

---

---

# CONSUMER REVIEW TRENDS FOR MUSIC APPLICATIONS



**GROUP 10 - DRAGON SOLUTIONS**  
CAROLYN MENAN, KEONHO SEO,  
JOSH GAVIN, ANIL JOSHI & DORIS LI

# AGENDA



Motivation  
for Study



Problem  
Question



Methodology



Analysis



Results



Limitations



Q&A



## MOTIVATION FOR STUDY

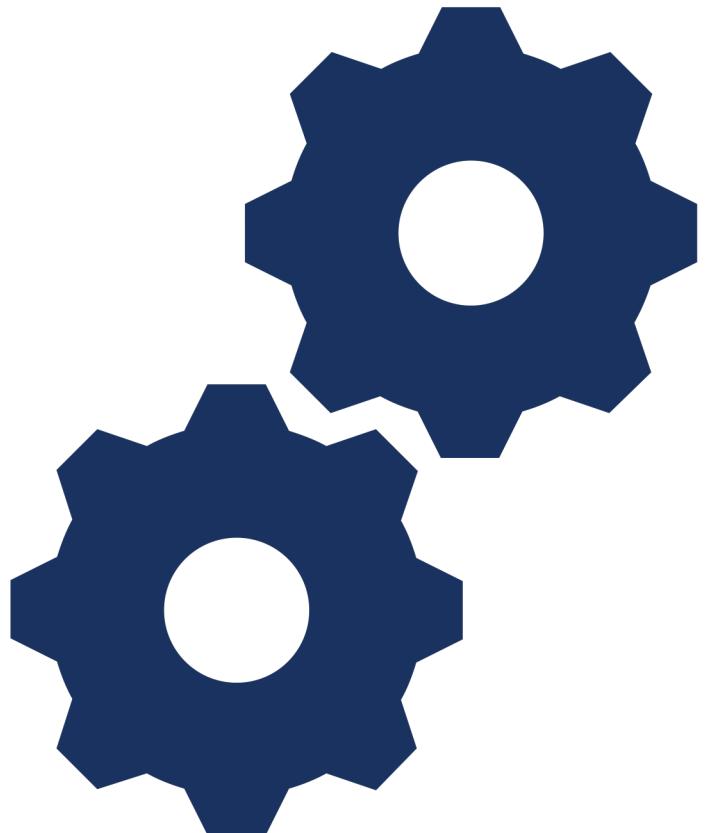
- What drives consumers to submit a review?
- What are the trends in review frequency?
- Do consumers care more about functionality, usability, or product offerings?

What are the changes in review volume and corresponding sentiment month over month that define user experience?

**Hypothesis:**  
Consumer review frequency and shared sentiments are primarily driven by new functionality releases.

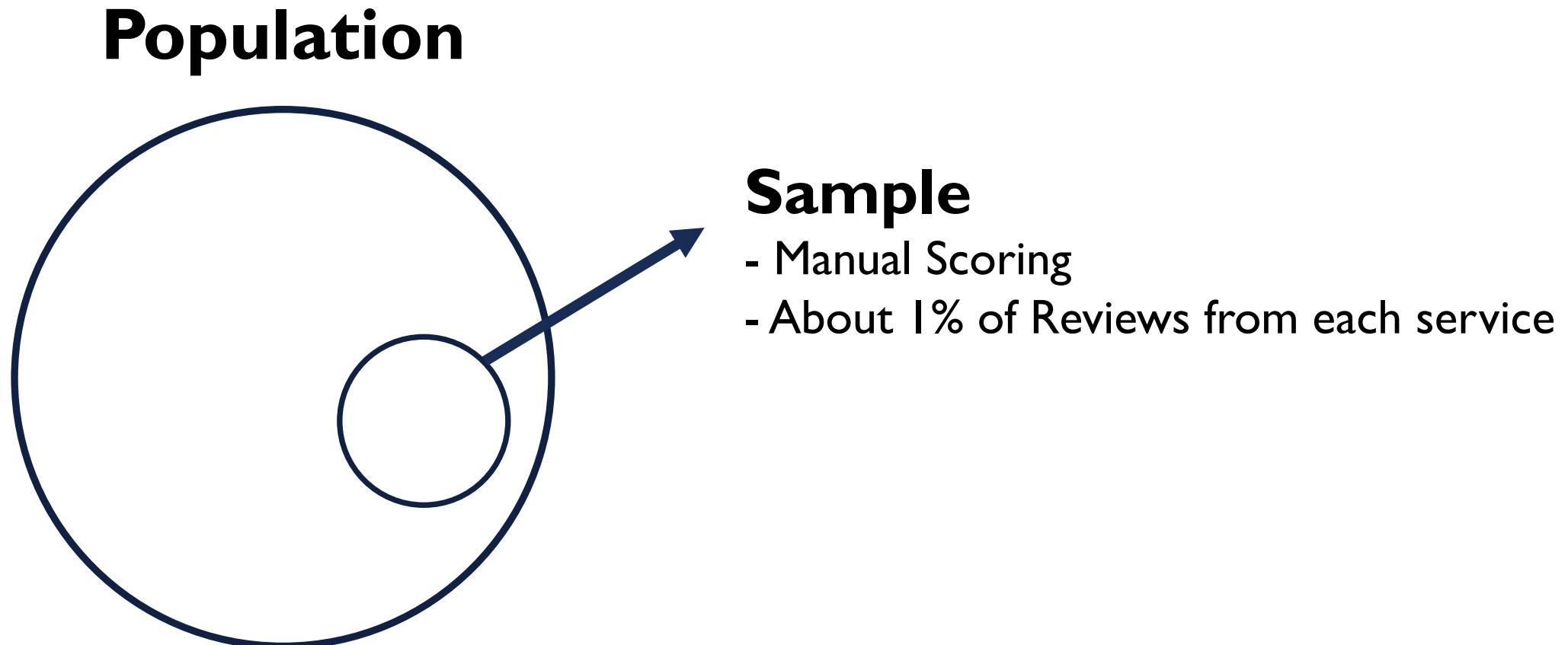
## PROBLEM QUESTION

---



## METHODOLOGY

## METHODOLOGY – SAMPLE FOR PREDICTIVE MODEL



# METHODOLOGY – SAMPLE FOR PREDICTIVE MODEL LEXICON AND MANUAL SCORING

Pandora					Manual	190
	Negative	Neutral	Positive			
Negative	12	12	11		Positive	0.91
Positive	0	14	141		Negative	0.34

**Neutral Review**

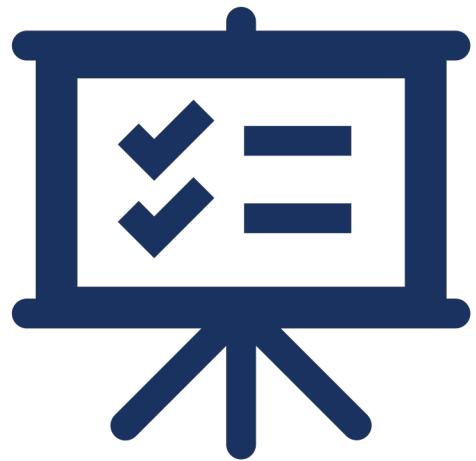
14%

Spotify					Manual	100
	Negative	Neutral	Positive			
Negative	5	5	6		Positive	0.90
Positive	1	8	76		Negative	0.31

13%

Amazon					Manual	120
	Negative	Neutral	Positive			
Negative	5	5	9		Positive	0.86
Positive	2	12	87		Negative	0.26

14%



## HOW CAN WE DEAL WITH NEUTRAL REVIEWS?

- PANDORA + SPOTIFY + AMAZON = 39,290 REVIEWS
- $39,290 * 0.14 = 5,500$  REVIEWS

# METHODOLOGY – NEUTRAL COMMENT REVIEW

review_id	date	review	score	bing_judgement
42	3948	18-Jan-13 Lost my good jazz stations on the radio years ago. Pandor...	positive	neutral
53	4809	18-Nov-14 I listen to pandora 24-7 just about. I only watch tv approx....	positive	neutral
68	6389	12-Mar-16 greT	positive	neutral
83	7842	14-Sep-15 Must have download for any phone	positive	neutral
88	8574	16-Feb-14 Sometimes it won't play the music so I have to skip the so...	negative	neutral
89	8817	30-Sep-15 Adds...	negative	neutral
93	9168	28-Apr-14 There's really not much to say here. It's exactly the same P...	negative	neutral
96	9467	21-Aug-15 AAAA++++	positive	neutral
101	10095	11-Sep-14 Pandora is a must have for music lovers. Advertisments ar...	positive	neutral
125	12565	22-Jan-15 Just okay	negative	neutral
128	13474	4-Nov-14 Don't use.	negative	neutral
130	13775	13-Oct-14 goog app	positive	neutral
136	14500	14-Nov-16 I don't know if anyone else has noticed this, but I sometim...	negative	neutral
137	14558	23-Aug-13 ok	negative	neutral
140	14691	5-May-16 I love the Pandora app a lot, but it has so many glitches. Li...	positive	neutral
158	16634	3-May-17 I absolutely love Pandora! It allows me to hear what I want ...	positive	neutral

**Hypothesis 1**  
Misspellings == Neutral?  
Not really

**Hypothesis 2**  
What about short comments?  
Probably...  
but how do we know if that is positive or negative ?

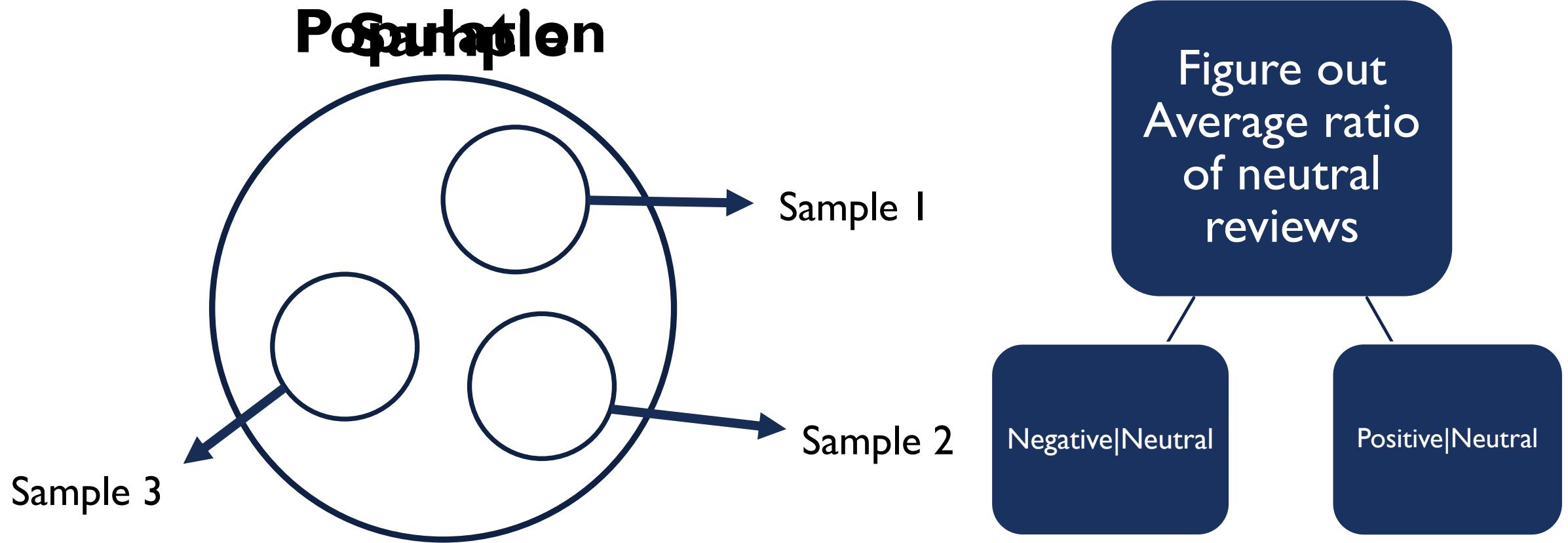
## METHODOLOGY – NEUTRAL COMMENT REVIEW

Resolve with Probability

Why?

All we want to know is Frequency

## METHODOLOGY – RESAMPLING



SO, WE CONDUCT 1000 TIMES OF RESAMPLING AND THEN...

Pandora

Positive	Negative
0.54	0.46

Spotify

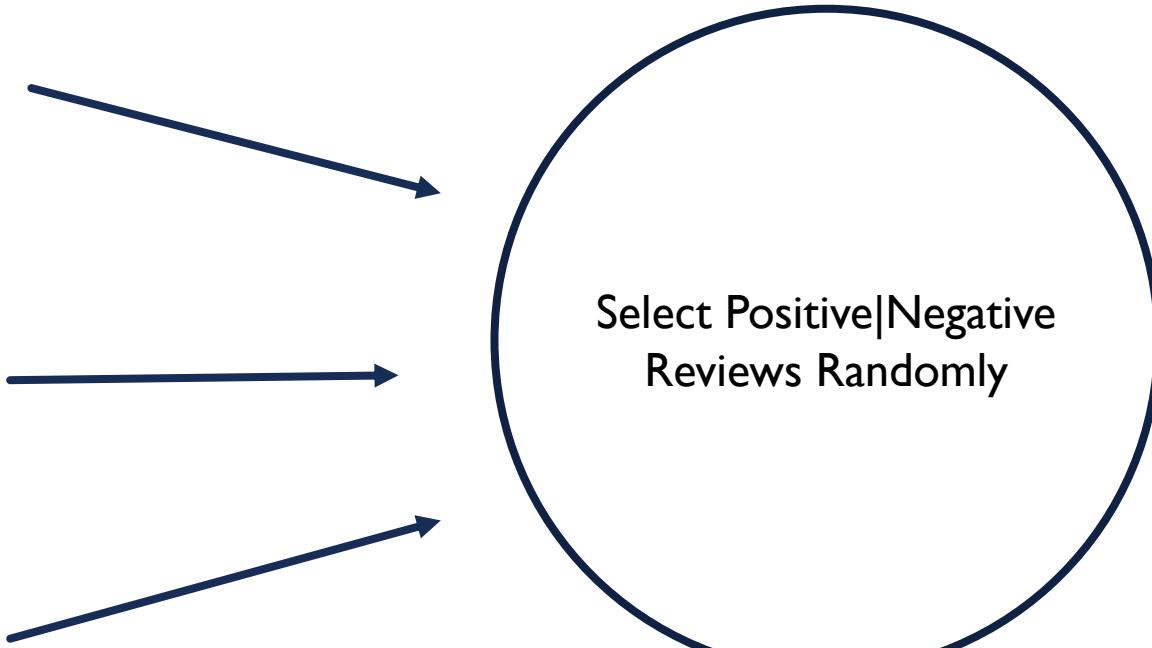
Positive	Negative
0.59	0.41

Amazon

Positive	Negative
0.70	0.30

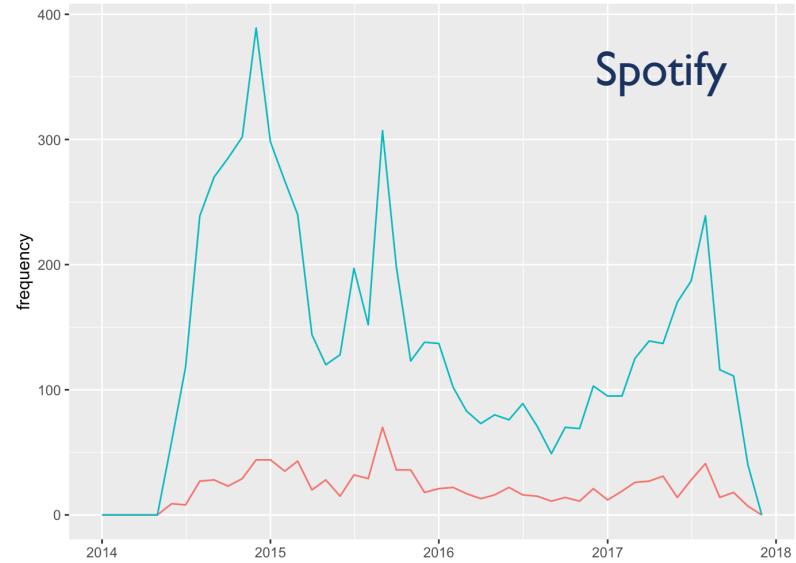
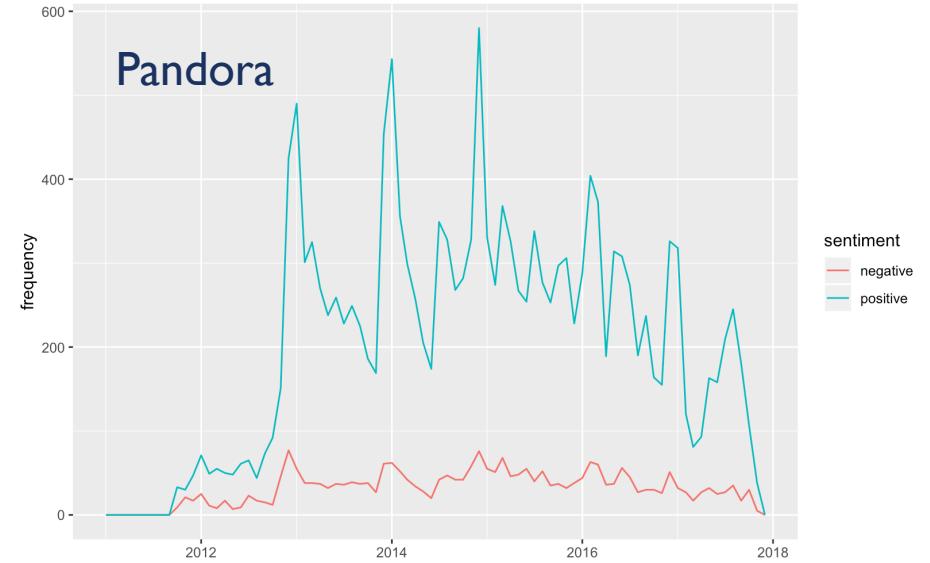
Neutral Reviews

Select Positive|Negative  
Reviews Randomly

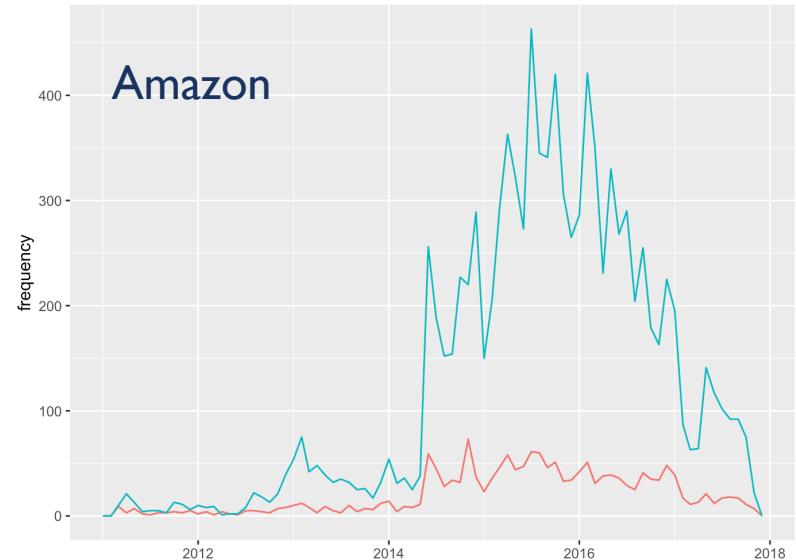




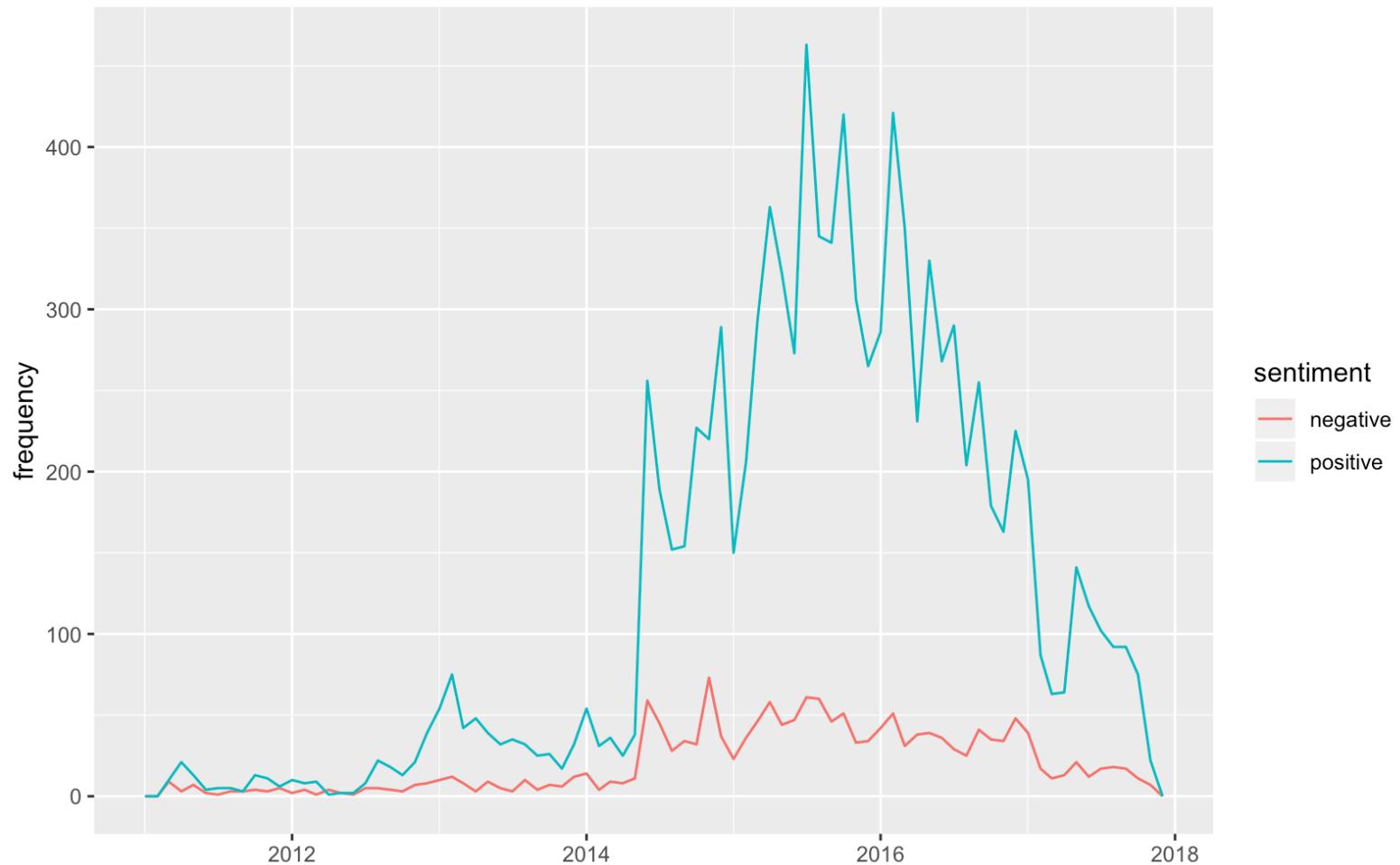
ANALYSIS



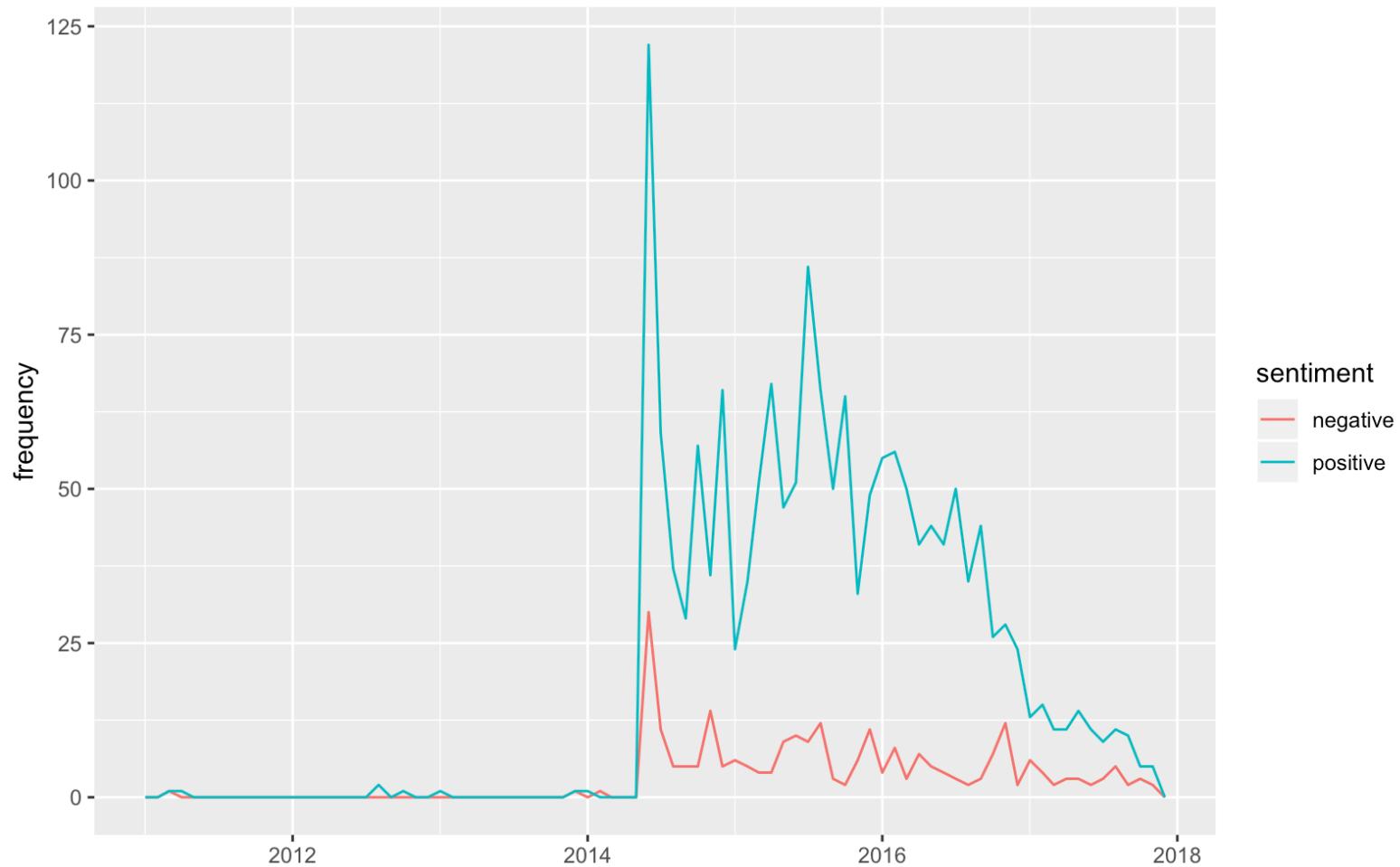
# ANALYSIS PROCESS & OVERALL REVIEW FREQUENCY



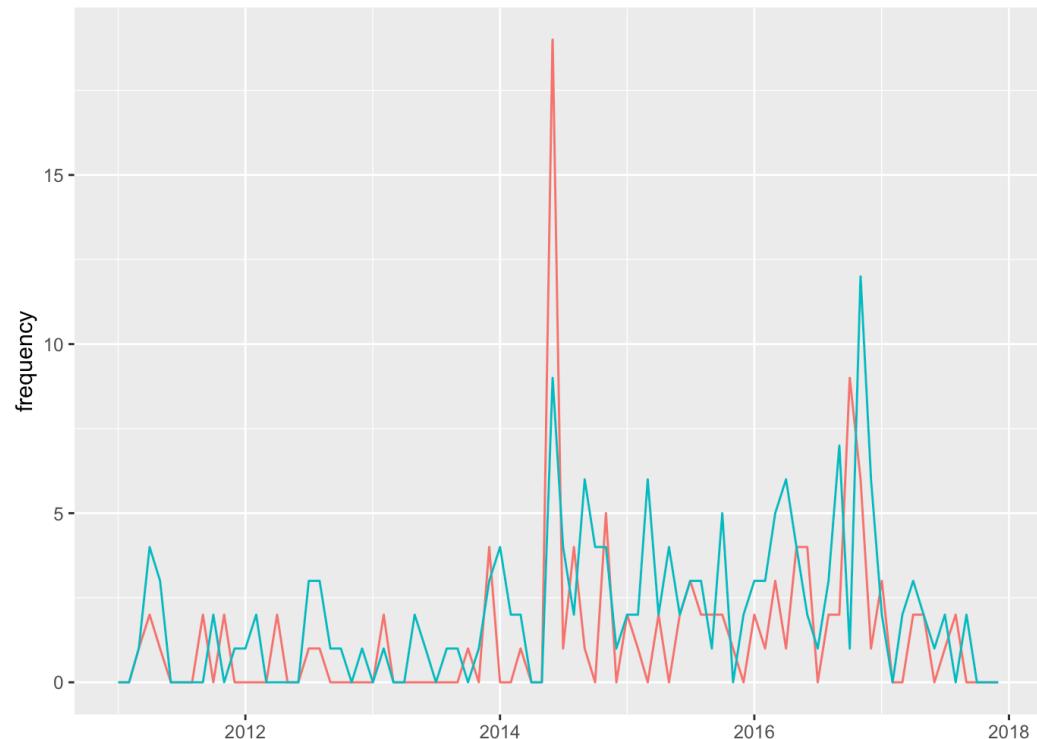
# AMAZON REVIEW FREQUENCY



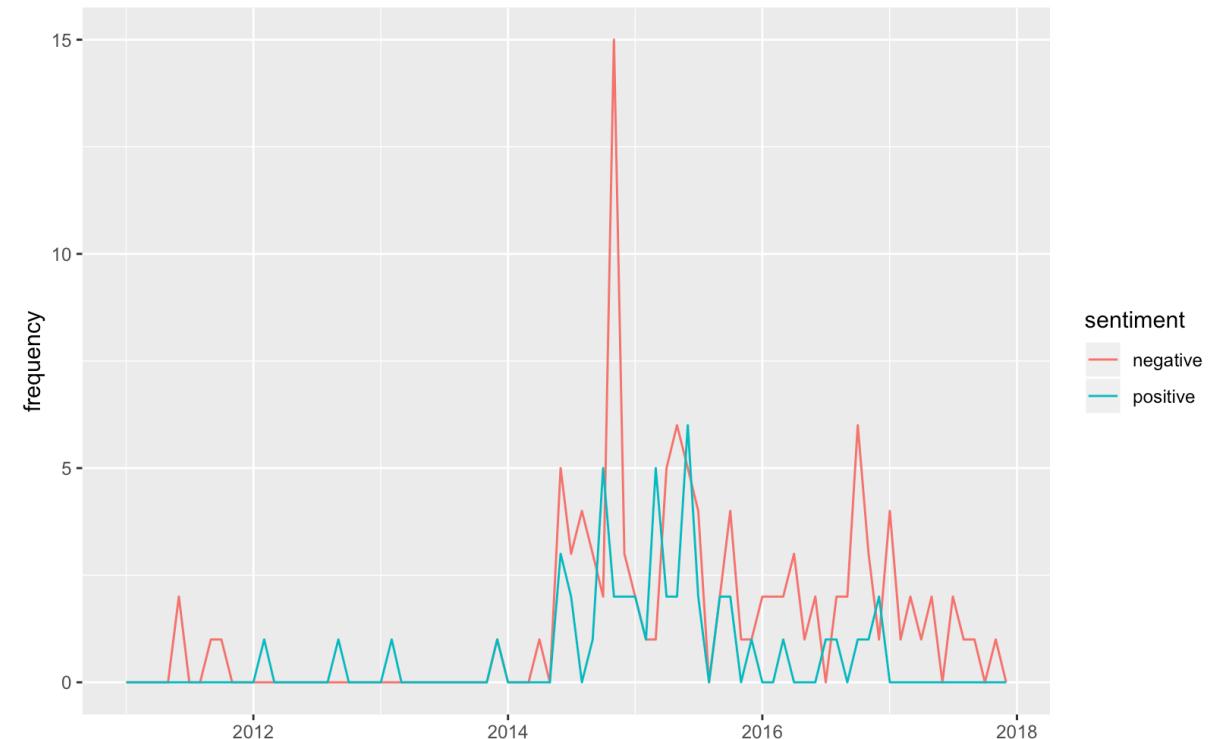
# AMAZON KEYWORD - PRIME



# AMAZON KEY WORDS – UPDATE AND CRASH



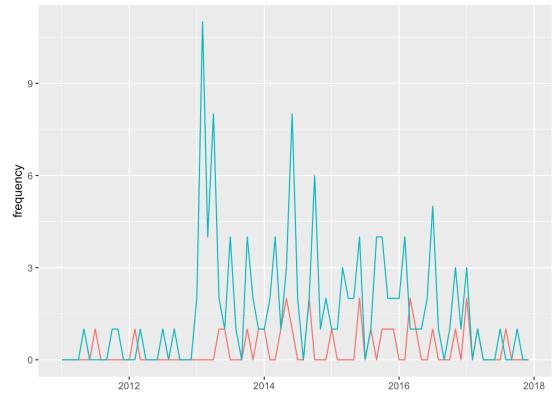
“Update”



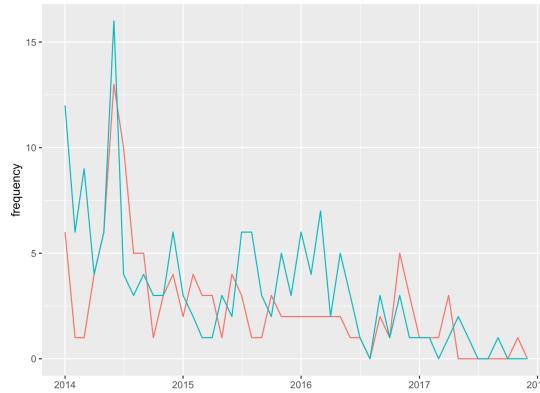
“Crash”

# UNIQUE AMAZON TREND

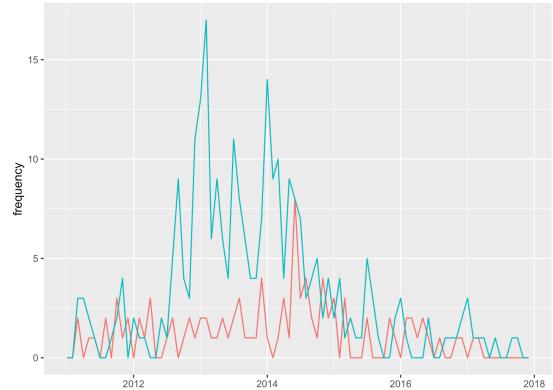
“CD”



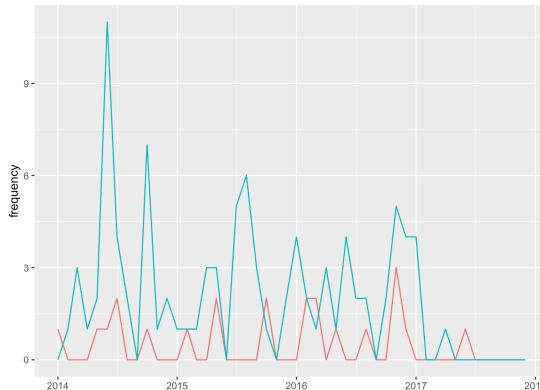
“Cloud”



“MP3”

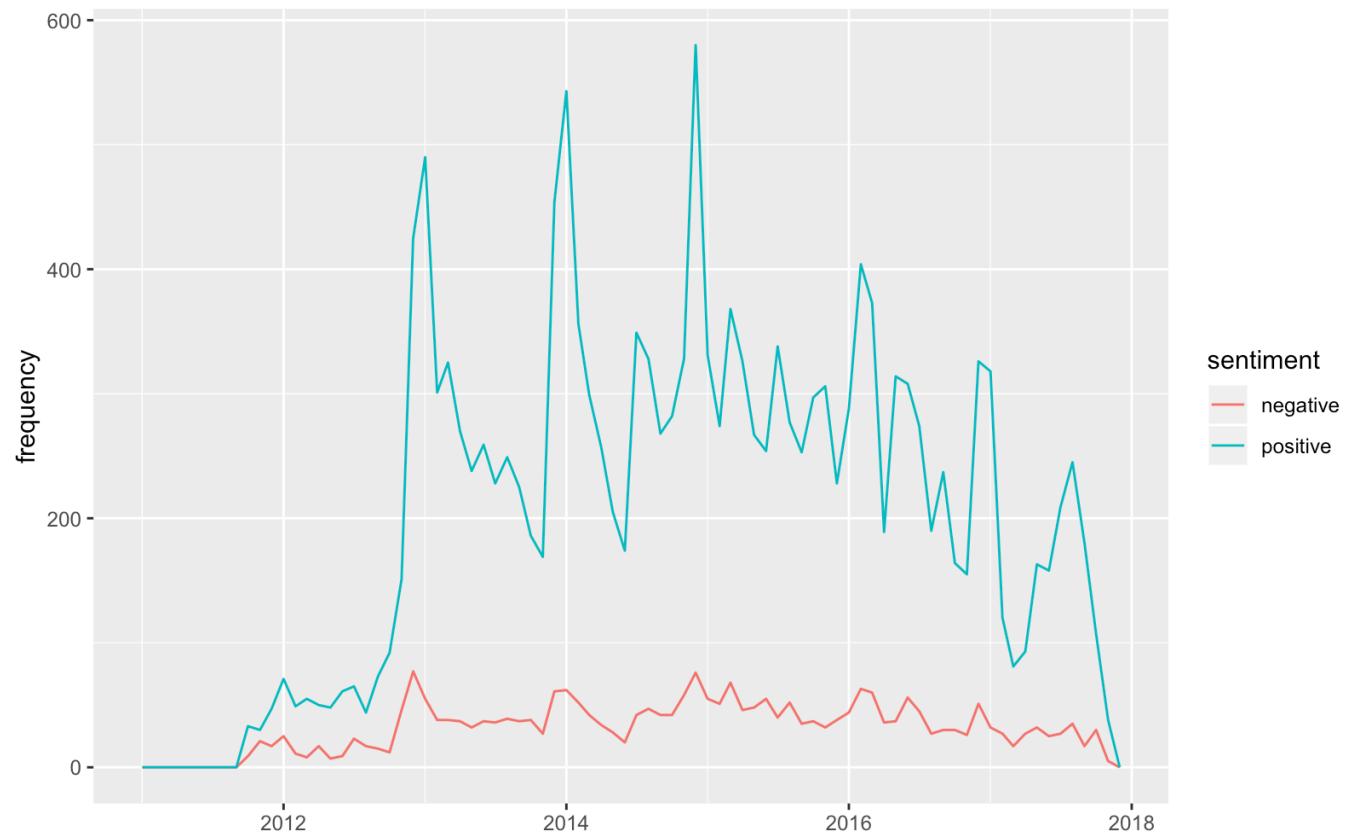


“iTunes”



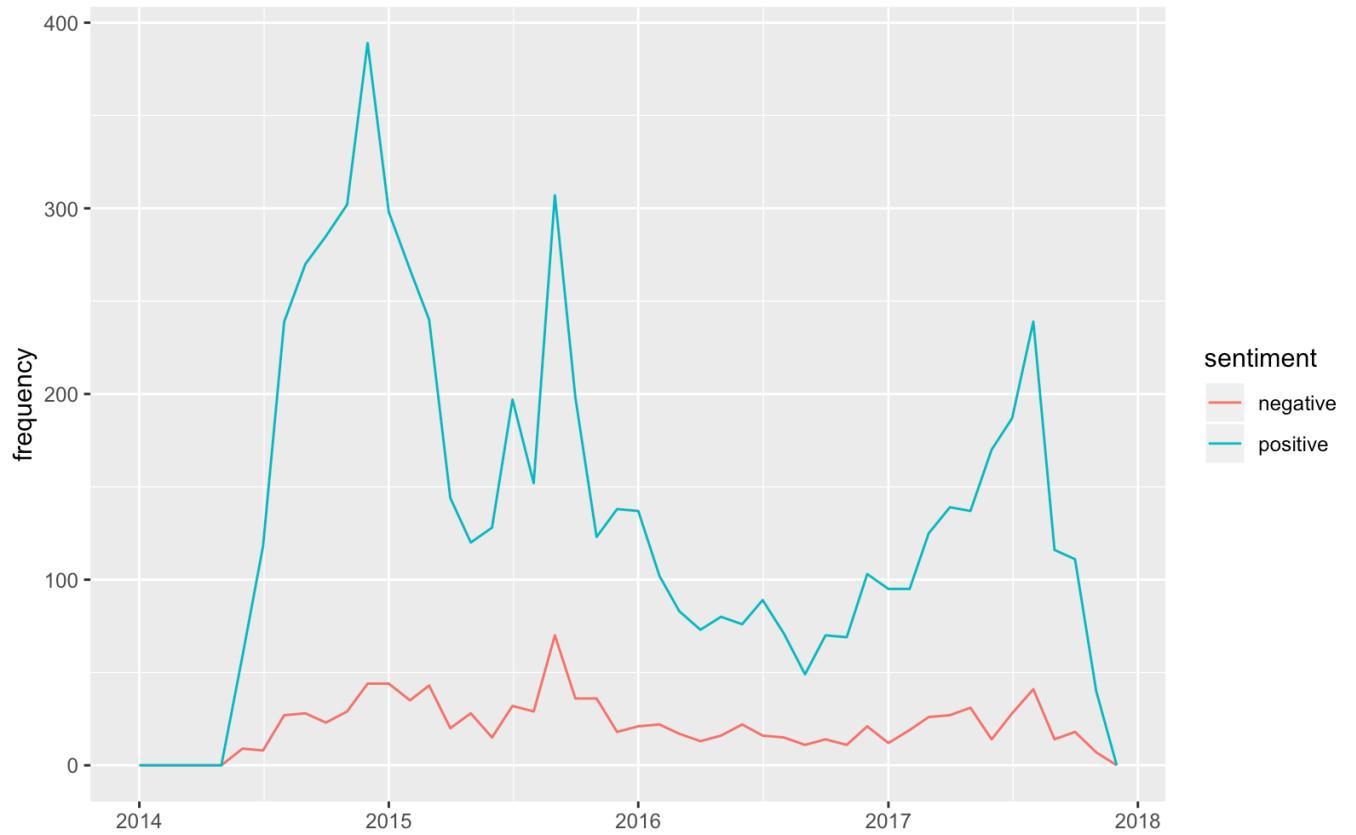
# PANDORA REVIEW FREQUENCY

- 2014 → Major mobile app redesign
- 2015 → Thumbprint radio
- 2016 → Pandora Plus
- 2017 → Pandora Premium



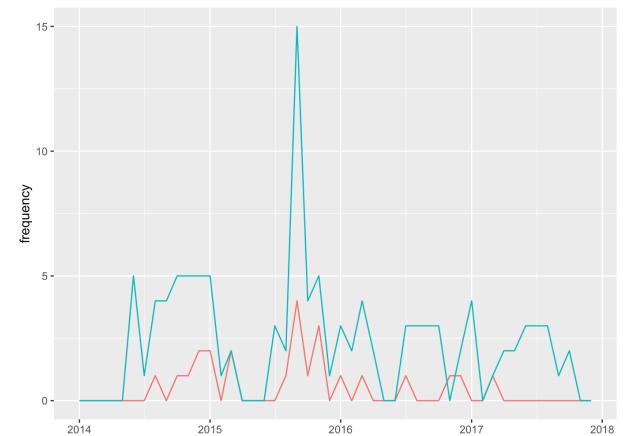
# SPOTIFY REVIEW FREQUENCY

- 2014 → Artist pay issues
- 2015 → Expands to Podcast, radio and video streaming
- 2015 → Privacy agreement concerns
- Other minor updates and fixes

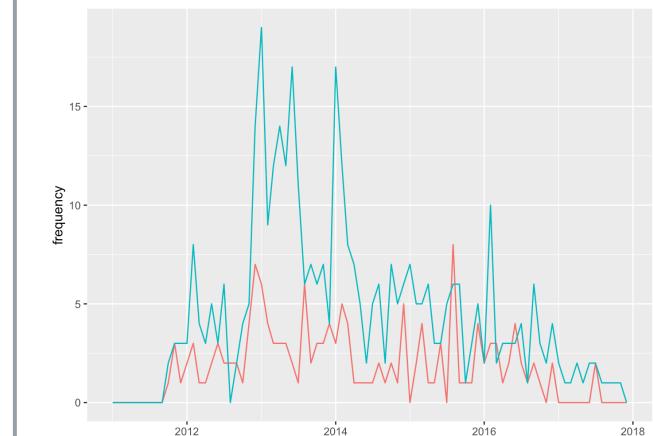


# SPOTIFY AND PANDORA SIMILARITIES

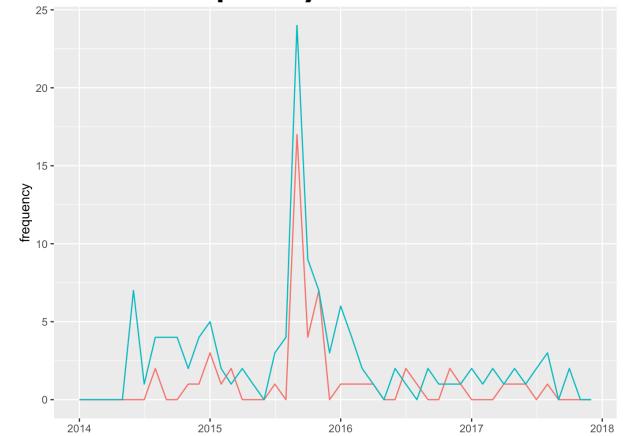
Spotify – “Skip”



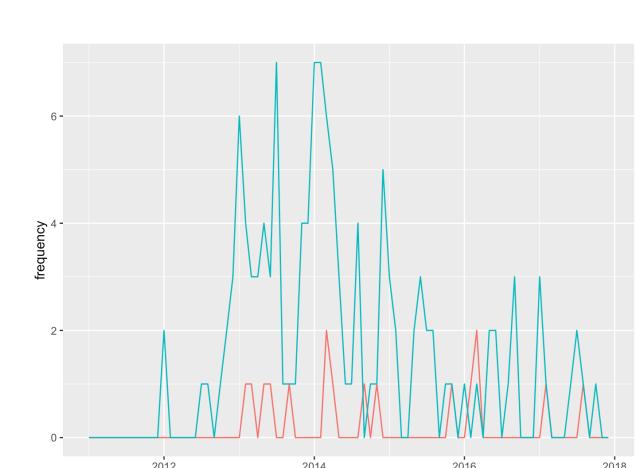
Pandora – “Skip”



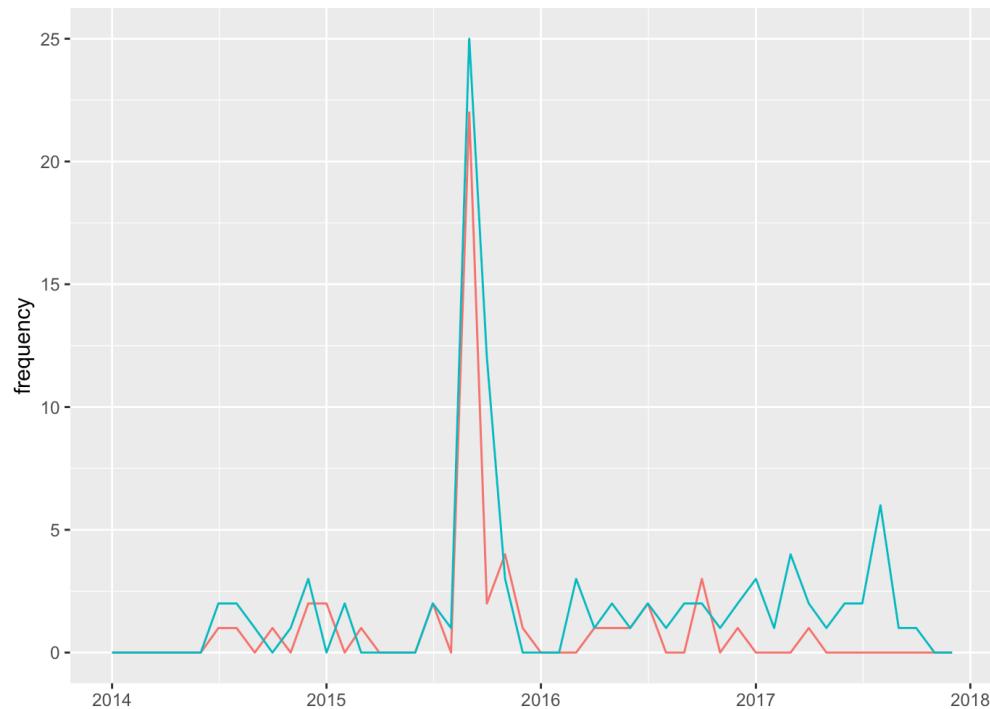
Spotify – “Shuffle”



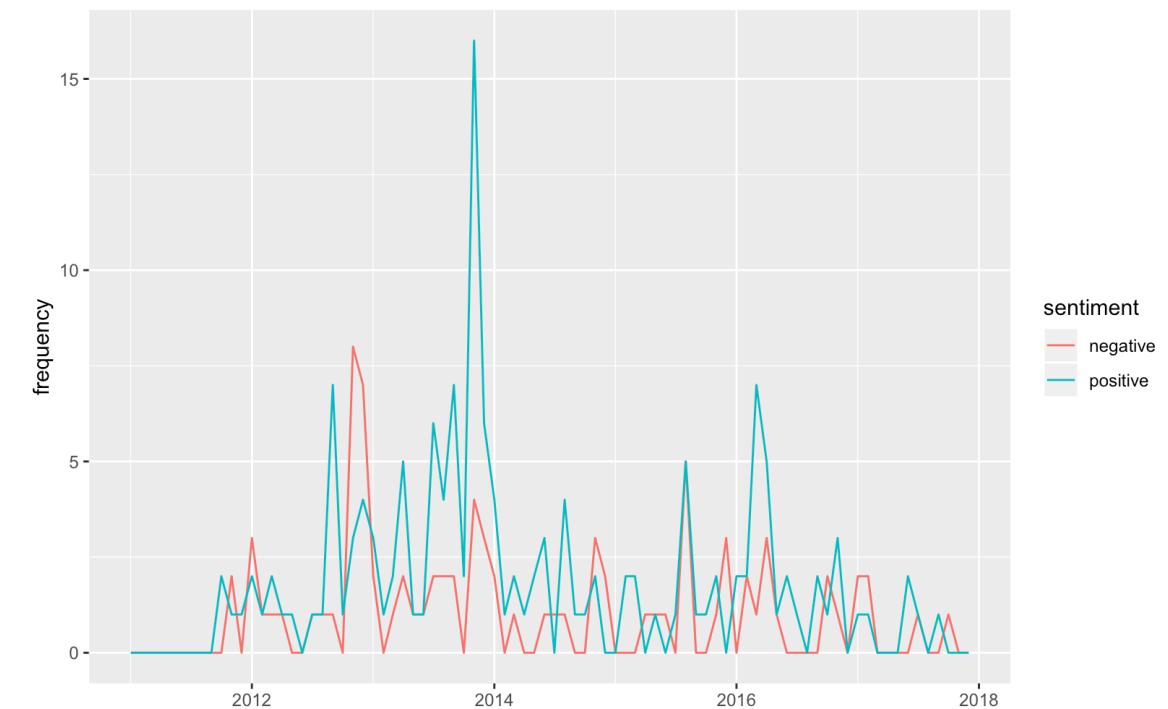
Pandora – “Shuffle”



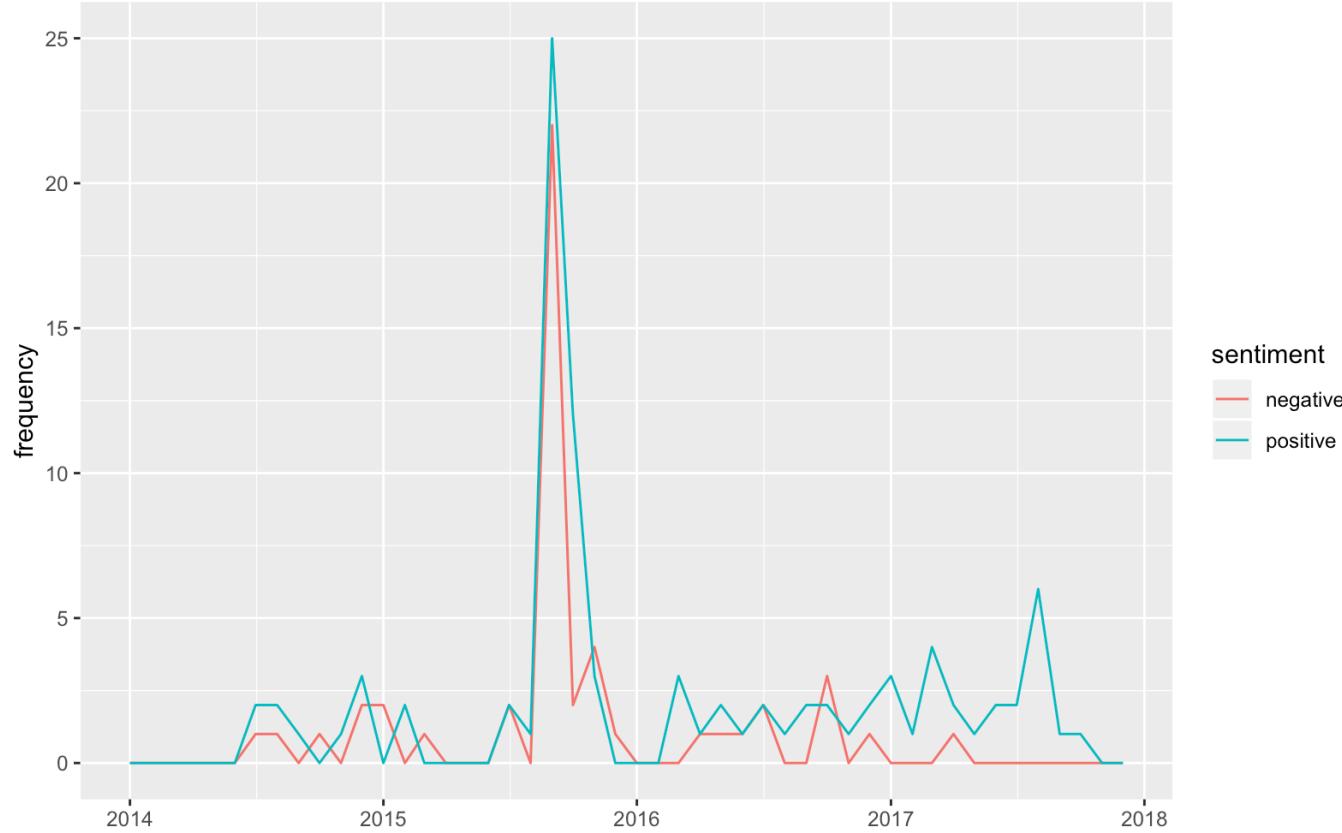
# SPOTIFY AND PANDORA SIMILARITIES



Spotify – “Update”

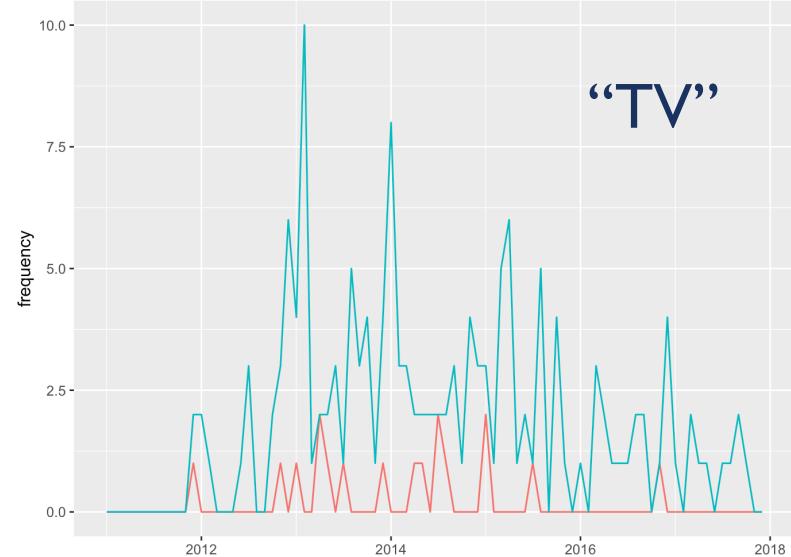
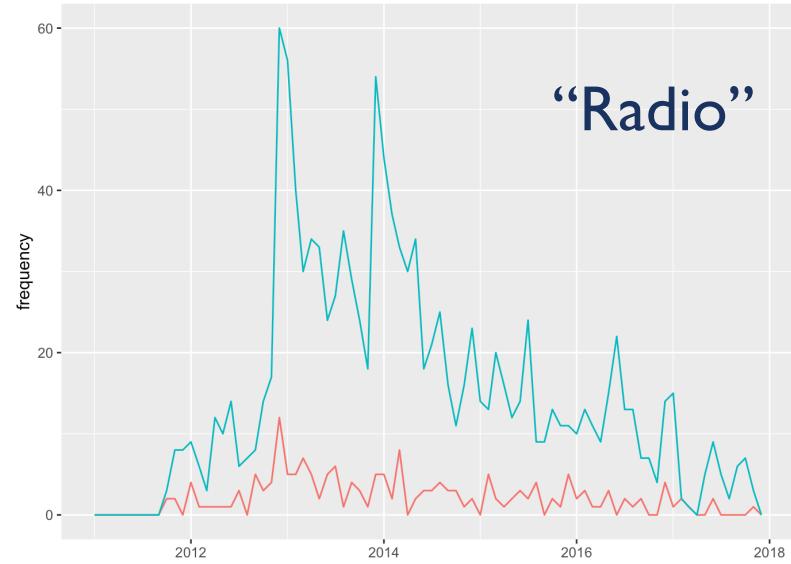
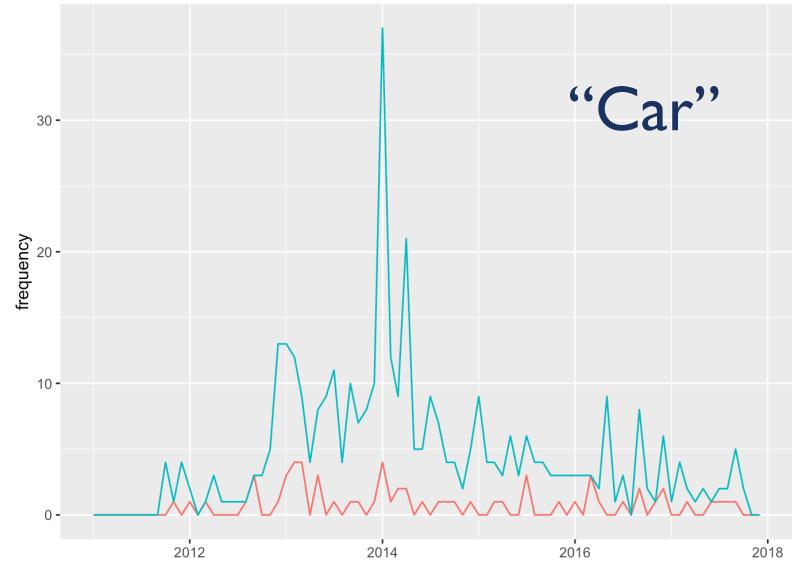


Pandora – “Update”



# SPOTIFY KEYWORD - FIX

# PANDORA LISTENING MEDIUMS



## PANDORA LISTENING MEDIUMS - REVIEWS

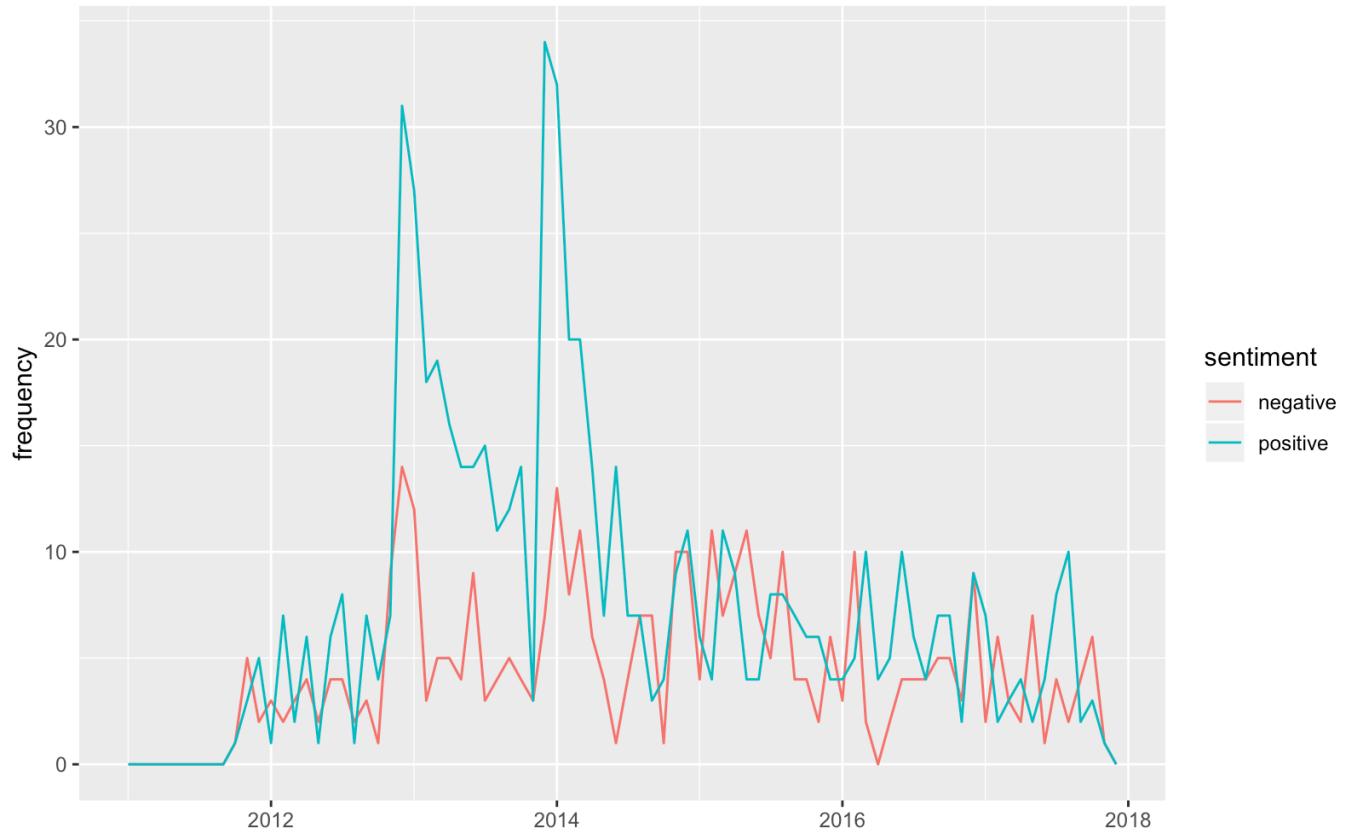
- 27 Dec 2012

“I love this app, I use it on my computer, phone, kindle, TV & Ipad. In fact the entire family uses it.”

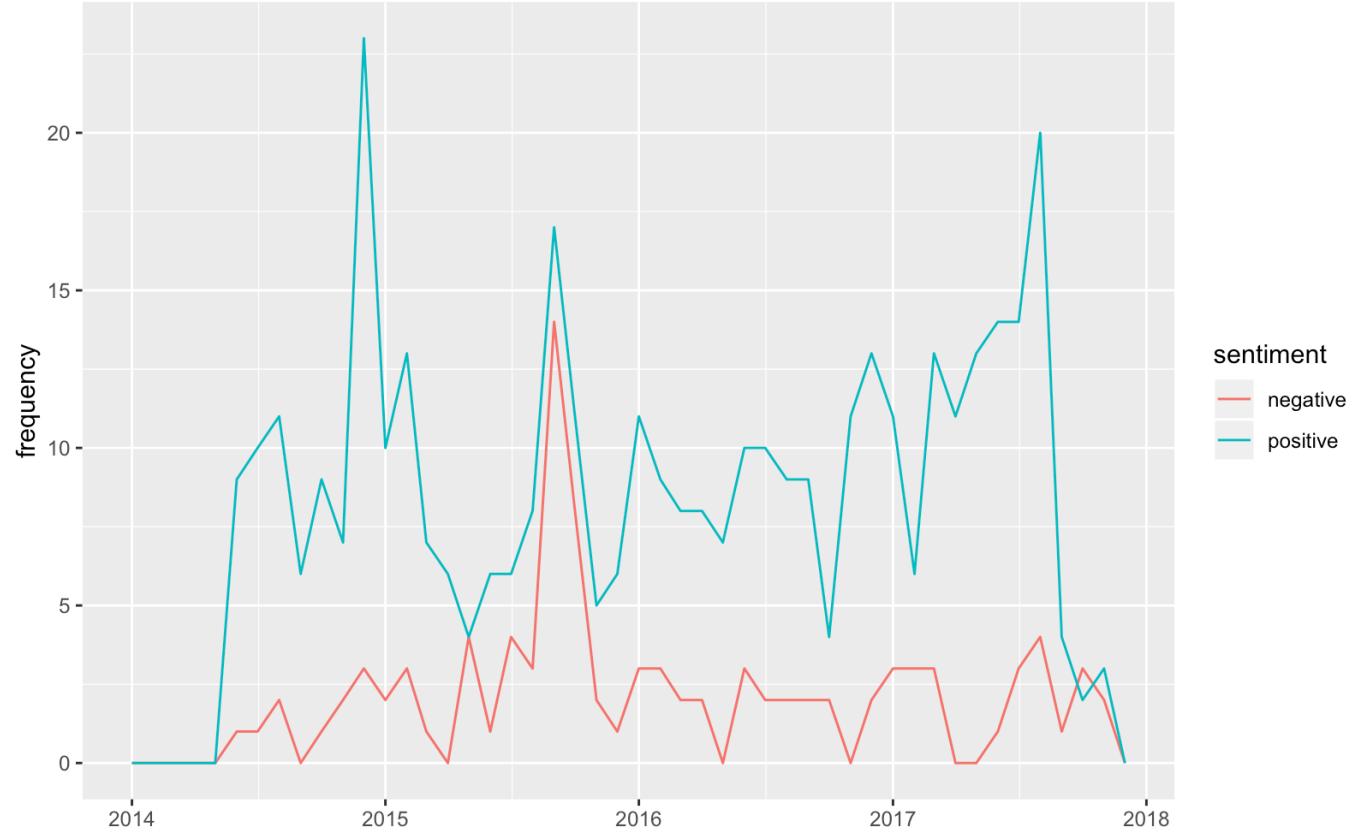
- 22 Feb 2013

“... when I look for a new car, I want to make sure I can get Pandora or Pandora One on my radio. It's easy to use and has a great variety of music.”

# PANDORA KEYWORD - COMMERCIAL



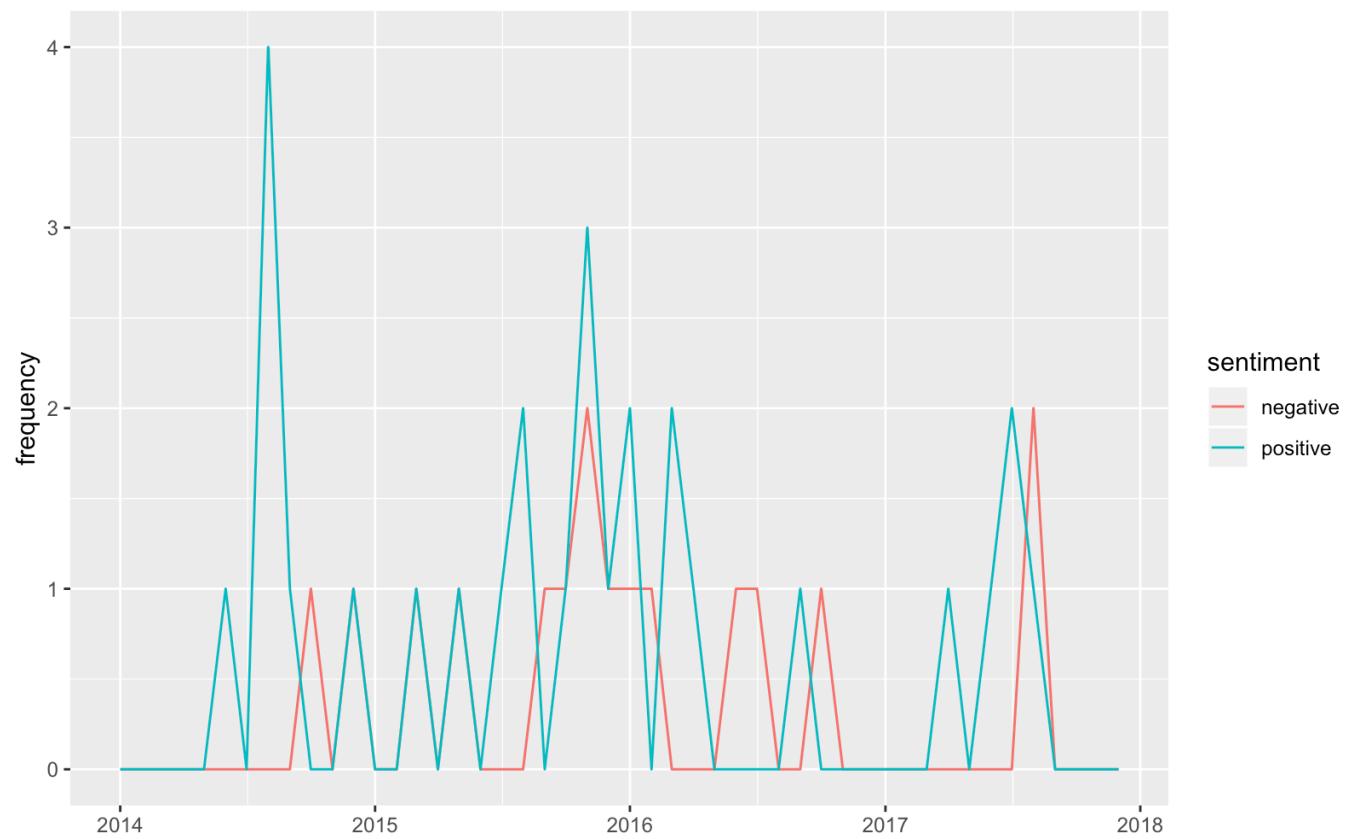
# SPOTIFY KEYWORD - PREMIUM



## SPOTIFY PREMIUM - REVIEWS

- 20 May 2015  
“I pay for premium and that is the best ten dollars spent every month.”
- 16 May 2015  
“I don't know how to upgrade to premium and it's making me really angry”

# SPOTIFY KEYWORD - EMAIL



## SPOTIFY EMAIL - REVIEW

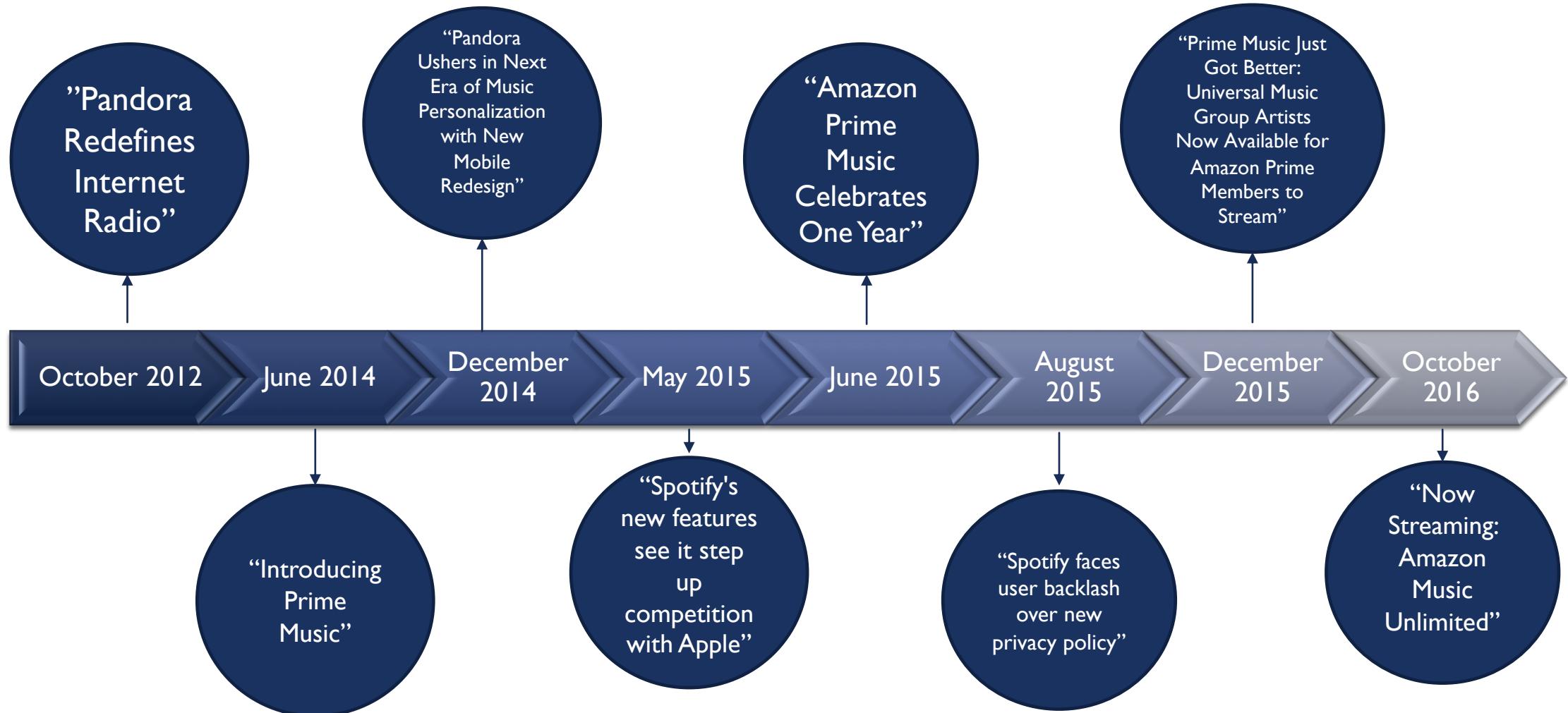
- 27 Jun 2016

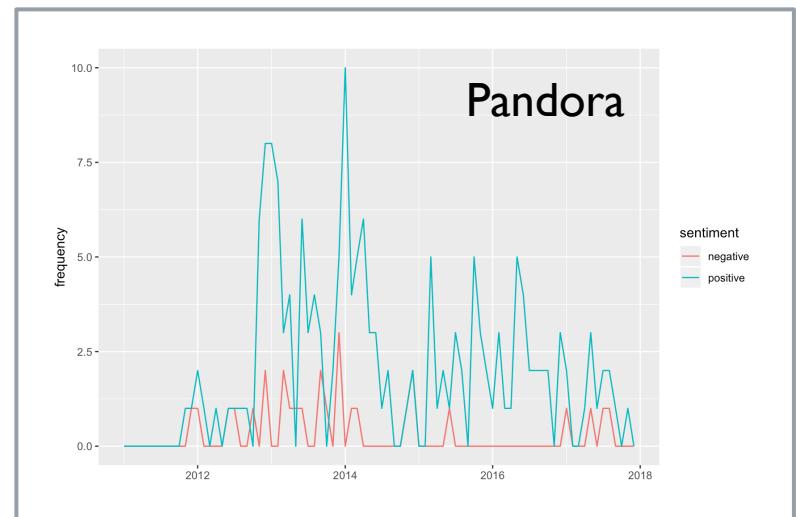
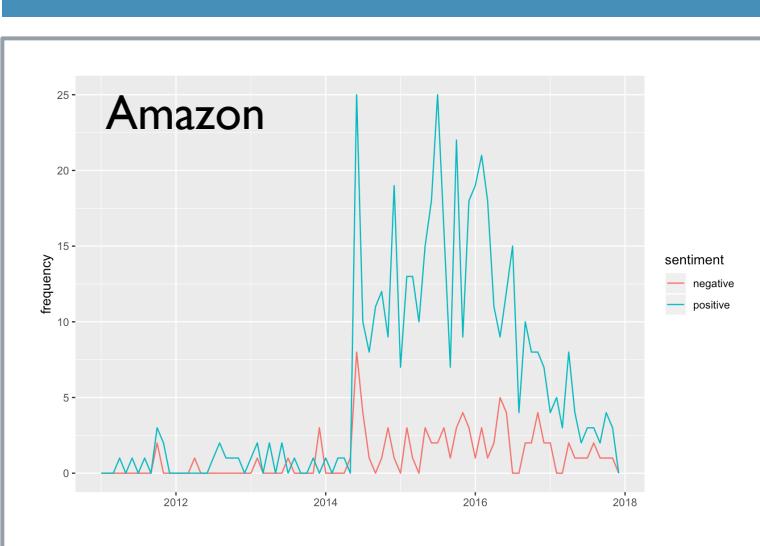
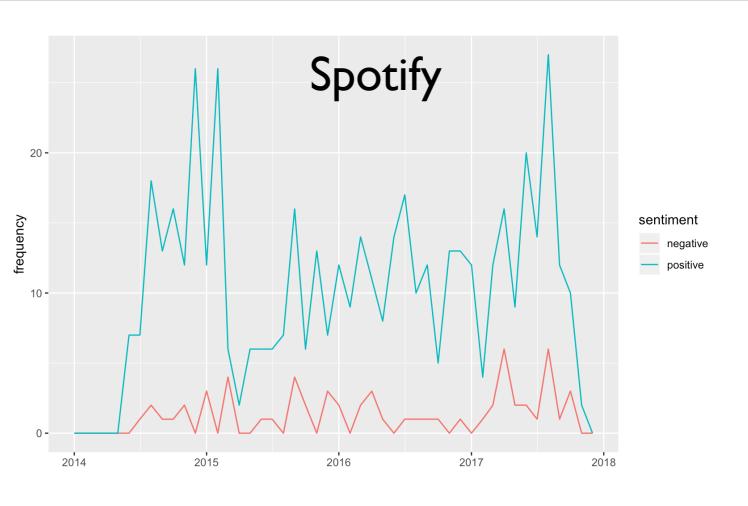
“Very disappointed in this app. Will not accept my email or password. Says one is wrong. I only have one and I've been using it for years. No point in having an app that I can't use so I deleted it!”



# RESULTS

# KEY DATE TIMELINE





## PLAYLIST INTERESTS

### HEADLINES

Spotify for Artists: “Your Year-end Data Awaits with 2017 Wrapped”

“Spotify Is Perfecting the Art of the Playlist”

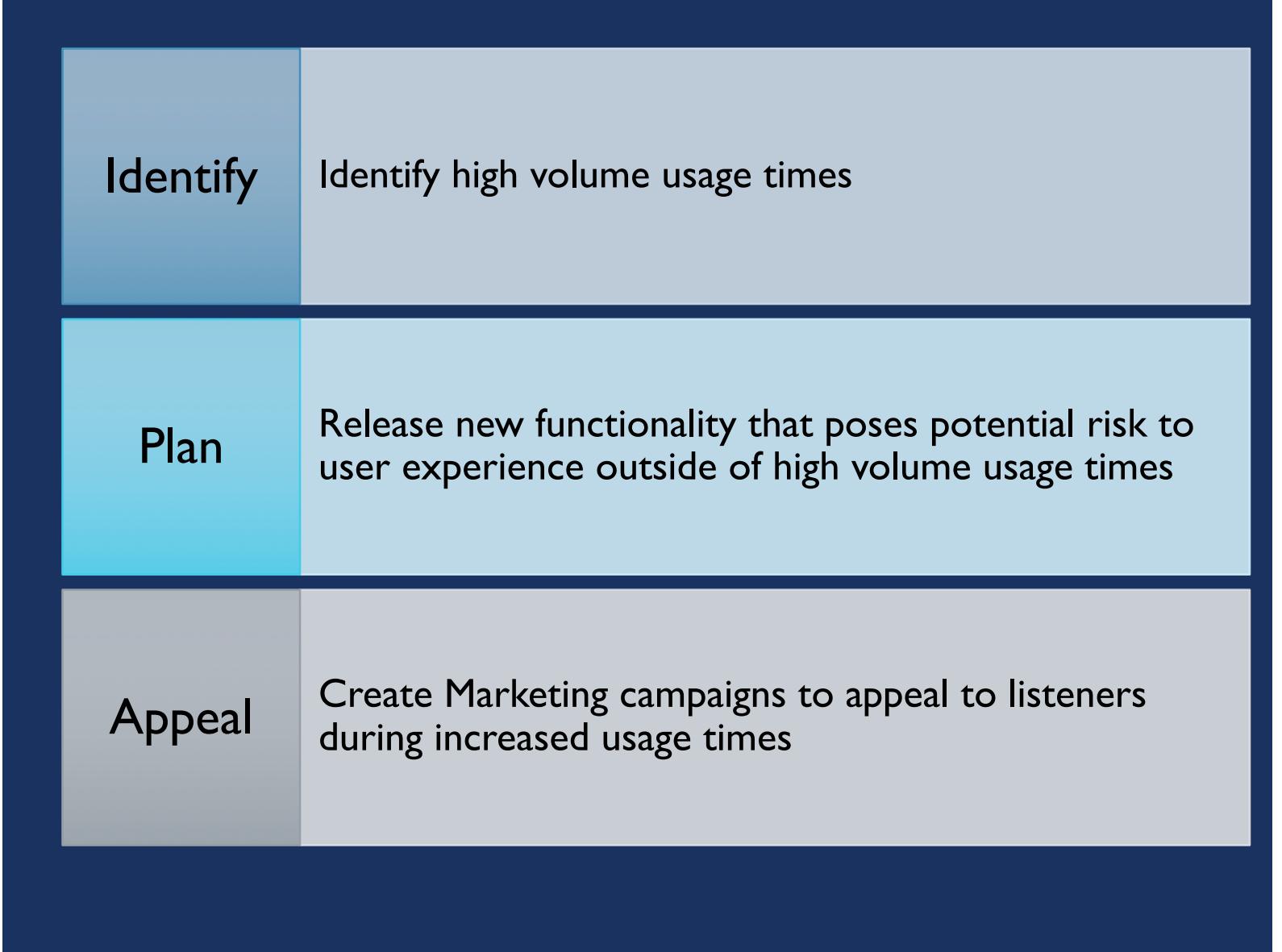
“Amazon Releases Songs of Summer—A Collection of Original Recordings Exclusively Streaming on Prime Music”

“All Is Bright — The Exclusive Amazon Holiday Playlist is Now Available on Prime Music”

“Pandora Unleashes Thumbprint Radio – A Uniquely Personal Station Inspired By All of Your Thumbs Up”

“Pandora Introduces Promoted Stations”

## OVERALL SUGGESTIONS





## LIMITATIONS

# “I LIKE YOU, BUT SOMETIMES YOU ARE TOO ANNOYING!”

Machine Interpretation	Linguistics interpretation
<ul style="list-style-type: none"><li>• &gt; bing_sentiment</li></ul> <pre>#A tibble: 2 x 2 word    sentiment &lt;chr&gt;   &lt;chr&gt; 1 I like    positive 2 annoying  negative</pre> <ul style="list-style-type: none"><li>• [I] "neutral"</li><li>• bing_score: 0</li></ul>	<ul style="list-style-type: none"><li>• Lexical Stress (word stress) “<b>BUT</b>” emphasize <b>adj. (ANNOYING)</b></li><li>• Human Emotion Analysis <b>adv. (TOO) + adj. (ANNOYING) + Exclamation Mark (!) = Negative</b></li></ul>



External Sources - Software Release  
Date missing or incomplete



Machine Interpretation vs. Human  
Emotion Analysis

# MACHINE INTERPRETATION VS. HUMAN EMOTION

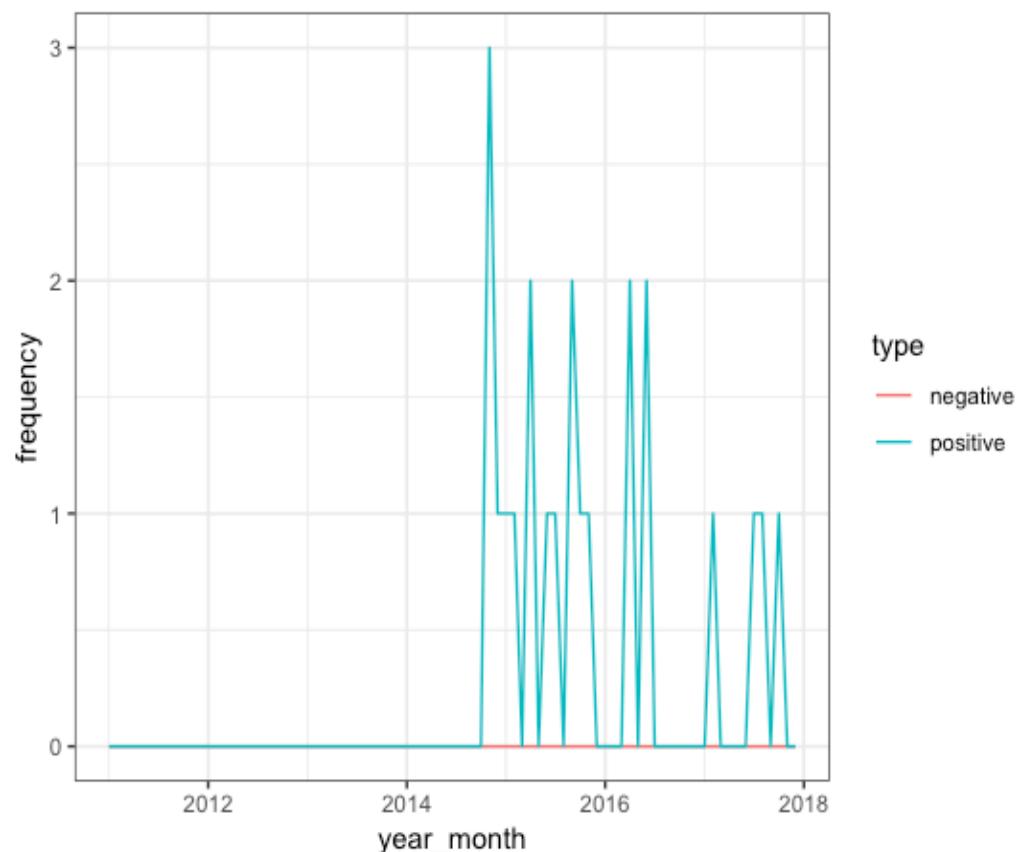
- Machine Interpretation
  - Neutral (Positive vs. Negative)

	<b>CI_P N</b>	<b>CI_N N</b>
Pandora	3.75% ~ 11.25%	2.84% ~ 9.74%
Spotify	1.76% ~ 12.33%	0.46% ~ 9.40%
Amazon	4.52% ~ 15.19%	0.63% ~ 7.84%

- Word(s) Missing in Dictionary
  - “Wish” – SMART
  - [Amazon, 19-OCT-2015] “*I wish I could download purchased music directly to my phone. Instead I have to go through this disgusting app Amazon is stuffing down my throat.*”

# MACHINE INTERPRETATION VS. HUMAN EMOTION

## Crazy Fans – Taylor Swift



## Meaningless Reviews

- [Spotify, 28-Nov-2015]  
“Asdfghjkl added wssdkkmllkp”
- [Pandora, 16-Mar-2017]  
“ðŸ’–ðŸ’–ðŸ’–ðŸ’–ðŸ’–ðŸ’–ðŸ’–ðŸ’–ðŸ’–...”

## MACHINE INTERPRETATION VS. HUMAN EMOTION – EMOJI RATINGS

**6139** | I ❤️ Pandora.

**16862** | You Also have to log in.😈😈😈😈

**8628** | 👍👍



QUESTIONS



## APPENDIX

# ALGORITHM

## Simulation

	Neutral	P/N	N/N	Sample #
Pandora	0.14	0.54	0.46	190
Spotify	0.12	0.59	0.41	100
Amazon	0.14	0.70	0.30	120

## Assume 95% Confidence Level

	Point Estimation		Variance		Standard Error	
	P/N	N/N	P/N	N/N	P/N	N/N
Pandora	0.0750	0.0629	0.0004	0.0003	0.0191	0.0176
Spotify	0.0704	0.0493	0.0007	0.0005	0.0270	0.0228
Amazon	0.0986	0.0423	0.0007	0.0003	0.0272	0.0184

	CI_P/N	CI_P/N	CI_N/N	CI_N/N
Pandora	3.76%	11.25%	2.84%	9.74%
Spotify	1.76%	12.33%	0.46%	9.40%
Amazon	4.52%	15.19%	0.63%	7.84%

# R CODE

```
21 # score_compare_service(review_id, date, review, score, bing_score)
22 # Pick 50 each time
23
24 resampling <- function(service){
25
26   neutral_average <- 0
27   positive_average <- 0
28   negative_average <- 0
29
30 for(i in c(2000:3000)){
31   set.seed(i)
32   random_data <- service[sample(nrow(service), 50),]
33
34   neutral_count <- sum(random_data$bing_score == 0)
35   positive_neutral <- sum(random_data$bing_score == 0 & random_data$score == 1)
36   negative_neutral <- sum(random_data$bing_score == 0 & random_data$score == -1)
37   cat(sprintf("Neutral : %.3f P-N : %.3f N-N : %.3f\n", neutral_count/50,
38         positive_neutral/neutral_count, negative_neutral/neutral_count))
39
40   neutral_average <- neutral_average + neutral_count/50
41   positive_average <- positive_average + positive_neutral/neutral_count
42   negative_average <- negative_average + negative_neutral/neutral_count
43 }
44 cat(sprintf("Neutral : %.3f Positive : %.3f Negative : %.3f\n",
45           neutral_average/1000, positive_average/1000, negative_average/1000))
46 }
47
48 resampling(score_compare_service)
49 }
```

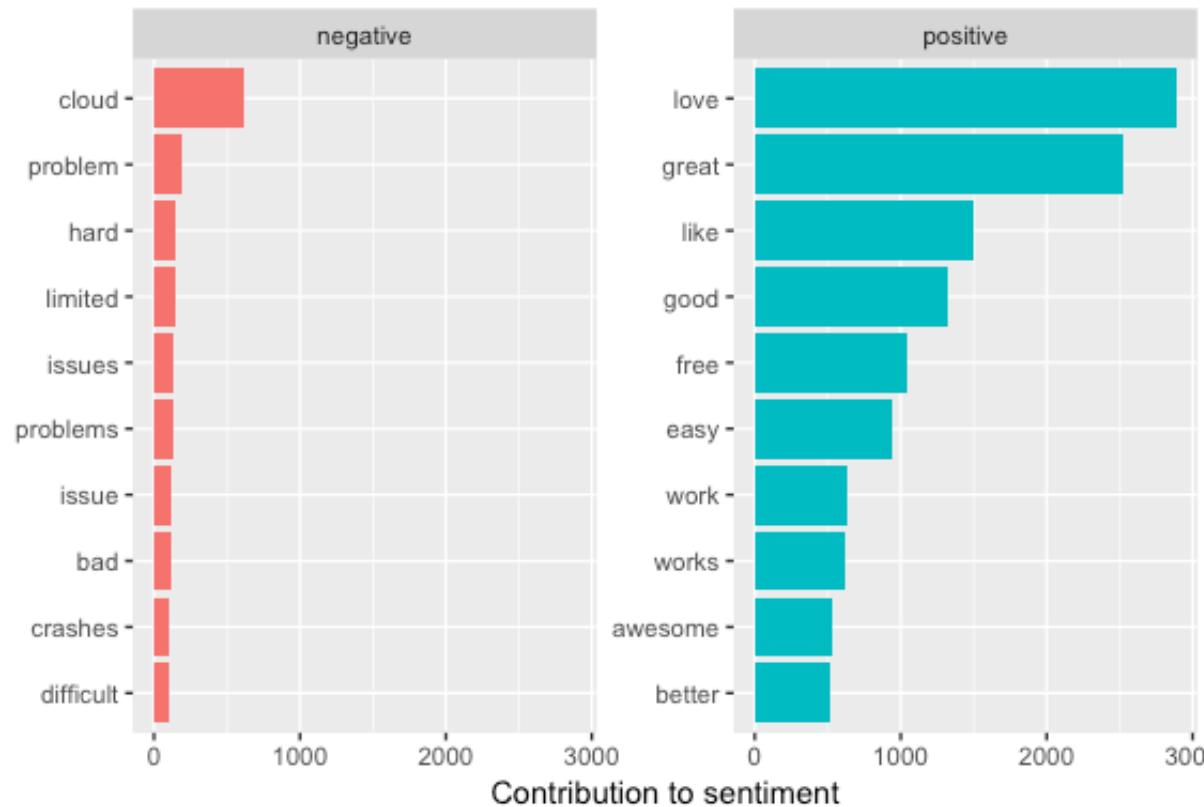
# R CODE

```
56 word_data <-function(service, start, end, word, sentiment){  
57  
58   word <- tolower(word)  
59  
60   # Filter Data between start date & end date  
61   extracted <- service[service$date >= start & service$date <= end,]  
62   # Filter Date that only contains word  
63   extracted <- extracted[grep(word, tolower(extracted$review)),]  
64  
65  
66   set.seed(101)  
67  
68   # Ratio  
69   # Pandora 0.14 0.54 0.46  
70   # Spotify 0.12 0.59 0.41  
71   # Amazon 0.14 0.70 0.30  
72  
73   ifelse(service$service == "pandora", positive_weight <- 0.54,  
74         ifelse(service$service == "spotify", positive_weight <- 0.59, positive_weight <- 0.70))  
75  
76   neutral_reviews <- extracted[extracted$bing_judgement == "neutral",] %>% select(review_id)  
77   positive_neutral <- neutral_reviews[sample(nrow(neutral_reviews), nrow(neutral_reviews) * positive_weight),]  
78   negative_neutral <- neutral_reviews[!(neutral_reviews$review_id %in% positive_neutral),]  
79  
80   extracted$bing_judgement <- ifelse(extracted$review_id %in% positive_neutral, "positive",  
81                                         ifelse(extracted$review_id %in% negative_neutral, "negative",  
82                                             extracted$bing_judgement))  
83  
84  
85  
86   extracted <- extracted[extracted$bing_judgement == sentiment,]  
87  
88   return(extracted)  
89 }  
90 }
```

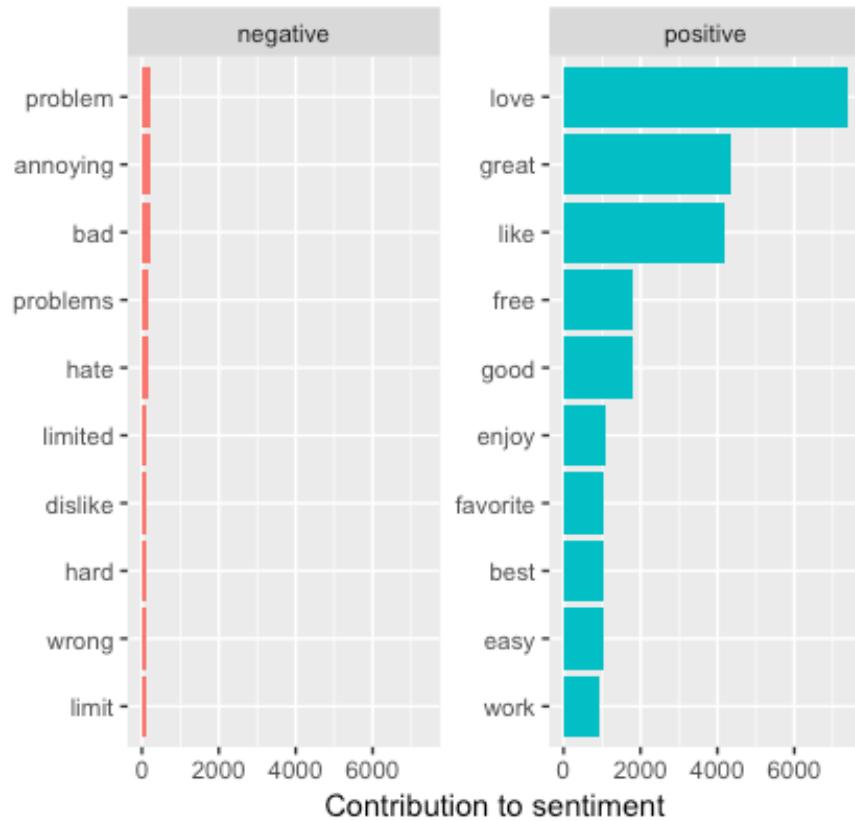
# R CODE

```
92 - frequency_month <- function(service, start, end, word, sentiment){  
93  
94   extracted <- word_data(service, start, end, word, sentiment)  
95  
96   # Make year-month column  
97   extracted$year_month <- anydate(format(as.Date(extracted$date), "%Y-%m"))  
98  
99   frequency_df <- extracted %>% group_by(year_month) %>% summarise(frequency = n())  
100  frequency_df <- frequency_df %>% pad(interval = 'month', start_val = anydate(start), end_val = anydate(end))  
101  frequency_df[is.na(frequency_df)] <- 0  
102  return (frequency_df)  
103 }  
104  
105  
106 - word_graph <- function(service, word, start, end){  
107   #whole = frequency_month(service, "2014-01-01", "2017-12-31", "", "")  
108   positive = frequency_month(service, start, end, word, "positive")  
109   negative = frequency_month(service, start, end, word, "negative")  
110  
111   #whole$type <- 'whole'  
112   positive$sentiment <- 'positive'  
113   negative$sentiment <- 'negative'  
114  
115   # Whole + Positive + Negative  
116   #frequency_df <- whole %>% full_join(positive) %>% full_join(negative)  
117   frequency_df <- positive %>% full_join(negative)  
118  
119   ret <- ggplot(frequency_df, aes(x = year_month)) +  
120     geom_line(aes(y = frequency, col = sentiment)) +  
121     theme(axis.title.x=element_blank())  
122  
123   return(ret)  
124 }  
125
```

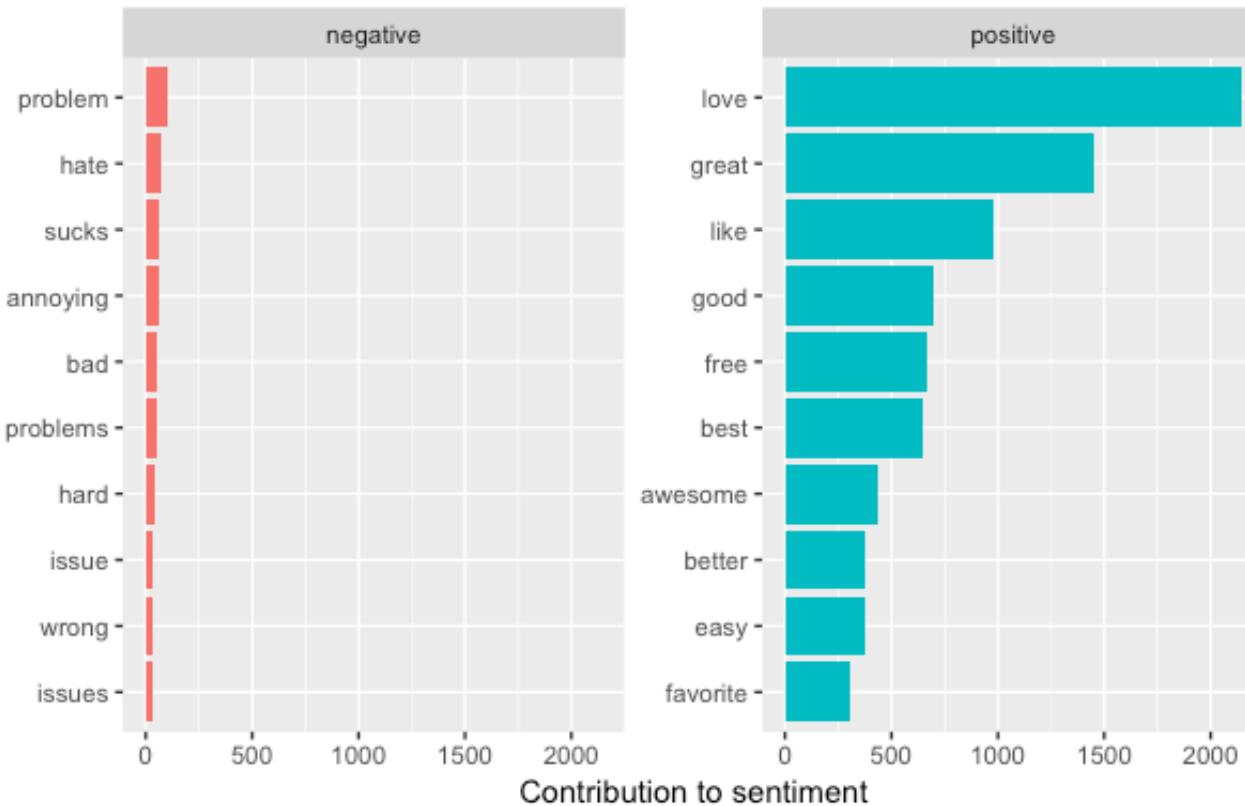
# AMAZON WORD FREQUENCY VISUALS



# PANDORA WORD FREQUENCY VISUALS



# SPOTIFY WORD FREQUENCY VISUALS



## REFERENCES

- Amazon Music. "Amazon Music Unlimited - Stream Millions of Songs Online Now." *Amazon Music Unlimited*, Amazon, n.d., music.amazon.com/home.
- Amazon.com, Inc. "Introducing Prime Music: Over One Million Songs, Hundreds of Playlists, Unlimited Listening, No Ads, Free With Amazon Prime." *Amazon.com, Inc. - Press Room*, Amazon, 12 June 2014, 9:00 AM EDT, press.aboutamazon.com/news-releases/news-release-details/introducing-prime-music-over-one-million-songs-hundreds.
- Amazon.com, Inc. "All Is Bright - The Exclusive Amazon Holiday Playlist Is Now Available on Prime Music." *Amazon.com, Inc. - Press Room*, Amazon, 20 Nov. 2014, 9:00AM EST, press.aboutamazon.com/news-releases/news-release-details/all-bright-exclusive-amazon-holiday-playlist-now-available-prime.
- Amazon.com, Inc. "Prime Music Just Got Better: Universal Music Group Artists Now Available for Amazon Prime Members to Stream." *Amazon.com, Inc. - Press Room*, Amazon, 29 Sept. 2015, 9:01AM EST, press.aboutamazon.com/news-releases/news-release-details/prime-music-just-got-better-universal-music-group-artists-now.
- Amazon.com, Inc. "Amazon Releases Songs of Summer-A Collection of Original Recordings Exclusively Streaming on Prime Music." *Amazon.com, Inc. - Press Room*, Amazon, 3 June 2016, 9:00 AM EDT, press.aboutamazon.com/news-releases/news-release-details/amazon-releases-songs-summer-collection-original-recordings.
- Amazon.com, Inc. "Now Streaming:Amazon Music Unlimited." *Amazon.com, Inc. - Press Room*, Amazon, 12 Oct. 2016, 5:50 AM EDT, press.aboutamazon.com/news-releases/news-release-details/now-streaming-amazon-music-unlimited.
- Blattberg, Eric. "Pandora's Priority: Engagement, Not New Listeners." *Digiday*, Digiday, 14 Nov. 2014, digiday.com/media/pandora-priority-engagement/.
- Company Release. "Pandora Redefines Mobile Internet Radio." *Pandora: Press Release*, Pandora, 29 Oct. 2012, 5:00 PM ET, investor.pandora.com/file/Index?KeyFile=14961689.

# REFERENCES

- Company Release. "Pandora Ushers in Next Era of Music Personalization with New Mobile Redesign." *Pandora: Press Release*, Pandora, 2 Dec. 2014, 9:00AM ET, [press.pandora.com/file/4247784/Index?KeyFile=26380360](http://press.pandora.com/file/4247784/Index?KeyFile=26380360).
- Company Release. "Pandora Unleashes Thumbprint Radio – A Uniquely Personal Station Inspired By All of Your Thumbs Up." *Pandora: Press Release*, Pandora, 14 Dec. 2015, 9:00AM ET, [investor.pandora.com/file/Index?KeyFile=32224916](http://investor.pandora.com/file/Index?KeyFile=32224916).
- Cubarrubia, RJ. "Pandora Ends Mobile Listening Cap." *Rolling Stone*, Rolling Stone, 23 Aug. 2013, 7:00 PM ET, [www.rollingstone.com/music/music-news/pandora-ends-cap-on-mobile-listening-66941/](http://www.rollingstone.com/music/music-news/pandora-ends-cap-on-mobile-listening-66941/).
- Dredge, Stuart. "Spotify's New Features See It Step up Competition with Apple." *The Guardian*, Guardian News and Media, 21 May 2015, 7:13 EDT, [www.theguardian.com/technology/2015/may/21/spotify-smartest-streaming-music-service-apple-daniel-ek](http://www.theguardian.com/technology/2015/may/21/spotify-smartest-streaming-music-service-apple-daniel-ek).
- Hern, Alex, and Jennifer Rankin. "Spotify's Chief Executive Apologises after User Backlash over New Privacy Policy." *The Guardian*, Guardian News and Media, 21 Aug. 2015, 8:03 EDT, [www.theguardian.com/technology/2015/aug/21/spotify-faces-user-backlash-over-new-privacy-policy](http://www.theguardian.com/technology/2015/aug/21/spotify-faces-user-backlash-over-new-privacy-policy).
- Lidsky, David. "The Definitive Timeline of Spotify's Critic-Defying Journey to Rule Music." *Fast Company*, Fast Company, 6 Aug. 2018, [www.fastcompany.com/90205527/the-definitive-timeline-of-spotifys-critic-defying-journey-to-rule-music](http://www.fastcompany.com/90205527/the-definitive-timeline-of-spotifys-critic-defying-journey-to-rule-music).
- Pandora Media. "Assets." *Pandora Newsroom*, Pandora, 2018, [investor.pandora.com/assets/Index?KeyGenPage=1073752142](http://investor.pandora.com/assets/Index?KeyGenPage=1073752142).
- Spotify Design Team. "Branding Guidelines: Our Logo." *Spotify for Developers*, Spotify, 2018, [developer.spotify.com/branding-guidelines/](http://developer.spotify.com/branding-guidelines/).
- Spotify for Artists. "Your Year-End Data Awaits with 2017 Wrapped." *Your Music – Guide – Spotify for Artists*, Spotify, 6 Dec. 2017, [artists.spotify.com/blog/your-year-end-data-awaits-with-2017-wrapped](http://artists.spotify.com/blog/your-year-end-data-awaits-with-2017-wrapped).
- Titcomb, James. "Spotify Asks for Your Photos, Location and Contacts in Privacy Code Revamp." *The Telegraph*, Telegraph Media Group, 21 Aug. 2015, 10:49 AM BST, [www.telegraph.co.uk/technology/news/11815778/spotify-privacy-policy-asks-for-photos-and-contacts.html](http://www.telegraph.co.uk/technology/news/11815778/spotify-privacy-policy-asks-for-photos-and-contacts.html).