w5_DH

October 30, 2021

1 Week 5: Digital Humanities

[2]:
```
import pandas as pd
import numpy as np; np.random.seed(1)
import matplotlib.pyplot as plt
import scipy.special
import itertools
import re
from scipy.stats import binom
from collections import Counter
```

[4]:
```
words_of_interest = ['upon', 'the', 'state', 'enough', 'while', 'any', 'his',␣
↪'were','to']
df = pd.read_csv('data/federalist-papersNew2.csv', index_col=0)
print("No. of articles: {}".format(len(df)))
df[words_of_interest].sample(6)
```

```
No. of articles: 85
```

[4]:

	upon	the	state	enough	while	any	his	were	to
10	0	261	3	0	0	4	8	0	100
4	0	86	6	0	0	5	2	1	51
26	6	201	7	7	0	10	6	7	95
51	0	202	7	0	0	1	0	4	50
36	6	251	25	0	0	10	0	1	120
55	0	182	7	0	0	8	0	6	78

[5]:
```
disputed_essays = df[df['AUTHOR'] == 'Hamilton OR Madison'].index
assert len(disputed_essays) == 12
assert set(disputed_essays) == {49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 62, 63}
```

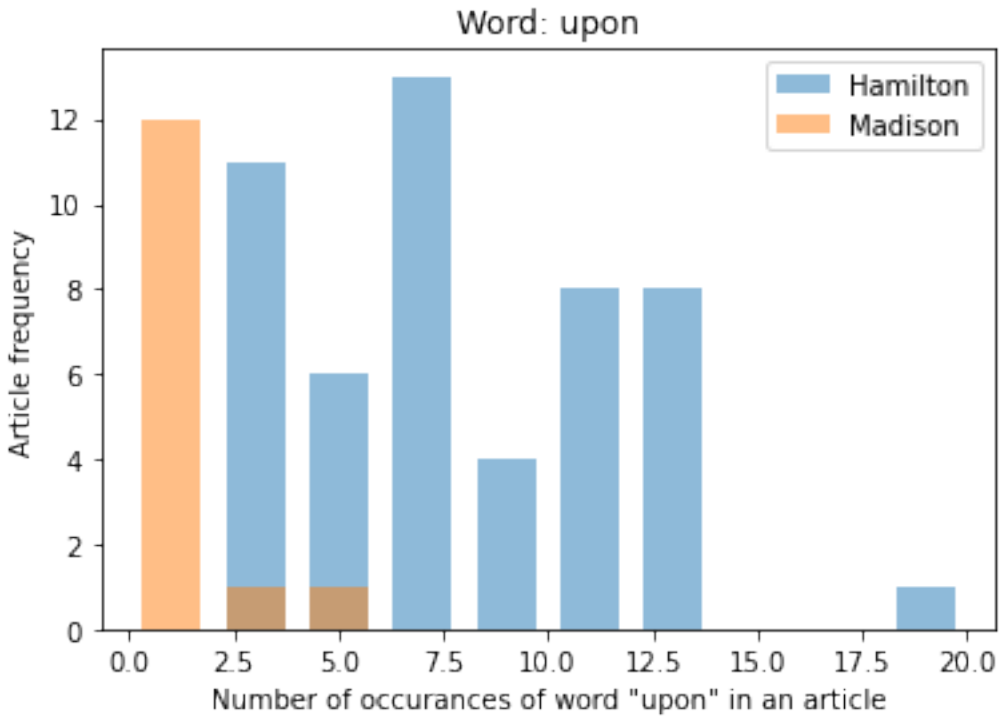
[6]:
```
df_known = df.loc[df['AUTHOR'].isin(('Hamilton', 'Madison'))]
print(df_known['AUTHOR'].value_counts())
```

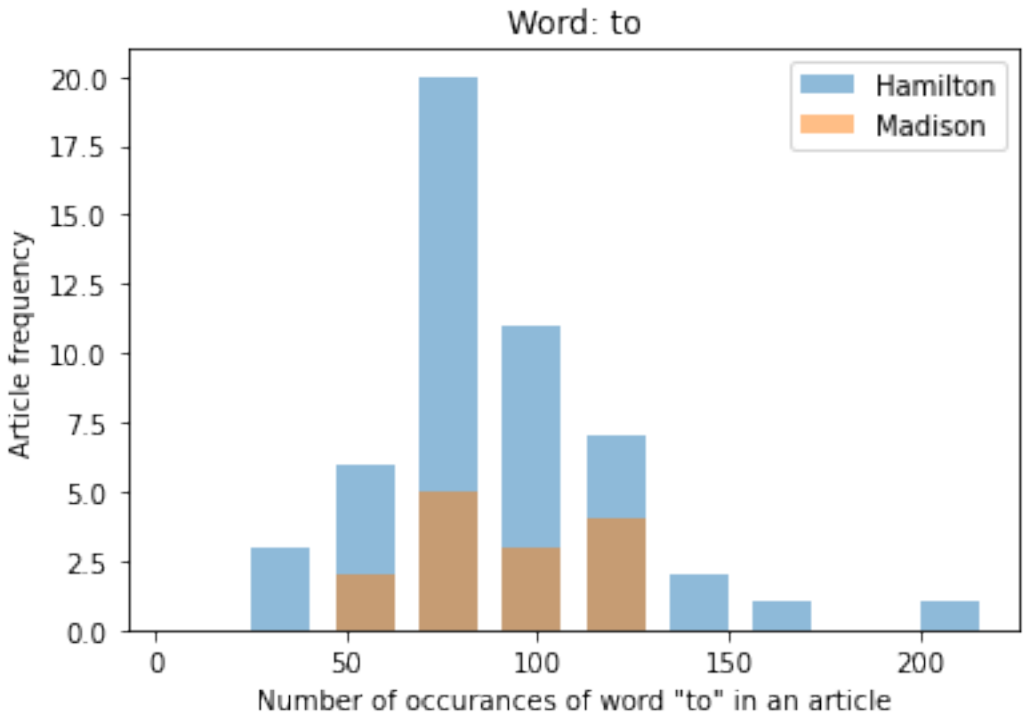
```
Hamilton    51
Madison     14
Name: AUTHOR, dtype: int64
```

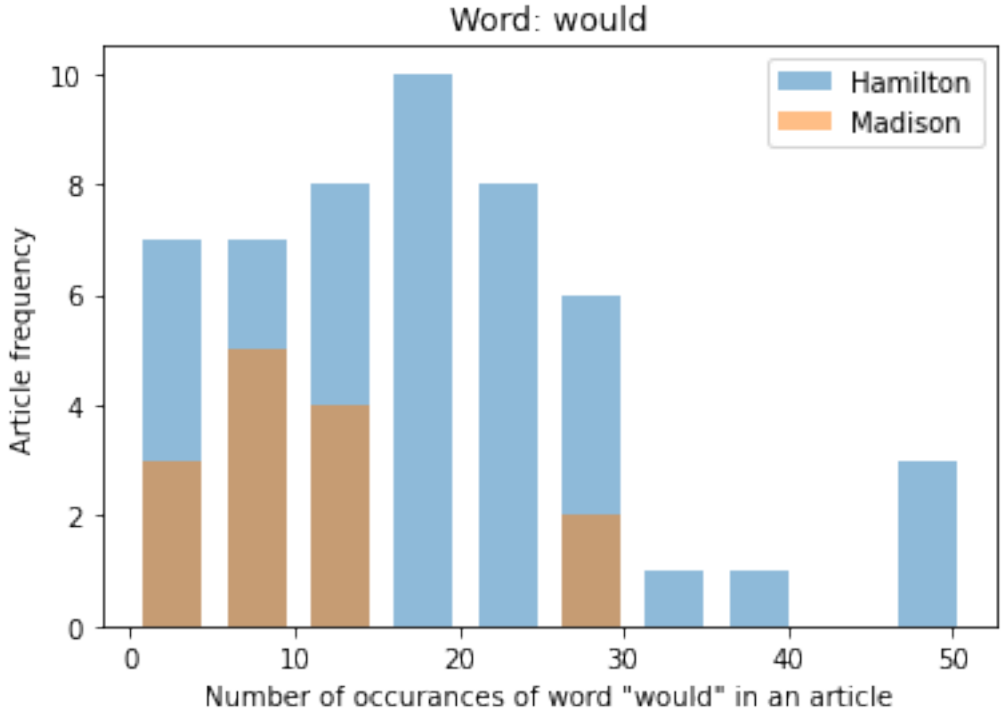
Q1. Considering the words 'to', 'upon' and 'would', draw a graph representing the occurrences of those words in Hamilton and Madison's articles.

Ans. Please find anaylsis below.

[41]:
```
for word in ['upon','to','would']:

    maxwordcount = df_known[word].max()
    df_known.groupby('AUTHOR')[word].plot.hist(rwidth=0.7,alpha=0.5, range=(0,␣
↪maxwordcount), legend=True)
    plt.title("Word: {}".format(word))
    plt.xlabel('Number of occurances of word "{}" in an article'.format(word))
    plt.ylabel('Article frequency')

    plt.show()
```



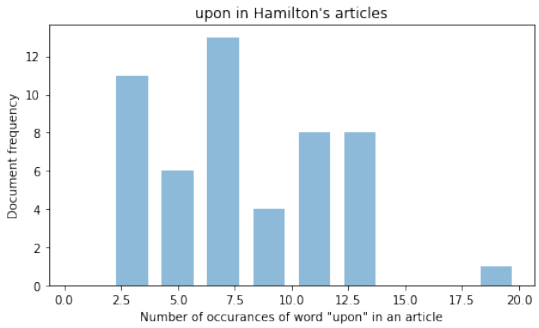

Word: to
Hamilton
Madison
Article frequency
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0
50
100
150
200
Number of occurances of word "to" in an article

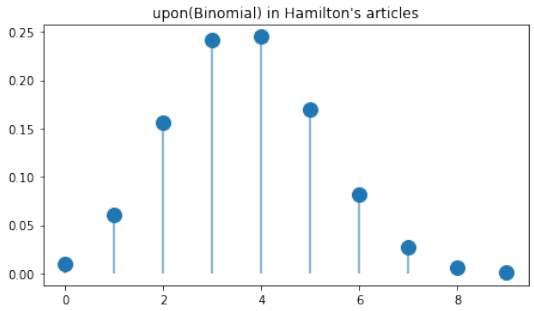

Word: would
Hamilton
Madison
Article frequency
10
8
6
4
2
0
0
10
20
30
40
50
Number of occurances of word "would" in an article

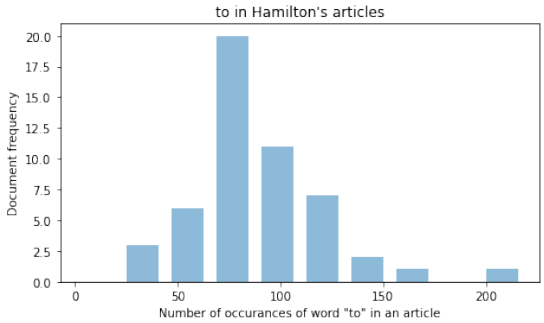
Q2. With these three words, model them as a binomial to reflect either occurrences in Hamilton or Madison's writing style.

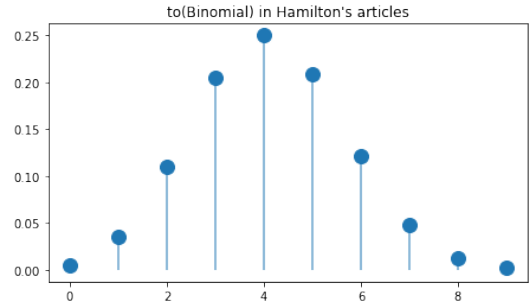
Binomial distribution for 3 words for Hamilton papers

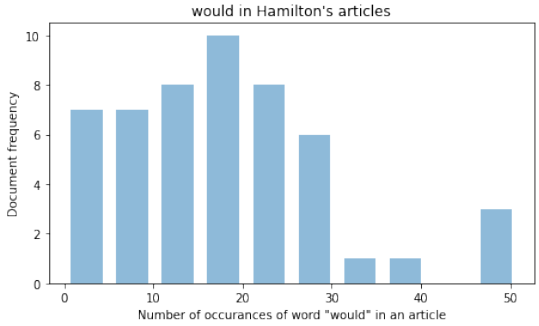
[52]:
```
for word in ['upon','to', 'would']:

    maxwordcount = df_known[word].max()
    plt.figure(figsize=(16,4))
    plt.subplot(1, 2, 1)
    plt.hist(df_known[df_known['AUTHOR'] == 'Hamilton'][word],
             rwidth=0.7,range=(0, maxwordcount), bins=10, color='tab:blue',␣
↪alpha=0.5)
    plt.title("{} in Hamilton's articles".format(word))
    plt.xlabel('Number of occurances of word "{}" in an article'.format(word))
    plt.ylabel('Document frequency')
    total = df[df['AUTHOR'] == 'Hamilton'][word].sum()
    mean = df[df['AUTHOR'] == 'Hamilton'][word].mean()
    p = mean/ maxwordcount
    plt.subplot(1, 2, 2)
    n = 10 # no. of bins
    x = np.arange(0, 10)
    plt.plot(x, binom.pmf(x, n, p), 'bo', ms=12, label='binom pmf',color='tab:
↪blue')
    plt.title(label= "{}(Binomial) in Hamilton's articles".format(word),␣
↪loc='center')
    plt.vlines(x, 0, binom.pmf(x, n, p), colors='b', lw=2, alpha=.5, color='tab:
↪blue')
    plt.show()
```

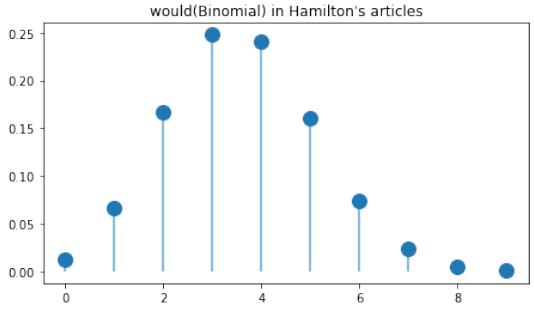








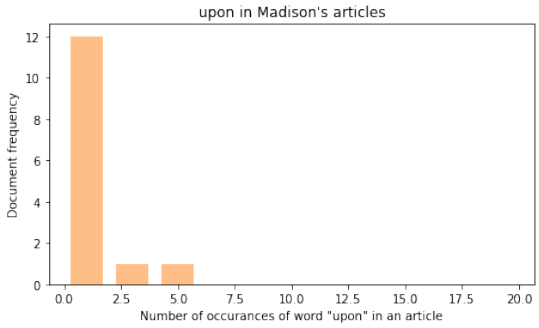


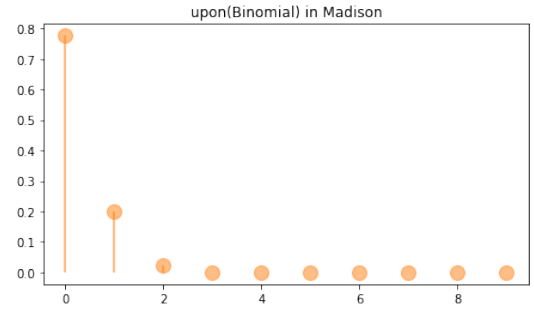


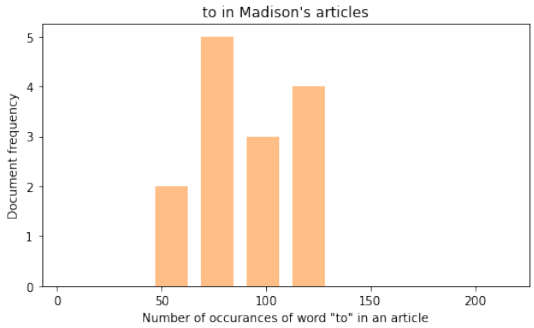
Binomial distribution for 3 words for Madison papers

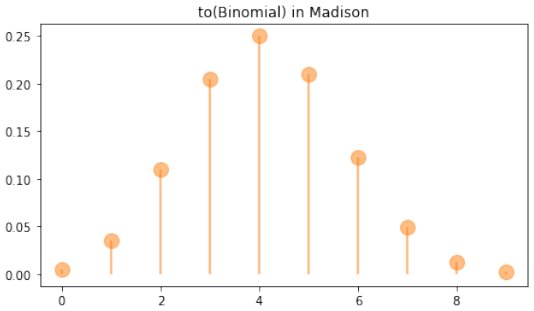
[51]:
```
for word in ['upon','to', 'would']:

    maxwordcount = df_known[word].max()
    plt.figure(figsize=(16,4))
    plt.subplot(1, 2, 1)
    plt.hist(df_known[df_known['AUTHOR'] == 'Madison'][word],
             rwidth=0.7,range=(0, maxwordcount), bins=10, color='tab:orange',␣
↪alpha=0.5)
    plt.title("{} in Madison's articles".format(word))
    plt.xlabel('Number of occurances of word "{}" in an article'.format(word))
    plt.ylabel('Document frequency')
    total = df[df['AUTHOR'] == 'Madison'][word].sum()
    mean = df[df['AUTHOR'] == 'Madison'][word].mean()
    p = mean/ maxwordcount
    plt.subplot(1, 2, 2)
    n = 10
    x = np.arange(0, 10)
    plt.plot(x, binom.pmf(x, n, p), 'bo', ms=12, label='binom pmf', color='tab:
↪orange', alpha=0.5)
```

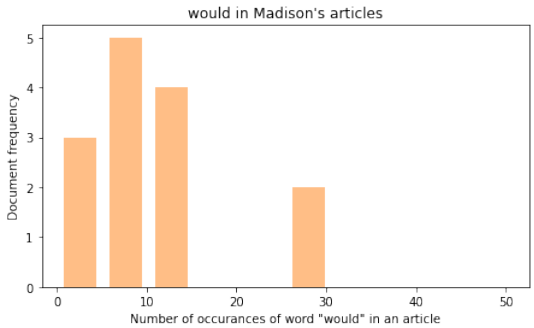
```
   plt.title(label= "{}(Binomial) in Madison's articles".format(word),␣
↪loc='center')
   plt.vlines(x, 0, binom.pmf(x, n, p), colors='b', lw=2, color='tab:orange',␣
↪alpha=0.5)

   plt.show()
```

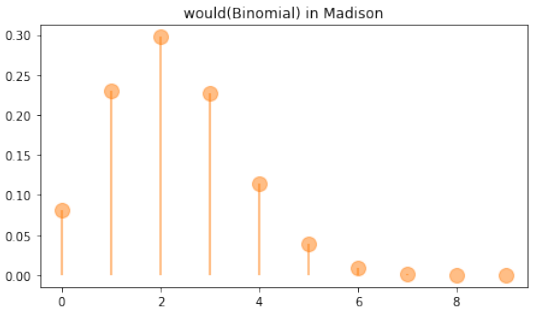












Q3. Represent with a histogram the article length. Does it make sense to view this distribution as a Gaussian?

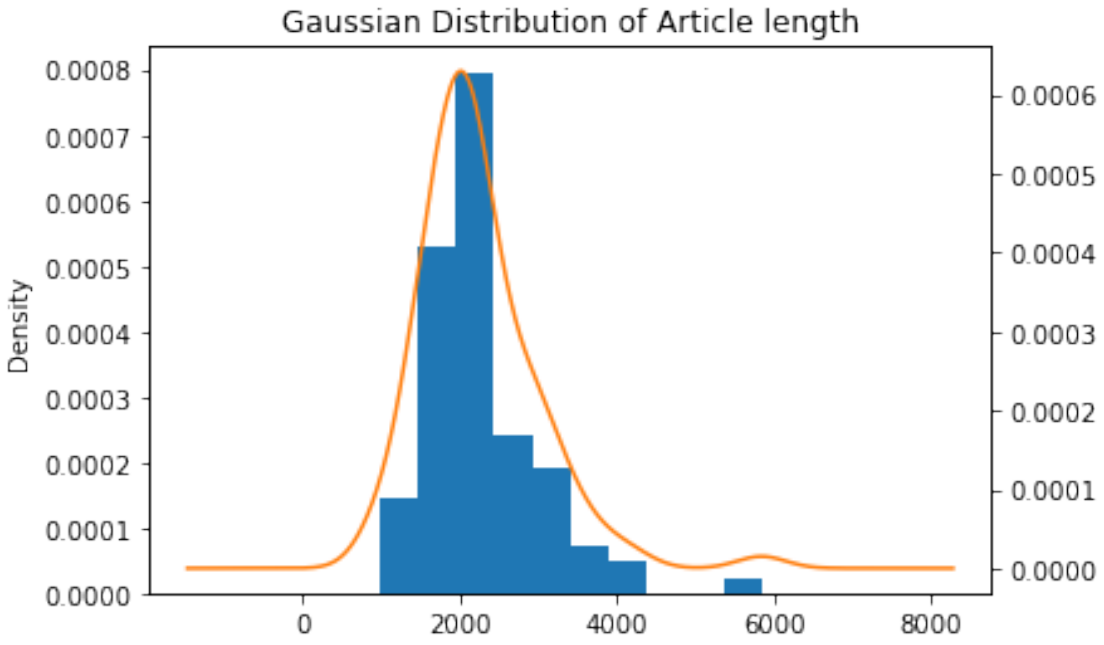
Ans. Yes, as below plotted graph we can view the artical length distribution as a Gaussian

Extracting only word columns as below

[53]:
```
print("Original Cols length         : {}".format(len(df.columns)))

all_word_cols = []
for col in df.columns:
    k= re.findall('[a-z]+', col,re.I)
    if k != []:
        all_word_cols.append(col)
print("Processed word tokens length : {}".format(len(all_word_cols)))
```

```
Original Cols length         : 11501
Processed word tokens length : 11275
```

[76]:
```
edited_rows = df[all_word_cols]
count_of_tokens = edited_rows.sum(axis=1)
count_of_tokens.plot(x= df, kind ='hist', density=True)
count_of_tokens.plot(kind='kde', secondary_y=True)
plt.title("Gaussian Distribution of Article length")
plt.show()
```



1.1 Problem 2: Processing the text

Loading sms_spam.csv file

[56]:
```
sms_text = pd.read_csv('corpus/sms_spam.csv', delimiter=",")
sms_text.head(5)
```

[56]:

	type	text
0	ham	Hope you are having a good week. Just checking in
1	ham	K..give back my thanks.
2	ham	Am also doing in cbe only. But have to pay.
3	spam	complimentary 4 STAR Ibiza Holiday or £10,000 …
4	spam	okmail: Dear Dave this is your final notice to…

1.1.1 Q1. Transform the text to lowercase

[58]:
```
sms_text_lower = sms_text.copy()
sms_text_lower['text'] = sms_text_lower['text'].str.lower()
print("Length of tokens in sms_text['text'] : {}".
 ↪format(len(sms_text_lower['text'])))
sms_text_lower.head(10)
```

```
Length of tokens in sms_text['text'] : 5559
```

[58]:

	type	text
0	ham	hope you are having a good week. just checking in
1	ham	k..give back my thanks.
2	ham	am also doing in cbe only. but have to pay.
3	spam	complimentary 4 star ibiza holiday or £10,000 …
4	spam	okmail: dear dave this is your final notice to…
5	ham	aiya we discuss later lar… pick u up at 4 is…
6	ham	are you this much buzy
7	ham	please ask mummy to call father
8	spam	marvel mobile play the official ultimate spide…
9	ham	fyi i'm at usf now, swing by the room whenever

1.1.2 Q2. Normalize the tokens (replace the English contraction by their equivalent such 'can't' -> 'can not')

[59]:
```
contractions = {
"ain't": "aim not",
"aren't": "are not",
"can't": "cannot",
"can't've": "cannot have",
"'cause": "because",
"could've": "could have",
"couldn't": "could not",
"couldn't've": "could not have",
```

```
"didn't": "did not",
"doesn't": "does not",
"don't": "do not",
"hadn't": "had not",
"hadn't've": "had not have",
"hasn't": "has not",
"haven't": "have not",
"he'd": "he had",
"he'd've": "he would have",
"he'll": "he will",
"he'll've": "he will have",
"he's": "he is",
"how'd": "how did",
"how'd'y": "how do you",
"how'll": "how will",
"how's": "how is",
"i'd": "I had",
"i'd've": "I would have",
"i'll": "I will",
"i'll've": "I will have",
"i'm": "I am",
"i've": "I have",
"isn't": "is not",
"it'd": "it would",
"it'd've": "it would have",
"it'll": "it will",
"it'll've": "it will have",
"it's": "it is",
"let's": "let us",
"ma'am": "madam",
"mayn't": "may not",
"might've": "might have",
"mightn't": "might not",
"mightn't've": "might not have",
"must've": "must have",
"mustn't": "must not",
"mustn't've": "must not have",
"needn't": "need not",
"needn't've": "need not have",
"o'clock": "of the clock",
"oughtn't": "ought not",
"oughtn't've": "ought not have",
"shan't": "shall not",
"sha'n't": "shall not",
"shan't've": "shall not have",
"she'd": "she would",
"she'd've": "she would have",
```

```
"she'll": "she will",
"she'll've": "she will have",
"she's": " she is",
"should've": "should have",
"shouldn't": "should not",
"shouldn't've": "should not have",
"so've": "so have",
"so's": "so as ",
"that'd": "that had",
"that'd've": "that would have",
"that's": "that is",
"there'd": "there would",
"there'd've": "there would have",
"there's": "there is",
"they'd": "they would",
"they'd've": "they would have",
"they'll": "they will",
"they'll've": "they will have",
"they're": "they are",
"they've": "they have",
"to've": "to have",
"wasn't": "was not",
"we'd": " we would",
"we'd've": "we would have",
"we'll": "we will",
"we'll've": "we will have",
"we're": "we are",
"we've": "we have",
"weren't": "were not",
"what'll": "what will",
"what'll've": "what will have",
"what're": "what are",
"what's": "what is",
"what've": "what have",
"when's": "when is",
"when've": "when have",
"where'd": "where did",
"where's": "where is",
"where've": "where have",
"who'll": "who will",
"who'll've": "who will have",
"who's": " who is",
"who've": "who have",
"why's": " why is",
"why've": "why have",
"will've": "will have",
"won't": "will not",
```

```
"won't've": "will not have",
"would've": "would have",
"wouldn't": "would not",
"wouldn't've": "would not have",
"y'all": "you all",
"y'all'd": "you all would",
"y'all'd've": "you all would have",
"y'all're": "you all are",
"y'all've": "you all have",
"you'd": "you had",
"you'd've": "you would have",
"you'll": "you will",
"you'll've": "you will have",
"you're": "you are",
"you've": "you have"
}

sms_text_lower_updated = sms_text_lower.copy()

contractions_array = []
for i, line in enumerate(sms_text_lower['text']):
    tokens_without_contractions = [contractions.get(word, word) for word in␣
 ↪line.split(" ")]
    sms_text_lower_updated['text'][i] = (" ").join(tokens_without_contractions)

sms_text_lower_updated.head(20)
```

[59]:

	type	text
0	ham	hope you are having a good week. just checking in
1	ham	k..give back my thanks.
2	ham	am also doing in cbe only. but have to pay.
3	spam	complimentary 4 star ibiza holiday or £10,000 …
4	spam	okmail: dear dave this is your final notice to…
5	ham	aiya we discuss later lar… pick u up at 4 is…
6	ham	are you this much buzy
7	ham	please ask mummy to call father
8	spam	marvel mobile play the official ultimate spide…
9	ham	fyi I am at usf now, swing by the room whenever
10	ham	sure thing big man. i have hockey elections at…
11	ham	i anything lor…
12	ham	by march ending, i should be ready. but will c…
13	ham	hmm well, night night
14	ham	k I will be sure to get up before noon and see…
15	ham	ha ha cool cool chikku chikku:-):-db-)
16	ham	darren was saying dat if u meeting da ge den w…
17	ham	he dint tell anything. he is angry on me that …
18	ham	up to u… u wan come then come lor… but i d…

```
19   spam   u can win £100 of music gift vouchers every we…
```

1.1.3 Q3. Be able to read a list of stopwords and to remove them when they appear in the text (two such lists are given in the folder 'Corpus').

First, we remove special characters from a file

[63]:
```
stop_words_1 = np.loadtxt('corpus/stopwords.txt', dtype='str')
sms_text_only_word_tokens = sms_text_lower_updated.copy()

for i,s in enumerate(sms_text_lower_updated['text']):
    only_word_tokens = re.findall("[a-z]+", s,re.I)
    sms_text_only_word_tokens['text'][i] =  (" ").join(only_word_tokens)

sms_text_only_word_tokens.head(10)
```

[63]:

	type	text
0	ham	hope you are having a good week just checking in
1	ham	k give back my thanks
2	ham	am also doing in cbe only but have to pay
3	spam	complimentary star ibiza holiday or cash needs…
4	spam	okmail dear dave this is your final notice to …
5	ham	aiya we discuss later lar pick u up at is it
6	ham	are you this much buzy
7	ham	please ask mummy to call father
8	spam	marvel mobile play the official ultimate spide…
9	ham	fyi I am at usf now swing by the room whenever

Removing stop words from first stopword file

[64]:
```
# Removing stop words from 2 files
sms_remove_stop_words = sms_text_only_word_tokens.copy()

for index,sms in enumerate(sms_text_only_word_tokens['text']):
    token_without_sw = [word for word in sms.split(" ") if not word in␣
 ↪stop_words_1]
    sms_remove_stop_words['text'][index] = (" ").join(token_without_sw)


sms_remove_stop_words.head(10)
```

[64]:

	type	text
0	ham	hope good week checking
1	ham	k give back thanks
2	ham	also cbe pay
3	spam	complimentary star ibiza holiday cash needs ur…

```
4  spam  okmail dear dave final notice collect tenerife…
5   ham                      aiya discuss later lar pick u
6   ham                                          much buzy
7   ham                       please ask mummy call father
8  spam  marvel mobile play official ultimate spider ma…
9   ham                      fyi I usf swing room whenever
```

Removing stop words from second stopword file

[65]:
```
stop_words_2 = np.loadtxt('corpus/StopwordSMART.txt', dtype='str')
sms_remove_stop_words_2 = sms_remove_stop_words.copy()

for index,sms in enumerate(sms_remove_stop_words['text']):
    token_without_sw = [word for word in sms.split(" ") if not word in␣
 ↪stop_words_2]
    sms_remove_stop_words_2['text'][index] = (" ").join(token_without_sw)

sms_remove_stop_words_2.head(10)
```

[65]:

	type	text
0	ham	hope good week checking
1	ham	give back
2	ham	cbe pay
3	spam	complimentary star ibiza holiday cash urgent c…
4	spam	okmail dear dave final notice collect tenerife…
5	ham	aiya discuss lar pick
6	ham	buzy
7	ham	mummy call father
8	spam	marvel mobile play official ultimate spider ma…
9	ham	fyi I usf swing room

1.1.4 Q4. Apply your preprocessing to both the spam and ham SMSs. Return the top 20 most frequent word-types for both categories

[66]:
```
ham_tokens = sms_remove_stop_words_2.loc[sms_remove_stop_words_2['type'] ==␣
 ↪'ham']
print("Total hams: ",len(ham_tokens))
spam_tokens = sms_remove_stop_words_2.loc[sms_remove_stop_words_2['type'] ==␣
 ↪'spam']
print("Total Spams:",len(spam_tokens))
```

```
Total hams:  4812
Total Spams: 747
```

Top 20 most frequent word-types for "ham" categories

[73]:
```
words_all = []

for i, words in enumerate(ham_tokens['text']):
    total_words = words.split(" ")
    for w in total_words:
        words_all.append(w)

words_dict = Counter(words_all)
dict_sorted = {k: v for k, v in sorted(words_dict.items(), key=lambda item:␣
 ↪item[1], reverse=True)}
print("Top 20 word types in Ham: {} ".format(list(dict_sorted.keys())[:20]))
```

```
Top 20 word types in Ham: ['I', 'ur', 'call', 'good', 'day', 'love', 'time',
'home', 'lor', 'da', 'today', 'dont', 'back', 'send', 'pls', 'night', 'hope',
'dear', 'hey', 'happy']
```

Top 20 most frequent word-types for "Spam" categories

[74]:
```
# 20 most frequent word-types for "spam" categories
words_all_spam = []

for i, words_spam in enumerate(spam_tokens['text']):
    total_words = words_spam.split(" ")
    for w in total_words:
        words_all_spam.append(w)

words_dict = Counter(words_all_spam)
dict_sorted = {k: v for k, v in sorted(words_dict.items(), key=lambda item:␣
 ↪item[1], reverse=True)}
print("Top 20 word types in Spam: {} ".format(list(dict_sorted.keys())[:20]))
```

```
Top 20 word types in Spam: ['call', 'free', 'txt', 'ur', 'mobile', 'stop',
'text', 'claim', 'reply', 'www', 'prize', 'cash', 'uk', 'win', 'send', 'nokia',
'urgent', 'box', 'week', 'tone']
```