



The math behind “Who is number one?”



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Who is Number one?

In the world of sports the question on everyone’s mind is always, “Who is number one”? The road to finding the top ranked individual in competition is more difficult than it may appear. Using Linear Algebra in a process called Markov Chains a set of rankings will be generated that represent each individuals standing in the overall pool of competition.

Random Walker Method

In the random walker method you will need a group of voters which we will call “monkeys”, and each monkey will be given one vote they will cast for the best competitor. Each monkey will randomly choose a game and cast its vote for the winner with probability $p \in (.5,1)$. This process will be repeated until the number of votes becomes fixed for each contestant.

Modeling the Random Walker method

Given that we have $p \in (.5,1)$, we will construct a transitional matrix D using two formulas.

$$1.) D_{ii} = -p \cdot l_i + (1-p) \cdot w_i$$

p is the assigned probability the voter will change his vote to the winner, l_i is the number of losses the competitor has, and w_i is the number of wins the competitor has. This formula will generate the value that run diagonally from the top left of the matrix to the bottom right.

$$2.) D_{ij} = .5 N_{ij} \frac{(2p-1)}{2} + A_{ij}, i \neq j.$$

N_{ij} is the number of contests between each competitor and A_{ij} will be ± 1 or 0 depending on the outcome of the contest. If i beats j it will be $+1$. If j beats i it will be -1 . If i and j did not play each other it will be 0. The first formula the diagonal, this formula will find all the other value in matrix D.

Incorporating variables

The Random Walker method generates a set of rankings that are based solely on wins and losses. These rankings are helpful in finding the top competitor, however, they can become more accurate. My project consists of ranking a pool of mixed martial arts fighters using the random walker method. In combat sports, physical attributes can be highly advantageous when used correctly. As a start, I ranked the fighters based solely on wins and losses. After seeing the results, I incorporated the variable of “reach advantage”, or how long each fighters’ arms are relative to their opponent. For example, if competitor A, which has a 65” arm span, and defeats competitor B which has a 70” arm span, then competitor A receives additional weight for defeating a fighter that has a reach advantage.

Results

Ranking the fighters while considering reach advantage considerably changed the rankings. I feel that the new rankings place more emphasis on skill rather than simply evaluating their records. As a result, some fighters made considerable jumps while others fell as far as 4 steps below their previous placement. Below you will see how much the rankings changed when reach is incorporated.

<p>Reach Factor=0, P=.75</p> <p>[1], Amanda Nunez, 8, 2, 69</p> <p>[2], [6], Holly Holm, 7, 2, 69</p> <p>[3], Rhonda Rousey, 6, 2, 68</p> <p>[4], Cat Zingano, 6, 2, 68</p> <p>[5], Valentina Shevchenko, 5, 3, 67</p> <p>[6], Sarah Mcmann, 5, 3, 66</p> <p>[7], Juliana Pena, 5, 4, 69</p> <p>[8], Alexis Davis, 4, 4, 68</p> <p>[9], Meisha Tate, 3, 6, 65</p> <p>[10], Sarah Kaufman, 3, 5, 66</p> <p>[11], Sarah Kaufman, 3, 5, 66</p> <p>[12], Liz Carmouche, 1, 7, 66</p> <p>[13], Beth Correria, 1, 5, 64</p> <p>[14], Jessica Eye, 0,7,66</p>	<p>Reach Factor=.04, P=.75</p> <p>[1], Amanda Nunez, 8, 2, 69</p> <p>[2], Sarah Kaufman, 3, 5, 66</p> <p>[3], Valentina Shevchenko, 5, 3, 67</p> <p>[4], Rhonda Rousey, 6, 2, 68</p> <p>[5], Cat Zingano, 6, 2, 68</p> <p>[6], Holly Holm, 7, 2, 69</p> <p>[7], Sarah Mcmann, 5, 3, 66</p> <p>[8], Alexis Davis, 4, 4, 68</p> <p>[9], Juliana Pena, 5, 4, 69</p> <p>[10], Liz Carmouche, 1, 7, 66</p> <p>[11], Meisha Tate, 3, 6, 65</p> <p>[12], Sarah Kaufman, 3, 5, 66</p> <p>[13], Jessica Eye, 0,7,66</p> <p>[14], Beth Correria, 1, 5, 64</p>
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The first set of rankings does not take the reach factor into consideration while the second places a large amount of emphasis on the reach factor. The numbers to the right of the names indicate wins, losses, and wingspan in inches.