

## Optimization of International Sport Event Tournament Schedules: A Managerial View on The Scheduling Fairness of The World Baseball Softball Confederation Premier 12 Tournament

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### Abstract

In 2015, the World Baseball Softball Confederation (WBSC) created the Premier 12 tournament. The first tournament was held across various venues in Japan and Taiwan. Questions were raised by stakeholders about the fairness of factors that potentially affected game results. This study analyzes the game schedule and other factors that might have unfairly affected the game results and proposes a more balanced schedule. This study provides meaningful discussions on the actual schedule and what could have been done differently to make it more successful. This research also provides justification behind the analysis of scheduling data for sport event organizers.

**Keywords:** scheduling; Premier 12; organizational fairness; home advantage; international sport tournaments

### 1. Introduction

In 2005, the International Olympic Committee (IOC) declared that baseball and softball would be eliminated from the Olympics starting with the 2012 London Summer Olympic Games. It was a disappointment to the stakeholders of baseball and softball (National Public Radio, 2005). After the IOC's announcement, the International Baseball Federation (IBAF) merged with the International Softball Federation (ISF). As a result, the World Baseball Softball Confederation (WBSC) was created in 2013. In 2014, the WBSC established the WBSC Premier 12 (Premier 12, hereafter) tournament with an expectation that baseball could be re-introduced to the Olympics again for the 2020 Tokyo Summer Olympics (British Baseball Federation, 2013).

Today, Premier 12 is an international baseball tournament that determines the best national baseball team in the world. Specifically, Premier 12 features the twelve highest-ranked national baseball teams in the world. Participating countries are determined by a point ranking. Points are collected by all age group international tournaments held in the past four years (The Japanese National Baseball Team, 2015).

The first Premier 12 tournament was held in locations throughout Japan and Taiwan from November 8 – 21, 2015. Participating countries included teams from four continents: three Asian countries (Japan, Taiwan, South Korea), two European countries (Netherlands, Italy), six North American countries (United States, Cuba, Puerto Rico, Dominican Republic, Canada, Mexico), and one South American country (Venezuela).

In general, event factors such as game location, game date, and game time can influence the success of teams who travel across the world to participate in any international sport tournament. However, an unusually high number of problems arose from the 2015 WBSC Premier 12 schedule. Noticeable home advantage benefits such as game location, date, and time (day or evening game), travel distance, unexpected scheduling change during the tournament were found in how the baseball event was administered. For example, the venue for the opening game was switched from the Tokyo Dome to the Sapporo Dome at the last minute allegedly because the Sapporo Dome was the home field of Japan's starting pitcher for the opening game. This was speculatively done due to a potentially unfair advantage that could influence athletic competition and performance (Putnam & Carre, 2012; Cunniffe et al., 2015).

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If left unaddressed, home advantage benefits could cause the WBSC to lose its positive brand-image and legitimacy because of scheduling fairness issues. Negative effects could include tournament reputation among the countries, baseball popularity worldwide, baseball fan skepticism, professional baseball players' willingness to participate, a decline in prospective tournament sponsors, and unfavorable media attention. This is counterproductive from the original purpose of Premier 12 to boost baseball's popularity and to help baseball become an Olympic sport again.

## 2. Literature Review

Scheduling fairness issues such as scheduling of sports competitions, team quality, and game location have been studied by many researchers (i.e. Aguilar, Romero, & Garcia, 2014; Bray, Law, & Foyle, 2003; Goossens&Spieksma, 2012). In particular, *team* performance can be influenced by a variety of factors including game schedule. Sport scheduling problems include break minimization, distance minimization, carry-over effects minimization, and balanced tournament designs (Ribeiro, 2012). Break minimization scheduling problems seek schedules with a minimum number of breaks for each team or, at least, with a balanced number of breaks. Distance minimization seeks a schedule that minimizes the total distance traveled by the teams. The carry-over effect is particularly significant in sports that require a great amount of physical effort such as wrestling, rugby, football, soccer, and martial arts. However, the findings in academic literature regarding carry-over effects are mixed. Since Premier 12 is a relatively short competition and baseball usually does not require a great amount of continuous physical effort, the authors did not consider carry-over effect in this study.

Another effect that can influence team performance is home advantage (see Aguilar et al., 2014, Bray et al., 2003, & Goumas, 2014 for complete review). The literature generally agrees that home advantage is prevalent in sports, especially in team sports (Goumas, 2014). It is almost impossible to remove it entirely from the game maybe because it inevitably is part of the game. For the present study, determining if any country (particularly the host countries) had a significant advantage on game location and game time over other countries was a key question.

Another key element in scheduling for sport event schedulers to consider is the quality of sleep for athletes. For example, choosing to schedule a game in the day or evening or choosing a different location may result in players performing at sub-optimal levels (Bray, Jones, & Owen, 2002). In addition to operational concerns, there is often an ethical element to sport events that also must be considered. Having a fair competition with high sportsmanship keeps the purity of sport. Analytical methods and examinations can provide sport organizers information to develop their tournament game schedule more fairly.

As a whole, little research has been done on international sport competition scheduling regarding fairness and home-field advantage. This is an important area of research, since sport players and teams should be treated fairly. This also affects other stakeholders including fans, prospective fans, media, and sponsors. Therefore, the purpose of the current study is to discover a better method for fair scheduling and operational decisions by: 1) determining the effect and fairness of scheduling, 2) examining home-field advantage benefits (e.g., game location, time (day or evening), travel distance, unexpected scheduling change during the tournament) on the Premier 12, and 3) making essential recommendations for future international sport events.

## 3. Methodology

This study focuses on scheduling among other potential issues of the Premier 12 tournament. Since the schedule data of the tournament is publicly available and the performance of the schedule is measurable, the performance of the actual schedule was quantified and a better schedule was sought. For the performance measure, this study focuses on the efficiency and the fairness in terms of travel distance and game interval as in

Table 1. The authors formulated the scheduling problem as four separate optimization problems that minimizes the performance measures above by changing decision variables while satisfying all constraints.

Table 1. Performance measures of the schedule.

	Travel distance	Game interval
Efficiency (total)	Total travel distance of all the teams	Total game intervals of all the teams
Fairness (s.d.)	s.d. of travel distances among teams	s.d. of game intervals among teams



4.2 Model Development

The 12 highest-ranked national baseball teams were grouped into groups A and B by the WBC for the tournament and each group had six teams each as seen in Table 4.

Table 4. Ranking and group of participating teams.

Top 12 Rankings as of November 2014		
Rank	Country	Group
1	Japan	B
2	United States	B
3	Cuba	A
4	Chinese Taipei	A
5	Netherlands	A
6	Dominican Republic	B
7	Canada	A
8	South Korea	B
9	Puerto Rico	A
10	Venezuela	B
11	Italy	A
12	Mexico	B

This study focuses only on the opening round games (i.e. all group games) because they are the only games that had been scheduled before the event started, which is typical of most international sporting events. The opening round of Premier 12 is a single round robin tournament, where every team faces each other exactly once (Ribeiro, 2012). As a result, it makes a total of  $2 \times \binom{6}{2} = 2 \times \frac{6(6-1)}{2} = 30$  games in the opening round.

Table 5 shows the schedule and the venues for opening round games. TD-JPN was the only stadium that was not used for opening round games.

Table 5. Venues and time slots for Premier 12 game schedule.

		Venue						
		IC-TPE	TY-TPE	TM-TPE	DL-TPE	SD-JPN	TD-JPN	
		1	2	3	4	5	6	
Time Slot	11/8 E	1						B1B4
	11/9 E	2	A2A3					
	11/10D	3	X <sub>1</sub>	X <sub>2</sub>				
	11/10 E	4	X <sub>3</sub>	X <sub>4</sub>				
	11/11D	5	X <sub>5</sub>	X <sub>6</sub>				
	11/11 E	6	X <sub>7</sub>	X <sub>8</sub>	X <sub>9</sub>	X <sub>10</sub>		
	11/12D	7	X <sub>11</sub>	X <sub>12</sub>				
	11/12 E	8	X <sub>13</sub>	X <sub>14</sub>	X <sub>15</sub>	X <sub>16</sub>		
	11/13D	9						
	11/13 E	10						
	11/14D	11	X <sub>17</sub>	X <sub>18</sub>				
	11/14 E	12	X <sub>19</sub>	X <sub>20</sub>	X <sub>21</sub>	X <sub>22</sub>		
	11/15D	13	X <sub>23</sub>	X <sub>24</sub>				
	11/15 E	14	X <sub>25</sub>	X <sub>26</sub>	X <sub>27</sub>	X <sub>28</sub>		

After the opening ceremony, all remaining opening-round games (N = 29) were held in one of four venues in Taiwan. Each venue was used at most two times per day. The time slots and venues that were used are summarized in Table 5 as gray cells. The optimization model assumes that the schedule and the venue for the first two games color-coded in white are fixed. Only the 28 gray slots could be controlled and optimized. This model uses team id to keep the model simple as summarized in Table 6. The team id indicates the group the team belongs to and its ranking in the group. For example, B2 means the second-ranked team in Group B.

Table 6. Team Ids.

Team Id	Team	Team Id	Team
A1	Cuba	B1	Japan
A2	Chinese Taipei	B2	United States
A3	Netherlands	B3	Dominican Republic
A4	Canada	B4	South Korea
A5	Puerto Rico	B5	Venezuela
A6	Italy	B6	Mexico

The authors assigned an id to each matchup from 1 to 28 as shown in Table 7. Matchups in the table indicate which team plays against which team. For example, B2B5 means the game between team B2 and team B5. This study assumes that there is no home-away distinction; the order in the matchup is not relevant for scheduling purposes.

Table 7. Id assigned for each matchup.

Id	Matchup	Id	Matchup
1	A1A2	15	B1B2
2	A1A3	16	B1B3
3	A1A4	17	B1B5
4	A1A5	18	B1B6
5	A1A6	19	B2B3
6	A2A4	20	B2B4
7	A2A5	21	B2B5
8	A2A6	22	B2B6
9	A3A4	23	B3B4
10	A3A5	24	B3B5
11	A3A6	25	B3B6
12	A4A5	26	B4B5
13	A4A6	27	B4B6
14	A5A6	28	B5B6

Decision variable  $X_i$  in Table 5 indicates the  $i$ th matchup at a certain venue at a certain time in the table. One matchup may be held only once in the opening round and the values of the 28 decision variables should be all different.

The objectives of this optimization problem are to:

- Minimize the total travel distance of all the teams,
- Minimize the variation of travel distances among teams,
- Minimize the total game intervals of all the teams, or
- Minimize the variation of game intervals among teams.

The constraint of this model can be formulated as follows:

s.t. values of  $X_1, \dots, X_{28}$  are all different

$$X_i \in \{1, 2, \dots, 27, 28\} \forall i$$

The constraints indicate that the matchups and game slots should have a one-to-one match relationship. This constraint is applied by selecting the “AllDifferent” constraint in Excel Solver.

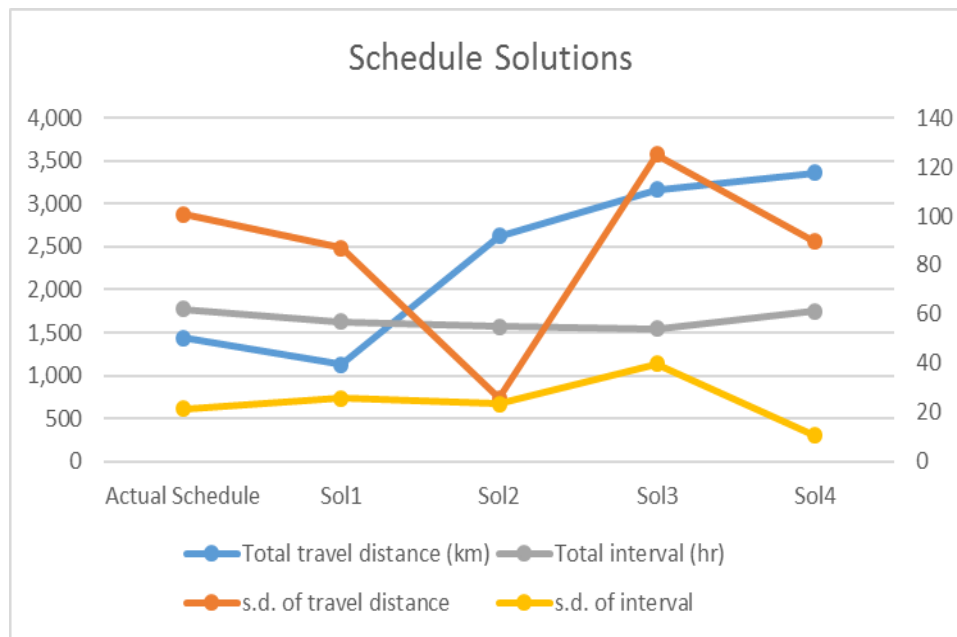
## 5. Results

In the actual schedule, the total travel distance during the opening round of all the participating teams was 1,441 *km* and the standard deviation (s.d.) of mean travel distance between games per team was 100.68 *km*. To optimize the schedule, two initial solutions were proposed: one minimizing the total travel distance, and one

minimizing s.d. of travel distance. After optimizing for travel distance, additional solutions were proposed: one minimizing the total game interval and one minimizing s.d. of game interval.

The schedule minimizing the total travel distance (Sol1) saves the most transportation-related expenses. The schedule minimizing s.d. of travel distance (Sol2) is the fairest to every team in terms of travel distance. The schedule minimizing the total interval (Sol3) minimizes gaps in time during the whole event period. The schedule minimizing s.d. of game interval (Sol4) is the fairest to every team in terms of game interval. All five scenarios regarding the decision factors are compared in Figure 1. No single solution dominates all the criteria.

Figure 1. Comparison of alternative schedules by four different measures.



## 6. Discussion and Conclusion

The WBSC formed the Premier 12 tournament after baseball got eliminated from the Olympics. The current study identified the fairness of scheduling for the World Baseball Softball Confederation's (WBSC) Premier 12 tournament and proposed a better-balanced schedule by formulating it as an optimization problem. Based on the findings, Japan (the co-hosting country) received an unfair competitive advantage based on scheduling. This is also salient due to the late changes made to the Premier 12 schedule. Other teams were disadvantaged by having to travel further. By modeling this scheduling problem as an integer programming problem, this study found better schedules than the actual one in terms of overall efficiency and fairness.

The host countries of Premier 12 may or may not have known that they could have done a better job with scheduling; event organizers' knowledge of advanced optimization techniques is unknown. Speculatively, they may have known about the lack of optimization and perceived unfairness but did so because of political or economic reasons. Regardless, the sport of baseball could gain more worldwide popularity if such international baseball events are run and administered in a fairer and more transparent way. This is particularly important if the goal of the WBSC and the sport of baseball is to have baseball reintroduced in the Olympic Games. If fairness and optimization are not achieved, it would be much more difficult to convince the IOC to reintroduce and then keep baseball as an Olympic sport. The best baseball news from 2016 was that the sport will return to the Tokyo Summer Olympics in 2020 (now 2021) as the WBSC hoped. However, there is currently no guarantee that baseball will continue in the Olympics after 2020 (USA Softball, 2019).

This study has some limitations that must be stated. The authors used information publicly available. WBSC and organizers of host countries who were involved in the Premier 12 tournament were not contacted. It is still uncertain how grouping of participating countries was done, and which instructions and procedures were used for grouping. The lack of transparency is an important factor in the justification for this research.

## 7. Implications and Future Research

*"The most important thing in the Olympic Games is not to win but to take part, just as the most important thing in life is not the triumph but the struggle. The essential thing is not to have conquered but to have fought well"*

(Baron de Coubertin, Founder of the Olympics as cited in BBC, 2014).

This is the message that the WBSC needs to keep it in mind. A good reputation can create more popularity and awareness of the event and the sport that is being played. Broadly, the practice of finding better schedules and its consideration as a significant factor affecting the success of the game can be applied to other sport tournament organizers.

The current study helps to shorten the sport and event literature gap relating to scheduling research using a novel scientific and systematic approach to optimize a sport event tournament schedule to create a more fair major international sport tournament schedule. Scheduling fairness, particularly in the international level of sport competition, is an important factor for the success of the competition. Scheduling officers and event administrators should understand the impact of an unfair schedule on participating teams and their players' performance. Unfair scheduling and heavy home advantages given to a host country could also create an unpleasant reputation and negative dialogues about the event among the fans. Thus, the equitable operation for all teams needs to be achieved by scheduling fairness. This may be achieved using optimization techniques such as the ones used in the present study.

Future research should consider concepts such as carry over-effect and players' perceptions of home advantages. These may have an impact on the outcome of international sport competitions. In addition, using the optimization techniques from the current study in other international sporting event contexts could provide additional information and guidance to international sport event organizers. Fairness and equity are key components to the future development and success of sport. Understanding how to optimize event schedules to promote fairness and equity is paramount.

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