

Spotify music ranking prediction

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DATA & GOAL

Target: **total streams** on Spotify

Danceability

Tempo, rhythm stability,
beat strength, regularity

Energy

Death metal vs Bach

Acousticness

Valence

Happy, cheerful, euphoric
Sad, depressed, angry

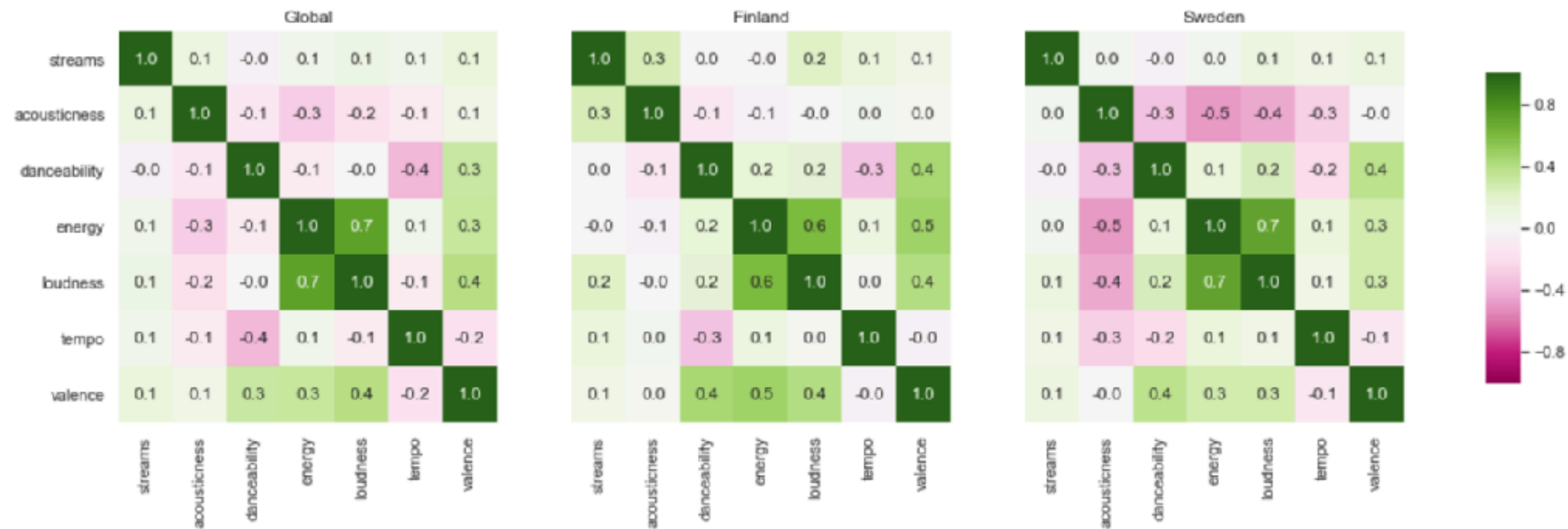
Tempo

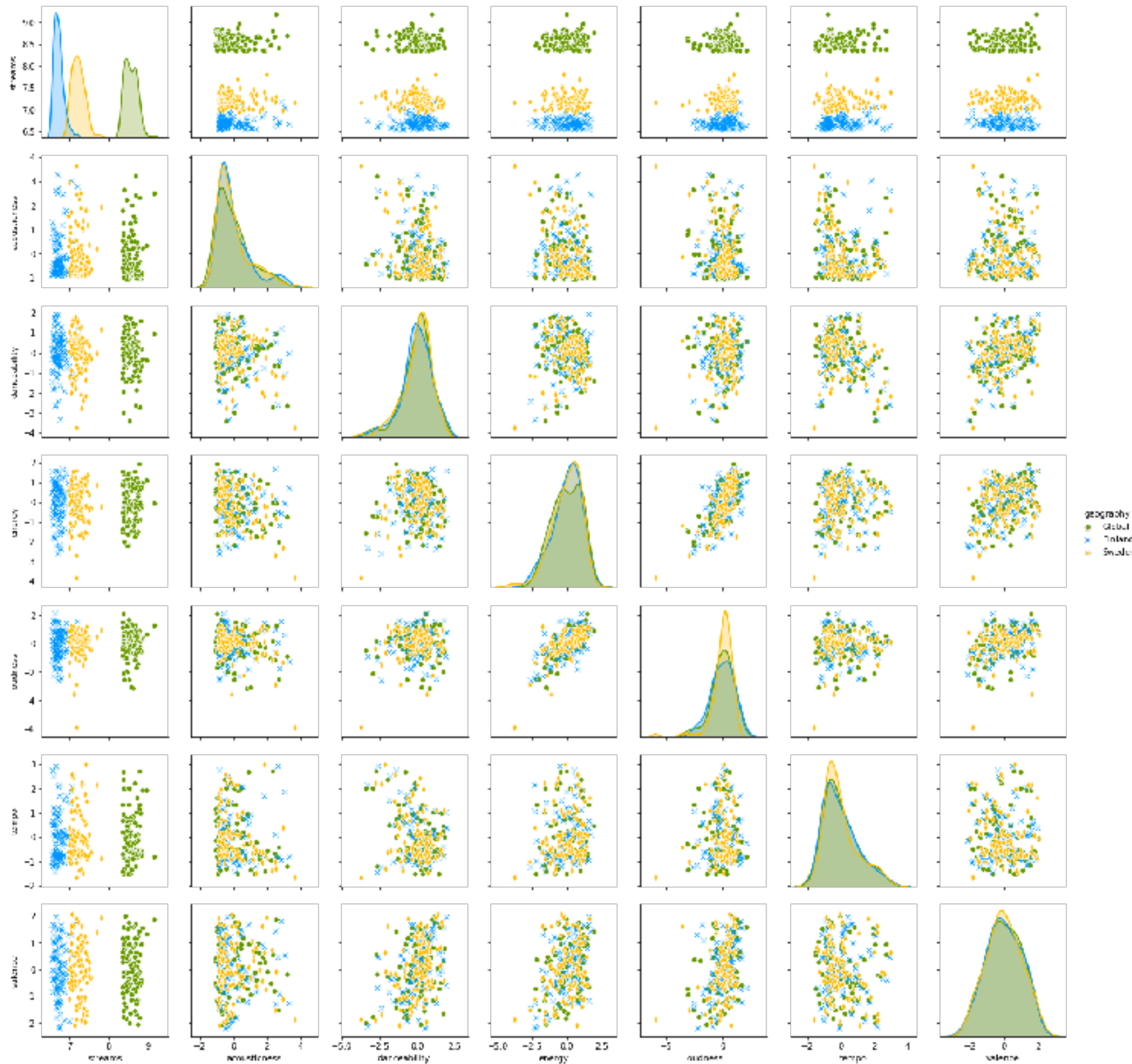
Speed, beat duration

Loudness

Exploratory data analysis

Figure 1. Feature pairwise correlation plot



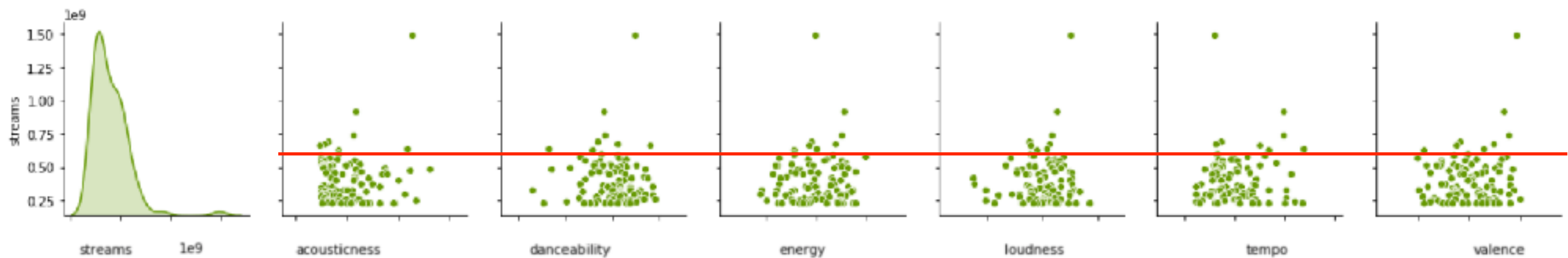


Explora -tory data analysis

Figure 2.
Feature pairwise
scatterplot

Exploratory data analysis

Figure 2. Feature pairwise scatterplot



Model & prior choice

- Linear regression with 3 predictors

$$Y \sim N(\alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_d X_d, \sigma)$$

- Non-linear regression with interaction terms with 5 predictors

$$Y \sim N(\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_2 X_4 + \beta_7 X_3 X_5 + \beta_8 X_1 X_5 + \beta_9 X_2 X_5, \sigma)$$

- Uninformative and weakly informative priors following Zellner

$$\beta_j \sim N(0, \frac{\sigma^2}{g}) \quad \alpha \sim N(0, 100\sigma_0^2), \text{ and } \beta_j \sim N(0, 100\sigma_0^2).$$

Model diagnostics

Model 1: Linear regression with 3 predictors

	mean	se_mean	sd	2.5%	25%	50%	75%	97.5%	n_eff	Rhat
a	8.774083	0.000293	0.018475	8.737628	8.762250	8.773631	8.786050	8.811840	3977.814460	0.999426
b[1]	0.024649	0.000237	0.015494	-0.006393	0.014677	0.024506	0.035100	0.054683	4291.545842	0.999662
b[2]	0.026977	0.000285	0.018368	-0.010112	0.014825	0.027040	0.039314	0.062038	4150.062894	0.999482
b[3]	0.045904	0.000391	0.024032	-0.002407	0.030046	0.046332	0.061807	0.092253	3784.439618	0.999822
sigma	0.097116	0.000258	0.014488	0.073484	0.086797	0.095401	0.105654	0.130574	3163.271457	1.000832

	loo	ploo	dloo	se	k>0.7	Predictors	Interaction terms	Type
Model								
Model 1	-46.7897	7.47276	6.67527	14.3998	1.0	3	0	Linear

Figure 3. Predictive performance of Model 1

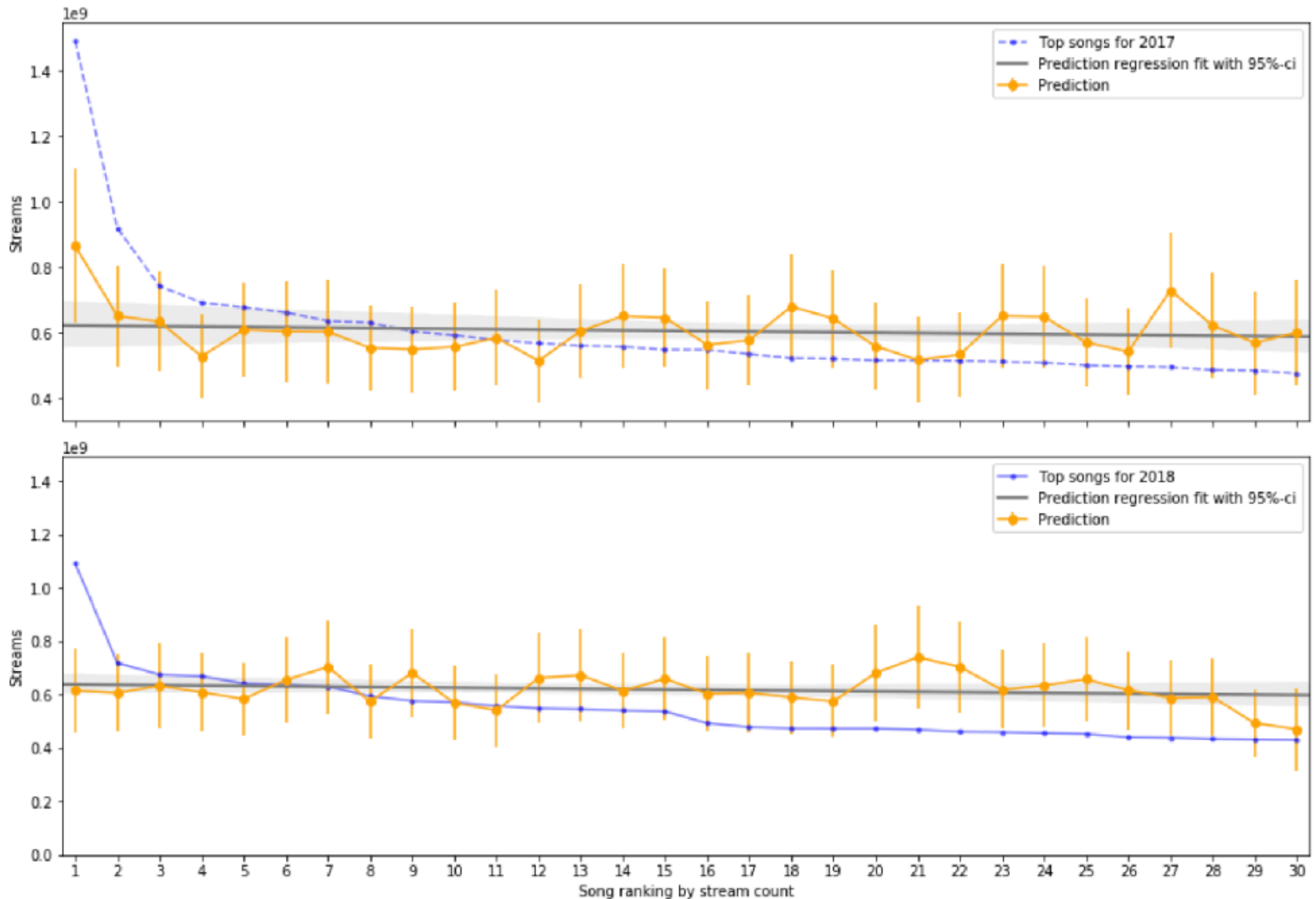
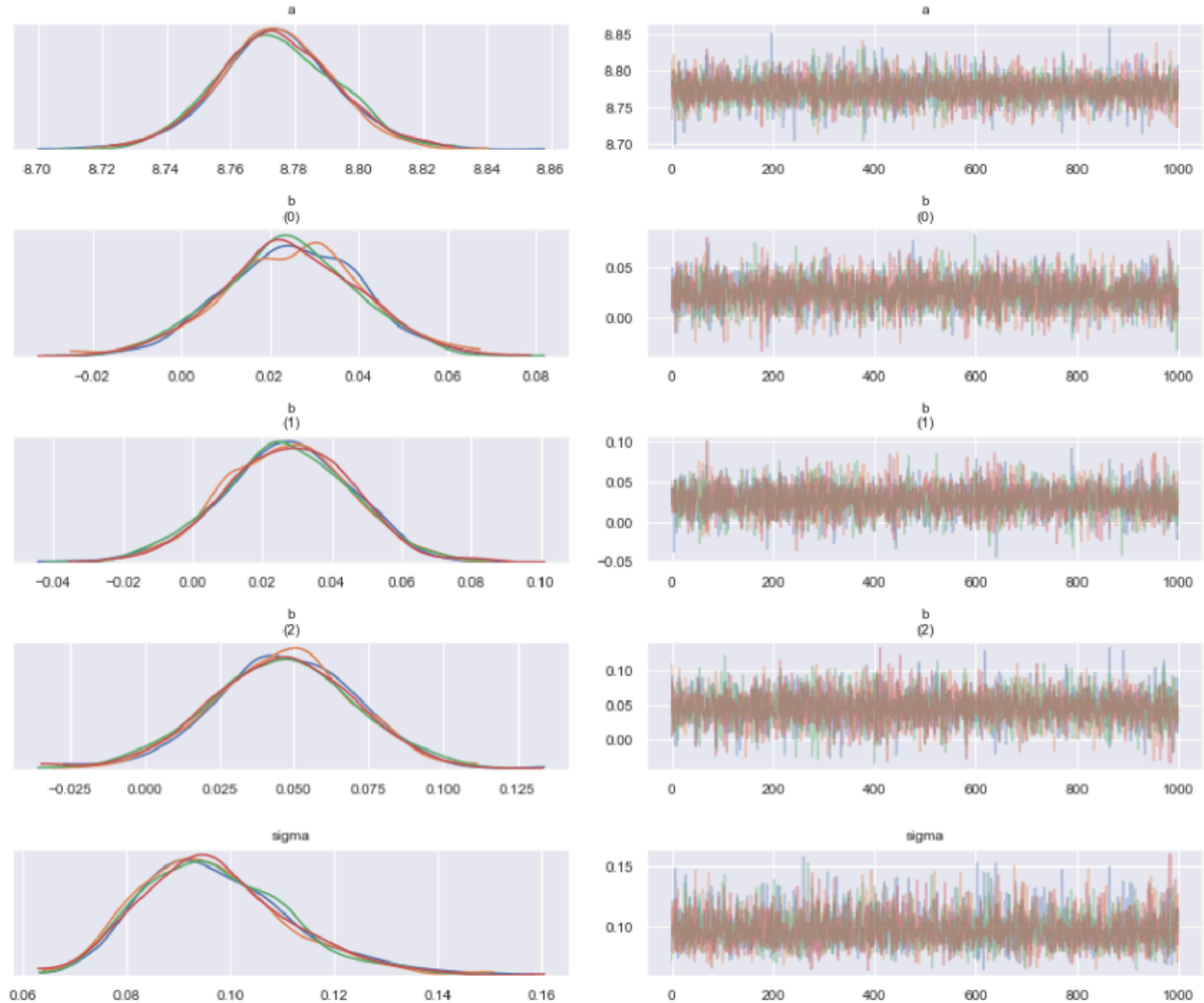


Figure 4. Trace plots of model 1



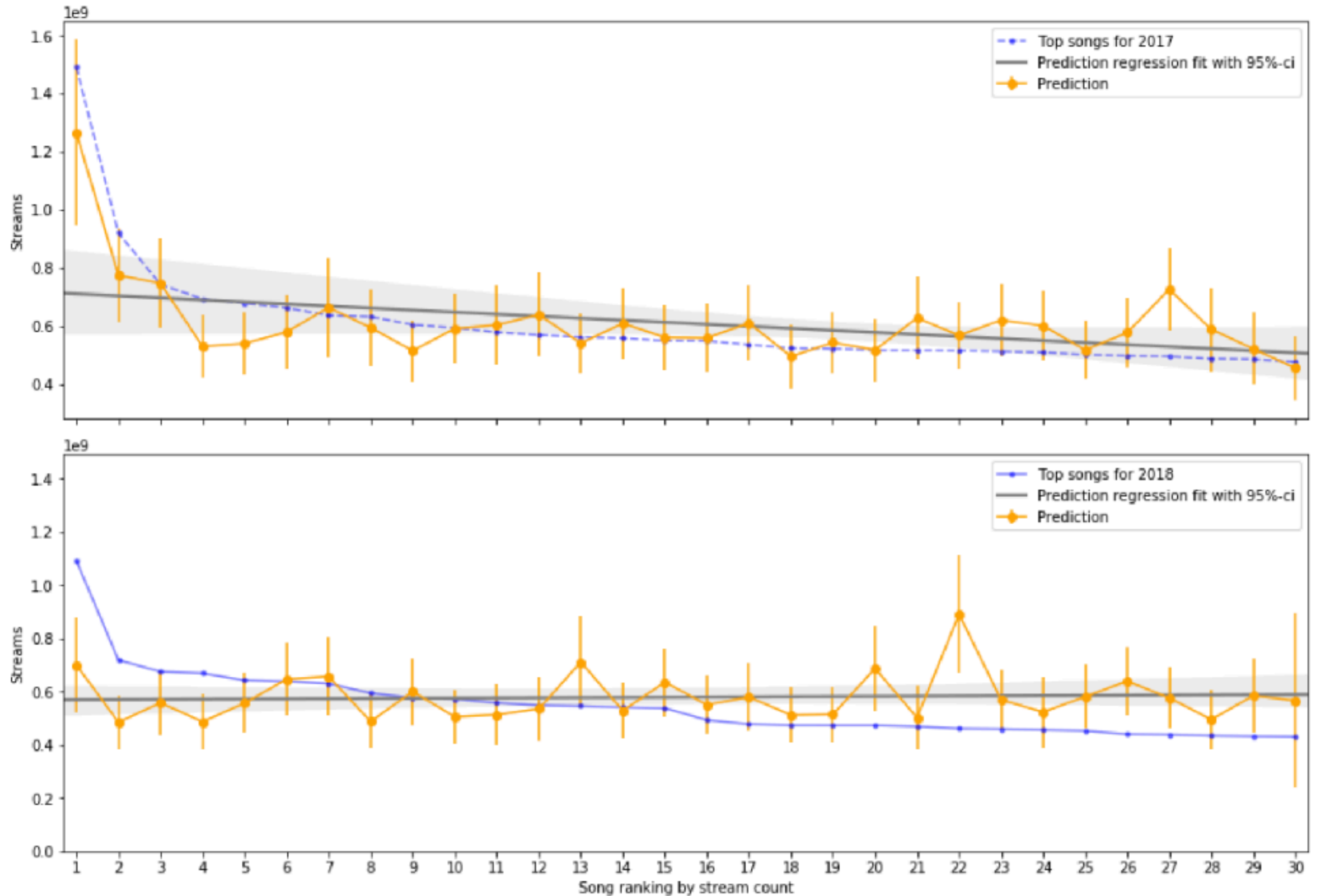
Model diagnostics

Model 2: Linear regression with 3 predictors

	mean	se_mean	sd	2.5%	25%	50%	75%	97.5%	n_eff	Rhat
a	8.728424	0.000389	0.020158	8.688706	8.715223	8.728735	8.741788	8.767825	2686.726787	1.002356
b[1]	0.003220	0.000322	0.016158	-0.028904	-0.007326	0.003327	0.013890	0.034465	2511.786295	1.001377
b[2]	-0.002634	0.000388	0.019684	-0.041825	-0.015390	-0.002223	0.010088	0.035605	2572.578450	1.001855
b[3]	0.023101	0.000529	0.027000	-0.030475	0.005858	0.022815	0.040605	0.076748	2605.178369	1.000530
b[4]	0.027016	0.000383	0.019940	-0.013155	0.014176	0.027138	0.039676	0.065983	2711.904930	1.000195
b[5]	0.029483	0.000419	0.020094	-0.009965	0.016512	0.029381	0.042268	0.069783	2296.859189	1.000317

	loo	ploo	dloo	se	k>0.7	Predictors	Interaction terms	Type
Model								
Model 5	-53.465	10.9997	0	8.36027	3.0	5	4	Non-linear

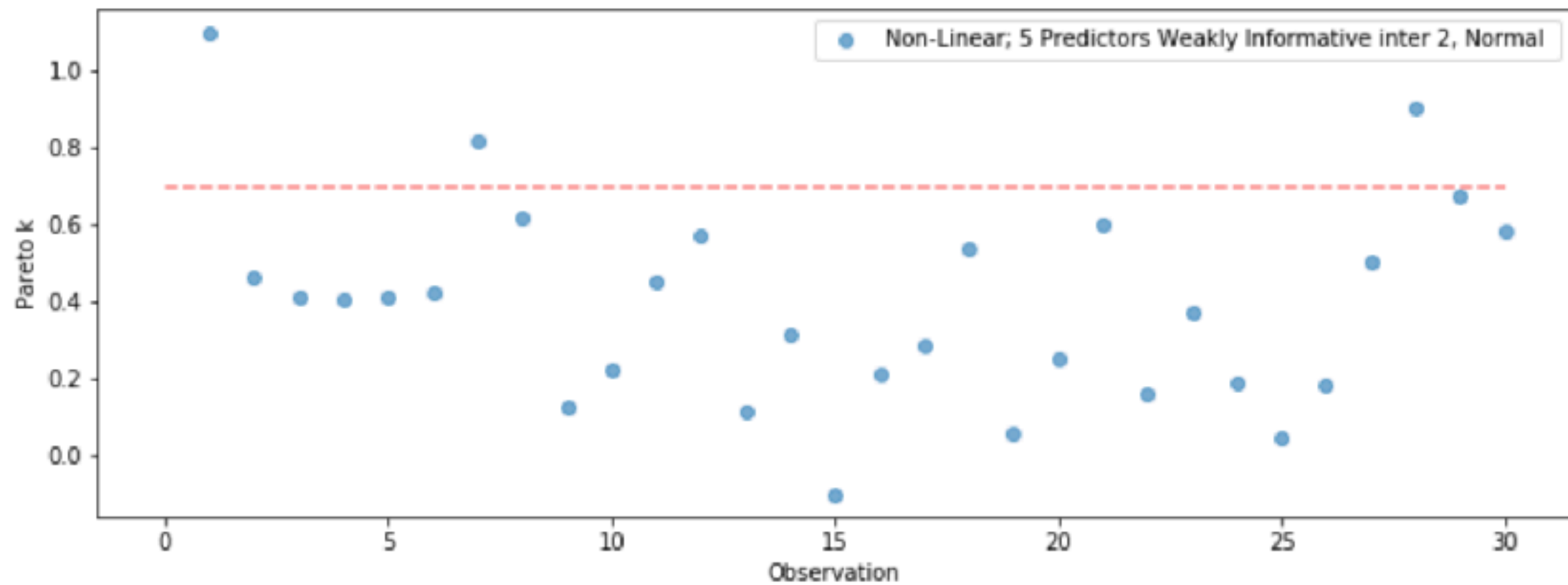
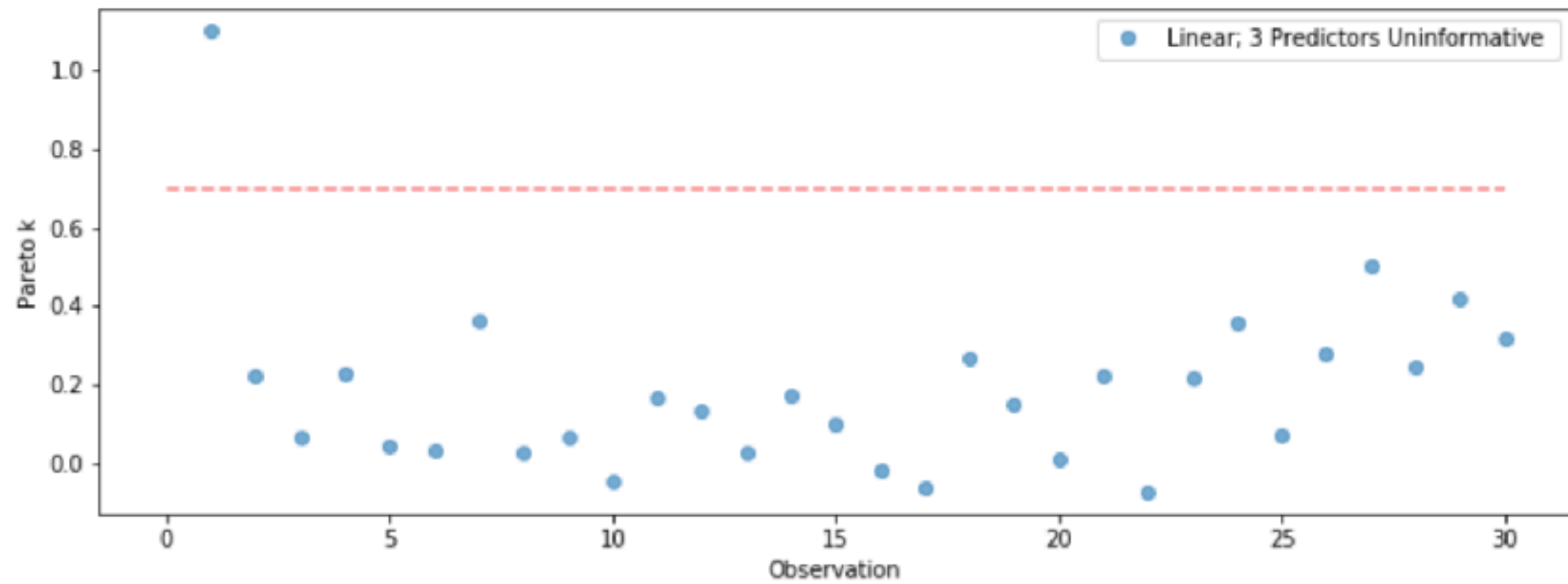
Figure 5. Predictive performance of Model 2



Model comparison

	loo	ploo	dloo	se	k>0.7	Predictors	Interaction terms	Type
Model								
Model 5	-53.465	10.9997	0	8.36027	3.0	5	4	Non-linear
Model 4	-47.0928	9.97253	6.37221	12.4703	3.0	5	2	Non-linear
Model 1	-46.7897	7.47276	6.67527	14.3998	1.0	3	0	Linear
Model 2	-46.5953	7.45972	6.86972	14.4637	1.0	3	0	Linear
Model 6	-46.2304	14.227	7.23464	7.16062	8.0	5	4	Non-linear
Model 8	-45.8098	18.317	7.65525	4.88308	14.0	5	4	Non-linear
Model 3	-43.532	10.0905	9.933	17.5365	1.0	5	0	Linear
Model 7	-39.4762	13.9418	13.9889	11.4084	7.0	5	2	Non-linear

Figure 6. K scores





Conclusion

- Model achieved decent performance on 2017 data
- Model does not generalize well on new data

A close-up photograph of two vintage-style microphones, likely Shure SM57s, resting on a light-colored wooden surface. The microphones are silver with black grilles. The word 'SHURE' is visible on the grilles, along with 'PRESTIGE SERIES' and 'SR325'. The image is overlaid with a dark green semi-transparent rectangle, and the word 'Limitation' is written in large white letters across the top.

Limitation

- Song ranking is determined by complex factors
- Inherent limitations in data
 - not sufficient to predict ranking
 - high variation across rankings
- Model does not generalize well on new data

A close-up photograph of two vintage microphones, likely from the Prestige Series, mounted on a wooden surface. The microphones have a distinctive grille pattern and are connected by cables. The image is overlaid with a semi-transparent green rectangle containing the title text.

Future improvement

- Gather more relevant data
 - marketing activities, social media
 - artists, genre etc.
- Informative prior with domain expertise
- Hierarchical model



Spotify

Thank you!

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