RiSK: Analysis of the Changes in Popular Music in the World

RiSK: Rhea Tejwani, Sue Zhang, Keena Gao

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Introduction and Data

Music is one of the most accessible ways to experience and communicate emotional experiences and opinions across cultural norms and language barriers. Popular music is especially able to broadcast its message, but popularity depends on the breadth of people that enjoy listening to it.

Trends in popular music are constantly changing, and these changes will affect globalization and cultural communication. For instance, hip-hop music, an aspect of the hip-hop cultural movement, was stated to be the most popular genre of music in the U.S. in 2017 in this Rolling Stone article: https://www.rollingstone.com/music/music-news/hip-hop-continued-to-dominate-the-music-business-in-2018-774422/. As students who frequently listen to music, we want to analyze the trends of popular music in our generation and the generations before us.

The data that we chose to analyze was curated by Sumat Singh (@iamsumat) on Kaggle, and contains variables that measure various characteristics of the most popular music in the world over the years 1956 to 2019 on the streaming service Spotify. https://www.kaggle.com/iamsumat/spotify-top-2000s-mega-dataset

The original data set was taken from the playlist on Spotify "Top 2000s" by the user PlaylistMachinery (@plamere) using Selenium with Python. It was scraped from http://sortyourmusic.playlistmachinery.com/. This data was uploaded 9 months ago.

This data set has 15 columns and 1994 rows. The observations in the data set describe the characteristics of the top 2000 most popular songs from 1956 to 2019 from Spotify.

The variables we will be focusing on are `Acousticness`, which is a measure from 0 to 100 representing the confidence measure that the song is acoustic (with 100 being high confidence and 0 being no/low confidence), `year`, which is the year the song was created, and `genre`, which is the genre of the music. We chose `Acousticness` because we thought that trends observed in `Acousticness` would reflect the development of technology used in music production in the modern era. Additionally, we focused on genres outside of English-speaking countries because an increase in technology, such as the popularization of the Internet in the 1990s, may also increase cross cultural communication including music. https://webfoundation.org/about/vision/history-of-the-web/

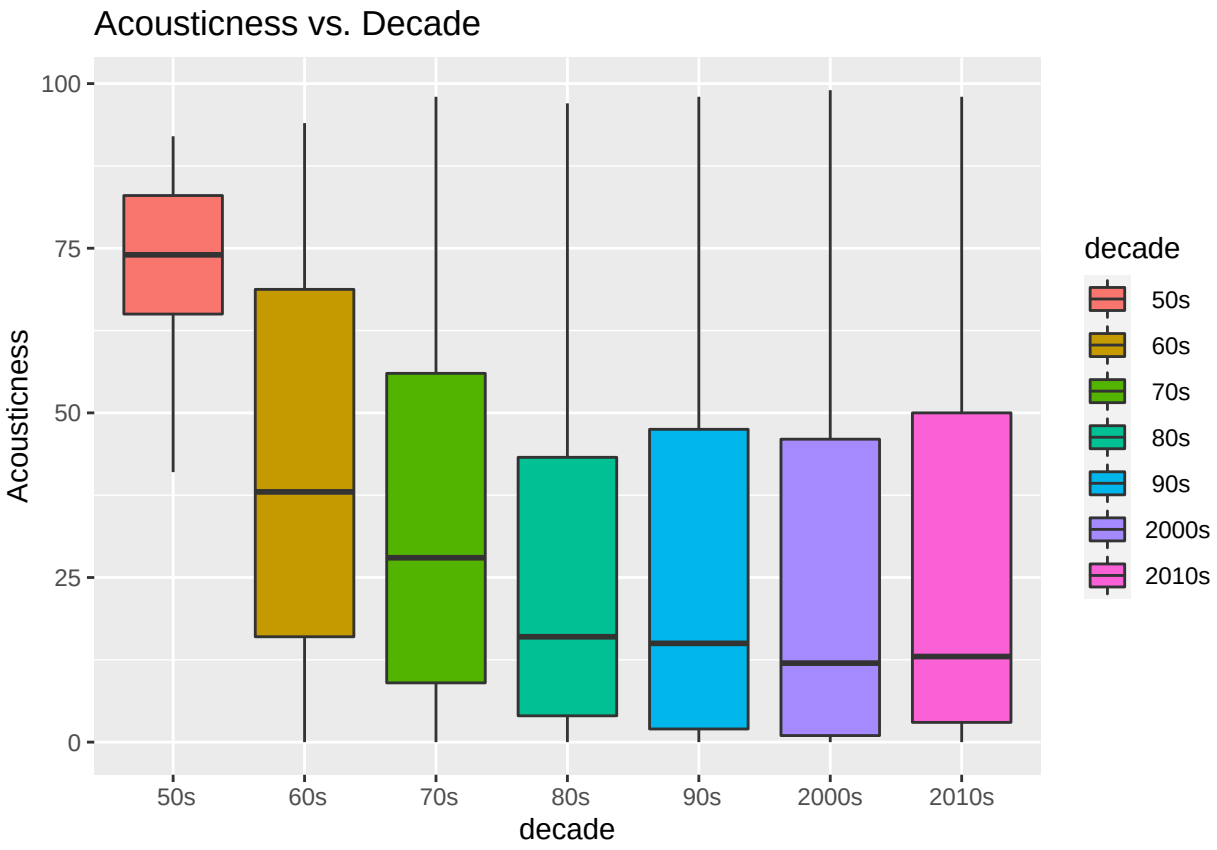
We explored patterns and mutated our chosen variables in the methodology section of this report to better explore the change of the standard deviation of Acousticness and the prevalence of non-English languages in popular music over time.

Our research question: Does our data provide sufficient evidence that the proportion of songs in non-English languages has increased from the time period of 1956-1989 to the time period of 1990 to present? Does our data provide sufficient evidence that the standard deviation in `Acousticness` has increased over time? The goal of our report is to observe how popular music has shifted to be more diverse in the characteristics of non-English genres or `Acousticness` over time.

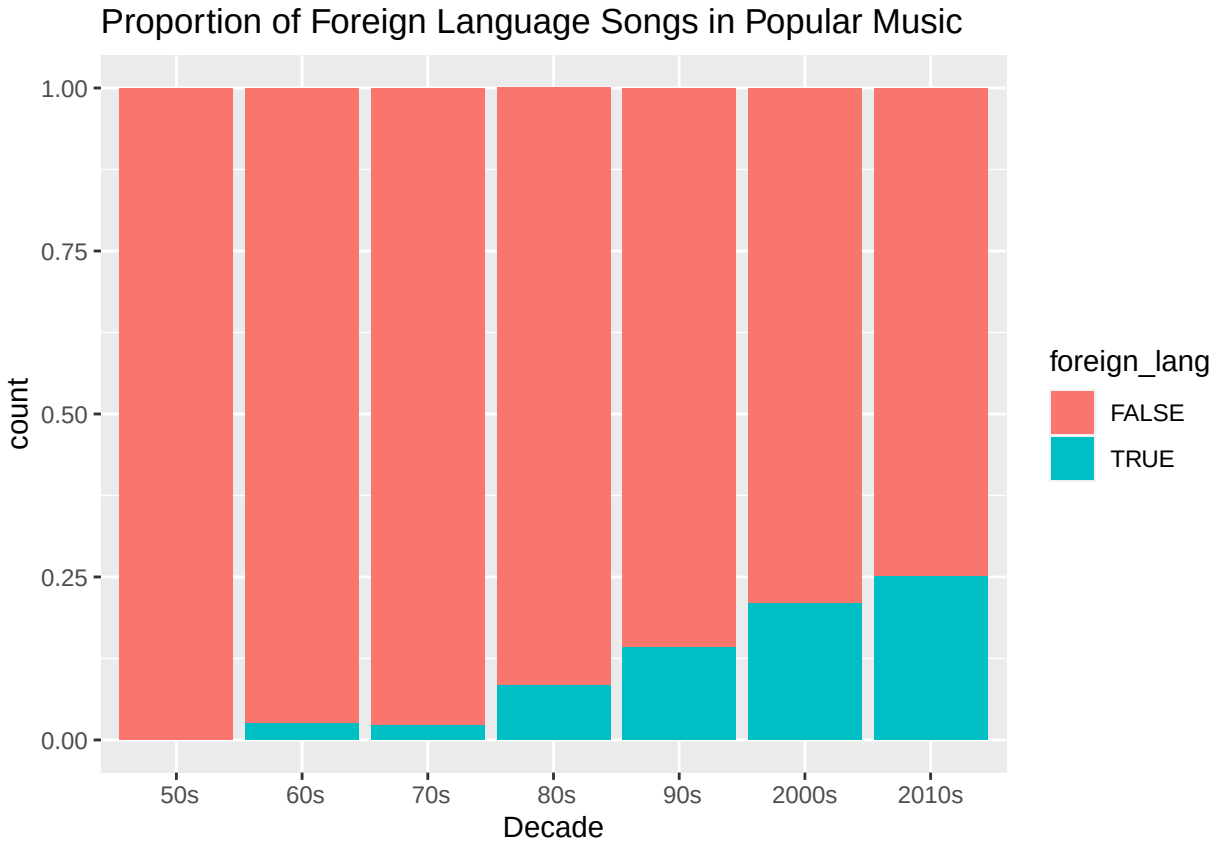
Methodology

There are no missing values in the data set. We will create new variables using the mutate and case_when functions as follows:

1. `decade`: categorical variable indicating the decade when the song was created using the categorical name of "50s", "60s", and so on
2. `period`: categorical variable in which "Oldies" represents when Year is before 1990 and "Present" for when Year is after 1989
3. `foreign_lang`: categorical variable in which "TRUE" stands for any song whose `Top Genre` name indicates that the song is spoken in a non-English language, "FALSE" otherwise
4. `pop`: categorical variable in which "TRUE" stands for any song whose `Top Genre` name has "pop" in it, "FALSE" otherwise
5. `sd`: standard deviation of Acousticness per year
6. `year`: numerical variable representing the years since the first Year in our data set (1956)



Older music tends to have a higher median value for `Acousticness`. The median acousticness has remained relatively constant from the 1990s to the 2010s and the majority of the interquartile range overlaps and is around the same size, which indicates they have similar spreads for `Acousticness`. There aren't any outliers in our data set.



The proportion of popular foreign language songs has increased over time. We noticed that the proportion of foreign language in the 50s is 0 or close to 0 and we think this is because we don't have as many observations in this decade since our data set starts at 1956.

We will use simulation-based hypothesis testing to see if the proportion of `foreign_lang` songs in this data set increased from the "Oldies" period to the "Present" period. We want to be able to test our null and alternative hypotheses and generate a p-value so we can answer our research question about whether we have significant evidence to claim that the proportion of non-English songs in popular music has increased from the "Oldies" time period to the "Present" time period.

We will use linear and interaction effects modeling to examine how the standard deviation of `Acousticness` has changed over time. This will allow us to represent the relationship between year, standard deviation of `Acousticness`, and whether a song is in the "pop" genre with a function.

Results

Hypothesis test for non-English popular songs

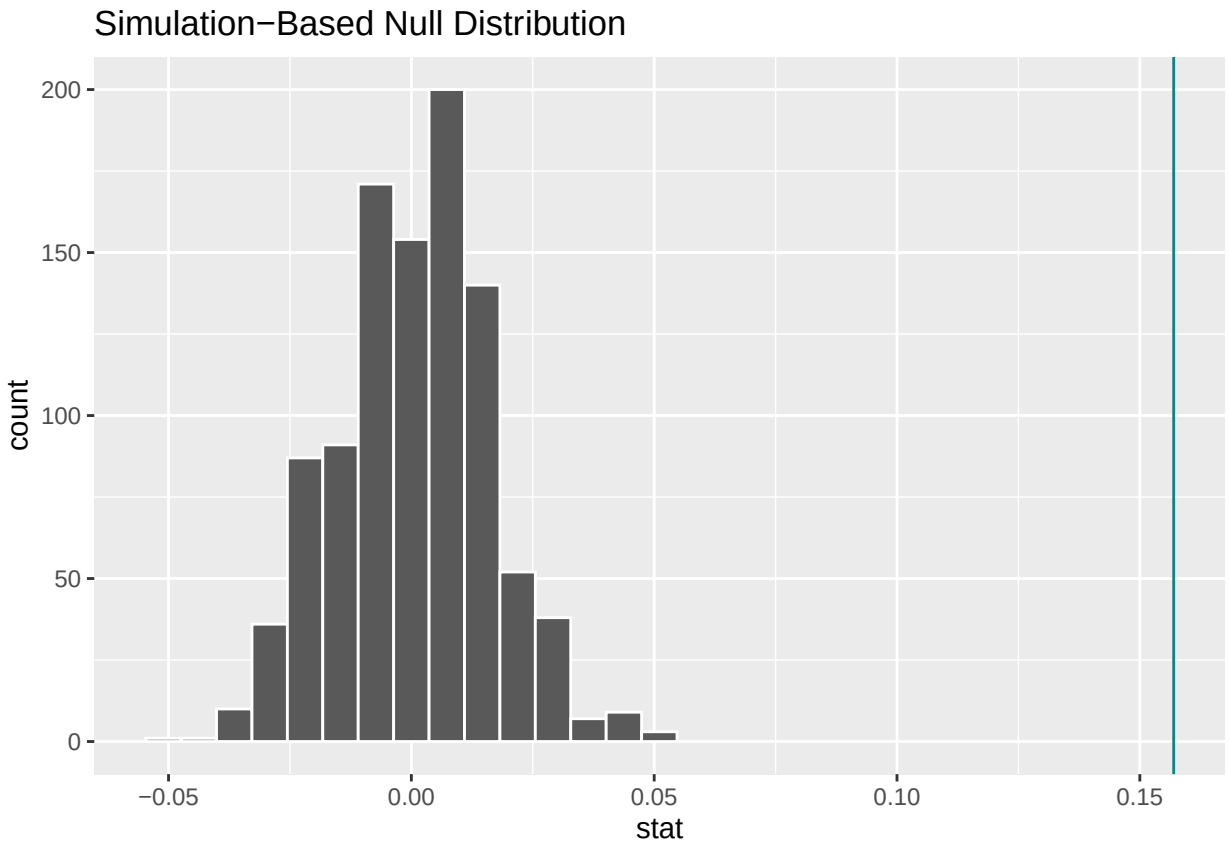
H0: The proportion of popular foreign language songs in the "Modern" time period is equal to the proportion of popular foreign language songs in the "Oldies" time period ($\rho_m = \rho_o$, where ρ_m is the proportion of popular foreign language songs in the "Modern" time period and ρ_o the proportion of popular foreign language songs in the "Oldies" time period)

Ha: The proportion of popular foreign language songs in the modern decades is greater than the proportion of popular foreign language songs in the "Oldies" time period ($\rho_m = \rho_o$, where ρ_m is the proportion of popular foreign language songs in the "Modern" time period and ρ_o the proportion of popular foreign language songs in the "Oldies" time period)

Alpha: 0.05 ($\alpha = 0.05$)

```
## # A tibble: 1 x 1
##   p_val
##   <dbl>
## 1     0
```

The p-value is very small, which is less than the pre-determined alpha level of 0.05, so we reject the null hypothesis. There is sufficient evidence to conclude that the proportion of popular foreign language songs in the modern decades is greater than the proportion of popular foreign language songs in the older decades.



Linear model for standard deviation of acousticness

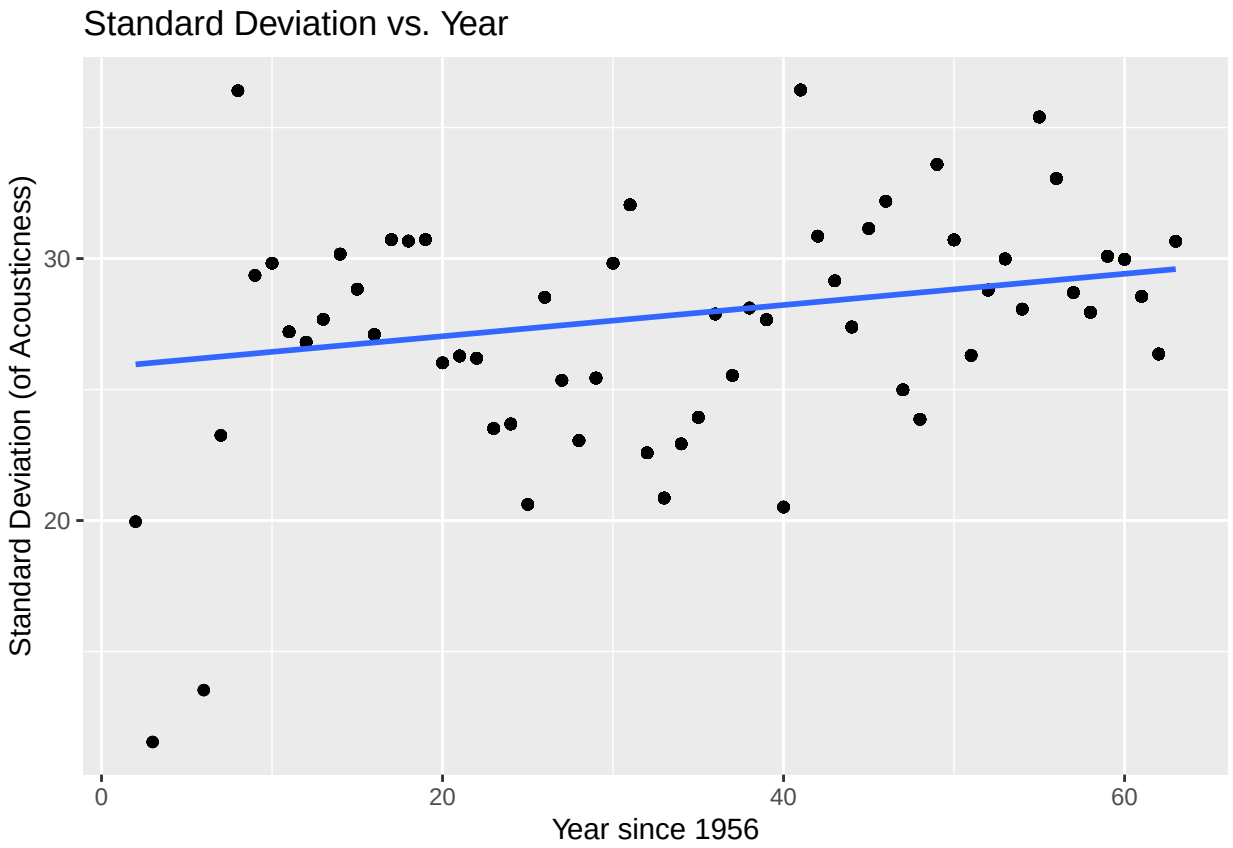
```
## # A tibble: 2 x 5
##   term        estimate std.error statistic  p.value
##   <chr>          <dbl>     <dbl>     <dbl>    <dbl>
## 1 (Intercept)  25.8      0.194       133.  0.
## 2 year          0.0596   0.00480      12.4 3.90e-34
```

We will be using the variable `sd`, which is the standard deviation of the `Acousticness` of the songs per year.

The linear equation for the model is $\widehat{sdofAcousticness} = 25.842 + 0.0596 \times year$

The intercept of this graph tells us that when the year is 1956, we expect the standard deviation for acousticness to be 25.842, holding all else constant.

The slope tells us that for each additional year, the standard deviation of Acousticness is expected to increase, on average, by 0.06.



This linear model suggests a slight positive linear relationship of the standard deviation of acousticness of popular songs and the year the popular songs were created.

Next, we chose to do a multiple linear regression model with interaction effects to allow for different slopes and explore whether the relationship between the explanatory variable of year and standard deviation of acousticness depends on the relationship between the explanatory variable of the pop genre and the standard deviation of acousticness.

```
## # A tibble: 4 x 5
##   term        estimate std.error statistic  p.value
##   <chr>          <dbl>     <dbl>     <dbl>    <dbl>
## 1 (Intercept) 25.9       0.209     124.    0.
## 2 year         0.0591    0.00538    11.0   2.66e-27
## 3 poppop      -0.113     0.610      -0.186 8.53e- 1
## 4 year:poppop  0.00278   0.0133      0.209 8.35e- 1
```

$\widehat{sdAcousticness} = 25.858 + 0.059 \times year - 0.113 \times pop - 0.003 \times year : pop$

The intercept of this graph tells us that when the year is 1956, we expect the standard deviation for acousticness to be 25.858.

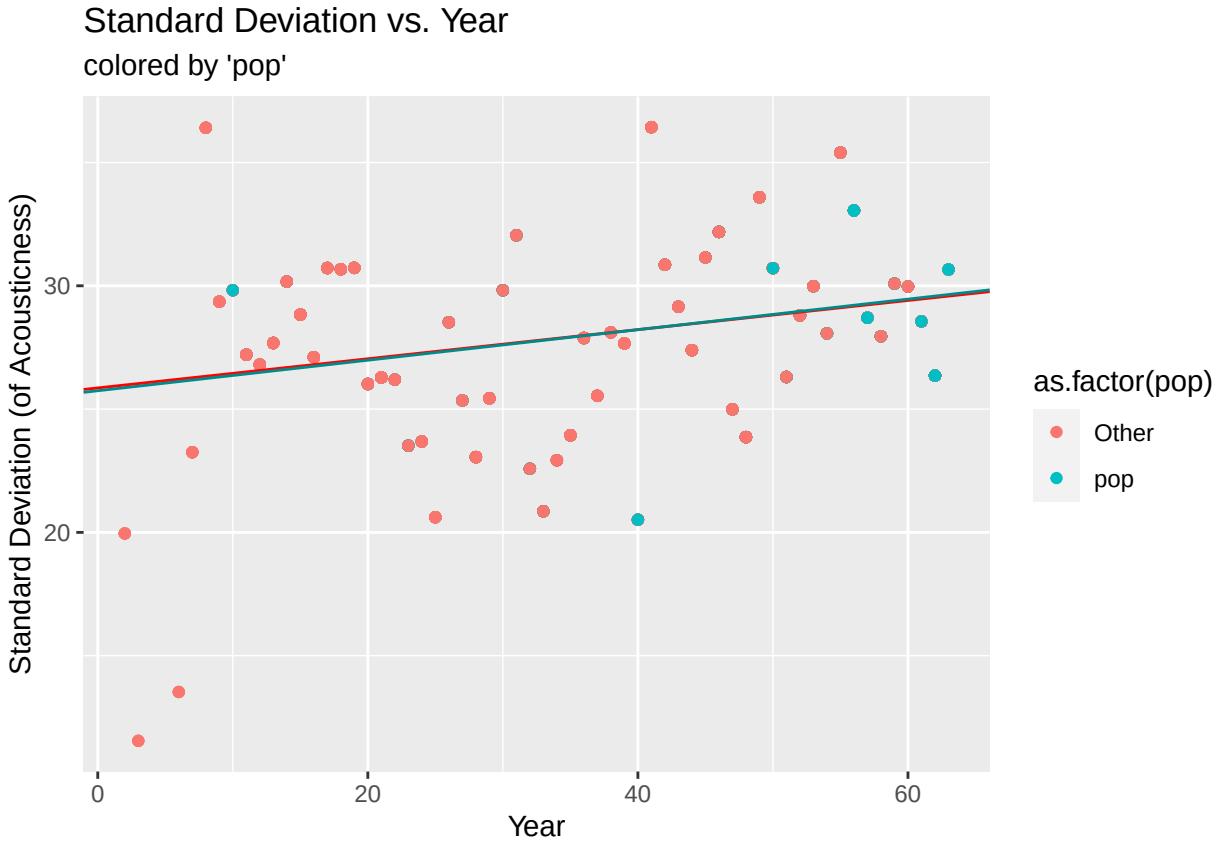
All else held constant, for every additional year since 1956, the standard deviation of acousticness for pop songs is predicted to increase, on average, by 0.056.

Linear Model for pop songs: $\widehat{sdAcousticness} = 25.858 + 0.056 \times year$

All else held constant, in 1956, pop songs are predicted, on average, to have a standard deviation of acousticness that is 0.113 less than non-pop songs.

Linear Model for songs in 1956: $\widehat{sdAcousticness} = 25.858 - 0.113 \times pop$

Rate of change in the standard deviation of acousticness as year increases depends on the genre since they have different slopes. They have the same intercept so we cannot say one model or the other has a consistently different standard deviation of acousticness.



R-squared values for the models:

```
## # A tibble: 1 x 2
##   r.squared adj.r.squared
##       <dbl>         <dbl>
## 1    0.0719        0.0714
```

```
## # A tibble: 1 x 2
##   r.squared adj.r.squared
##       <dbl>         <dbl>
## 1    0.0719        0.0705
```

Because the adjusted R^2 value is larger for the non-interactive linear model compared to the interactive linear model, the non-interactive linear model is a better fit for our data.

Discussion

We have learned using our simulation-based hypothesis test that there is significant evidence that the proportion of non english songs in popular music has increased from the "Oldies" time period of before 1990 to the "Present" time period of after 1989. We have learned that there is not enough evidence to show using linear regression with and without interaction effects that the standard deviation of Acousticness increased over time.

The data in general appeared to be pretty reliable but given it was taken from Spotify, it may have eliminated some pieces of data coming in from other methods of listening to music like Apple Music. The validity of our categorical variables like Top Genre and pop are questionable because these are subjective factors and the

labeling of one song as “alternative pop rock” or “pop rock” is subjective to the listener. There are limitations to the analysis we can do with this data set, since there may be many other factors that are not variables which we cannot include in our modeling which impact the diversity of popular music. In addition, we have a limited number of samples of popular music.

Our simulation based hypothesis testing method may not have been the best choice given that we do not know whether the songs are independent or not, as some could have come from the same album or artist. We chose to separate the time periods into “Oldies” and “Present” based on the fact that the Internet became widely used by the public in the 1990s but even so, our choice to represent these two time periods is somewhat arbitrary. The data also began in 1956 so for our decades variable, the 50s had much fewer data points than the other decades. This means that the proportion of non english songs for the 50s may have impacted the Oldies time period more and skewed our data or conclusions. There could be more information within specific decades or years that we missed by doing the larger time period. Our analysis could be improved by creating linear regression models

Our linear regression method was not the best choice since there wasn’t a very strong correlation and our graph shows a lot of variation from our line of best fit.

Furthermore, the interaction effect was very small between the pop genre and acousticness so our second model which included the interaction effect had barely any difference from the original model. If we could redo our project, we would find a dataset where there is popular music in the United States so we could better examine how one country responds to cultural shifts in music instead of worldwide. It can also be seen as a form of extrapolation if we use our conclusions from the dataset to talk about years outside the dataset, so if we were to redo our project, we find a dataset with more years included.