Review of: "A Probability-Based Algorithm for Evaluating Climbing Difficulty Grades"

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Potential competing interests: No potential competing interests to declare.

1. The abstract is too short to follow the work.
2. Keywords are missing in the abstract.
3. A thorough proofreading of the document is suggested.
4. The proposed model simplifies climbing dynamics by considering route and boulder sections separated by rests. This simplification may not capture the full complexity of climbing, especially in situations where rest intervals are not well-defined or are context-dependent.
5. Climbing grades are inherently subjective, and individual climbers may perceive the difficulty of a route differently. The model, while introducing a probabilistic approach, may not fully address the inherent subjectivity in assigning climbing grades.
6. The model assumes independence between route sections and rests. In reality, the difficulty of one section may influence the climber's fatigue and performance in subsequent sections, challenging the assumption of independence.
7. The comparative study of some of the hardest routes is presented as a short analysis. The limited number of routes analyzed may not be representative of the diversity of climbing scenarios, and the model's performance should be further validated across a more extensive dataset.
8. The effectiveness of the model depends on accurate parameter fitting. The sensitivity of the model to different parameter values and the potential impact of variations in climbing styles and preferences on parameter choice need further investigation.
9. While the model introduces a probabilistic approach, it may not fully capture the inherent uncertainty in climbers' feelings about route difficulty. The subjective nature of climbing experiences makes it challenging to quantify and model uncertainty accurately.
10. The model primarily focuses on climber attributes and experiences without explicit consideration of route features. Characteristics such as hold types, spacing, and route length, which influence climbing difficulty, are not explicitly incorporated into the model.
11. The numerical computation program used for the model is not yet user-friendly or available online. Lack of accessibility limits the practical use of the model by climbing enthusiasts, and efforts should be made to develop a more user-friendly interface.
12. The model does not incorporate direct feedback from climbers who have attempted the routes. Including climber feedback could enhance the model's accuracy and provide valuable insights into the factors influencing perceived

difficulty.

13. The model is specifically designed for rock climbing routes and may not be directly applicable to other forms of climbing, such as ice climbing or indoor climbing, where the dynamics and challenges differ.

14. The model does not explicitly consider different climbing styles (e.g., bouldering, lead climbing) and their unique challenges. Future work could explore how the model could be adapted to account for diverse climbing styles.

15. The probabilistic model introduced assumes a static probability density of grade for each route, neglecting potential changes in climber perception over time. Climbing trends, evolving techniques, and changing route conditions may influence the dynamics of grade assignment, and the model's static nature may limit its adaptability.

16. The model uses a binary classification of rest and no-rest intervals, which oversimplifies the nuanced nature of climbing pauses. Climbers may engage in partial rests or encounter unexpected challenges that disrupt the assumed binary classification. A more granular approach to rest classification could enhance model accuracy.

17. Environmental factors, such as weather conditions, altitude, or time of day, can significantly impact climbing difficulty. The model does not incorporate these external variables, and future enhancements could explore their influence on route grading.

18. The model represents climbing difficulty as a single-dimensional grade, which may not fully capture the multi-faceted nature of difficulty in climbing. Including additional dimensions, such as technical difficulty, endurance, and mental challenge, could offer a more comprehensive evaluation.

19. Climbing routes may evolve over time due to natural rock changes, route cleaning, or human interventions. The model does not consider the dynamic nature of routes, and a more adaptive approach accounting for route evolution could improve accuracy.

20. The model assumes a homogeneous climber population without accounting for individual variations in climbing styles, preferences, or physical attributes. Tailoring the model to diverse climber profiles may provide a more personalized and accurate grading system.

21. The impact of route setters, individuals responsible for designing climbing routes, on the model's predictions is not explicitly explored. Understanding how different route setters may influence the model's outcomes could provide insights into the role of human creativity in grading.

22. Biomechanical aspects, such as a climber's body proportions, strength distribution, or preferred climbing techniques, are not considered in the model. Integrating biomechanical factors could contribute to a more detailed and personalized assessment of climbing difficulty.

23. The model may lack transparency in explaining how specific route features or climber attributes contribute to the assigned grades. Enhancing the interpretability of the model's decisions could facilitate trust and understanding among climbers and route setters.

24. The model places significant emphasis on individual route sections, potentially overlooking the cumulative impact of the entire route on a climber's experience. A more holistic approach considering the overall route structure could yield a more accurate representation of difficulty.

25. The model does not delve deeply into climber psychology, including factors like motivation, fear, or the psychological aspects of overcoming challenges. Exploring these psychological dimensions could add richness to the model's

understanding of climbing difficulty.