



# Constructing the Barrel Zone for College Softball

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## Abstract and Objectives

The implementation of Statcast "tracking technology" in all MLB ballparks in 2015 led to another sabermetric revolution, allowing for previously impossible analyses in all facets of the sport (Statcast).

This technology led to the development of the "barrel" metric, which measures the quality of contact a batter makes with a pitch. The benefit of the barrel statistic is that it "measure[s] inputs rather than outputs," meaning players are judged by what they themselves completely control, and is a great metric for "evaluat[ing] a player in a smaller sample and ... correlates nicely to an outcome that everyone agrees is important" (Carleton).

The objective of this research is to define an analogous version of the barrel metric for college softball by recreating the barrel zone.

## Important Terminology

**Batting Average:** Measures the rate a player earns a base hit per at-bat ("Batting Average (AVG)").

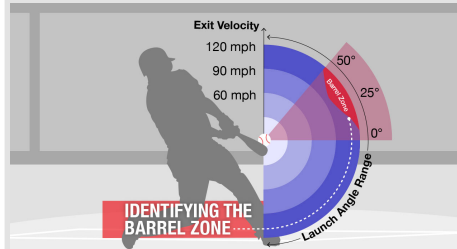
**Slugging Percentage:** Measures the rate a player earns total bases per at-bat (0 for out or reaching on error, 1 for single, 2 for double, 3 for triple, and 4 for home run) ("Slugging Percentage (SLG)").

**Launch Angle:** Measures the vertical angle a batted ball is traveling immediately after contact is made with the bat, relative to the ground ("Launch Angle (LA)").

**Exit Velocity:** Measures the speed a batted ball is traveling immediately after contact is made with the bat ("Exit Velocity (EV)").

**Barrel:** A batted ball hit into fair play is considered a barrel if it is hit in the "barrel zone," which is the range of launch angle and exit velocity whereby the expected batting average is at least .500 and expected slugging percentage is at least 1.500 ("Barrel").

## Major League Baseball's Barrel Zone



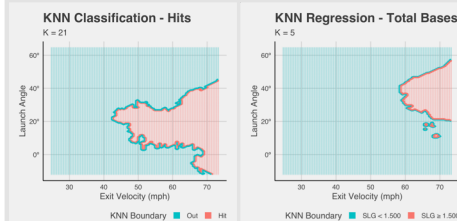
<https://www.mlb.com/glossary/statcast/barrel>

## Methodology

K-Nearest Neighbors (KNN) classification was used to find the range of launch angles and exit velocities in which the expected batting average is at least .500, and KNN regression was used to find the range in which the expected slugging percentage is at least 1.500. The intersection of these ranges was then taken to find the barrel zone.

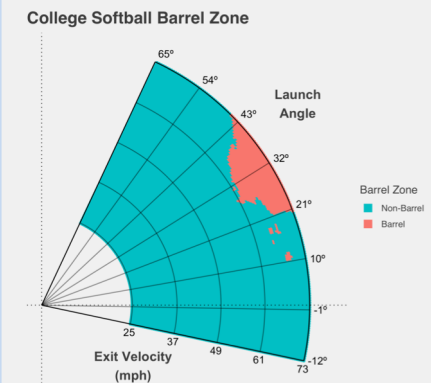
The decision to use KNN modeling was based on the hypothesized non-linear decision boundary, having only two predictors, and the relatively small sample size ( $n = 287$ ) which makes computing distances fairly efficient.

30% of the data was held for testing, and 5-fold cross-validation was used to find the optimal  $k$  hyperparameter for both the classification and regression models, resulting in  $k$ -values of 21 and 5, respectively.



## Conclusions

This research found the barrel zone for college softball to be batted balls with a launch angle between about 21° and 39° and an exit velocity above about 63 mph, with the launch angle range becoming wider as the exit velocity increases. The following is a visual representation:



## Comparison to MLB Barrel Zone

Comparing this college softball barrel zone to that of MLB, we see that the shape of the barrel zones are very similar.

One difference is that the barrel zone launch angle range for softball is lower than that for MLB. One potential explanation is that due to its larger surface area, air resistance has a greater impact on the flight of softballs than baseballs, and thus it is more difficult to hit a softball as far as a baseball ("Air Resistance: Terminal Velocity"). Therefore, if a softball is hit at the upper end of the MLB barrel zone's launch angle range, say at 50°, with large exit velocity, while in the MLB that would likely be a home run, for a softball the air resistance could see it fall for a flyout. For context, the range of launch angles for all home runs in the data was 26.42° to 41.96°, and the greatest launch angle of a base hit was 46.08°.

## Limitations

One limitation of this research was the relatively small sample of batted balls for which the FlightScope software recorded both the exit velocity and launch angle. A more robust dataset, particularly with more extra-base hits, would allow for greater confidence in the employment of more sophisticated modeling techniques, such as linear or quadratic discriminant analysis or support vector machines. With more future data, these more advanced families of models can be used, and the shape of the college softball barrel zone can be further fine-tuned.

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- University of Michigan softball team
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## Citations

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