Text_Mining

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Learning Objective

- Remove stop words and identify frequently used words in a text
- Compare word counts between different groups of text

Resources

Text Mining with R by Julia Silge and David Robinson.

Tidy Text Format

This first video corresponds to the online book sections 1.1 - 1.2 which I suggest you read first.

Tidy text format (ttf): A table with one token per row where a token is a meaningful unit of text such as a word, n-gram, sentence or paragraph.

Other text mining tools use:

- strings
- corpus: contain raw strings annotated with metadata
- document-term matrix: sparse matrix with each row containing one document and each column one term or word; entries are generally counts or td-idf (term frequency - inverse document freq)

```
text <- c("If You Forget Me",
"by Pablo Neruda",
"I want you to know",
"one thing.",
"You know how this is:",
"if I look",
"at the crystal moon, at the red branch",
"of the slow autumn at my window,",
"if I touch",
"near the fire",
"the impalpable ash",
"or the wrinkled body of the log,",
"everything carries me to you,",
"as if everything that exists,",
"aromas, light, metals,",
"were little boats",
"that sail",
"toward those isles of yours that wait for me."
)
text
```

```
##  [1] "If You Forget Me"
##  [2] "by Pablo Neruda"
##  [3] "I want you to know"
##  [4] "one thing."
##  [5] "You know how this is:"
##  [6] "if I look"
##  [7] "at the crystal moon, at the red branch"
##  [8] "of the slow autumn at my window,"
##  [9] "if I touch"
## [10] "near the fire"
## [11] "the impalpable ash"
## [12] "or the wrinkled body of the log,"
## [13] "everything carries me to you,"
## [14] "as if everything that exists,"
## [15] "aromas, light, metals,"
## [16] "were little boats"
## [17] "that sail"
## [18] "toward those isles of yours that wait for me."
```

```
text_df <- tibble(
  line = 1:length(text),
  text = text
)
text_df
```

```
## # A tibble: 18 x 2
##     line text
##    <int> <chr>
##  1     1 If You Forget Me
##  2     2 by Pablo Neruda
##  3     3 I want you to know
##  4     4 one thing.
##  5     5 You know how this is:
##  6     6 if I look
##  7     7 at the crystal moon, at the red branch
##  8     8 of the slow autumn at my window,
##  9     9 if I touch
## 10    10 near the fire
## 11    11 the impalpable ash
## 12    12 or the wrinkled body of the log,
## 13    13 everything carries me to you,
## 14    14 as if everything that exists,
## 15    15 aromas, light, metals,
## 16    16 were little boats
## 17    17 that sail
## 18    18 toward those isles of yours that wait for me.
```

```
text_df %>%
  unnest_tokens(word, text)
```

```
## # A tibble: 80 x 2
##     line word
##    <int> <chr>
##  1     1 if
##  2     1 you
##  3     1 forget
##  4     1 me
##  5     2 by
##  6     2 pablo
##  7     2 neruda
##  8     3 i
##  9     3 want
## 10     3 you
## # ... with 70 more rows
```

```
data(stop_words)
text_word_count <- text_df %>%
  unnest_tokens(word, text) %>%
  anti_join(stop_words) %>% # get rid of uninteresting words
  count(word, sort = TRUE) # count of each word left
```

---

unnest_tokens() on larger text

Section 1.3 in online book.

Let's look at a larger text, say all of Jane Austen's novels.

```
orig_books <- austen_books() %>%
  group_by(book) %>%
  mutate(linenumber = row_number(),
         chapter = cumsum(str_detect(text,
             regex("^chapter [\\divxlc]",
                   ignore_case = TRUE)))) %>%
  ungroup() %>%
  select(chapter, linenumber, everything())
orig_books
```

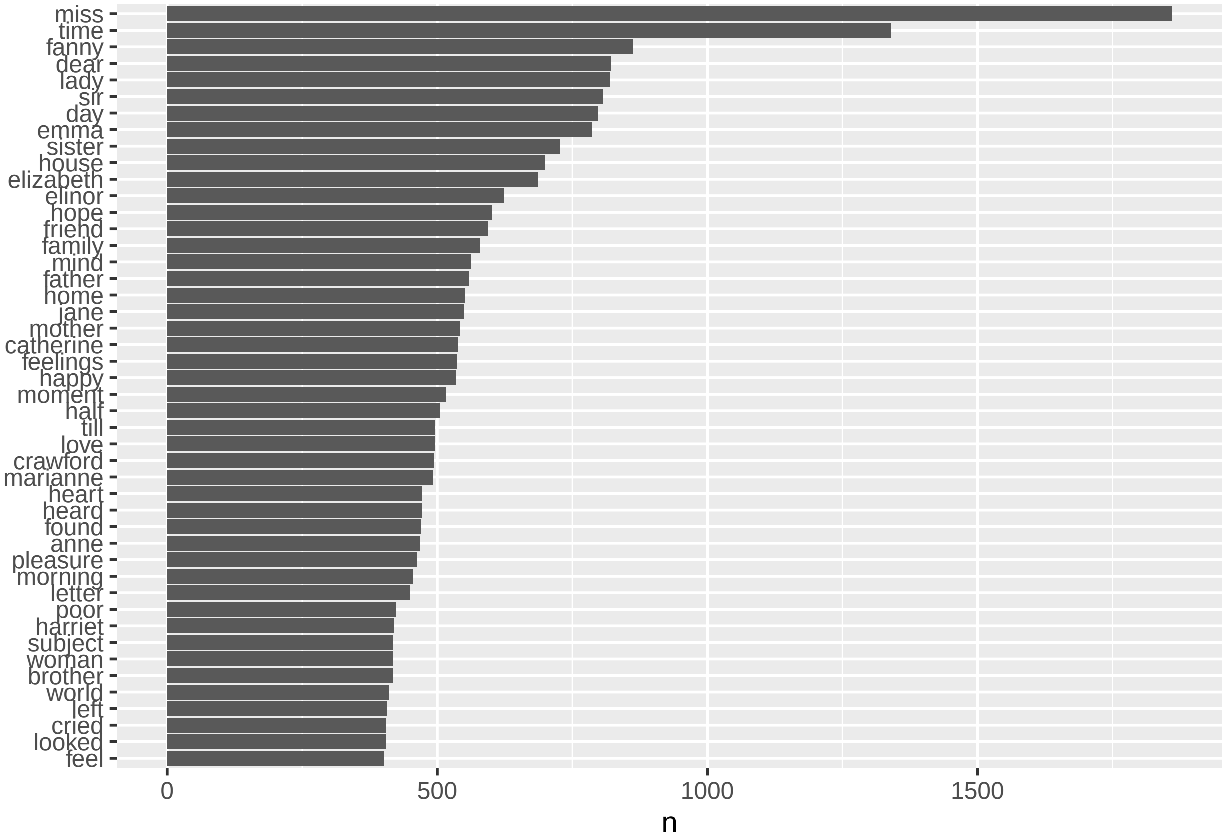
```
## # A tibble: 73,422 x 4
##    chapter linenumber text                    book
##      <int>      <int> <chr>                   <fct>
##  1       0          1 "SENSE AND SENSIBILITY" Sense & Sensibility
##  2       0          2 ""                      Sense & Sensibility
##  3       0          3 "by Jane Austen"        Sense & Sensibility
##  4       0          4 ""                      Sense & Sensibility
##  5       0          5 "(1811)"                Sense & Sensibility
##  6       0          6 ""                      Sense & Sensibility
##  7       0          7 ""                      Sense & Sensibility
##  8       0          8 ""                      Sense & Sensibility
##  9       0          9 ""                      Sense & Sensibility
## 10       1         10 "CHAPTER 1"             Sense & Sensibility
## # ... with 73,412 more rows
```

```
#  make data tidy
tidy_books <- orig_books %>%
  unnest_tokens(word, text) %>%
  # use str_extract because some gutenberg texts have other symbols around
  # the words as part of the encoding
  mutate(word = str_extract(word, "[a-z']+")) %>%
  anti_join(stop_words)
```

```
tidy_books %>%
  count(word, sort = TRUE)
```

```
## # A tibble: 13,464 x 2
##    word       n
##  * <chr>  <int>
##  1 miss    1860
##  2 time    1339
##  3 fanny    862
##  4 dear     822
##  5 lady     819
##  6 sir      807
##  7 day      797
##  8 emma     787
##  9 sister   727
## 10 house    699
## # ... with 13,454 more rows
```

```
# visualize
tidy_books %>%
  count(word, sort = TRUE) %>%
  filter(n > 400) %>%
  mutate(word = reorder(word,n)) %>%
  ggplot(aes(word, n)) +
    geom_col() +
    xlab(NULL) +
    coord_flip()
```



Compare word frequencies between authors

This section corresponds to section 1.4 in the online book.

We now compare frequencies across different authors. We will look at H.G. Wells (The Island of Doctor Moreau, The War of the Worlds, The Time Machine, and The Invisible Man) and the Bronte Sisters (Jane Eyre, Wuthering Heights, Agnes Grey, The Tenant of Wildfell Hall and Villette) since they are from a similar time-frame as Jane Austen.

First, take a few minutes to explore the gutenberg website. We will search by author and then find the book numbers we want to download.

```r
hgwells <- gutenberg_download(c(35, 36, 159, 5230))
bronte <- gutenberg_download(c(767, 768, 969, 1260, 9182))
tidy_hgwells <- hgwells %>%
  unnest_tokens(word, text) %>%
  mutate(word = str_extract(word, "[a-z']+")) %>%
  anti_join(stop_words)
tidy_bronte <- bronte %>%
  unnest_tokens(word, text) %>%
  mutate(word = str_extract(word, "[a-z']+")) %>%
  anti_join(stop_words)
tidy_hgwells %>%
  count(word, sort = TRUE)
```

```
## # A tibble: 11,648 x 2
##    word       n
##  * <chr>  <int>
##  1 time     454
##  2 people   302
##  3 door     260
##  4 heard    249
##  5 black    232
##  6 stood    229
##  7 white    222
##  8 hand     218
##  9 kemp     213
## 10 eyes     210
## # ... with 11,638 more rows
```

```
tidy_bronte %>%
  count(word, sort = TRUE)
```

```
## # A tibble: 22,516 x 2
##    word       n
##  * <chr>  <int>
##  1 time    1065
##  2 miss     856
##  3 day      828
##  4 hand     768
##  5 eyes     713
##  6 night    647
##  7 heart    638
##  8 looked   602
##  9 door     592
## 10 half     588
## # ... with 22,506 more rows
```

Put all three authors together in one tibble with a new column showing author.

```
frequency_by_word_across_authors <- bind_rows(mutate(tidy_bronte,
                 author = "Bronte"),
                 mutate(tidy_hgwells, author = "Wells"),
                 mutate(tidy_books, author = "Austen")) %>%
            mutate(word = str_extract(word, "[a-z']+")) %>%
            count(author, word) %>%
            group_by(author) %>%
            mutate(proportion = n / sum(n)) %>%
            select(-n) %>%
            spread(author, proportion)
frequency_by_word_across_authors
```

```
## # A tibble: 28,678 x 4
##    word             Austen      Bronte      Wells
##    <chr>             <dbl>       <dbl>      <dbl>
##  1 a'most      NA           0.0000160   NA
##  2 a'n't        0.00000462 NA           NA
##  3 aback       NA           0.00000400  0.0000150
##  4 abaht       NA           0.00000400 NA
##  5 abandon     NA           0.0000320   0.0000150
##  6 abandoned    0.00000462  0.0000920   0.000180
##  7 abandoning  NA           0.00000400  0.0000450
##  8 abandonment NA           0.0000200   0.0000150
##  9 abart       NA          NA           0.0000150
## 10 abase       NA           0.00000400 NA
## # ... with 28,668 more rows
```

```
frequency <- frequency_by_word_across_authors %>%
            gather(author, proportion, `Bronte`:`Wells`)
frequency
```

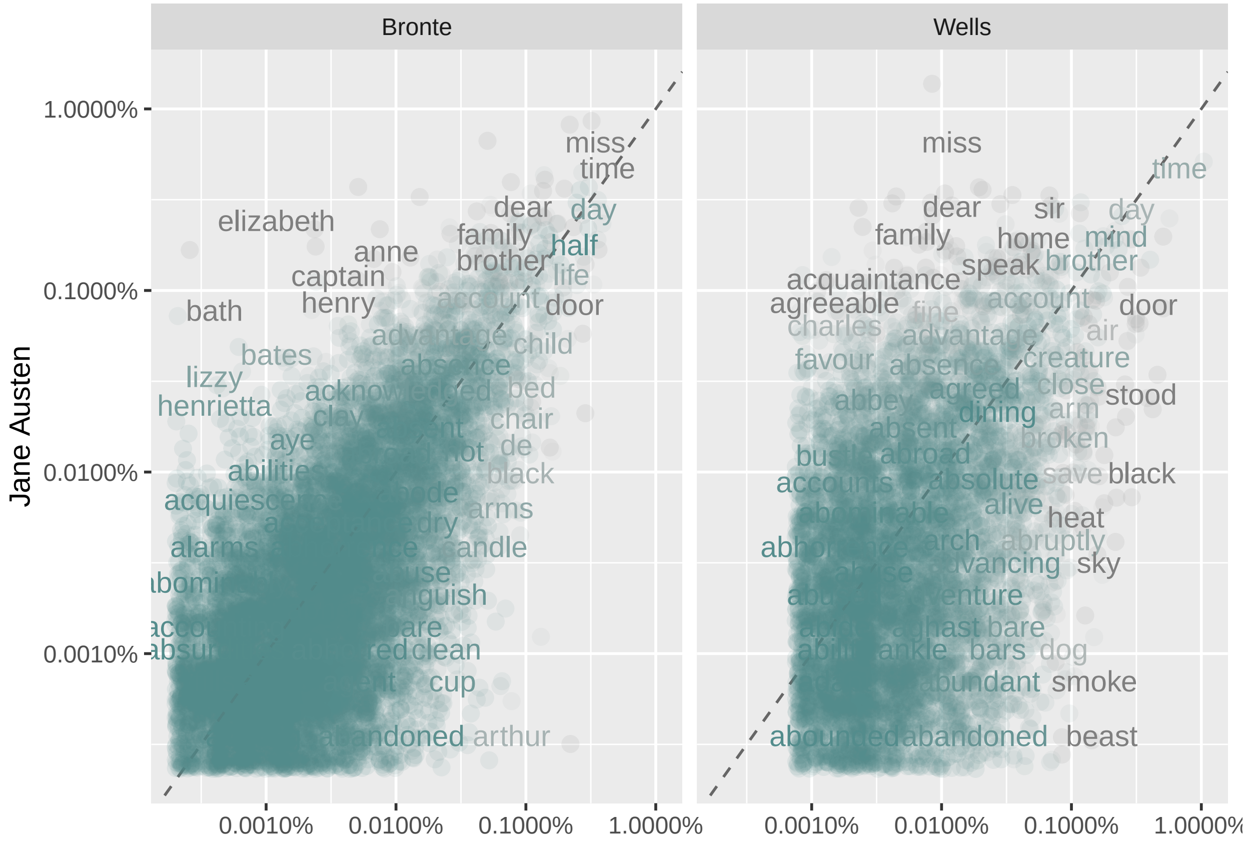
```
## # A tibble: 57,356 x 4
##    word             Austen author  proportion
##    <chr>             <dbl> <chr>        <dbl>
##  1 a'most      NA          Bronte  0.0000160
##  2 a'n't        0.00000462 Bronte NA
##  3 aback       NA          Bronte  0.00000400
##  4 abaht       NA          Bronte  0.00000400
##  5 abandon     NA          Bronte  0.0000320
##  6 abandoned    0.00000462 Bronte  0.0000920
##  7 abandoning  NA          Bronte  0.00000400
##  8 abandonment NA          Bronte  0.0000200
##  9 abart       NA          Bronte NA
## 10 abase       NA          Bronte  0.00000400
## # ... with 57,346 more rows
```

Compare word frequency by author to Austen

Book sections 1.5 - 1.6

Now let's graph the frequency comparison of each other author to Jane Austen.

```
frequency %>% ggplot(aes(x = proportion,
          y = `Austen`,
          color = abs(`Austen` - proportion))) +
  geom_abline(color = "gray40", lty = 2) +
  geom_jitter(alpha = 0.1, size = 2.5,
              width = 0.3, height = 0.3) +
  geom_text(aes(label = word),
            check_overlap = TRUE, vjust = 1.5) +
  scale_x_log10(labels = percent_format()) +
  scale_y_log10(labels = percent_format()) +
  scale_color_gradient(limits = c(0, 0.001),
                       low = "darkslategray4",
                       high = "gray75") +
  facet_wrap(~author, ncol = 2) +
  theme(legend.position="none") +
  labs(y = "Jane Austen", x = NULL)
```



We can tell that Austen and Bronte are more similar (grouped closer to the line) than Austen and Wells. Let's use a correlation test to quantify the amounts.

```
df_Bronte <- frequency[frequency$author == "Bronte",]
df_Bronte
```

```
## # A tibble: 28,678 x 4
##    word             Austen author  proportion
##    <chr>             <dbl> <chr>        <dbl>
##  1 a'most      NA          Bronte  0.0000160
##  2 a'n't        0.00000462 Bronte  NA
##  3 aback       NA          Bronte  0.00000400
##  4 abaht       NA          Bronte  0.00000400
##  5 abandon     NA          Bronte  0.0000320
##  6 abandoned    0.00000462 Bronte  0.0000920
##  7 abandoning  NA          Bronte  0.00000400
##  8 abandonment NA          Bronte  0.0000200
##  9 abart       NA          Bronte  NA
## 10 abase       NA          Bronte  0.00000400
## # ... with 28,668 more rows
```

```
cor.test(data = df_Bronte,  ~ proportion + `Austen`)
```

```
##
##  Pearson's product-moment correlation
##
## data:  proportion and Austen
## t = 119.07, df = 10299, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.7528218 0.7690770
## sample estimates:
##       cor
## 0.7610689
```

```r
df_Wells <- frequency[frequency$author == "Wells",]
df_Wells
```

```
## # A tibble: 28,678 x 4
##    word             Austen author proportion
##    <chr>             <dbl> <chr>       <dbl>
##  1 a'most      NA          Wells  NA
##  2 a'n't        0.00000462 Wells  NA
##  3 aback       NA          Wells   0.0000150
##  4 abaht       NA          Wells  NA
##  5 abandon     NA          Wells   0.0000150
##  6 abandoned    0.00000462 Wells   0.000180
##  7 abandoning  NA          Wells   0.0000450
##  8 abandonment NA          Wells   0.0000150
##  9 abart       NA          Wells   0.0000150
## 10 abase       NA          Wells  NA
## # ... with 28,668 more rows
```

```r
cor.test(data = df_Wells,  ~ proportion + `Austen`)
```

```
##
##  Pearson's product-moment correlation
##
## data:  proportion and Austen
## t = 36.296, df = 6010, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.4030622 0.4445345
## sample estimates:
##       cor
## 0.4240206
```

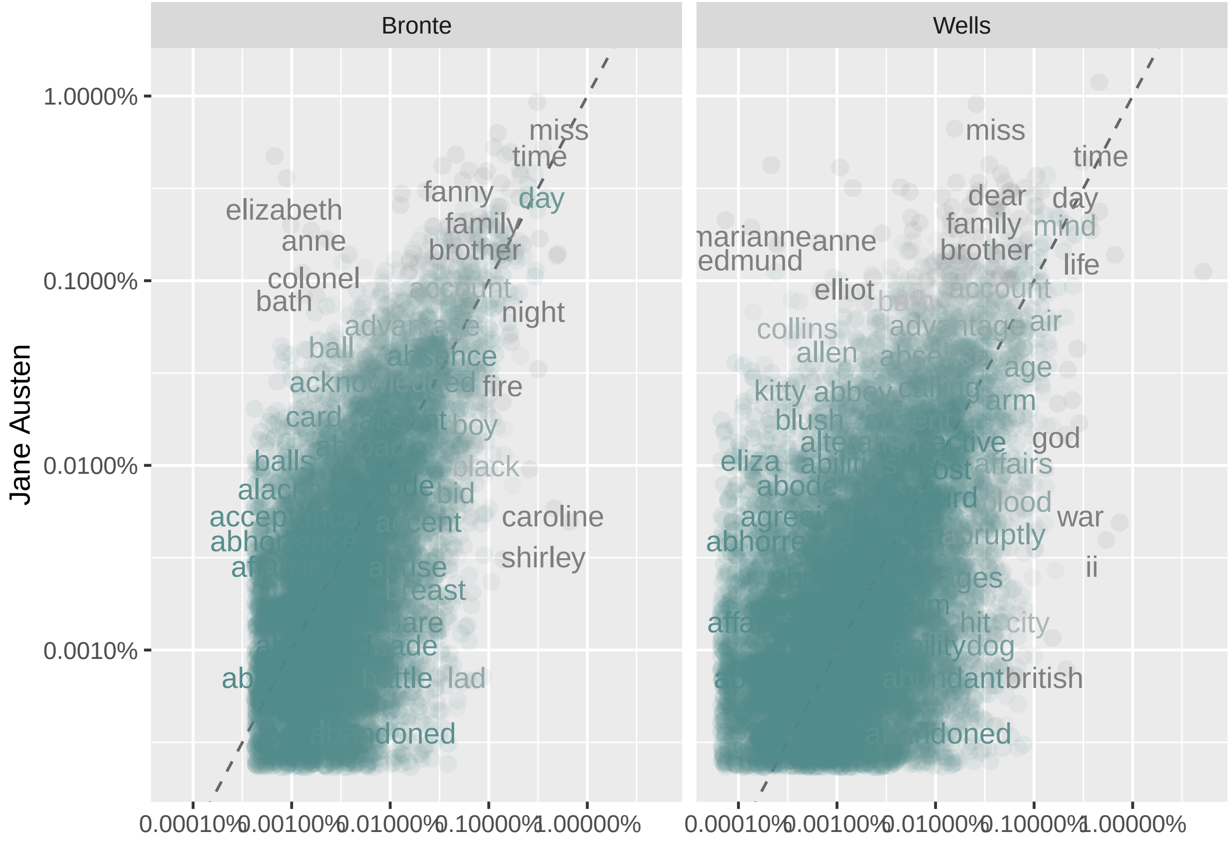
- **Exercise 1:** Repeat the above analysis using all the H.G. Wells and Bronte works that are available on gutenberg.org

You will need to use gutenberg_works(author == "Wells, H. G. (Herbert George)") to get started. We figured this out by looking at any H.G. Wells book on the gutenberg.org website and then looking at the Bibiliography Record to see how the author is listed there. Similarly, find the Bronte works.

- **Exercise 2:** Pick three other authors from Gutenberg.org and download their works. Compare the authors. Which two are more alike? Some suggestions if you can't think of any: Mark Twain, Leo Tolstoy, Charles Dickens.

```
## # A tibble: 46,018 x 4
##    word          Austen     Bronte       Wells
##    <chr>          <dbl>      <dbl>       <dbl>
##  1 a'hm     NA          NA          0.00000132
##  2 a'll     NA          NA          0.00000396
##  3 a'most   NA           0.0000168  0.00000132
##  4 a'n't     0.00000462 NA         NA
##  5 a'penny  NA          NA          0.00000132
##  6 aah      NA          NA          0.00000132
##  7 aar      NA          NA          0.00000264
##  8 aaron    NA           0.0000168  0.00000396
##  9 aaronson NA          NA          0.00000264
## 10 ab       NA          NA          0.00000132
## # ... with 46,008 more rows
```

```
## # A tibble: 92,036 x 4
##    word           Austen author proportion
##    <chr>           <dbl> <chr>       <dbl>
##  1 a'hm     NA          Bronte NA
##  2 a'll     NA          Bronte NA
##  3 a'most   NA          Bronte  0.0000168
##  4 a'n't     0.00000462 Bronte NA
##  5 a'penny  NA          Bronte NA
##  6 aah      NA          Bronte NA
##  7 aar      NA          Bronte NA
##  8 aaron    NA          Bronte  0.0000168
##  9 aaronson NA          Bronte NA
## 10 ab       NA          Bronte NA
## # ... with 92,026 more rows
```



```
## # A tibble: 46,018 x 4
##    word           Austen author proportion
##    <chr>           <dbl> <chr>       <dbl>
##  1 a'hm     NA          Bronte NA
##  2 a'll     NA          Bronte NA
##  3 a'most   NA          Bronte  0.0000168
##  4 a'n't     0.00000462 Bronte NA
##  5 a'penny  NA          Bronte NA
##  6 aah      NA          Bronte NA
##  7 aar      NA          Bronte NA
##  8 aaron    NA          Bronte  0.0000168
##  9 aaronson NA          Bronte NA
## 10 ab       NA          Bronte NA
## # ... with 46,008 more rows
```

```
## 
##  Pearson's product-moment correlation
## 
## data:  proportion and Austen
## t = 92.943, df = 8838, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.6923591 0.7134481
## sample estimates:
##       cor 
## 0.7030581
```

```
## # A tibble: 46,018 x 4
##    word          Austen author  proportion
##    <chr>          <dbl> <chr>        <dbl>
##  1 a'hm     NA          Wells   0.00000132
##  2 a'll     NA          Wells   0.00000396
##  3 a'most   NA          Wells   0.00000132
##  4 a'n't     0.00000462 Wells  NA
##  5 a'penny  NA          Wells   0.00000132
##  6 aah      NA          Wells   0.00000132
##  7 aar      NA          Wells   0.00000264
##  8 aaron    NA          Wells   0.00000396
##  9 aaronson NA          Wells   0.00000264
## 10 ab       NA          Wells   0.00000132
## # ... with 46,008 more rows
```

```
## 
##  Pearson's product-moment correlation
## 
## data:  proportion and Austen
## t = 29.618, df = 10910, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.2553507 0.2900850
## sample estimates:
##       cor 
## 0.2728068
```