

Developing and deploying optimization models with FICO Xpress

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Mots-clés : *mathematical modeling software, optimization solvers, project deployment.*

1 Introduction

FICO Xpress Optimization [1] is a software suite for developing and deploying optimization models. It comprises a set of solvers, including linear, mixed-integer, and various nonlinear solvers as well as a constraint programming solver. Users have the flexibility to choose among several options for formulating their optimization models : direct interfaces to the solver libraries are available for several programming languages such as C, Java, .NET, Python, R. Alternatively, the user can opt to work with an algebraic modelling language, most prominently Xpress Mosel [2], a free software (see also [3]) that forms part of the Xpress suite and that provides access to all solvers of the Xpress suite, including a robust optimization module that is only available through Mosel. Third party modelling tools, such as AMPL or GAMS equally provide interfaces to certain Xpress solvers.

1.1 Some history

Xpress solvers and modelling tools have been commercialized for 40 years. The set of solvers of the Xpress suite started of with just LP and MIP solvers in the 1980s. Since the end of the 1990s it has been gradually enriched with solvers for other problem types, such as quadratically constrained quadratic problems, convex nonlinear problems, second order cone problems, a sequential linear solver for general nonlinear problems and the solvers Knitro and Kalis provided into the suite by our partner Artelys SA.

The original modelling component mp-model was replaced in 2001 by Mosel.

About 10 years ago the software suite has been extended with deployment capabilities via Xpress Insight. Insight is a platform for the creation of web-based multi-user apps with scenario handling that relies on the distributed computing mechanisms of Mosel for the remote execution of programs.

Major additions made over that last two years to the set of products within FICO Xpress are (1) a global solver for general nonlinear problems and (2) the possibility of deploying optimization problems implemented in Python to Xpress Insight.

2 Software demos

We shall demo two examples of optimization models and their respective deployment via Xpress Insight, using some of the newly added functionality.

2.1 Developing and deploying Mosel models

The first example is a Mosel implementation of a nonlinear distancing problem, minimizing the required space for seating staff in an office subject to minimum distance requirements

between every pair of persons. We shall discuss several formulation variants, including the use of different nonlinear solvers. We show how to embed this model and its graphical output into an Insight app that allows users to change the input configurations.

2.2 Developing and deploying Python models

As a second demo we shall present two Python models. The first one will demonstrate how to create a Benders decomposition algorithm. The second example will showcase how a model can be turned into a robust application ready for being deployed in a business environment, simply by adding specific markup.

3 Online resources

- FICO Xpress is available freely for download in a size-limited version : <https://content.fico.com/xpress-optimization-community-license>.
- Academic institutions can join the Xpress Academic Partner programme free of charge to obtain full licenses : <http://www.fico.com/app>.
- The Xpress documentation is freely accessible online : <http://www.fico.com/fico-xpress-optimization/docs/latest>
- The Xpress Optimization Community provides access to discussion groups, video tutorials and further material : <http://community.fico.com/optimization>

Références

- [1] FICO Xpress. <http://www.fico.com/xpress>, 2023.
- [2] Y. Colombani, B. Daniel and S. Heipcke. *Mosel : a Modular Environment for Modeling and Solving Problems*. In : J. Kallrath (ed.) : Modeling Languages in Mathematical Optimization. Kluwer Academic Publishers, Norwell, 211–238, 2004.
- [3] Mosel Open Source repository. <https://github.com/fico-xpress/mosel>, 2017.