CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

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Project Number

J0228

Project Title

What Is the Optimal Release Angle for Shooting a Free Throw?

Abstract

Objectives/Goals

Research on the optimal release angle for shooting a free throw compares effectiveness for low (35-45º), medium (45-50º) and high (50-58º) release angles. My hypothesis states that shooter release angle will be a determining factor in the number of free throws made. I tested this hypothesis for four different release angles (42,47,52,57º), predicting that the highest number of free throws will be made at a release angle of 52º. I used my results to model the parabolic trajectory of a free throw, calculating the maximum height and the angle of entry into the hoop for the optimal release angle.

Methods/Materials

To control for release angle I built a freestanding release angle guide that locates where the basketball must pass at 10 feet above the ground on the path to the basket. I determined the x and y coordinates of the release point of a free throw for each subject, and used the tangent ratio to calculate the horizontal location of the guide for each release angle tested. Subjects shot ten free throws at each release angle over two separate trials, and the number of free throws made was recorded. Parabolic trajectories were calculated both by hand and using a TI-83 calculator, were graphed using LoggerPro software, and were recorded digitally for video analysis.

Results

In all but one trial, each shooter made the highest number of free throws at the release angle of 52º. Each shooter's average number of free throws made across both trials was the highest at 52º. Finally, the highest number of free throws made over two trials for all shooters, 7.1/10, was at 52º. The next highest average was 5.6/10 for the release angle of 47º.

Conclusions/Discussion

I proved my hypothesis correct that the highest number of free throws will be made at a release angle of 52º. I calculated the parabolic equation for each shooter for each release angle using points on the path of the free throw. I duplicated these calculations for selected free throws by completing a quadratic regression using video data. I took the first derivative of each parabolic equation to calculate the maximum height and angle of entry for each release angle. The maximum height at the optimal release angle of 52º was consistent for all shooters, and the angle of entry was exactly that predicted by the research. My research is important because many young people play basketball, and this can teach them a new approach to making a free throw.

Summary Statement

My project determines which of four free throw release angles results in the highest number of shots made, then calculates the ball's parabolic trajectory to develop conclusions regarding the maximum height and preferred angle of ball entry

Help Received

My father helped me to build and transport the 10 foot release angle guide that I used to control for the release angle of each shooter.