

SHOT APTITUDE (SA): A MEASURE OF A PLAYER'S INHERENT ABILITY TO PERFORM IN SHOOTING AND SHOT SELECTION

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ABSTRACT. The aim of this paper is to describe and list a new Pool Stats metric, which we call a sabermetric, after the notion that was introduced to the sport of baseball by Bill James. Shot aptitude is the inherent ability of a player to act decisively and effectively while at the table. Time is a large contribution in this decision making process, but other factors are also sensitive to the calculations. We will describe and provide a brief summary of the factors and weight functions below.

1. INTRODUCTION

One can find many useful applications to a metric which illustrates a player's inherent ability. Such applications can include ranking of professional pool and billiards players. A more practical use is as a guide to inform a player how they can adjust their game and improve their aptitude or conversely improve their aptitude and adjust their game also.

How does one increase their shot aptitude and how will it help you?

- (1) Make your shots.
- (2) If you're going to miss, miss on difficult shots, not easy ones; as you will be penalized less in SA.
- (3) If you are overthinking your game and taking too long to decide, adjust yourself to making better and quicker decisions.
- (4) Play more and better defense.
- (5) Watch your foul game. Sometimes we get forced to foul, but other times it's on us.
- (6) Get used to playing with a shot-clock to speed up your thought process and decision making abilities. We think it is integral to the game of pool that a shot clock be necessary as it not only makes it more interesting, but enhances the player's thinking ability.
- (7) If you are making harder shots, but taking too long to execute, your SA may drop only slightly, if at all. Instead, try having better cue ball placement so the next shot is easier and faster thereby increasing your SA.

2. ANALYSIS

The factors in shot aptitude measure the attributes of any give shot which was recorded with the Pool Stats Pro app. We consider the following shot attributes for a given player:

- (1) p : Player (i.e. PlayerID)
- (2) S_p^+ : Made shot

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- (3) S_p^- : Missed shot
- (4) S_p^f : Foul shot
- (5) S_p^d : Defensive/Safety shot
- (6) t_x : Time to shoot
- (7) $\mathcal{P}(\mathfrak{s})$: Shot probability
- (8) T_{S_p} : Total shots

Equation 2.1. *Shot Aptitude is made up of four weight functions and averaged by the total number of shots for a given player.*

$$\mathcal{SA}(p) = \frac{\tau(p) + \eta(p) + \theta(p) + \iota(p)}{T_{S_p}}$$

The following equations, which we call *Aggregated Factors*, are the weight functions in order from left to right on the top side of the \mathcal{SA} function.

Equation 2.2. *Aggregated Made Shot Factor (AMSF)*

$$\tau(p) = \Delta \left(\sum_{\mathfrak{m}=S_p^+} (65 - t_{\mathfrak{m}})(1 - \mathcal{P}(\mathfrak{m})) \right)$$

Equation 2.3. *Aggregated Miss Shot Factor (AMiSF)*

$$\eta(p) = \Gamma \left(\sum_{\mathfrak{s}=S_p^-} (t_{\mathfrak{s}})(\mathcal{P}(\mathfrak{s})) \right)$$

Equation 2.4. *Aggregated Defensive Shot Factor (ADSF)*

$$\theta(p) = \text{B} \left(\sum_{\mathfrak{d}=S_p^d} (65 - t_{\mathfrak{d}})(1 - \mathcal{P}(\mathfrak{d})) \right)$$

Equation 2.5. *Aggregated Foul Shot Factor (AFSF)*

$$\iota(p) = \text{A} \left(\sum_{\mathfrak{f}=S_p^f} (t_{\mathfrak{f}})(\mathcal{P}(\mathfrak{f})) \right)$$

The maximum t_x value is 60 (60 seconds). For $\tau(p)$ and $\theta(p)$ we calculate $65 - t_x$ as the first variable in order to give some value to made and defensive shots where $\max t_x$ was reached. Notice also, that for the negative factors i.e., Miss Shot Factor and Foul Shot Factor, we multiply by time to shoot t_x . This is intuitive since the longer it takes to shoot and miss or foul, the more you are penalized. Given more time the player should be less prone to create negative value.

Where the scalar weights in the weight functions are defined as follows:

Equation 2.6. *Scalar weights*

$$\Delta = 2 \quad \Gamma = -2 \quad B = 1.5 \quad A = -3$$

These scalar weights will be fitted appropriately as more data becomes available over the course of time. For now, we think the scalar weights provide a reasonable measure of the value given by a given by an Aggregated Factor or weight function. As new stats are added and conjured up the weight functions may change to include new attributes of a shot. This paper may have subsequent publications. Please stay informed by going to <https://www.poolstats.co> for the latest and up-to-date information on our publications.

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