A Bayesian Hierarchical Model For Predicting Song Popularity

Statistics 775

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Predicting Song Popularity From Audio Features

- Do things like tempo, rhythm, timbre, and other qualities of the sound help drive popularity?

- The main idea:

  - Use Spotify's Web API to sample 100 songs per year from 1970 – 2021 (so $n = 5100$)

  - For each song, extract its popularity and audio features (loudness, danceability, speechiness, valence, acousticness, and more)

  - Build a hierarchical model
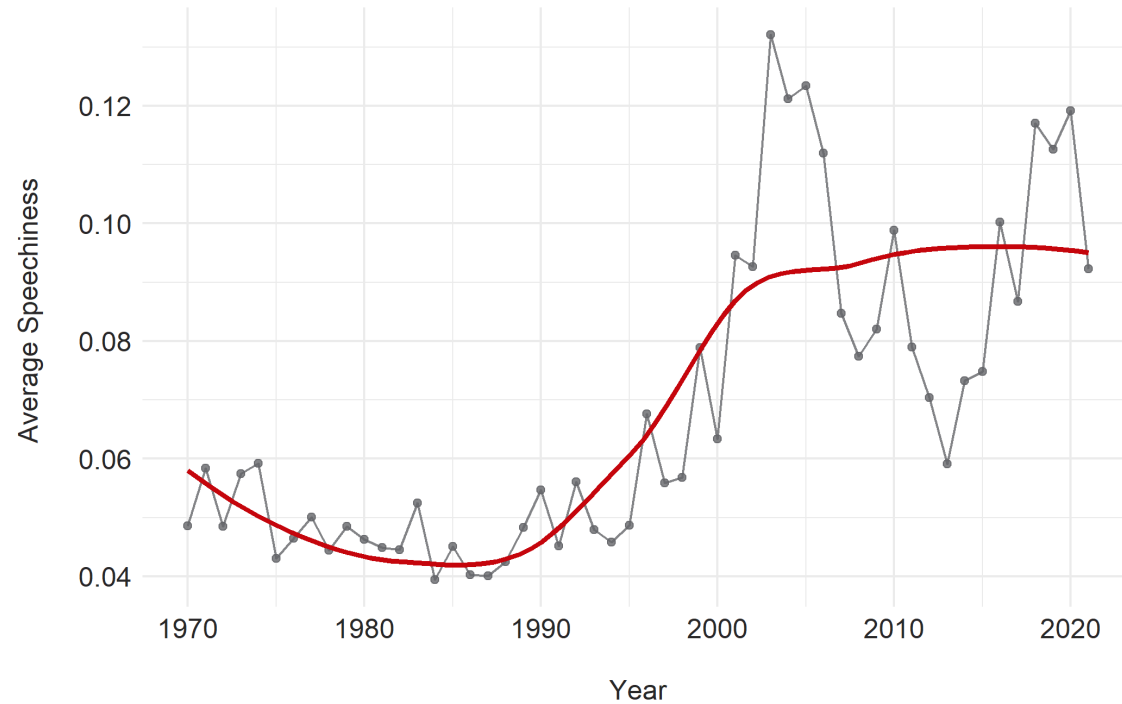
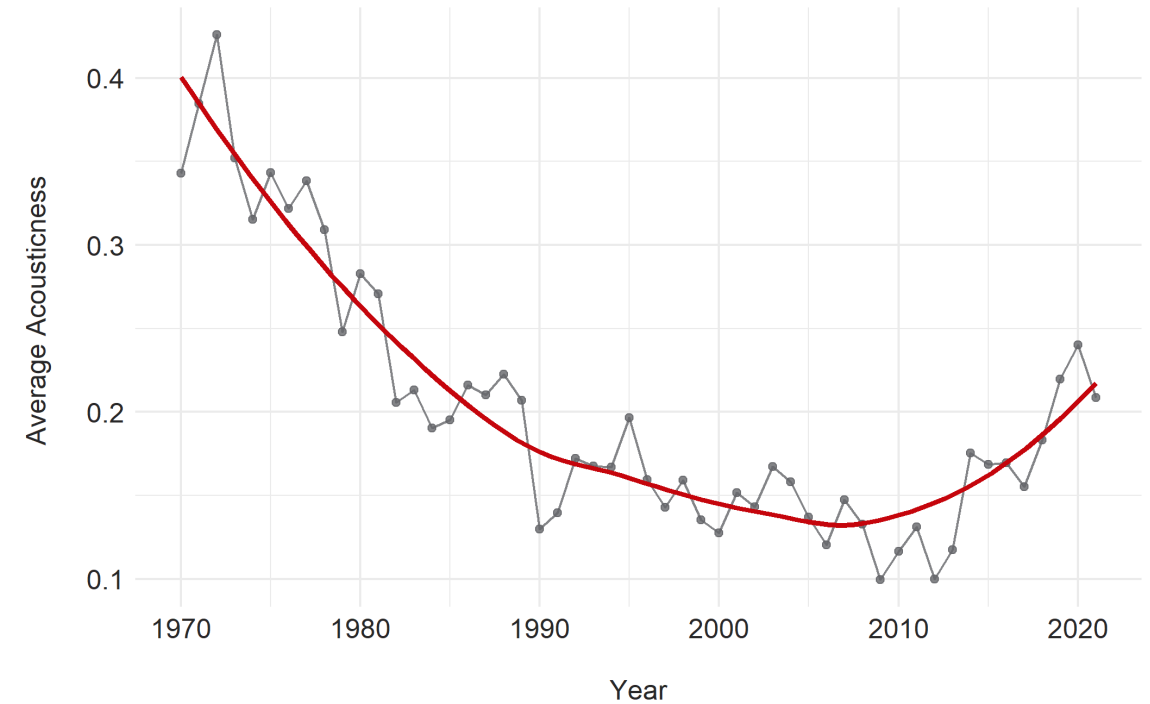# Audio Features Are (Mostly) Intuitive

Audio Features: "All Too Well" vs "Butter"
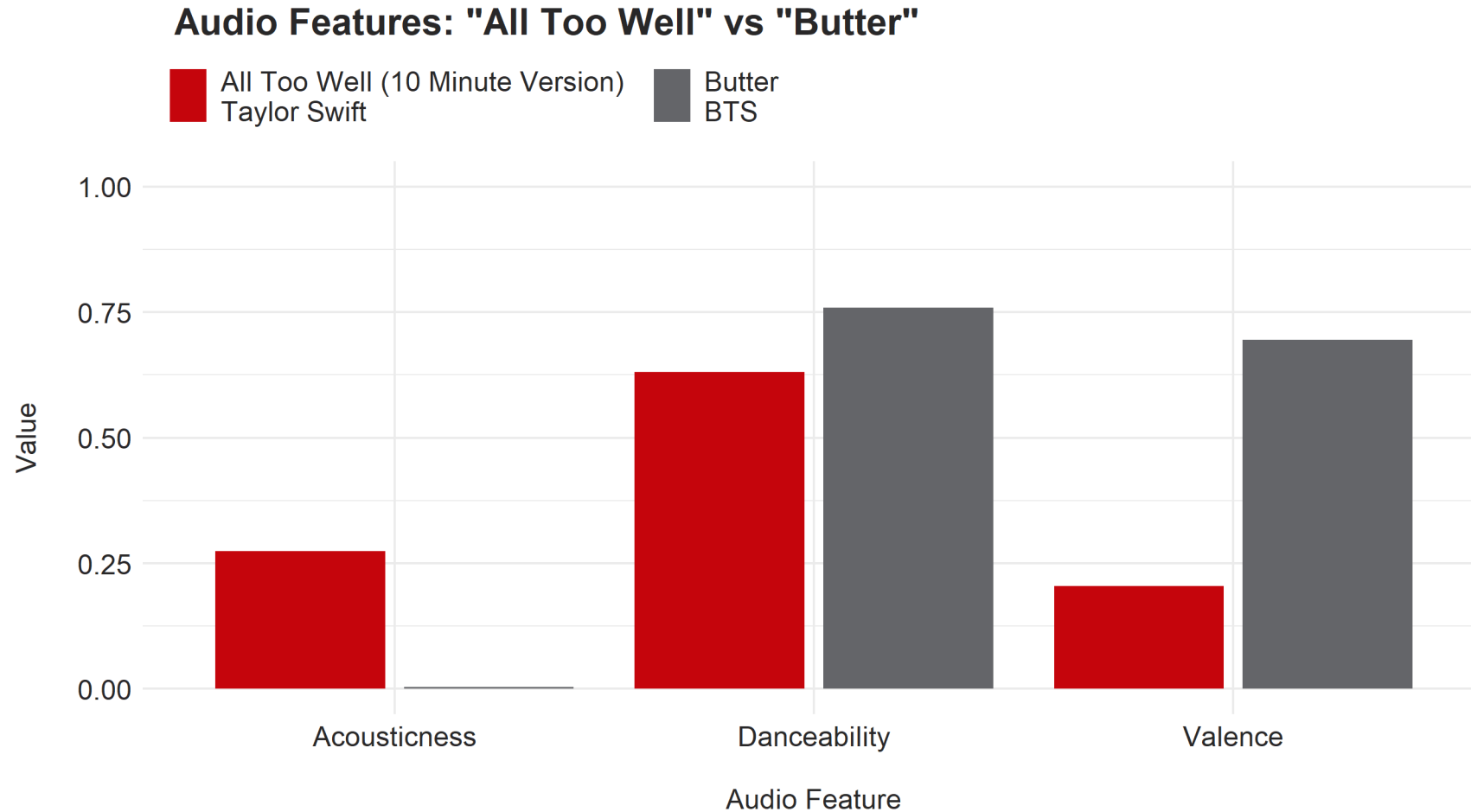
Audio Features Have Prominent Trends

Modeling Popularity

- Consider 10 predictors (audio features) and 6 groups (decades)

- Use a standard multiple linear regression setup (layer 1)

  - $Y_{it} \mid \alpha_t \; \boldsymbol{\beta}_t \; \sigma^2 \sim N(\mu_{it}, \sigma^2)$ where $\mu_{it} = \alpha_t + x_i^T \boldsymbol{\beta}_t$

- Allow intercept and slopes to vary by decade (layer 2)

  - $\alpha_t \mid \mu_\alpha \; \tau_\alpha^2 \sim N(\mu_\alpha, \tau_\alpha^2)$

    $\beta_{jt} \mid \mu_{\beta_j} \; \tau_\beta^2 \sim N(\mu_{\beta_j}, \tau_\beta^2)$

- Set priors/hyperparameters using both prior predictive checks and prior knowledge regarding coefficient directions (layer 3)

Model Performance and Conclusions

- In general, audio features are only weakly predictive of popularity

  - The model suggests danceability is most influential

- Our perception of music is complicated!

- Spotify's audio features (the publicly-available ones, at least) don't capture everything