Assessing Group Dominance: A Novel Method for Ranking and Analysis

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Abstract

This paper introduces a novel method for calculating group-level dominance scores, incorporating rank sums, weight bias adjustments for unequal group sizes, and the concept of the Upper Dominant Half (UDH). This method offers a fair and scalable approach for comparing group performance, addressing limitations in existing dominance ranking methods. Empirical validation and theoretical implications are discussed.

1 Introduction

- Overview of dominance ranking methods in psychology and related fields. - Limitations of existing methods (e.g., David's Score, Elo-Rating). - Purpose of this research: Introducing a group-level dominance calculation method.

2 Proposed Methodology

2.1 Key Components

- **Ranks**: Sequential ranks assigned to items within and across groups. Where there is

$$k = \text{number of groups}, \quad n_i = \text{number of items in each group}$$

$$\text{N} = \sum_{i}^{k} n_i, \quad n_i = \text{Number of items in each group} \tag{1}$$

- **Upper Dominant Half (UDH)**:

$$\text{UDH} = \frac{N(N+1)}{2} - \frac{(a-1)a}{2}, \quad a = \lceil N/2 \rceil \tag{2}$$

- **Weight Bias (w_i)**:

$$w_i = 1 - \frac{n_i - X_{EI}}{n_i}, \quad X_{EI} = \frac{N}{k} \tag{3}$$

2.2 Dominance Score Formula

$$U_i = w_i \cdot \frac{\sum R_i}{\text{UDH}} \tag{4}$$

- $\sum R_i$: Sum of ranks for group i.
- UDH: Benchmark for dominance potential.
- w_i: Adjustment for group size bias.

3 Empirical Validation

3.1 Simulated Examples

- Description of simulations with varied group sizes and ranks. - Verification of theoretical bounds ($U_i \leq 1$).

3.2 Case Studies

- Real-world examples demonstrating the method's application. - Comparison with existing methods (e.g., David's Score).

4 Discussion

4.1 Theoretical Implications

- Fairness in dominance ranking. - Applicability to group-level analyses.

4.2 Practical Applications

- Group comparisons in psychological experiments. - Applicability to interdisciplinary fields (e.g., organizational behavior, education).

5 ToDo

- finish Udemy Data Science Course
- remember to mention this is better for non-parametric ordinal data etc. Test a parametric significance level with the data and compare the significance to prove that it is not suitable for normal distribution etc. data
- for above try to derive a formula to test suitability to apply the approach
- continuous data (i need figure out or explicitly state that the data has to be varied)
- integrating p-value calculations, if groups have something significant or not
- check if you can use an existing table to calculate p-value, or may be transform a given value to be checked to a existing table of p-values

- prove the range of the normalized rank (is it 0 to 1, or 0 to infinity)
- Compare different research methods (Kruskall wallis 'H' test already an extension of Man whitney U test)
- summary of findings
- visual intuition of the derivation
- get an dominance example (3 number of groups, unequal items in group, tied ranks etc., odd total number of groups for ceiling)
- annotate for bibliography

6 Conclusion

References

- Placeholder for references to key papers and prior work.