An Examination of Timeout Value, Strategy, and Momentum in NCAA Division 1 Men's Basketball

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Introduction

The sport of basketball is often described as "a game of runs". A typical basketball game may have several stretches when one team scores the majority of points in a short portion of the game, only to be followed by the other team answering with a scoring run of its own. Coaches seem to take timeouts when their team is on a negative scoring run, feeling pressure to stop an opponent's quick flurry of scoring. This work seeks to examine how timeouts are used in NCAA Division 1 men's basketball and whether there is any truth to the notion that timeouts stop opponent momentum by decreasing the rate of opponent scoring or swinging the rate of scoring in favor of the timeout-calling team. The data used in this project are 10,409 complete NCAA basketball play-by-play logs from the 2016-17 and 2017-18 seasons, scraped from ESPN.com using the `ncaahoopR` package for the R statistical computing language. [1]

A First Pass

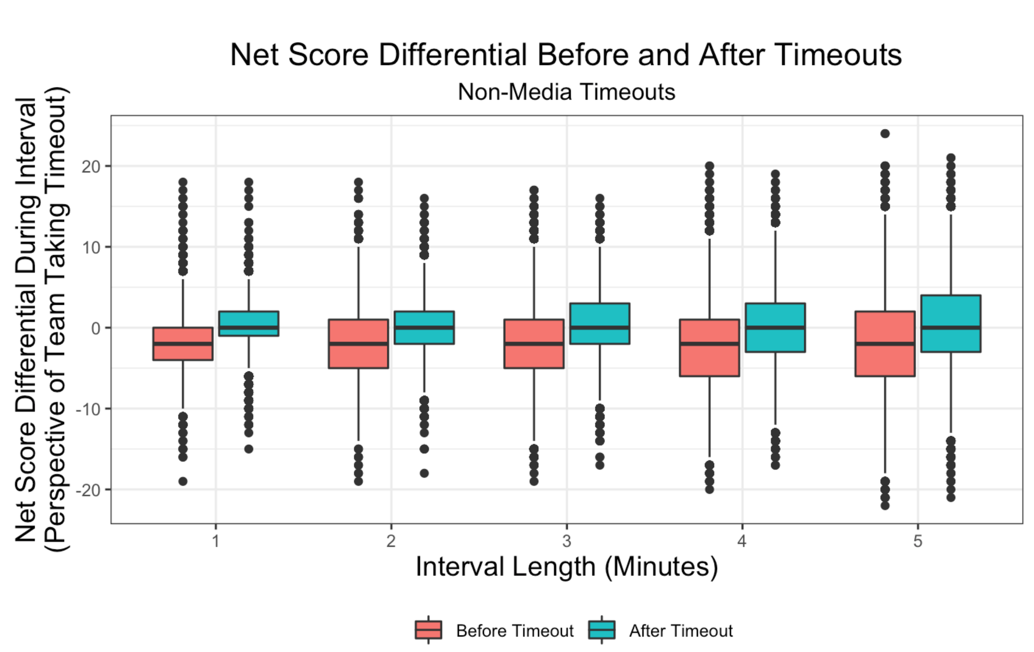

Figure 1: Net Score Differential Distributions Before and After Called (Non-Media) Timeouts

A first pass at trying to quantify momentum is to look at the net score differential, from the perspective of the timeout calling team, during equal length intervals before and after the timeout. For each 1-5 minute interval, the timeout calling team has a higher average net score differential in post-timeout intervals when compared to corresponding pre-timeout intervals, with the variance in post-timeout net score differential lower than the variance in pre-timeout net differentials for each equal length interval.

Points Above Expectation

To account for the fact that coaches are more likely to call timeouts when their team is on a negative scoring run, this section outlines a framework for modeling the number of points a team would expect to score in a certain time interval given a particular game situation, were the run of play to continue as normal. Taking the difference between the number of points a team scored following a timeout and the number of points they were expected to score given the particular game situation allows one to quantify the value of a timeout in terms of Points Above Expectation (PAE).

More formally, let S_{ijkB} and S_{ijkA} denote the net score differential for a team in $i-$minute intervals before and after game state j (time remaining, score differential, and pre-game point spread) of game k.

$$S_{ijkA} = \boldsymbol{X}_{ijk}^T\boldsymbol{\beta} + \gamma_k + \epsilon_{ijk}$$
$$\gamma_k \sim N(0, \tau^2) \text{ and } \epsilon_{ijk} \sim N(0, \sigma^2)$$

$\boldsymbol{X}_{ijk}$ is a vector of covariates encoding information about the particular game state. Specifically, the following covariates are considered:

- S_{ijkB}: The team's net score differential in the i second interval preceding game state j of game k.
- `favored_by`: The pre-game point spread from the team's perspective.
- `score_diff`: The current score differential from the team's perspective.
- `time_remaining`: The amount of time remaining in the game.

The training set for these models removed all game states where a timeout took place (both media and non-media) in order to adequately capture expected behavior without immediate stoppage of play. Predicting these models on game states that are timeouts allows for an estimate of how much better or worse a team performed as a result of the stoppage in play. Specifically points above expectation is given by the residual:

$$\hat{S}_{ijkA} - S_{ijkA}$$

Results

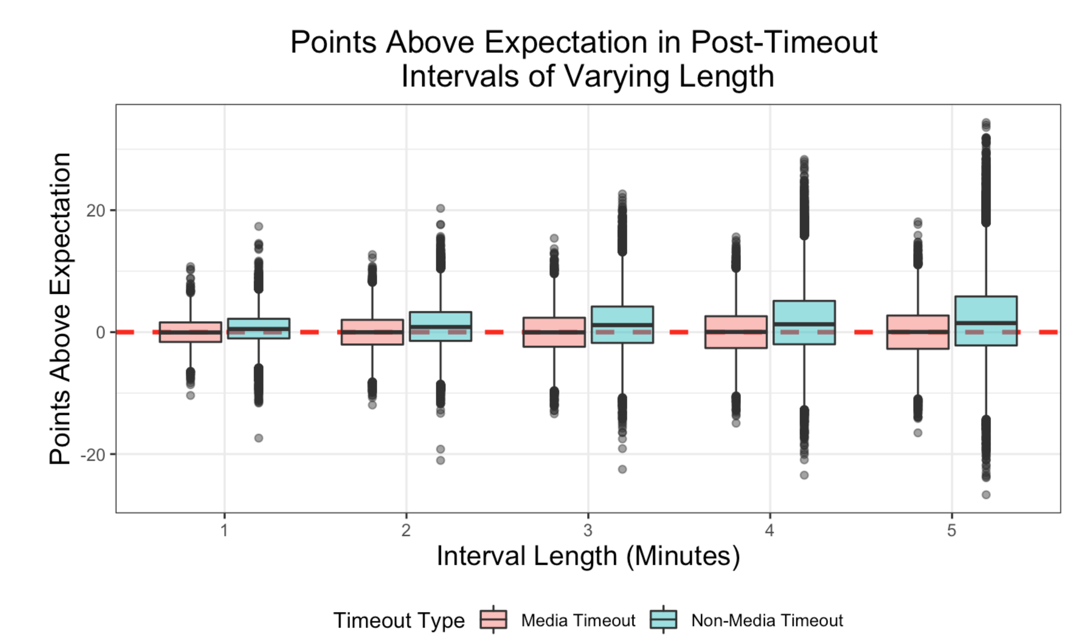

Figure 2: Distributions of PAE After Timeouts

For each of the five intervals, non-media timeouts have median PAE > 0. That is, on average, teams calling a timeout perform better in up to five minute intervals following the timeout than would be expected were no timeout to be called from an equivalent game state. This does not hold for media timeouts, suggesting that even after accounting for the fact that teams are more likely to take timeouts following negative scoring runs, there appears to be more benefit in called timeouts compared with media timeouts.

As the below figure shows, teams tend to out perform expectation after timeouts by larger margins earlier in the game than later in the game. This is likely due to the fact that more timeouts are taken later in the game than in the beginning of the game, and that there are more stoppages of continuous game play towards the end of games.

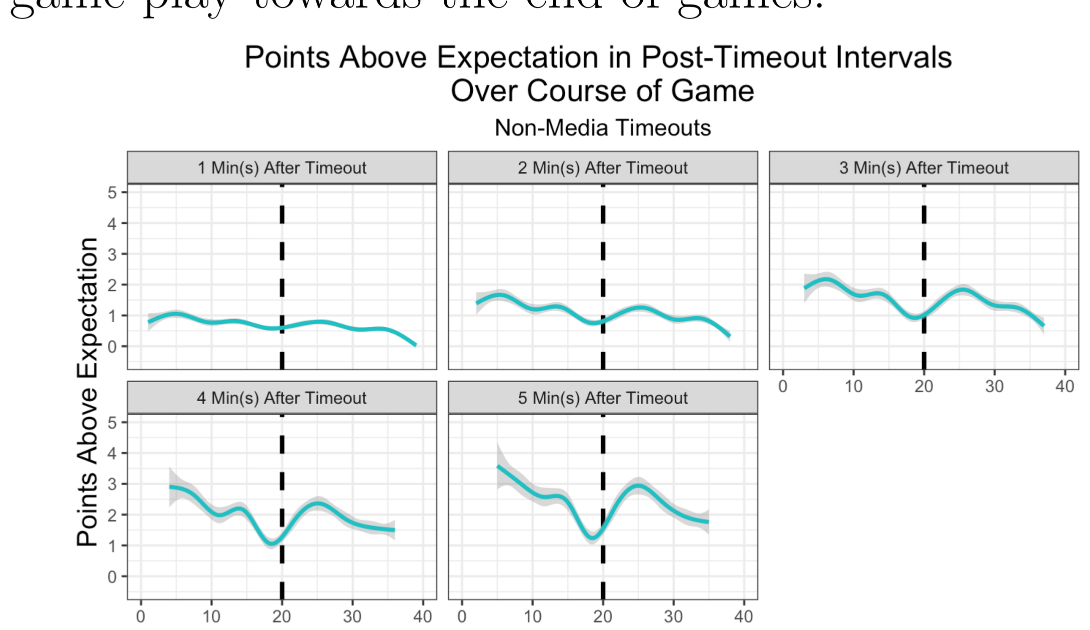

Figure 3: Average PAE After Non-Media Timeouts Throughout the Course of a Game

Timeout Value

A decent proxy for timeout value because it is the average PAE in the five minute interval following a timeout (from Figure 3) multiplied by the value of increasing the score differential by 1 point in the team's favor at that particular time of game, which comes from the the win probability model outlined in the full paper version of this work [2]. The resulting values reflect a team's increase in the odds of winning a game by taking a timeout and experiencing the average 5 minute boost in PAE.

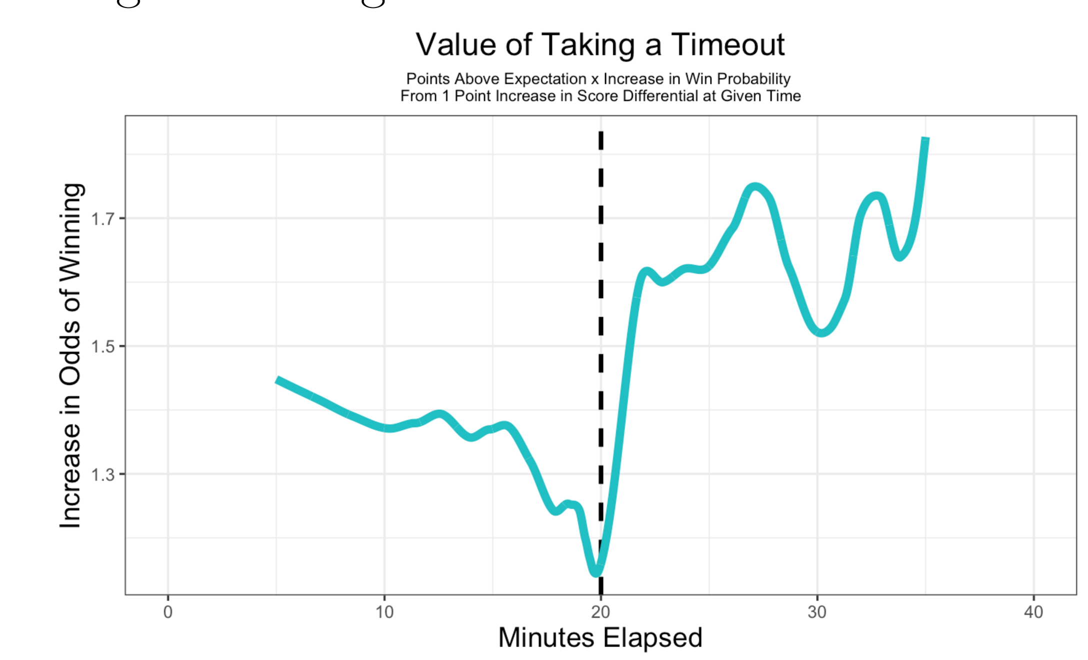

Figure 4: Value of Taking a Timeout

Takeaways

- On average, taking a timeout improves net score differential in intervals up to ≥ 5 minutes following the timeout.
- Coaches should be more aggressive with early first half timeouts.
- "Use it or Lose it" timeouts right before halftime are least valuable, though are still better than not taking a timeout.

References

[1] L. Benz.
ncaahoopR: An R package for working with NCAA Basketball Play-by-Play Data.
https://github.com/lbenz730/ncaahoopR, 2019.

[2] L. Benz.
An Examination of Timeout Value, Strategy, and Momentum in NCAA Division 1 Men's Basketball.
https://github.com/lbenz730/Senior-Thesis, 2019.