Example of the Research Process: Rethinking WAR for Starting Pitchers

Lets say I wanted to start a sports analytics project, but maybe I don't have many ideas right now.

A good way to get started is to simply Read something, anything, that you are interested about.

FIP ← Fangraphs

xRA ← Baseball Reference

Runs Allowed, ignore sequencing Randomness

1B ≈

HR 1B 1B out out out → 1 Run A

1B 1B HR out out out → 3 Run A

↓

$\{ \overset{2}{1B}, \overset{1}{HR}, \overset{3}{out} \}$

↓ ↓ ↓

$2(.9) + (2) + (0) = 3.8$

$$\text{ifFIP} = \frac{13 \cdot HR + 3 \cdot (BB + HPB) - 2 \cdot (K + IFFB)}{IP} + C$$

WAR: pitcher observed performance → Wins

need to choose a metric to capture his performance.

1. Fangraphs: FIP
2. B. Ref: xRA

$$\text{ifFIP} = \frac{13 \cdot HR + 3 \cdot (BB + HPB) - 2 \cdot (K + IFFB)}{IP} + C$$

Thought: averaging pitcher performance over the course of a season seems odd

Let's explore some consequences of the modeling assumption.

game	1	2	3	4	5	6	total
earned runs	0	10	1	2	1	1	15
innings pitched	9	4	6	7	8	7	41

Table 1: Max Scherzer's performance over six games prior to the 2014 All Star break.

4 dominant performances → ≥ 4 wins

$$\frac{15 \text{ Runs}}{41 \text{ innings}} \times \frac{9 \text{ innings}}{\text{game}} = \frac{3.66 \text{ Run}}{\text{complete game}}$$

$$\approx \frac{0.55 \text{ Win prob}}{\text{Complete game}}$$

0.6?

×6

= 3.3 to 3.6 wins

3.5

0.5 diff in wins, and hence in WAR over 6 games

$$(0.5)\frac{162}{6} = 27(0.5) = 13.5$$

ex

A: Alternates b/t allowing (10) Runs and 0 Runs in each complete game

B: → exactly 5 Runs in each complete game

ex

A: alternates b/t 0 and 7 Runs in each complete game

B: 0 and 14

Existing WAR: A → 3.5 R/g
B → 7 R/g

"Real" WAR: both win about half their games

You can only lose a game once

not all Runs have the same value

the R^{th} Run in a game has less value as R increases;

$R \mapsto WAR(R)$

$WAR(R) - WAR(R+1)$

goes to 0

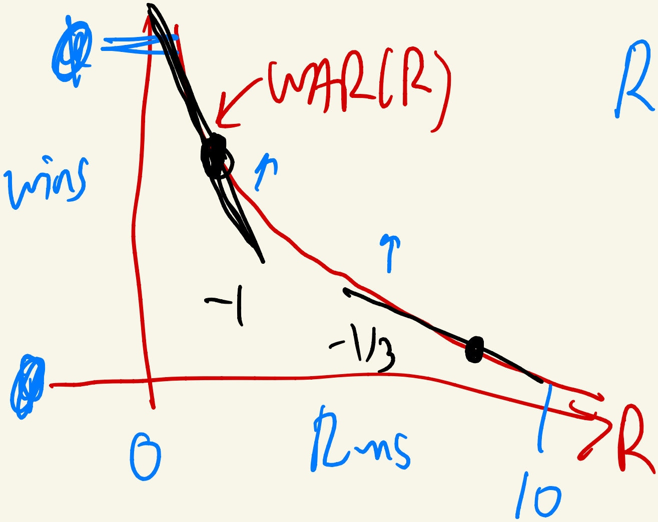
and decreasing

the marginal difference in game WAR of allowing 1 additional Run after already having allowed R Runs

$WAR(10) - WAR(9) \approx 0$

$WAR(R)$ Convex

(2^{nd} derivative positive)



R = Runs Allowed

Averaging pitcher performance over the ~~Problem~~ course of a season is problematic

* Historical WAR — how many wins did ~~Scherzer~~ actually contribute ~~[illegible]~~ last season?

* Predictive WAR — how many will he contribute next season?

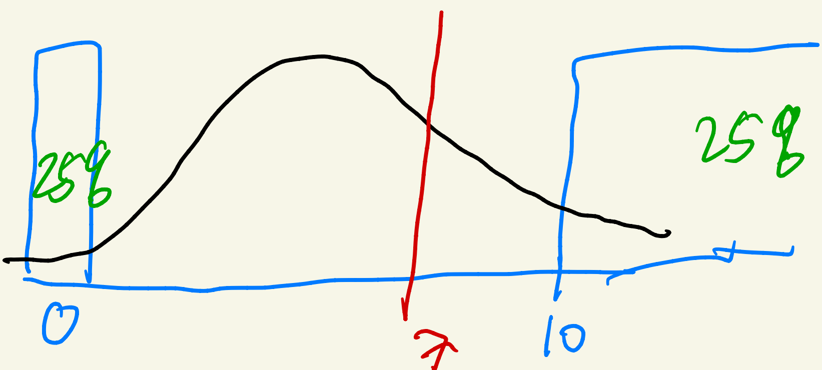
If it is true that a pitcher's event sequence (e.g. 1B, out, HR, out vs. HR, 1B, out, out) is entirely due to randomness — A

then predictive WAR will be better by ignoring sequencing. — B

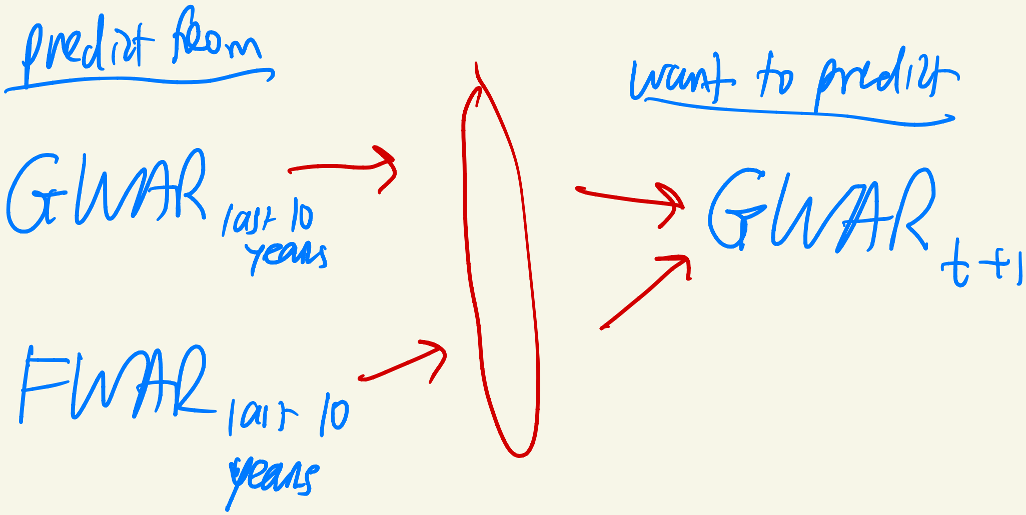
if it is true

$A \Rightarrow B$

$\text{not } B \Rightarrow \text{not } A$



- Historical WAR should be game-by-game WAR
- goal is to predict next season's historical WAR



Goal: Lets fix the problem. Make one incremental improvement [Research].

→ calculate historical WAR in each individual game.

Seasonal WAR = sum of game WARs.

How to do this?

English → Math

One step at a time / Start Simple

WAR: WAR = wins above replacement

Wins: W = How many wins (W.P.) did Scherzer contribute in this game

Above Replacement W_{rep} = How many wins ($w_i p_i$) would a replacement-level pitcher have contributed in this game

$$WAR = W - W_{Rep}.$$

One Step a time Start with W

Wins

Math: win probability

pitcher valuation: we only want to judge Scherzer for things he's Responsible for

- game-level

his observed performance

Observed performance → Wins

Scherzer's game performance

Runs Allowed R → because Runs defines winning

Exit Inning I

Exit Base-state S

Exit Outs O

Variables that affect his performance → confounders

opposing team's batting quality

his team's fielding quality

Ballpark

League (NL vs. AL)

Season

Variables that don't affect his performance

his team's batting quality/opposing team's defense

Goal map performance → wins

Start Simple

- Runs Allowed R
- Exit Inning I
- ~~Exit Base-State S~~
- ~~Exit Outs O~~

simplest case: assume pitcher finishes his last inning.

Task pitcher allows R runs through I complete innings. What is his team's win probability $f = f(I, R)$.

This is the simplest, most granular version of the question. And it is still nontrivial.