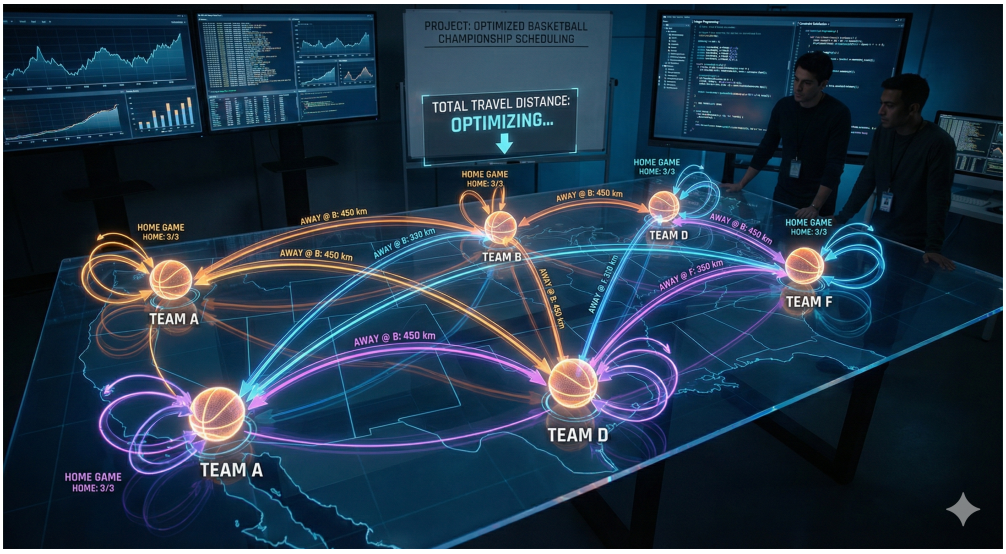
Optimizing the Schedule of a Basketball Championship

Lucas Goutodier Gabriel Suissa



1 Motivation

Scheduling a basketball championship is a complex organizational task involving multiple competing objectives and constraints. Each team must face every other team a fixed number of times, while respecting practical considerations such as rest days, home/away balance, and travel requirements. Poorly designed schedules may lead to unfair competitive conditions, excessive travel for some teams, or logistical inefficiencies.

This project addresses the problem of designing an optimized and fair schedule for a basketball league using Operations Research (OR) methods. The primary objective is to minimize the total travel distance incurred by all teams over the season, while ensuring a realistic and balanced competition structure. This problem naturally arises in professional sports leagues and constitutes a real-world application of combinatorial optimization and integer programming techniques.

2 Method

We model the scheduling problem as a combinatorial optimization problem. Each team is associated with a fixed home location, and distances between teams are computed using a synthetic geographic representation. The objective function aims to minimize the total travel distance accumulated by all teams throughout the season.

As a first step, we focus on a simplified setting with a limited number of teams. The model enforces core constraints such as:

- each team plays at most one game per round,
- each matchup involves exactly one home team and one away team,
- teams return to their home location at the end of the season.

The optimization model is implemented in Python. Integer Programming techniques are intended to be used to decide match assignments across rounds. In addition, a baseline approach based on random schedule generation is implemented to provide a point of comparison for evaluating solution quality.

3 Preliminary Experiments

We conducted preliminary computational experiments on synthetic datasets consisting of up to six teams. Each team is assigned randomly generated coordinates on a two-dimensional grid, and pairwise travel distances are computed using Euclidean distance.

A function to compute the total travel distance of a given schedule has been implemented. This function tracks the movement of each team across rounds, accounting for travel between consecutive games and the return to the home location at the end of the season.

As a baseline, we evaluated randomly generated schedules and computed their associated total travel distances. These experiments provide a reference cost level against which optimized schedules will be compared. Initial results show significant variability in travel distance across random schedules, highlighting the potential benefit of optimization-based approaches.

At this stage, experiments are limited to small problem instances to ensure feasibility and to validate the correctness of the evaluation framework. No numerical instability or infeasibility issues were observed in the baseline computations.

4 Next Steps

Based on the preliminary results, the next steps of the project include:

- implementing a complete integer programming formulation for the scheduling problem,
- comparing optimized schedules against the random baseline in terms of total travel distance and fairness metrics,
- extending experiments to larger numbers of teams,
- incorporating additional constraints such as home/away balance and rest-day requirements,
- performing sensitivity analysis to study the impact of problem parameters on solution quality.

These steps will allow us to assess the effectiveness and scalability of the proposed optimization approach and to refine the model toward a realistic championship scheduling framework.

Contributions

Lucas Goutodier contributed to problem formulation, data generation, and baseline modeling. Gabriel Suissa contributed to the implementation of travel cost evaluation, experimental setup, and analysis of preliminary results.