```
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Description: Analysis and evaluation of charbot data
             Open Avenues and Businessolver Internship
```

```
The given data set is a CSV file of instant messages sent to and from a chatbot.
The first step in exploration is understand and document columns in the data set.
```

In [1]:
```
import pandas as pd
import numpy as np
twcs_df = pd.read_csv("/Users/nepets/chatbot/twcs.csv")
```

In [2]:
```
print('shape is:', twcs_df.shape)
```

```
shape is: (2811774, 7)
```

In [3]:
```
twcs_df.head(10)
```

Out[3]:

	tweet_id	author_id	inbound	created_at	text	response_tweet_id	in_response_to_tweet_id
0	1	sprintcare	False	Tue Oct 31 22:10:47 +0000 2017	@115712 I understand. I would like to assist y...	2	3.0
1	2	115712	True	Tue Oct 31 22:11:45 +0000 2017	@sprintcare and how do you propose we do that	NaN	1.0
2	3	115712	True	Tue Oct 31 22:08:27 +0000 2017	@sprintcare I have sent several private messag...	1	4.0
3	4	sprintcare	False	Tue Oct 31 21:54:49 +0000 2017	@115712 Please send us a Private Message so th...	3	5.0
4	5	115712	True	Tue Oct 31 21:49:35 +0000 2017	@sprintcare I did.	4	6.0
5	6	sprintcare	False	Tue Oct 31 21:46:24 +0000 2017	@115712 Can you please send us a private messa...	5,7	8.0
6	8	115712	True	Tue Oct 31 21:45:10 +0000 2017	@sprintcare is the worst customer service	9,6,10	NaN
7	11	sprintcare	False	Tue Oct 31 22:10:35 +0000 2017	@115713 This is saddening to hear. Please shoo...	NaN	12.0
8	12	115713	True	Tue Oct 31 22:04:47 +0000 2017	@sprintcare You gonna magically change your co...	11,13,14	15.0
9	15	sprintcare	False	Tue Oct 31 20:03:31 +0000 2017	@115713 We understand your concerns and we'd l...	12	16.0

In [4]:
```
twcs_df.dtypes
```

Out[4]:
```
tweet_id                 int64
author_id               object
inbound                   bool
created_at              object
text                    object
response_tweet_id       object
in_response_to_tweet_id float64
dtype: object
```

The data contains about 2.8 million records and seven columns.

The line number is displayed at the far leftt but it is not in a column.
tweet_id is a unique identifier for each record and can be used as a key or index.
author_id is address of the person or bot sending the tweet.
inbound is a boolean value. If true the message is sent to the bot. If false the message is from the bot.
created_at is a string stating the date and time the Tweet was created.
text is the Tweet.
response_tweet_id is the tweet_id of the original Tweet.
in_response_to_tweet_id is the tweet_id of the Tweet that started the conversation.

The following code will clean the data. Comverting the created at time stamp from a string to a datatime object. Clean the text of the Tweet by casting it to lovercase, removing URLs. punctuation, stop words, 10 most common words, 10 rarest words, and emojis. The clean data will be put in two new columns preserving the original sata set.

In [5]:
```
# Translate the created_at column from a string to a datetime object in a new column
# add a column to put the cleaned text in
import datetime
twcs_df['created_td'] = pd.to_datetime(twcs_df['created_at'])
twcs_df['clean_text'] = 'clean tweet'
```

In [6]:
```
# cast the tweet text into lowercase
twcs_df['clean_text'] = twcs_df.loc[:,'text'].str.lower()
```

In [7]:
```
# remove all URLs from text
import re
twcs_df['clean_text'] = twcs_df['clean_text'].replace(r'http\S+', '', regex=True).replace(r'www\S-
```

In [8]:
```
# remove punctuation with the exception of the @ symbol
import string
punctuations = '!"#$%&\'()*+,-./:;<=>?[\]^_`{|}~'
print(punctuations)

%timeit
def remove_punctuations(text):
    return text.translate(str.maketrans('','',punctuations))

twcs_df['clean_text'] = twcs_df['clean_text'].apply(lambda text: remove_punctuations(text))
```

```
!"#$%&'()*+,-./:;<=>?[\]^_`{|}~
```

In [9]:
```
# import and update Natural Language Toolkit
import nltk
import ssl

try:
    _create_unverified_https_context = ssl._create_unverified_context
except AttributeError:
    pass
else:
    ssl._create_default_https_context = _create_unverified_https_context

# nltk.download()
```

In [10]:
```
# import and list stopwords
# nltk.download('stopwords')
from nltk.corpus import stopwords
', '.join(stopwords.words('english'))
```

Out[10]:
```
"i, me, my, myself, we, our, ours, ourselves, you, you're, you've, you'll, you'd, your, yours, y
ourself, yourselves, he, him, his, himself, she, she's, her, hers, herself, it, it's, its, itsel
f, they, them, their, theirs, themselves, what, which, who, whom, this, that, that'll, these, th
ose, am, is, are, was, were, be, been, being, have, has, had, having, do, does, did, doing, a, a
n, the, and, but, if, or, because, as, until, while, of, at, by, for, with, about, against, betw
een, into, through, during, before, after, above, below, to, from, up, down, in, out, on, off, o
ver, under, again, further, then, once, here, there, when, where, why, how, all, any, both, eac
h, 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, should'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, haven, haven't, isn,
isn't, ma, mightn, mightn't, mustn, mustn't, needn, needn't, shan, shan't, shouldn, shouldn't, w
asn, wasn't, weren, weren't, won, won't, wouldn, wouldn't"
```

In [11]:
```
# remove the stop words listed above
stopwords_set = set(stopwords.words('english'))
def remove_stopwords(text):
    return ' '.join(words for words in str(text).split() if words not in stopwords_set)

twcs_df['clean_text'] = twcs_df['clean_text'].apply(lambda text: remove_stopwords(text))
```

In [12]:
```
# count frequency of word use
from collections import Counter
cnt = Counter()

for text in twcs_df['clean_text'].values:
    for word in text.split():
        cnt[word] +=1

cnt.most_common(10)
```

Out[12]:
```
[('us', 451277),
 ('please', 402715),
 ('dm', 335422),
 ('help', 267643),
 ('hi', 224603),
 ('thanks', 206452),
 ('get', 200373),
 ('sorry', 192246),
 ('like', 146386),
 ('know', 145409)]
```

In [13]:
```
# remove 10 most common words
freq_words = set([w for (w,wc) in cnt.most_common(10)])

def remove_freqwords(text):
    return ' '.join(word for word in str(text).split() if word not in freq_words)

twcs_df['clean_text'] = twcs_df['clean_text'].apply(lambda text:remove_freqwords(text))
```

In [14]:
```
# remove 10 rarest words
n_rare_words = 10
rare_words = set([w for (w,c) in cnt.most_common()][:- n_rare_words: -1])
print(rare_words)

def remove_rarewords(text):
    return ' '.join(word for word in str(text).split() if word not in rare_words)

twcs_df['clean_text'] = twcs_df['clean_text'].apply(lambda text:remove_rarewords(text))
```

```
{'いきなり来たんだけど', '@823867', '@823868', 'notjustxmasallyearround', '@823866', '当サイトからそのようなメールをお送りすることはございません。当サイトの名をかたるフィッシング行為が増えているようです。連絡先に電話をしたりしないようお気を付けください。', 'なんですかこれ！！？', '@823869', '@823870'}
```

In [15]:
```
# This will remove all numbers but it would also remove the Tweet IDs
# numbers = '0123456789'
# %timeit
# def remove_numbers(text):
#     return text.translate(str.maketrans('','',numbers))

# twcs_df['clean_text'] = twcs_df['clean_text'].apply(lambda text: remove_numbers(text))
# twcs_df.head(10)
```

In [64]:
```
# remove emoji
from cleantext import clean
def remove_emoji(text):
    return clean(text, no_emoji=True)
twcs_df['clean_text'] = twcs_df['clean_text'].apply(lambda text:remove_emoji(text))
twcs_df
```

Out[64]:

	tweet_id	author_id	inbound	created_at	text	response_tweet_id	in_response_to_tweet_id	created_
0	1	sprintcare	False	Tue Oct 31 22:10:47 +0000 2017	@115712 I understand. I would like to assist y...	2	3.0	2017-10-22:10:47+00:
1	2	115712	True	Tue Oct 31 22:11:45 +0000 2017	@sprintcare and how do you propose we do that	NaN	1.0	2017-10-22:11:45+00:
2	3	115712	True	Tue Oct 31 22:08:27 +0000 2017	@sprintcare I have sent several private messag...	1	4.0	2017-10-22:08:27+00:
3	4	sprintcare	False	Tue Oct 31 21:54:49 +0000 2017	@115712 Please send us a Private Message so th...	3	5.0	2017-10-21:54:49+00:
4	5	115712	True	Tue Oct 31 21:49:35 +0000 2017	@sprintcare I did.	4	6.0	2017-10-21:49:35+00:
...	...	...	...	...	...	...	...	
2811769	2987947	sprintcare	False	Wed Nov 22 08:43:51 +0000 2017	@823869 Hey, we'd be happy to look into this f...	NaN	2987948.0	2017-11-08:43:51+00:
2811770	2987948	823869	True	Wed Nov 22 08:35:16 +0000 2017	@115714 wtf!? I've been having really shitty s...	2987947	NaN	2017-11-08:35:16+00:
2811771	2812240	121673	True	Thu Nov 23 04:13:07 +0000 2017	@143549 @sprintcare You have to go to https://...	NaN	2812239.0	2017-11-04:13:07+00:
2811772	2987949	AldiUK	False	Wed Nov 22 08:31:24 +0000 2017	@823870 Sounds delicious, Sarah! 😋 https://t.c...	NaN	2987950.0	2017-11-08:31:24+00:
2811773	2987950	823870	True	Tue Nov 21 22:01:04 +0000 2017	@AldiUK warm sloe gin mince pies with ice cre...	2987951,2987949	NaN	2017-11-22:01:04+00:

2811774 rows × 9 columns

In [17]:
```
twcs_df.dtypes
```

Out[17]:
```
tweet_id                              int64
author_id                            object
inbound                                bool
created_at                           object
text                                 object
response_tweet_id                    object
in_response_to_tweet_id             float64
created_td                datetime64[ns, UTC]
clean_text                           object
dtype: object
```

In [18]:
```
twcs_df.memory_usage(deep=True)
```

Out[18]:
```
Index                         128
tweet_id                 22494192
author_id               182884606
inbound                   2811774
created_at              244624338
text                    590460669
response_tweet_id       149127014
in_response_to_tweet_id  22494192
created_td               22494192
clean_text              358034225
dtype: int64
```

The text size was reduced from 590 million bytes to 358 million bytes. In other words 40% of the text was removed.

In [19]:
```
# recount frequency of word use
cnt = Counter()

for text in twcs_df['clean_text'].values:
    for word in text.split():
        cnt[word] +=1

cnt.most_common(10)
```

Out[19]:
```
[('look', 139620),
 ('send', 138915),
 ('@amazonhelp', 137238),
 ('well', 134029),
 ('service', 133716),
 ('im', 131788),
 ('number', 123459),
 ('account', 120118),
 ('email', 116879),
 ('phone', 114018)]
```

The most common words are now a better indication of the information being sent to and from the chatbot.

In [20]:
```
# and rare words
n_rare_words = 10
rare_words = set([w for (w,c) in cnt.most_common()][:- n_rare_words: -1])
print(rare_words)
```

```
{'@823863', '@823861', 'nightmaretodealwith', "'spend", '@823864', '@823865', '@823862', '@82386
0', 'reservationnot'}
```

To start the evaluation bedeteermining how many Tweeters are there and who ate the most common.

In [21]:
```
twcs_df['author_id'].describe()
```

Out[21]:
```
count        2811774
unique        702777
top       AmazonHelp
freq          169840
Name: author_id, dtype: object
```

There are 2.8 million Tweeters.

In [22]:
```
# Top ten most populat outbound chatbots.
twcs_df['author_id'].value_counts().head(10)
```

Out[22]:
```
AmazonHelp         169840
AppleSupport       106860
Uber_Support        56270
SpotifyCares        43265
Delta               42253
Tesco               38573
AmericanAir         36764
TMobileHelp         34317
comcastcares        33031
British_Airways     29361
Name: author_id, dtype: int64
```

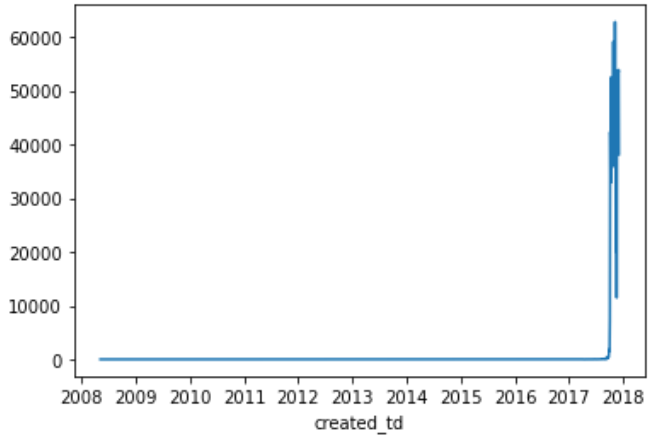
In [23]:
```
# The top 10 authors of inbound tweets.
twcs_df['author_id'].loc[twcs_df['inbound']==True].value_counts().head(10)
```

Out[23]:
```
115911    1286
120576    1010
115913     563
116230     454
169172     448
117627     406
115888     332
116136     295
116421     276
115722     252
Name: author_id, dtype: int64
```

Next let us considered when the tweets were set.

In [24]:
```
twcs_df['created_td'].groupby([twcs_df['created_td'].dt.date]).count().plot()
```

Out[24]:
```
<AxesSubplot:xlabel='created_td'>
```



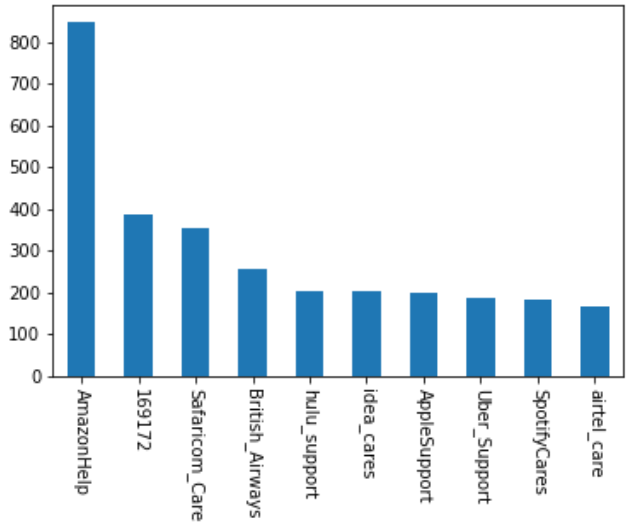
Interesting 90% of the Tweets were sent in the last quarter of 2017.

In [62]:
```
# Top Tweeter before October 2017.
twcs_df['author_id'].loc[twcs_df['created_td'] < '2017-10-01'].value_counts().head(10)
```

Out[62]:
```
AmazonHelp         847
169172             385
Safaricom_Care     354
British_Airways    254
hulu_support       204
idea_cares         203
AppleSupport       198
Uber_Support       186
SpotifyCares       182
airtel_care        165
Name: author_id, dtype: int64
```

In [75]:
```
twcs_df['author_id'].loc[twcs_df['created_td'] < '2017-10-01'].value_counts().head(10).plot.bar(x
```

Out[75]:
```
<AxesSubplot:>
```

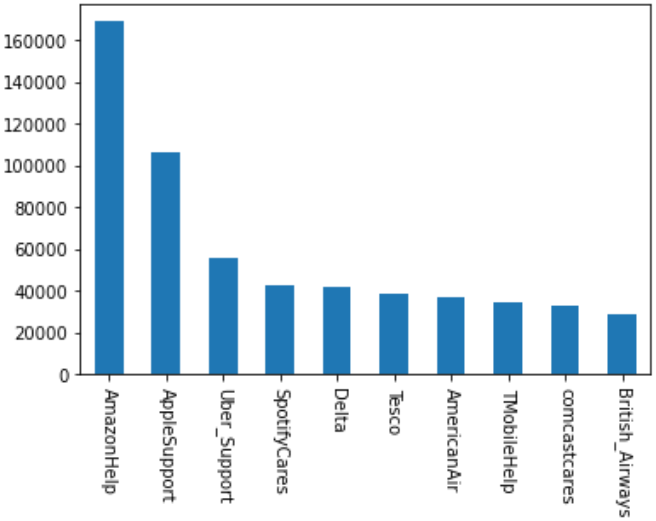


In [63]:
```
# Top Tweeter including and after October 2017.
twcs_df['author_id'].loc[twcs_df['created_td'] >= '2017-10-01'].value_counts().head(10)
```

Out[63]:
```
AmazonHelp         168993
AppleSupport       106662
Uber_Support        56084
SpotifyCares        43083
Delta               42100
Tesco               38446
AmericanAir         36666
TMobileHelp         34204
comcastcares        32938
British_Airways     29107
Name: author_id, dtype: int64
```

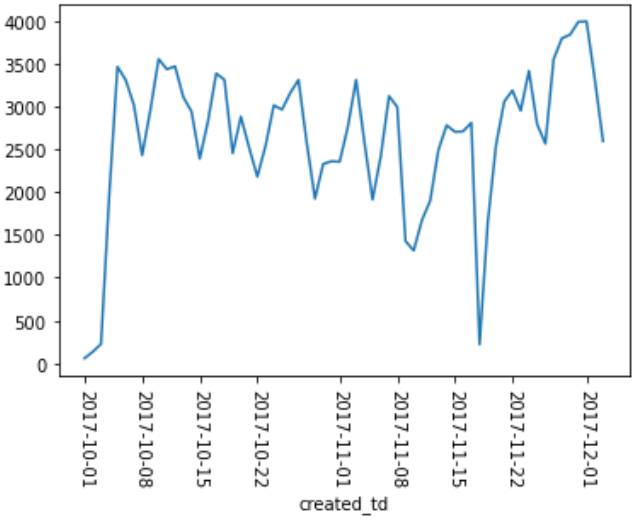
In [76]:
```
twcs_df['author_id'].loc[twcs_df['created_td'] >= '2017-10-01'].value_counts().head(10).plot.bar(
```

Out[76]: <AxesSubplot:>

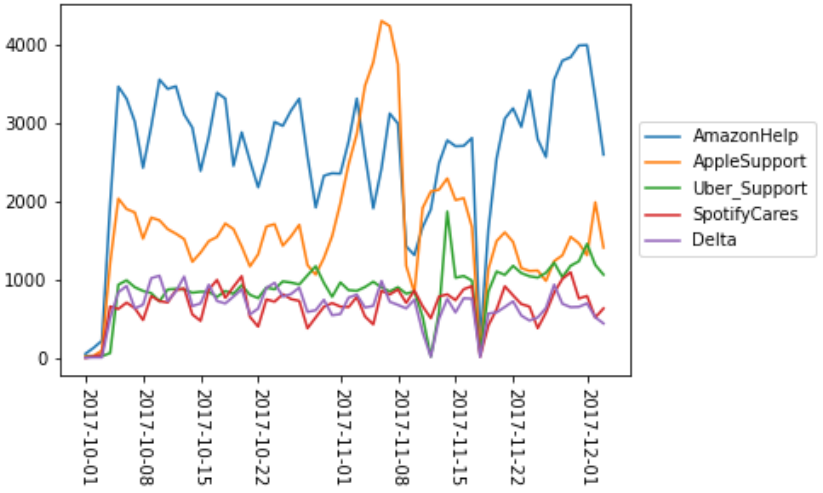


In [27]:
```
# When did the Tweets happen?
twcs_df['author_id'].loc[twcs_df['created_td'] >= '2017-10-01'].loc[twcs_df['author_id'] == 'Amaz
```

Out[27]: <AxesSubplot:xlabel='created_td'>



In [31]:
```
# Who are the top 5 Tweeter in this time frame?
import matplotlib.dates as mdates
import matplotlib.pylab as plt
import matplotlib as mpl
temp_df = twcs_df.loc[twcs_df['created_td'] >= '2017-10-01']
top_5 = temp_df['author_id'].value_counts().head().index.tolist()
for i in top_5:
    plt.plot(temp_df['author_id'].loc[temp_df['author_id'] == i ].groupby([temp_df['created_td'].
    plt.legend(loc='center left', bbox_to_anchor=(1, 0.5))
    plt.xticks(rotation = 270)
```

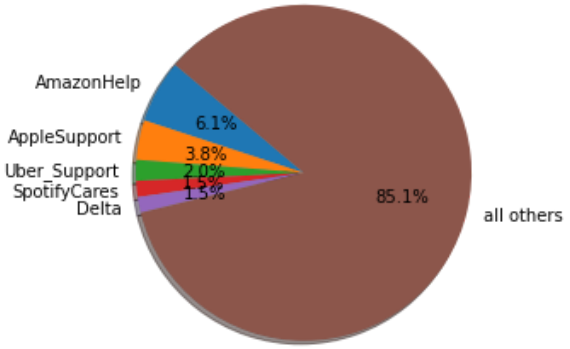


In [92]:
```
# top 5 compared to all other Tweeters
tweets_df  = pd.DataFrame( columns=['author_id','count'])
for i in top_5:
    tweets_df.loc[len(tweets_df.index)] = [i, temp_df['author_id'].loc[temp_df['author_id'] == i ]

tweets_df.loc[len(tweets_df.index)] = [ 'all others', temp_df['author_id'].count() - tweets_df['c
tweets_df
```

Out[92]:

	author_id	count
0	AmazonHelp	168993
1	AppleSupport	106662
2	Uber_Support	56084
3	SpotifyCares	43083
4	Delta	42100
5	all others	2374039

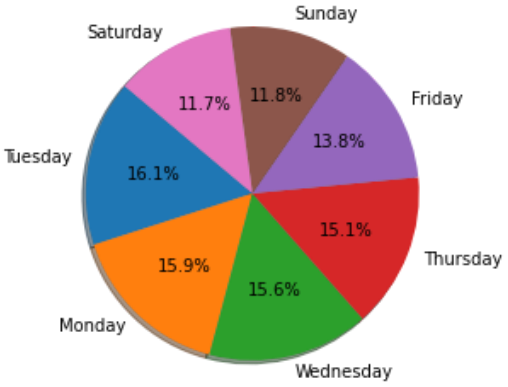
In [94]:
```
labels = tweets_df['author_id'].unique()
sizes = tweets_df['count']

plt.pie(sizes, labels=labels, autopct='%1.1f%%', shadow=True, startangle=140)
plt.axis('equal')
plt.show()
```



In [61]:
```
# Tweet frequency by day of the week
temp_df['created_td'].dt.day_name().value_counts()
```

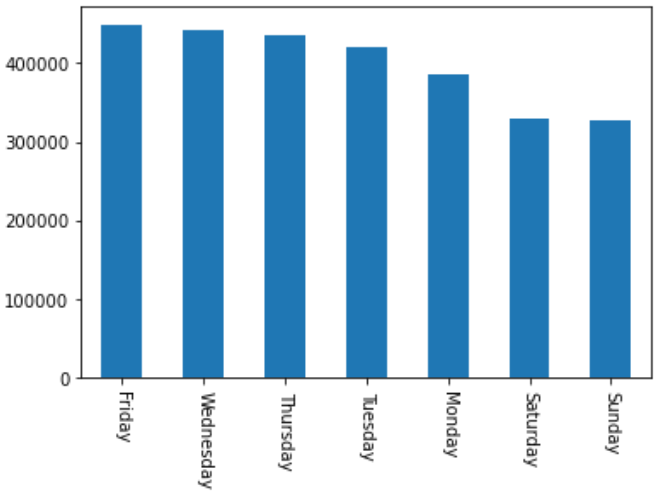
Out[61]:
```
Friday       449070
Wednesday    442694
Thursday     436755
Tuesday      420282
Monday       385449
Saturday     329215
Sunday       327496
Name: created_td, dtype: int64
```

In [73]:
```
dayofweek = pd.value_counts(temp_df['created_td'].dt.day_name().values, sort=True)
labels = temp_df['created_td'].dt.day_name().unique()
sizes = dayofweek

plt.pie(sizes, labels=labels, autopct='%1.1f%%', shadow=True, startangle=140)
plt.axis('equal')
plt.show()
```



In [74]:
```
temp_df['created_td'].dt.day_name().value_counts().plot.bar(x='word', y='count', rot=270)
```

Out[74]: <AxesSubplot:>



In [ ]:
```

```