

Minor League Baseball Realignment

Optimal Leagues by Distance and Affiliation

Eli Katz, Steven Witkin, Anton Dahbura

The Johns Hopkins University Department of Computer Science
Baltimore, MD March 2020

Introduction

As part of the Johns Hopkins Minor League Scheduling Research Team, we have accumulated several years of experience working with minor league presidents and minor league scheduling committees to optimize MiLB league schedules in the face of the complicated geographical and other league- and team-specific challenges.

During our meetings with each league during the 2019 Baseball Winter Meetings in San Diego, we realized that while Major League Baseball (MLB) has been working on a recently revealed plan to realign Minor League Baseball (MiLB), it evidently has not considered the new logistical issues that are likely to be caused in the process of attempting to resolve existing issues, with the risk of having a new alignment of teams into leagues that does not meet the stated objectives of MLB.

MLB has proposed eliminating 42 MiLB franchises to, among other goals, improve player health and welfare by reducing team travel throughout the MiLB season [1]. We therefore feel that it is extremely important to analyze the proposed plan as well as future realignment proposals to determine the optimal realignment of the remaining MiLB teams into leagues and to identify the advantages and disadvantages of such plans both on their own merits and in comparison to the current alignment scheme.

Our main objective is to be conformant with the master structure of MiLB and the MLB plan, thereby creating an alignment of the four full-season levels of MiLB with 30 teams each in a configuration that reduces average travel for each team, while also minimizing the number of teams that would be forced to change levels. The master structure also dictates that each MLB team has exactly one MiLB affiliate at each level, so that realignment in general will require some MiLB teams to trade their current MLB affiliation with other MiLB teams that in some cases are more distant from the parent MLB club.

The discussion in this paper describes many of the subtleties involved in creating viable minor league schedules, especially those that impact the amount of travel for teams. These factors preclude using simplistic and uninformed measures such as average distance among teams in a league as a metric for goodness of schedules.

The results of our analysis reveal the hidden dimensions of complexity that are inherent in any effort to realign MiLB, and show that under the current realignment plan proposed by MLB, the number, types and severity of new issues introduced are arguably not a noticeable improvement over the current MiLB structure and will not significantly improve the wear and tear on MiLB players.

Assumptions

We began the process using the [plan](#) that was reported by Ballpark Digest [2], eliminating 42 minor league teams and removing Short-Season A leagues (New York-Penn League, Appalachian League, Pioneer League). We have additionally spoken to a number of MiLB league presidents for some more recent updates, and together we decided on the following assumptions:

- Original 42 teams eliminated
- Two (independent) Atlantic League teams (Sugarland and St. Paul) added to AAA
- Bowling Green moves from High-A to AA
- Brooklyn moves from Low-A to AA, specifically Eastern League
- Fresno moves from AAA to High-A, specifically the California League
- Wichita moves from AAA to AA, specifically the Texas League
- Aberdeen, Hudson Valley, Tri-City, West Virginia (Black Bears) move from Low-A to A
- Charleston, Columbia and Augusta move from A to High-A, specifically the Carolina League
- Six of the 8 teams in the current short-season Northwest League move from Short-Season A to Low-A, with the remaining two teams (likely to be Tri-City and Salem-Keizer) eliminated
- Each of the 30 MLB teams will have exactly one affiliate in each of the 4 remaining levels.

We do not know the exact details of the plan currently under negotiation, and those details are subject to change as the negotiations continue. However, this analysis aims to uncover issues and oversights in the general proposed realignment plan. In addition, our analysis adds clarity to the complexity of virtually any non-trivial realignment plan for MiLB for analysis of future plans.

Methodology

We created several iterations of realignment plans for the remaining 120 teams that satisfy the specific assumptions above, and in the process both found a best-case realignment plan and exposed some logistical issues with the MLB specifications. We were able to mitigate some of these issues, but other issues do not have a solution within the MLB's current proposition, and those are highlighted below.

Our most robust plan was created using an Integer Linear Program, coded in MATLAB and solved using Gurobi Optimization software. This program accounts for the realignment of the Eastern, Texas, Southern, Carolina, Midwest, and South Atlantic Leagues. The other leagues

(International League, Pacific Coast League, California League, Northwest League) were either left untouched by the above plan, or in a position where we felt any changes would severely impact the geography of the teams. For instance, we felt that the California League should be left untouched after the addition of the Fresno Grizzlies and the elimination of the Lancaster Jethawks since no other Minor League franchise is close enough for a sensible move into the league.

We restricted the possible size of each league to emerge in the realignment, making sure that they stay at sizes of either 6, 8, 10, 12, 14 or 16. We then placed a weight for each team's possible travel to any other team and accounted for each possible pairing of teams being placed in a given league. We placed an additional penalty for teams changing levels or causing an affiliation conflict with another franchise in the same level. Our program returns the new affiliations, as well as new distance matrices for each league, all league changes and all affiliation conflicts.

Optimized Plan

The mapping of our proposed optimized plan can be found at <https://arcg.is/ODL5Sr> using ArcGis Online. The details can be found in the Appendix and Figures 1 and 2.

AAA

The International League remains as is with 14 teams in the existing three-division alignment.

The Pacific Coast League remains with 16 teams, with St. Paul and Sugarland replacing Fresno and Wichita (see above).

AA

The Southern League is reduced from 10 teams to 8 with Chattanooga and Jackson eliminated and Mississippi (near Jackson, Mississippi) moving to the Texas League. Bowling Green is added to the Southern League from the Midwest League.

The Texas League increases from 8 to 10 teams, with the current 8 teams and the addition of Wichita from the Pacific Coast League and Mississippi from the Southern League.

The Eastern League remains at 12 teams with Erie and Binghamton eliminated and the addition of Brooklyn from the New York-Penn League and Wilmington from the Carolina League.

High-A

The California League remains with 8 teams, with Fresno moving in from the Pacific Coast League and Lancaster eliminated.

The Carolina League increases from 10 to 12 teams with the elimination of Frederick, Wilmington, and the addition of Asheville, Augusta, Columbia (South Carolina) and Charleston (South Carolina) from the South Atlantic League.

The Florida State League decreases from 12 to 10 teams with the elimination of Daytona and Florida (Kissimmee, Florida).

Low-A

The Midwest League decreases from 16 to 12 teams with the elimination of Clinton, Beloit and Burlington, and the move of Bowling Green to the Southern League.

The South Atlantic League decreases from 16 to 12 teams and is split into two 6-team leagues (North and South) with the elimination of Hagerstown, Lexington, and Charleston, West Virginia and the moves of Asheville, Augusta, Charleston (South Carolina) and Columbia to the Carolina League, plus the addition of Hudson Valley, West Virginia (Black Bears), Tri-City and Aberdeen from the New York-Penn League and Pulaski from the Appalachian League.

The Northwest League moves to Low-A with the remaining six Low-A teams.

Issues For Future Consideration

- The Northwest league is currently an 8-team, short-season league. The released plan would have only 6 of these teams remaining, and move them to a full-season, A-level league. This is extremely problematic due to the distances between the remaining teams, with an average of about 360 miles per trip. The current league has two four-team divisions that can play within each division without issue. The new realignment would force one team from each division to be playing another in every series, dramatically increasing travel. Another consideration is the umpire crews, who almost always have to travel over 500 miles to avoid seeing the same team in consecutive series. Switching to full-season also means that teams will be playing in April and May when many games will have serious weather issues.
- In the proposed plan, four teams would remain from the New York-Penn League (NYPL) and move to A level (this does not count Brooklyn who is set to join the Eastern League). The current A level leagues are comprised of teams mostly in the Mid-Atlantic and Southern areas of the Eastern Seaboard, which often causes issues for already-present outlying teams too far north. These NYPL teams must then either move up three levels to the more geographically suitable Eastern League, which may not be feasible for most franchises and would require other teams to move down, or be forced to face a poor travel schedule. Our solution involves splitting the South Atlantic League into two 6-team leagues, one in the Northeast and one in the Southeast; however, this will cause issues similar to those that the

Northwest League will face due to weather and a 6-team configuration. Any 6-team full-season league, including the Northwest League, would face the challenge of scheduling over 120 games so that pairs of teams do not play each other too often in a short period of time, and so that umpire crews do not see the same teams excessively.

- Some of the teams (West Virginia BB, Eugene and Tri-City) that are in the plan to transition from half-season to full-season schedules share their facilities with multiple spring college and/or high school baseball programs, and in some cases the facilities are owned by or under the control of organizations that will not permit professional baseball to make use of their facilities before June.
- We did not generate actual season schedules for the realigned leagues since to be realistic it is necessary to define the format (how many times each team plays each of the other leagues), league preferences such as lengths of series and maximum duration of home stands and road trips, team-specific constraints, dates and location of the All-Star Game, and so on. We are assessing the potential for goodness of schedules that can be generated for the realigned leagues based on our experience, and conclude that feasible schedules can likely be generated for the resulting realigned leagues but they will have approximately the same amount of total travel, long trips, choppiness of home-away patterns, day-of-week home game balance, and other properties as the schedules for the current leagues.
- One possible assignment of a parent MLB team for each minor league team is included in the potential plan shown in the Appendix. Note that the assignment scheme could vary depending on the priority given to the distance an MiLB team is from its MLB affiliate vs. the number of MiLB teams that change affiliations; however, in any case there is unlikely to be an assignment that meets the entirety of requirements for all MLB and MiLB teams.
- Note that we performed our analysis strictly given the list of teams to remain and to be eliminated based on the information available. We have not included in our analysis the opportunities for realignment if the proposed list of eliminated teams is changed. However, we recommend that future assessments of the viability of MiLB franchises include a thorough analysis of the implications for realignment plans.

Conclusions

The current structure of MiLB has multiple dimensions, including the geographical cohesiveness of each league, the number of teams in each league (ideally an even number between 8 and 16), the layered aspect of MiLB with four full-season layers, each layer with 30 teams and one MiLB affiliate for each MLB organization at each layer, and right-sizing of MiLB facilities and markets for each layer.

In a sense the current MiLB alignment has achieved a state of relative equilibrium through its evolution over the past few decades, with a few exceptions that stand out such as some leagues that are too spread out geographically, some MiLB teams that are relatively distant from their MLB parent, and so on. However, as our study confirms, attempting to fix one or more shortcomings of the existing MiLB leagues leads to a realignment that simply introduces new significant shortcomings. The current concept under consideration by MLB, based on our analysis, does not improve any conditions related to player wear and tear based on any reasonable metric.

It is our goal to introduce into the MiLB realignment discussions the issues and methodology presented here to improve the process of designing any future MiLB realignment.

DISCLAIMER: The research group is led by Dr. Anton Dahbura, a computer science professor at Johns Hopkins University and executive director of the JHU Information Security Institute, who has owned a minority interest in the Hagerstown Suns, a Class A affiliate of the Washington Nationals, for 9 years. The MiLB realignment plan analysis described in this paper does not include the Hagerstown Suns and does not make any recommendation regarding the future of the team, since it is one of the 42 teams on the list of teams to be contracted as part of the realignment plan.

References

[1] Robert Litan. *Will Congress save certain Minor League Baseball teams from the chopping block?* *The Athletic*, February 5, 2020.

[2] Kevin Reichard. *More Details Emerge on MLB's Assault on Hometown Baseball.* *Ballpark Digest*, November 18, 2019.

Appendix

Potential Plan - Bold means changed affiliation

League	Level	Original Size	New Size	Teams and Affiliations	
International League	AAA	14	14	<ul style="list-style-type: none"> ● Buffalo (TOR) ● Charlotte (CWS) ● Columbus (CLE) ● Durham (TB) ● Gwinnett (ATL) ● Indianapolis (PIT) ● Lehigh Valley (PHI) 	<ul style="list-style-type: none"> ● Louisville (CIN) ● Norfolk (BAL) ● Pawtucket (BOS) ● Rochester (WAS) ● Scranton/Wilkes Barre (NYY) ● Syracuse (NYM) ● Toledo (DET)
Pacific Coast League	AAA	16	16	<ul style="list-style-type: none"> ● Albuquerque (COL) ● San Antonio (MIL) ● El Paso (SD) ● Iowa (CHC) ● Las Vegas (OAK) ● Memphis (STL) ● Nashville (MIA) ● Oklahoma (LAD) 	<ul style="list-style-type: none"> ● Omaha (KC) ● Reno (ARI) ● Round Rock (TEX) ● Sacramento (SF) ● Salt Lake City (LAA) ● Tacoma (SEA) ● St. Paul (MIN) ● Sugar Land (HOU)
Texas League	AA	8	10	<ul style="list-style-type: none"> ● Wichita (ARI) ● Mississippi (ATL) ● Arkansas (SEA) ● Corpus Christi (HOU) ● Frisco (TEX) 	<ul style="list-style-type: none"> ● Midland (OAK) ● Northwest Ark. (KC) ● Amarillo (SD) ● Springfield (STL) ● Tulsa (LAD)
Southern League	AA	10	8	<ul style="list-style-type: none"> ● Biloxi (MIL) ● Birmingham (CWS) ● Jacksonville (MIA) ● Rocket City (LAA) 	<ul style="list-style-type: none"> ● Montgomery (TB) ● Pensacola (MIN) ● Tennessee (CHC) ● Bowling Green (CIN)
Eastern League	AA	12	12	<ul style="list-style-type: none"> ● Akron (CLE) ● Altoona (PIT) ● Bowie (BAL) ● Harrisburg (WAS) ● Hartford (COL) ● New Hampshire (TOR) 	<ul style="list-style-type: none"> ● Portland (BOS) ● Reading (PHI) ● Richmond (SF) ● Trenton (NYY) ● Wilmington (DET) ● Brooklyn (NYM)

Florida State League	A+	12	10	<ul style="list-style-type: none"> ● Bradenton (PIT) ● Charlotte Stone Crabs (TB) ● Clearwater (PHI) ● Dunedin (TOR) ● Fort Myers (MIN) 	<ul style="list-style-type: none"> ● Jupiter (MIA) ● Lakeland (DET) ● Palm Beach (STL) ● St. Lucie (NYM) ● Tampa (NYY)
Carolina League	A+	10	12	<ul style="list-style-type: none"> ● Fayetteville (HOU) ● Carolina (MIL) ● Down East (TEX) ● Lynchburg (CLE) ● Myrtle Beach (CHC) ● Salem (BOS) 	<ul style="list-style-type: none"> ● Fredericksburg (WAS) ● Winston-Salem (CWS) ● Asheville (CIN) ● Augusta (ATL) ● Columbia (BAL) ● Charleston (KC)
California League	A+	8	8	<ul style="list-style-type: none"> ● Inland Empire (LAA) ● Lake Elsinore (SD) ● Modesto (SEA) ● Visalia (ARI) 	<ul style="list-style-type: none"> ● San Jose (SF) ● Stockton(OAK) ● Fresno (COL) ● Rancho Cucamonga (LAD)
Midwest League	A	16	12	<ul style="list-style-type: none"> ● Cedar Rapids (MIN) ● Dayton (CIN) ● Fort Wayne (SD) ● Great Lakes (LAD) ● Kane County (ARI) ● Lake County (CLE) 	<ul style="list-style-type: none"> ● Lansing (TOR) ● Peoria (STL) ● Quad Cities (HOU) ● South Bend (CHC) ● West Michigan (DET) ● Wisconsin (MIL)
South Atlantic League - South	A	14	6	<ul style="list-style-type: none"> ● Rome (ATL) ● Greensboro (MIA) ● Greenville (BOS) 	<ul style="list-style-type: none"> ● Hickory (TEX) ● Kannapolis (CWS) ● Pulaski (NYY)
South Atlantic League - North	A	-	6	<ul style="list-style-type: none"> ● Hudson Valley (NYM) ● Tri-City (TB) ● Aberdeen (BAL) 	<ul style="list-style-type: none"> ● West Virginia BB (PIT) ● Delmarva (WAS) ● Lakewood (PHI)
Northwest League	A	8	6	<ul style="list-style-type: none"> ● Boise (COL) ● Eugene (SF) ● Everett (SEA) 	<ul style="list-style-type: none"> ● Hillsboro (LAA) ● Spokane (KC) ● Vancouver (OAK)

- Extra changes made for distance:
 - Round Rock to TEX, Nashville to MIA
 - Fresno to COL
- Otherwise done to minimize number of required affiliate swaps

Affiliations Issues:

Two affiliates in the same league

MLB Team/Level	Level	Teams
Miami Marlins	AA	Wichita + Jacksonville
Tampa Bay Rays	AA	Bowling Green + Montgomery, in same league
New York Mets	A+	Columbia + St. Lucie
Pittsburgh Pirates	A	Greensboro + West Virginia BB
San Francisco Giants	A+	San Jose + Augusta
Kansas City Royals	AA	Wilmington + NW Arkansas
Baltimore Orioles	A	Delmarva + Aberdeen, in same league
Houston Astros	A	Quad Cities + Tri City
Toronto Blue Jays	A	Lansing + Vancouver
Texas Rangers	A	Hickory + Spokane
Arizona Diamondbacks	A	Kane County + Hillsboro
Chicago Cubs	A	South Bend + Eugene
New York Yankees	A+	Charleston + Tampa

Teams Missing an Affiliate

MLB Team	Level(s)
Arizona Diamondbacks	AA
Atlanta Braves	A+
Baltimore Orioles	A+
Cincinnati Reds	A+, AA
Detroit Tigers	AA, A+
Kansas City Royals	A
Los Angeles Angels	A
Miami Marlins	A

New York Mets	A
Oakland Athletics	A
San Francisco Giants	A
Washington Nationals	A

Teams Changing Levels

Minor League Team	Change
Fresno Grizzlies	AAA to A+
Wichita	AAA to AA
Bowling Green	A to AA
Wilmington Blue Rocks	A+ to AA
Brooklyn Cyclones	Low A to AA
Asheville	A to A+
Augusta	A to A+
Columbia	A to A+
Charleston	A to A+
Pulaski Yankees	Rookie to A
Hudson Valley	Low A to A
Tri-City	Low A to A
Aberdeen	Low A to A
West Virginia Black Bears	Low A to A
The Entire Northwest League	Low A to A

