Rewarding batters for baserunner advancement
A ridge-regressed Rasch model

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SPORTS
ANALYTICS

Background

- Allen (2014): LHB singles more valuable than RHB singles
  - because if runner is on 1B, he more likely gets to 3B
  - LHBs undervalued by $\sim \$300,000$/year on average
  - RHBs overvalued by $\sim \$150,000$/year on average
- This observation has been made before
  - Pakin (1993)
  - James (1997)
- But no one quantified its value before Allen (2014)

- Today: Extend Allen's work to evaluate individual players

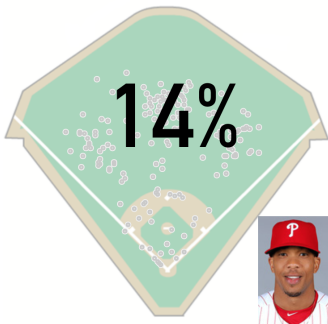# Singles spray charts (2014)
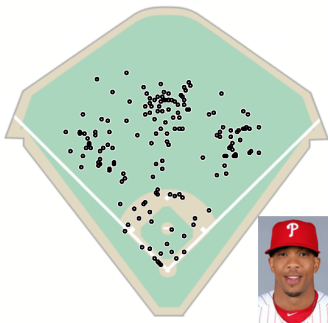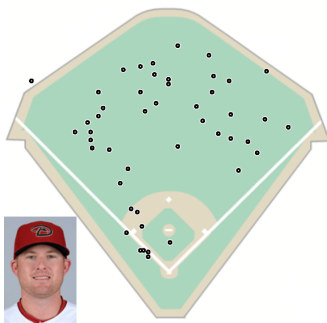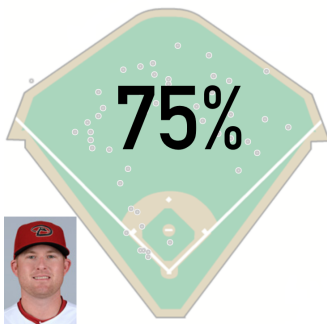
Ben Revere

Mark Trumbo

Images created with Bill Petti's Spray Chart Comparison tool
Portraits from Baseball-Reference.com

Singles spray charts (2014)

Ben Revere

Mark Trumbo

14%

75%

Images created with Bill Petti's Spray Chart Comparison tool
Portraits from Baseball-Reference.com

Probabilistic baserunning model

- For each single with a runner on 1B, observe:
    - B_i: the batter
    - R_i: the runner on 1B
    - H_i: handedness of B_i (L or R)
    - z_i: vector of additional covariates to control for (e.g. indicators of full count, two outs, home team)

- $Y_i = \begin{cases} 1 & \text{if } R_i \text{ safely reaches third or home} \\ 0 & \text{otherwise} \end{cases}$

Model (logistic regression):

$$P(Y_i = 1) = \frac{e^{\alpha + \beta_{B_i} + \rho_{R_i} + \theta_{H_i} + \zeta^T z_i}}{1 + e^{\alpha + \beta_{B_i} + \rho_{R_i} + \theta_{H_i} + \zeta^T z_i}} = \frac{e^{\eta_i}}{1 + e^{\eta_i}}$$

Illustrative example

$\alpha = -1.52$

$\beta_{\text{Morse}} = -0.01$

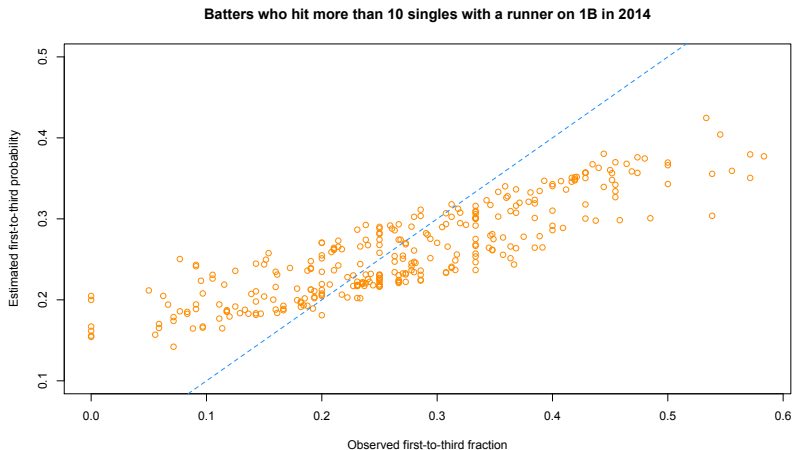$\rho_{\text{Pence}} = +0.42$

$\theta_R = +0.00$

$$P(Y = 1) = \frac{e^{-1.52-0.01+0.42+0.00}}{1 + e^{-1.52-0.01+0.42+0.00}} = \frac{e^{-1.11}}{1 + e^{-1.11}} = 24.7\%$$

Fitting the model

$$(\hat{\alpha}, \hat{\beta}, \hat{\rho}, \hat{\theta}, \hat{\zeta}) =$$

$$\arg\min \left\{ -\sum_{i=1}^{n} \log P(y_i|\eta_i) + \lambda \left(||\beta||_2^2 + ||\rho||_2^2 + ||\theta||_2^2 + ||\zeta||_2^2 \right) \right\}$$

- Solve this optimization problem with R package `glmnet` (coordinate descent)
- λ is *regularization parameter*, chosen via cross-validation
- Benefit of regularization: regression to the mean

1st-to-3rd advancement: estimated vs. observed

Batters who hit more than 10 singles with a runner on 1B in 2014

Implications for wOBA

Event	Actual Total	Theoretical breakup		
		Getting on	Moving over	Inning killer
OUT	−0.27	−0.01	−0.10	−0.16
BB	0.30	0.24	0.06	——
1B	0.46	0.25	0.21	——
2B	0.75	0.41	0.34	——
3B	1.03	0.61	0.42	——
HR	1.40	1.00	0.40	——

$$wOBA_{naive} \propto .57*BB + .73*1B + 1.02*2B + 1.30*3B + 1.67*HR$$

Implications for wOBA

| Event | Actual Total | Theoretical breakup | | |
		Getting on	Moving over	Inning Killer
OUT	−0.25	−0.00	−0.09	−0.16
BB	0.30	0.24	0.06	—
1B	???	0.25	.09 + .06+0.13	—
2B	???	0.40	.14+0.27	—
3B	1.01	0.59	0.42	—
HR	1.40	1.00	0.40	—

$wOBA_{\text{Miguel Cabrera}} \propto .55*BB+.70*1B+.99*2B+1.26*3B+1.65*HR$

$wOBA_{\text{Willie Bloomquist}} \propto .55*BB+.68*1B+.97*2B+1.26*3B+1.65*HR$

# Batters most overrated/underrated by wOBA

Player	Adjustment
James Loney	+.0032
Robinson Cano	+.0026
Eric Hosmer	+.0024
Joe Mauer	+.0024
Jed Lowrie	+.0023
...	
Rajai Davis	−.0030
Adeiny Hechavarria	−.0033
Danny Santana	−.0033
Starling Marte	−.0034
Dee Gordon	−.0037

Histogram

Frequency

Personalized wOBA minus naive wOBA
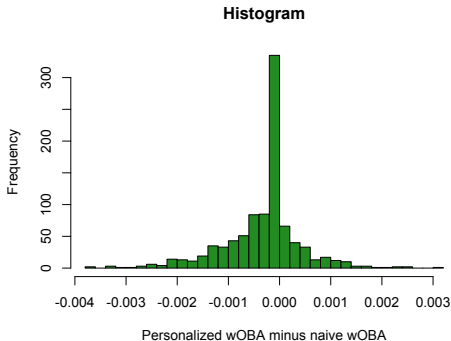
Batters most overrated/underrated by wOBA

Player	Adjustment
James Loney	+$1.33M
Robinson Cano	+$1.08M
Eric Hosmer	+$1.03M
Joe Mauer	+$1.00M
Jed Lowrie	+$0.96M
...	
Rajai Davis	−$1.26M
Adeiny Hechavarria	−$1.37M
Danny Santana	−$1.37M
Starling Marte	−$1.41M
Dee Gordon	−$1.54M

Histogram

Adjusted value minus naive value
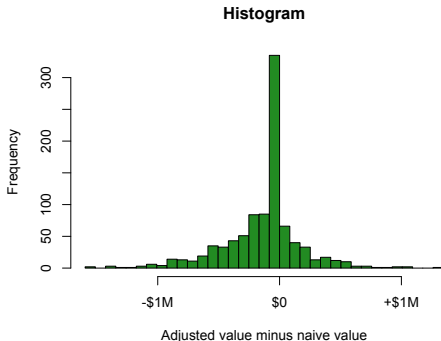
Conclusions

- Identified $1.33M in surplus value for James Loney in 2014
  - Not accounted for anywhere else, publicly
- Results on 2014 data are consistent with Allen (2014)
  - But allow for results on individual players

Acknowledgments

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References

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Backup slides

The dataset

- From Retrosheet play-by-play data
- All singles with a runner on 1B in 2014, excluding:
  - Plays with at least one error
  - Batted balls classified as popups
  - Plays when lead runner is thrown out
- Otherwise, anything goes
- $< 5\%$ of singles excluded
- Sample size: $n = 8571$ singles; 641 batters; 671 runners

Summary of results

R	$\hat{\rho}_R$
Elvis Andrus	0.73
Dexter Fowler	0.73
Rajai Davis	0.63
Jackie Bradley, Jr.	0.63
Brian Dozier	0.62

...

Chris Carter	-0.49
Billy Butler	-0.53
Pablo Sandoval	-0.55
Starlin Castro	-0.61
Victor Martinez	-0.73

$$\hat{\alpha} = -1.52$$

$$\hat{\theta}_L = 0.43$$

$$\hat{\zeta}_{home} = 0.13$$

$$\hat{\zeta}_{2outs} = 0.42$$

$$\hat{\zeta}_{2outs,3-2} = 1.24$$

Future work

- Consider baserunner advancement on outs
- Include identity of fielder as variable in regression
- Adjust WAR for baserunning