

The Relationship Between Program Structure and Score in Figure Skating

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Abstract

This study examines the influence of a figure skater's program on the skater's final score. The present research uses two clustering algorithms to categorize programs by structure, using data from Intermediate Plus-level programs at the Excel Nationals competitions from 2024 to 2026. Results show that programs which feature difficult elements in the middle third typically yielded better scores. However, this finding is complicated by the variety of program structures that yielded high scores.

Introduction

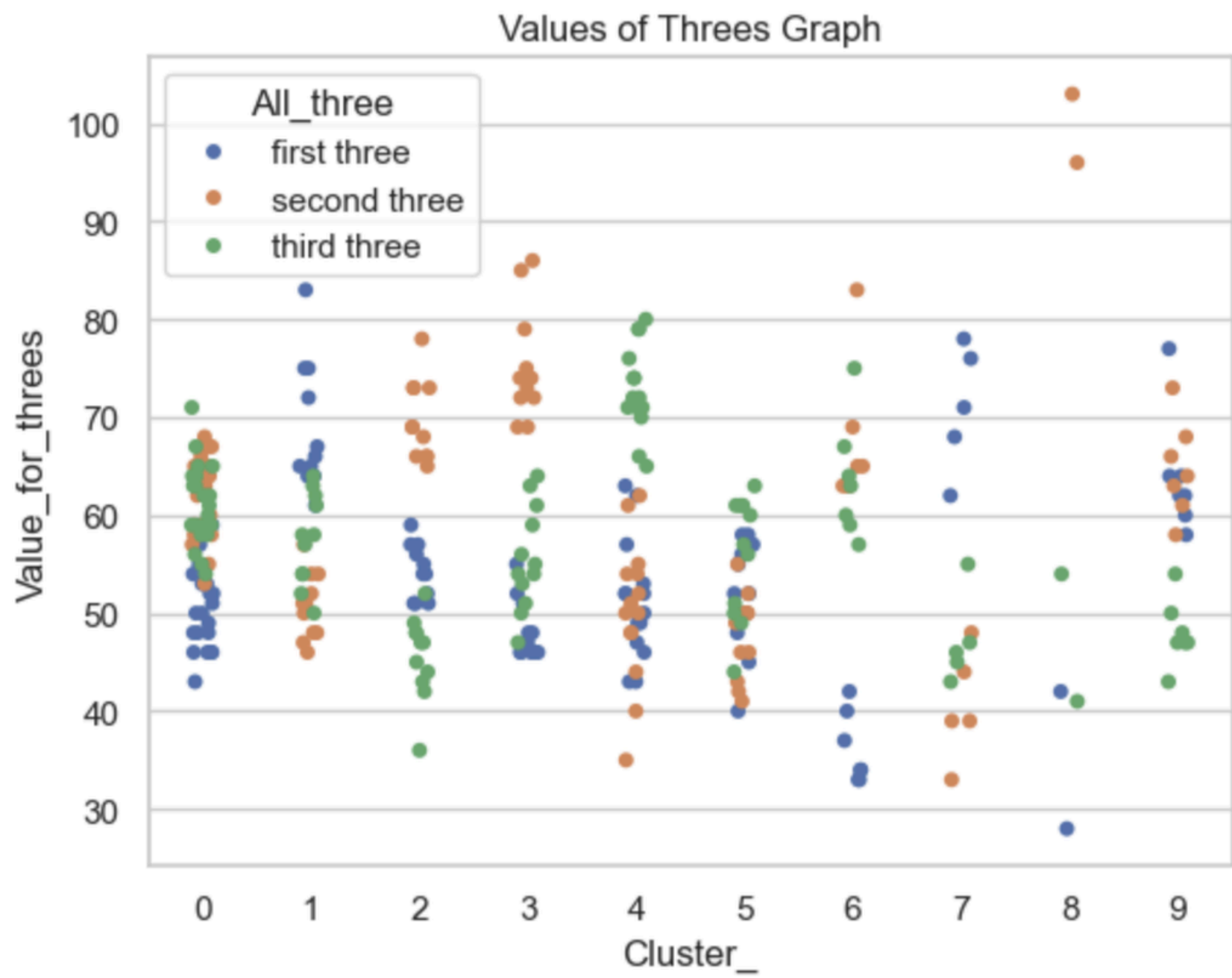
The present research examines whether the structure of a figure skater's program influences the resulting score. A figure skating program consists of a choreographed routine with jumps and spins. The data come from programs performed at a specific competition, The Excel Nationals, and level, Intermediate Plus, from 2024 to 2026. We use unsupervised clustering algorithms to categorize programs by their structures, and analyze them by their scores. We hope beginning skaters can use these studies to achieve higher scores.

Methods

We collected the element order of each skater using BeautifulSoup version 4.8.1 as a web scraper. After sorting the data into a readable HTML file, we merged each skater's executed elements into a dataframe for processing with Python. We gathered the data from the Excel National competition websites and translated the element names into numerical values using a system of multiplying each base value by 10. To reduce the dimensions of the data without sacrificing the placement of high-value elements, we grouped the elements into three sets. Then, we used two clustering algorithms (KMeans & Hierarchical Agglomerative clustering) to group different programs together, revealing types of figure skating program structures.

Results

After running clustering on the dataset, we found that Clusters 8 and 3 have the same pattern of getting the highest score in the second set (orange dots), the medium score in the third set (green dots), and the lowest score in the first set (blue dots). However, Cluster 8 only has two skaters in its group, making it an outlier to the dataset. Cluster 6 has the lowest score in the first set, the relatively higher scores in both second and third sets. Cluster 9 has the lowest score in the third set and relatively higher scores in the first and second sets. Cluster 5 has no pattern, as all the three sets have very close scores.



	mean	std	min	max	count
Cluster 0 Scores	43.5885714	4.35100595	35.06	52.93	21
Cluster 1 Scores	47.0872727	2.16753819	43.17	50.72	11
Cluster 2 Scores	41.9009090	3.14590989	37.49	49.75	11
Cluster 3 Scores	46.0958333	3.06345455	43.02	52.33	12
Cluster 4 Scores	44.1635714	4.95597014	34.44	54.75	14
Cluster 5 Scores	37.7845454	4.47466951	29.64	42.9	11
Cluster 6 Scores	45.3028571	5.83003920	37.16	54.07	7
Cluster 7 Scores	41.546	4.50676491	35.76	48.21	5
Cluster 8 Scores	49.695	2.43951839	47.97	51.42	2
Cluster 9 Scores	46.4271428	2.51712610	44.28	51.73	7

Discussion

In both clustering algorithms, we observed that the clusters with crowded and mixed up values among three sets of elements tend to have low scores. It implies that this kind of program structure should be avoided. We also noticed that certain clusters, those whose second set received the highest value and the third set as the second highest, gained relatively higher scores. It revealed the ideal program structure that skaters will prefer. However, there are a variety of program structures that could receive high scores, further promoting the need for more research in this topic.

Conclusion

We saw similar clusters and their statistics across both algorithms. It indicates that our results are robust across at least two slightly different clustering techniques. Ultimately, we acknowledge that no perfect program structure could ameliorate poor skating in a competition. There are many factors involved in the performance that are not shown in the scores. Still, we believe that this research area is one with high potential for fruitful further investigations. Running this data through advanced statistical models could provide clearer results.

References

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