

# An Examination of Sport Climbing Competition Format and Scoring System

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## **Abstract**

The purpose of this paper is to investigate sport climbing, one of the sports making its debut on the Olympics stage at Tokyo 2020. In particular, we take a closer look at the controversial competition format and scoring system of sport climbing. . . Simulation. Data Analysis: drop and re-rank, correlations

*Keywords:* sport climbing, scoring system, 2020 Summer Olympics

# 1 Introduction

In 2016, the International Olympic Committee announced the addition of five new sports to the 2020 Summer Olympics in Tokyo, Japan, which would then reschedule for 2021 due to the impact of the COVID-19 global pandemic. The five new features to Tokyo 2020’s competitions program include baseball/softball, karate, skateboard, sports climbing, and surfing. One of the new sports, sport climbing, got our attention, specifically because of its unique scoring system and the fact that only one set of medals is awarded for each gender.

Sport climbing at the 2020 Tokyo Olympics consists of three disciplines: speed climbing, bouldering, and lead climbing. Speed climbing takes place on a standardized course and competitors try to reach the top of the course as fast as possible. For Tokyo 2020, speed climbing is being contested in a head-to-head format with ranks determined by how far a competitor advances in the bracket. In bouldering, contestants have a fixed amount of time to complete as many courses as they can. Winners are determined based on who completes the most courses and ties are broken based on who had the fewest attempts. Ties are further broken by the competitor achieved the most “zone holds”, which are holds approximately halfway through each course. Finally, in lead climbing, an athlete gets one point for each hold that they reach, so whoever reaches the highest point on the wall is the winner. Each lead climber only gets one attempt and when they fall their attempt is over. These three different climbing disciplines demand different sets of skills and, often, athletes specialize in a single event. However, since only one set of Olympic medals is awarded to sport climbing, rather than choosing only one of these disciplines to include in the Olympics, all three events were chosen to be included as a sort of climbing triathlon.

At the 2020 Summer Olympics, both men’s and women’s sport climbing competitions begin with 20 climbers who has previously qualified for the Olympics from qualifying events held in 2019 and 2020. All 20 athletes compete in each of the three disciplines in the qualification round, and their performances in each concentration are ranked from 1 to 20. A competitor’s total score is then computed as the product of their ranks in the three events and the lower product is better; specifically,

$$Score_i = R_i^S \times R_i^B \times R_i^L, \tag{1}$$

where  $R_i^S$ ,  $R_i^B$ , and  $R_i^L$  are the ranks of the  $i$ -th competitor in speed climbing, bouldering, and lead climbing, respectively.

The top 8 finishers in the qualification round advance to the finals where they once again compete in all three of speed climbing, bouldering, and lead climbing. The total score for each climber in the final stage is determined by multiplying their ranks in each discipline, similar to the qualification round. This implies that the climber with the lowest product of ranks in the final wins the gold medal. This type of scoring system heavily rewards high finishes and relatively ignores poor finishes. For instance, if climber A finished 1st, 20th, and 20th and climber B finished 10th, 10th, and 10th, climber B would have a score of 1000 whereas climber A would have a much better score of 400, despite finishing last in 2 out of 3 of the events.

Heavily criticized

Other sports scoring methods

The manuscript is outlined as follows. We first begin with some descriptions of the data and methods in Section 2. Our analyses and results are then presented in Sections 3 and 4. Finally, in Section 5, we summarize up our main findings and provide a discussion to close out the paper.

## 2 Data and Methods

Our first sets of data come from a simulation study that we conducted, with the purpose of examining the rankings and scoring for climbers in both qualification and final rounds. For each round, we performed 10000 simulations, and this was accomplished by randomly assigning the ranks of each event to every participant, with the assumption that the ranks are uniformly distributed. After the completion of the simulations, we calculated the total scores for every simulated round, as well as the final standings for the climbing athletes. The simulation results allow to answer questions about various topics, including the distributions of scores for qualifying and final rounds, and the probabilities of advancing to the finals or winning a medal, given certain conditions.

Table 1 and Figure 1 are numerical and visual summaries of climbing total score obtained from our simulated data for the qualification and final rounds.

Table 1: Descriptive statistics of simulated scores for qualification and final rounds

round	min	Q1	median	Q3	max	mean	sd	n
Qualification	1.00	240.00	684.00	1638.00	8000.00	1158.84	1273.48	200000
Final	1.00	24.00	60.00	126.00	512.00	91.12	91.35	80000

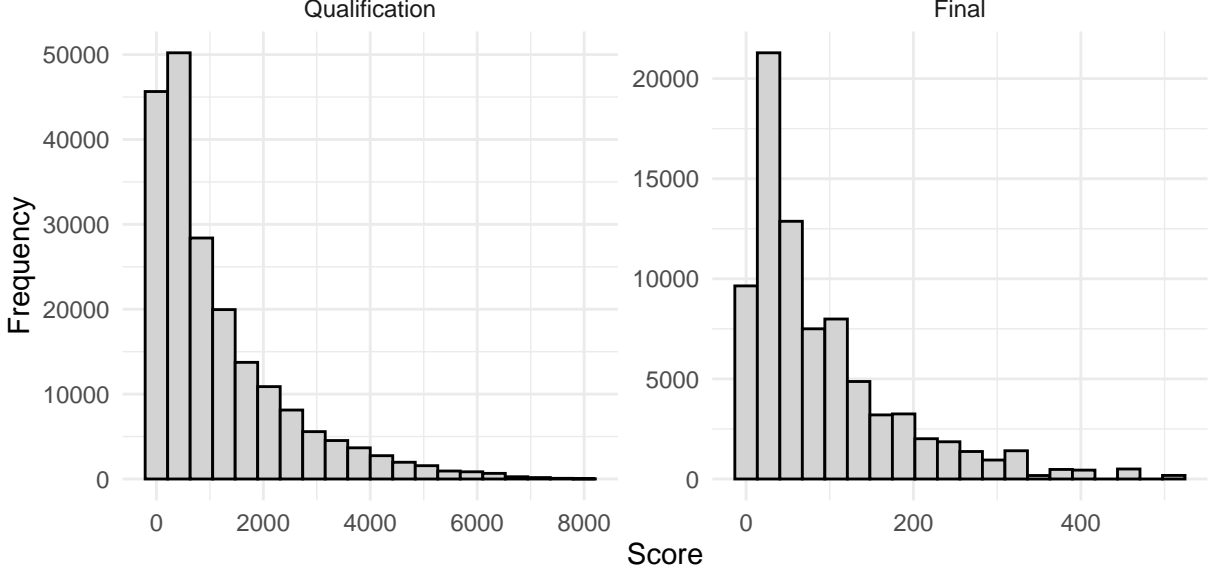


Figure 1: Histogram of simulated scores for qualification and final rounds

Additionally, we rely historical results from major climbing competitions in recent years. We collected data on climbing contests that took place between 2018 and 2020, where the combined format was used to determine the scores and ranks of climbers. The events include the 2020 Continental Championships of Europe, Africa, Oceania, Pan-America; 2019 and 2018 World Championships; 2018 Asian Games; and 2018 Youth Olympics. Data were obtained from various sources, including the event websites, Wikipedia, and the International Federation of Sport Climbing (IFSC). The main attributes of our datasets are the name and nationality of the climbers; bib number (for some competitions); the finishing place of climbers in speed climbing, bouldering, and lead climbing; the total score (which equals the product of event ranks); and the final rank. We utilize this data to compute the correlations between the event ranks and final table position, as well as to look at how often the final orderings change if one athlete is dropped and the ranks for each discipline

are re-computed.

## 3 Simulations

### 3.1 Uniform Ranks

In this section, we discuss the results of our simulations described in Section 2. For the qualification round, our simulation study shows that a climber is almost guaranteed to make the final round if they win the first event (with a 99.51% chance of advancing) or if they win at least one of the three climbing concentrations (99.48%). On the other hand, finishing last in the first event or in any event would certainly hurt an athlete's chance of finishing in the top 8, as the probabilities of a climber advancing given they finish last in the first and in any event are 0.1830 and 0.1885, respectively. In addition, the average score for qualification positions 1 to 8 are displayed in Table 2. We notice that on average, the minimum score that one should aim for in order to move on to the final round is about 434 (for 8th rank).

Table 2: The average scores for the top 10 qualification ranks according to our simulations. A climber will secure a finalist spot if they finish in the top 8.

Rank	Average score
1	36.02
2	73.61
3	115.40
4	162.23
5	216.00
6	278.16
7	350.33
8	434.59
9	532.14
10	642.33

Regarding the finals, a climber is very likely to finish in the top 3 and hence earn a medal

if they win the first event (83.03% chance) or any event (85.01% chance). Furthermore, according to our final simulations, in order to obtain a climbing medal, the average scores (rounded down) that put an athlete in position to receive gold, silver, and bronze medals are 9, 20, and 33, respectively (see Table 3).

Table 3: The average scores for all final ranks according to our simulations. Ranks 1, 2, and 3 are table positions that guarantee medalist status for climbers.

Rank	Average score
1	9.67
2	20.41
3	33.26
4	50.59
5	74.76
6	110.05
7	164.43
8	265.78

## 3.2 Leave-one-climber-out

We would expect that if a climber with a high combined ranking is removed from the list of competitors, the placement of lower-ranked climbers will shift. In the most trivial case, if we were to remove the 3rd place climber, we would see 4th place climber shift to 3rd, 5th place climber shift to 4th, etc. It is maybe less trivial that when a climber is removed from the list, the placement of their higher-ranking competitors may also shift. In other words, there is a non-zero probability of seeing a change in the placement - particularly of medalists - regardless of the fact that no changes occurred in the performance of the remaining climbers. Real examples are given in section 4.2. In this section, we conduct simulations to analyze the probability of seeing a reordering of medalists when one non-medalist is removed from the list of finalists.

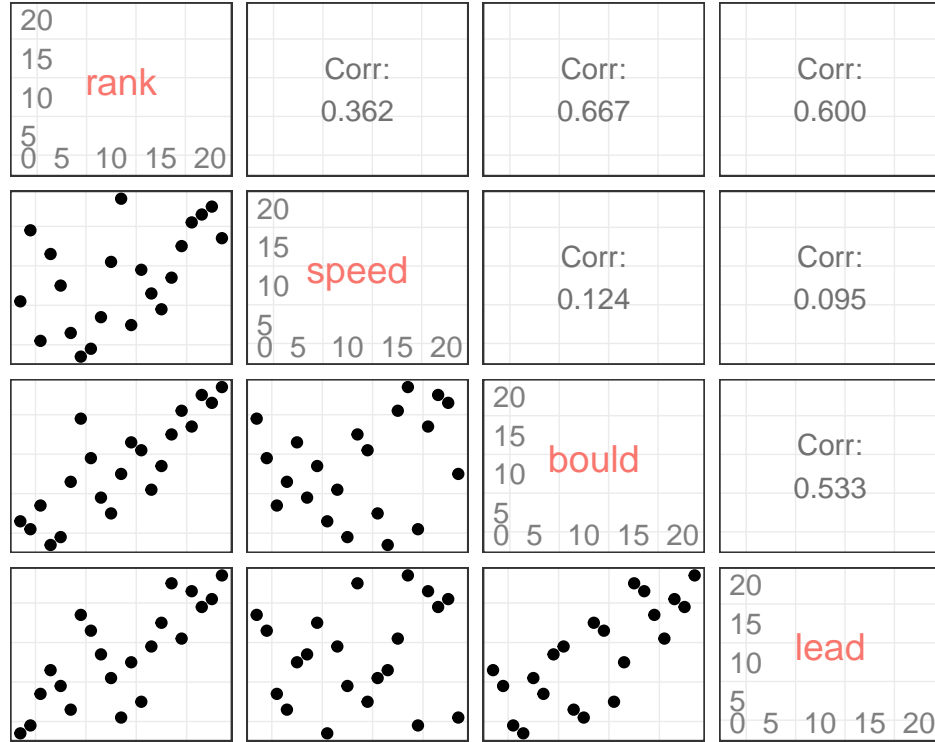


Figure 2: Kendall's rank correlations - 2018 World Championship, Women's Qualification

## 4 Data Analysis

### 4.1 Rank Correlation

For our analysis on the relationship between the rankings of the events and the final result, we used data from the 2018 Youth Olympics Women's Qualification. Figure 2 is a scatterplot and correlation matrix between the ranks of the individual events and the final standings, with Kendall's Tau (Kendall Rank Correlation Coefficient) as our measure of ordinal association between the quantities. It is evidently clear that there exists a strong and positive correlation between the ranks of bouldering and lead climbing, and as a results, the standings of these two events are highly correlated with the final rankings. On the other hand, the correlation with the final rank is not as strong for speed climbing. Thus, speed climbers are facing a huge disadvantage in this scoring system, compared to those that are specialized in the other two concentrations.

## 4.2 Leave-one-climber-out Analysis

Another interesting question that we are interested in investigating is “What would happen to the rankings if a single climber is removed?”.

This illustrates the idea of IIA

We once again make use of data from the 2018 Youth Olympics for this analysis, but this time we examine the final round of both men’s and women’s competitions.

Figure 3 shows the plots

A single climber excluded changes things drastically, especially order of medalists.

The cases where someone behind you drops out and your ranking changes. Figure  
in-text citation Hammond (2007) Westera (2006)

## References

- Hammond, T. (2007), ‘Rank injustice?: How the scoring method for cross-country running competitions violates major social choice principles’, *Public Choice* **133**, 359–375.
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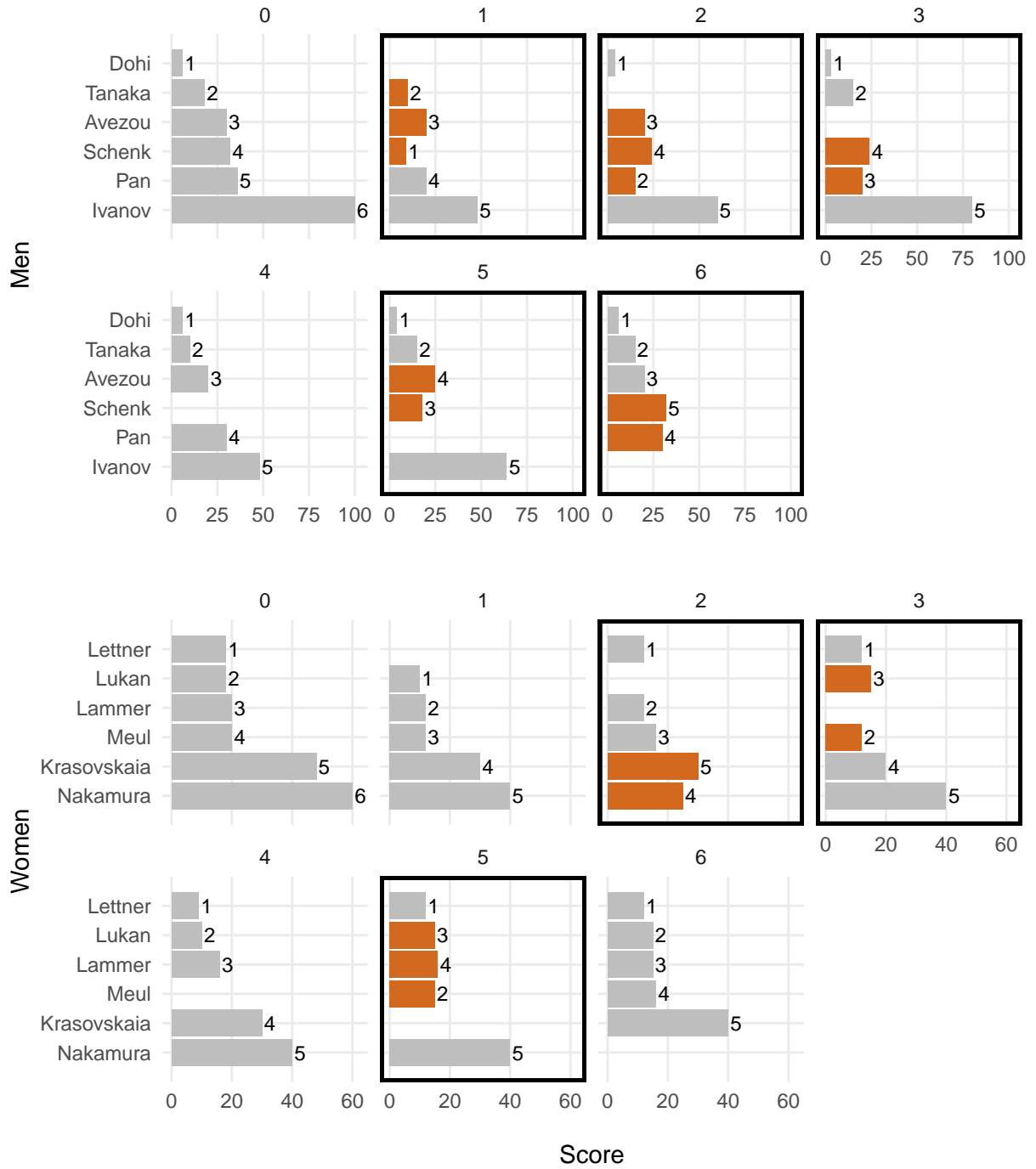


Figure 3: This figure illustrates the changes to the final rankings of the 2018 Youth Olympics Men's and Women's Finals when we leave out one climber. For each gender competition, each panel represents the rank of the drop-out athlete, with 0 being the original final results. Each case with a change in rank orderings is highlighted by a black panel border, and any player with a rank change is represented by a red-filled bar