Scheduling the Brazilian Football Tournament in Practice

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Professional sports leagues face challenging optimization problems. Devising good tournament schedules is of utmost importance for players, teams, fans, sponsors, hosting cities, and the media. Fair and balanced schedules are a major issue for ensuring attractiveness and confidence in the tournament outcome. The annual Brazilian football tournament is a compact, mirrored, double round-robin tournament played by 20 teams. We describe the integer programming approach that has been proposed for solving the scheduling problem associated with this tournament and report on the successful practical experience after running this system for three years.

1 Introduction

Professional football teams do not want to waste their investments in players and structure due to poor game playing schedules. National and international competitions played in parallel require strong coordination of travel and game schedules. Professional leagues face challenging optimization problems and efficient schedules are of major interest for players, teams, fans, sponsors, and the media; see recent literature surveys in [1, 4, 6].

The annual football tournament organized by the Brazilian Football Confederation (CBF) is Brazil's most important sporting event. Its major sponsor is TV Globo, the largest media group and television network in Brazil.

Nurmi et al [3] have noticed that few professional leagues have adopted optimization models to date. This seems to be due both to the hardness of

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the problem and to some fuzzy preference restrictions and criteria that can be hard to describe, and also to the resistance of teams and leagues to using new tools that introduce modern techniques in sports management.

This work summarizes the formulation and the implementation of the optimization software developed by the authors in partnership with CBF to determine good schedules for the two divisions of the Brazilian football tournament, extending the developments reported in [5]. We also report on the practical experience resulting from using this interactive software to schedule the 2009, 2010, and 2011 editions of the tournament.

2 Schedule Requirements

The annual Brazilian soccer tournament lasts for seven months, from May to December. Each division (Series A and Series B) is structured as a compact, mirrored, double round-robin tournament played by $n = 20$ teams over $2(n - 1) = 38$ rounds. *Weekend rounds* are played on Saturdays and Sundays, while *midweek rounds* are played on Wednesdays and Thursdays. The dates available for game playing change from year to year and must be coordinated with other competitions, such as Brazil's Cup, South America's Cup, and Libertadores Cup. Some games are required to be played on weekends.

Twelve teams form the so-called *Group of Twelve* (G12), which are the strongest founding teams of the league and have greater broadcast rights. The teams are organized by pairs with complementary home-away patterns of game playing. Teams in the same pair are usually based in the same home city.

Regional games involve two opposing teams whose home cities are located in the same state. *Classic* games (or derbies) are those that involve two opponents based in the same home city and with a long tradition of rivalry. They are usually the most important games and attract the largest attendances.

The tournament schedule should satisfy a number of constraints, ranging from fairness to security issues, and from technical to broadcasting criteria. Most of them reflect strategies for maximizing revenues and tournament attractiveness, while others attempt to avoid unfair game sequences that could benefit some team. These requirements fall in five classes: round-robin constraints, home-away patterns of game playing, classic and regional games, geographical and G12 constraints, and perfect matching of paired teams.

The maximization of gate attendance and TV audience is the major issue at stake. Major revenues earned by the teams come from broadcast and merchandising rights paid by the sponsors, who request good schedules that draw large audiences. Fair and balanced schedules are also a major issue for the attractiveness of the tournament and for the confidence in its outcome.

3 Solution Approach

The problem summarized in the previous section has been formulated as an integer programming model, see Ribeiro and Urrutia [7] for details.

We developed a three-phase solution approach based on a "first-break, then-schedule" decomposition scheme similar to that proposed in [2] to schedule a basketball league. In the first phase, we create feasible home-away patterns. In the second phase, we assign a different feasible home-away pattern to each team. Finally, in the third phase, we seek an optimal schedule by solving a simpler version of the integer programming model, obtained by variable fixations.

4 Practical Experience

The optimization model and the software system have been developed, tuned, and validated over the last four years. CBF and TV Globo staff participated actively in this effort. The system was validated with data of the 2005 and 2006 A editions of the tournament.

The system was used for the first time in 2009 as the official scheduler of the Brazilian football tournament. A number of schedules have been provided to the users, who selected their preferred choice. New criteria have been added in the model along the decision process based on successive refinements of the solution, as the decision makers evaluated and filtered the different schedules. The organizers checked each proposed schedule and imposed additional constraints (or removed existing constraints) to handle specific situations that might be desired to fine-tune the schedule. This tournament was the most attractive until that year, with four teams still in contention for the title when all games in the last round simultaneously started. The title changed hands several times, as the scores of the ten games underway changed. The goal that decided the tournament for Flamengo was scored only 20 minutes before the end of the tournament. The champion was not known until the last game ended, contrary to what had happened in previous years when the winners were known many rounds before the end of the tournament, making the games of the last rounds very uninteresting.

The optimization system was used for the second time in 2010. Once again, the decision makers were happy with the schedules the system computed. This was a particularly difficult tournament to schedule. Since it had to be interrupted in June and July during the 2010 World Cup, there were few dates available for game playing. As a consequence, there were many midweek rounds and few weekend rounds, making it impossible to schedule all classic games in double weekend rounds. The system sought a schedule with a maximum number of classic games played at double weekend rounds. Once again, the title was decided in the last round, with three teams still in contention for the title when their matches started. The goal that decided the tournament for Fluminense was scored 25 minutes before the end of the tournament.

In order to increase the interest for the games played in the last rounds, it was decided to schedule all derbies in the last rounds of the 2011 edition of the tournament. Due to old local rivalries, teams give their best when playing against rivals from the same city. Adding these new constraints lead to a

harder optimization problem, for which not even feasible solutions could have been obtained without an automated system. The schedule produced by the optimizer lead to the tightest tournament of all time. Five teams were still in contention a few rounds before the last. Two draws in the most important games played in the last round decided the title for Corinthians. Any additional goal in any of these two matches could have changed the outcome of the tournament. The press was unanimous in crediting the success of the tournament to the new constraints.

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