Exercise -2

Import necessary packages

In [1]:

```
import nltk
nltk.download('punkt') # for sent_tokenize
nltk.download('stopwords')
nltk.download('wordnet') # for WordNetLemmatizer
```

```
[nltk_data] Downloading package punkt to
[nltk_data]     /Users/anitateladevalapalli/nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package stopwords to
[nltk_data]     /Users/anitateladevalapalli/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package wordnet to
[nltk_data]     /Users/anitateladevalapalli/nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
```

Out[1]:

```
True
```

In [2]:

```
# Setting random seed
seed = 123
# Data manipulation/analysis
import numpy as np
import pandas as pd
# Data partitioning
from sklearn.model_selection import train_test_split
# Text preprocessing/analysis
import re
from nltk import word_tokenize, sent_tokenize, FreqDist
from nltk.util import ngrams
from nltk.corpus import stopwords
from nltk.stem import WordNetLemmatizer
from nltk.tokenize import RegexpTokenizer
# Visualisation
import matplotlib.pyplot as plt
import seaborn as sns
sns.set(style="whitegrid", context='talk',
        palette=['#D44D5C', '#43AA8B'])
```

Downloaded the weather sentiment data from the Github link provided

https://data.world/crowdflower/weather-sentiment

In [3]:

```
sample= pd.read_csv('/Users/anitateladevalapalli/Downloads/weather.csv')
sample.head()
```

Out[3]:

	_unit_id	_canary	_unit_state	_trusted_judgments	_last_judgment_at	what_emotion_does_the_author
0	314960380	NaN	finalized	20	8/24/13 0:21	

	_unit_id	_canary	_unit_state	_trusted_judgments	_last_judgment_at	what_emotion_does_the_author
1	314960381	NaN	finalized	20	8/24/13 0:49	
2	314960382	NaN	finalized	20	8/24/13 0:55	
3	314960383	NaN	finalized	20	8/24/13 0:48	
4	314960384	NaN	finalized	20	8/24/13 1:19	

In [4]:

```
sample['emotion']=sample['what_emotion_does_the_author_express_specifically_about_the_weat
```

In [5]:

```
sample.drop(['what_emotion_does_the_author_express_specifically_about_the_weather'],axis=1
```

Out[5]:

	_unit_id	_canary	_unit_state	_trusted_judgments	_last_judgment_at	what_emotion_does_the_auth
0	314960380	NaN	finalized	20	8/24/13 0:21	
1	314960381	NaN	finalized	20	8/24/13 0:49	
2	314960382	NaN	finalized	20	8/24/13 0:55	
3	314960383	NaN	finalized	20	8/24/13 0:48	
4	314960384	NaN	finalized	20	8/24/13 1:19	

	_unit_id	_canary	_unit_state	_trusted_judgments	_last_judgment_at	what_emotion_does_the_auth
...	...	...	...	...	...	
995	314961375	NaN	finalized	20	8/24/13 0:50	
996	314961376	NaN	finalized	20	8/24/13 0:36	
997	314961377	NaN	finalized	20	8/24/13 0:16	
998	314961378	NaN	finalized	20	8/24/13 0:38	
999	314961379	NaN	finalized	20	8/24/13 0:30	

1000 rows × 10 columns

In [6]:

```
sample['emotion'].value_counts()
```

Out[6]:

```
Negative                                    271
Neutral / author is just sharing information    261
Tweet not related to weather condition      235
Positive                                    231
I can't tell                                  2
Name: emotion, dtype: int64
```

In [7]:

```
values = ["Neutral / author is just sharing information","Tweet not related to weather con
sample = sample[sample.emotion.isin(values) == False]
sample.head()
```

Out[7]:

	_unit_id	_canary	_unit_state	_trusted_judgments	_last_judgment_at	what_emotion_does_the_author
0	314960380	NaN	finalized	20	8/24/13 0:21	

	_unit_id	_canary	_unit_state	_trusted_judgments	_last_judgment_at	what_emotion_does_the_author
1	314960381	NaN	finalized	20	8/24/13 0:49	
3	314960383	NaN	finalized	20	8/24/13 0:48	
5	314960385	NaN	finalized	20	8/24/13 0:27	
7	314960387	NaN	finalized	20	8/24/13 0:40	

In [8]:

```
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()
```

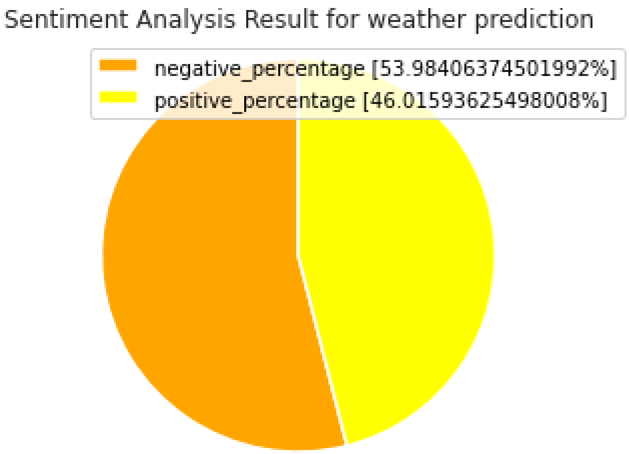
In [9]:

```
sample['em']= le.fit_transform(sample['emotion'])
percentages=sample.em.value_counts()*100/len(sample)
percentages[2]=100-(percentages[0]+percentages[1])
```

plotting the percentage of negative and positive tweets

In [10]:

```
labels = ['negative_percentage ['+str(percentages[0])+'%]','positive_percentage ['+str(pe
colors = ['orange', 'yellow','yellowgreen']
sizes= [percentages[0],percentages[1]]
patches, texts = plt.pie(sizes,colors=colors, startangle=90)
plt.style.use('default')
plt.legend(labels)
plt.title("Sentiment Analysis Result for weather prediction")
plt.axis('equal')
plt.show()
```



In [11]:

```
X_train, X_test, y_train, y_test = train_test_split(sample['tweet_text'], sample['emotion'
                                                     stratify=sample['emotion'])
# Append sentiment back using indices
train = pd.concat([X_train, y_train], axis=1)
test = pd.concat([X_test, y_test], axis=1)
```

In [12]:

```
print(f"Train: {train.shape[0]} rows and {train.shape[1]} columns")
print(f"{train['emotion'].value_counts()}\n")
print(f"Test: {test.shape[0]} rows and {test.shape[1]} columns")
print(test['emotion'].value_counts())
```

```
Train: 401 rows and 2 columns
Negative    216
Positive    185
Name: emotion, dtype: int64

Test: 101 rows and 2 columns
Negative    55
Positive    46
Name: emotion, dtype: int64
```

In [13]:

```
train.head()
```

Out[13]:

	tweet_text	emotion
432	cold in here cold outside	Negative
390	What a tease yesterday's nice weather was. .	Positive
928	@mention and a #happymonday 2 u too sweets. Im...	Negative
156	Just a heads up to everyone, weather is crazy ...	Negative
295	@mention loving this awesome Iowa weather!! s...	Positive

In [14]:

```
train_string = " ".join(X_train.values)
print(f"***** Extract of train_string ***** \n{train_string[:101]}", "\n")
# Split train_corpus by white space
splits = train_string.split()
print(f"***** Extract of splits ***** \n{splits[:18]}\n")
```

```
***** Extract of train_string *****
cold in here cold outside What a tease yesterday's nice weather was. . @mention and a #hap
pymonday 2

***** Extract of splits *****
['cold', 'in', 'here', 'cold', 'outside', 'What', 'a', 'tease', "yesterday's", 'nice', 'we
ather', 'was.', '.', '@mention', 'and', 'a', '#happymonday', '2']
```

In [15]:

```
print(f"Number of strings: {len(splits)}")
print(f"Number of unique strings: {len(set(splits))}")
```

```
Number of strings: 5708
Number of unique strings: 2255
```

10 most common strings

In [16]:

```
freq_splits = FreqDist(splits)
print(f"***** 10 most common strings ***** \n{freq_splits.most_common(10)}", "\n")
```

```
***** 10 most common strings *****
[('the', 191), ('weather', 128), ('to', 113), ('I', 112), ('@mention', 109), ('in', 97),
('a', 90), ('is', 86), ('and', 83), ('this', 59)]
```

In [17]:

```python
short = set(s for s in splits if len(s)<4)
short = [(s, freq_splits[s]) for s in short]
short.sort(key=lambda x:x[1], reverse=True)
short
```

Out[17]:

```
[('the', 191),
 ('to', 113),
 ('I', 112),
 ('in', 97),
 ('a', 90),
 ('is', 86),
 ('and', 83),
 ('for', 53),
 ('on', 46),
 ('be', 43),
 ('out', 42),
 ('RT', 41),
 ('of', 39),
 ('my', 39),
 ('it', 38),
 ('hot', 34),
 ('so', 33),
 ('at', 32),
 ('The', 28),
 ('you', 24),
 ('me', 24),
 ('was', 23),
 ('all', 21),
 ('its', 21),
 ('day', 18),
 ('not', 18),
 ('but', 17),
 ('are', 15),
 (':)', 15),
 ('go', 15),
 ('Its', 13),
 ('&', 13),
 ('as', 13),
 ('has', 13),
 ('up', 12),
 ('too', 12),
 ("I'm", 11),
 ('-', 11),
 ('2', 10),
 ('we', 9),
 ('It', 8),
 ('get', 8),
 ('lol', 8),
 ('am', 8),
 ('can', 7),
 ('got', 7),
 ('...', 7),
 ('In', 7),
 ('or', 7),
 ('no', 7),
 ('80', 7),
 ('an', 7),
 ('bad', 7),
 ('by', 7),
 ('way', 6),
 ('So', 6),
 ('!', 6),
 ('u', 6),
 (':(', 6),
 ('now', 5),
 ('A', 5),
 ('n', 5),
 ('For', 5),
 ('how', 5),
 ('(@', 5),
 ('say', 5),
 ('new', 5),
 ('My', 5),
 ('.', 5),
 ('up!', 5),
 ('off', 5),
 ('We', 5),
 ('do', 5),
 ('May', 4),
 ('see', 4),
 ('If', 4),
 ('You', 4),
 ('Day', 4),
 ('Im', 4),
 ('sun', 4),
 ('6', 4),
 ('i', 4),
 ('had', 4),
 ('why', 4),
 ('our', 4),
 ('car', 4),
 ('And', 4),
 ('60', 3),
 ('On', 3),
 ('But', 3),
 ('4', 3),
 ('#fb', 3),
 ('Is', 3),
 (',', 3),
 ('Lol', 3),
 ('3', 3),
 ('da', 3),
 (':D', 3),
 ('tha', 3),
 ('Omg', 3),
 ('im', 3),
 ('if', 3),
 ('Not', 3),
 ('Bad', 3),
 ('soo', 3),
 ('Me', 3),
 ('us', 3),
 ('in.', 3),
 ('cuz', 2),
 ('up.', 2),
 ('she', 2),
 ('ass', 2),
 ('dog', 2),
 ('dis', 2),
 ('90', 2),
 ('on.', 2),
 ('Oh', 2),
 ('NOT', 2),
 ('70', 2),
 ('one', 2),
 ('jus', 2),
 (':/', 2),
 ('Man', 2),
 ('hit', 2),
 ('New', 2),
 ('90s', 2),
 ('Hi', 2),
 ('who', 2),
 ('fun', 2),
 ('w/', 2),
 ("i'm", 2),
 ('Now', 2),
 ('No', 2),
 (':', 2),
 ('via', 2),
 ('At', 2),
 ('ask', 2),
 ('old', 2),
 ('bed', 2),
 ('any', 2),
 ('81', 2),
 ('bit', 2),
 ('@', 2),
 ('air', 2),
 ('idk', 2),
 ('Do', 2),
 ('(:', 2),
 ('Had', 2),
 ('wit', 2),
 ('big', 1),
 ('c:', 1),
 ('Our', 1),
 ('5', 1),
 ('bus', 1),
 ('eat', 1),
 ('Wow', 1),
 ('oil', 1),
 ('DC!', 1),
 ('gas', 1),
 ('66', 1),
 ('oh', 1),
 ('NYC', 1),
 ('yea', 1),
 ('red', 1),
 ('ME', 1),
 ('TO', 1),
 ('t', 1),
 ('Hot', 1),
 ('-5', 1),
 ('As', 1),
 (':I', 1),
 ('end', 1),
 ('tee', 1),
 ('abt', 1),
 ('a/c', 1),
 ("'BU", 1),
 ('far', 1),
 ('ill', 1),
 ('en', 1),
 ('Ok', 1),
 ('IN', 1),
 ('rum', 1),
 ('plz', 1),
 ('nd', 1),
 ('TPC', 1),
 ('add', 1),
 (';)', 1),
 ('OK!', 1),
 ('BET', 1),
 ('x', 1),
 ('put', 1),
 ('WIN', 1),
 ('let', 1),
 ('Bar', 1),
 ('Umm', 1),
 ('lls', 1),
 ('Idk', 1),
 ('ALL', 1),
 ('75', 1),
 ('WI.', 1),
 ('san', 1),
 ('KC.', 1),
 ('bay', 1),
 ('Da', 1),
 ('9', 1),
 ('l8r', 1),
 ('yu', 1),
 ('N', 1),
 (';p', 1),
 ('kno', 1),
 ('PHX', 1),
 ('hey', 1),
 ('yaw', 1),
 ('I.', 1),
 ('Los', 1),
 ('Yac', 1),
 ('MO.', 1),
 (':))', 1),
 (':-)', 1),
 ('Viv', 1),
 ('it!', 1),
 ('war', 1),
 ('nvr', 1),
 ('fl', 1),
 ('d', 1),
 ('Key', 1),
 ('Jus', 1),
 ('FL', 1),
 ('God', 1),
 ('dem', 1),
 ('91', 1),
 ('Y', 1),
 ('Ran', 1),
 ('sky', 1),
 ('WHY', 1),
 ('Ch', 1),
 ('dnt', 1),
 ('sit', 1),
 ('35', 1),
 ('Eat', 1),
 ('oy,', 1),
 ('cum', 1),
 ('8', 1),
 ('wld', 1),
 ('MA', 1),
 ('s', 1),
 ('50', 1),
 ('in,', 1),
 ('~', 1),
 ('may', 1),
 ('Air', 1),
 ('60s', 1),
 ('lay', 1),
 ('man', 1),
 ('s/o', 1),
 ('on!', 1),
 ('RT:', 1),
 ('Om', 1),
 ('TV', 1),
 ('+', 1),
 ('THE', 1),
 ('LOL', 1),
 ('imm', 1),
 ('HOT', 1),
 ('eww', 1),
 ('):', 1),
 ('pub', 1),
 ('w/o', 1),
 ('OFF', 1),
 ('try', 1),
 ('it.', 1),
 ('OK,', 1),
 ('smh', 1),
 ('art', 1),
 ('Of', 1),
 ('Got', 1),
 ('blk', 1),
 ('0', 1),
 ('81%', 1),
 ('?', 1),
 ('omg', 1),
 (':p', 1),
 ('AP', 1),
 ('AZ', 1),
 ("'s", 1),
 ('me!', 1),
 ('yay', 1),
 ('o_O', 1),
 ('due', 1),
 ('AM!', 1),
 ('OUR', 1),
 ('in!', 1),
 ('=', 1),
 ('1', 1),
 ('gym', 1),
 (':-(', 1),
 ('Let', 1),
 ('62', 1),
 (':0)', 1),
 ('sad', 1),
 ('VA', 1),
 ('row', 1),
 (':S', 1),
 ('BRB', 1),
 ('de', 1),
 ('AC', 1),
 ('h', 1),
 ('YW!', 1),
 ('ER', 1),
 ('rec', 1),
 ('zoo', 1),
 ('BE', 1),
 ('per', 1),
 ('cup', 1),
 ('bot', 1),
 ('cld', 1),
 ('#Wx', 1),
 ('WE', 1),
 ('56', 1),
 ('TV.', 1),
 ('six', 1),
 ('EF4', 1),
 ('his', 1),
 ('O.o', 1),
 ('61', 1),
 ('Meg', 1),
 ('Smh', 1),
 ('be!', 1),
 ('FL!', 1),
 ('Cap', 1),
 ('240', 1),
 ('duh', 1),
 ('wet', 1),
 ('MU', 1),
 ('DC:', 1),
 ('he', 1),
 ('San', 1),
 ('=O', 1),
 ('st', 1),
 ('guy', 1),
 ('HQ.', 1),
 ('AND', 1),
 ('af', 1),
 ('Thx', 1),
 ("I'd", 1),
 ('..', 1),
 ('Did', 1),
 ('TC:', 1),
 ('^_^', 1),
 ('nyc', 1),
 ('10', 1),
 ('me.', 1),
 ('!!', 1),
 ('dam', 1),
 ('_', 1),
 ('WI', 1),
 ('Um', 1),
 ('82', 1),
 ('IT', 1),
 ('Mad', 1),
 ('BUT', 1),
 ('xx', 1),
 ('ATL', 1),
 ('ya', 1),
 ('aye', 1),
 ('SG.', 1),
 ('Ahh', 1),
 ('100', 1),
 ('3rd', 1),
 ('$18', 1),
 ('jog', 1),
 ('her', 1),
 ('31', 1),
 ('65', 1),
 (':((', 1),
 ('Be', 1),
 ('Up', 1),
 ('7lb', 1),
 ('y', 1),
 ('D;', 1),
 ('Why', 1),
 ('78', 1),
 ('70.', 1),
 ('by:', 1),
 ('K9.', 1)]
```

In [18]:

```
long = set(s for s in splits if len(s)>15)
long = [(s, freq_splits[s]) for s in long]
long.sort(key=lambda x:x[1], reverse=True)
long
```

Out[18]:

```
[('mirrors/monitor/television,', 1),
 ('#fuckyeahsummer!!', 1),
 ('Cuddling...alone', 1),
 ('Thunderstorm....wait,', 1),
 ('morning.....bring', 1),
 ('weather&beautiful', 1),
 ('#weathermanhasagreenthumb', 1),
 ('#yeahiamthattype', 1),
 ('#Ithoughtitwassummer', 1),
 ('Foothills/Shendoah', 1),
 ('#popularnameregardlessofparticipation', 1)]
```

Summarise strings matching a pattern.

In [19]:

```
def summarise(pattern, strings, freq):

    # Find matches
    compiled_pattern = re.compile(pattern)
    matches = [s for s in strings if compiled_pattern.search(s)]

    # Print volume and proportion of matches
    print("{} strings, that is {:.2%} of total".format(len(matches), len(matches)/ len(str

    # Create list of tuples containing matches and their frequency
    output = [(s, freq[s]) for s in set(matches)]
    output.sort(key=lambda x:x[1], reverse=True)

    return output
# Find strings possibly containing html tag
summarise(r"/?>?w*<|/>", splits, freq_splits)
```

```
0 strings, that is 0.00% of total
```

Out[19]:

```
[]
```

In [20]:

```
summarise(r"\d", splits, freq_splits)
```

```
87 strings, that is 1.52% of total
```

Out[20]:

```
[('2', 10),
 ('80', 7),
 ('6', 4),
 ('3', 3),
 ('60', 3),
 ('4', 3),
 ('90', 2),
 ('70', 2),
 ('90s', 2),
 ('81', 2),
 ('240', 1),
 (':0)', 1),
 ('$18', 1),
 ('6.69', 1),
 ('75', 1),
 ('1065', 1),
 ('91', 1),
 ('hell+2', 1),
 ('6:30!', 1),
 ('56', 1),
 ('31', 1),
 ('65', 1),
 ('5', 1),
 ('4-7.', 1),
 ('#11in11', 1),
 ('&lt;3', 1),
 ('82', 1),
 ('(#16).', 1),
 ('EF4', 1),
 ('8:30', 1),
 ('0', 1),
 ('9', 1),
 ('l8r', 1),
 ('35', 1),
 ('2day', 1),
 ('every1', 1),
 ('1', 1),
 ('2012', 1),
 ('7-Eleven)', 1),
 ('60s', 1),
 ('81%', 1),
 ('8', 1),
 ('oh...8', 1),
 ('-5', 1),
 ('#summer2011', 1),
 ('7lb', 1),
 ('10', 1),
 ('61', 1),
 ('100', 1),
 ('3rd', 1),
 ('62', 1),
 ('78', 1),
 ('66', 1),
 ('70.', 1),
 ('5:15', 1),
 ('8am!', 1),
 ('50', 1),
 ('K9.', 1),
 ('Mexico..85', 1)]
```

In [21]:

```
summarise(r"\w+-+\w+", splits, freq_splits)
```

```
15 strings, that is 0.26% of total
```

Out[21]:

```
[('Forks-ish', 1),
 ('Sox-Rangers', 1),
 ('Chi-town.', 1),
 ('4-7.', 1),
 ('DePaul-Indiana', 1),
 ('tweet-ability', 1),
 ('7-Eleven)', 1),
 ('great-except', 1),
 ('flu-ish', 1),
 ('Storm-Downed', 1),
 ('bi-polar', 1),
 ('High-Atis', 1),
 ('b-roll', 1),
 ('Bi-polar!', 1),
 ('semi-perf', 1)]
```

In [22]:

```
summarise(r"\w+[_!&/)(<\|}{\[\]]\w+", splits, freq_splits)
```

```
11 strings, that is 0.19% of total
```

Out[22]:

```
[('SHEESH&lt;&lt;', 1),
 ('mirrors/monitor/television,', 1),
 ('weather&beautiful', 1),
 ('w/hubby', 1),
 ('o_O', 1),
 ('a/c', 1),
 ('pic&gt;', 1),
 ('Foothills/Shendoah', 1),
 ('w/o', 1),
 ('s/o', 1),
 ("too!i'm", 1)]
```

Find words that contain a same character 3+ times in a row.

In [23]:

```python
def find_outlaw(word):

    is_outlaw = False
    for i, letter in enumerate(word):
        if i > 1:
            if word[i] == word[i-1] == word[i-2] and word[i].isalpha():
                is_outlaw = True
                break
    return is_outlaw
outlaws = [s for s in splits if find_outlaw(s)]
print("{} strings, that is {:.2%} of total".format(len(outlaws), len(outlaws)/ len(splits)
outlaw_freq = [(s, freq_splits[s]) for s in set(outlaws)]
outlaw_freq.sort(key=lambda x:x[1], reverse=True)
outlaw_freq
```

Out[23]:

```
21 strings, that is 0.37% of total
[('sooooo', 2),
 ('sooo', 2),
 ('Uqhhh', 1),
 ('awwww', 1),
 ('DOOOOOM.', 1),
 ('Stooooopppp.', 1),
 ('Mmmmmm', 1),
 ('Andddd', 1),
 ('Helloooo,', 1),
 ('Ughhhhhh', 1),
 ('Mmmm', 1),
 ('Insaneeee', 1),
 ('efferrr', 1),
 ('shhhh,', 1),
 ('Ahhh', 1),
 ('biiiiiiiiiitch!', 1),
 ('wowww', 1),
 ('freezzzinnggg!', 1),
 ('ittt', 1)]
```

In [24]:

```python
tokeniser = RegexpTokenizer("[A-Za-z]+")
tokens = tokeniser.tokenize(train_string)
print(tokens[:20], "\n")
```

```
['cold', 'in', 'here', 'cold', 'outside', 'What', 'a', 'tease', 'yesterday', 's', 'nice',
'weather', 'was', 'mention', 'and', 'a', 'happymonday', 'u', 'too', 'sweets']
```

In [25]:

```python
print(f"Number of tokens: {len(tokens)}")
print(f"Number of unique tokens: {len(set(tokens))}")
```

```
Number of tokens: 5764
Number of unique tokens: 1801
```

In [26]:

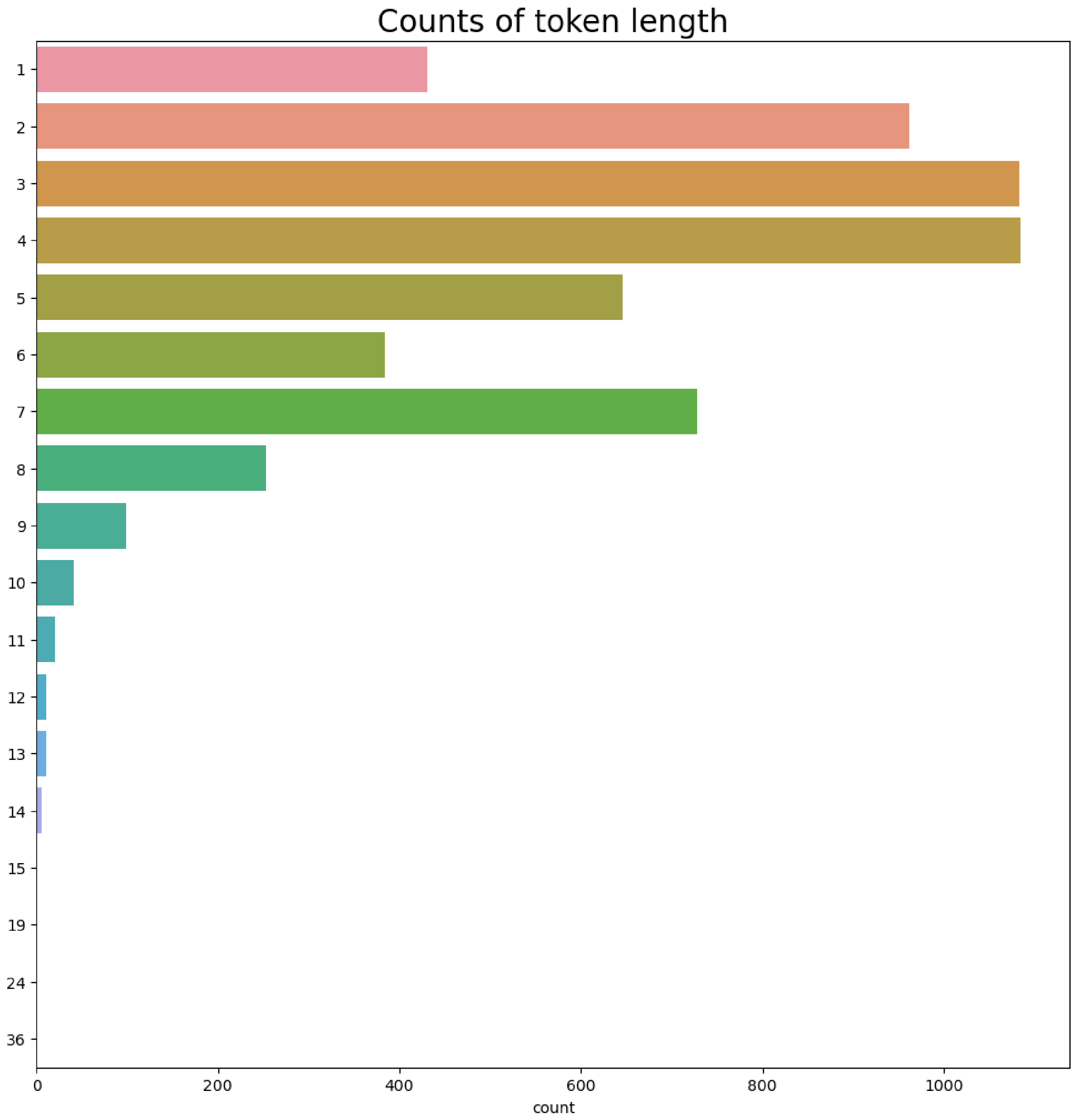
```
lemmatiser = WordNetLemmatizer()
tokens_norm = [lemmatiser.lemmatize(t.lower(), "v") for t in tokens]
print(f"Number of unique tokens: {len(set(tokens_norm))}")
```

```
Number of unique tokens: 1390
```

In [27]:

```
token_length = [len(t) for t in tokens]
# Average number of characters per token
print(f"Average number of characters per token: {round(np.mean(token_length),4)}")
# Plot distribution
plt.figure(figsize=(12, 12))
sns.countplot(y=token_length)
plt.title("Counts of token length", size=20);
```

```
Average number of characters per token: 4.2615
```



In [28]:

```
pd.DataFrame(data=token_length, columns=['length']).query("length>10").value_counts()
```

Out[28]:

```
length
11        20
13        11
12        10
14         6
15         1
19         1
24         1
36         1
dtype: int64
```

In [29]:

```python
[t for t in tokens if len(t)>=20]
```

Out[29]:

```
['weathermanhasagreenthumb', 'popularnameregardlessofparticipation']
```

In [30]:

```python
stop_words = stopwords.words("english")
print(f"There are {len(stop_words)} stopwords.\n")
print(stop_words)
```

```
There are 179 stopwords.

['i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves', 'you', "you're", "you've",
"you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves', 'he', 'him', 'his', 'himsel
f', 'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its', 'itself', 'they', 'the
m', 'their', 'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'that', "tha
t'll", 'these', 'those', 'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'have',
'has', 'had', 'having', 'do', 'does', 'did', 'doing', 'a', 'an', 'the', 'and', 'but', 'i
f', 'or', 'because', 'as', 'until', 'while', 'of', 'at', 'by', 'for', 'with', 'about', 'ag
ainst', 'between', 'into', 'through', 'during', 'before', 'after', 'above', 'below', 'to',
'from', 'up', 'down', 'in', 'out', 'on', 'off', 'over', 'under', 'again', 'further', 'the
n', 'once', 'here', 'there', 'when', 'where', 'why', 'how', 'all', 'any', 'both', 'each',
'few', 'more', 'most', 'other', 'some', 'such', 'no', 'nor', 'not', 'only', 'own', 'same',
'so', 'than', 'too', 'very', 's', 't', 'can', 'will', 'just', 'don', "don't", 'should', "s
hould've", 'now', 'd', 'll', 'm', 'o', 're', 've', 'y', 'ain', 'aren', "aren't", 'couldn',
"couldn't", 'didn', "didn't", 'doesn', "doesn't", 'hadn', "hadn't", 'hasn', "hasn't", 'hav
en', "haven't", 'isn', "isn't", 'ma', 'mightn', "mightn't", 'mustn', "mustn't", 'needn',
"needn't", 'shan', "shan't", 'shouldn', "shouldn't", 'wasn', "wasn't", 'weren', "weren't",
'won', "won't", 'wouldn', "wouldn't"]
```

In [31]:

```python
stop_words.extend(["cannot", "could", "done", "let", "may" "mayn",  "might", "must", "need
print(f"There are {len(stop_words)} stopwords.\n")
```

```
There are 192 stopwords.
```

In [32]:

```python
freq_stopwords = [(sw, tokens_norm.count(sw)) for sw in stop_words]
freq_stopwords.sort(key=lambda x: x[1], reverse=True)
freq_stopwords[:10]
```

Out[32]:

```
[('the', 224),
 ('be', 211),
 ('i', 143),
 ('to', 114),
 ('in', 111),
 ('a', 100),
 ('it', 98),
 ('and', 88),
 ('s', 87),
 ('this', 76)]
```

In [33]:

```python
n_stopwords = len([t for t in tokens_norm if t in stop_words])
```

```
print(f"{n_stopwords} tokens are stop words.")
print(f"That is {round(100*n_stopwords/len(tokens_norm),2)}%.")
```

```
2425 tokens are stop words.
That is 42.07%.
```

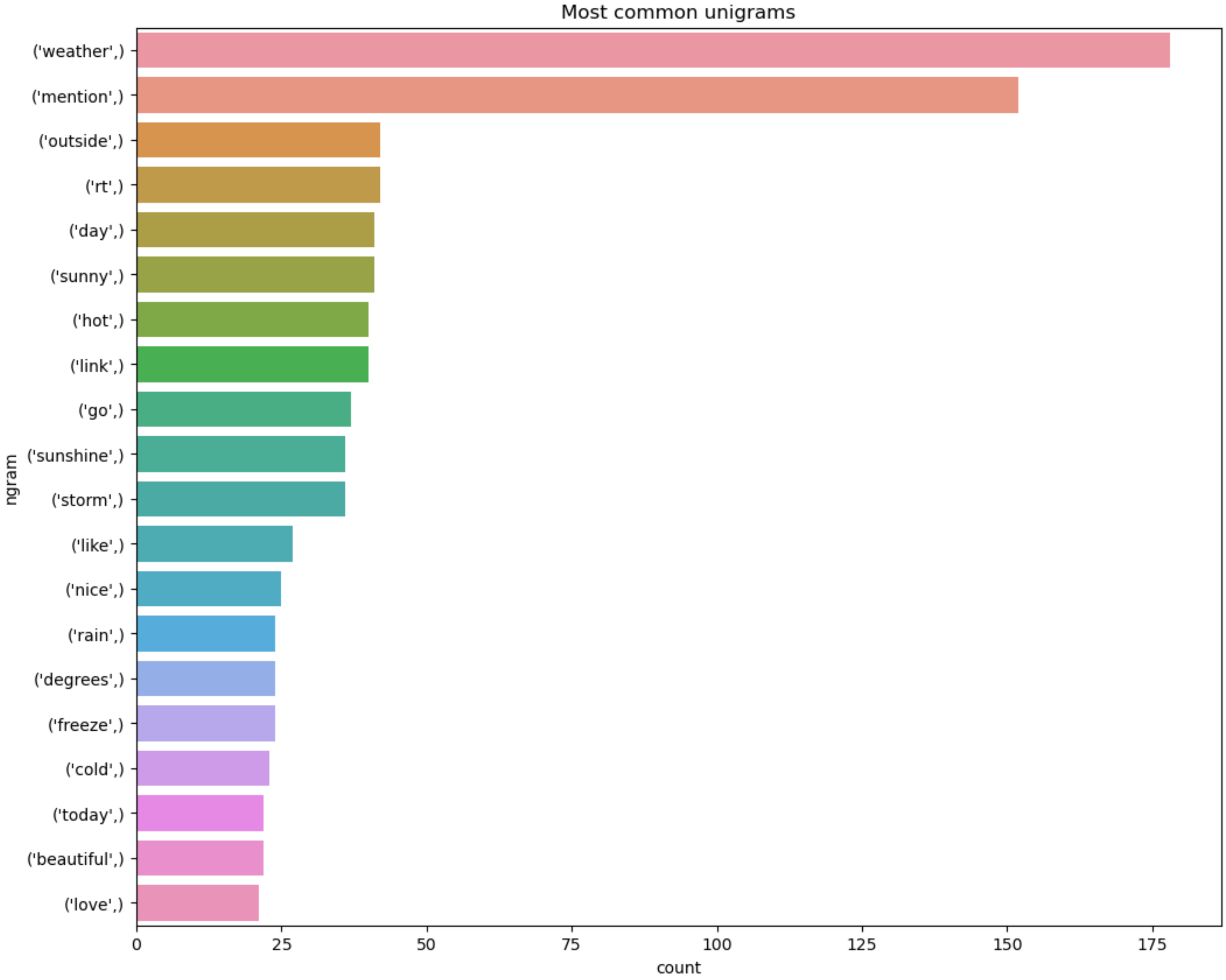
In [34]:

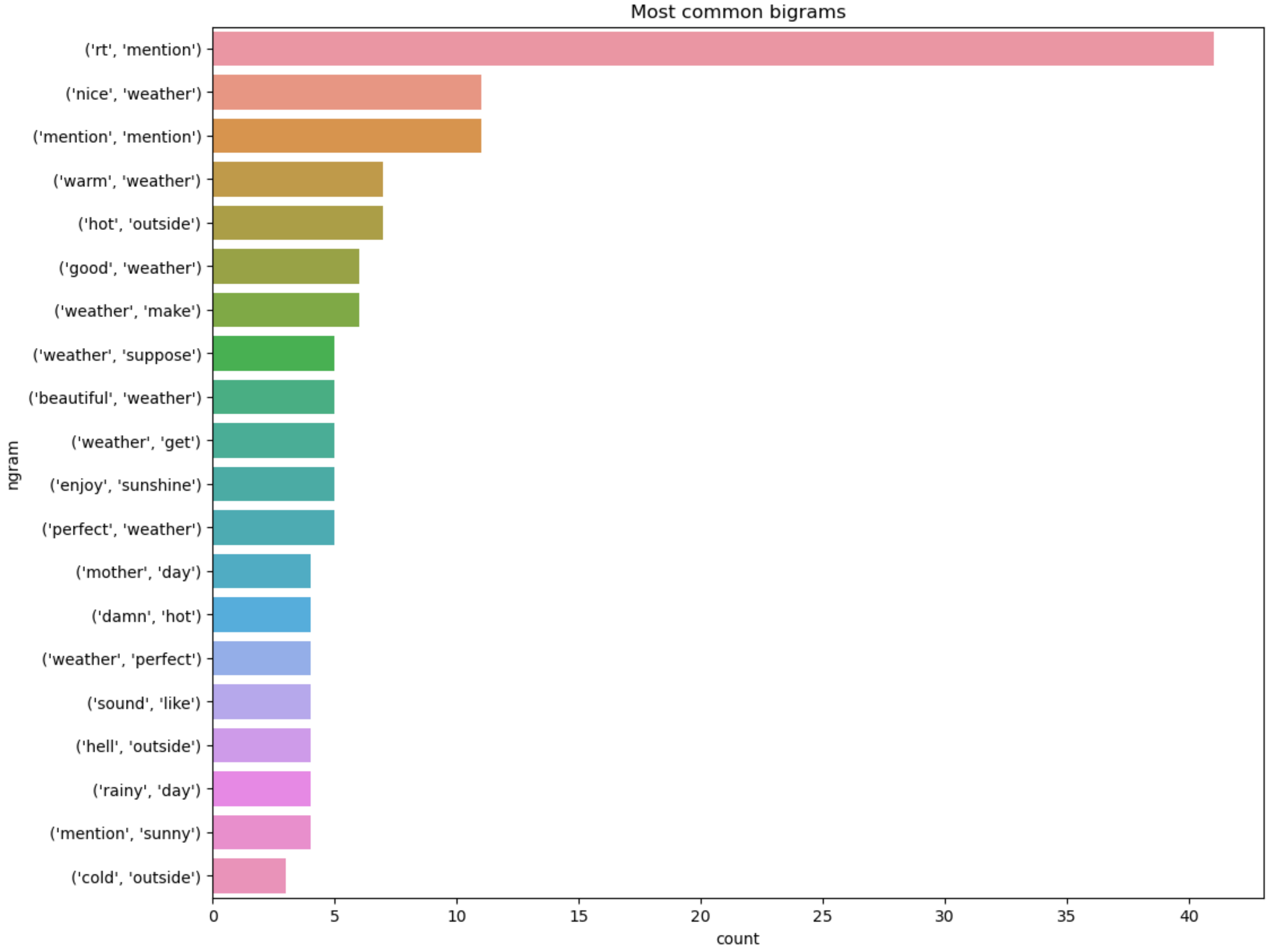
```
tokens_clean = [t for t in tokens_norm if t not in stop_words]
print(f"Number of tokens: {len(tokens_clean)}")
```

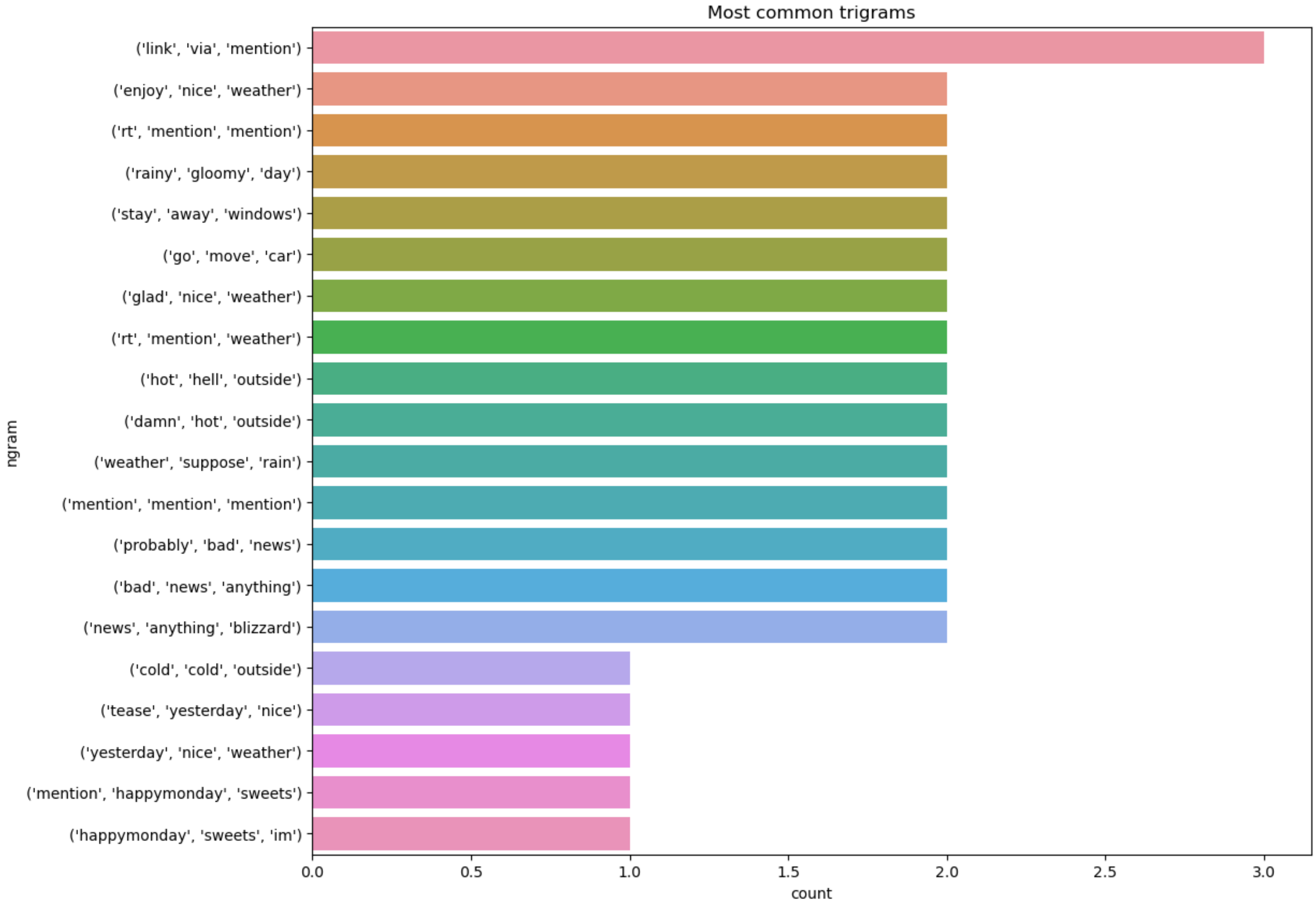
```
Number of tokens: 3339
```

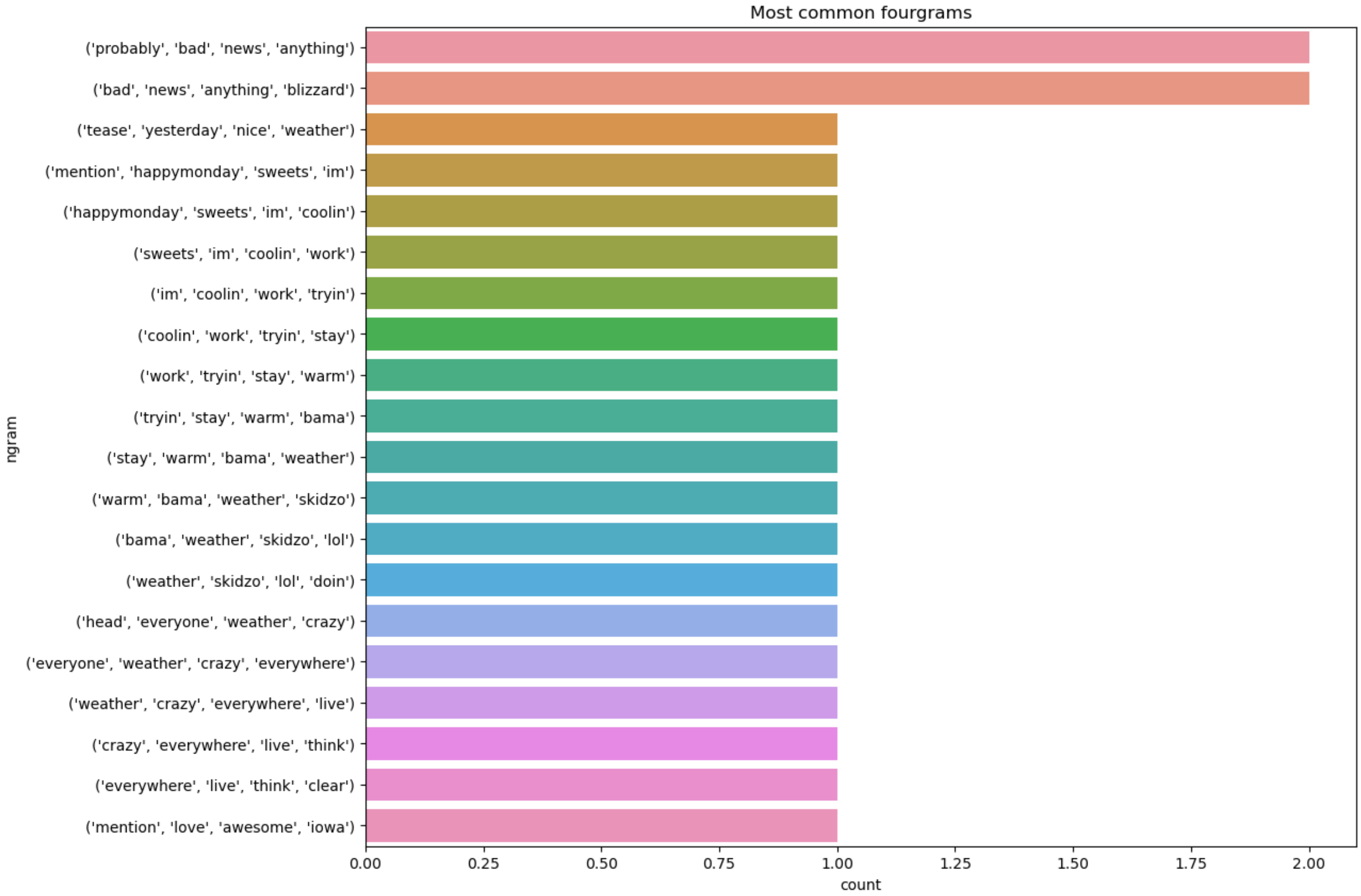
In [35]:

```
def preprocess_text(text):
    """Preprocess text into normalised tokens."""
    # Tokenise words into alphabetic tokens
    tokeniser = RegexpTokenizer(r'[A-Za-z]{2,}')
    tokens = tokeniser.tokenize(text)

    # Lowercase and lemmatise
    lemmatiser = WordNetLemmatizer()
    lemmas = [lemmatiser.lemmatize(token.lower(), pos='v') for token in tokens]

    # Remove stopwords
    keywords= [lemma for lemma in lemmas if lemma not in stop_words]
    return keywords
def get_frequent_ngram(corpus, ngram, n=20):
    """Find most common n n-grams tokens."""
    # Preprocess each document
    documents = [preprocess_text(document) for document in corpus]

    # Find ngrams per document
    n_grams = [list(ngrams(document, ngram)) for document in documents]

    # Find frequency of ngrams
    n_grams_flattened = [item for sublist in n_grams for item in sublist]
    freq_dist = FreqDist(n_grams_flattened)
    top_freq = freq_dist.most_common(n)
    return pd.DataFrame(top_freq, columns=["ngram", "count"])
# Get frequent ngrams for all 4
for i in range(1,5):
    mapping = {1:"uni", 2:"bi", 3:"tri", 4:"four"}
    plt.figure(figsize=(12,10))
    sns.barplot(x="count", y="ngram", data=get_frequent_ngram(train['tweet_text'], i))
    plt.title(f"Most common {mapping[i]}grams");
```


Most common unigrams
('weather',)
('mention',)
('outside',)
('rt',)
('day',)
('sunny',)
('hot',)
('link',)
('go',)
('sunshine',)
('storm',)
('like',)
('nice',)
('rain',)
('degrees',)
('freeze',)
('cold',)
('today',)
('beautiful',)
('love',)
ngram
0
25
50
75
100
125
150
175
count


Most common bigrams
('rt', 'mention')
('nice', 'weather')
('mention', 'mention')
('warm', 'weather')
('hot', 'outside')
('good', 'weather')
('weather', 'make')
('weather', 'suppose')
('beautiful', 'weather')
('weather', 'get')
('enjoy', 'sunshine')
('perfect', 'weather')
('mother', 'day')
('damn', 'hot')
('weather', 'perfect')
('sound', 'like')
('hell', 'outside')
('rainy', 'day')
('mention', 'sunny')
('cold', 'outside')
ngram
0
5
10
15
20
25
30
35
40
count


Most common trigrams
('link', 'via', 'mention')
('enjoy', 'nice', 'weather')
('rt', 'mention', 'mention')
('rainy', 'gloomy', 'day')
('stay', 'away', 'windows')
('go', 'move', 'car')
('glad', 'nice', 'weather')
('rt', 'mention', 'weather')
('hot', 'hell', 'outside')
('damn', 'hot', 'outside')
('weather', 'suppose', 'rain')
('mention', 'mention', 'mention')
('probably', 'bad', 'news')
('bad', 'news', 'anything')
('news', 'anything', 'blizzard')
('cold', 'cold', 'outside')
('tease', 'yesterday', 'nice')
('yesterday', 'nice', 'weather')
('mention', 'happymonday', 'sweets')
('happymonday', 'sweets', 'im')
ngram
0.0
0.5
1.0
1.5
2.0
2.5
3.0
count



In [36]:

```
# tokeniser = RegexpTokenizer("[A-Za-z]+")
train["n_sentences"] = train["tweet_text"].apply(sent_tokenize).apply(len)
train["tokens"] = train["tweet_text"].apply(tokeniser.tokenize)
train["n_tokens"] = train["tokens"].apply(len)
train["n_characters"] = train["tweet_text"].apply(len)
train["n_stopwords"] = train["tokens"].apply(lambda tokens: len([t for t in tokens if t in
train["p_stopwords"] = train["n_stopwords"]/train["n_tokens"]
# Inspect head
columns = ['emotion', 'n_sentences', 'n_tokens', 'n_characters', 'n_stopwords', 'p_stopwor
train[columns].head()
```

Out[36]:

	emotion	n_sentences	n_tokens	n_characters	n_stopwords	p_stopwords
432	Negative	1	5	25	2	0.400000
390	Positive	2	8	44	3	0.375000
928	Negative	4	24	132	8	0.333333
156	Negative	2	23	117	10	0.434783
295	Positive	2	15	95	5	0.333333

In [37]:

```
train.describe()
```

Out[37]:

	n_sentences	n_tokens	n_characters	n_stopwords	p_stopwords
count	401.000000	401.000000	401.000000	401.000000	401.000000
mean	1.877805	14.374065	79.344140	5.082294	0.333716
std	0.998765	6.521099	34.922146	3.189939	0.137444
min	1.000000	1.000000	8.000000	0.000000	0.000000

	n_sentences	n_tokens	n_characters	n_stopwords	p_stopwords
25%	1.000000	9.000000	51.000000	3.000000	0.250000
50%	2.000000	14.000000	77.000000	5.000000	0.333333
75%	2.000000	20.000000	110.000000	7.000000	0.421053
max	8.000000	29.000000	140.000000	14.000000	0.750000

In [38]:

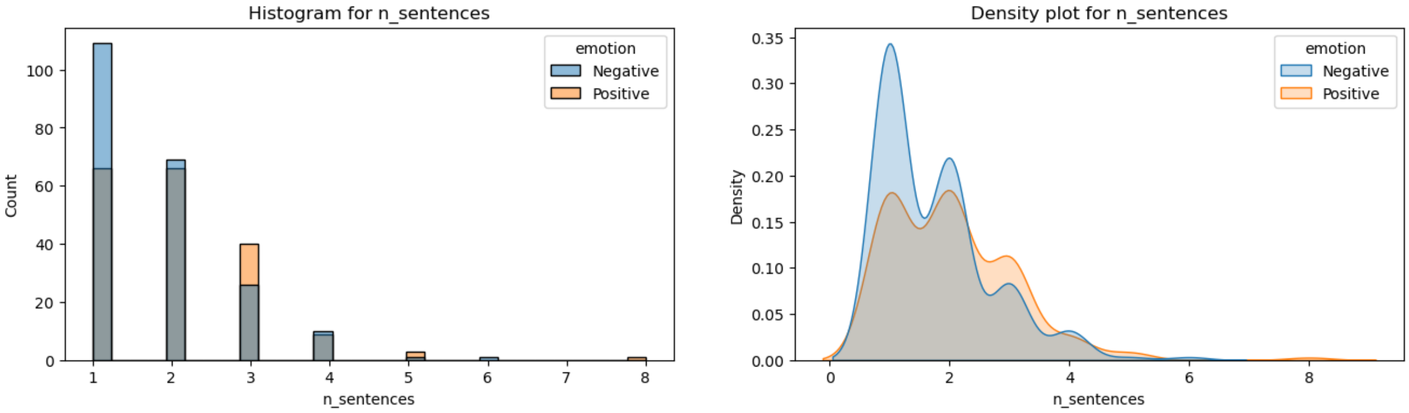
```
num_vars = train.select_dtypes(np.number).columns
train.groupby("emotion")[num_vars].agg(["mean", "median"])
```

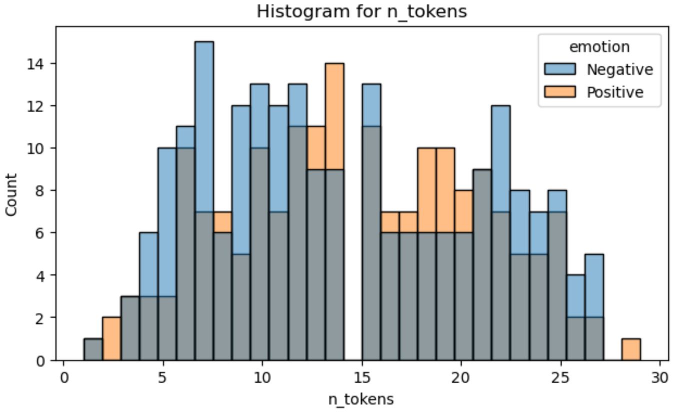
Out[38]:

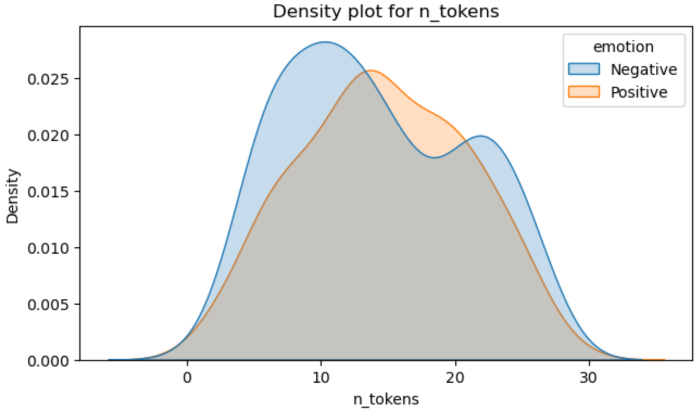
	n_sentences		n_tokens		n_characters		n_stopwords		p_stopwords	
	mean	median	mean	median	mean	median	mean	median	mean	median
emotion										
Negative	1.740741	1.0	14.125000	13.0	76.092593	72.5	5.226852	5.0	0.348673	0.363636
Positive	2.037838	2.0	14.664865	14.0	83.140541	82.0	4.913514	5.0	0.316252	0.333333

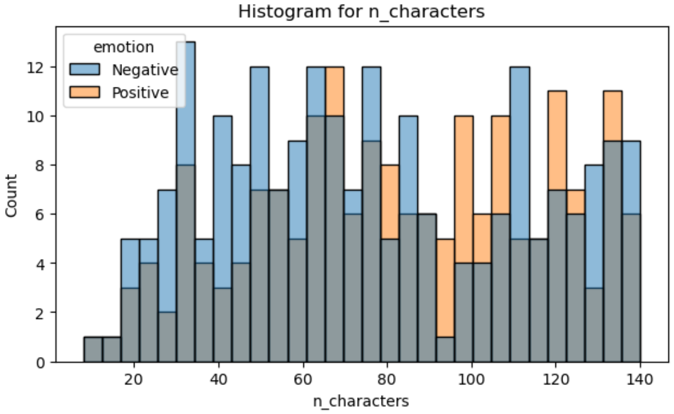
In [39]:

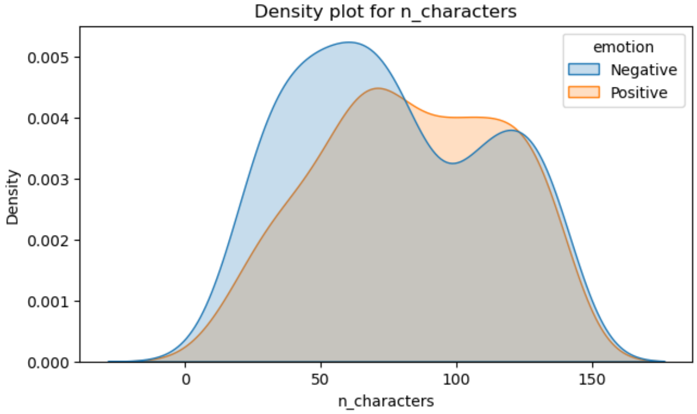
```
def plot_distribution(df, var, hue):
    """Plot overlayed histogram and density plot per sentiment."""
    fig, ax = plt.subplots(nrows=1, ncols=2, figsize=[16,4])

    # Histogram
    sns.histplot(data=df, x=var, hue=hue, bins=30, kde=False, ax=ax[0])
    ax[0].set_title(f"Histogram for {var}")

    # Density plot
    sns.kdeplot(data=df, x=var, hue=hue, shade=True, ax=ax[1])
    ax[1].set_title(f"Density plot for {var}");

# Plot for all numerical variables
for var in num_vars:
    plot_distribution(train, var, 'emotion')
```

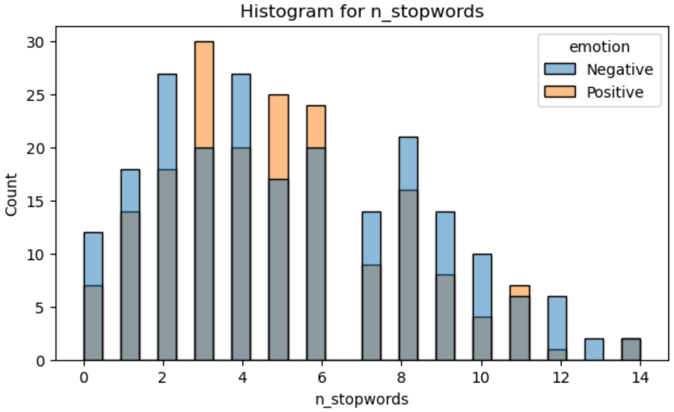


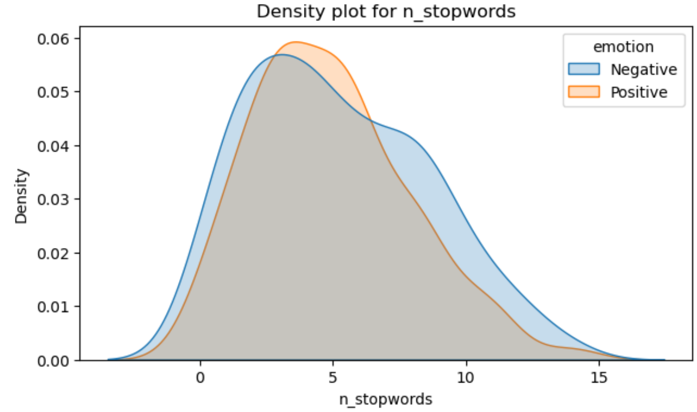

Histogram for n_tokens
Count
n_tokens
0
2
4
6
8
10
12
14
0
5
10
15
20
25
30
emotion
Negative
Positive

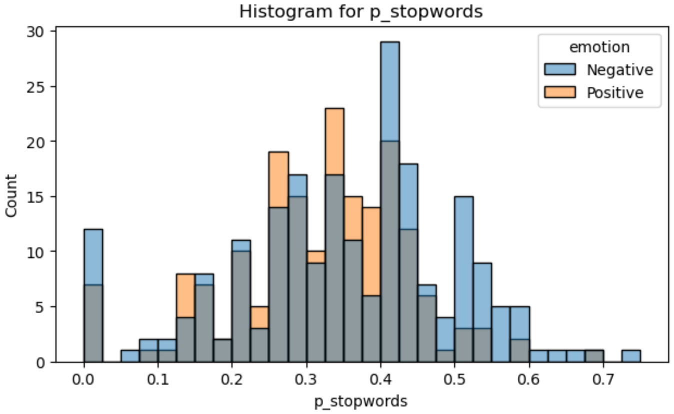

Density plot for n_tokens
Density
n_tokens
0.000
0.005
0.010
0.015
0.020
0.025
0
10
20
30
emotion
Negative
Positive

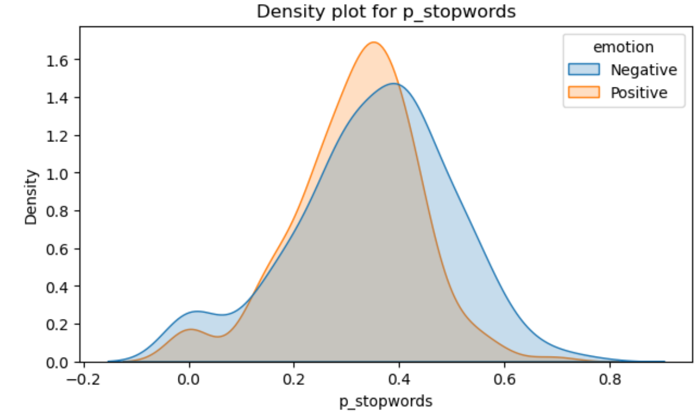

Histogram for n_characters
Count
n_characters
0
2
4
6
8
10
12
20
40
60
80
100
120
140
emotion
Negative
Positive


Density plot for n_characters
Density
n_characters
0.000
0.001
0.002
0.003
0.004
0.005
0
50
100
150
emotion
Negative
Positive


Histogram for n_stopwords
Count
n_stopwords
0
5
10
15
20
25
30
0
2
4
6
8
10
12
14
emotion
Negative
Positive


Density plot for n_stopwords
Density
n_stopwords
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0
5
10
15
emotion
Negative
Positive


Histogram for p_stopwords
Count
p_stopwords
0
5
10
15
20
25
30
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
emotion
Negative
Positive


Density plot for p_stopwords
Density
p_stopwords
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
−0.2
0.0
0.2
0.4
0.6
0.8
emotion
Negative
Positive