Eurovision Song Contest Analysis

Introduction to Data Analysis and Machine Learning

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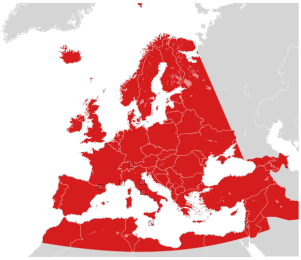
Introduction

Eurovision Song Contest ESC: Contextualization

Yearly song contest since 1956 (the oldest TV program still airing) where the participants are active members of the European Broadcasting Union (EBU). Each participant country performs an original song and the winner is selected based on the jury point distribution from the other participants.

The ESC has undergone numerous variations (televoting in 1998), we will focus on the jury point system established since 1975[1]:

Each participant country nominates a jury panel which gives from 1-8, 10, 12 points to their favorite performances.



[1] Wikipedia contributors 2025.

Questions and Motivation

Europe's multicultural diversity suggests that voting preferences between countries could be influenced by factors such as language, political relationships, or ideological similarities. Then:

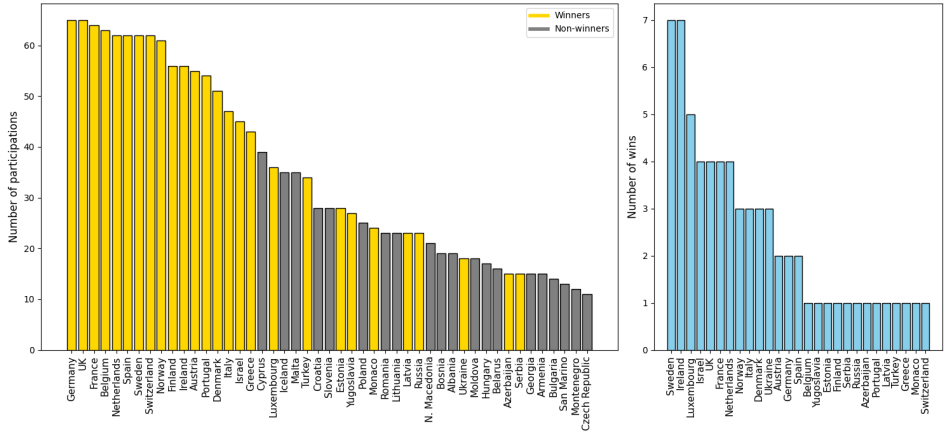
Are there voting biases between countries?

Do voting patterns suggest consistent alliances or blocs among countries?

Data Exploration

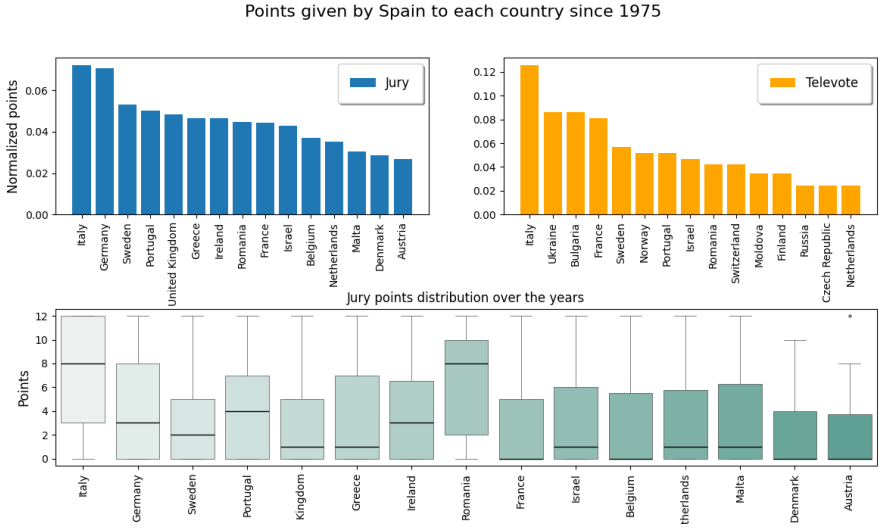
Data exploration

Data[2]: Votes from each country (1956-2023)



[2]Burgoyne, Spijkervet, and Baker 2023.

One country analysis: Spain



Country Voting Analysis

Bias Dyads

Smallest possible social group.

We define quality Q of a song from country j at year t as the sample mean of points received from the other country juries:

$$Q_{jt} = \frac{1}{p-2} \sum_{i \neq j} C_{ijt}$$

Then, the bias[3] B from country i to country j at year t is:

$$B_{ijt} = C_{ijt} - Q_{jt}$$

[3] Charron 2013.

Bias Dyads

From 1975 to 1998

Voter	Receiver	B_{vr}	Count	p-value
Malta	Slovakia	9.12	2	0.13
Cyprus	Greece	8.13	13	0.00
Greece	Cyprus	6.54	13	0.00
Turkey	Bosnia	6.24	4	0.04
Croatia	Malta	5.02	5	0.03
Malta	Croatia	4.80	5	0.07
Netherlands	Russia	4.74	2	0.31
Malta	Luxembourg	4.42	4	0.23
Portugal	Italy	4.31	17	0.00
Malta	Turkey	4.02	7	0.01

From 1998 to 2023

Voter	Receiver	B_{vr}	Count	p-value
Greece	Cyprus	10.05	11	0.00
Cyprus	Greece	9.16	11	0.00
Armenia	Montenegro	8.89	2	0.14
N. Macedonia	Albania	8.72	4	0.00
Romania	Moldova	8.27	10	0.00
Azerbaijan	Turkey	8.20	4	0.00
Serbia	N. Macedonia	8.02	3	0.03
Turkey	Azerbaijan	7.98	4	0.00
Moldova	Romania	7.71	10	0.00
Lithuania	Georgia	7.64	5	0.00

T-test for the mean of the bias pair. Null hypothesis: $\langle B_{ij} \rangle_t = 0$.

If there is bias is due to chance.

Correlation in voting patterns

How similar are the voting patterns of countries?

We compute a correlation matrix from data, which consists of the average number of points that one country gives to another in the years that both of them compete[4].

Pearson correlation coefficient:

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

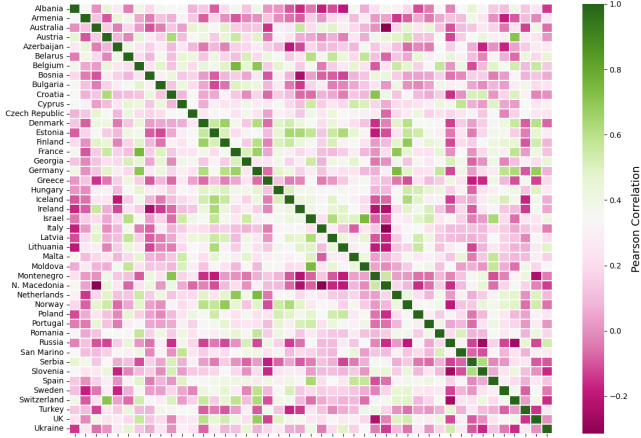
Bootstrap with replacement. The resulting correlation coefficients are the mean of resampling the data 10^5 times.

[4] Fenn et al. 2006.

Correlation in voting patterns

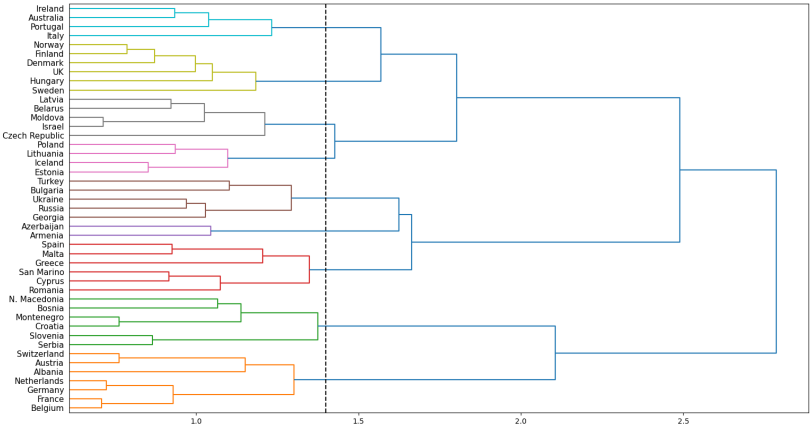
- From 2006 to 2023.
- Countries with at least 5 contest entries.
- Distance matrix:

$$d = \sqrt{2(1 - r)}$$



Hierarchical clustering

Linkage method: Ward variance minimization algorithm with euclidean distance: least biased results.

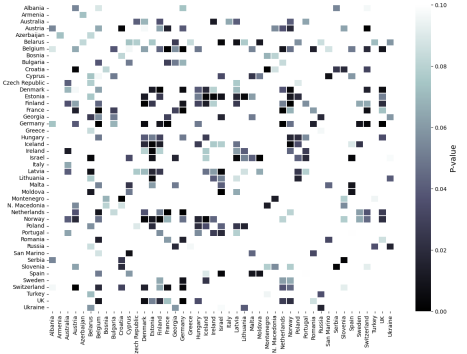


Randomization testing

Null hypothesis: No relationship between variables.

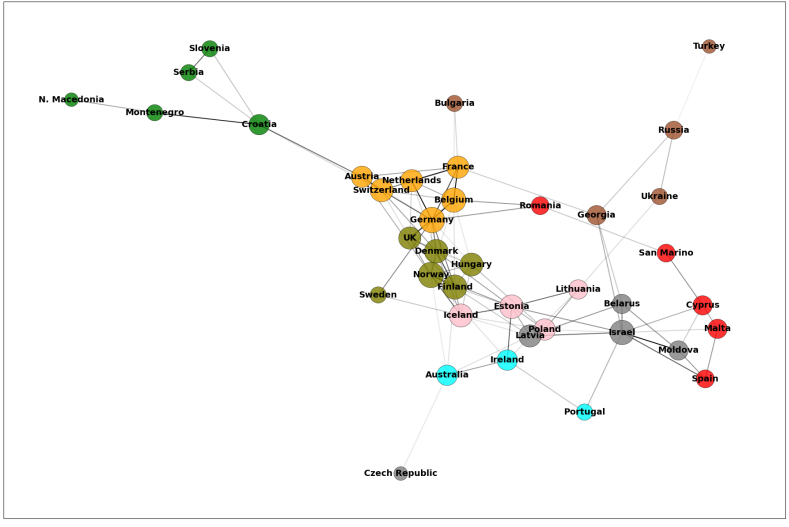
We shuffle the data 10^5 times and calculate the Pearson correlation after each shuffle. The p-value is defined as:

$$p_{\text{value}} = \frac{\#\text{ of times that } |r_{\text{shuffled}}| \geq |r_{\text{data}}|}{\#\text{ of shuffles}}$$



Graph visualization

Threshold based on significance: p-value < 0.05. Weighted graph with correlation.



Random contest comparison

Does similar voting imply vote exchanges?

Comparison probability of voting among members of a cluster with a random contest[5]. For each year with N participants:

$$P_{\text{random}} = \frac{10}{N}$$

The observed probabilities are the number of times that one country votes to another in all the years that both compete.

This analysis defines what being close means.

[5] Fenn et al. 2006.

Voting frequency in clusters

Binomial test. Null hypothesis: The probability of a country A giving points to country B is a Bernoulli process with P_{random} (Right-tail test).

Receiver	Finland		Hungary		Denmark		Sweden		UK		Norway	
Voter	Random	Observed	Random	Observed	Random	Observed	Random	Observed	Random	Observed	Random	Observed
Finland	-	-	0.41	0.80	0.41	0.57	0.41	1.00	0.41	0.18	0.41	0.67
Hungary	0.41	0.20	-	-	0.40	0.50	0.40	0.78	0.40	0.11	0.40	0.67
Denmark	0.41	0.57	0.40	0.17	-	-	0.41	1.00	0.41	0.36	0.41	0.80
Sweden	0.41	0.73	0.40	0.44	0.41	0.60	-	-	0.41	0.19	0.41	0.92
UK	0.41	0.36	0.40	0.11	0.41	0.64	0.41	0.69	-	-	0.41	0.21
Norway	0.41	0.44	0.40	0.17	0.41	0.90	0.41	1.00	0.41	0.43	-	-

Grey if $P_{\text{random}} < P_{\text{observed}}$. Orange if p-value < 0.1. Red if p-value < 0.05.

Voting in clusters

Cluster 2 Ex-Yugoslavia:

Receiver	Bosnia		Slovenia		Croatia		Serbia		N. Macedonia		Montenegro	
Voter	Random	Observed	Random	Observed	Random	Observed	Random	Observed	Random	Observed	Random	Observed
Bosnia	-	-	0.43	1.00	0.42	1.00	0.42	1.00	0.42	1.00	-	-
Slovenia	0.43	1.00	-	-	0.40	0.00	0.41	0.50	0.42	1.00	0.39	1.00
Croatia	0.42	1.00	0.40	1.00	-	-	0.41	1.00	0.43	1.00	-	-
Serbia	0.42	1.00	0.41	0.67	0.41	0.67	-	-	0.41	1.00	0.38	1.00
N. Macedonia	0.42	1.00	0.42	0.50	0.43	1.00	0.41	0.67	-	-	-	-
Montenegro	-	-	0.39	1.00	-	-	0.38	1.00	-	-	-	-

Bias in clusters

Averages bias between the members of each cluster over the years.

Cluster	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021	2022	2023	Average
1	0.51	-0.85	-0.94	0.25	0.48	1.67	0.19	0.95	1.23	0.26	1.38	-0.07	0.53	0.97	0.70	0.65	0.11	0.47
2	7.18	5.29	7.28	10.11	10.34	8.51	6.50	-	6.84	6.97	0.06	-	-0.96	-0.47	-	-	4.30	5.53
3	1.70	2.28	3.25	0.91	2.32	1.49	1.86	0.75	0.00	1.45	1.11	1.78	6.74	2.19	2.28	-0.02	0.74	1.81
4	-	-	-4.04	-3.24	-3.86	-	-	-3.72	-2.96	-1.09	-1.99	-1.70	-	-	-	-1.88	-	-2.72
5	1.35	0.65	2.42	-0.53	1.93	5.52	0.53	1.22	2.61	0.34	-0.92	-3.12	-1.35	-	-2.07	-	-	0.61
6	-	-	-0.95	3.25	-	-0.20	2.53	0.75	-0.21	0.72	1.11	-	2.16	-0.95	-1.42	-0.46	0.62	0.53
7	-0.52	1.77	-2.52	-1.02	1.62	-	-	2.39	-	-3.22	-0.62	-0.28	0.64	-1.27	-1.70	-0.62	-2.03	-0.53
8	2.45	2.35	3.87	1.25	1.75	2.37	0.95	1.48	1.65	0.52	-1.23	0.33	0.14	0.93	0.80	1.35	2.30	1.37
9	-	-	-	-	-0.92	-1.26	-0.84	-1.77	-	0.58	-2.12	-2.83	0.10	-1.77	0.01	-2.13	-0.73	-1.14

Highlight high bias in cluster 2 (Ex-Yugoslavia).

Negative bias in cluster 4 (Armenia and Azerbaijan).

Conclusions and Further Discussions

Conclusions

Conclusions:

- Statistically significant correlations between countries (some more robust than others).
- If a group of countries exhibits similar voting patterns, this may imply mutual voting tendencies.
- Alliances reflected in highly statistically significant bias.

Further discussions:

- Study reciprocity in voting (deeper complex network analysis).
- How robust are the clusters when considering televoting?
- Voting clusters evolution over time.
- Other clustering techniques.

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