Location: Waldhotel am See, 12527 Berlin-Schmöckwitz, Germany, only 12 km away from Berlin airport. (https://www.waldhotelamsee.de/). The hotel at the rim of Berlin is located in a forest and lake environment. Besides an inspiring course environment the hotel offers swimming in the lake and boating, walking and sports activities. The hotel offers free parking and free WLAN access to the course participants.

Alternative: For those, who cannot attend, notice a) the course offered at Bad Dürkheim (October 26-30, 2026) and b) that I sell the course material at half the price and offer individual online-hours at a rate of 200 €/hour. Get in touch to find out more about this option.

Offering:

- Course material via download server (GAMS, presentations, examples, literature)
- Full GAMS software with several solvers (temporary license for 2 months)
- One of the following books: Book „Gemischt-Ganzzahlige Optimierung in der Praxis“ (Josef Kallrath, Vieweg 2012), or alternatively, „Business Optimization Using Mathematical Programming“ (Josef Kallrath, 2nd Edition, Springer 2021).
- Full board board (3 nights Sun-Tue, 3 x breakfast, 3 x lunch, 2 dinners – basic course
- Full board board (2 nights Wed-Thu, 2 breakfasts, 2 lunch, 1 dinner) – advanced course
- Free analysis and consulting on industrial participants' problems (send them in early; this offering does not apply to participants from universities or students)
- Participants have access to the complete course material prior to the course
- Course Language: English. All course material will be in English.

Course Fees include accommodation, food and beverages**:**

- Specified on the registration form (last page of this document).
- Discounts on early registrations, or combined courses registration.

Registration:

- Fill-out and sign the form (last page of this document), send it to me
- or send your registration data by e-mail to JosefKallrath.SC@sci-con.de

I also offer in-house courses accommodated to the client's wishes. Contact me under josefKallrath.SC@sci-con.de for further details.

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Basic GAMS Course
– Modeling and Optimization with GAMS –

Summary: GAMS Basic Course

This three-day course is designed to help those new to GAMS become more familiar with it and gain the knowledge to model and solve simple optimization problems. The participants will receive an introduction to mathematical optimization, including modeling and solution algorithms. Following the course, the participants will be able to map decision problems to the basic objects of optimization models: indices, data, variables, constraints, and objective functions. The course is designed for participants with no prior knowledge of GAMS, though experience with other programming languages may be beneficial. As a new addition to the course: we will be looking at how ChatGPT/CoPilot could be used for the generation or analysis of GAMS code.

The course offers ample opportunity for discussion and analysis of participants' own problems, in addition to the presentation, examples, and hands-on activities.

Target group of participants

The course is ideal for participants who have either some elementary mathematics background, or have already done their first steps with GAMS, or have used another programming language for at least 6 months and wish to

- gain an overview and introduction to mathematical optimization,
- become familiar with the basic concepts of index sets, indices, variables, constraints, and objective functions, as well as how to use these objects in GAMS,
- learn how to model and to implement optimization problems in GAMS,
- experience ChatGPT or DeepSeek supporting you to construct GAMS models, or
- bring your own optimization problems to use for a free analysis and, if possible, a first implementation.

It would be greatly beneficial for the participants to prepare for their involvement in the course by communicating and specifying their expectations and desired outcomes.

Things to Do Before the Course

The course will be conducted on your laptop. It is recommended that your laptop has admin rights. GAMS, the course software, examples, presentations and useful literature will be distributed by a download server prior to the course. Please install GAMS on your machine and **work through the presentations to prepare for the course**. Tell us about your expectations, fields and problems of interest prior to the course.

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Part 1: Overview & Basic Objects in GAMS

Day 1: (9:30-17:50) – starting with Registration (coffee, tea, refreshments)

Session 1a: Welcome and Introduction (9:30-10:00)

- Introduction, course objectives, expectations of the participants
- Overview, the presentations and other materials
- Course structure on the CD, Preparing the Laptops

Session 1b: Foundations of Mathematical Optimization (10:00-11:15)

- Optimization models and solution algorithms
- Algebraic modeling languages
- A simple example about cows and pigs

Coffee break (11:15-11:30)

Session 1c: Overview - Modeling with GAMS (Part I) (11:30-12:30)

- The structure of a GAMS Program:
- Indices, variables, constraints and objective functions
- Model declaration, conditional operators, $, and, or, …
- Solve statement, interpretation of *.log and *.lst files and *.log files

Lunch break (12:30-14:00)

Session 1c: Overview - Modeling with GAMS (Part II) (14:00-15:00)

- GAMS Studio / GAMS IDE and the Cows & Pigs Example – Exercise
- GAMS Studio / GAMS IDE – New versus old interface (* optionally *)
- Inspecting GAMS symbols in GDX files
- The role of ChatGPT & DeepSeek in modeling and GAMS coding support

Session 2a: Sets (15:00-16:10)

- Simple Sets and Multi-dimensional sets
- Subsets and domain checking
- Operations on Sets, operations on set elements, Dynamic Sets

Coffee break (16:10-16:30)

Session 2b: Data Objects (16:30-17:50)

- Scalars, Scalars, parameters and tables
- Exercise: Cows & Pigs using Sets & Parameters and working with GDX files
- Operations on scalars and parameters
- Exercises: Demand given per day and product – 6 tasks

Dinner (18:00-19:30, Hotel Restaurant)

Day 2: (9:30-17:45)

Session 3a: Variables (09:30-10:00)

- Declarations
- Attributes and assignment statements
- Display and variables in *.lst files
- Using the solution values of variables

Session 3b: Equations and Inequalities (10:00-11:30)

- Declarations & Definitions
- Model declaration, Conditional operators, $, and, or, …
- ----- coffee break embedded in this exercise -----
- Exercises Boat: Model Building, implementation & debugging, interpretation

Session 3c: Option Statement and Solver Communication (11:30-12:30)

- GAMS Options: Solver (reslim, optcr, optca)
- Feedback mechanisms GAMS & Solver
- What you get after COMPILE / What you get after RUN
- Exercises: NLPexercise

Lunch break (12:30-14:00)

Session 3d: Generating GAMS Code Using ChatGPT/CoPilot (14:00-15:15)

- Exercises Cutstock: Model Building and Implementation
- Exercises Cutstock: Debugging Compilation Errors

Session 4a: Conditional Expressions (15:15-16:00)

- Using the $ Symbol in Conditional Expressions
- Logical Operators
- Exercises: Modifying the transport problem

Coffee break (16:00-16:20)

Session 4b: Procedural Language Elements (16:20-17:50)

- For, If, Loop, Repeat and While
- Exercise on FOR/WHILE: Complete Enumeration (Cows-Pigs)
- Exercises on IF/WHILE : Analyzing the points collected by a soccer team
- $Exit, $Goto and $Label Statement

Dinner (18:00-19:30, Hotel Restaurant)

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Day 3 (09:30-17:45)

Session B5a: Input Simple Text Files (09:30-10:40)

- Feeding data into GAMS
- Reading csv-files ($ondelim, $offdelim)
- Exercises: Read the data from the “Cutstock” example from file

Coffee break (10:40-11:00)

Session B5b: Output of Simple Text Files (11:00-12:25)

- Put & Write facilities
- Formatted output
- Report Generation: Put & Write-Facilities, Advanced Formatting, Put_Utilities
- Exercises: Output the results from the “Cutstock” example to files

Lunch break (12:30-14:00, Hotel Restaurant)

Session 6: GAMS Usage (14:00-15:30)

- GAMS Special Functions
- Compile-time versus Runtime Commands I - the $ command
- Calling GAMS from Command Shells
- A Larger Application Example: Energy Portfolio Optimization

Coffee break (15:30-15:50)

Session 7: Exercises: Modeling & Debugging (15:50-17:20)

- Exercises: Model Building and Implementation
- Exercises: Debugging Compilation Errors
- Diagnosing Infeasibilities

Session 8: GAMS Resources & Final discussion (17:20-17:45)

- GAMSLib, GAMS Utilties, GAMS Web, GAMS WiKi-Support
- Outlook into the Advanced Course
- Final discussion

End (17:45)

The agenda may change slightly !

Optionally, depending on the weather and participants’ preferences, afternoon sessions can be shifted to the evening after dinner enjoying the lake, environment or Berlin City.

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Advanced Optimization Course
– Modeling and Optimization with GAMS –

Summary: GAMS Advanced Course

This two-days course helps the *mathematically inclined participants* to learn advanced techniques for better using GAMS to model and *solve larger or complicated optimization problems, especially, mixed integer optimization problems*. The participants will increase their knowledge on using GAMS efficiently and will learn more about procedural and modular language features, background on the solvers embedded in GAMS, how to interface to systems outside GAMS and how to use and create Function Libraries. The course assumes the participants to have some basic knowledge on GAMS and familiarity with the GAMS-IDE or GAMS Studio. For the *mathematical part of this course*, it is beneficial for participants to have a decent mathematical background.

The participants will learn more about the *MILP, NLP and MINLP solvers* as well as on *global optimization techniques*. We stress that difficult and large optimization problems require a tight connection between modeling and algorithms aspects. This leads to *sequence of models, nested solve statements, and decomposition techniques* – detailed examples will be discussed. An important aspect of the course is the development of industrial applications software. The course will provide tricks-of-the-trade not covered by the GAMS documentation or other public sources.

The course offers ample opportunity for discussion and analysis of participants' own problems, in addition to the presentation, examples, and hands-on activities.

Target group of participants

Ideally, participants with a good mathematics background or some years of GAMS experience. For the Advanced Course, only attendees are accepted who have attended the GAMS Basic Course or have at least 6 months experience with GAMS.

It is strongly recommended that participants of the Advanced Course also attend the Basic Course, even if they have used GAMS previously. Based on experience from the past 16 years, the initial three days of the Basic Course facilitate a uniform level of understanding, foster consistency in approach to GAMS usage, and provide a valuable opportunity for group dynamics and a shared learning experience.

The advanced course is ideal for participants who wish to

- *solve large and difficult problems* and learn about approaches to attack them using use *polylithic modeling and solution approaches*
- *reduce computing time and memory requirements when solving difficult or large optimization problems*, or want to benefit from the *scenario solver GUSS*

- exploit the MIP restart feature in Cplex in sequences of models
- learn how to *transform apparently nonlinear optimization problems to linear ones*
- learn more about *nonlinear optimization and global optimization techniques*
- obtain insights into how the GAMS solvers among them Cplex, Gurobi, XpressMP, Conopt, Baron, Lindoglobal and others
- increase the efficiency with which they use GAMS
- use GAMS in a more modular way using macros, the batinclude command, and advanced compile time features, e.g., loops in compile time languages
- enhancing the usefulness of GAMS output, *e.g.*, using the put_utilities
- learn about GDX, the GDX utilities and how link with other programs such as MS Excel or MS Access; special focus on how to extract data from MS Excel
- to find out about more powerful things GAMS can do that are not so well known because of hidden features or a lack of treatment in the documentation & tricks-of the trade
- to refresh their knowledge and learn more about more recent GAMS features
- experience ChatGPT or DeepSeek supporting you to construct GAMS models
- bring their own GAMS models and problems (the course offers a free analysis and, in most cases, an improvement)
- repairing and fixing models which do not produce solutions as wanted
- get inspiration on how to solve very difficult and large problems by polylithic methods combining LP, MILP, NLP, or MINLP with heuristics.

The participants may prepare their participations by communicating and specifying what they expect from this course and what sort of problems they want to solve.

Things to Do Before the Course

The course will be conducted on participants' laptops. Laptops should have administration rights in case some adjustments are needed. Note that GAMS, the course software, examples, presentations and useful literature will be distributed by a download link prior to the course. Please, install GAMS on your machine and **work yourself through the presentations to prepare for the course**. In many cases the GAMS Studio will be used, in some cases we might run applications in a DOS command shell, or connect to Excel spreadsheets. And, last but not least, tell us about your expectations, fields of interest and problems prior to the course.


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Part 1: LP & MILP / Procedural Structures / Sequential Models

Day 1: (9:30-17:45) -- starting with Registration (coffee, tea, refreshments)

Session 1a: Welcome and Introduction (9:30-9:45)

- Introduction, course objectives, expectations of the participants
- Overview, the presentations and other materials

Session 1b: Foundations and GAMS Solvers (09:45-11:00)

- Optimization problems and solution algorithms
- LP: Revised Simplex and Interior point methods
- MILP: Branch&Bound and Branch&Cut
- Warm-Up Exercise: Modeling a Set Covering Problem (1e)

Coffee break (11:00-11:20)

Session 1c-1: The Art of Modeling Optimization Problems (11:20-12:20)

- The art of modeling: BigM formulations, logical constraints, etc
- Equivalent linear formulations for special nonlinear problems (1e)
- Monolithic versus polylithic models
  – standard versus tailor-made solution techniques

Lunch break (12:20-13:30, Hotel Restaurant)

Session 1c-2: Programming Mathematical Algorithms in GAMS (13:30-14:45)

- Branching on special ordered sets and semi-continuous variables (1e)
- Procedural language elements in GAMS – Programming own B&B Schemes

Session 2a: GAMS Advanced Usage (14:45-15:30)

- Domain Check and Universe (*) Declaration
- Compile-time versus Runtime commands II (1e)
- Proper Indexing and Profiling
- Fast Hot Starts: Scenario Solver GUSS

Coffee break (15:30-15:50)

Session 2b: GAMS Advanced Procedural Language Elements (15:50-17:00)

- Sequences of models, modular structures in GAMS
- Macros and Subroutines in GAMS ($macro & $batinclude) (1e)

Session 3: Multi-criteria Optimization (17:00-17:20)

- Foundations of multi-criteria optimization and Goal Programming
- Successive Problem Solving:
  - several MODEL and SOLVE statements
  - evaluating the results of a solve statement & generating the next model

Session 4: Difficult and Large-Scale Problems I (17:20-18:00)

- What makes optimization problems difficult ?
- Column Enumeration and Column Generation
- Paper industry cutting stock example: Gilmore-Gomory approach (1e)

Dinner (18:00-19:30, Hotel Restaurant)

The agenda may change slightly!

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Part 2: NLP & MINLP & Global / Interfacing with GAMS / Hybrid Methods

Day 2: (09:00-17:45)

Session 5a: Foundations of NLP and GAMS NLP Solvers (09:00-10:15)

- Foundations of nonlinear optimization: NLP ; GAMS & NLP
- Efficient formulations of NLP-problems
- Example "Molecule" with Solvers: MINOS, ConOpt, CoinIPOPT, SNOPT
- Exercise: A nonconvex NLP problem – dependence on initial value (1e)

Session 5b: GAMS Function Library Facility (10:15-10:45)

- Using Function Libraries / Creating Own Function Libraries (*optional*)
- Programming Own Functions (*optional*) – Embedded Python (*optional*)

Coffee break (10:45-11:00)

Session 5c: MINLP & Global Optimization in GAMS (11:00-12:25)

- Foundations of and ideas in mixed integer nonlinear optimization (MINLP)
- Foundations of Global optimization techniques – Global Solvers in GAMS
- Examples: Molecule & Cutting circles from rectangles
- Exercise: MINLP – Convex versus Nonconvex (1e)

Lunch break (12:25-13:30, Hotel Restaurant)

Session 6a: GDX and the GDX Utilities (13:30-15:15)

- GDX and the GDX Utility (1e)
- GAMS – Excel: Data Import and Export (1e)

Session 6b: Interfacing with GAMS (15:15-15:45)

- Interfacing with GAMS
- Building Applications
- Running GAMS from Excel: Cutting Stock and other examples

Coffee break (15:45-16:15)

Session 7: Difficult and Large-Scale Problems II (16:15-17:15)

- Introduction and Examples to Hybrid methods and Fix-and-Relax Techniques
- Hybrid example: (1+1) Evolutionary Algorithm + LP (Supply Management)
- Genetic Algorithm example in GAMS – Solving a non-convex NLP problem

Session 8: Tricks, GAMS Resources & Final Discussion (17:15-17:45)

- Tricks-of-the Trade: how to do .. ? Parallelization ! Parallel Polylithic M&S
- GAMS Resources: GAMSLib, GAMS Utilties, GAMS Web

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About the Lecturer

Josef Kallrath obtained his PhD in astrophysics from Bonn University (Germany) in 1989. He is a professor at the University of Florida (Gainesville, FL, https://josefkallrath.github.io/homepage), and solves real-world problems in industry using a broad spectrum of methods in scientific computing, from modeling physical systems to supporting decisions processes by mathematical optimization. He has written review articles on the subject, about 130 research papers in astronomy and applied mathematics, and several books on mixed integer optimization, as well as one on eclipsing binary stars. Among the books relevant to this course are

Business Optimization Using Mathematical Programming (J. Kallrath, 2021) – 2nd edition, Springer, Cham, Switzerland

Gemischt-Ganzzahlige Optimierung in der Praxis (J. Kallrath, 2002 & 2012, Vieweg)

Modeling Languages in Mathematical Optimization (J. Kallrath, 2004, Kluwer)

Algebraic Modeling Systems: Modeling and Solving Real World Optimization (J. Kallrath, 2012, Kluwer)

Real Optimization with SAP APO (J. Kallrath and T. I. Maindl, 2006, Springer)

Optimization in the Energy Industry (J. Kallrath, Panos M. Pardalos, S. Rebennack, and S. Scheidt, Editors, 2008, Springer)

Josef Kallrath is an experienced consultant and course instructor with a comprehensive understanding of modeling and optimization systems. He has provided consulting services on a global scale to a diverse array of industries, including energy, metals, paper, process, refineries, and telecommunications. He has served as the leader of the Real World Optimization Working Group of the German Operations Research Society since 2002. His long-term research interests include polylithic modeling and solution approaches that employ parallel computing techniques to address complex optimization problems. These approaches may utilize techniques such as column generation or hybrid methods, for instance.

Thank you for your interest in my courses.

I am looking forward to the upcoming events.

Registration GAMS Courses 2026

in 12527 Berlin-Schmöckwitz, Berlin, Germany

Herewith, I register **bindingly** for the GAMS courses crossed below.

1. PERSONAL DATA

Name: _____

Company: _____

Street / P.O. box: _____

ZIP code, city: _____

Phone /Fax : _____

E-Mail: _____

2. WORKSHOP FEE (CROSS WHAT FITS)

FEES EXCL. 19% VAT

☐	B261	21-23.09.2026 (early / regular registration)	**€ 3800 / 4200**
☐	A261	24-25.09.2026 (early / regular registration)	**€ 3000 / 3300**
☐	B261+A261	21-25.09.2026 (early / regular registration)	**€ 5800 / 6500**

Early registration deadline is May 08, 2026 for B261 & A261. General registration deadline is June 09, 2026. 19% VAT will be added.

Please transfer the fee latest 5 days before the course.
We accept only payments by wire transfer to a German or US bank account.
Upon registration, we will send you the payment instructions to your valid email address.

3. ACCOMMODATION AND MEALS (CROSS WHAT FITS)

For the participants of the courses the hotel reservation is made automatically to a single non-smoking room from the night prior to the start of the course. Please, select and cross what fits.

☐ Smoking room ☐ Vegetarian meals ☐ Vegan meals
☐ Extra follow-up night ☐ Double room ☐ Arriving late on Sunday

Terms and Conditions

1. After the registration is received, an invoice with payment instructions is send to the participants. Early-registration participants need to complete the payment before May 15, 2026.
2. Upon receipt of payment, participants are eligible to download the course material.

With my signature below I agree to the Terms and Conditions.

_____ _____

Place, Date Signature

Please send your registration data to JosefKallrath.SC@sci-con.de

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