

# Examining the Effects of NCAA Aluminum Bat Restrictions on Offensive Team Performance, 2010—2011

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## Aluminum bats in NCAA baseball

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- Non-wood bats used exclusively since 1974
- Various changes to date
- 1986:
  - Length-to-weight ratio reduced from -3 oz. to -5 oz.
  - Increased bat speed, ball exit speed

## Aluminum bats in NCAA baseball

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- 1998:
  - Impose upper limit on ball exit speed ratio (BESR)
  - Reduce the diameter of the barrel from 2.75 in. to 2.50 in.
  - Increase length-to-weight ratio back to -3 oz.
  - Impose lower limit on bat's moment of inertia (MOI)

## Aluminum bats in NCAA baseball

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- 2008:
  - NCAA College Baseball Rules Committee issued mandatory restrictions on non-wood bat construction
  - Effective in 2011
  - Previous bats were too dangerous
  - Teams were modifying the structure to improve performance

## Aluminum Bats in NCAA Baseball

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- Ball exit speed ratio (BESR)
  - Ratio of inbound and rebound speeds of the ball
    - Min. = 0.712 (29 in. bat)
    - Max. = 0.754 (36 in. bat)
- Bat-ball coefficient of restitution (BBCOR)
  - Manufactured to perform similarly to wood
  - Max. limit = 0.500

## Questions

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- Will team strategy and performance be influenced by NCAA aluminum bat regulations?
  - Will teams hit fewer homeruns as a result of bat regulations?
  - If so, will teams decide to employ more sacrifice bunts and/or stolen bases to compensate for the decline in bat performance?

## Hypotheses

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- NCAA baseball teams will, on average, hit fewer home runs as a result of bat restrictions.
- Similarly, teams will employ a variety of game- and strategy-related decisions such as increasing sacrifice bunts and stolen bases as a result of bat restrictions.

## Data

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- NCAA Div. I baseball team statistics for years 2010– 2011
- 2010: Bat = BESR
- 2011: Bat = BBCOR
- Data location:

<http://www.ncaa.com/stats/baseball/d1>



# Data

## Custom Reporting

Generate your own reports to determine where your team and players rank in the statistics.

Select Division

Click here to select

Select Reporting Week

Click here to select

Select Category

Click here to select

Select Type of Statistic to View

Click here to select

Select Report Format

HTML

**VIEW REPORT** on NCAA.org ➔

bat	yr	gms	o.ab	o.h	o.ba	o.r	o.rpg	o.2b	o.2b.pg	o.3b	o.3b.pg	o.hr	o.hr.pg	o.tb	o.slg	o.sb	o.cs
1	2011	58	1948	656	0.34	541	8.9	146	2.70	36	0.73	86	1.51	1109	0.52	159	34
1	2011	55	1923	622	0.32	495	8.5	130	2.45	29	0.64	80	1.36	965	0.50	155	47
1	2011	60	2083	666	0.32	509	8.2	149	2.40	27	0.64	81	1.33	1036	0.49	134	35
1	2011	61	2145	685	0.32	382	8.0	132	2.40	28	0.51	80	1.31	1028	0.49	117	30
1	2011	53	1992	635	0.32	455	7.7	136	2.39	27	0.48	60	1.09	933	0.49	93	23
1	2011	63	2158	687	0.32	453	7.4	152	2.34	24	0.48	64	1.05	1034	0.48	116	40

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bat	yr	gms	o.ab	o.h	o.ba	o.r	o.rpg	o.2b	o.2b.pg	o.3b	o.3b.pg	o.hr	o.hr.pg	o.tb	o.slg	o.sb	o.cs
0	2010	54	1860	553	0.30	394	6.7	112	1.93	12	0.23	41	0.87	657	0.45	58	40
0	2010	56	2011	607	0.30	344	6.9	123	1.98	15	0.27	46	0.88	823	0.45	64	20
0	2010	60	2111	682	0.32	407	8.0	134	2.31	17	0.34	60	1.30	1081	0.51	100	24
0	2010	53	1855	505	0.27	309	5.3	73	1.52	7	0.13	25	0.48	717	0.38	27	21
0	2010	54	1918	585	0.31	436	7.0	112	2.04	15	0.25	49	0.91	1077	0.46	65	25
0	2010	62	2125	675	0.32	393	7.7	116	2.19	17	0.31	71	1.16	928	0.49	81	26

## Variables

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- Predictor
  - Bat type
    - BESR
    - BBCOR
- Outcomes
  - Home runs (o.hr)
  - Sacrifice bunts (o.sh)
  - Stolen bases (o.sb)

## Procedures

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- MANOVA
- Shapiro-Wilk tests for multivariate normality
- Multivariate effect sizes ( $\eta^2 = 1 - \Lambda_W$ )
- Univariate effect sizes (Cohen's  $d$ )
- Post-hoc univariate 95% CIs about each mean difference

## Descriptives

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- Home runs (2010/2011)
  - Min. = 7/7
  - Max. = 131/86
- Sacrifice bunts (2010/2011)
  - Min. = 2/9
  - Max. = 78/111
- Stolen Bases (2010/2011)
  - Min. = 19/15
  - Max. = 216/159

## Descriptives

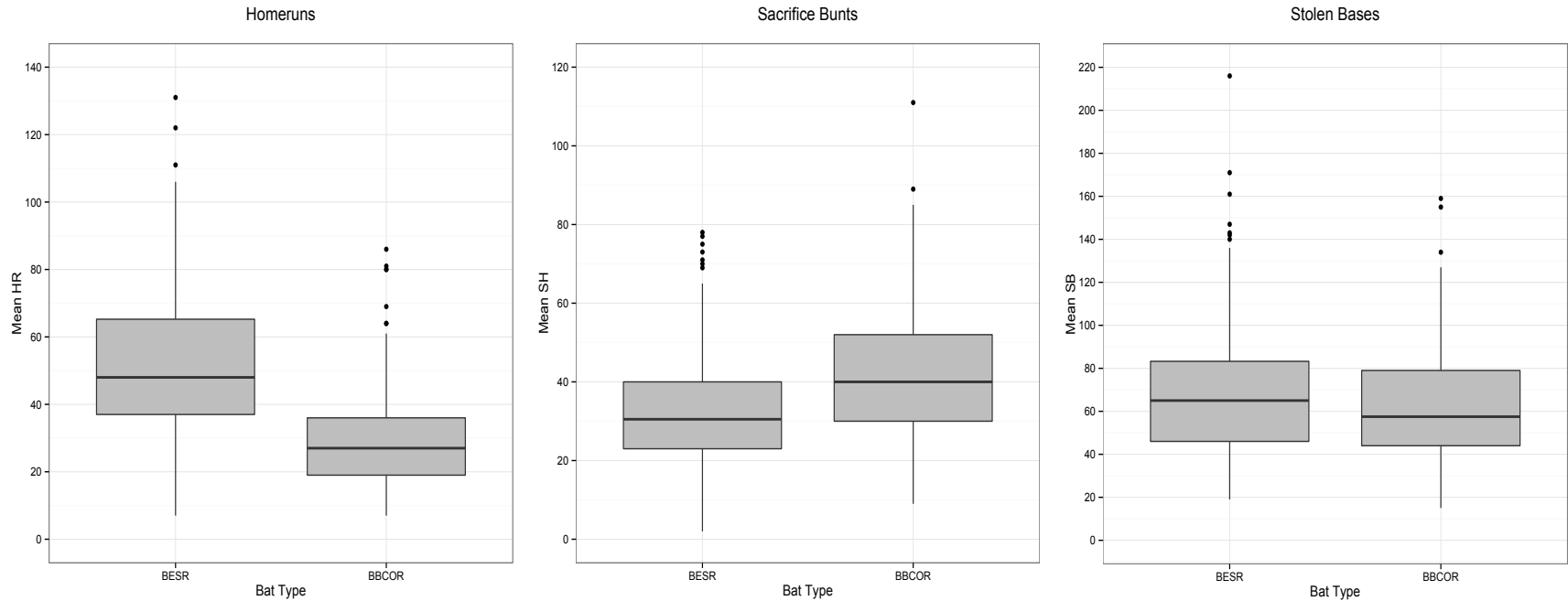
Table 1

*Mean Scores and Standard Deviations for Measures of Offensive Production as a Function of Bat Type*

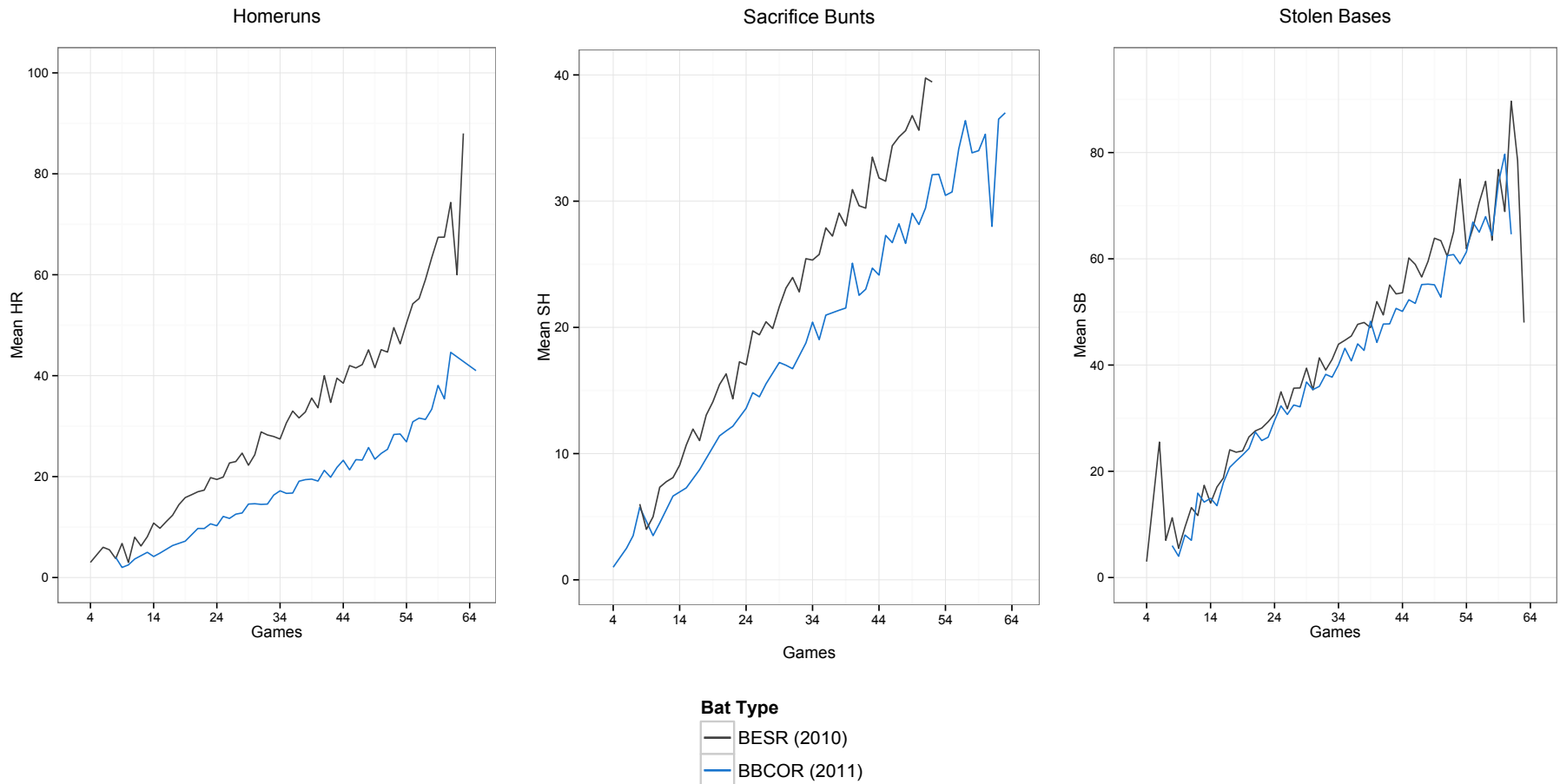
Bat Type	Home Runs		Sacrifice Bunts		Stolen Bases	
	$\mu$	$\sigma$	$\mu$	$\sigma$	$\mu$	$\sigma$
BESR	52.27	22.08	32.53	14.17	67.70	9.02
BBCOR	28.82	13.93	41.85	16.38	62.10	24.99

*Note.* BESR = ball exit speed ratio, BBCOR = ball-bat coefficient of restitution,  $N = 292$ .

## Mean Predictor Visualization



## Season Trends among Predictors



## Multivariate & Univariate Analyses

Table 2

*Multivariate and Univariate Analyses of Variance for BBCOR Bats*

	Multivariate				Univariate			$\Delta R^2$
	$T^2$	$\Lambda_W$	$\eta^2$		$F$	Int. [95% CI]	$B$ [95% CI]	
	--	--	--	HR	235.50 <sup>***</sup>	52.27 [50.15, 54.39]	-23.45 [-26.45, -20.44]	0.287
BBCOR	6.37	0.14	0.86	SH	53.96 <sup>***</sup>	33.53 [30.77, 34.29]	9.31 [6.82, 11.80]	0.083
	--	--	--	SB	6.23 <sup>*</sup>	67.70 [64.58, 70.81]	-5.59 [-9.99, -1.19]	0.012

Note.  $\Lambda_W$  = Wilks' lambda,  $T^2$  = Hotelling's T,  $\eta^2$  = Eta squared, Int. = Intercept, B = Unstandardized beta,  $\Delta R^2$  = Adjusted R square, HR = home runs, SH = sacrifice bunts, SB = stolen bases,

<sup>\*\*\*</sup> =  $p < 0.001$ , <sup>\*\*</sup> =  $p < 0.01$ , <sup>\*</sup> =  $p < 0.05$ .



## Variability

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- Wilks' lambda ( $\Lambda_W$ ) indicates approximately 14% of variability among differences between years remains unexplained
- Conversely, approximately 86% of variability among differences between years is explained by predictors

## Home Runs

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- As expected, declined sharply in 2011
- As a result, teams predicted to hit 20 – 26 fewer HRs per season
- Strongest effect observed ( $d = 1.3$ )
- No surprise since many NCAA teams may have been accustomed to utilizing BESR bats

## Sacrifice Bunts

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- As expected, teams executed more sacrifice bunts
- As a result, teams predicted to execute 6 – 11 more SHs per season
- Moderate effect observed ( $d = 0.68$ )
- Likely a result of teams attempting to manufacture runs

## Stolen Bases

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- Stolen bases actually declined in 2011
- Hypothesized they would increase
- Lack of practical significance in model results

## Conclusions

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- Findings indicate sizable main effects of bat type on team home run and sacrifice bunt totals
- Variability among stolen bases not meaningful
- Future studies should include subsequent years, pitching and defensive predictors

Thanks y'all!

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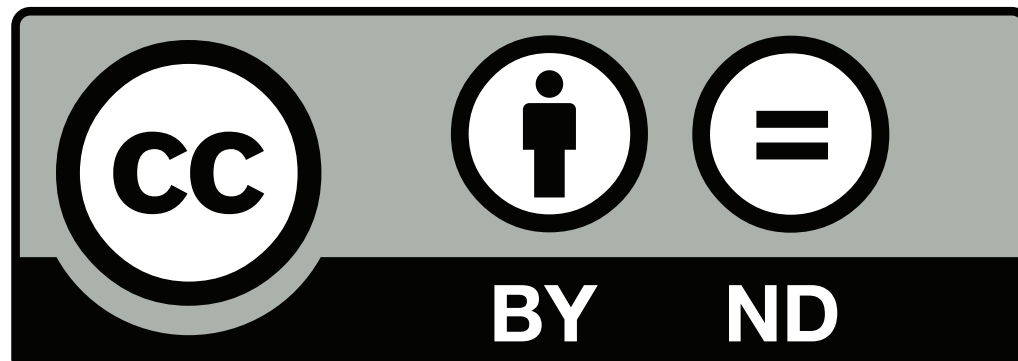
abaggett@umhb.edu

 @aaron\_baggett

 <http://github.com/aaronbaggett/NCAA>

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