WAR in Baseball

Stat 184 Final Project

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Introduction

With the evolution of technology during the 21st century, statistics in baseball have not only been made more widely accessible, but they have become far more prominent in their usage. These statistics include WAR, ERA, and Batting Average, and they can all be used to determine how good each player is. However, these statistics can be somewhat misleading, which may cause someone to believe that a player is a lot better or a lot worse than they actually are.

In this report, the following question will be answered: What major baseball stats are the most crucial for predicting WAR? Other various player statistics will be compared to players' WAR (wins above replacement), to see which stats significantly benefit and help to prove a player's importance. Physical player attributes of height, weight and age will also be compared against these statistics to evaluate if they also have influence on their importance.

In this report, our data collections processes, the comparisons of statistics and an explanation of how they apply to baseball and the players' effectiveness, and the conclusions that were drawn from the visualizations are all presented.

Project Information

Reliable data sources from ESPN, MLB.com, Baseball Savant, Baseball Reference, and FanGraphs were used to ensure that accurate data was used for the plots. A selected group of important statistics were used, and they were weighed against WAR (wins above replacement) to see if there was any correlation, strong or weak.

For the data frame, the top 35 batters and 25 pitchers in WAR rankings were used (for better separation, and once the samples sizes for players is exceeded, the WARs for players are very similar, so the data would start to skew). Using these separate groups, important player statistics are used to see if they have a strong relationship with WAR and each other. Lastly, the significance of WAR is compared across positions to see if there is any correlation.

An insight that was garnered pertained to figuring out how to import images and use them on plots and graphs. This was a big advancement because it helped to de-clutter the graphs and make them more appealing to look at. This feature also helps to make it easier to assign a face to a better player.

The challenges that were faced involved figuring out how to load the data using an HTML and also how to slice, filter, and re-label a data set. Another thing that was challenging was to put a player label for a

specific player. This could not be figured out, so to improvise, these players were specifically pointed out through descriptions, added labels, and images in post in the presentation.

For the code, it was priority to ensure it was accessible and easy to understand so that the code is easy to read and reproducible. Since the data is strictly baseball numbers, there are no biases in the data, only correct baseball data that is not considered sensitive. Lasltly, the code was made to be as clean as possible, with some guidelines made which explains to the user how certain areas of the code work. This allows other people to easily modify it and add anything they need to. Also, to make this process eaier, sharing the code is very simple. The only difficult part of the code is the process to import images, since a custom function had to be made to make it work. Outside of that challenge, every other chunk of code can be accessed using common packages.

Data Provenance

- **Collection Purpose**: These platforms collect stats for public consumption and player evaluation.
- **Cases**: The data set consists of top 35 batters and 25 pitchers by WAR.
- **Time Frame**: Data reflects player performance for the 2023 MLB season.

FAIR and CARE Principles

FAIR

- Findable: The data sources are widely accessible via public platforms like ESPN and FanGraphs.
- Accessible: The raw data is open and available to anyone with internet access.
- Interoperable: Data has been cleaned and structured in a format compatible with analysis tools.
- Reusable: Data cleaning ensures reproducibility and accuracy.

CARE

- Collective Benefit: The analysis serves researchers, fans, and analysts.
- Authority to Control: The data usage adheres to public domain and licensed access rights.
- Responsibility: Code and data cleaning methods are clearly documented.
- Ethics: The analysis avoids misrepresentation or misuse of the data set.

Variables

WAR: Wins Above Replacement (how impactful a player is to their team)

ORTG: Offensive Rating (how good the player is on offense)

DRTG: Defensive Rating (how good the player is on defense)

WRC+: Weighted Runs Created + (hitting rating across different eras and ballparks using adjusted offensive production)

ERA: Earned Run Average (the estimated runs allowed for a pitcher in a game)

FIP: Fielding Independent Pitching (estimates a pitchers run prevention independent of the defense)

Age: Player Age (years)

Positions: Player Position (First Base, Second Base, Shortstop, etc.)

Weight: Player Weight (lbs)

Height; Player height (in)

Data

Hitting/Fielding

In the Hitting/Fielding Data, initially the top 50 baseball players in WAR standings were taken, according to ESPN. This data was then filtered down to just get the top field players (sample size of 35). In addition to the metrics that were already in the table we got from ESPN, Height and Weight (Baseball Reference), WRC+ (Fan Graphs), and Bat Speed (Fan Graphs) were also added. In addition, positions for the players were used for the final graph of comparing WAR across positions. Next, a img_path column was appended into the table so that PNG's of the players could be used for the graphs. To further clean the data, the data values were made to be numeric to use in the graphs. Finally, one adjustment for the data had to be made since Kyle Tucker didn't meet and at bat requirement for FIP. This means that there is a data set which does not include him.

```
Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag

The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```
# A tibble: 6 × 10
  X1    X2              X3    X4    X5    X6    X7    X8    X9    X10
  <chr> <chr>           <chr> <chr> <chr> <chr> <chr> <chr> <chr> <chr>
1 1     Aaron Judge     10.8  11.7  -0.9  8.6   5     4.4   85.7  0.6
2 2     Bobby Witt Jr.  9.4   9.2   1.2   7.2   4.8   4.4   69.6  0.5
3 3     Shohei Ohtani   9.2   9.2   -1.7  7.1   4.9   4.5   70.3  0.5
4 4     Gunnar Henderson 9.1  8.5   1.5   6.9   4.8   4.4   66.3  0.5
5 5     Jarren Duran    8.7   6.2   2.5   6.5   4.6   4.4   61.3  0.5
6 6     Juan Soto       7.9   7.9   -0.5  5.8   4.7   4.4   55.6  0.5
```

```
 [1] "X1"  "X2"  "X3"  "X4"  "X5"  "X6"  "X7"  "X8"  "X9"  "X10"
```

```
tibble [50 × 10] (S3: tbl_df/tbl/data.frame)
 $ Rank  : chr [1:50] "1" "2" "3" "4" ...
```

```
 $ Player: chr [1:50] "A. Judge" "B. Witt Jr" "S. Ohtani" "G. Henderson" ...
 $ War   : chr [1:50] "10.8" "9.4" "9.2" "9.1" ...
 $ ORTG  : chr [1:50] "11.7" "9.2" "9.2" "8.5" ...
 $ DRTG  : chr [1:50] "-0.9" "1.2" "-1.7" "1.5" ...
 $ WAA   : chr [1:50] "8.6" "7.2" "7.1" "6.9" ...
 $ TRPG  : chr [1:50] "5" "4.8" "4.9" "4.8" ...
 $ ORPG  : chr [1:50] "4.4" "4.4" "4.5" "4.4" ...
 $ RAA   : chr [1:50] "85.7" "69.6" "70.3" "66.3" ...
 $ WAAWP : chr [1:50] "0.6" "0.5" "0.5" "0.5" ...
[1] "character"
```

Hitter/Fielder Player Data Table

Rank	Player	War	ORTG	DRTG	Position	Weight	WRC_plus	img_path
1	A. Judge	10.8	11.7	-0.9	Outfield	282	218	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/33192.png
2	B. Witt Jr	9.4	9.2	1.2	Shortstop	200	168	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/42403.png
3	S. Ohtani	9.2	9.2	-1.7	Designated Hitter	209	181	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/39832.png
4	G. Henderson	9.1	8.5	1.5	Shortstop	220	155	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/42507.png
5	J. Duran	8.7	6.2	2.5	Outfield	212	129	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/41610.png
6	J. Soto	7.9	7.9	-0.5	Outfield	224	180	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/36969.png
7	M. Chapman	7.1	5.4	2.2	Third Base	215	121	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/33857.png
8	F. Lindor	7.0	6.8	1.2	Shortstop	190	137	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/32129.png
9	J. Ramirez	6.8	6.2	0.7	Third Base	190	141	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/32801.png&w=
	K. Marte	6.8	5.8	1.3	Second Base	210	151	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/32512.png
	V. Guerrero Jr	6.2	6.3	-1.0	First Base	245	165	https://a.espncdn.com/i/headshots/mlb/players/fu
	B. Rooker	5.6	5.7	-1.4	Designated Hitter	225	164	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/40926.png
19	R. Greene	5.4	3.9	1.0	Outfield	200	135	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/42179.png
	Y. Alvarez	5.4	5.9	-1.6	Designated Hitter	237	168	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/36018.png

Rank	Player	War	ORTG	DRTG	Position	Weight	WRC_plus	img_path
22	E. De La Cruz	5.2	5.4	0.8	Shortstop	200	118	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/4917694.png
23	Z. Neto	5.1	4.0	2.1	Shortstop	185	114	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/4666100.png
	D. Varsho	5.1	1.9	3.1	Outfield	207	99	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/40963.png
26	C. Seager	5.0	4.5	1.1	Shortstop	215	140	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/32691.png
	M. Winn	4.9	3.5	2.4	Shortstop	185	103	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/4683365.png
	W. Contreras	4.9	4.6	0.9	Catcher	212	131	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/39895.png
30	B. Harper	4.8	4.3	-0.2	First Base	210	145	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/30951.png
	M. Betts	4.8	4.6	0.5	Shortstop	180	141	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/33039.png
32	K. Tucker	4.7	4.0	0.4	Outfield	212	0	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/34967.png
	F. Freeman	4.7	4.6	-0.6	First Base	220	137	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/30193.png
34	C. Raleigh	4.6	4.1	1.4	Catcher	235	117	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/41292.png&w=
	B. Turang	4.6	2.4	2.7	Second Base	188	87	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/41179.png
39	J. Merrill	4.4	4.5	0.5	Outfield	195	130	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/4872691.png
40	M. Ozuna	4.3	4.3	-1.7	Designated Hitter	225	154	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/31668.png
	J. Rodriguez	4.3	4.0	0.7	Outfield	228	116	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/41044.png
	T. Hernandez	4.3	4.6	-1.0	Outfield	215	134	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/33377.png
	A. Bregman	4.1	3.5	1.0	Third Base	190	118	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/34886.png&w=
	M. Semien	4.1	3.1	1.7	Second Base	195	99	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/32146.png
	J. Pena	4.1	3.7	1.4	Shortstop	202	100	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/41273.png
49	B. Doyle	4.0	2.9	1.6	Outfield	220	97	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/42462.png

Rank	Player	War	ORTG	DRTG	Position	Weight	WRC_plus	img_path
	A. Gimenez	4.0	1.9	2.7	Second Base	161	83	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/37729.png

Pitching

For the Pitching Data, the top 25 baseball players in WAR rankings were taken, according to ESPN, since the remaining 15 pitchers in the top 50 didn't seem like enough of a sample size to create meaningful plots and graphs. The data was then filtered down to clean the table and rename columns. Some more statistics were added to table which include FIP (Fan graphs) and age and height (Baseball Reference). Like the Hitting/Fielding Data, an img_path column was added for player PNG images to use in the graphs. The data was also made to numeric, like the hitting data, for the values to be used in plots.

Pitcher Player Data Table

Rank	Player	War	ERA	FIP	Age	Height	img_path
1	T. Skubal	6.3	2.39	2.49	28	75	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/42409.png
2	H. Greene	6.3	2.75	3.47	25	77	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/39635.png
3	C. Sale	6.2	2.38	2.09	35	78	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/30948.png
4	Z. Wheeler	6.1	2.57	3.13	34	76	https://a.espncdn.com/i/headshots/mlb/players/full/31267.png
5	P. Skenes	5.9	1.96	2.44	22	76	https://a.espncdn.com/i/headshots/mlb/players/full/4719507.png
6	E. Fedde	5.6	3.30	3.86	31	74	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/33793.png
7	S. Lugo	5.3	3.00	3.25	35	76	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/34873.png
8	R. Lopez	5.1	1.99	2.92	30	71	https://a.espncdn.com/i/headshots/mlb/players/full/33860.png
9	C. Ragans	4.9	3.14	2.99	26	76	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/41054.png&w=350&h=254
10	F. Valdez	4.5	2.91	3.25	31	71	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/36581.png
	E. Clase	4.5	0.61	2.22	26	74	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/41743.png
	R. Blanco	4.5	2.80	4.15	31	75	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/41829.png
13	D. Cease	4.2	3.47	3.10	28	74	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/34943.png

Rank	Player	War	ERA	FIP	Age	Height	img_path
14	G. Crochet	4.1	3.58	2.96	25	78	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/4297835.png
	M. King	4.1	2.95	3.33	29	75	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/40429.png
16	N. Martinez	4.0	3.10	3.21	34	73	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/33372.png
	T. Scott	4.0	1.75	2.92	30	72	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/35135.png&w=350&h=254
18	L. Webb	3.7	3.47	2.95	28	73	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/41216.png
19	A. Nola	3.6	3.57	3.94	31	73	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/33709.png
20	T. Houck	3.5	3.12	3.32	28	77	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/41009.png
	M. Wacha	3.5	3.35	3.65	33	78	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/32640.png
	M. Fried	3.5	3.25	3.33	30	76	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/32685.png
23	C. Burnes	3.4	2.92	3.55	30	75	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/39878.png
	B. Miller	3.4	2.94	3.58	26	74	https://a.espncdn.com/i/headshots/mlb/players/full/4654313.png
	C. Sanchez	3.4	3.32	3.00	27	73	https://a.espncdn.com/combiner/i?img=/i/headshots/mlb/players/full/42359.png

Creating a Image File Reading Function

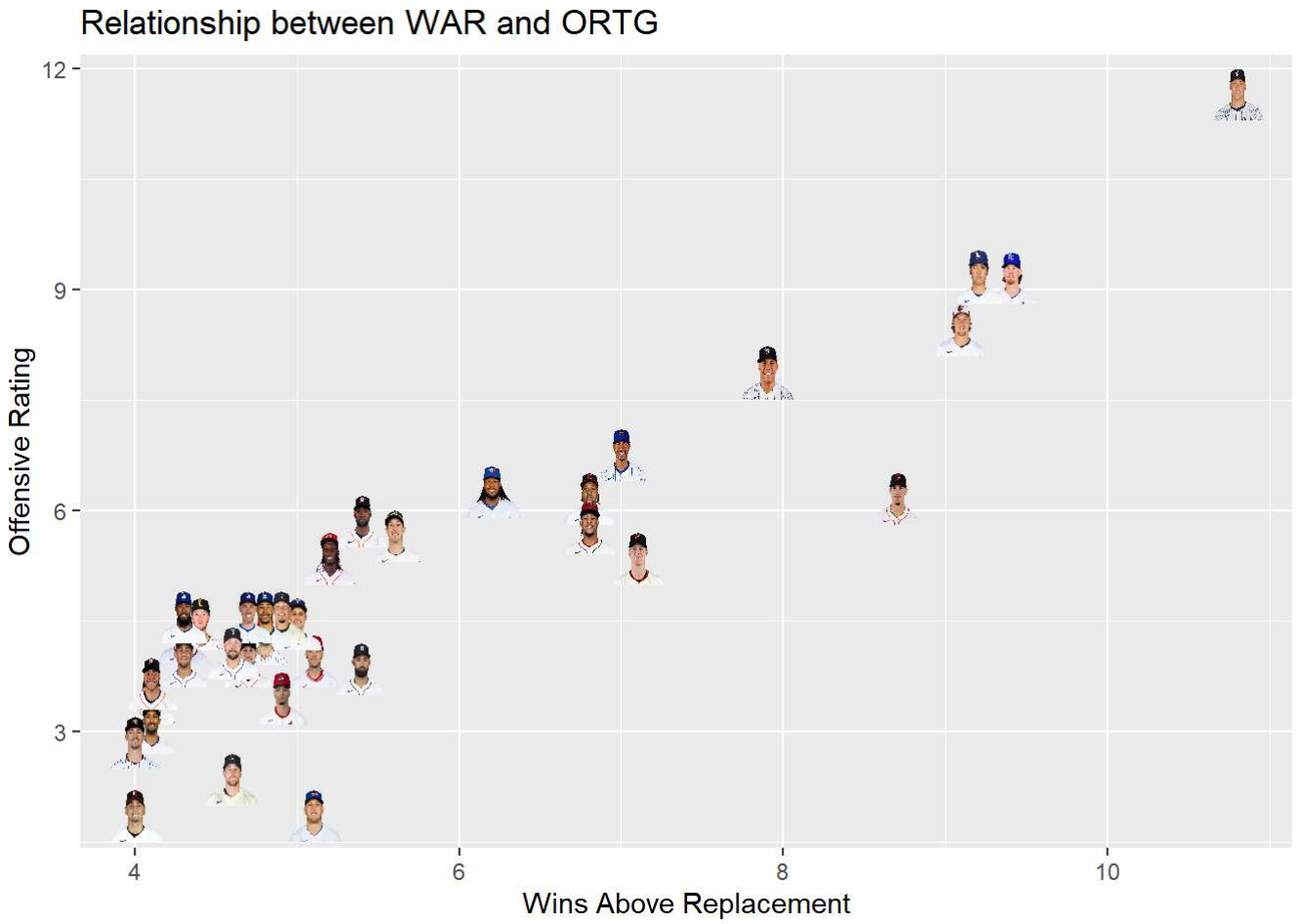
This chunk of code allows player images to be inputted on the plots and graphs. The readPNGfromURL function is used in a majority of the plots. In the first plot, where it works from and how it works can be seen.

```
readPNGfromURL <- function(url) {
  temp <- tempfile()
  download.file(url, temp, mode = "wb")
  img <- readPNG(temp)
  unlink(temp)
  return(img)
}
```

Player Hitting/Fielding Relationships

War v. ORTG

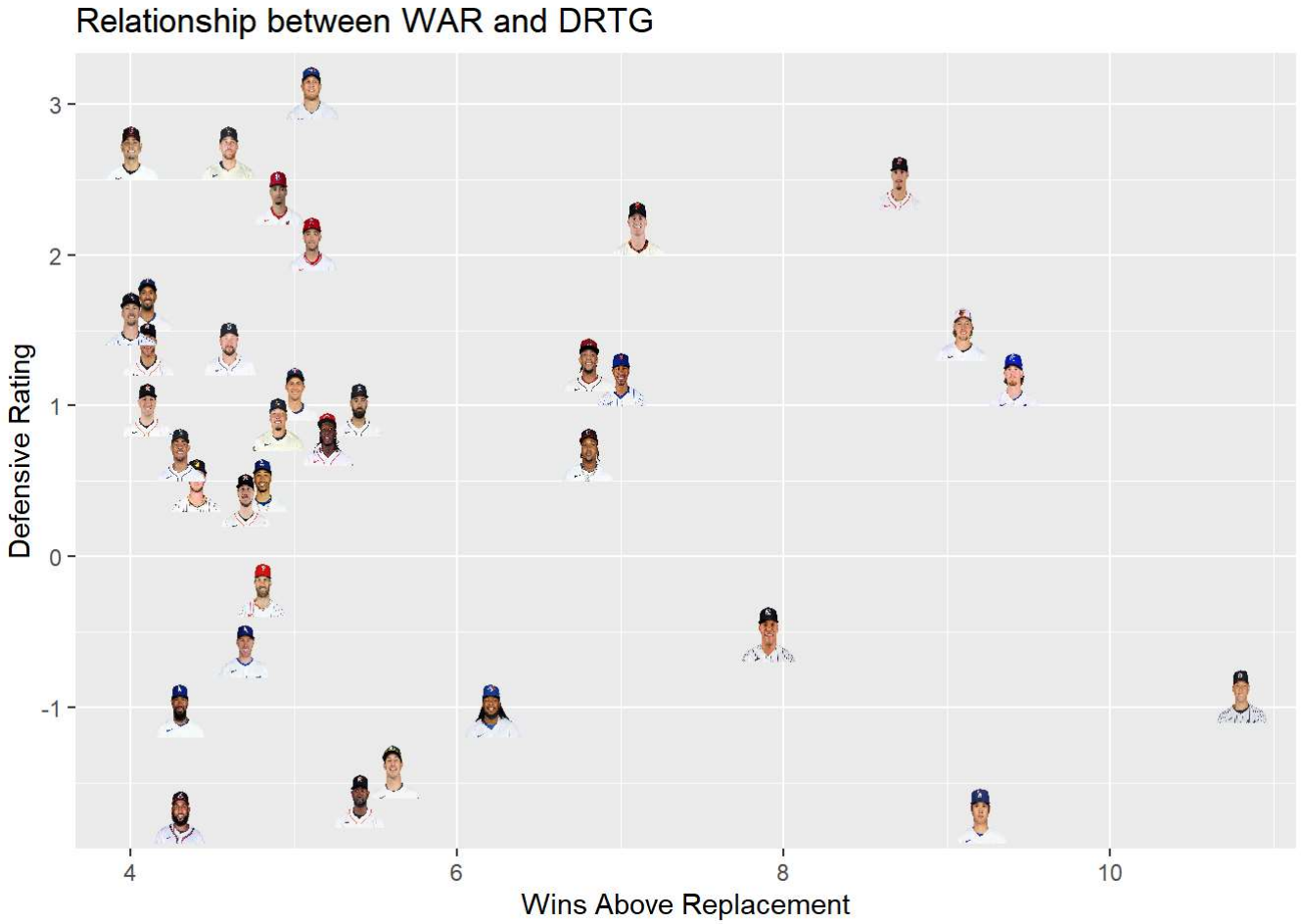
```
r_War_ORTG <- ggplot(data = CleanNoPitchData,
       mapping = aes(War, ORTG)) +
  geom_point() +
  labs(title = "Relationship between WAR and ORTG",
       x = "Wins Above Replacement",
       y = "Offensive Rating")

for (i in 1:nrow(CleanNoPitchData)) {
  img <- readPNGfromURL(CleanNoPitchData$img_path[i])

  r_War_ORTG <- r_War_ORTG + annotation_raster(
    img,
    xmin = CleanNoPitchData$War[i] - 0.2, xmax = CleanNoPitchData$War[i] + 0.2,
    ymin = CleanNoPitchData$ORTG[i] - 0.4, ymax = CleanNoPitchData$ORTG[i] + 0.4
  )
}

print(r_War_ORTG)
```



This graph indicates that there is a defined positive relationship between WAR and ORTG (Offensive Rating). This means that the players who excel at offense will typically be more impactful to their team. With Aaron Judge having a historic Offensive season and winning the AL MVP, he is seen in the top right corner (11.7 ORTG) and possibly being a potential outlier of this plot. Other players to look for are Shohei Ohtani (9.2

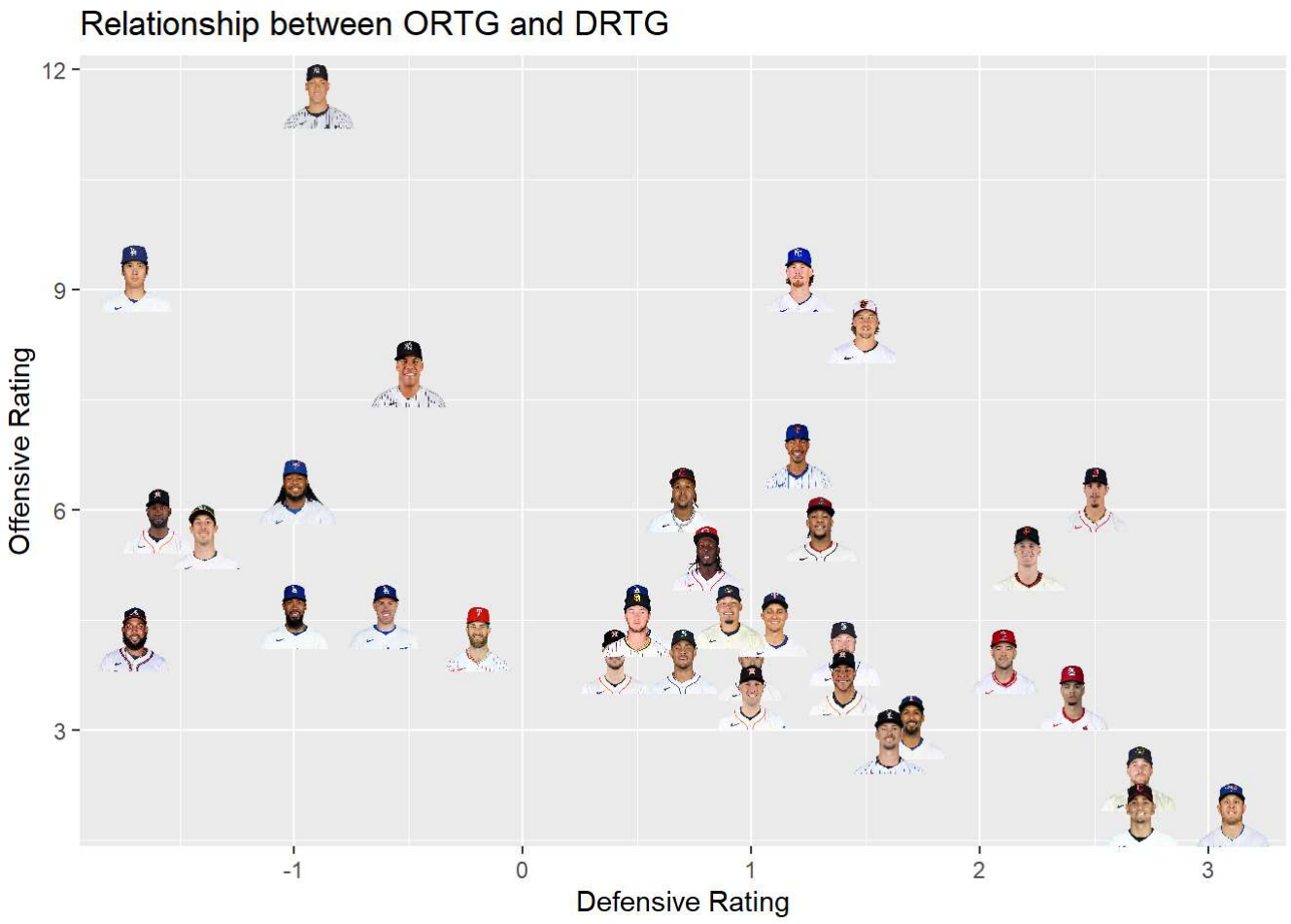
ORTG), who shares space with Bobby Witt Jr. (9.2 ORTG) and Gunner Henderson (9.1 ORTG) (the three players closest to Judge). Ohtani won the NL MVP, having the first 50-50 season in MLB history (50 home runs and 50 stolen bases). Lastly, the only other players in MVP consideration are right around the middle of this graph (Juan Soto, Francisco Lindor, and Ketel Marte), showing that those with the closest considerations for MVP will tend to have higher offensive ratings on average, proving this significance between ORTG and WAR.

War v. DRTG



This graph indicates that there is a either a rough, slightly negative relationship or no clear relationship at all between WAR and DRTG (Defensive Rating). This shows that the players who excel at defense are not confirmed to have a high WAR. Looking at Aaron Judge again (the farthest right player), he has the highest WAR out of the top 35 players in the MLB, however, he is a sub-par defender (-0.9 DRTG). Additionally, players like Daulton Varsho (3.1 DRTG), Brice Turang (2.7 DRTG), and Andres Gimenez (2.7 DRTG) have the highest Defensive Ratings out of these 35 players, but they have a fairly low WAR on average. Similarly to Judge, Marcel Ozuna (bottom left) has a terrible DRTG (-1.7) and also has a low WAR. These players on the graph indicates that defensive rating a not a good predictor of WAR.

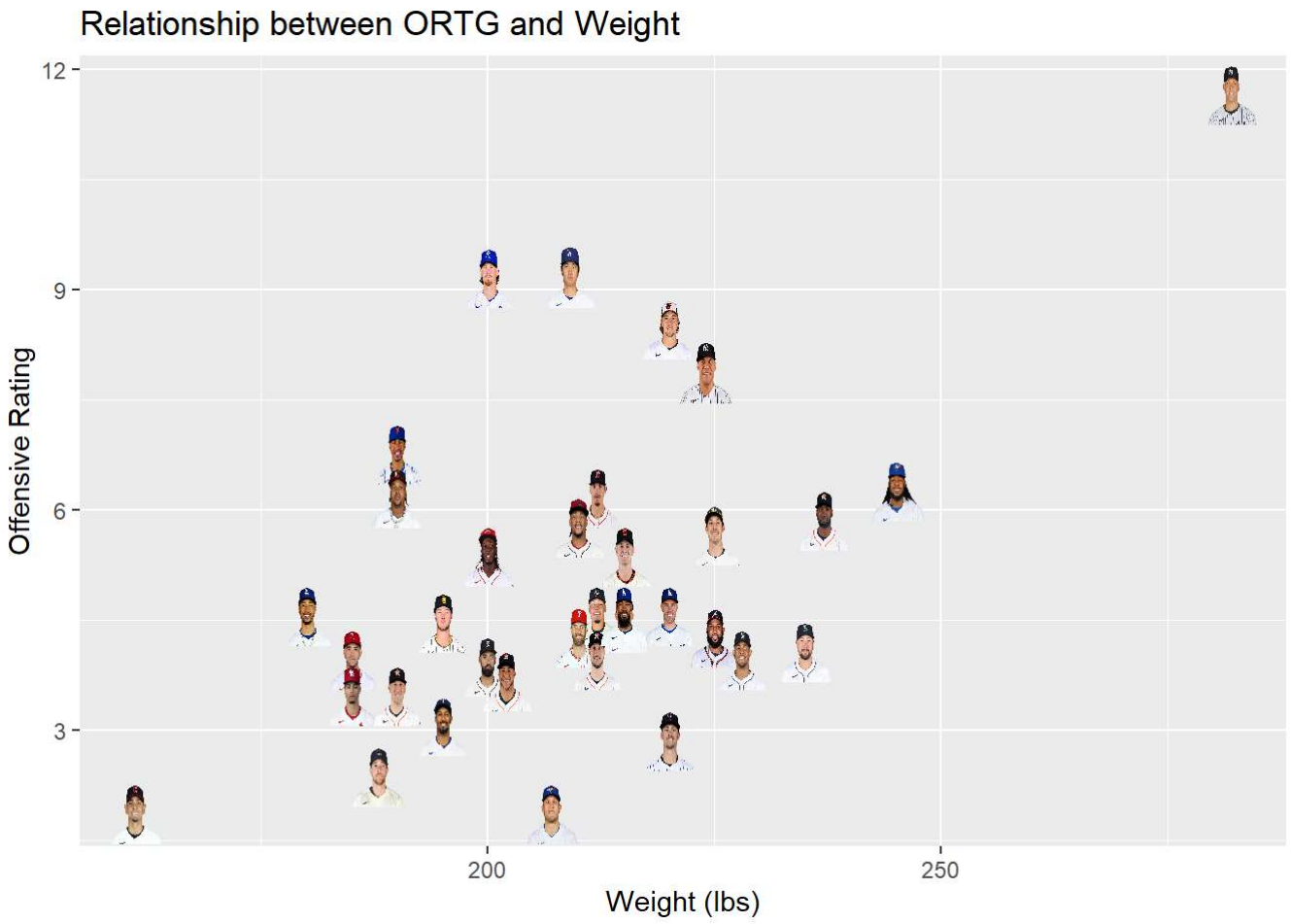
ORTG v. DRTG



In this graph, a slight negative relationship between ORTG and DRTG can be oberseved. This indicates that the players who excel at offense are typically not the greatest defenders, and vice-versa. On the left most side of the graph around the middle, the 4 players (Shohei Ohtani (blue hat), Yordan Alvarez (black hat), Brent Rooker (green hat), and Marcel Ozuna (below Alvarez)) are all Designated Hitters. This position allows players to only play offense because they are plus hitters and below average defensive players. Next to them are a couple first basemen that share a similar play style. Vladmir Guerrero Jr., Freddie Freeman, and Bryce Harper are pretty good players at the plate, yet show some struggles on the first base position. Lastly, two players can be seen which encompass the most ideal post on this graph. Bobby Witt and Gunner Henderson proved this season that they are elite both with a bat and glove in their hands since they have the highest combination of ORTG and DRTG.

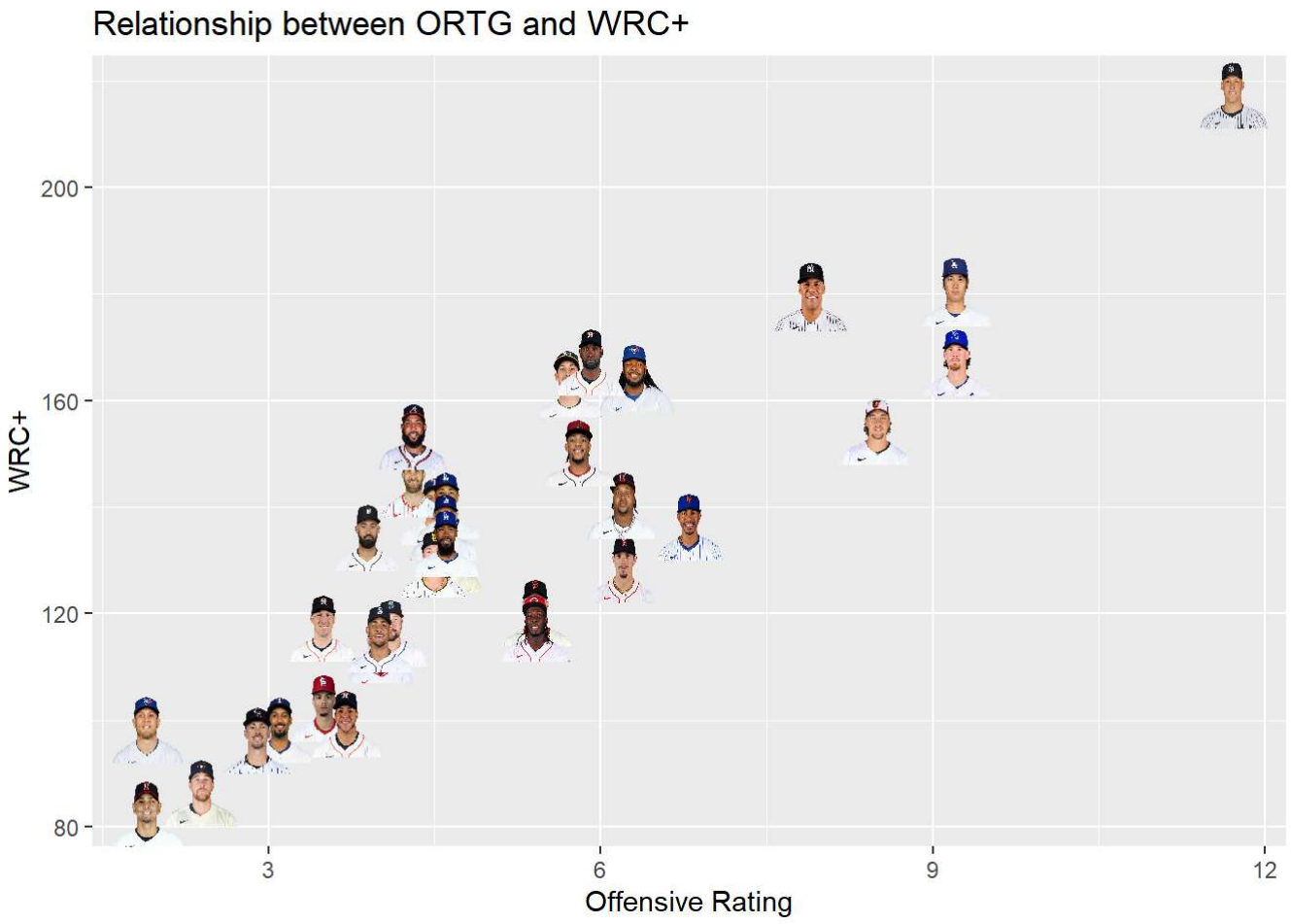
Other Relationships that could help predict WAR

ORTG v. Player Weight



When looking at the relationship between player weight and ORTG, case could be made for a positive relationship. This means that the heavier a player is, the better offensive stats they may have. However, this is not the case. Without outliers in Aaron Judge (top right) and Andres Gimenez (bottom left), there is no defined, strong relationship between weight and ORTG. So, a player can, in theory, thrive at the plate regardless of their weight.

ORTG v. WRC+

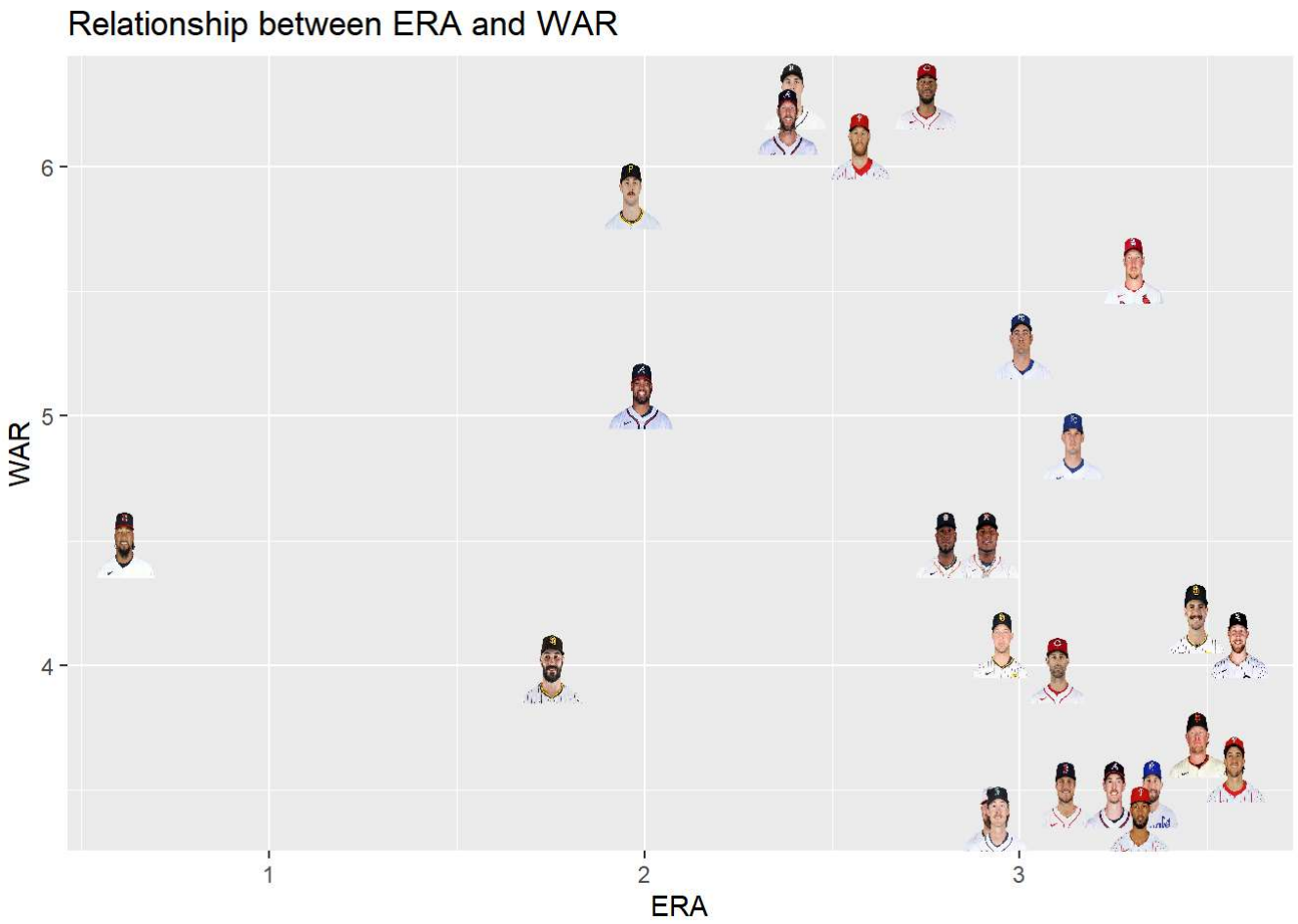


WRC+ and ORTG appear to have a very strong, positive relationship. This means that WRC+ is a good predictor for WAR. WRC+ is a variable that is just an adjusted version of ORTG. It factors in hitting rating across different eras and ballparks using adjusted offensive production. Once again, Aaron Judge is above and beyond as the best offensive player, according to this graph. Thus, it can be determined that players with great Offensive Ratings will have great WRC+ numbers.

Kyle Tucker was filtered out of the data for this plot due to him not being eligible for WRC+ (not enough at bats).

Pitching Relationships

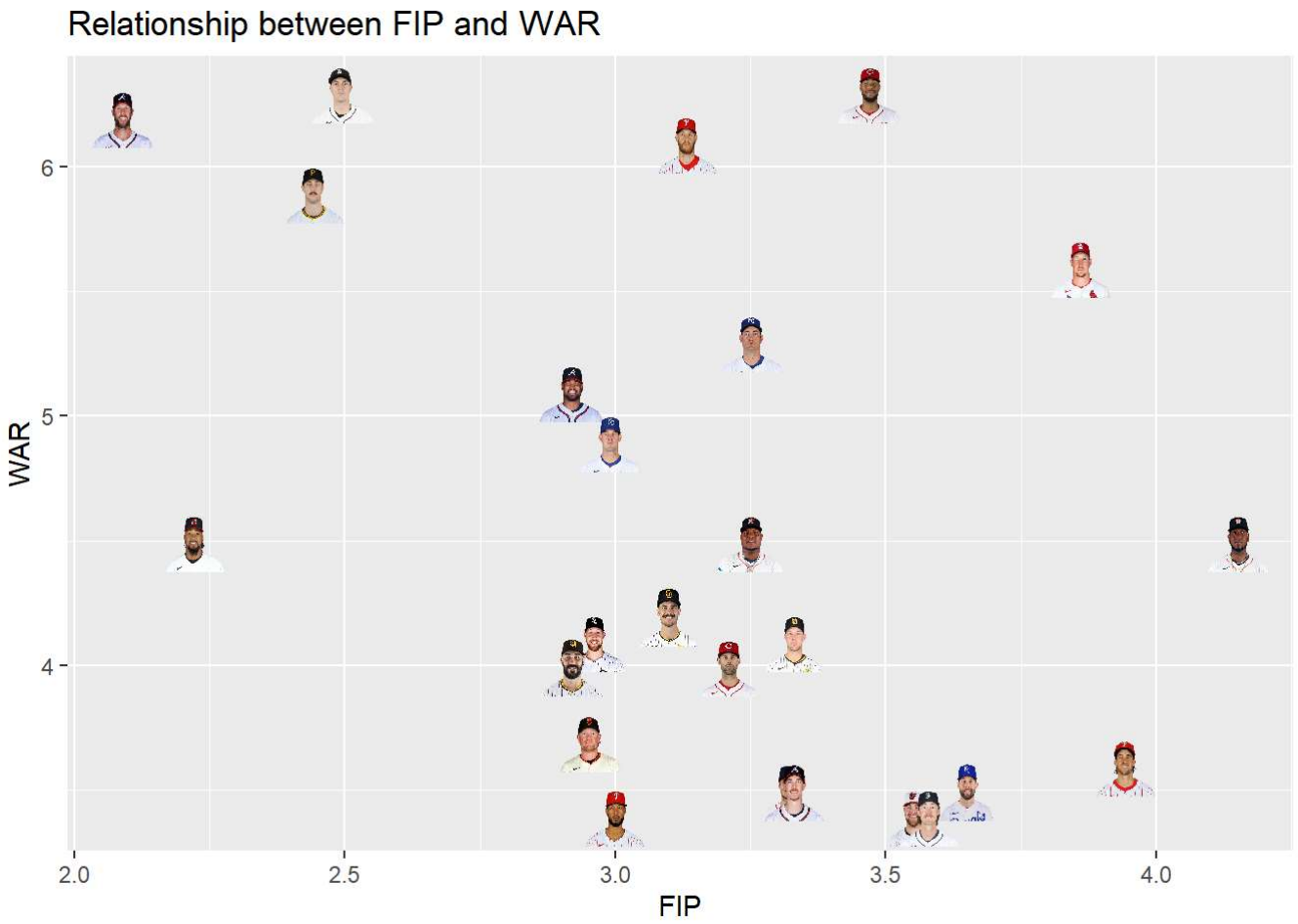
War v. ERA



This graph indicates that there is a steep negative correlation, meaning that players who have high WAR usually have a low (below 3.0) ERA. ERA helps to show the production of a pitcher when they pitch. For example, Paul Skenes had 1.96 ERA last season. If he were to pitch a full game (9 innings), he would only allow 1.96 earned runs. The players toward the top of this plot (Tarik Skubal, Zack Wheeler, Chris Sale, and Hunter Greene) have the highest WAR's for all pitchers this season with sub-3 ERA's (which are elite numbers). Paul Skenes is to the left of the group, proving he is also an elite pitcher, but the reason he is a little lower can be explained by his team's lacking competitiveness against other teams. The two outlier players that are a lot lower than the rest of the pitchers (Emanuel Clase (farthest left) and Tanner Scott) are relief pitchers. This position goes in to pitch after the starting pitcher either gets to a high pitch count or is playing bad. They typically only pitch one inning, so their ERA's are typically super low. So, this proves that if a player has a low ERA, they will be a more impactful pitcher.

For clarification, a Run is when a player scores, regardless if the pitcher was at fault. An Earned Run is when a pitcher allows a hit that scores a run (i.e. player its a home run or player gets a base hit that scores a run).

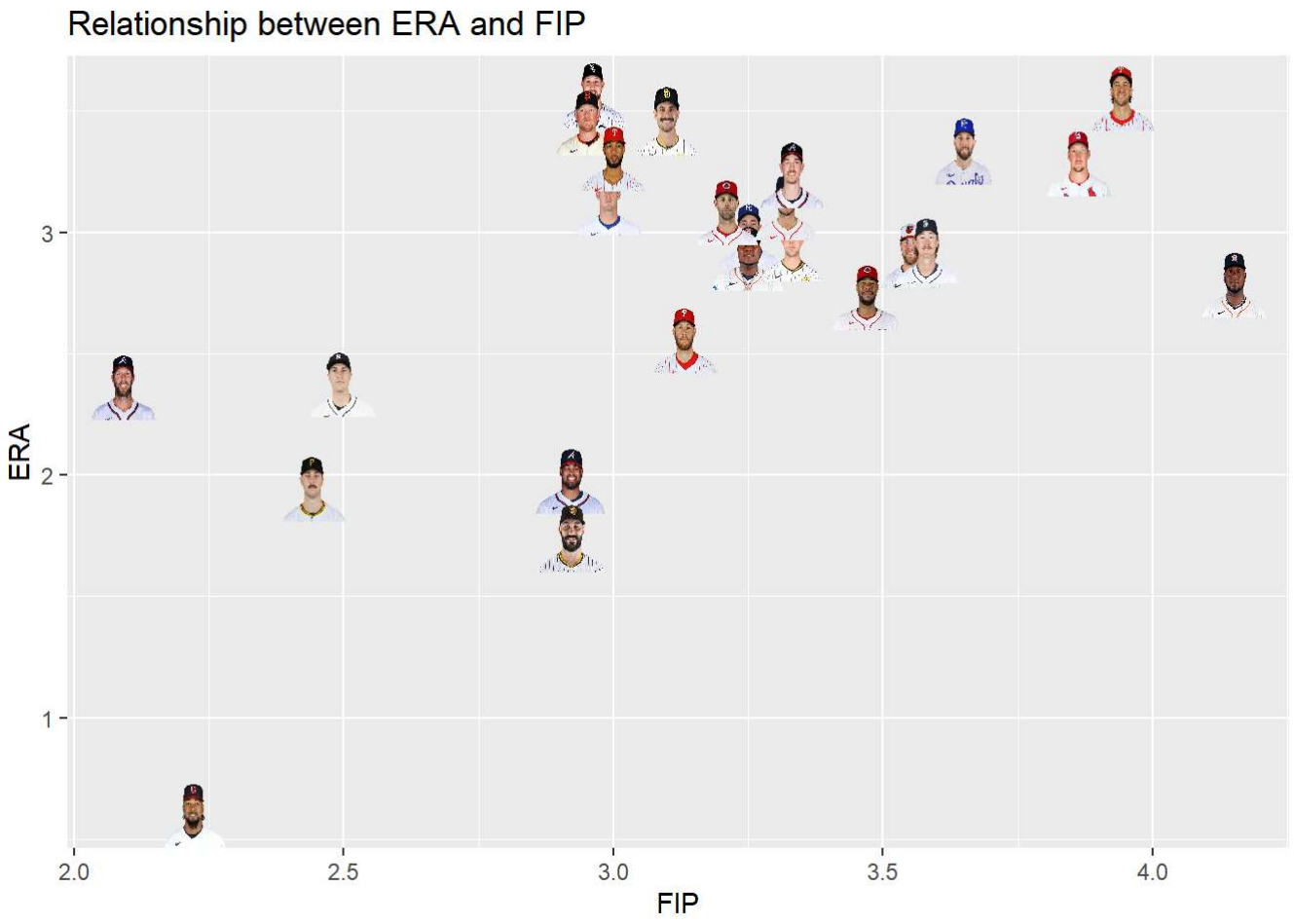
War v. FIP



It can be concluded from this graph that WAR and FIP have a weak negative correlation. This means that a dominant pitcher in the MLB, who has a high WAR, will tend to have a low FIP. Looking back at Paul Skenes, he is amongst the group of top pitchers of last season in this graph along with Chris Sale and Tarik Skubal (both of which won Cy Young). The FIP stat keeps the fielding defense constant for all pitchers. The reason that FIP might not be a great predictor of WAR can be shown by two players, Zack Wheeler and Hunter Greene (both top middle). Both of these pitchers were dominant last season, as shown by their high WAR's, however, their FIP values exclude them from the elite pitching group on this plot (top left). This is due to the team fielding defense of these pitchers either being around average or above average. Using Hunter Greene as an example, this would mean that his pitching production relies more on fielding outs rather than strike outs (which is not a bad thing). For some more context about Hunter Greene, he is a hard thrower and gets a lot of strikeouts, but manages to give up hits more often and gives up more walks, which is where the fielding defense comes into play. Thus, FIP can be a good predictor of WAR, but there does need to be some additional context for some players in order to prevent it from being extrapolated or misleading.

FIP is similar to ERA, but it keeps the defensive performance of the pitchers team constant, so this is a specific metric that tracks the individual performance of the pitcher. (only strikes, walks, and home runs allowed).

ERA v. FIP



From this graph, there is a visible positive correlation between ERA and FIP. Pitchers want to aim for having low values in both stats values. The group of elite pitchers mentioned before (Chris Sale, Tarik Skubal, Paul Skenes, and Zack Wheeler) are in the ideal zone for a pitcher on the plot (sub-3.25 FIP and sub-3 ERA). Once more, the two relief pitchers are also in the zone. But, a new face in. Reynaldo Lopez (just above Tanner Scott) is seen to be a great pitcher in this zone, amounting an impressive 1.99 ERA. The Relief Pitcher-turned-Starter had an amazing season, however, with the context that he was out in parts of the season due to injury, it is more clear as to why his ERA was one of the lowest for a starter. But, when he pitched, he was known to be great. So, there is a strong likelihood that a player with a low ERA will tend to have a low FIP.

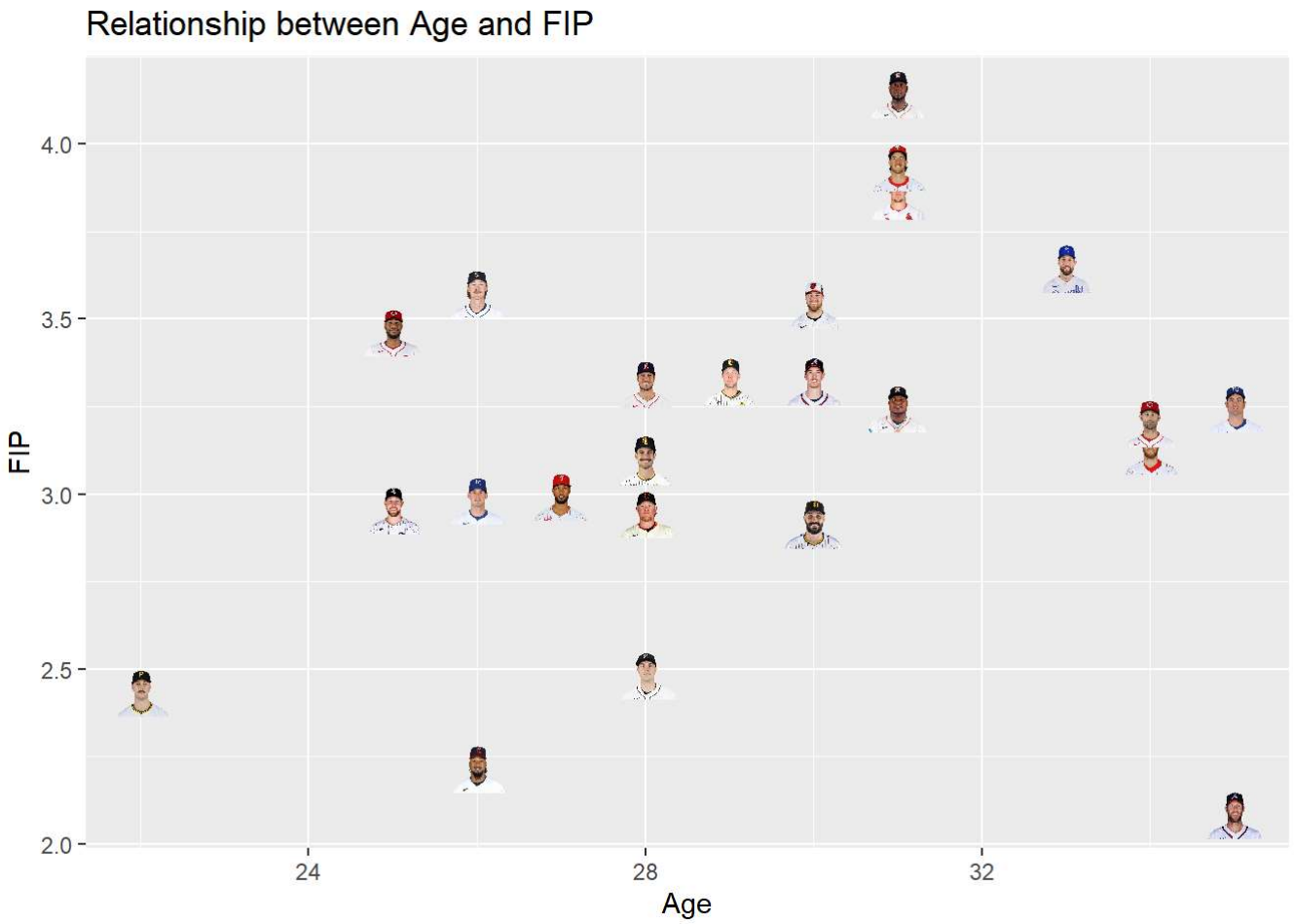
The ERA of an average pitcher is around 3.50.

The FIP of an average pitcher is around 4.25.

These two numbers would put an average pitcher in the top right of this graph.

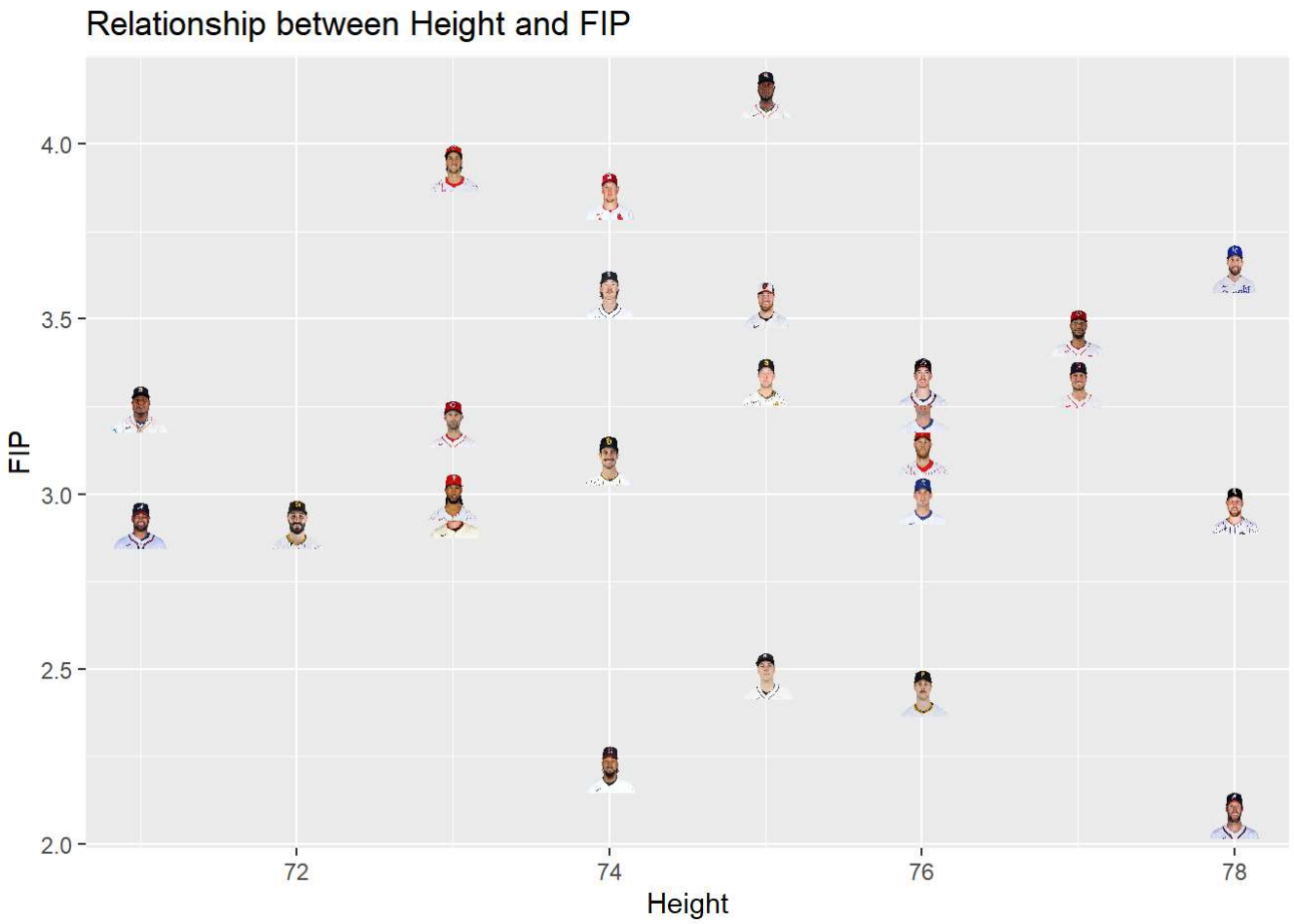
Other Relationships that could predict WAR

FIP v. Age



Even though it does look like there is slight correlation between Age and FIP, there is no specific age range where a pitcher is dominant. For example, Chris Sale (bottom right) and Paul Skenes (bottom left) are dominant pitchers (low FIP), yet they were born 13 years apart. This is where baseball is different from most other sports, since age isn't a determinant of how good a player is, especially for pitchers. Justin Verlander (not on this graph) is a 41 year old pitcher for the Astros that is finally starting to decline, but had been great for a long time (especially throughout his 30's). So, it can be determined that age isn't a good predictor of FIP, even though one might think it would be.

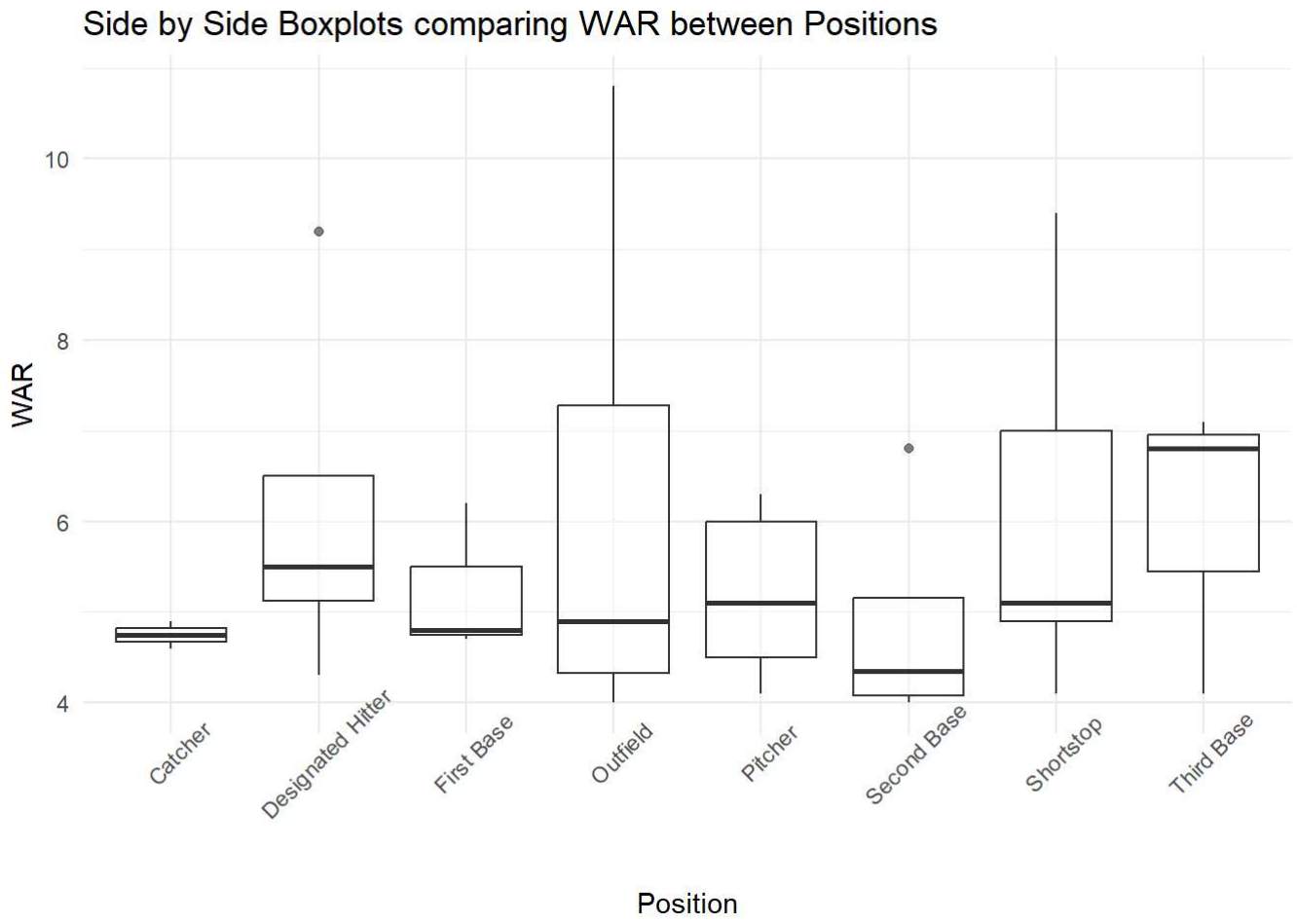
FIP v. Height



There appears to be no correlation FIP and height, proving that there is no ideal height necessary to be an elite pitcher. However, the best pitchers, historically, tend to be taller. A good majority of the pitchers on the graph are capable of throwing near 100 mph and a good majority of pitchers, in today's MLB, are taller than 6 feet. The reason people say taller is better is because the taller one is, the bigger their arms are and thus the harder/faster they can throw, and therefore throwing pitches that are harder to hit. Also high release points make for difficulty to predict a pitch. So, the graph proves that height isn't a great indicator of how good a pitcher is.

War v. Position

```
CleanBaseballData$War <- as.numeric(CleanBaseballData$War)

ggplot(CleanBaseballData,
       aes(x = Position,
           y = War)) +
  geom_boxplot(alpha = 0.6) +
  labs(title = "Side by Side Boxplots comparing WAR between Positions",
       x = "Position",
       y = "WAR") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45))
```



From the Side-by-Side Boxplots, it can be determined that a player's fielding position don't determine WAR. The reason some interquartile ranges are bigger than others is solely due to sample size (there were only 2 catchers in the top 35 in WAR). So, a player can have a good WAR regardless of position.

Conclusion

Hitter/Field Players

WAR seems to be heavily influenced by the offensive production of a player, as showcased by the heavy, positive correlation between WAR and Offensive rating. This is clear through the MVP finalists for the AL and the NL being closer to the top right than most players, but more specifically though Aaron Judge. He had the highest ORTG out of any player in the MLB and also had the highest WAR in the league.

It is also clear that, even though Defensive Rating is a very important stat, it seemingly does not contribute that much to a player's WAR, with little to no correlation between the Defensive Rating and WAR. Looking at players like Daulton Varsho and Andres Gimenez, they were elite on the defensive side of the game, however, they had some of lowest WAR's in the entire data set.

There appears to also be a negative correlation between Offensive and Defensive rating, which indicates that if a player excels at offense, they might not be the greatest defender, and vice-versa (with a few exceptions). The definition of the Designated Hitter position also explains their location on the graph (good

offense and bad defense). And, to point out two players, it can be seen that Andres Gimenez, who has a high Defensive Rating, has a low Offensive Rating and low WAR. Meanwhile, Aaron Judge had a low Defensive Rating, but had a high Offensive Rating and a high WAR, which aligns with our conclusion of the plot.

Finally, for the other relationship graphs, it was concluded that Player Weight was a non-derterminant of ORTG. A player can be any realistic weight and still put up a good offensive rating. With WRC+, a player with good WRC+ will have a good Offensive Rating. This makes sense since WRC+ is an altered Offensive Rating stat, meaning that they are pretty similar, explaining their positive correlation with each other.

Pitchers

It was determined that WAR appears to have a negative correlation with both ERA and FIP, meaning the pitchers with high WAR tend to have lower ERA's and FIP's. An elite group of pitchers (Chris Sale, Tarik Skubal, and Zack Wheeler) tended to be bunched together since they all had low ERA's and low FIP's.

ERA and FIP tend to have a strong positive correlation with each other. This shows that as a pitcher's ERA gets worse (increases), their FIP will also get worse (increase). From this, it was clear that there was an ideal area to be in (a good player would have a sub-3 in ERA and sub-3.25 in FIP). This is where the most elite pitchers would be. It was also shown that the average pitcher would not be close to this "ideal zone" and would be located to the far upper right of the plot.

Lastly, it is apparent that height and age are generally not a factor in a pitcher's overall performance and are just physical attributes. For the relationship between WAR an height, there was no clear indicator of height effecting WAR. However, the only present claim is that all of the players included in the pitching data set are 6-foot plus in height. With the example player we provided (Justin Verlander), that was pointed out out that for age, it clear that one can still be a great pitcher no matter how old they are. It was also noticed that on the WAR v. Age plot, Paul Skenes and Chris Sale were both great pitchers even though there was a significant age gap between them.

Sources

ESPN. MLB WAR Leaders. ESPN, https://www.espn.com/mlb/war/leaders. Accessed 18 Dec. 2024.

ESPN. MLB WAR Leaders – Pitching. ESPN, https://www.espn.com/mlb/war/leaders/_/type/pitching. Accessed 18 Dec. 2024.

MLB. Players. Major League Baseball, https://www.mlb.com/players. Accessed 18 Dec. 2024.

Baseball Savant. Statcast Data and Leaderboards. Baseball Savant, https://baseballsavant.mlb.com/. Accessed 18 Dec. 2024.

Baseball Reference. Major League Baseball Statistics and History. Baseball Reference, https://www.baseball-reference.com/. Accessed 18 Dec. 2024.

FanGraphs. MLB Leaderboards – Pitching Stats. FanGraphs, https://www.fangraphs.com/leaders/major-league?pos=all&stats=pit&type=8. Accessed 18 Dec. 2024.