



Most Valuable Player

Josh Sellers

- Major League Baseball (MLB) has become an analytical sport
 - Player analysis is more technical
 - Traditional methods have less relevance
 - Moneyball

Background



GOAL: A way to model player value

- Fans want to understand these changes
 - However, they lack a technical background
- Fans need a simple way of following team's moves
- Enlightened fans will gain a sense of connection
 - Teams want invested fans

Problem



©drake

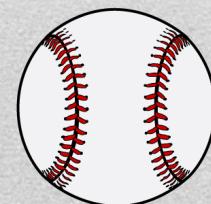
- WAR – Wins Above Replacement
 - How many wins does a player contribute above the average amount
- WAR compared to salary approximates player value
- Modeling player WAR and salary over time
 - Allows fans to predict a player's value
 - Gives value to rookies, free agents and rostered players

Approach



- Same starting year for compared players
- Constant pay over time
- No unexpectedly huge or small contracts
- Consistent performance by players
 - No exceeding or falling below expectations
- All non-pitchers have similar rates of injury and decline
- No minor league busts

Assumptions



$$V_n = \left(\frac{W_n - p_n}{\log_{10}(S_n/50,000)} \right)$$

$$S_n = \begin{cases} b_f S_0 & \text{for free agents} \\ b_r S_{n-1} & \text{if } n \leq 6, n \neq 3, \text{ rookie and } n \geq 1 \\ b_3 S_{n-1} & \text{if } n = 3 \text{ and rookie} \\ b_c S_6 & \text{if } n > 6 \text{ and rookie} \\ b_c S_0 & \text{for rostered players} \\ S_0 & \text{for trades} \end{cases}$$

Equations



$$W_n = \begin{cases} \left(\frac{W_{expected} - W_{n-1}}{|W_{expected} - W_{n-1}|} \right) r_p + W_{n-1} & \text{if } A_n \leq 26 \text{ and pitcher} \\ \left(\frac{W_{expected} - W_{n-1}}{|W_{expected} - W_{n-1}|} \right) r_h + W_{n-1} & \text{if } A_n \leq 28 \text{ and hitter} \\ \frac{1}{2}(A_n - 26)d_p + W_{n-1} & \text{if } A_n > 26 \text{ and pitcher} \\ \frac{2}{9}(A_n - 28)d_h + W_{n-1} & \text{if } A_n > 28 \text{ and hitter} \end{cases}$$

$$p_n = \begin{cases} (s_p)(i_p)(W_n) & \text{if pitcher} \\ (s_h)(i_h)(W_n) & \text{if fielder} \end{cases}$$

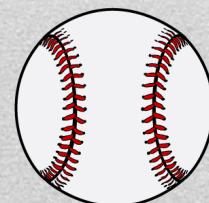
Equations



Variables List

Variable	Summary	Units	Range
V_n	Player value	WAR	No range for WAR
W_n	Player WAR	WAR	No range for WAR
S_n	Player salary	Dollars	$S_n \geq$ League minimum
p_n	Injury loss potential	WAR	No range for WAR
$W_{expected}$	Expected WAR	WAR	Value based on WAR table
A_n	Age during contract	Years	Must not be a student
S_0	Initial Salary	Dollars	$S_0 \geq$ League minimum
W_0	Initial WAR	WAR	No range for WAR
n	Number of years since first year of contract	Years	$n \geq 0$

Variables

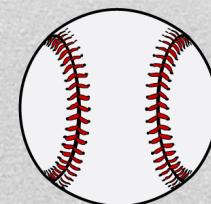


©drake

Parameters List

Parameter	Summary	Units	Value
s_p	Percentage of season missed for pitcher	N/A	0.41
s_h	Percentage of season missed for hitter	N/A	0.23
d_p	Rate of decline for pitchers	WAR	-0.187
d_h	Rate of decline for hitters	WAR	-0.576
i_p	Injury incidence rates for pitchers	N/A	0.00416
i_h	Injury incidence rates for hitters	N/A	0.00210
r_p	Rate of increase in WAR for pitchers	WAR	0.695
r_h	Rate of increase in WAR for hitters	WAR	0.651
b_f	Boost in salary for free agent	N/A	1.81
b_r	Boost in salary for a rookie	N/A	1.33
b_c	Boost in salary for rostered player	N/A	1.66
b_3	Boost in salary for rookie arbitration	N/A	4.5

Parameters





Craig Kimbrel Test	
Expected V_n	Actual V_n
1.712501393	2.352585909
2.13358191	2.8234279
2.472395263	2.717880745
1.99287864	1.114559783
1.532892321	0.5526782
1.35927698	0.367483053
1.15588934	1.428483063
Totals	
12.35941585	11.35709865
Error	
0.088254688	

Jason Heyward Test	
Expected V_n	Actual V_n
3.24843025	6.4
3.469422186	2.285485974
3.646541169	5.043528887
2.735779756	1.887530839
2.889799792	3.022690869
3.026063648	2.838385048
2.470175799	-0.109740088
Totals	
21.4862126	21.36788153
Error	
0.005537801	

Madison Bumgarner Test	
Expected V_n	Actual V_n
2.374285317	2.283208144
2.714501537	1.832256026
2.989835517	3.063626161
2.344784648	2.028427111
2.539112555	2.155130049
2.080752303	2.094728109
1.814345892	1.17951491
Totals	
16.85761777	14.63689051
Error	
0.151721246	

Results (rookies)



©dab

Brandon Phillips Test	
Expected V_n	Actual V_n
1.611847605	1.680523111
1.372834085	0.7562354
1.038215156	0.714222322
0.607990819	1.470457722
0.082161073	0.336104622
-0.53927408	0.336104622
Totals	
4.173774657	5.293647799
Error	
0.211550368	

Joe Mauer Test	
Expected V_n	Actual V_n
2.411763129	0.56332573
2.317516243	1.614867093
2.129022469	1.99041758
1.846281809	0.788656022
1.469294262	0.56332573
0.998059829	0.86376612
0.432578508	1.276871655
Totals	
11.60451625	7.661229931
Error	
0.514706692	

Felix Hernandez Test	
Expected V_n	Actual V_n
1.83566295	1.926660908
1.791752497	2.519479649
1.660021138	1.630251538
1.440468873	0.592818741
1.133095702	0.296409371
Totals	
7.861001159	6.965620207
Error	
0.12854289	

Results (rostered)



©dab

Robinson Cano Test	
Expected V_n	Actual V_n
2.617647472	2.386954188
2.391744801	1.268069412
2.075481062	2.72261962
1.668856255	1.268069412
Totals	
8.75372959	7.645712633
Error	
0.144920037	

Albert Pujols Test	
Expected V_n	Actual V_n
1.698716092	1.790215641
1.426240358	0.559442388
1.062939379	1.454550208
0.608813156	1.156180935
0.063861688	0.522146229
-0.571915024	-0.671330865
Totals	
4.288655648	4.811204535
Error	
0.108610823	

Darren O'Day Test	
Expected V_n	Actual V_n
1.244267985	1.134154617
0.930685622	1.304277809
0.512575805	1.587816463
Totals	
2.687529412	4.026248889
Error	
0.332497944	

Results (free agents)



- Model does a good job for rookies
- Free agents and rostered players are less accurate
 - Due to variability in decline
 - These types of players earn shorter contracts anyway

Evaluation



- Model meets needs of casual fan
 - Gives decent estimate of player value
 - While not completely accurate, it provides enough insights
- Further analysis into player decline and injury could improve accuracy
 - Allow for longer veteran contracts
 - Factor in lower value for injuries

Assessment



- Younger players tend to have more value
- Long contracts are a gamble
- A lot of variability exists in Baseball

Conclusion

