



## TP A.13

### Number of lines of aim required for different types of shots

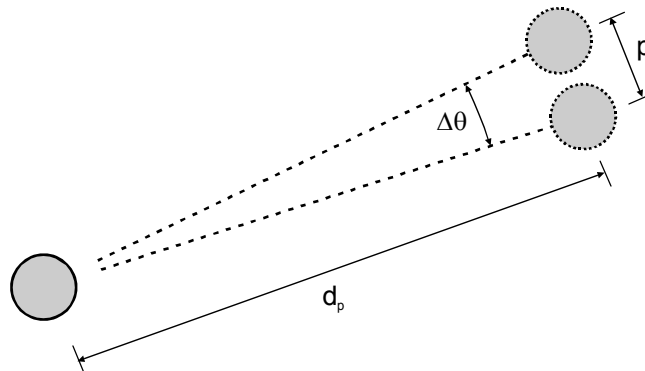
supporting:

“The Illustrated Principles of Pool and Billiards”

<http://billiards.colostate.edu>

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originally posted: 6/27/05    last revision: 5/12/23



For a given distance from the pocket ( $d_p$ ) and a given effective target size of the pocket ( $p$ ), the allowable angle error in the object ball path is:

$$\Delta\theta(p, d_p) := 2 \cdot \text{atan} \left( \frac{\frac{p}{2}}{d_p} \right)$$

For an aiming system to cover all possible cut angle shots, the angles between each line of aim must not be any larger than this allowable error. Otherwise, some shots between the lines of aim would be missed. Therefore, the minimum number of required lines of aim, assuming the lines of aim are equally spaced, is:

$$N_{\min}(\Delta\theta) := \frac{90 \cdot \text{deg}}{\Delta\theta}$$

Based on Figure 3.37 in the book, the effective target size of a pocket, on average for a slow shot with access to a full, unshimmed pocket, is:

$$p := 3 \cdot \text{in}$$

Here are some example values for various length shots:

$$d_p := 1 \cdot \text{ft} \quad \Delta\theta(p, d_p) = 14.25 \text{ deg} \quad N_{\min}(\Delta\theta(p, d_p)) = 6.316$$

$$d_p := 3 \cdot \text{ft} \quad \Delta\theta(p, d_p) = 4.772 \text{ deg} \quad N_{\min}(\Delta\theta(p, d_p)) = 18.86$$

$$d_p := 6 \cdot \text{ft} \quad \Delta\theta(p, d_p) = 2.387 \text{ deg} \quad N_{\min}(\Delta\theta(p, d_p)) = 37.705$$

Now, if we only consider cut shots over a certain range (e.g., 7.5 degrees to 52.5 degrees), where we use only three lines of equally spaced aim (at 15, 30, and 45 degrees), the percentage of cut shots covered by these lines of aim over this limited cut shot range would be:

$$\text{coverage}(p, d_p) := \frac{\Delta\theta(p, d_p)}{\frac{52.5 \cdot \text{deg} - 7.5 \cdot \text{deg}}{3}}$$

If this number is less than 100%, then the three lines of aim do not provide full coverage over the entire cut shot range (i.e., shots between the aiming lines cannot be made without compensation or adjustment). If this number is greater than 100%, then the aiming regions overlap (i.e., some "in-between" shots will be sinkable from two different aiming lines).

$$d_p := 0.5 \cdot \text{ft} \quad \text{coverage}(p, d_p) = 187.15 \%$$

$$d_p := 1 \cdot \text{ft} \quad \text{coverage}(p, d_p) = 95 \%$$

$$d_p := 2 \cdot \text{ft} \quad \text{coverage}(p, d_p) = 47.684 \%$$

$$d_p := 6 \cdot \text{ft} \quad \text{coverage}(p, d_p) = 15.913 \%$$

So with three lines of aim over the limited cut angle range, all shots less than a 1/2 foot from the pocket will be made, 5% of shots 1 foot away will be missed, 52% of shots 2 feet away will be missed, and 84% of shots 6 feet away will be missed.