Mixed Models as the Basis for Catcher Evaluation and Forecasting

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Baseball Prospectus & Pitch Info
Primary Research Team

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Founder, Pitch Info

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Contributor, Baseball Prospectus
Lead Scientist, Pitch Info

Jonathan Judge:
Contributor, Baseball Prospectus
Also a lawyer in real life, otherwise he’d be here (I’ll do my best)
Outline

● What is Catcher “Framing”?
● The Value of Framing Revealed
● Regressed Probabilistic Model (“RPM”) - GAM+WOWY
● Called Strikes Above Average (“CSAA”) - MM
● Forecasting Framing
What is Catcher “Framing”?
What is Catcher “Framing”?  
The ability to receive a pitch such that the likelihood of a called strike is maximized  
Make borderline strikes stay strikes, and steal the occasional ball and turn it into a strike
What is Catcher “Framing”?

STRIKE ANATOMY

ONE OF THE FOUR ZONES OF DECEPTION

STRIKE ZONE

BREAK DOWN OF THE PERCENTAGE OF PITCHES CALLED STRIKES IN AND AROUND THE STRIKE ZONE.

Almost never called a strike
Rarely called a strike
Often called a strike
Almost always called a strike

0% 50% 100%

Source: Pavlidis, ESPN The Magazine, July 2014
The Value of Framing Revealed
The Value of Framing Revealed

● New Technologies
  ○ PITCHf/x by Sportvision
    ■ Data published by MLB Advanced Media
  ○ Trackman
    ■ Will replace PITCHf/x

● Research Breakthroughs
  ○ John Walsh, 2007 (strike zones and values)
  ○ Dan Turkenkopf, 2008
  ○ New York Yankees, 2009 (unpublished)
  ○ Mike Fast, 2011
  ○ Max Marchi, 2011 & 2013
The Value of Framing Revealed

- Walsh established how the ‘run expectancy’ of an at bat changes from count to count, providing the ‘run value’ of a framed pitch
- Turkenkopf, Fast, Marchi and others found a wide range of skill and value in the MLB catching pool
- Studies were reproduced, and Marchi applied more robust techniques
  - Also tackled historical data that predated tracking technology
The Value of Framing Revealed

<table>
<thead>
<tr>
<th>Ball</th>
<th>Strike</th>
<th>Run Value</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.07</td>
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<tr>
<td>0</td>
<td>1</td>
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<td>2</td>
<td>0.18</td>
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<tr>
<td>1</td>
<td>0</td>
<td>0.10</td>
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<tr>
<td>1</td>
<td>1</td>
<td>0.10</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>0.22</td>
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<tr>
<td>3</td>
<td>1</td>
<td>0.24</td>
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<tr>
<td>3</td>
<td>2</td>
<td>0.54</td>
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The Value of Framing Revealed

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<tr>
<td>McCann</td>
<td>172</td>
</tr>
<tr>
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<td>163</td>
</tr>
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<td>Lucroy</td>
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Source: CSAA model
# The Value of Framing Revealed

## 2014

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## Best Seasons 2008-2014

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## Total 2008-2014

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- 2 - 3 wins
- 3 - 5 wins
- 18 - 20 wins
Regressed Probabilistic Model using GAM and “WOWY”

library(mgvc)
**RPM: The Impetus**

### 2014

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#### Results

- **2 - 3 wins**
- **4 - 6 wins**
- **18 - 20 wins**

*Didn't Pass Sniff Tests*
RPM: The Goal

Address issues raised by skeptics

- Factoring in pitch type
- Control for batter and pitcher handedness
- Deal with variance in batter strike zones
- Account for the umpire and the pitcher
- Show the numbers!
  - Statcorner publishes +/- numbers
  - The more advanced researchers didn’t share and were hired by teams
RPM: The Data

Pitch Info provides accurate pitch type data and recalibrations to Baseball Prospectus, BrooksBaseball.net and at least one team in every division of Major League Baseball.

/appeal to authority
RPM: Generalized Additive Model

For every year, count and pitch type ...

```r
pitchlist$stand <- as.factor(pitchlist$stand)
pitchlist$throws <- as.factor(pitchlist$throws)
pitchlist$ball <- as.factor(pitchlist$ball)
pitchlist$strike <- as.factor(pitchlist$strike)
pitchlist$g_factor <- do.call(paste, c(pitchlist[c("stand","throws")], sep = ""))
pitchlist$g_factor <- as.factor(pitchlist$g_factor)

# model
fit <- bam(c~s(cx,cz,by=g_factor)+ball*strike , data=pitchlist, family=binomial, cluster=c1)

# predict
myarea <- expand.grid(cx=seq(from=px_min, to=px_max,length.out=lenvar),
cz=seq(from=pz_min, to=pz_max,length.out=lenvar))

# variables from the model
myarea$ball <- bp
myarea$strike <- sp
myarea$g_factor <- paste(standp,throwsp,p,sep="")
myarea$fit <- c(predict(fit,newdata=myarea,type="response"))

# creates maps for each season/group/throws/stands/count/pitch type
```
RPM: The Goal Revisited

Address issues raised by skeptics

- Factoring in pitch type
- Control for batter and pitcher handedness
- Deal with variance in batter strike zones
- Account for the umpire and the pitcher
- Show the numbers!
  - Statcorner publishes +/- numbers
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**RPM: With or Without You ("WOWY")**

Developed by Tom Tango [http://www.tangotiger.net/catchers.html](http://www.tangotiger.net/catchers.html)

WOWY compares all the available pitcher/catcher combinations in order to assess whether a particular catcher, given the pitchers he has caught throughout his career, has fared better or worse than expected. - Marchi, Hardball Times, 2012

RPM created adjustments based on WOWY for each pitcher and umpire and applied that to each pitch called.

\[
\text{catcher\_score} = \text{call} - \text{CS\_probability} - \text{pitcher\_adjustment} - \text{umpire\_adjustment}
\]

\[
\text{call} = 1 \text{ for strike, 0 for ball; multiply score by count-specific or generic run value for total value}
\]
RPM: Regression

- Regress each catcher to league average (0)
- Regression was based on intraclass correlation ("ICC") of each measurement.
- ICC consistency and agreement both showed that a 50/50 point occurred after ~290 framing opportunities

The amount to regress “r” is based on the framing chances “n” and this 50/50 point

\[ r = \frac{n}{n + 290} \]
RPM: Agreement With Scouting

Scouts vs RPM: Framing

Scouting Score

RPM Runs per 7000
RPM: Example 1, Red Sox Upgrade

Christian Vazquez

A.J. Pierzynski
RPM: Example 2, The Extremes

Wilin Rosario

Jonathan Lucroy
RPM: We Published It
Called Strikes Above Average: Mixed Models

library(lme4)
CSAA: The Goal

- Replace WOWY and ‘manual’ regression with a more robust technique
- Replicate Marchi’s “retrosheet” work
- Make Judge do most of the work
- Publish it all
CSAA: Why a Mixed Model?

Fixed Effects
- called strike probability (from RPM’s GAM)
- ball/strike
- home field advantage

Random Effects
- catcher
- pitcher
- umpire
- batter
CSAA: PITCHf/x

IV selection driven by theory and BIC

The null is the hardest part …

Final value …
CSAA: Historical

IV selection driven by theory and BIC

The null is the hardest part ...

Final value ...
Forecasting: PECOTA or Not

Projection system developed by Nate Silver and Clay Davenport and maintained by Baseball Prospectus employee Rob McQuown.

Relies on pools of comparable players, minor league equivalents (MLE) and aging curves to generate a range of projections for each player.

Projects Fielding Runs Above Average (“FRAA”)

We can add CSAA to FRAA

For now let’s project CSAA alone...
Forecasting Framing: Challenges

- Limited player pool
- Rule changes
  - strike zone enforcement
  - actual change to strike zone definition
- Umpire training
  - they use PITCHf/x
- Limited Minor League data
Forecasting Framing: Aging

We may lack enough variance for fielding comps, but we have a good idea of how catchers age from 25-35.

Catching seasons dating to 1988 were used.

Results consistent with Marchi’s study.

Survivor bias: generate a conservative projection for catchers who don’t continue (approx -0.003 CSAA).

```
aging <-
ddply(d.age.surv, c("age.x"), summarise,
gap = as.numeric(wtd.mean(gap, weights= n.harmonic)) ,
n = length(age.x) )
ageing$cumu.gap <- cumsum(aging$gap)
fit <- loess( aging$cumu.gap~aging$age.x, weights=aging$n ,span=.55)
```
Forecasting Framing: Testing 2014

- Use the basic 5|3|1 * chances for weighting for past seasons
- Age the weighted value
- Hope for the best

Weighted Correlation $r = .797$ stderr $= .064$
RMSE .008
MAE .007

*Std Dev of CSAA ~ .10 to .12
Forecasting Framing: 2015

Setting each to a 7000 chance season

<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td>Rene Rivera (recently traded to Tampa)</td>
<td>32</td>
</tr>
<tr>
<td>Hank Conger (recently traded to Houston)</td>
<td>30</td>
</tr>
<tr>
<td>Christian Vazquez (promoted in 2014 by Boston)</td>
<td>28</td>
</tr>
</tbody>
</table>