Bat Speed – Part 2

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Question and Hypothesis

- Question
  - Does the weight distribution of a baseball bat effect the swing speed?
- Hypothesis
  - I think the weight distribution will affect the swing speed because when the weight is on the handle, the end of the bat that makes contact with the ball will become lighter causing it whip around faster. If the end of the bat is weighted, than it will feel heavier and harder to get around.

Procedures

- I measured the center of mass of a bat by balancing it on a 1/8 inch thick aluminum bar held in a vice.
- I measured the period of oscillation to calculate the moment of inertia. To do this, an aluminum bar was placed six inches from the handle to serve as a pivot point, and balanced on two saw horses at a fixed distance of 12 inches.
- I pulled the bat back to a fixed distance and let go while simultaneously pressing go on the stopwatch, then counted five oscillations and stopped the time. I took the average of the five trails and then I divided the average by five because I counted five oscillations to diminish the error in the timing.
- I calculated the moment of inertia according to the following formula: $I=T^2mgd/(4\pi^2)$ where I= the moment of inertia, T= period of oscillation, m= mass, g= the force of gravity, and d= the distance from the pivot point to the center of mass.
- I used my double pendulum test apparatus from last year's project to measure the bat speed of three bats including the two that didn't fit with the weight trend from last year's project.
- I added two ounces of weight using led weights and duct tape to the handle, sweet spot, and end of the bat. Then I did all of the tests with each of these three conditions described above.
- I then analyzed and graphed my results in Microsoft Excel.

Period Measuring Setup

Bat speed Apparatus Setup

- Relaxed position

- Loaded position

Conditions Measured

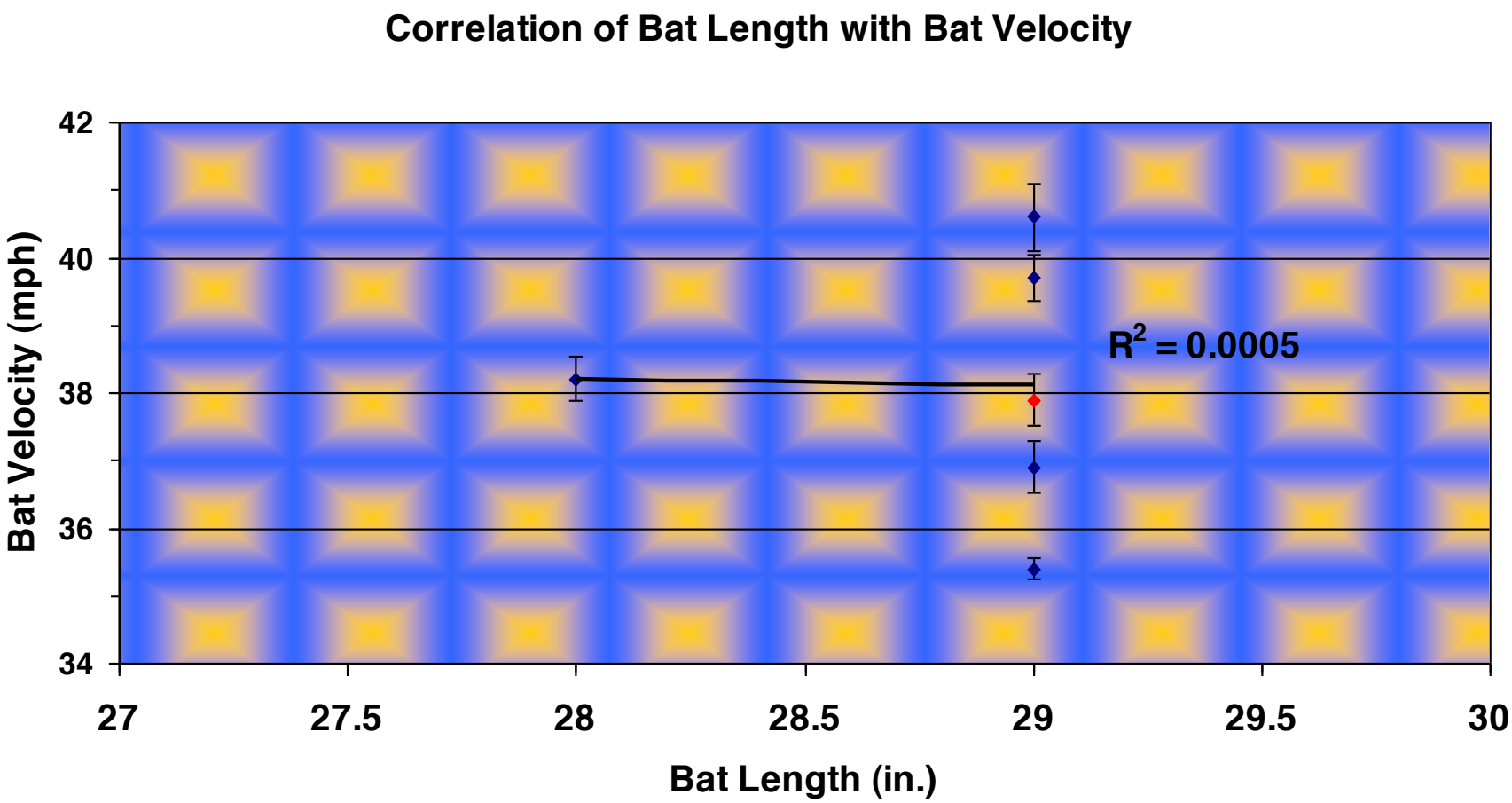
Condition	Weight (2 oz)	Bat			
		Length (in.)	Weight (oz.)	Barrel (in.)	Description
1	None	29	20	2 3/4	Easton 29/20
2	None	28	18	2 5/8	Easton 28/18
3	None	29	18.5	2 1/4	Louisville Slugger 29/18.5
4	End	29	20.5	2 1/4	Louisville Slugger 29/18.5
5	Sweet-spot	29	20.5	2 1/4	Louisville Slugger 29/18.5
6	Handle	29	20.5	2 1/4	Louisville Slugger 29/18.5

- Measured center of mass, did 5 period trails, and calculated the moment of inertia
- 10 speed trials were conducted with each condition, and bat speed recorded

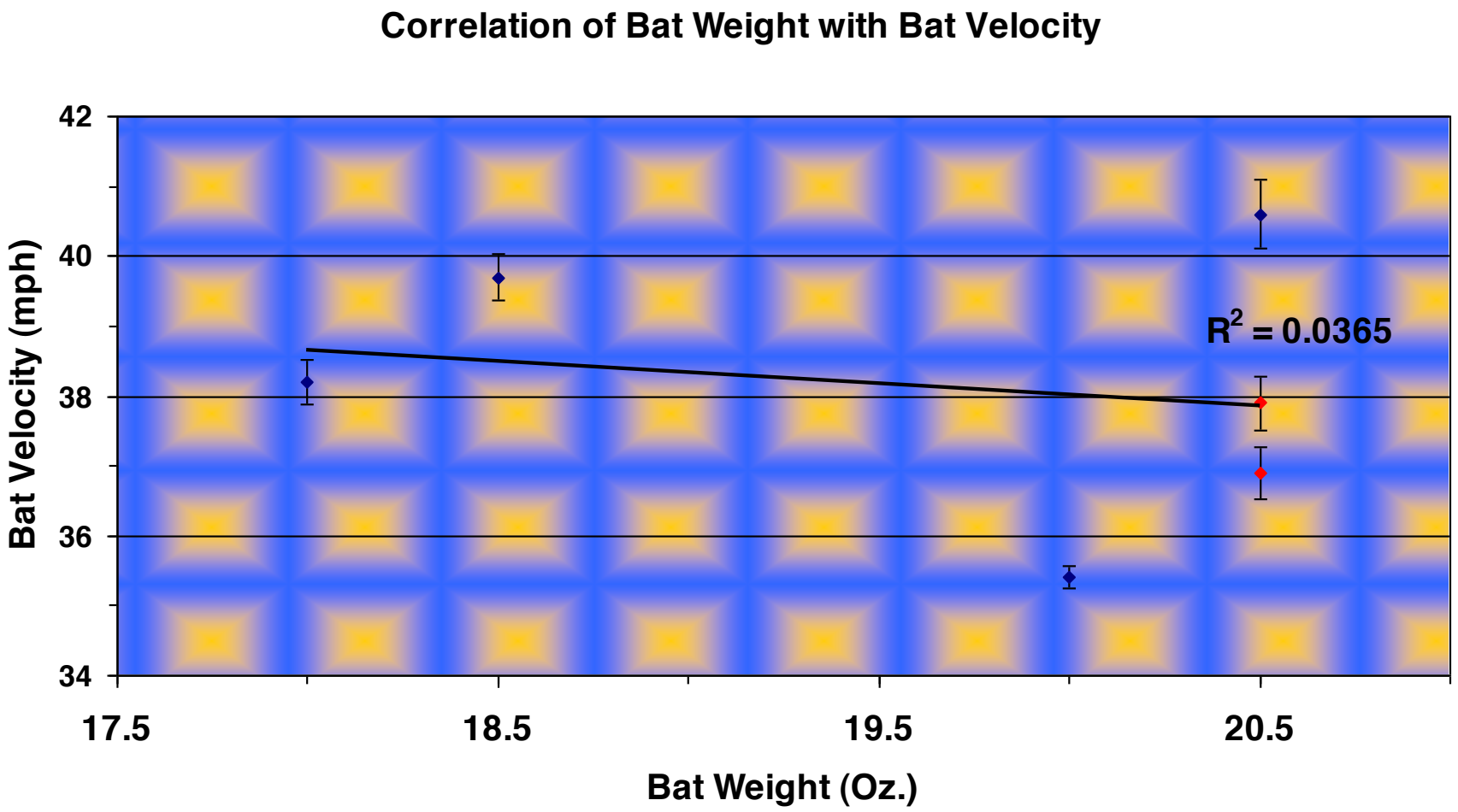
Experimental Data and Calculations

Bat	Speed (mph)	Length (in)	Weight (oz.)	Period (sec.)	Center of Mass (in.)	Moment of Inertia (oz.-in^2)
Easton 29/20	35	29	20	1.3	19.0	4543
Easton 28/18	38	28	18	1.3	18.4	3897
Louisville slugger 29/18.5	40	29	18.5	1.3	16.9	3386
Louisville slugger 29/18.5 + 2 oz. at end	37	29	20.5	1.4	17.8	4238
Louisville slugger 29/18.5 + 2 oz at sweet-spot	38	29	20.5	1.3	17.3	3668
Louisville slugger 29/18.5 + 2 oz at handle	41	29	20.5	1.3	16.0	3254

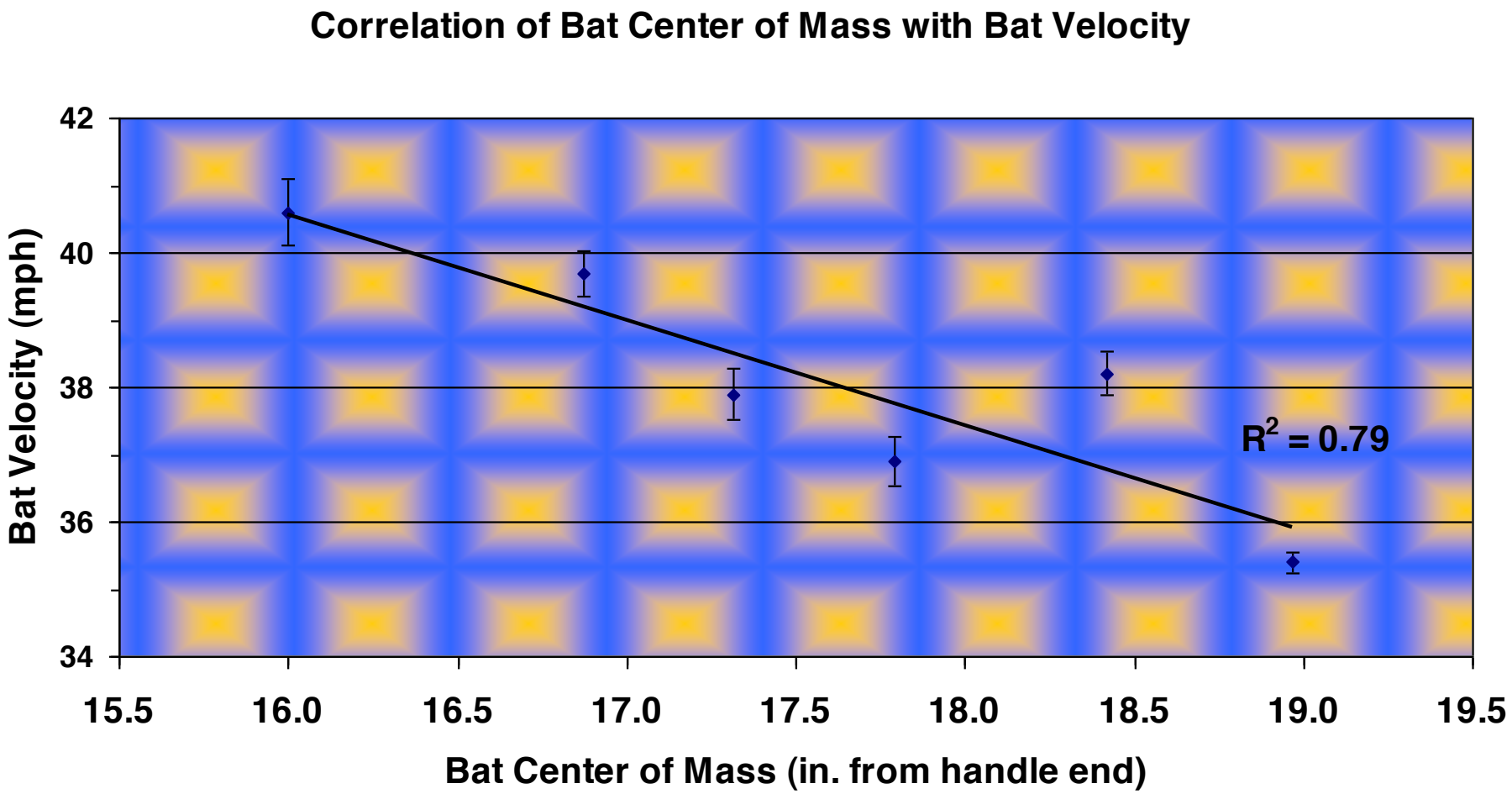
Bat Velocity Does Not Correlate With Length



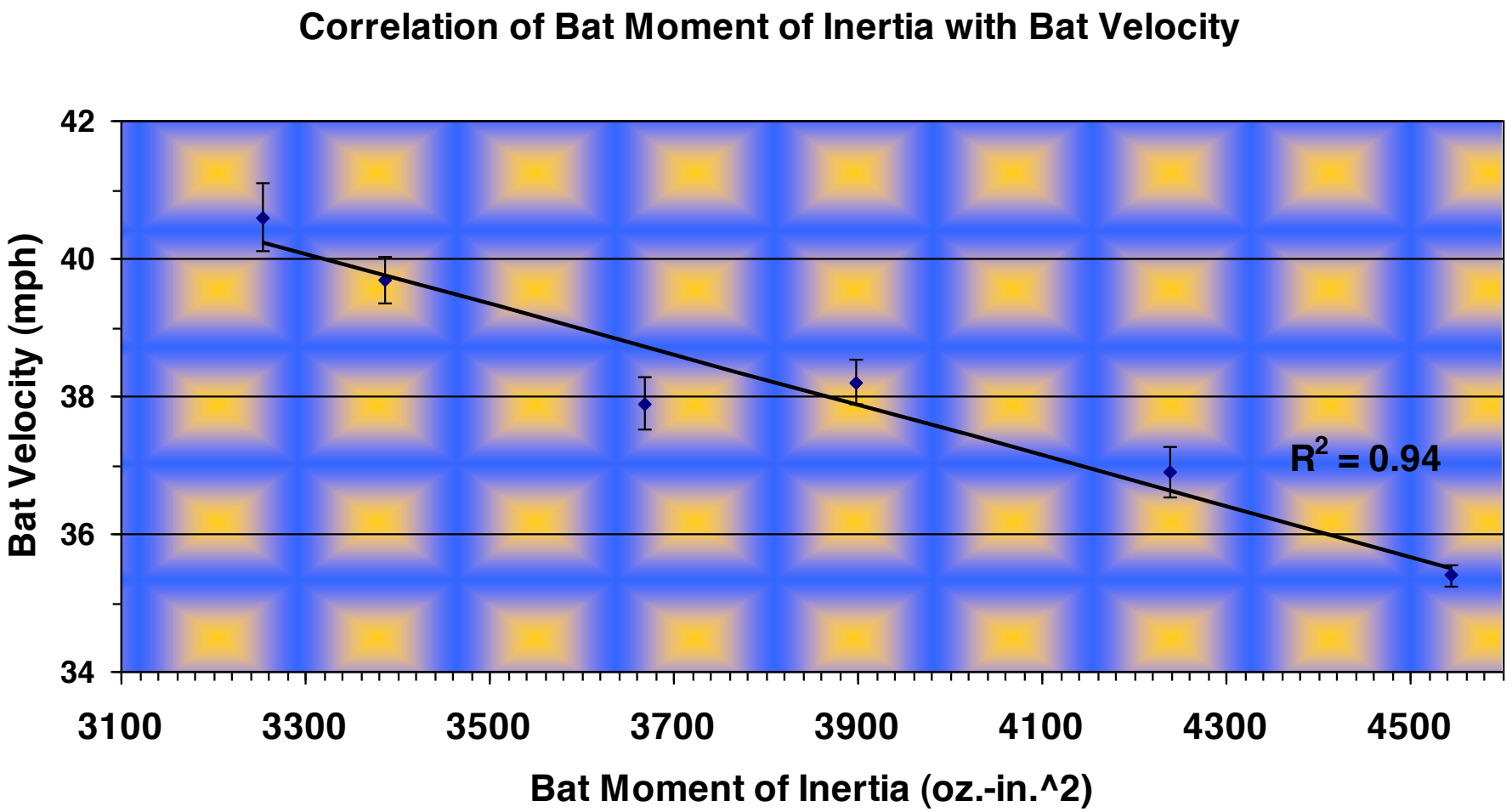
Bat Velocity Does Not Correlate With Weight



Bat Velocity Correlates With Center of Mass



Bat Velocity Correlates With Moment of Inertia



Conclusions – Part 2

- Baseball swings can be modeled with pendulums.
- Bat length and weight do not correlate with velocity
- Bat center of mass and moment of inertia correlate well with bat velocity
- Hitters should consider weight distribution, not just length and weight, of bat when selecting a bat

Bibliography

- Adair, R. The Physics of Baseball, Harper-Collins Inc., New York, 2002, pp 29-46, 79-111.
- Baker, D. You Can Teach Hitting, McGraw-Hill, New York, 1993, pp 15-45.
- Russell, D. Swing Weight of a Softball Bat, www.kettering.edu/~drussell/bats-new/Papers/TPT-SwingWeight.pdf (2006).
- Russell, D. Physics and Acoustics of Baseball and Softball Bats, http://paws.kettering.edu/~drussell/bats.html (2007).
- http://perfectgolfswingreview.net/overview.htm "Overview of the modern, total body golf swing" (2008).
- www.batspeed.com "Bat Speed Research" (2007).

Appendix 2

Moment of Inertia Table

Moment of Inertia For Various Bats

Bat	Year (approx.)	Barrel Dia. (in.)	Length (in)	Weight (oz.)	Period (sec.)	Center of Mass (in.)	Moment of Inertia (oz.-in^2)
Louisville slugger 29/18.5	2004 ?	2 1/4	29	18.5	1.31	16.9	3386
Easton Stealth 28/18	2006	2 5/8	28	18.5	1.32	18.4	3897
Easton Stealth 29/20	2005	2 5/8	29	20	1.34	19.0	4543
LS Dynasty 30/20.5	2006	2 5/8	30	20.5	1.40	18.4	4859
Combat -10 31/21	2009	2 5/8	31	21	1.42	19.3	5516
LS Omaha TPX 31/21.5 (Thomas)	2007	2 5/8	31	21.5	1.43	19.5	5775
LS Omaha TPX SX 31/22.5 (Hugh)	2006 ?	2 5/8	31	22.5	1.45	19.4	6236
Combat -8 31/23	2009	2 5/8	31	23	1.40	19.5	5949