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Regression Final Project:

Spotify vs. Apple Songs in Playlist!

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Questions / Goals

1. **Popularity**
   What factors make a song appear more in number of Spotify playlists? Apple playlists?

2. **Spotify**
   Create one MLR model with the predictor being #_in_spotify_playlists

3. **Apple**
   Create one MLR model with the predictor being #_in_apple_playlists

Bias / Issues in Data

Genre

Disproportionate

Observations per genre are disproportionate

Streams

Missing Information

Total streams are only listed for Spotify

Playlist

Disproportionate

There are a disproportionate number of Spotify vs Apple users/playlists

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Dataset & Cleaning

Original Dataset

- Top Spotify Songs (kaggle.com)
- Contains list of popular songs for spotify and apple
- 953 Observations
- Original 24 columns

Data Cleaning

- Manually added a feature “genre” to each observation
- Removed all observations with null values and features that were not wanted
- Remaining observations = 804
- Remaining columns = 14

Regressors: Categorical

Genre

Categorical: What type of genre the song is

Key

Categorical: The note of the song

Mode

Categorical: Major or Minor

Regressors: Numerical

BPM
Numerical: Beats per minute

Valence
Numerical: The musical positivity of the song

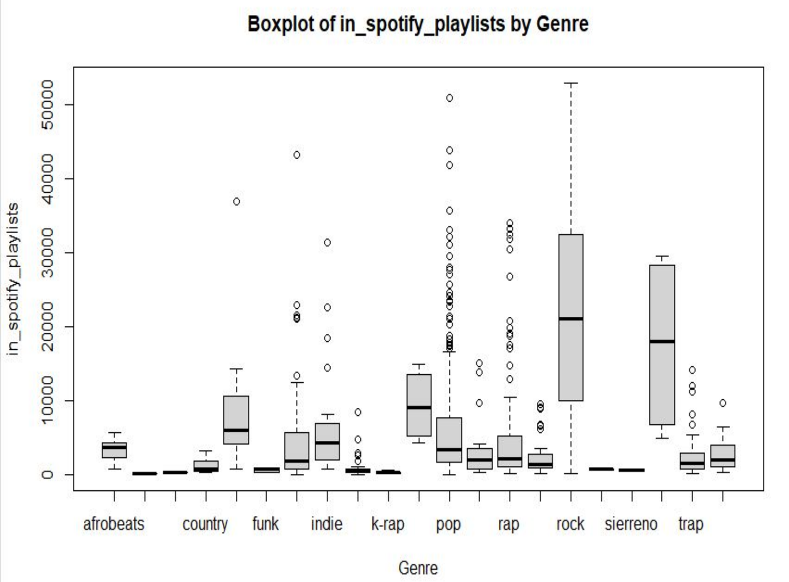
Danceability
Numerical: How danceable the song is

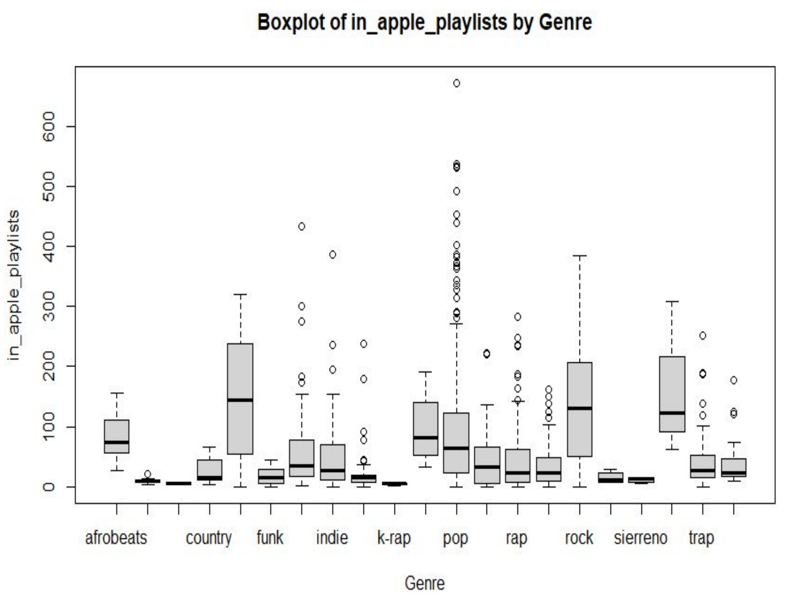
Energy
Numerical: How upbeat the song is

Acousticness
Numerical: Measure of how acoustic the song is

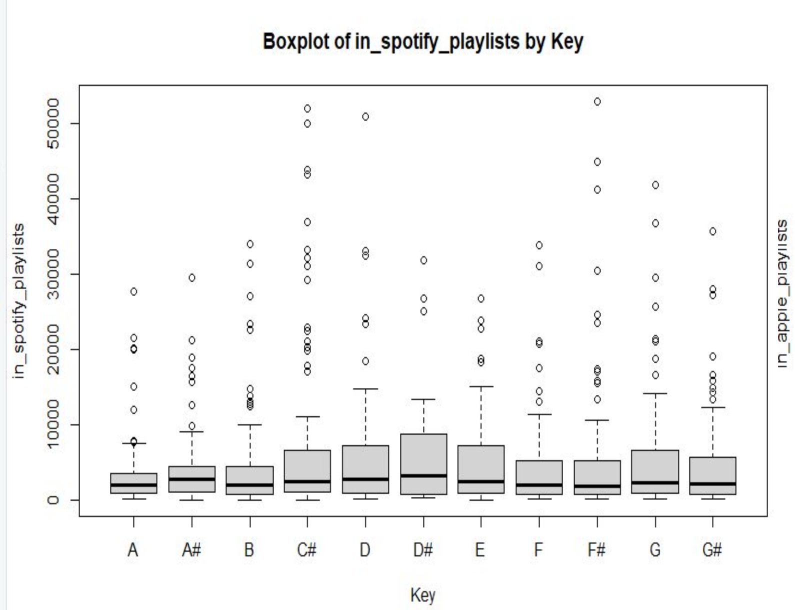
Instrumentalness
Numerical: Measure of how instrumental the song is

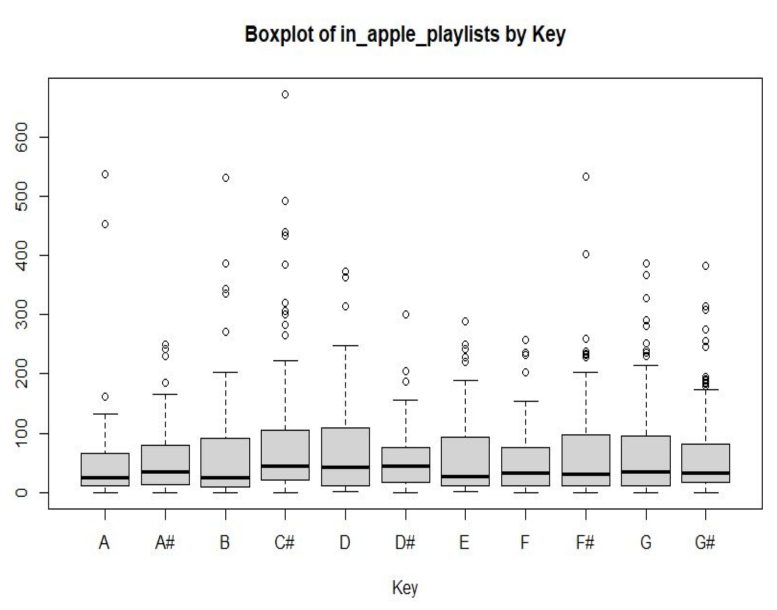
Spotify Vs Apple: Genre Boxplot



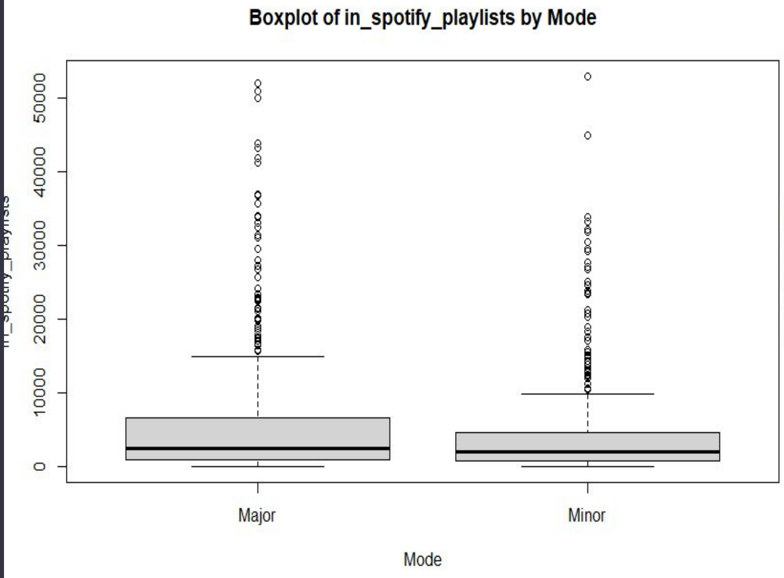


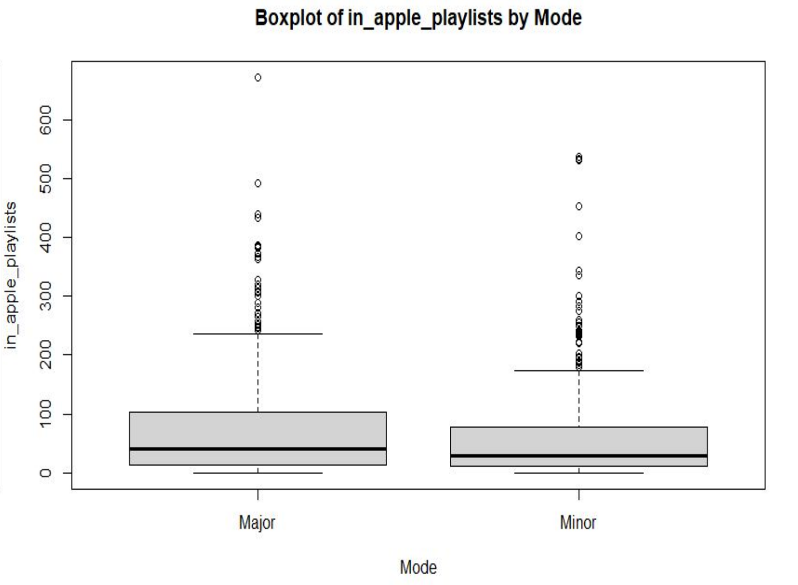
Spotify Vs Apple: Key Boxplot





Spotify vs Apple : Mode Boxplot





Boxplot Summary

- In both Apple and Spotify, the pop genre had the most outliers
- Between the two streaming services the concentration of genre observations varied greatly
- Comparing the observations of key between the streaming services shows a consistent distribution for C#, but other keys have a high variability in both Spotify and Apple
- Comparing the major and minor modes, major and minor in Spotify has similar concentration of points while Apple has a wider distribution for major
- We decided to keep all categorical variables because of the variability between each regressor

Spotify: Backward Model

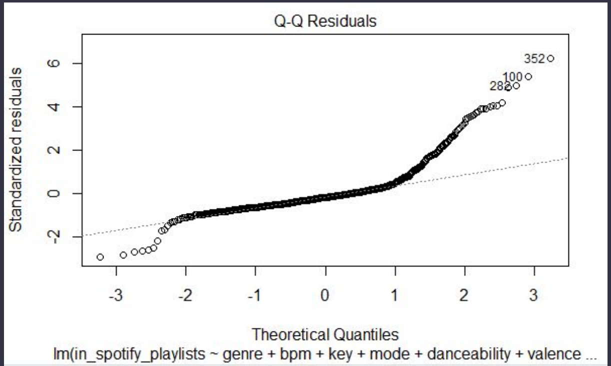
```
Call:
lm(formula = in_spotify_playlists ~ genre + energy, data = data)

Residuals:
   Min     1Q Median     3Q    Max
-20938  -3603  -1416    788  43710

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)          -20.00    2868.26  -0.007 0.994437
genreBollywood     -3356.41    3760.28  -0.893 0.372349
genreCorrido       -3144.54    4119.00  -0.763 0.445441
genrecountry       -2633.11    3348.34  -0.786 0.431875
genreedm            4722.99    3262.62   1.448 0.148128
genrefunk          -2229.73    3469.26  -0.643 0.520600
genrehip hop        1601.69    2800.52   0.572 0.567537
genreindie          3733.22    3011.17   1.240 0.215425
genreK-Pop         -2868.64    2845.88  -1.008 0.313767
genrek-rap         -3189.85    4119.10  -0.774 0.438925
genrelounge         7696.46    4440.37   1.733 0.083438 .
genrepop            3152.88    2691.58   1.171 0.241799
genreR&B             206.70    3053.46   0.068 0.946046
genrerap            2205.01    2744.22   0.804 0.421924
genrereggaeton     -1466.43    2798.28  -0.524 0.600394
genrerock          18896.60    2943.80   6.419 2.38e-10 ***
genresertanejo     -3309.37    4125.48  -0.802 0.422693
genresierreno      -2254.09    4411.32  -0.511 0.609509
genresoul          14742.01    4411.89   3.341 0.000873 ***
genretrap           -701.10    2817.30  -0.249 0.803538
genreUrban Latino   -781.87    3070.83  -0.255 0.799089
energy                51.85      16.63   3.118 0.001889 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

s: 7034 on 782 degrees of freedom
Multiple R-squared: 0.2648,
Adjusted R-squared: 0.2451
F-statistic: 13.41 on 21 and 782 DF,  p-value: < 2.2e-16
```

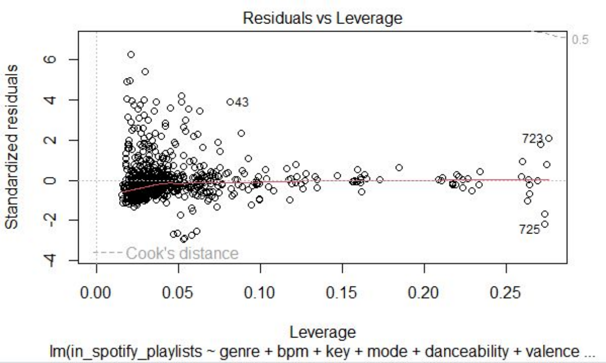
- Alpha: 0.05

Interpretation

- $Y = -20.00 \pm \text{genrecoeff}x_1 + 51.85x_2$
- Genre is the first regressor added, with energy added subsequently
- Energy has a low p-value (0.001889), which suggests that it is statistically significant
- The F-statistic (13.41) suggests that the model's predictors collectively have a significant effect on the dependent variable
- R^2 value is one of the higher model options

Spotify: Model Plots





- Light-tailed distribution
- We have more extreme values than would be expected of a normal distribution
- There are not any leverage points according to the Residuals Vs. Leverage plot.

Apple: Backward Model

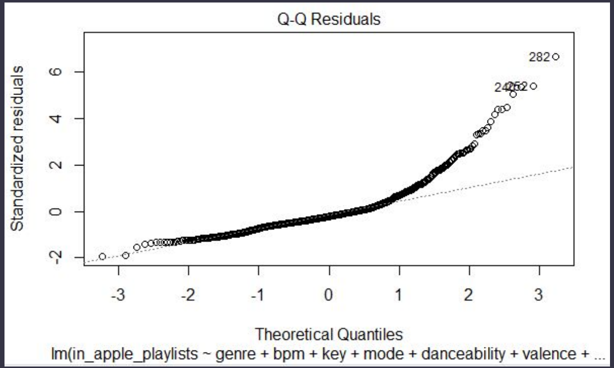
```
Call:
lm(formula = in_apple_playlists ~ genre + bpm + danceability +
    energy, data = data1)

Residuals:
    Min      1Q  Median      3Q     Max
-147.44  -43.11  -18.91   15.28  560.91

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       -12.1194    38.5895  -0.314  0.75356
genreBollywood    -77.5005    43.7986  -1.769  0.07721 .
genreCorrido      -88.8685    48.2114  -1.843  0.06566 .
genrecountry      -64.0704    39.2260  -1.633  0.10280
genreedm           46.9947    38.0716   1.234  0.21743
genrefunk         -73.8543    40.5913  -1.819  0.06922 .
genrehip hop      -26.4415    32.7012  -0.809  0.41900
genreindie        -14.3762    35.3226  -0.407  0.68412
genreK-Pop        -68.8622    33.2267  -2.072  0.03855 *
genrek-rap        -80.5834    48.0163  -1.678  0.09370 .
genrelounge        30.6312    51.8840   0.590  0.55511
genrepop           14.7070    31.4707   0.467  0.64040
genreR&B          -26.2833    35.7037  -0.736  0.46186
genrerap          -38.9141    32.0292  -1.215  0.22475
genrereggaeton    -56.9888    32.7049  -1.743  0.08181 .
genrerock          56.6562    34.4987   1.642  0.10094
genresertanejo    -81.9132    48.1904  -1.700  0.08957 .
genresierreno     -75.5975    51.5334  -1.467  0.14279
genresoul          72.9664    51.4257   1.419  0.15634
genretrap         -48.0112    32.8944  -1.460  0.14482
genreUrban Latino -51.2284    35.8521  -1.429  0.15344
bpm                 0.2329     0.1060   2.197  0.02834 *
danceability        0.5619     0.2234   2.515  0.01210 *
energy              0.5072     0.1952   2.598  0.00955 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

s: 81.92 on 780 degrees of freedom
Multiple R-squared: 0.1622,
Adjusted R-squared: 0.1375
F-statistic: 6.565 on 23 and 780 DF,  p-value: < 2.2e-16
```

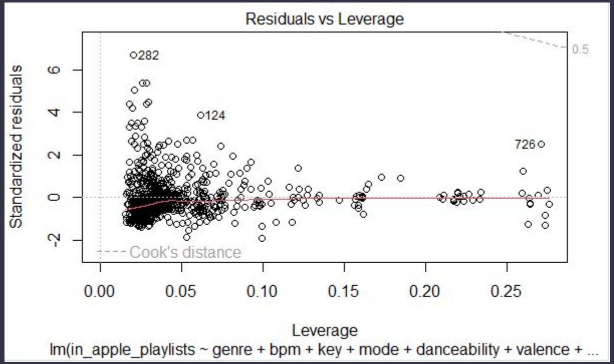
- Alpha = 0.05

Interpretation

- $Y = -12.1194 \pm \text{genrecoeff}x_1 + 0.2329x_2 + 0.5619x_3 + 0.5072x_4$
- Genre is the first regressor added, with BPM, danceability, and energy added subsequently
- The F-statistic (6.565) suggests that the model’s predictors collectively have a significant effect on the dependent variable
- Energy has the lowest p-value (0.00955), which suggests that it is statistically significant
- R^2 value is one of the higher model options

Apple: Model Plots





- Light Right Tail Distribution
- No leverage points –all points far from Cook's D
- Distribution shows more extreme values than a normal distribution

Comparing the Two Models

- Spotify only deemed two regressors as significant for the prediction of amount of playlists a song will appear in
- Apple picked four regressors that were significant to our predictor
- Both step functions deemed genre the most significant, adding that regressor first to the model
- While energy was added in both models bpm and danceability were deemed more significant in the model for Apple playlists
- Overall the Spotify model deemed the only necessary regressors to be energy and genre while the Apple model selected genre, bpm, danceability and energy

Final Interpretation

- H_0: All β_i are = 0
- H_1: At least one $\beta_i \neq 0$
- Both backward models for Spotify and Apple have a statistically significant F-statistic, which suggest that all of the predictors collectively have a significant effect on the dependent variable (in_spotify_playlists & in_apple_playlists)
- The p-values for both the Spotify and Apple backward models are 2.2e-16, which is very close to 0. This indicates an extremely high level of significance.
- **Final:** As both the p-values are 2.2e-16, which is less than the alpha of 0.05, we reject the null hypothesis, and conclude that models are both statistically significant.

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Thanks!

Do you have any questions?

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Appendix

Additional Work

All additional work done that was not included in the final presentation

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Regression Final Project

- Unknown what the original dataset's focus was.
- Unknown how regressors like danceability were created
- Compared stepwise model selection with backward. For #_in_spotify_playlists they both ended up with the same features at a 10% and 5% level. However, when comparing with apple, the backward was more stringent at both 10% and 5%. We decided to stay with backward selection to get our final model
- There does not seem to be a transformation required for linearization
- Tried Logistic Regression model on data by converting a category into 1s and 0s
- Relationship produced a strong nonlinear relationship
- Tried a few different transformation to the model such as: sqrt and log
- None of the transformations produced a linear relationship(decided to move away from this approach)