
# Deploying Your Application Built Around GAMS

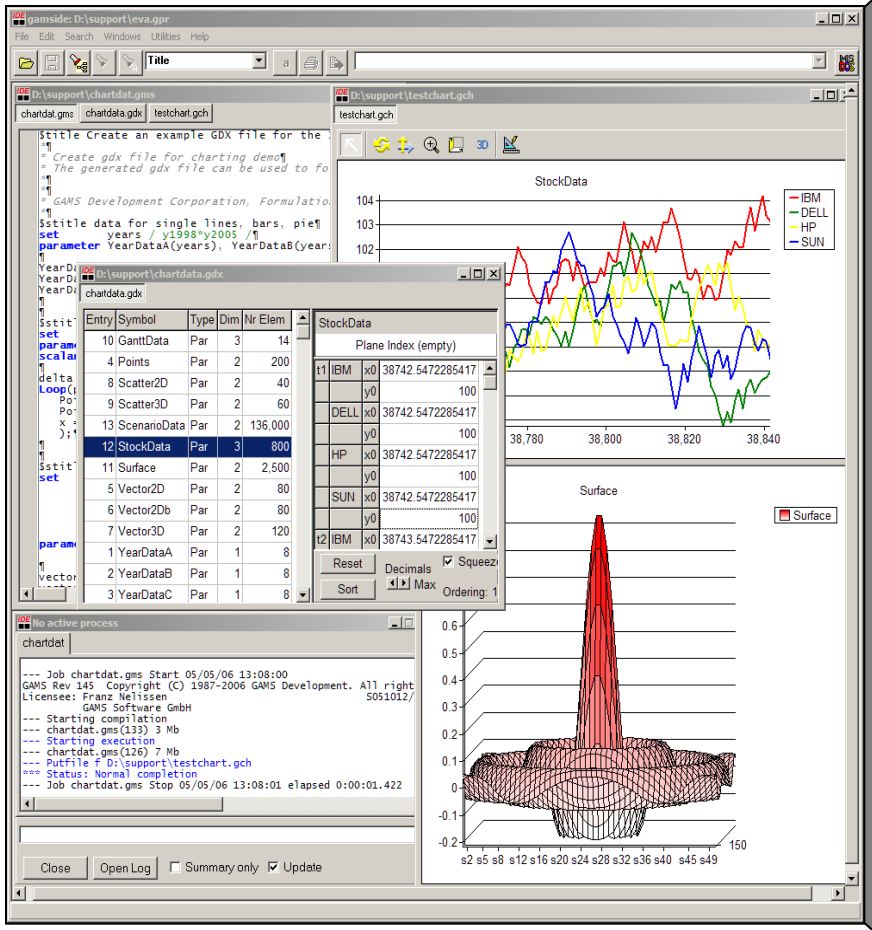
**Lutz Westermann** lwestermann@gams.com

**GAMS Software GmbH** www.gams.com

**GAMS Development Corporation**

INFORMATICS RISING


# GAMS at a Glance




**G**eneral **A**lgebraic **M**odeling **S**ystem

- Algebraic Modeling Language
- 30+ Integrated Solvers
- 10+ Supported MP classes
- 10+ Supported Platforms
- Connectivity- & Productivity Tools
  - IDE
  - Model Libraries
  - GDX, Interfaces & Tools
  - Grid Computing
  - Benchmarking
  - Compression & Encryption
  - Deployment System
  - APIs (C, Fortran, Java, .Net ...)
  - …


# Outline

- Prerequisites
  - Object Oriented GAMS API
  - Cutting Stock Problem
- Building an Application around GAMS
- What's New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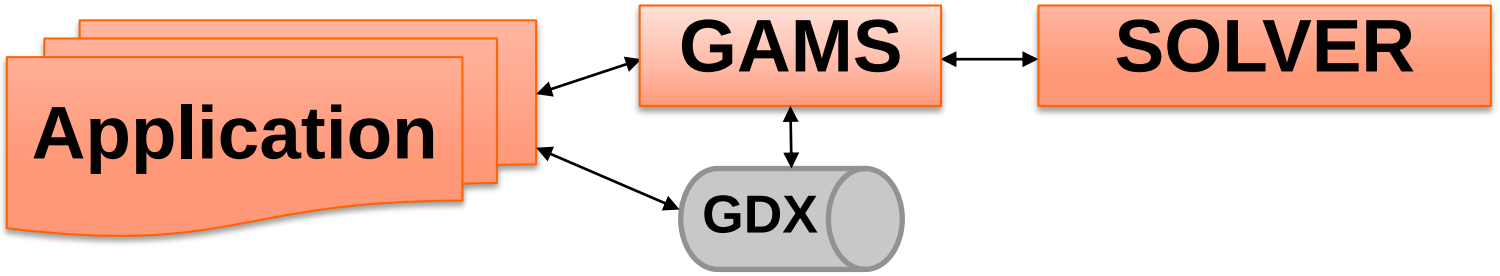
# Calling GAMS from your Application




**Creating Input for GAMS Model**

→ Data handling using GDX API

**Callout to GAMS**

→GAMS option settings using Option API

→Starting GAMS using GAMS API

**Reading Solution from GAMS Model**

→ Data handling using GDX API


# Low level APIs → Object Oriented API

- Low level APIs
  - GDX, OPT, GAMSX, GMO, …
  - High performance and flexibility
  - Automatically generated imperative APIs for several languages (C, Delphi, Java, Python, C#, …)

- Object Oriented GAMS API
  - Additional layer on top of the low level APIs
  - Object Oriented
  - Written by hand to meet the specific requirements of different Object Oriented languages


# Features of the object oriented API

- No modeling capability, model is still written in GAMS
- Prepare input data and retrieve results in a convenient way → *GAMSDatabase*
- Control GAMS execution → *GAMSJob*
- Scenario Solving: Feature to solve multiple very similar models in a dynamic and efficient way.
  →*GAMSModelInstance*
- Seamless integration of GAMS into other programming environments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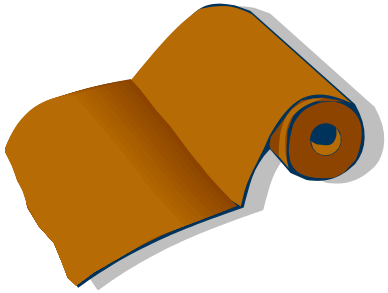
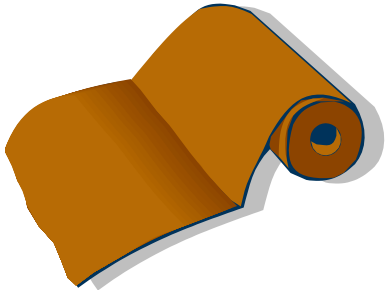
# Cutting Stock Problem: Objective

- Cut out paper products …
  - of different sizes
  - from large raw paper rolls
  - in order to meet customer's demand



- Objective: minimize the required number of paper rolls

# Cutting Stock Problem: Input / Output

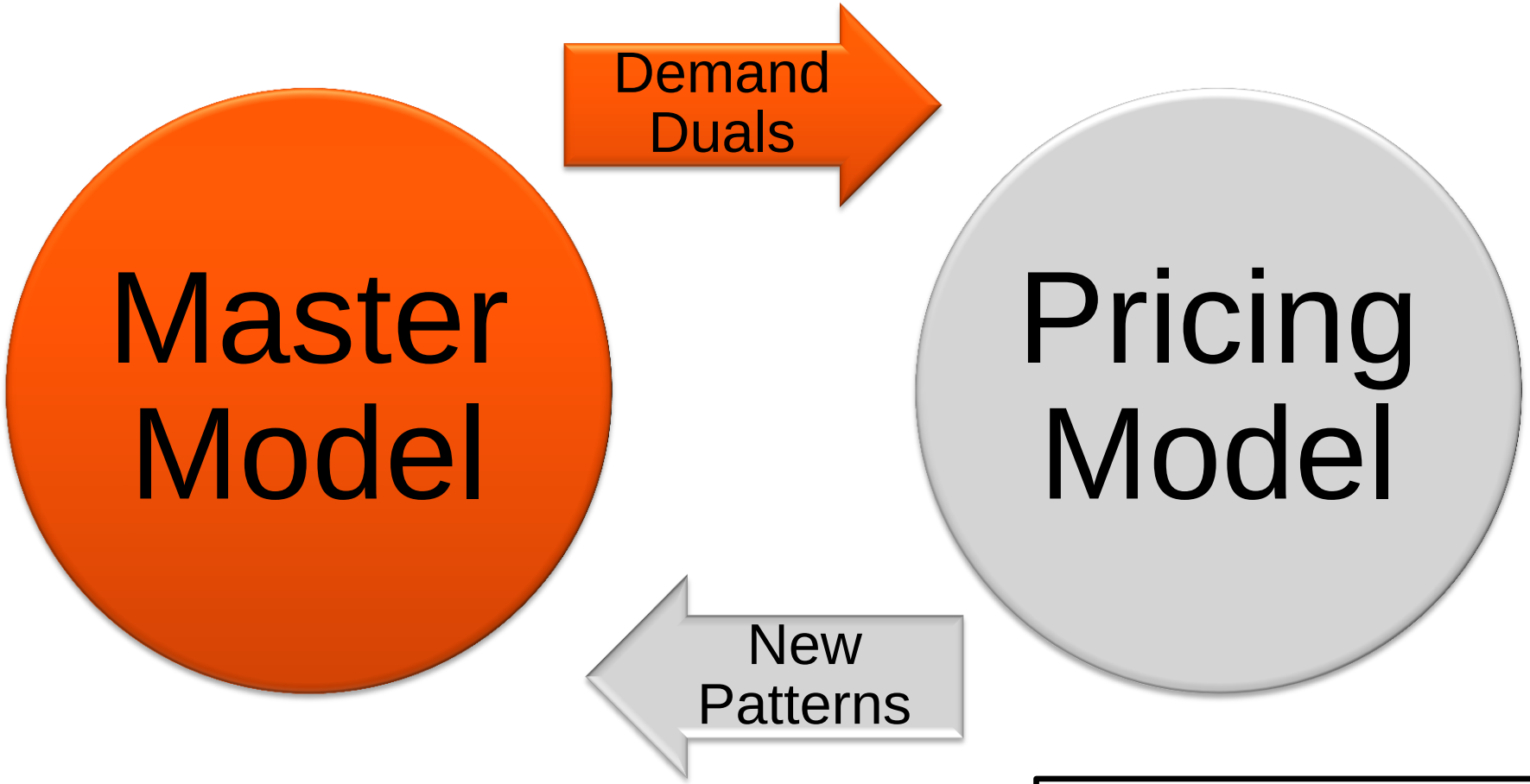


- Input:
  - Number of different products with…
    - Width of product
    - Demand of product
  - Width of raw paper roll

- Output:
  - Different cutting patterns
  - Usage of those patterns

    ➔ Number of required raw paper rolls


# Cutting Stock Problem: Column Generation




➔ cutstock.gms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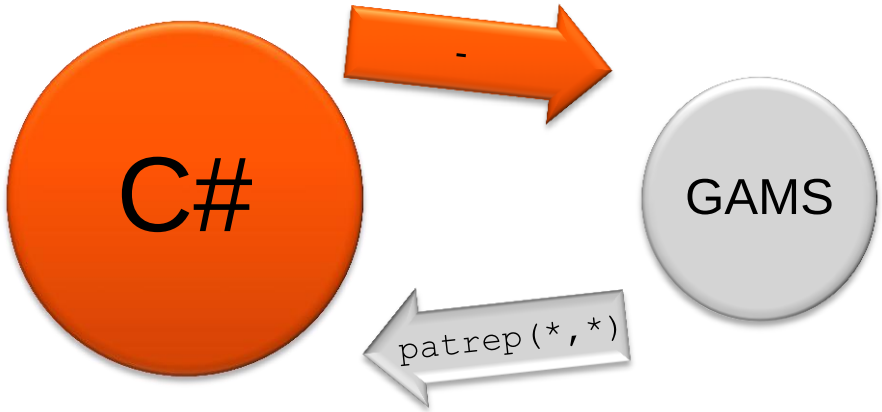
# Application Step 1

- What are we going to do?
  1. Run the model
  2. Print out the results
  3. Change the solver used
- Interface:

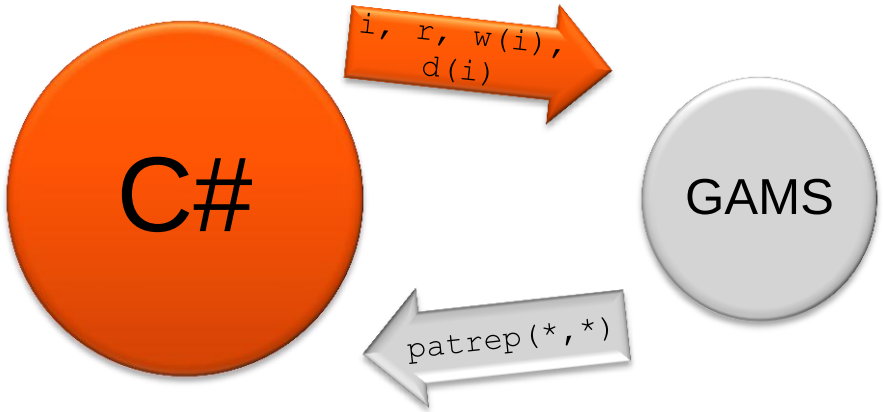



- What do we need?
  1. GAMSWorkspace & GAMSJob
  2. GAMSParameter
  3. GAMSOptions (Solvers)

➔ Step1.cs

# Application Step 2

- What are we going to do?
  - Define the input data within the application
  - Store the data and pass it to the model
  - Check for Errors
- Interface:

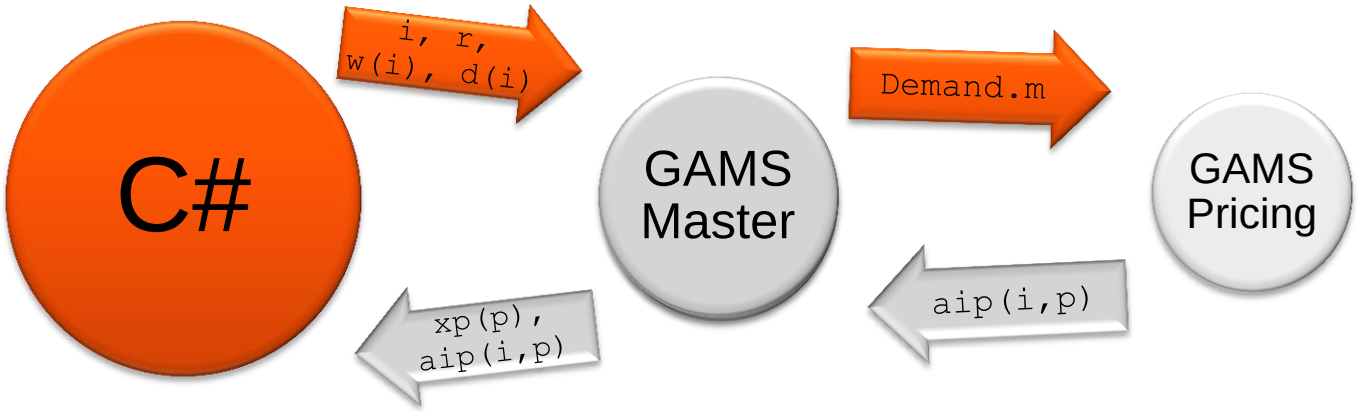



- What do we need?
  - GAMSDatabase
  - GAMSOptions (Defines)
  - GAMSException

➔ Step2.cs

# Application Step 3

- What are we going to do?
  - Move the logic of the algorithm from GAMS into the application layer (➔ improve performance)
- Interface:




- What do we need?
  - GAMSCheckpoint
  - GAMSModelInstance
  - GAMSModifier


# Excursus: GAMSModelInstance etc.

**GAMSJob**

- Manages the execution of a GAMS program given by GAMS model source

creates

**GAMSCheckpoint**

- Captures the state of a `GAMSJob`

initializes

**GAMSModelInstance**

- A single mathematical model generated by a GAMS solve statement

modifies

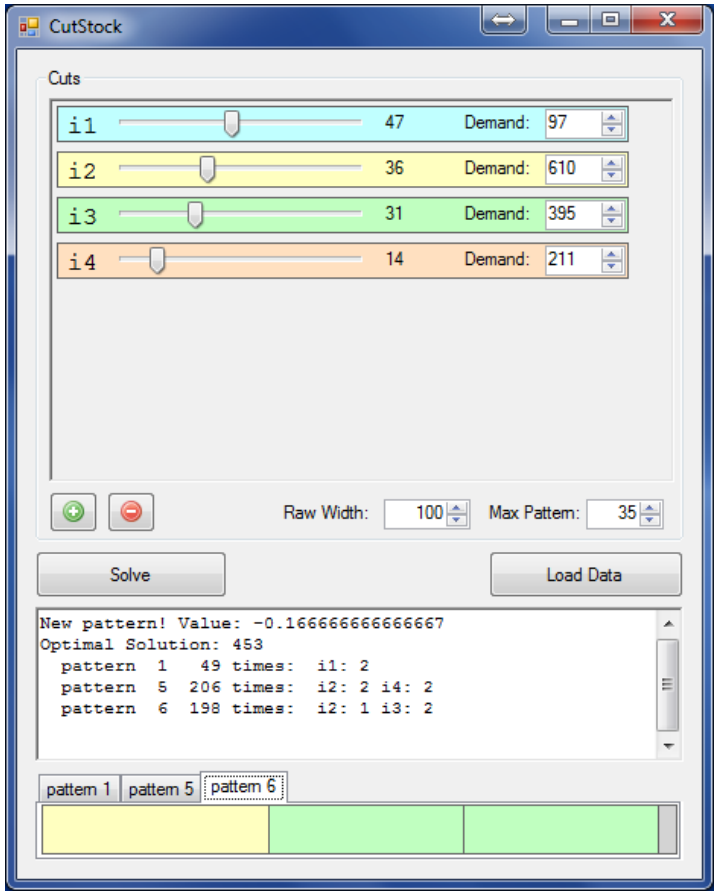
**GAMSModifier**

- Marks elements of a `GAMSModelInstance` to be modifiable

➔ Step3.cs

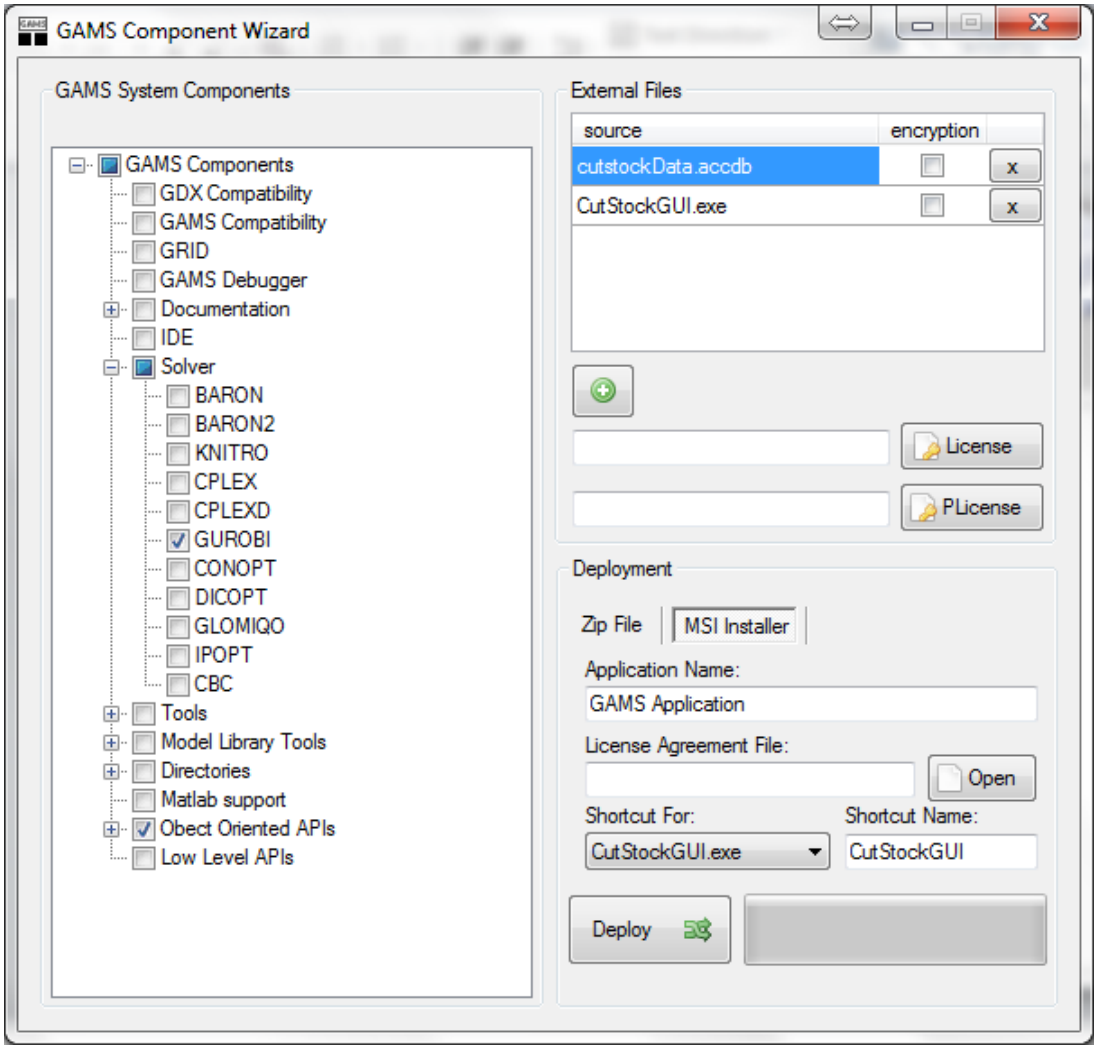
# Application Step 4

- What are we going to do?
  - Add a graphical user interface




➔ Step4.cs

# Deploying the Application

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# New GAMS Distribution 23.9.3

**Released September, 27th** www.gams.com/download

- **Solver updates**
  - BARON 11.3
  - CONOPT 3.15F
  - CPLEX 12.4 fixpack 1
  - GLOMIQO 2.0
  - GUROBI 5.0.1
  - KNITRO 8.0
  - LINDO 7.0.1.487
  - MOSEK 6 rev 137
  - XPRESS 23.0.05
  - …

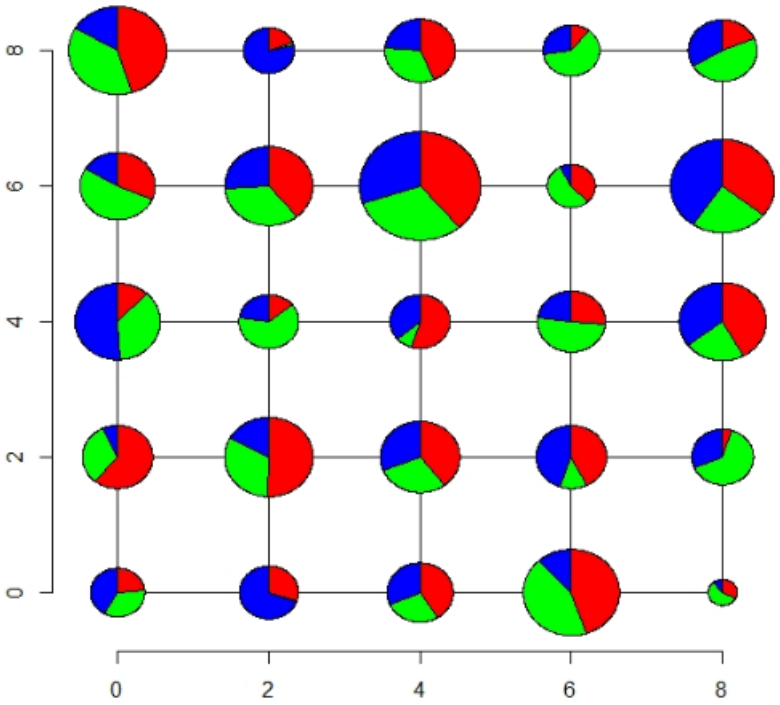

# Object Oriented GAMS API

- Object Oriented API provides an additional abstraction layer of the low level GAMS APIs
- Powerful and convenient link to other programming languages
- .NET API with many examples is part of the current GAMS release available at *www.gams.com*
- Python and Java under development

Object Oriented GAMS API: .NET and Beyond,
Michael Bussieck, Monday, 8am, Suite 322

# GDXRRW

- GDXRRW bridges the gap between R and GAMS
- Fits into the ecosystem of existing GDX utilities
- Presents data in a natural form for R users




Source: http://blog.modelworks.ch

GDXRRW: Exchanging Data between GAMS and R, Steven Dirkse, Monday, 11am, Suite 322


# Stochastic Programming in GAMS

- The Extended Mathematical Programming (EMP) framework is used to replace parameters in the model by random variables
- Support for Multi-stage recourse problems and chance constraint models
- Easy to add uncertainty to existing deterministic models, to either use specialized algorithms or create Deterministic Equivalent (new free solver DE)

Stochastic Programming in GAMS,
Lutz Westermann, Monday, 11am, Suite 322


# Contacting GAMS

Europe

**GAMS Software GmbH**
**P.O. Box 40 59**
**50216 Frechen,**
**Germany**

Phone: +49 221 949 9170
Fax: +49 221 949 9171

info@gams.de

USA

**GAMS Development Corp.**
**1217 Potomac Street, NW**
**Washington, DC 20007**
**USA**

Phone: +1 202 342 0180
Fax: +1 202 342 0181

sales@gams.com
support@gams.com

http://www.gams.com