05_homework

Solveig Senf

```
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.5
v forcats   1.0.0     v stringr   1.5.1
v ggplot2   3.5.1     v tibble    3.2.1
v lubridate 1.9.4     v tidyr     1.3.1
v purrr     1.0.4
-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to becor
```

```
library(tidytext)
library(textdata)
library(wordcloud)
```

```
Loading required package: RColorBrewer
```

```
library(wordcloud2)
library(viridis)
```

```
Loading required package: viridisLite
```

```
library(ggthemes)
library(gutenbergr)
library(readr)
library(RCurl)
```

```
Attaching package: 'RCurl'

The following object is masked from 'package:tidyr':

    complete
```

```
library(ggraph)
library(igraph)
```

```
Attaching package: 'igraph'

The following objects are masked from 'package:lubridate':

    %--%, union

The following objects are masked from 'package:dplyr':

    as_data_frame, groups, union

The following objects are masked from 'package:purrr':

    compose, simplify

The following object is masked from 'package:tidyr':

    crossing

The following object is masked from 'package:tibble':

    as_data_frame

The following objects are masked from 'package:stats':

    decompose, spectrum

The following object is masked from 'package:base':

    union
```

```
library(tm)
```

```
Loading required package: NLP

Attaching package: 'NLP'

The following object is masked from 'package:ggplot2':

    annotate
```

```
library(topicmodels)
```

On Your Own: Harry Potter

The `potter_untidy` dataset includes the text of 7 books of the Harry Potter series by J.K. Rowling. For a brief overview of the books (or movies), see this quote from Wikipedia:

> Harry Potter is a series of seven fantasy novels written by British author J. K. Rowling. The novels chronicle the lives of a young wizard, Harry Potter, and his friends Hermione Granger and Ron Weasley, all of whom are students at Hogwarts School of Witchcraft and Wizardry. The main story arc concerns Harry's conflict with Lord Voldemort, a dark wizard who intends to become immortal, overthrow the wizard governing body known as the Ministry of Magic, and subjugate all wizards and Muggles (non-magical people).

Homework Problems

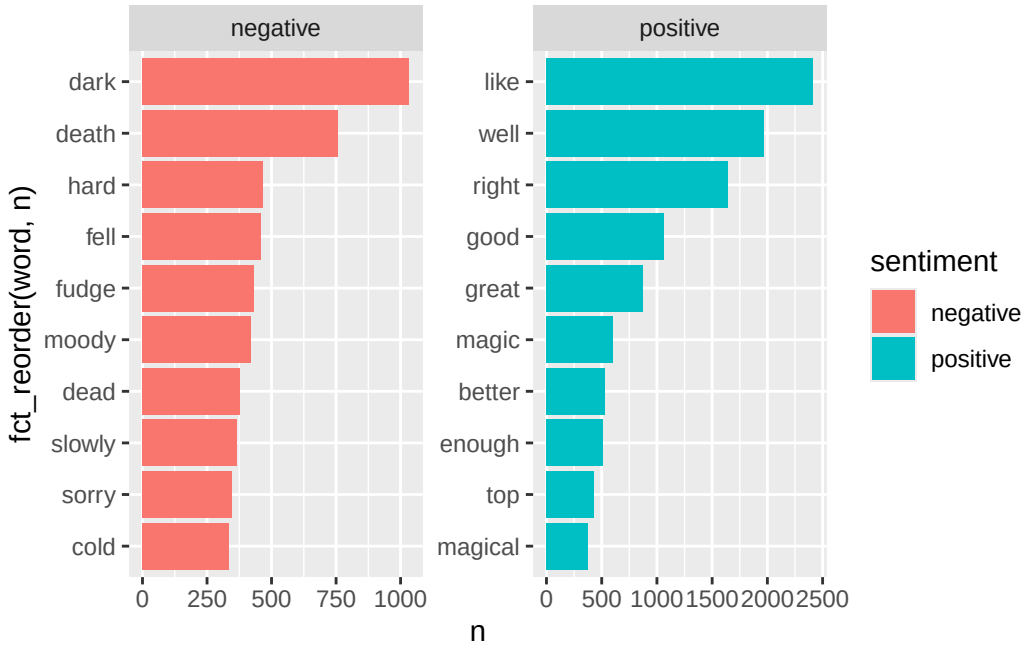
1. What words contribute the most to negative and positive sentiment scores? Show a faceted bar plot of the top 10 negative and the top 10 positive words (according to the "bing" lexicon) across the entire series.

```
bing_sentiments <- get_sentiments(lexicon = "bing")

potter_tidy |>
  inner_join(bing_sentiments) |> #adds sentiment column
  count(sentiment, word, sort = TRUE) |>
  group_by(sentiment) |>
  slice_max(n, n = 10) |>
```

```
  ungroup() |>
  ggplot(aes(x = fct_reorder(word, n), y = n, fill = sentiment)) +
    geom_col() +
    coord_flip() +
    facet_wrap(~ sentiment, scales = "free")
```

```
Joining with `by = join_by(word)`
```

```
Warning in inner_join(potter_tidy, bing_sentiments): Detected an unexpected many-to-many rela
i Row 41432 of `x` matches multiple rows in `y`.
i Row 2698 of `y` matches multiple rows in `x`.
i If a many-to-many relationship is expected, set `relationship =
  "many-to-many"` to silence this warning.
```



2. Find a list of the top 10 words associated with "fear" and with "trust" (according to the "nrc" lexicon) across the entire series.

```
fear_words <- get_sentiments("nrc") |>
  filter(sentiment == "fear") |>
  inner_join(potter_tidy) |>
  count(word, sort = TRUE) |>
  slice_max(n, n = 10)
```

```
Joining with `by = join_by(word)`
```

```
trust_words <- get_sentiments("nrc") |>
  filter(sentiment == "trust") |>
  inner_join(potter_tidy) |>
  count(word, sort = TRUE) |>
  slice_max(n, n = 10)
```

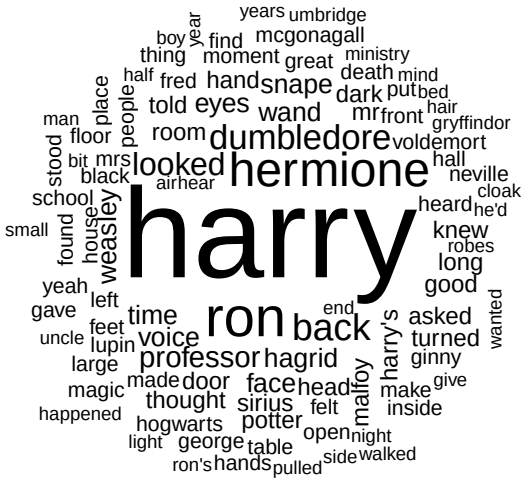
```
Joining with `by = join_by(word)`
```

3. Make a wordcloud for the entire series after removing stop words using the "smart" source.

```
smart_stopwords <- get_stopwords(source = "smart")

words <- potter_tidy |>
  anti_join(smart_stopwords) |>
  count(word) |>
  filter(word != "NA") |>
  arrange(desc(n))
```

```
Joining with `by = join_by(word)`
```

```
wordcloud(
  words = words$word,
  freq = words$n,
  max.words = 100,
  random.order = FALSE
)
```



4. Create a wordcloud with the top 20 negative words and the top 20 positive words in the Harry Potter series according to the bing lexicon. The words should be sized by their respective counts and colored based on whether their sentiment is positive or negative. (Feel free to be resourceful and creative to color words by a third variable!)

```
bing_potter <- potter_tidy |>
  inner_join(bing_sentiments) |>
  count(sentiment, word, sort = TRUE) |>
  group_by(sentiment) |>
  slice_max(n, n = 10) |>
  mutate(color = ifelse(sentiment == "negative", "dodgerblue", "gold"), #adds a color column
         n = n/max(n)) #evens the frequency across negative and positive values for plotting
```

```
Joining with `by = join_by(word)`
```

```
Warning in inner_join(potter_tidy, bing_sentiments): Detected an unexpected many-to-many rela
i Row 41432 of `x` matches multiple rows in `y`.
i Row 2698 of `y` matches multiple rows in `x`.
i If a many-to-many relationship is expected, set `relationship =
  "many-to-many"` to silence this warning.
```

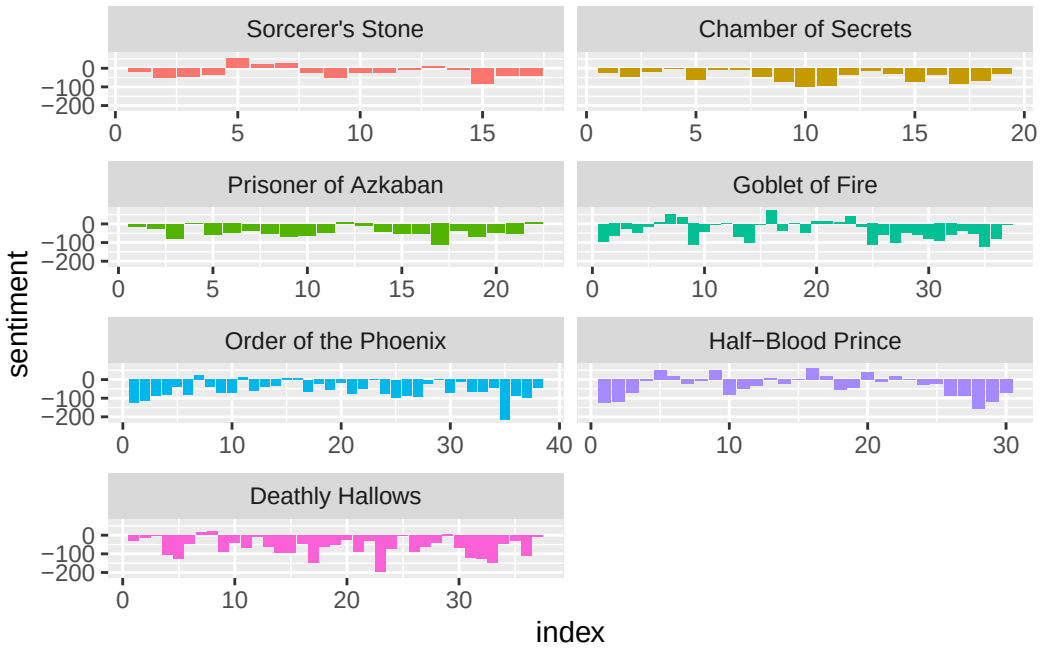
```
wordcloud(
  words = bing_potter$word,
  freq = bing_potter$n,
  max.words = 100,
  random.order = FALSE,
  rot.per = 0.35,
  scale = c(4, 0.25),
  colors = bing_potter$color)
```

5. Make a faceted bar chart to compare the positive/negative sentiment trajectory over the 7 Harry Potter books. You should have one bar per chapter (thus chapter becomes the index), and the bar should extend up from 0 if there are more positive than negative words in a chapter (according to the "bing" lexicon), and it will extend down from 0 if there are more negative than positive words.

```
potter_tidy_words <- potter_tidy |>
  group_by(title) |>
  mutate(linenumber = row_number()) |>
  ungroup()

potter_tidy_words_count <- potter_tidy_words |>
  count(word, title, sort = TRUE)
```

```
potter_tidy_words |>
  inner_join(bing_sentiments, relationship = "many-to-many") |>
  count(title, index = chapter, sentiment) |>
  pivot_wider(names_from = sentiment, values_from = n, values_fill = 0) |>
  mutate(sentiment = positive - negative) |>
  ggplot(aes(x = index, y = sentiment, fill = title)) +
    geom_col(show.legend = FALSE) +
    facet_wrap(~title, ncol = 2, scales = "free_x")
```

```
Joining with `by = join_by(word)`
```

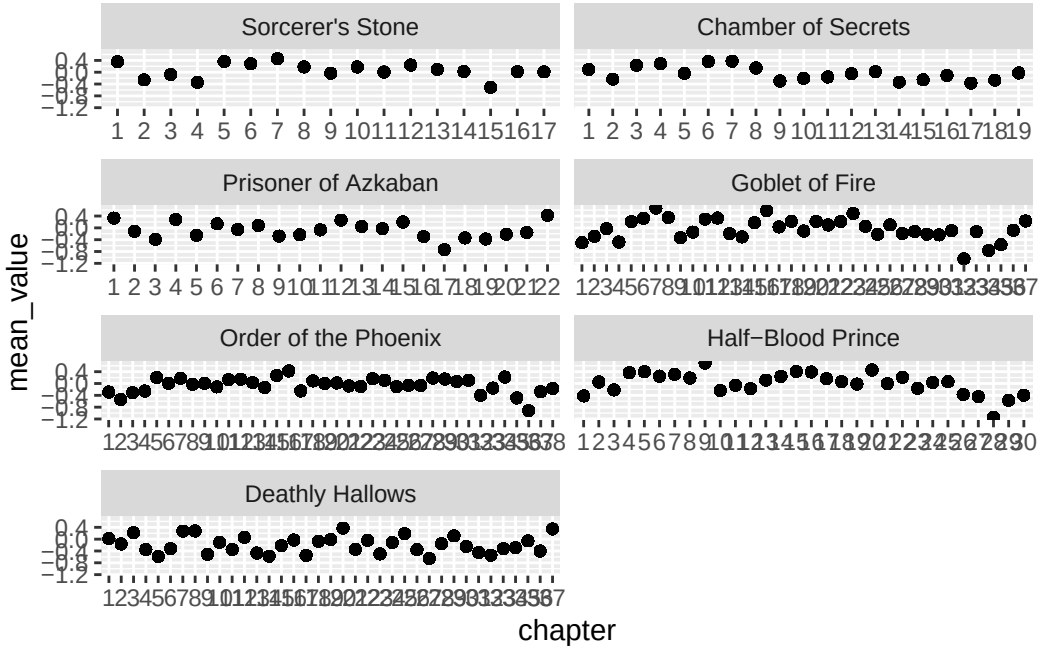


6. Repeat (5) using a faceted scatterplot to show the average sentiment score according to the "afinn" lexicon for each chapter. (Hint: use `mutate(chapter_factor = factor(chapter))` to treat chapter as a factor variable.)

```
afinn_sentiments <- get_sentiments(lexicon = "afinn")

potter_tidy_words |>
  inner_join(afinn_sentiments, relationship = "many-to-many") |>
  mutate(chapter = factor(chapter)) |>
  group_by(title, chapter) |>
```

```
  mutate(mean_value = mean(value)) |>
  ungroup() |>
  ggplot(aes(x = chapter, y = mean_value, fill = title)) +
    geom_point(show.legend = FALSE) +
    facet_wrap(~title, ncol = 2, scales = "free_x")
```

```
Joining with `by = join_by(word)`
```



7. Make a faceted bar plot showing the top 10 words that distinguish each book according to the tf-idf statistic.

```
potter_tfidf <- potter_tidy_words_count |>
  bind_tf_idf(word, title, n)

potter_tfidf
```

```
# A tibble: 67,876 x 6
   word  title                     n     tf   idf tf_idf
   <chr> <fct>                 <int>  <dbl> <dbl>  <dbl>
 1 the   Order of the Phoenix 11740 0.0454     0      0
 2 the   Deathly Hallows      10335 0.0523     0      0
```

```
 3 the   Goblet of Fire        9305 0.0485     0      0
 4 the   Half-Blood Prince     7508 0.0438     0      0
 5 to    Order of the Phoenix  6518 0.0252     0      0
 6 and   Order of the Phoenix  6189 0.0239     0      0
 7 and   Deathly Hallows       5510 0.0279     0      0
 8 of    Order of the Phoenix  5332 0.0206     0      0
 9 the   Prisoner of Azkaban   4990 0.0474     0      0
10 and   Goblet of Fire        4959 0.0258     0      0
# i 67,866 more rows
```

```
potter_tfidf |>
  arrange(-tf_idf)
```

```
# A tibble: 67,876 x 6
   word        title                     n       tf   idf   tf_idf
   <chr>       <fct>                 <int>    <dbl> <dbl>    <dbl>
 1 slughorn    Half-Blood Prince       335 0.00196  1.25  0.00245
 2 umbridge    Order of the Phoenix    496 0.00192  0.847 0.00162
 3 bagman      Goblet of Fire          208 0.00108  1.25  0.00136
 4 lockhart    Chamber of Secrets      197 0.00231  0.560 0.00129
 5 lupin       Prisoner of Azkaban     369 0.00351  0.336 0.00118
 6 winky       Goblet of Fire          145 0.000756 1.25  0.000947
 7 champions   Goblet of Fire           84 0.000438 1.95  0.000852
 8 xenophilius Deathly Hallows          79 0.000400 1.95  0.000778
 9 griphook    Deathly Hallows         117 0.000592 1.25  0.000742
10 mclaggen    Half-Blood Prince        65 0.000379 1.95  0.000738
# i 67,866 more rows
```

```
potter_tfidf |>
  group_by(title) |>
  arrange(desc(tf_idf)) |>
  slice_max(tf_idf, n = 10) |>
  ungroup() |>
  ggplot(aes(x = fct_reorder(word, tf_idf), y = tf_idf, fill = title)) +
    geom_col(show.legend = FALSE) +
    coord_flip() +
    facet_wrap(~title, scales = "free")
```

8. Repeat (7) to show the top 10 2-word combinations that distinguish each book.

```
potter_twowords <- potter_untidy |>
  group_by(title) |>
  mutate(linenumber = row_number()) |>
  ungroup() |>
  unnest_tokens(bigram, text, token = "ngrams", n = 2) |> #two-word combinations
  filter(bigram != "NA")

potter_twowords |>
  count(bigram, sort = TRUE)
```

```
# A tibble: 339,536 x 2
   bigram         n
   <chr>      <int>
 1 of the      4895
 2 in the      3572
 3 said harry  2626
 4 he was      2490
 5 at the      2435
 6 to the      2386
 7 on the      2360
```

```
 8 he had      2138
 9 it was      2123
10 out of      1911
# i 339,526 more rows
```

```
bigrams_filtered <- potter_twowords |>
  separate(bigram, c("word1", "word2"), sep = " ") |>
  count(word1, word2, sort = TRUE) |>
  filter(!is.na(word1) & !is.na(word2))

bigrams_filtered
```

```
# A tibble: 339,536 x 3
   word1 word2     n
   <chr> <chr> <int>
 1 of    the    4895
 2 in    the    3572
 3 said  harry  2626
 4 he    was    2490
 5 at    the    2435
 6 to    the    2386
 7 on    the    2360
 8 he    had    2138
 9 it    was    2123
10 out   of     1911
# i 339,526 more rows
```

```
bigrams_united <- bigrams_filtered |>
  unite(bigram, word1, word2, sep = " ")

bigrams_united
```

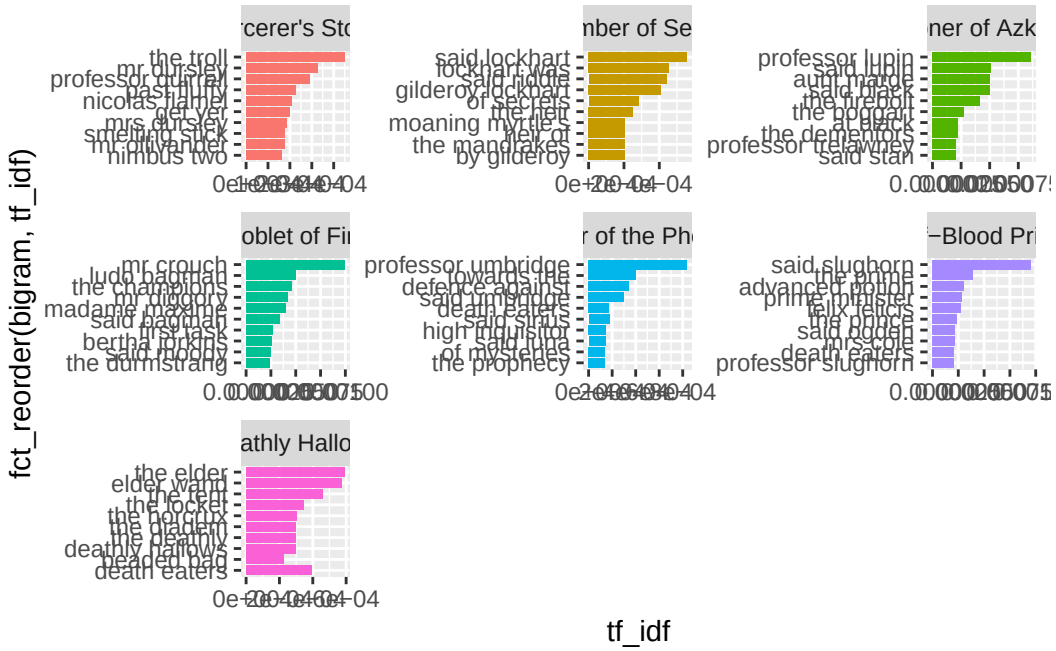
```
# A tibble: 339,536 x 2
   bigram         n
   <chr>      <int>
 1 of the      4895
 2 in the      3572
 3 said harry  2626
 4 he was      2490
 5 at the      2435
 6 to the      2386
```

```
 7 on the      2360
 8 he had      2138
 9 it was      2123
10 out of      1911
# i 339,526 more rows
```

```
bigram_tf_idf <- potter_twowords |>
  count(title, bigram) |>
  bind_tf_idf(bigram, title, n) |>
  arrange(desc(tf_idf))

bigram_tf_idf |> arrange(desc(tf_idf))
```

```
# A tibble: 523,142 x 6
   title                bigram                n       tf   idf   tf_idf
   <fct>                <chr>             <int>    <dbl> <dbl>    <dbl>
 1 Goblet of Fire       mr crouch           152 0.000792 1.25  0.000993
 2 Half-Blood Prince    said slughorn        84 0.000491 1.95  0.000954
 3 Prisoner of Azkaban  professor lupin     107 0.00102  0.847 0.000861
 4 Order of the Phoenix professor umbridge  173 0.000669 1.25  0.000838
 5 Deathly Hallows      the elder            60 0.000304 1.95  0.000591
 6 Deathly Hallows      elder wand           58 0.000294 1.95  0.000571
 7 Chamber of Secrets   said lockhart        38 0.000445 1.25  0.000558
 8 Prisoner of Azkaban  said lupin           97 0.000922 0.560 0.000516
 9 Prisoner of Azkaban  aunt marge           42 0.000399 1.25  0.000500
10 Prisoner of Azkaban  said black           27 0.000257 1.95  0.000499
# i 523,132 more rows
```

```
bigram_tf_idf |>
  group_by(title) |>
  arrange(desc(tf_idf)) |>
  slice_max(tf_idf, n = 10) |>
  ungroup() |>
  ggplot(aes(x = fct_reorder(bigram, tf_idf), y = tf_idf, fill = title)) +
    geom_col(show.legend = FALSE) +
    coord_flip() +
    facet_wrap(~title, scales = "free")
```



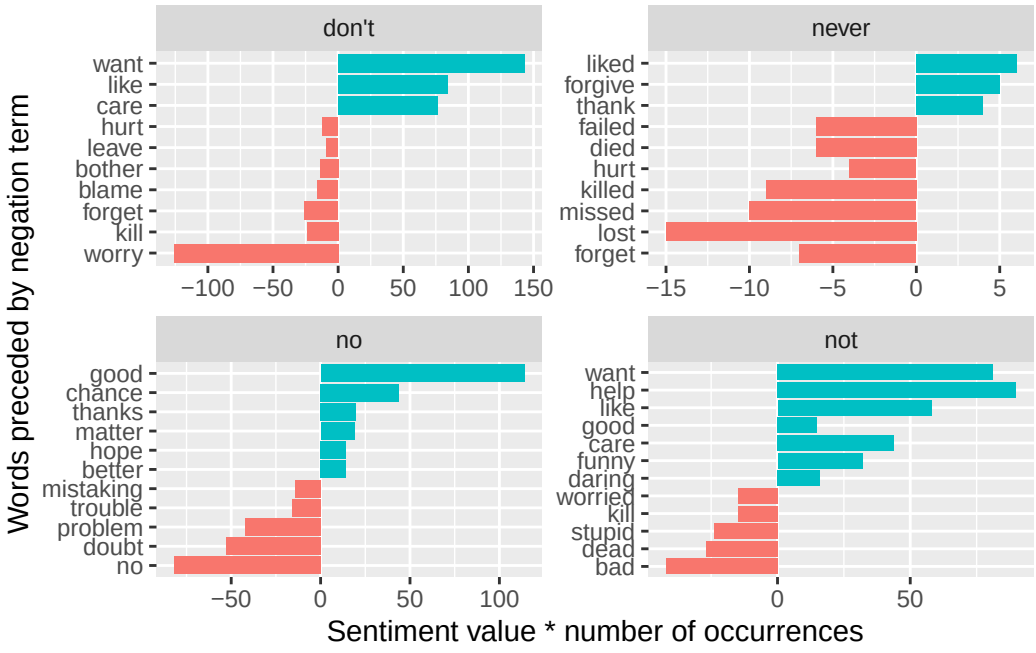
9. Find which words contributed most in the "wrong" direction using the afinn sentiment combined with how often a word appears among all 7 books. Come up with a list of 4 negation words, and for each negation word, illustrate the words associated with the largest "wrong" contributions in a faceted bar plot.

```
negation_words_potter <- c("don't", "not", "no", "never")

afinn <- get_sentiments("afinn")

negated_words_potter <- bigrams_filtered |>
  filter(word1 %in% negation_words_potter) |>
  inner_join(afinn, by = c(word2 = "word")) |>
  arrange(desc(n))

negated_words_potter
```

```
# A tibble: 401 x 4
   word1 word2     n value
   <chr> <chr> <int> <dbl>
 1 don't want    143     1
 2 no    no       82    -1
 3 not   want     81     1
```

```
 4 no    doubt    53    -1
 5 not   help     45     2
 6 don't like     42     2
 7 don't worry    42    -3
 8 don't care     38     2
 9 no    good     38     3
10 not   like     29     2
# i 391 more rows
```

```
negated_words_potter |>
  mutate(contribution = n * value) |>
  arrange(desc(abs(contribution))) |>
  group_by(word1) |>
  slice_max(abs(contribution), n = 10) |>
  ungroup() |>
  mutate(word2 = reorder(word2, contribution)) |>
  ggplot(aes(n * value, word2, fill = n * value > 0)) +
    geom_col(show.legend = FALSE) +
    facet_wrap(~word1, scales = "free") +
    labs(x = "Sentiment value * number of occurrences",
         y = "Words preceded by negation term")
```



10. Select a set of 4 "interesting" terms and then use the Phi coefficient to find and plot

the 6 words most correlated with each of your "interesting" words. Start by dividing `potter_tidy` into 80-word sections and then remove names and spells and stop words.

```
potter_section_words <- potter_tidy |>
 mutate(section = row_number() %/% 80) |> #separates words into 80-word sections
 filter(!word %in% stop_words$word,
        !word %in% potter_names_long$name,
        !word %in% potter_spells$spell)

potter_section_words
```

```
# A tibble: 346,550 x 5
   title            chapter book_num word      section
   <fct>              <dbl>    <dbl> <chr>       <dbl>
 1 Sorcerer's Stone       1        1 boy             0
 2 Sorcerer's Stone       1        1 lived           0
 3 Sorcerer's Stone       1        1 privet          0
 4 Sorcerer's Stone       1        1 drive           0
 5 Sorcerer's Stone       1        1 proud           0
 6 Sorcerer's Stone       1        1 perfectly       0
 7 Sorcerer's Stone       1        1 normal          0
 8 Sorcerer's Stone       1        1 people          0
 9 Sorcerer's Stone       1        1 expect          0
10 Sorcerer's Stone       1        1 involved        0
# i 346,540 more rows
```

```
# count words co-occuring within sections
library(widyr)
word_pairs <- potter_section_words |>
  pairwise_count(word, section, sort = TRUE)

word_pairs
```

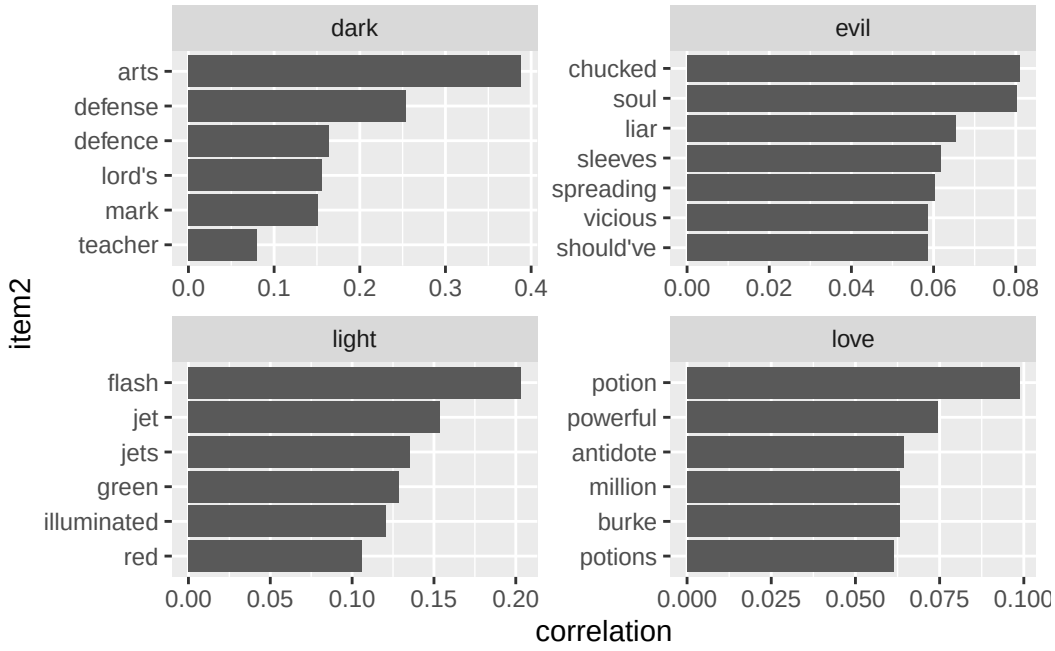
```
# A tibble: 5,345,536 x 3
   item1     item2         n
   <chr>     <chr>     <dbl>
 1 eaters    death       301
 2 death     eaters      301
 3 looked    eyes        295
 4 eyes      looked      295
 5 looked    time        241
```

```
 6 time      looked      241
 7 harry's   looked      227
 8 looked    harry's     227
 9 professor looked      224
10 looked    professor   224
# i 5,345,526 more rows
```

```
# filter for at least relatively common words first
word_cors <- potter_section_words |>
  group_by(word) |>
  filter(n() >= 10) |>
  pairwise_cor(word, section, sort = TRUE)

word_cors
```

```
# A tibble: 28,286,442 x 3
   item1    item2    correlation
   <chr>    <chr>          <dbl>
 1 snare    devil's        1
 2 devil's  snare          1
 3 patronum expecto        0.977
 4 expecto  patronum       0.977
 5 grubbly  plank          0.925
 6 plank    grubbly        0.925
 7 kedavra  avada          0.906
 8 avada    kedavra        0.906
 9 crescent magnolia       0.904
10 magnolia crescent       0.904
# i 28,286,432 more rows
```

```
word_cors |>
  filter(item1 %in% c("love", "light", "dark", "evil")) |>
  group_by(item1) |>
  slice_max(correlation, n = 6) |>
  ungroup() |>
  mutate(item2 = reorder(item2, correlation)) |>
  ggplot(aes(item2, correlation)) +
    geom_bar(stat = "identity") +
    facet_wrap(~ item1, scales = "free") +
    coord_flip()
```



11. Create a network graph to visualize the correlations and clusters of words that were found by the `widyr` package in (10).

```
set.seed(2016)

word_cors |>
  filter(correlation > .5) |>
  graph_from_data_frame() |>
  ggraph(layout = "fr") +
    geom_edge_link(aes(edge_alpha = correlation), show.legend = FALSE) +
    geom_node_point(color = "lightblue", size = 5) +
    geom_node_text(aes(label = name), repel = TRUE) +
    theme_void()
```

12. Use LDA to fit a 2-topic model to all 7 Harry Potter books. Be sure to remove names, spells, and stop words before running your topic models. (a) Make a plot to illustrate words with greatest difference between two topics, using log ratio. (b) Print a table with the gamma variable for each document and topic. Based on (a) and (b), can you interpret what the two topics represent?

```
book_words_potter <- potter_untidy |>
  group_by(title) |>
  mutate(linenumber = row_number()) |>
  ungroup() |>
  unnest_tokens(word, text)

book_word_count_potter <- book_words_potter |>
  count(word, title, sort = TRUE)

book_word_count_potter
```

```
# A tibble: 67,876 x 3
   word  title                     n
   <chr> <fct>                 <int>
 1 the   Order of the Phoenix 11740
 2 the   Deathly Hallows      10335
```

```
 3 the   Goblet of Fire        9305
 4 the   Half-Blood Prince     7508
 5 to    Order of the Phoenix  6518
 6 and   Order of the Phoenix  6189
 7 and   Deathly Hallows       5510
 8 of    Order of the Phoenix  5332
 9 the   Prisoner of Azkaban   4990
10 and   Goblet of Fire        4959
# i 67,866 more rows
```

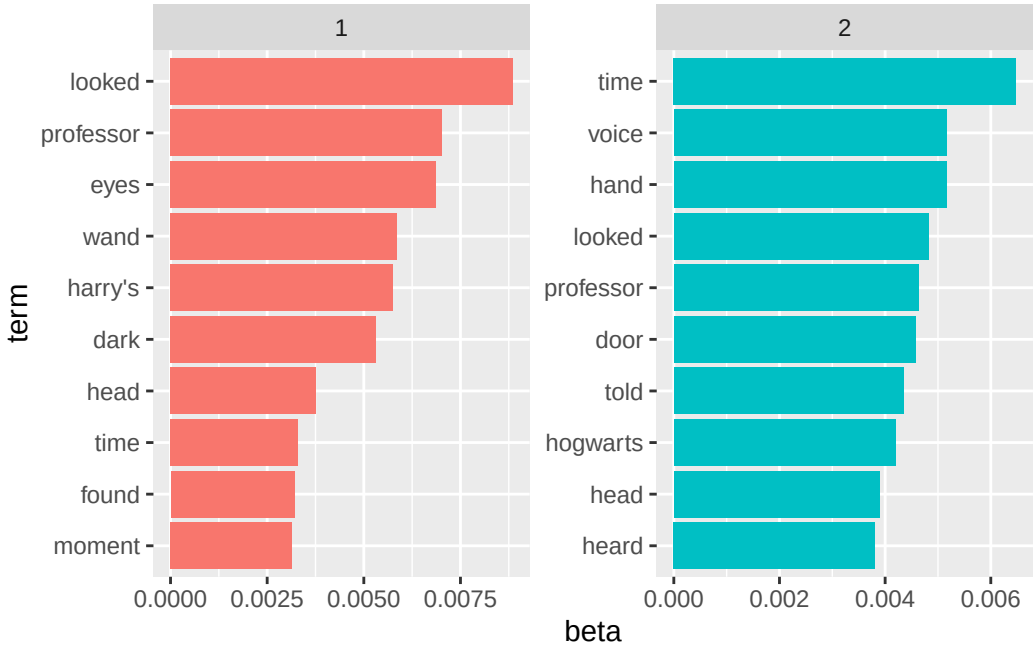
```
potter_books_dtm <- book_word_count_potter |>
  filter(!word %in% stop_words$word,
         !word %in% potter_names_long$name,
         !word %in% potter_spells$spell) |>
  cast_dtm(title, word, n)

potter_books_lda <- LDA(potter_books_dtm, k = 2, control = list(seed = 1234))
potter_books_lda
```

```
A LDA_VEM topic model with 2 topics.
```

```
potter_books_topics <- tidy(potter_books_lda, matrix = "beta")
potter_books_topics
```

```
# A tibble: 46,932 x 3
   topic term         beta
   <int> <chr>       <dbl>
 1     1 professor 0.00703
 2     2 professor 0.00463
 3     1 wand      0.00585
 4     2 wand      0.00368
 5     1 looked    0.00885
 6     2 looked    0.00482
 7     1 voice     0.00310
 8     2 voice     0.00516
 9     1 time      0.00330
10     2 time      0.00647
# i 46,922 more rows
```

```r
# Find the most common words within each topic
potter_books_top_terms <- potter_books_topics |>
  group_by(topic) |>
  slice_max(beta, n = 10) |>
  ungroup() |>
  arrange(topic, -beta)

potter_books_top_terms |>
  mutate(term = reorder_within(term, beta, topic)) |>
  ggplot(aes(beta, term, fill = factor(topic))) +
    geom_col(show.legend = FALSE) +
    facet_wrap(~ topic, scales = "free") +
    scale_y_reordered()
```




```r
beta_wide_potter <- potter_books_topics |>
  mutate(topic = paste0("topic", topic)) |>
  pivot_wider(names_from = topic, values_from = beta) |>
  filter(topic1 > .001 | topic2 > .001) |>
  mutate(log_ratio = log2(topic2 / topic1))

beta_wide_potter
```

```
# A tibble: 206 x 4
   term       topic1  topic2 log_ratio
   <chr>       <dbl>   <dbl>     <dbl>
 1 professor 0.00703 0.00463   -0.603
 2 wand      0.00585 0.00368   -0.668
 3 looked    0.00885 0.00482   -0.875
 4 voice     0.00310 0.00516    0.735
 5 time      0.00330 0.00647    0.973
 6 door      0.00287 0.00458    0.673
 7 head      0.00375 0.00390    0.0543
 8 harry's   0.00576 0.00232   -1.31
 9 eyes      0.00688 0.00254   -1.44
10 death     0.00210 0.00226    0.110
# i 196 more rows
```

```r
#uses log ratio to find difference between topics
beta_wide_potter |>
  arrange(desc(abs(log_ratio))) |>
  slice_max(abs(log_ratio), n = 20) |>
  mutate(term = reorder(term, log_ratio)) |>
  ggplot(aes(log_ratio, term, fill = log_ratio > 0)) +
    geom_col(show.legend = FALSE) +
    labs(x = "Log ratio of Beta values",
         y = "Words in Harry Potter books")
```


```
potter_books_documents <- tidy(potter_books_lda, matrix = "gamma")
potter_books_documents
```

```
# A tibble: 14 x 3
   document             topic gamma
   <chr>                <int> <dbl>
 1 Sorcerer's Stone         1 0.499
 2 Chamber of Secrets       1 0.476
 3 Prisoner of Azkaban      1 0.505
 4 Goblet of Fire           1 0.465
 5 Order of the Phoenix     1 0.469
 6 Half-Blood Prince        1 0.486
 7 Deathly Hallows          1 0.505
 8 Sorcerer's Stone         2 0.501
 9 Chamber of Secrets       2 0.524
10 Prisoner of Azkaban      2 0.495
11 Goblet of Fire           2 0.535
12 Order of the Phoenix     2 0.531
13 Half-Blood Prince        2 0.514
14 Deathly Hallows          2 0.495
```

```
#Prisoner of Azkaban and Deathly Hallows vs Sorcerer's Stone, Chamber of Secrets, Goblet of F
```