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OVERVIEW OF SELECTED INFORMATION TOOLS FOR LINEAR PROGRAMMING

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Abstract. Currently, linear programming and operational analysis methods are used in optimizing fleet planning, crew scheduling, yield management and aircraft maintenance planning. In recent years, there has also been a significant increase in the availability of information tools that can solve these tasks in an automated way - from simple tools such as Excel Solver to specialised systems such as Gurobi or FICO Xpress. This article offers a comprehensive overview of selected information tools that can be used for linear programming. The available software tools were compared in terms of type, modelling approach, performance, licensing and practical suitability. It serves as a guide for the selection of a tool according to the nature of the task, the scope of the model and the technical or licensing capabilities of the organisation.

Keywords: operational analysis; linear programming; optimization; aviation; software; decision making

1. INTRODUCTION

With the increasing demands for efficiency and accuracy in aerospace decision making, operational analysis and linear programming techniques play a key role in solving complex optimization problems. These methods enable airlines, airports and regulators to efficiently plan and allocate resources, reduce costs and improve the performance of operational processes. Linear programming is a mathematical method used to optimize a linear objective function subject to linear constraints, making it an essential tool for solving complex allocation and optimization problems. Operational analysis is a broader field that encompasses linear programming along with other analytical and mathematical modeling techniques to support decision making and problem solving in a variety of industries. These techniques include simulation, queueing theory, network analysis, and decision analysis to help organizations optimize processes, reduce costs, and increase efficiency.

The use of linear programming and operational analysis methods is playing an increasingly important role in aviation management decision making. These methods allow to systematically solve complex tasks related to resource allocation, flight planning, crew assignment, yield optimisation or maintenance planning. The importance of these methods lies primarily in their ability to replace intuitive decision-making with quantitatively based outputs, which significantly increases the quality and transparency of the manager's decision-making processes. In the dynamic and regulated environment of aviation, such an approach is particularly important as it allows us to react quickly to change, use resources efficiently and at the same time ensure a high standard of service. However, for the practical application of this theoretical knowledge, it is essential to be familiar with the available software tools that enable efficient modelling and solving of optimisation problems.

2. LITERATURE REVIEW

Optimization methods and operational analysis tools are increasingly being applied in air transport, where they contribute to more efficient planning, management and decision-making in various areas of operation. One of the most important applications of linear programming in aviation is fleet management and planning. Airlines use optimization models to efficiently assign aircraft to routes in order to minimize operating costs while ensuring that regulatory requirements and operational constraints are met. The complexity of this task is greatly increased by the impact of unpredictable events such as adverse weather conditions, technical failures or fluctuations in passenger demand. Several studies confirm the effectiveness of advanced optimization techniques in this area. The researchers presented a new fleet assignment and routing model that was tested on a two-day airline schedule with 645 round-trip flights and 170 aircraft divided into 24 fleet types. Using the XPress Optimization Suite (XPressMP), the solution handled more than 70 million constraints and approximately 110,000 variables, achieving a 36.7% cost reduction compared to the original plan generated by the commercial software [1]. Another major study by other researchers focused on robust maintenance scheduling and assignment of a huge number of aircraft. Computational results showed that the MILP-based models achieved high accuracy with minimal differences between the linear programming (LP) and integer solutions, and the implementation used IBM's CPLEX optimization software [2]. These results confirm that the application of advanced LP and MILP models can significantly improve the efficiency of fleet planning, optimize resource utilization and reduce the overall operating costs in air transport.

Air navigation service providers and airlines use LP-based models to optimise flight paths to reduce fuel consumption, minimise delays and manage congested airspace efficiently. These models integrate weather forecasts, capacity constraints and aircraft performance parameters to enable more efficient coordination of air traffic flow. The researchers proposed a dynamic network flow model for rerouting flights in response to changes in weather conditions. The formulation was based on a multi-commodity integer flow model, using Lagrange relaxation and random rounding heuristics to generate feasible routes. Their approach achieved solutions that were within 1% of the theoretically lowest possible value of the objective function, known as the lower bound. This indicates the high accuracy of the results with respect to the optimal solution [3]. Hierarchical optimization models were also presented in the study, where the authors divided the decision-making process into two levels: the first optimized the flow of traffic in the network, while the second determined the specific routes of individual aircraft. Calculations performed using CPLEX showed that for smaller instances exact solutions could be achieved, while for larger instances a combination with heuristics was needed, with results within 13% of the optimal value [4].

Operational analysis techniques play an important role in the efficient management of airport resources such as check-in counters, handling equipment and service vehicles. Their aim is to minimise congestion and delays, reduce costs and improve the flow of operations. Researchers proposed a check-in desk allocation optimization model that integrated simulation and LP to determine the optimal number and placement of check-in counters while maintaining the desired level of service. The models implemented in AIMMS and solved using CPLEX demonstrated that more than 90% of passengers did not wait longer than 10 minutes, while also minimizing operational costs [5]. Other researchers have focused on optimizing the scheduling of service vehicles, specifically shuttle buses and baggage trailers. Their model, formulated as a MILP, was solved using the GLPK tool and augmented with genetic heuristics. Calculations showed that optimized scheduling reduced fuel costs and delays by more than 20%, while in many cases achieving complete elimination of delays [6]. These results confirm the contribution of LP and MILP techniques in the efficient allocation of airport resources, while highlighting the possibilities of combining them with heuristic methods in solving large-scale problems.

Optimising pricing and revenue management is one of the key areas where LP and MILP techniques are used effectively. Airlines use models to dynamically assign ticket prices and allocate capacity to maximize profit while taking into account demand, competition and operational constraints. A team of researchers presented an approach based on robust optimization for networked yield management under uncertainty. The model used the concept of so-called polyhedral uncertainty to model variable demand and optimized reservation limits based on a minimum regret criterion. Computational experiments demonstrated an improvement in revenue management policy while increasing resilience to fluctuations in customer behavior [7]. Other researchers have applied LP to determine the optimal number of flights between two cities under a low-cost profit-maximizing model.

Their model used the simplex method and was implemented using the Lingo tool. The results showed that LP can effectively balance demand, cost, and profitability even with a simple problem formulation [8].

Effective aircraft maintenance planning is key to ensuring the safety, reliability and availability of the fleet. LP and MILP-based models allow the timing of maintenance interventions to be optimised to minimise aircraft downtime while meeting stringent regulatory requirements. The researchers developed a branching and pricing algorithm to optimize the routing of aircraft to maintenance interventions, addressing problems arising from unexpected events such as weather-induced delays or technical failures. The model, implemented in a C++ environment, was used by the CPLEX solver and allowed the generation of feasible maintenance routes that were dynamically adaptable to current operating conditions [9]. Another researcher presented a MILP-based multi-objective framework aimed at minimizing maintenance violations and optimizing resource allocation. The model used an iterative algorithm and was implemented in Python using the Gurobi solver. Computational experiments performed on real flight schedules showed high efficiency in coordinating maintenance across multiple maintenance centers [10].

3. INFORMATION TOOLS FOR LINEAR PROGRAMMING

This chapter gives an overview of selected information tools used for the solution of linear programming tasks, which are an integral part of linear programming.

3.1. Gurobi

Gurobi Optimizer is a latest-generation commercial optimization solver, considered one of the fastest tools for solving linear programming and MILP problems. Its high performance and flexibility predestine it to solve large-scale optimization models in industry and academia. Gurobi has been deployed in leading airlines such as Air France and KLM, where it is used to optimize crew planning, flight scheduling, fleet management and engine maintenanceGurobi [11][13].

Modeling capabilities

Gurobi primarily functions as a computational engine, with modeling done via APIs in languages such as Python, C++, Java, .NET, or MATLAB. The most widespread use of the Python API is to create flexible and complex models, including advanced constraints typical of crew scheduling or aircraft allocation. For users preferring algebraic modeling, Gurobi can be used as a solver in environments such as AMPL or GAMS [11].

Solver performance

Gurobi solver is among the best tools in solving large and sparse optimization problems, which is typical for airline transportation. In independent benchmarks (e.g., MIPLIB), it regularly achieves top results. Its solver can efficiently parallelize branching and bounding on multicore processors, and uses advanced heuristics and cutting equations, thus significantly reducing computation time. Air France reports a significant speedup in solving optimization problems after switching to Gurobi [12][13].

Integration and API

Gurobi supports a wide range of integration options. In addition to classic APIs, it also offers cloud computing support via Gurobi Compute Server or Gurobi Cloud. This enables the deployment of optimization models in modern IT environments, e.g. within web applications or airline decision support systems [11].

Licensing and costs

Gurobi is a premium commercial product with high costs for enterprise deployments. However, for academic use, it provides very generous free licenses for students and academics, with no limit on model size. The licenses are renewable and readily available, making Gurobi an ideal choice for university teaching projects as well [12].

Suitability for Aviation Management

With its speed, stability and ability to solve large MILP models, Gurobi is ideal for solving problems such as crew scheduling, fleet assignment, yield management and maintenance planning. Its successful deployment in companies such as Air France and KLM confirms its relevance for practical airline applications [13].

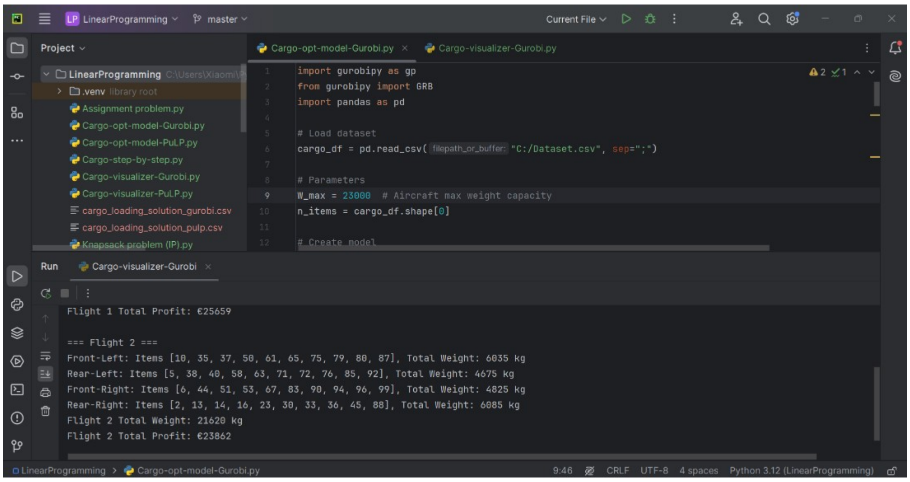

Figure 1 Overview of Gurobi in the PyCharm interface

3.2. FICO XPress

FICO Xpress Optimization Suite is a very good commercial tool for solving LP and MILP problems. Originally developed as Dash Xpress-MP, Xpress has established a solid position among the best solvers in the OA field. With its advanced algorithms and high speed, it ranks on par with solvers such as Gurobi and CPLEX. In the aviation domain, Xpress has been applied for example in crew scheduling, fleet allocation and flight path optimization [15][17][18].

Modeling capabilities

Xpress uses its own modeling language, Mosel, which combines an algebraic style similar to AMPL or OPL with programming logic. Mosel also allows for natural modeling of complex problems such as multilevel crew scheduling or integratedXpress flight plan recovery models [30].

For modern integrations, Xpress also offers a Python API (library) as well as interfaces for C, C++, Java, and .NET. In addition, the Xpress Insight platform allows to turn optimization models into fully functional web applications, which is advantageous when deploying optimization into operational environments [15].

Solver performance

Xpress Optimizer solver is among the fastest available solvers for LP and MILP [14]. It has advanced techniques such as slice equations, Benders decomposition, and parallel processing [15]. In benchmarks, its performance is on par with Gurobi and CPLEX, with Xpress scoring slightly higher on some problem types (e.g., pure LP problems) [29]. Xpress also handles very large-scale problems (more than a billion non-zero elements in the matrix), which makes it well suited for solving complex aerospace problems.

Integration and API

Xpress offers flexible integration options: Mosel IDE (Workbench) for creating and debugging models, Python API for data-driven applications and integration into data process flows, REST API via Xpress Insight for deploying models as services. Xpress is also compatible with external modeling languages such as AMPL and GAMS, allowing it to be used in existing projects [15].

Licensing and costs

Xpress is commercial software with premium licensing. FICO provides free academic licenses on demand, similar to Gurobi and CPLEX. There is also a Community Edition with limited model sizes, suitable for teaching and small projects [16].

Suitability for Aviation Management

Xpress is ideal for crew scheduling, fleet allocation, disruption management and revenue optimization solutions. Its speed, flexibility, and integration capabilities make FICO Xpress a suitable choice for challenging aviation optimization tasks [17][18].

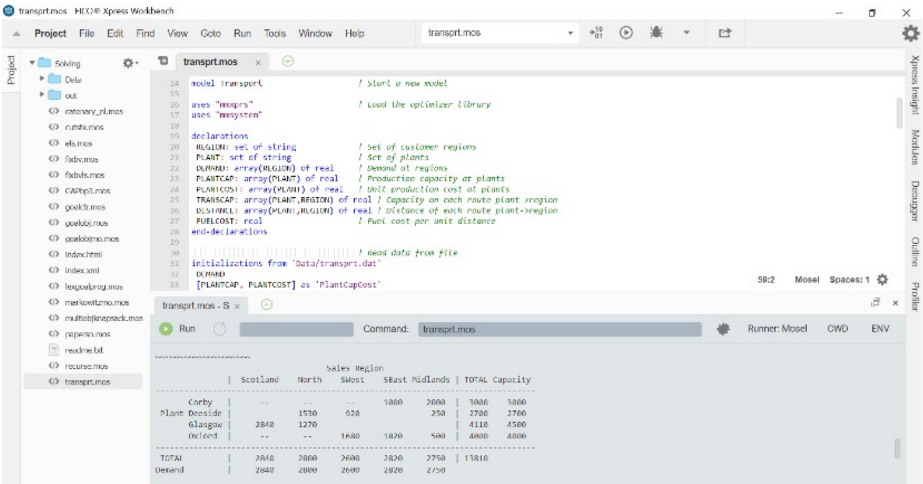

Figure 2 FICO Xpress Interface Overview

3.3. MATLAB

MATLAB is a high-level computing environment widely used in engineering and science. In the area of optimization, it offers an Optimization Toolbox that includes a solver to support linear programming and MILP. Since 2024, MATLAB has significantly enhanced its capabilities in this area by integrating the HiGHS open solver as the default tool for LP and MILP problems. This change has significantly increased the speed and efficiency of solving optimization problems [19].

MATLAB is particularly popular in academic environments due to its accessibility, integration with data analysis, and visualization capabilities, making it well suited for the analysis of optimization results in the aerospace domain [21][22].

Modeling Capabilities

MATLAB offers two approaches to formulating optimization problems:

- Solver-oriented modeling (classical, matrices A, b, c for linprog/intlinprog),
- Problem-oriented modeling (newer, declaring variables and constraints symbolically) [19].

Although MATLAB is not a pure optimization tool like Gurobi or CPLEX, for medium-sized models (e.g., planning with several thousand variables) it provides sufficient flexibility and ease of modeling.

Solver Performance

Historically, MATLAB solvers (linprog, intlinprog) have lagged behind specialized commercial tools. However, the integration of the HiGHS solver since version R2024a has significantly improved performance. A huge speedup in solving MILP problems was observed in the benchmarks compared to the old versions. HiGHS offers advanced techniques such as preprocessing, slice equations, interior point method for LPs, thus solving LPs and MILPs has been greatly accelerated [19].

Integration and interfaces

MATLAB is primarily a custom computing environment. Optimization tasks can be integrated into scripts, Simulink simulations or MATLAB functions. MATLAB also allows for extended integration, but that is not the focus of this thesis. This ecosystem allows for a natural integration of optimization with data analysis, simulations, and visualization of results (e.g., graphical representation of flight paths or crew schedules) [19].

Licensing and costs

MATLAB is commercial proprietary software. Many universities provide free access to MATLAB, including the Optimization Toolbox, to students and staff as part of an academic license. For commercial use, licensing MATLAB and its add-on tools is quite expensive [20].

Suitability for aviation management

MATLAB is particularly suitable for prototyping solutions (e.g. flight scheduling), experiments with small to medium-sized problems (up to several thousand variables), visualization of optimization results (graphs, network diagrams), teaching optimization and simulation in the field of transport and logistics. Thanks to the new integration of the HiGHS solver, MATLAB is now able to solve even larger LP/MILP models with sufficient efficiency for research and teaching needs [19].

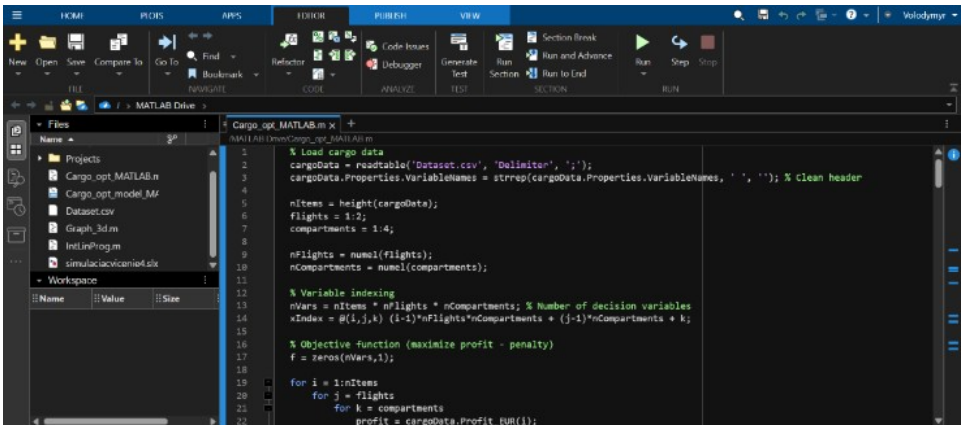

Figure 3 MATLAB Interface Overview

3.4. Microsoft Excel Solver a OpenSolver

Microsoft Excel Solver is a built-in optimization tool in Microsoft Excel that allows you to solve LP and MILP problems. It is mainly designed for solving smaller problems and is widely used in both corporate practice and educational environments due to its ease of use [23].

To extend the capabilities of Excel, the OpenSolver add-in has been developed, which also allows solving larger optimization models by removing the built-in limitations of Solver and uses the open-source CBC (Coin-OR Branch and Cut Solver) [24].

Modeling Capabilities

Excel Solver allows you to define decision variables, constraints, and an objective function using classic Excel cells and formulas [23]. OpenSolver maintains the same modeling method, but allows to solve larger models and connect to powerful solvers such as Gurobi or NEOS server [24]. Modeling in both tools is fully visual, does not require programming, and is very suitable for quickly building and modifying LP/MILP models.

Solver Performance

Excel Solver uses the Simplex algorithm (for LP) and branching and bounding (for MILP). The performance is suitable for small models (dozens of variables and constraints) [23]. OpenSolver uses the default CBC solver, which handles medium-sized models (hundreds of constraints), but is considerably slower than professional solvers like Gurobi. OpenSolver allows, if needed, to solve even larger models by leveraging compute servers (e.g. NEOS) or by connecting to professional solvers [24].

Integration and interfaces

Both Excel Solver and OpenSolver integrate directly into the Microsoft Excel environment. The user defines the model via Excel cells, OpenSolver then replaces the solver process with a powerful solver without having to change the existing model. OpenSolver installs as a simple plug-in with no programming required [24].

Licensing and costs

Excel Solver is part of Microsoft Excel (commercial license secured by a university license) [23]. OpenSolver is a free open source tool (GPL license). It does not require a separate license, only an existing Excel installation [24].

Suitability for Aviation Management

Excel Solver and OpenSolver are suitable for small planning tasks (e.g., small fleet assignments, airport resource planning), quick scenario analyses (what-if analyses), teaching purposes (demonstration of LP/MILP concepts). However, they are not suitable for solving large and highly complex aviation optimization problems (e.g., global flight scheduling, large-scale crew models). Thus, OpenSolver and Excel Solver represent an initial step towards applied optimization in aviation, with the possibility of subsequent migration to more powerful tools.

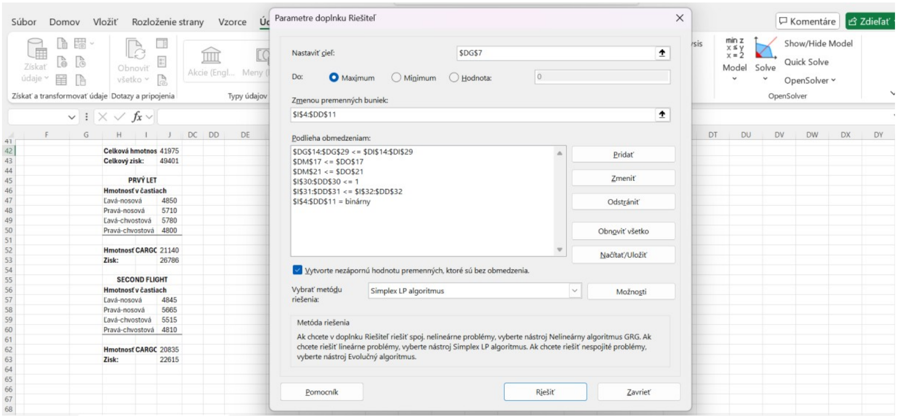

Figure 4 Microsoft Excel Solver Interface Overview

3.5. PuPL

PuLP is an open source Python library for formulating and solving LP and MILP problems. It is designed with an emphasis on ease of use and rapid creation of optimization models using readable and intuitive code. Due to the fact that it is free of charge and the possibility to connect to multiple solvers, it is popular in academic settings as well as in practice as a tool for prototyping and testing optimization approaches [25].

Modeling Capabilities

PuLP allows the formulation of LP and MILP problems in a declarative manner - the user defines the decision variables, objective function, and constraints in a Python environment. The library itself does not contain its own solver, but acts as an interface to various external solvers [25][26]. The default solver is COIN-OR, which is installed automatically. However, other solvers (such as Gurobi, and others) can be connected [26]. The models are flexible, easy to read and modify, allowing for rapid iterations in development. PuLP is ideal for tasks where the user wants to maintain full control over the model structure while taking advantage of Python.

Solver performance

The performance when using PuLP depends entirely on the chosen solver. For small to medium sized problems (tens to hundreds of variables and constraints), CBC achieves reliable solutions in seconds to minutes. For larger problems, solving with CBC can be significantly slower (compared to Gurobi or CPLEX) [25].

Integration and interfaces

PuLP is designed for direct use in Python and supports interactive use in Jupyter notebooks,integration into more complex software systems or analytical data streams [26]. No special environment is required - just Python and the PuLP library installed.

Licensing and costs

PuLP is distributed under the MIT license, which means that it is completely free for use in both academic and commercial environments, has no limitations on model size or deployment type, and has customization, modification, and integration capabilities without the need to contact the manufacturer [26]. The licensing openness makes PuLP an attractive solution, especially for smaller enterprises, academic institutions and research teams with limited budgets.

Suitability for Aviation Management

PuLP is particularly suitable for strategic and tactical planning tasks such as crew scheduling, aircraft assignment or capacity planning, prototyping and testing optimization models in a Python environment, e-learning applications (students can model and solve LP/MILP problems in their own environment), and solver benchmarking (ability to switch between CBC, Gurobi, CPLEX). However, it is not suitable for extremely large real-time problems and robust optimization.

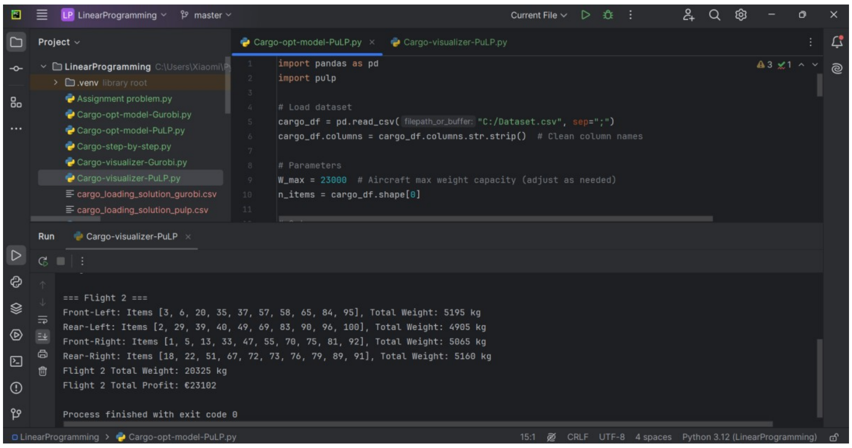

Figure 5 Overview of PuLP in the PyCharm interface

3.6. Comparison of the analysed software tools used for solving problems by linear programming

The following overview table summarises the main differences between the analysed tools in terms of type, modelling approach, performance, licensing and practical suitability. It serves as a guide for the selection of a tool according to the nature of the task, the scope of the model and the technical or licensing capabilities of the organisation.

Table 1 Comparative table of the selected LP tools

Tool	Type	Modeling	Solver	License	Suitable Use
Gurobi	Commercial	API	Own	Free Academic License	Programmable aviation problems
PuLP	Open Source	Python	External	Free	Teaching, prototyping, use in small airlines
CPLEX	Commercial	Algebraic, API	Own	Free Academic License	Programmable aviation problems
Xpress	Commercial	Mosel, API	Own	Free Academic License	Programmable aviation problems
MATLAB	Commercial	Problem-oriented modeling	HiGHS	Free Academic License	Prototypes, visualizations, simulations
Excel Solver	Commercial	Visual	Own	Free Academic License	Teaching, demonstrations, smaller tasks
OpenSolver	Open Source	Visual	External	Free	Teaching, applications for small airlines

4. CONCLUSION

In current practice, linear programming and operational analysis methods are used to optimize fleet planning, crew scheduling, yield management, and aircraft maintenance planning. In recent years, there has also been a significant increase in the availability of information tools that can solve these tasks in an automated way - from simple tools such as Excel Solver to specialised systems such as Gurobi or FICO Xpress. The authors aimed to create an overview of selected tools to support the solution of linear programming tasks, to assess their practical applicability in the field of aviation.

MATLAB has proven to be very useful in solving smaller problems. It allows the creation of models without the need for programming, and its interface automatically generates the mathematical formulation of the model, which contributes significantly to the understanding of the problem. It is therefore an excellent choice for teaching linear programming, especially given its free availability to academic institutions and the rich range of teaching materials.

Microsoft Excel with Solver add-in is a relatively simple tool for smaller problems. It provides a clear output and its widespread use in business practice makes it a suitable alternative for small aerospace companies already using Microsoft Office. As an extension to Excel, OpenSolver overcomes some of the limitations of the original solver.

Gurobi provides exceptional computing power, but working with it requires programming knowledge. This can be a challenge for users with no previous experience, but is also an advantage if automation or integration into wider software systems is required. It is an ideal tool for both academic environment and for management decision making in larger airlines.

FICO Xpress with Mosel language offers a powerful solution similar to Gurobi, while its syntax is more mathematical and may be clearer for some users. It is suitable for both teaching and commercial use, especially in larger organisations where the emphasis is on robustness of the solution and readability of the model.

As a free tool, PuLP is fully sufficient for solving smaller problems. Its free nature and easy integration into the Python environment make it suitable for training, prototyping models or deployment in smaller enterprises.

All the tools analysed in this thesis not only allowed to compare different approaches to modelling and solving linear programming problems, but above all showed their practical contribution to managerial decision making in aviation. Each of the researchers provided valuable outputs that can be used in flight planning, resource allocation or yield optimization.

Air transport is one of the most demanding and dynamic sectors of logistics, where effective decision-making plays a key role. Due to high operational costs, limited resources and stringent safety requirements, it is essential to use advanced analytical methods to optimise planning and operations. Among the most important tools in this field are linear programming and operational analysis, which allow decision problems to be mathematically modelled and solved efficiently using computational methods.

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5. LITERATURE LIST

[1] Unal, Y. Z. Sevkli, M. Uysal, O. Turkyilmaz, A. A new approach to fleet assignment and aircraft routing problems. *Transportation Research Procedia*, 2021, roč. 59, s. 67–75. ISSN 2352-1465. DOI: 10.1016/j.trpro.2021.11.098. [cit. 01.05.2025.] Dostupné na internete: https://www.sciencedirect.com/science/article/pii/S2352146521008590

[2] Liang, Z. Feng, Y. Zhang, X. WU, T. Chaovalitwongse, W. A. Robust weekly aircraft maintenance routing problem and the extension to the tail assignment problem. *Transportation Research Part B: Methodological*, 2015, roč. 78, s. 238–259. ISSN 0191-2615. DOI: 10.1016/j.trb.2015.03.013. [cit. 01.05.2025.] Dostupné na internete: https://www.sciencedirect.com/science/article/abs/pii/S0191261515000569
[3] Bertsimas, D. Patterson, S. The Traffic Flow Management Rerouting Problem in Air Traffic Control: A Dynamic Network Flow Approach. *Transportation Science*, 2000, roč. 34, č. 3, s. 239–255. DOI: 10.1287/trsc.34.3.239.12300. [cit. 01.05.2025.] Dostupné na internete: https://pubsonline.informs.org/doi/10.1287/trsc.34.3.239.12300
[4] Dell'olmo, P. Lulli, G. A new hierarchical architecture for Air Traffic Management: Optimisation of airway capacity in a Free Flight scenario. European Journal of Operational Research, 2003, roč. 144, č. 1, s. 179–193. ISSN 0377-2217. DOI: 10.1016/S0377-2217(01)00394-0. [cit. 01.05.2025.] Dostupné na internete: https://www.sciencedirect.com/science/article/abs/pii/S0377221701003940
[5] Araujo, G. Repolho, H. Optimizing the Airport Check-In Counter Allocation Problem. *Journal of Transport Literature*, 2015, roč. 9, č. 4, s. 15–19. DOI: 10.1590/2238-1031.jtl.v9n4a3. [cit. 01.05.2025.] Dostupné na internete: https://www.researchgate.net/publication/281979436
[6] Kuhn, W. Loth, S. Genetic algorithms for airport vehicle scheduling. *International Journal of Simulation Modelling*, 2010, roč. 9, č. 4, s. 191–202. DOI: 10.2514/atcq.18.1.63 [cit. 01.05.2025.] Dostupné na internete: https://www.researchgate.net/publication/317172538
[7] An, J. Mikhaylov, A. Jung, S.-U. A Linear Programming approach for robust network revenue management in the airline industry. *Journal of Air Transport Management*, 2021, roč. 91. ISSN 0969-6997. DOI: 10.1016/j.jairtraman.2020.101979. [cit. 01.05.2025.] Dostupné na internete: https://www.sciencedirect.com/science/article/abs/pii/S0969699720305615
[8] Patel, P. Ali, A. Airline route optimization using linear programming model. In: Proceedings of the 2018 International Conference on Industrial Engineering and Operations Management (IEOM). Bandung: IEOM Society, 2018. ISBN 978-1-5323-5943-9. [cit. 01.05.2025.] Dostupné na internete: https://www.ieomsociety.org/ieom2018/papers/719.pdf
[9] Sarac, A. – Batta, R. – Rump, C. A branch-and-price approach for operational aircraft maintenance routing. *European Journal of Operational Research*, 2006, roč. 175, č. 3, s. 1850–1869. DOI: 10.1016/j.ejor.2004.10.033. [cit. 01.05.2025.] Dostupné na internete: https://www.researchgate.net/publication/4939074
[10] Boyaci, B. An optimisation framework for airline fleet maintenance scheduling and tail assignment. Istanbul: Istanbul Technical University, 2019. [cit. 01.05.2025.] Dostupné na internete: https://www.academia.edu/111142554
[11] GUROBI OPTIMIZATION, LLC. Gurobi Optimizer Reference Manual. [online]. [cit. 01.05.2025.] Dostupné na internete: https://docs.gurobi.com/projects/optimizer/en/current/index.html
[12] GUROBI OPTIMIZATION, LLC. Gurobi Academic License Program. [online]. [cit. 01.05.2025.] Dostupné na internete: https://www.gurobi.com/academia/academic-program-and-licenses/
[13] GUROBI OPTIMIZATION, LLC. Air France and KLM optimize crew scheduling and fleet planning using Gurobi. [online]. [cit. 01.05.2025.] Dostupné na internete: https://www.gurobi.com/case_studies/air-france-tail-assignment-optimization/
[14] GUROBI OPTIMIZATION, LLC. Gurobi Benchmarks and Performance Comparison. [online]. [cit. 01.05.2025.] Dostupné na internete: https://cdn.gurobi.com/wp-content/uploads/Gurobi_8_Performance_Benchmarks.pdf
[15] FICO. FICO® Xpress Optimization Online Help. [online]. [cit. 01.05.2025.] Dostupné na internete: https://www.fico.com/fico-xpress-optimization/docs/latest/overview.html
[16] FICO. FICO® Xpress Xpress Trial and Licensing Options. [online]. [cit. 01.05.2025.] Dostupné na internete: https://www.fico.com/en/fico-xpress-trial-and-licensing-options
Nguyen, A. & et al. Lawn mower injuries in children: A 30-year experience. *ANZ Journal of Surgery.* 2008. Vol. 78. No. 9. P. 759-763.

[17] FICO. Southwest Airlines - FICO. [online]. [cit. 01.05.2025.] Dostupné na internete: https://www.fico.com/en/latest-thinking/case-study/southwest-airlines
[18] FICO. American Airlines | FICO. [online]. [cit. 01.05.2025.] Dostupné na internete: https://www.fico.com/en/latest-thinking/case-study/american-airlines
[19] MathWorks. Optimization Toolbox. [online]. [cit. 01.05.2025.] Dostupné na internete: https://www.mathworks.com/products/optimization.html
[20] MathWorks. Pricing and Licensing. [online]. [cit. 01.05.2025.] Dostupné na internete: https://www.mathworks.com/pricing-licensing.html
[21] MathWorks. Airbus Uses Artificial Intelligence and Deep Learning for Automatic Defect Detection. [online]. [cit. 01.05.2025.] Dostupné na internete: https://www.mathworks.com/company/user_stories/case-studies/airbus-uses-artificial-intelligence-and-deep-learning-for-automatic-defect-detection.html
[22] MathWorks. Model Aircraft Design Optimization with MATLAB. [online]. [cit. 01.05.2025.] Dostupné na internete: https://www.mathworks.com/videos/model-aircraft-design-optimization-with-matlab-1670308968191.html
[23] Microsoft Corporation. Define and solve a problem by using Solver. [online]. [cit. 01.05.2025.] Dostupné na internete: https://support.microsoft.com/en-us/office/define-and-solve-a-problem-by-using-solver-5d1a388f-079d-43ac-a7eb-f63e45925040
[24] Mason, A., & Dunn, J. (n.d.). OpenSolver for Excel – The Open Source Optimization Solver for Excel. [online]. [cit. 01.05.2025.] Dostupné na internete: https://opensolver.org/
[25] Mitchell, S., O'Sullivan, M., & Dunning, I. (2011). PuLP: A Linear Programming Toolkit for Python. Optimization Online. [online]. [cit. 01.05.2025.] Dostupné na internete: https://optimization-online.org/2011/09/3178/
[26] COIN-OR. Optimization with PuLP. [online]. [cit. 01.05.2025.] Dostupné na internete: https://coin-or.github.io/pulp/

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