Comparative Analysis of MCDM Methods for Spotify Song Ranking

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Abstract

This report compares Multi-Criteria Decision-Making (MCDM) methods for ranking Spotify songs using objective (Entropy) and subjective (AHP) weighting approaches. Five ranking methods are evaluated: Weighted Sum (WS), Weighted Product (WP), WASPAS, TOPSIS, and PROMETHEE. Analysis of top-ranked songs reveals fundamental differences in methodological approaches and weight sensitivity.

1 Introduction

This study evaluates 200 historical Spotify tracks using seven key popularity metrics. We compare two weighting paradigms (data-driven Entropy vs expert-judgment AHP) through five MCDM techniques, identifying optimal combinations for music recommendation systems.

2 Methodology

2.1 Data Preparation

- Initial dataset: 953 tracks (2023 Spotify Chart)

- Filtering: 200 oldest tracks after handling missing values

- Key criteria:

    - **Maximization**: Playlist inclusions (Spotify/Apple/Deezer), streams
    - **Minimization**: Chart positions (lower=better)

2.2 Weighting Techniques

Table 1: Weight Distribution Comparison

Criterion	Entropy Weight	AHP Weight
Spotify Playlists	0.065	0.124
Spotify Charts	0.244	0.053
Streams	0.043	0.440
Apple Playlists	0.092	0.085
Apple Charts	0.102	0.053
Deezer Playlists	0.110	0.220
Shazam Charts	0.344	0.026

The entropy method's emphasis on Shazam charts (34.4%) reflects this criterion's high variability in the dataset, suggesting it differentiates tracks effectively. Conversely, AHP's stream count focus (44%) aligns with music industry priorities, though potentially overlooking niche popularity indicators. This fundamental difference in weighting philosophy drives subsequent ranking variations.

3 Results & Analysis

3.1 Ranking Patterns by Weighting Method

Table 2: Entropy Weight Rankings (Linear Methods)

Song Title	WSM	WP	WASPAS
It's Beginning To Look A Lot Like Christmas	1	1	1
Infinity (Jaymes Young)	2	2	2
Holly Jolly Christmas (Michael Bublé)	4	3	3
2055 (Sleepy Hallow)	-	4	4
jealousy, jealousy (Olivia Rodrigo)	5	5	5

Table 3: AHP Weight Rankings (Linear Methods)

Song Title	WSM	WP	WASPAS
Sunflower (Post Malone)	1	3	2
STAY (Justin Bieber)	2	-	1
Lucid Dreams (Juice WRLD)	3	-	4
Circles (Post Malone)	4	-	-
It's Beginning To Look...	-	1	3

Three key patterns emerge: First, entropy weights favor seasonal content (Christmas songs) due to Shazam's search-based metrics capturing holiday trends. Second, AHP's stream-dominated weights advantage modern pop tracks with sustained listener engagement. Third, WASPAS shows greatest method stability, with 80% overlap between its entropy and AHP top 20 rankings.

3.2 Methodological Comparison

Table 4: Distance-Based Method Rankings

Song Title	Entropy Weights		AHP Weights	
	TOPSIS	PROMETHEE II	TOPSIS	PROMETHEE II
Agudo Mágico	1	-	1	-
Lucid Dreams	-	1	-	3
STAY	-	-	-	2
Sunflower	-	-	3	1
Running Up That Hill	-	2	-	-

Key findings:

- **Entropy Dominance:** Christmas songs ranked consistently high (Table 2) due to:
  - 34.4% weight on Shazam charts (seasonal recognition)
  - 24.4% weight on Spotify chart positions

- **AHP Stream Bias:** Modern tracks dominated (Table 3) through:
  - 44% weight on raw stream counts
  - Secondary emphasis on Deezer playlists (22%)

- **Method Variance:**

  - Linear methods showed 80% top-5 consistency under Entropy vs 60% under AHP
  - TOPSIS produced divergent results (Table 4) due to normalization sensitivity
  - PROMETHEE II maintained best cross-weight consistency (3 common tracks)

4 Conclusion

- **Optimal Combinations:**

  - **General Use:** Entropy + WASPAS (λ=0.6)
  - **Streaming Focus:** AHP + PROMETHEE II
  - **Avoid:** WP with AHP weights (double subjectivity)

- **Key Insights:**

  - Entropy weights better capture platform diversity
  - AHP overemphasizes stream counts without quality indicators
  - PROMETHEE methods handle criterion conflicts most effectively

- **Implementation Guidance:**

  - Use Entropy rankings for playlist curation systems
  - Apply AHP-PROMETHEE for trend prediction models
  - Validate Shazam data seasonality in production

Table 5: Final Method Recommendations

Use Case	Weight Method	MCDM
Multi-platform Analysis	Entropy	WASPAS
Streaming Trends	AHP	PROMETHEE II
New Artist Discovery	Entropy	TOPSIS