# Article : 1 Revisiting the Hot Hand Theory with Free Throw Data in a Multivariate Framework (January 2010)

In 2010, Jeremy Arkes studied all free throws attempted during the 2005-06 NBA season to find out the evidence for “hot hand” in game situation as many researchers in the past believed that  hot hand is a myth. It was just based on people's perception, not reality . Jeremy argued that almost all studies in past have tested for the hot hand at the individual level in univariate frameworks and therefore may not have had enough power to detect the hot hand. He, therefore, used a multivariate framework and combined all players into one model with individual player fixed effects. The data of the 89 players were investigated who had 50 sets of two or more free throws. He could find that hitting the first free throw is associated with a 2- to 3-percentage-points higher probability of hitting the second free throw. He used fixed-effect logit models to estimate the effect of making previous free throws on the probability of making a given free throw. He used several variants of the model to check different questions and sensitivity analysis of the results. He estimated weather a player is more likely to make a second free throw in a set of free throws once he made the first free throw. It was then examined whether the success on a free throw relies on success of attempts prior to the last free throw. He further suggested that one drawback of the approach in study could be “cold hand” which can influence the results. It essentially refers to the players being studied may have made low percentage of shots in certain periods but not any particular periods in which they made extraordinarily high percentage of shots.

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# Article : 2 The Hot (Invisble?) Hand : Can Time Sequence Patterns of Success/Failure in Sports Be Modeled as Repeated Random Independent Trials?

# In 2011, Gur Yaari and Shmuel Eisenmann studied the free throws data of 5 consecutive seasons (2005-6 to 2009-10 ) of NBA and come to a conclusion that a collection of individual sequences is indeed biased toward a hot hand tendency. The motivation for study came from the various research in the field sparked by the “hot hand” phenomenon published by Gilovich, Vallone and Tversky which was regarded as a pioneering paper in Cognitive Psychology which claimed that the observed patterns could have been produced by random which may be connected to the way human beings perceive the random world surrounding them and not to the objective features of reality. Yaari categorized the NBA dataset with three types of free throws sequences. The average of player success rate and conditional probabilities were calculated for all players. The results were then tested for statistical significance under Non-stationarity (NS) change and Conditional probability (CP), which could be studied with the aid of the hypergeometric distribution. The study found strong evidence for the existence of “hot hand “ phenomenon in free shots of NBA players . In was further observed that there is a existence of pattern on aggregated data that do not necessarily exist at the individual level. It was further observed that the probability of success increases with the order of throw attempts in a sequence .Conditional probability gave the insight that “Hot hand” pattern was visible even analysing individual sequence separately. It was stressed that that aggregated data (or mean behavior) can deviate significantly from the microscopic dynamics underlying it and hence there are chances of deviations of results.

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