Original Article

The puncher's chance in professional mixed martial arts competition

GRAHAM WILD

School of Engineering and Information Technology, University of New South Wales (UNSW) Canberra, Australia

ABSTRACT

Mixed Martial Arts (MMA) and particularly the Ultimate Fighting Championship (UFC), has rapidly evolved and grown significantly over the past 20 years. Sports performance research into MMA is limited, and as such, there are potential gains to be made by practitioners supported by scientific research. The outcomes of UFC bouts from 1997 to 2020 that ended with a knockout (n = 1815) were analysed as a function of each fighters significant strike percentage to quantify the "*puncher's chance*". Logistic regression was utilised to model the association between the outcome (win or loss), and the strike percentage. The limit of this model then provides the absolute minimum odds associated with the puncher's chance (as the percentage approaches zero). Results gave a value of approximately 1:2000 for a fighter that is being completely outclassed. Features in the data highlighted what are dubbed "*practical*" values of the puncher's chance. For a mildly outclassed fighter, landing 35% to 45% of total strikes, the odds were 1:40.

Keywords: MMA; Sports performance; UFC.

Cite this article as:
Wild, G. (2022). The puncher's chance in professional mixed martial arts competition. *Journal of Human Sport and Exercise*, *17*(2), 370-377. https://doi.org/10.14198/jhse.2022.172.12

Corresponding author. *School of Engineering and Information Technology, UNSW Canberra, ACT, Australia.* *https://orcid.org/0000-0003-1223-4675*
E-mail: G.wild@adfa.edu.au
Submitted for publication August 20, 2020.
Accepted for publication October 16, 2020.
Published April 01, 2022 *(in press* October 28, 2020).
JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

doi:10.14198/jhse.2022.172.12

INTRODUCTION

Mixed martial arts are not a new concept, and many "*Gendai Budo*" (lit. modern martial arts) were started by their founder mixing other arts together; Judo is an example of this (Kano, 1994). However, modern professional MMA is a very specific evolution of practical and competitive martial arts (Kim, 2010). MMA today is typically seen to have three aspects, boxing and kickboxing, wrestling, and Brazilian Jiu Jitsu (BJJ); instead of specific disciplines, these can be thought of in terms of the domain specialisation, striking, take downs and their defences, and fighting on the ground (Bolotin & Bakayev, 2018). That is, other martial arts can feed into these aspects, striking could come from savate, karate, or kenpo etc, while grappling aspects can come from judo, sambo, or submission wrestling etc. As with many other arts though, MMA is much more than the sum of its parts. New strategies and techniques have developed based upon the rules and environment, that are unique. An example of this is the use of the cage in either helping in defence or offence in given situations; since the cage is unique to MMA, the tactics and techniques incorporating its use are also unique (Staack, 2019).

Sports is filled with ideals and stories that illustrate layers of the human experience. The underdog ideal is something that many fans relate too. Fry (2017) gives examples of the US National Hockey Team's "*Miracle on Ice*" and the Leicester City Football Club becoming champions of the English Premier League at 1:5000 odds. Looking at the underdog phenomena as a single sporting action, the concept typically thought of is the "*Hail Mary Pass*" in American Football (Skinner, 2011). Interestingly the odds associated with such plays, and the significant payoff, does not make then as rare as common usage of the term in non-football contexts implies (Burke, 2012). In combat sports, the analogue of the "*Hail Mary*" is the "*puncher's chance*".

The aim of this work is to quantify the puncher's chance in professional mixed martial art competition. The puncher's chance is a boxing idiom that indicates the improbable. In boxing, it specifically refers to a boxer who is out matched, still having the capacity to win, if they can land one or two clean heavy punches (Jones, 2013). In mixed martial arts (MMA), the concept is not limited to just punching, given kicking and strikes with elbows and knees are allowed (in MMA some refer to the puncher's chance as the striker's chance). That said, the premise is the same, an out matched fighter can still get lucky and land a successful strike and turn the tide of a bout. The question is then asked, what is the puncher's (striker's) chance in a profession MMA bout? This work will quantitatively analyse all Ultimate Fighting Championship (UFC) bouts in terms of significant strikes landed, to determine when the dominant striker was knocked out (KO), or the fight was stopped due to strikes, referred to as a technical knockout (TKO).

MATERIAL AND METHODS

Methodology

The underlying research methodology utilised in this work is correlation, which is a descriptive research design (Leedy & Ormrod, 2013). Specifically, the proportion (or percentage) or significant strikes landed by fighter was correlated to the outcome of the fight (win or loss).

Sample

The population of interest is all professional MMA bouts. The most important sample of these, and also the most convenient sample (in terms of data availability and uniformity) is the sample of fights from the UFC, specifically from when the UFC first started to introduce the weight division and stopped doing tournament style events. Specifically, data was taken from 1997 at UFC12 up to but not including UFC251. The sample

included all non-numbered UFC events in addition to the numbered events (those typically considered pay per view events).

Data and Measures

The data was extracted from the official UFC statistics site. Only those bouts that ended in either KO or TKO were included in the initial analysis, with the outcome for each fighter encoded as either win (1) or loss (0). The proportion (percentage) of the total significant strikes landed (x) was calculated using the provided total significant strikes landed metric, which is included in the UFC official statistics. Given as,

$$x_a = \frac{s_a}{s_a + s_b} 100\% \quad (1)$$

where the strike percentage for fighter "a" (x_a) is given by the ratio of the total strikes landed by a on fighter b (s_a), relative to the total strikes by both a and b (s_a + s_b).

Analysis

The final data was analysed using logistic regression. While logistic regression is typically utilised to give the odds ratio, the key metric of interest in this work is the probability of a positive outcome (a win) as the proportion of strikes approaches zero. Logistic regression is necessary since the outcome of a bout is a dichotomous variable (win or lose), while the strike ratio is a continuous variable. The statistical hypotheses to be tested with logistic regression are:

H_0: $\beta = 0$
H_A: $\beta \neq 0$

where β is the variable in the fitted logit function, that relates the continuous variable to the dichotomous output. The logit has the form (Hosmer, Lemeshow, & Sturdivant, 2013),

$$\pi(x) = \frac{e^{\alpha+\beta x}}{1+e^{\alpha+\beta x}} \quad (2)$$

Here, π is the estimated probability of the dichotomous outcome at the given predictor level (x), in this case, the striking ratio. So, if the logistic model is considered statistically significant, then the odds of winning can be correlated to the strike percentage.

RESULTS

From UFC 12 (Feb 7, 1997) to UFC on ESPN 12 (Jun 27, 2020), there have been 5529 UFC bouts, with 5437 ending with a winner (the other bouts are either a draw, a NC, or were overturned after the fact). Of these, 1818 bouts ended with a KO/TKO, and 3 of those bouts have no striking statistics (missing), and hence are omitted. This represents the sample of bouts needed for the analysis, and gives 1815 winners and 1815 losers, for a total sample of 3630 for the logistic regression. The distribution of these 1815 bouts in terms of strike percentage are summarised in Figure 1.

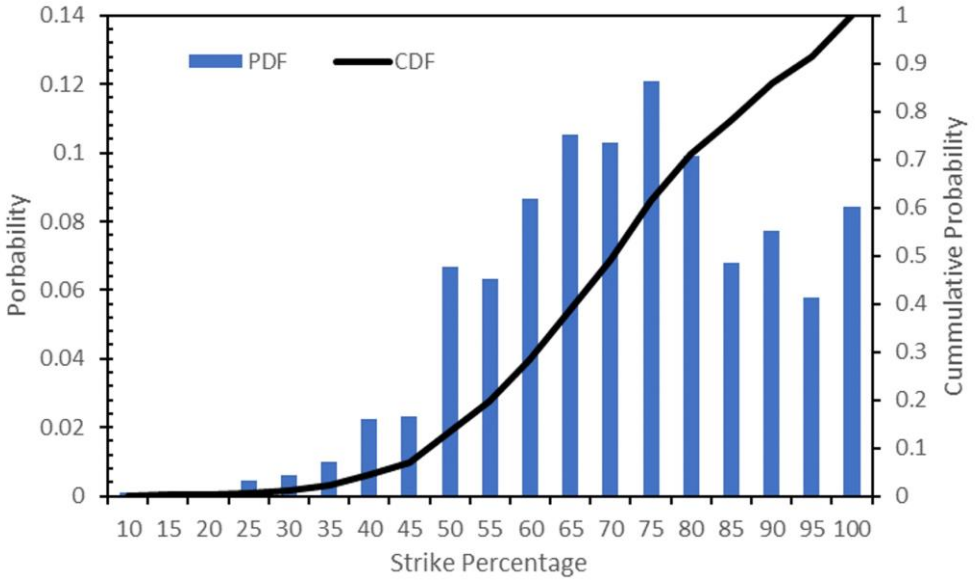

Figure 1. Discrete distribution of fights ending for different strike percentages; showing both the probability distribution function, and the cumulative distribution function. Strike percentages are counted as less than or equal to the indicated value.

There are some interesting features of the distribution shown in Figure 1; these provide insights into practical values of the punchers chance. The three different values of interest are summarised in Table 1. It is interesting to note that for less than or equal to 45%, the probability of winning drops off significantly, then again for less than or equal to 35%, and finally for less than or equal to 20%. The associated odds ratios are given as 1:14, 1:43, and 1:453, respectively for these three points.

Table 1. The count of bouts with less than or equal to the associated strike percentage, and the corresponding probability and odds (against).

Percentage	Count	Probability	Odds
20	4	0.0022	453
35	41	0.0226	43
45	124	0.0683	14

Figure 2 shows the results (win = 1, lose = 0) for the 3630 fighters and their respective strike percentage. Also shown in Figure 2 is the fitted logit function given by (2). The model was statistically significant giving a McFadden's pseudo r^2 of 0.58, χ^2 of 2912, and a p-value of < .001. The result to note here is that the McFadden's pseudo r^2 of 0.58 suggests that about 60% (58%) of the outcome of a KO/TKO bout is determine purely by out striking an opponent; the remaining 40% would be a combination of all other aspects, such as aggression and control (Collier, Johnson, & Ruggiero, 2012). The relevant model parameters are, a = -6.5, and b = 0.13. Using these parameters in (1) and setting x equal to zero gives a minimum probability of 0.001481; this then corresponds to a minimum odds ratio of 1:674. That is, in the extreme case where a "*superior*" fighter throws "*infinitely*" more strikes, and the other fighter throws a single strike, that fighter would still win, on average, one in every 674 bouts that end in knockouts.

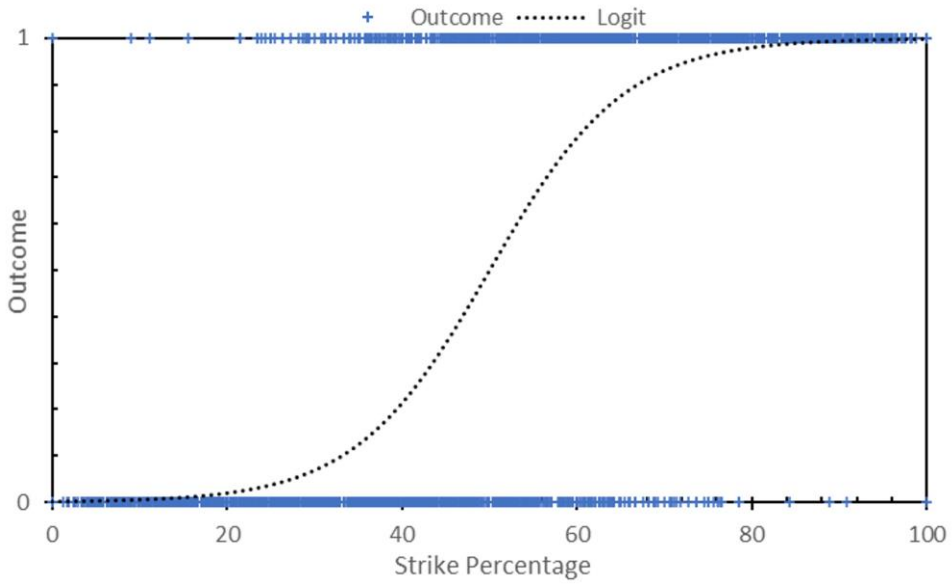

Figure 2. Wins (1) and loses (0) recorded at different strike percentages for 3630 fighters.

All the results thus far have been referenced to the bouts that only ended with a KO/TKO. Given this only occurs in 1818 times out of 5437 total bouts with a winner, all the probabilities and respective odds ratio need to be scaled by this factor. As such, relative to all bouts, the probabilities and odds are shows in Table 2. The new minimum odds ratio decreases to 1:2018.

Table 2. Final probability and odds (against), for the key strike percentages (less than or equal to).

Category	Percentage	Probability	Odds
Completely Outclassed	0	0.00050	2018
Severely Outclassed	20	0.00074	1356
Moderately Outclassed	35	0.00755	131
Mildly Outclassed	45	0.02284	43

The final consideration is to use the produced model to simulate outcomes for the observed strike percentages. For each fighter (n = 3630), a uniform random number was generated between 0 and 1; if this number was below the probability expected, the bout was simulated as a win, otherwise it was a loss. This simulation was repeated 10 times, giving an average and confidence interval for each group of strike percentages. The results of the simulation are shown in Figure 3. In general, the shape is very similar, although the model overestimates values below 50%, and underestimates values from 55% to 80%. Given this work focus on the lower values, utilising the observed percentage is critical, which has been done for all but the minimum value (x = 0) presented above.

DISCUSSION

In recent UFC events, the Derrick Lewis vs Alexander Volkov bout at UFC 229 on the 7th of October, 2018 is considered a perfect example of the puncher's chance in MMA (Bradford, 2018). For Lewis, his final strike percentage in that bout was 24.38%, which gives a predicted total (not just KO/TKO) win probability of 0.0115, and an odds ratio of 1:86. It should also be noted that looking at the observed distribution, the win probability was only 0.0022, with an odds ratio of 451. This difference is due to the asymmetry of the observed

distribution, and the limitation when modelling it with logistic regression (see Figure 3). The odds associated with this case example then becomes a metric for comparison for the conclusions. Where the line is drawn to determine the "*practical*" puncher's chances depends on subjective opinion. We can say that based on the modelling, a fighter who is completely outclassed in a stand-up fight, still has a one in 2000 chance of "*winging it*" (throwing a wild lucky strike) and knocking out their opponent. If we define the puncher's chance relative to a fighter "*losing the fight*" in terms of striking (mildly outclassed), then they have a one in 40 chance of winning, by knocking out their opponent. Two further categories were also identified.

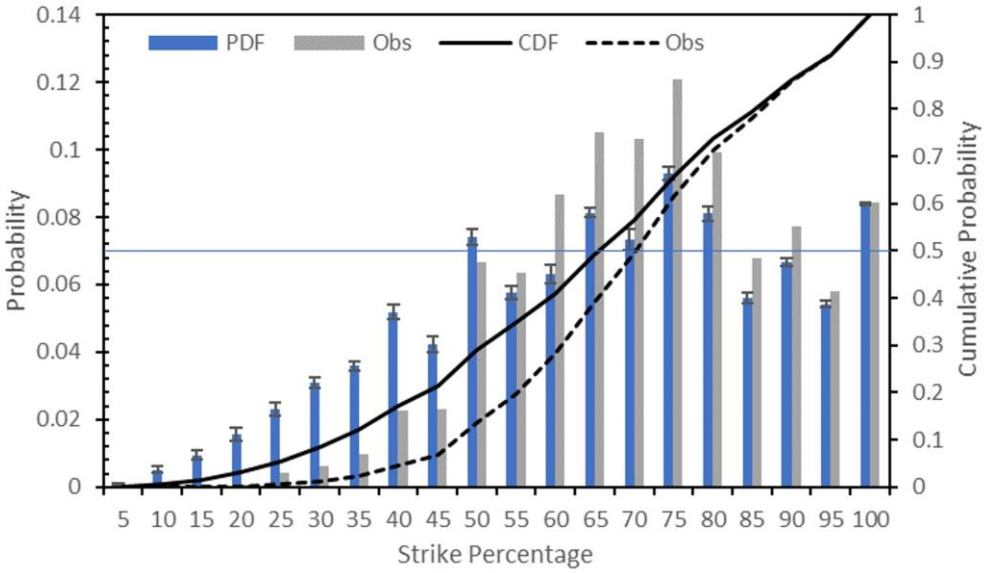

Figure 3. Simulating results for the observed strike percentages, showing the mean confidence interval (as error bars) for the PDF, and the average CDF; both plotted with the observed values from Figure 1 for comparison.

The work presented here is based on the assumption that UFC events are representative of professional MMA. Given the less than expected odds proven here, the "*high level*" of competition could skew the odds, such that the puncher's chance could be better in other fight promotions, and by extension, much better in non-professional MMA bouts. With suitable data, it would be interesting to examine how the "*level*" of competition moderates the puncher's chance.

Looking at subjective discussions in online forums, it is noted that the opinion of many is that the puncher's chance is on the order of one in ten, up to one in five. The technical nature of the sport combined with the results presented here, suggests that "*luck*" is much less likely than expected by spectators and fans. That is, while we think highly of the underdog scenario, in practice in a professional MMA bout, the odds of an underdog who is being outclassed winning, is far less likely than we would hope.

CONCLUSIONS

In conclusion, the puncher's chance in professional MMA, specifically the UFC, has been quantified. Utilising 1815 bouts from 1997 to 2020, the striking percentages for 3630 fighters were regressed against the fighter's outcome (win or loss). The specific type of regression undertaken was logistic regression, given the dichotomous nature of the outcome. The fitted logit was statistically significate, and the pseudo coefficient of

determination, suggested that for fights ending in knockout, 60% of the variance observed in the outcome was explained by strike percentage. For a strike percentage of zero, the model indicated that the odds of a the completely outclassed fighter winning by knockout were 1:674. Factoring in the full population of fights (5437), these odds reduced to 1:2018. That is, if a fighter is completely outclassed, his chances of winning the fight, even if it is not stopped before the end, are only 1 in 2000. In a practical situation, the likelihood of a fighter throwing one punch in response to infinitely many is unrealistic. In a realistic situation, where a fighter is mildly outclassed (landing only 35% to 45% of the total strikes) their odds of winning by knockout are 1:43. If the fighter is moderately outclassed (landing only 20% to 35% of the total strikes) the odds reduce to 1:131, and for a fighter who is severely outclassed (landing less than 20% of the total strikes) the odds reduce further to 1:1356.

SUPPORTING AGENCIES

No funding agencies were reported by the author.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

REFERENCES

Bolotin, A., & Bakayev, V. (2018). Pedagogical practice for development of coordination potential of MMA fighters and estimation of its efficiency. Journal of Human Sport and Exercise, 13(1), 72-88. https://doi.org/10.14198/jhse.2018.131.08

Bradford, B. (2018, October 7). UFC 229: Derrick Lewis earns miracle knockout of Alexander Volkov with 10 seconds remaining. Sporting News. Retrieved from https://www.sportingnews.com/au/mma/news/ufc-229-derrick-lewis-earns-miracle-knockout-of-alexander-volkov-with-10-seconds-remaining/1ktzrnqr2ytef16vhhl2wm6ixh

Burke, B. (2012, September 25). Hail Mary Probabilities. Advanced Football Analytics. Retrieved from http://archive.advancedfootballanalytics.com/2012/09/hail-mary-probabilities.html

Collier, T., Johnson, A. L., & Ruggiero, J. (2012). Aggression in Mixed Martial Arts: An Analysis of the Likelihood of Winning a Decision. In R. T. Jewell (Ed.), Violence and Aggression in Sporting Contests: Economics, History and Policy (pp. 97-109). New York, NY: Springer New York. https://doi.org/10.1007/978-1-4419-6630-8_7

Fry, J. P. (2017). Underdogs, upsets, and overachievers. Journal of the Philosophy of Sport, 44(1), 15-28. https://doi.org/10.1080/00948705.2017.1279974

Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). Applied Logistic Regression. Hobokan, NY: Wiley. https://doi.org/10.1002/9781118548387

Jones, B. (2013). Fighting Talk: Boxing and the Modern Lexicon. Auckland, NZ: Penguin Random House.

Kano, J. (1994). Kodokan Judo. New York, NY: Kodansha International.

Kim, M. (2010). Mixed martial arts: the evolution of a combat sport and its laws and regulations. Sports Lawyers Journal, 17(1), 27-48.

Leedy, P., & Ormrod, J. E. (2013). Practical Research: Planning and Design (10th ed.). Boston, U.S.A: Pearson Education Inc.

Skinner, B. (2011). Scoring strategies for the underdog: A general, quantitative method for determining optimal sports strategies. Journal of Quantitative Analysis in Sports, 7(4). https://doi.org/10.2202/1559-0410.1364

Staack, M. (2019). Fighting As Real As It Gets : A Micro-Sociological Encounter. Stuttgart, Germany: J. B. Metzler'sche Verlagsbuchhandlung & Carl Ernst Poeschel GmbH. https://doi.org/10.1007/978-3-476-04991-9