Sentiment Prediction based on Drug reviews

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In [1]:

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
import seaborn as sns
import os
!pip install wget
!pip install wordcloud
from wordcloud import WordCloud
!pip install yellowbrick
```

```
Requirement already satisfied: wget in c:\programdata\anaconda3\lib\site-pack
ages (3.2)
Requirement already satisfied: wordcloud in c:\programdata\anaconda3\lib\site
-packages (1.8.1)
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e-packages (from wordcloud) (3.1.0)
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ckages (from wordcloud) (6.0.0)
Requirement already satisfied: cycler>=0.10 in c:\programdata\anaconda3\lib\s
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\lib\site-packages (from matplotlib->wordcloud) (1.1.0)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in
c:\programdata\anaconda3\lib\site-packages (from matplotlib->wordcloud) (2.4.
0)
Requirement already satisfied: python-dateutil>=2.1 in c:\programdata\anacond
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te-packages (1.2)
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oaming\python\python37\site-packages (from yellowbrick) (0.23.2)
Requirement already satisfied: matplotlib!=3.0.0,>=2.0.2 in c:\programdata\an
aconda3\lib\site-packages (from yellowbrick) (3.1.0)
Requirement already satisfied: numpy>=1.13.0 in c:\programdata\anaconda3\lib
\site-packages (from yellowbrick) (1.16.4)
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Requirement already satisfied: joblib>=0.11 in c:\programdata\anaconda3\lib\s
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Requirement already satisfied: threadpoolctl>=2.0.0 in c:\programdata\anacond
a3\lib\site-packages (from scikit-learn>=0.20->yellowbrick) (2.1.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\programdata\anaconda3
\lib\site-packages (from matplotlib!=3.0.0,>=2.0.2->yellowbrick) (1.1.0)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in
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ellowbrick) (2.4.0)
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Requirement already satisfied: six in c:\programdata\anaconda3\lib\site-packa
ges (from cycler>=0.10.0->yellowbrick) (1.12.0)
Requirement already satisfied: setuptools in c:\programdata\anaconda3\lib\sit
e-packages (from kiwisolver>=1.0.1->matplotlib!=3.0.0,>=2.0.2->yellowbrick)
(41.0.1)
```

In [91]:
```
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
import seaborn as sn
import matplotlib.pyplot as plt
from yellowbrick.classifier import ROCAUC
from yellowbrick.datasets import load_spam
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from yellowbrick.classifier import ClassificationReport
```

Import the data file for the analysis

In [189]:
```
import wget
```

In [190]:
```
import re
```

In [191]:
```
wget.download('https://archive.ics.uci.edu/ml/machine-learning-databases/0046
2/drugsCom_raw.zip')
```

Out[191]:
```
'drugsCom_raw (23).zip'
```

In [193]:
```
import zipfile
```

In [192]:
```
with zipfile.ZipFile("drugsCom_raw.zip","r")as zip_ref:
    zip_ref.extractall()
```

In [194]:
```
dftest = pd.read_csv('drugsComTest_raw.tsv',delimiter = '\t')
```

In [195]:
```
dftrain = pd.read_csv('drugsComTrain_raw.tsv',delimiter = '\t')
```

In [196]:
```
combine = [dftrain,dftest]
df = pd.concat(combine)
```

In [197]:

```
df.head()
```

Out[197]:

	Unnamed: 0	drugName	condition	review	rating	date	usefulCount
0	206461	Valsartan	Left Ventricular Dysfunction	"It has no side effect, I take it in combinati...	9.0	May 20, 2012	27
1	95260	Guanfacine	ADHD	"My son is halfway through his fourth week of ...	8.0	April 27, 2010	192
2	92703	Lybrel	Birth Control	"I used to take another oral contraceptive, wh...	5.0	December 14, 2009	17
3	138000	Ortho Evra	Birth Control	"This is my first time using any form of birth...	8.0	November 3, 2015	10
4	35696	Buprenorphine / naloxone	Opiate Dependence	"Suboxone has completely turned my life around...	9.0	November 27, 2016	37

Data Cleaning

In [198]:

```
df['date'] = pd.to_datetime(df['date'])
dftrain['date'] = pd.to_datetime(dftrain['date'])
```

In [159]:

```
df_drug_review=pd.DataFrame(dftrain)
df_drug_review.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 161297 entries, 0 to 161296
Data columns (total 7 columns):
Unnamed: 0     161297 non-null int64
drugName       161297 non-null object
condition      160398 non-null object
review         161297 non-null object
rating         161297 non-null float64
date           161297 non-null object
usefulCount    161297 non-null int64
dtypes: float64(1), int64(2), object(4)
memory usage: 8.6+ MB
```

There are 161297 records exsists in the dataset and 6 variablea are available

Look at the summary stastics of numerical fileds

In [160]:

```
df_drug_review.describe()[['rating','usefulCount']]
```

Out[160]:

	rating	usefulCount
count	161297.000000	161297.000000
mean	6.994377	28.004755
std	3.272329	36.403742
min	1.000000	0.000000
25%	5.000000	6.000000
50%	8.000000	16.000000
75%	10.000000	36.000000
max	10.000000	1291.000000

As we see,mean rating value of all drugs is 6.9 and around average of 28 people found the drug reviews are useful

Check the dataset for the missing values

In [162]:

```
df_drug_review.isnull().values.any()
```

Out[162]:

```
True
```

In [163]:

```
df_drug_review.columns[df_drug_review.isnull().any()].tolist()
```

Out[163]:

```
['condition']
```

Looks like "condition" attribute is missing the values but rest of the fields are ok

In [164]:

```
size = df_drug_review.shape[0]

print ("Total Size of the dataset : ", size)

total_na = df_drug_review.isnull().sum(axis = 0)['condition']
print ("Null values : ", total_na)

print ("PERCENTAGE : ", (total_na/size)*100)
```

```
Total Size of the dataset :  161297
Null values :  899
PERCENTAGE :  0.5573569254232875
```

"condition" variable is having missing the values and % of missing values are 0.5%.So we have removed them from the analysis

Check for Duplicate values

In [165]:
```
df_drug_review.duplicated()
```

Out[165]:

```
0         False
1         False
2         False
3         False
4         False
5         False
6         False
7         False
8         False
9         False
10        False
11        False
12        False
13        False
14        False
15        False
16        False
17        False
18        False
19        False
20        False
21        False
22        False
23        False
24        False
25        False
26        False
27        False
28        False
29        False
          ...  
161267    False
161268    False
161269    False
161270    False
161271    False
161272    False
161273    False
161274    False
161275    False
161276    False
161277    False
161278    False
161279    False
161280    False
161281    False
161282    False
161283    False
161284    False
161285    False
161286    False
161287    False
161288    False
161289    False
161290    False
161291    False
161292    False
```

```
161293    False
161294    False
161295    False
161296    False
Length: 161297, dtype: bool
```

Convert the all column names into lower case

```
In [166]: df_drug_review.columns=df_drug_review.columns.str.lower()
```

How many unique drugs and conditions exsists in the dataset?

```
In [167]: ##number of unique drugs present in the dataset
          df_drug_review['drugname'].nunique()

Out[167]: 3436
```

```
In [168]: ##number of unique conditions present in the dataset
          df_drug_review['condition'].nunique()

Out[168]: 884
```

There are 3431 drugs and 884 unique health conditions exsists in the dataset

Exploratory Data Analysis (EDA)

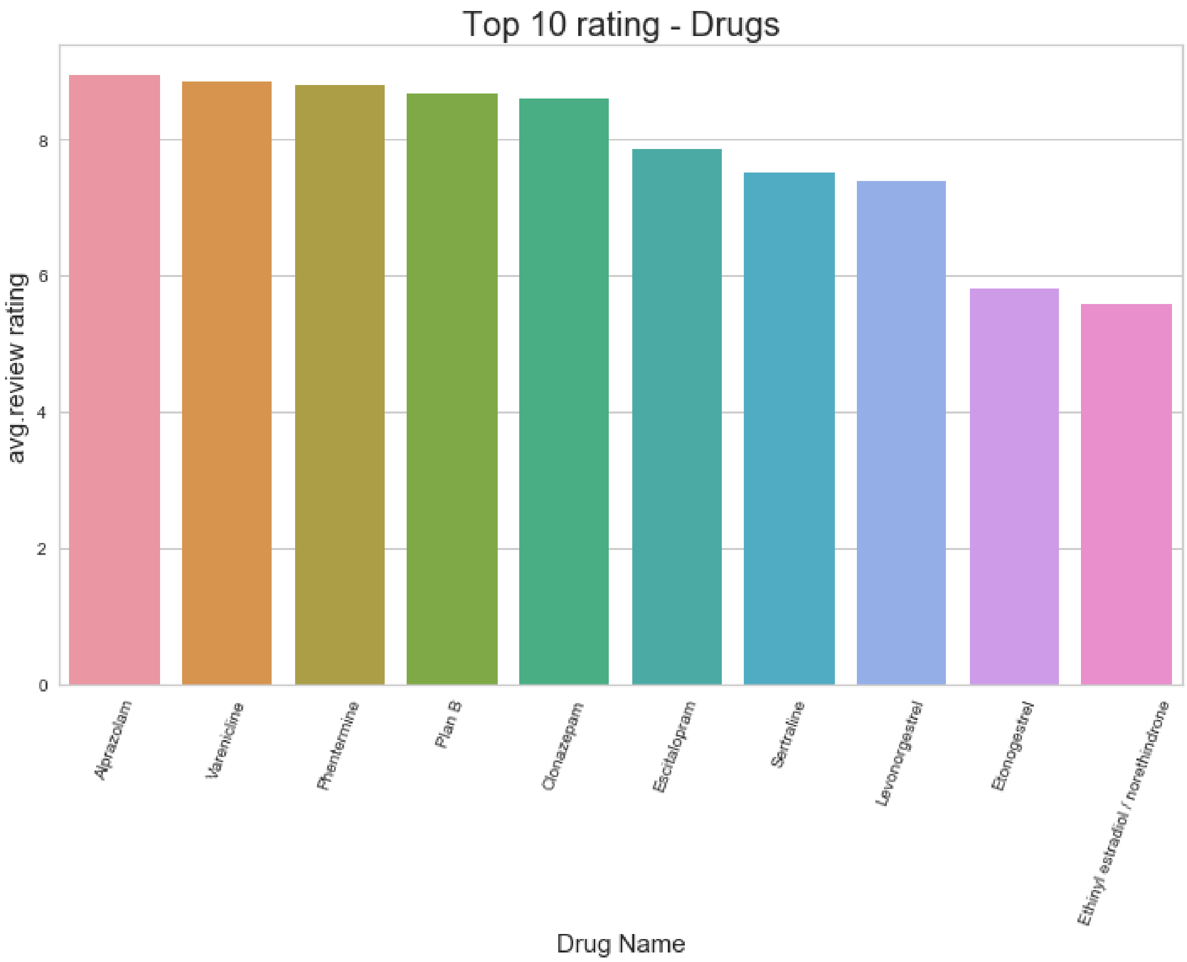
Let us analyse the drugs attribute

What are Top 10 drugs in the dataset?

In [169]:

```python
##Find list of drugs which are having rating 10
df_drug_review_10 = dict(df_drug_review.loc[df_drug_review.rating == 10, "drugname"].value_counts())
drugname = list(df_drug_review_10.keys())
drug_rating = list(df_drug_review_10.values())
df_drug_review_10=df_drug_review.groupby(['drugname']).count()['rating'].reset_index().sort_values(by='rating', ascending=False)
#Calculate the mean review rating for Top 10 drugs
top_10_drugs=pd.DataFrame(drugname[0:10],columns=['drugname'])
top_10_drugs=pd.merge(top_10_drugs,df_drug_review,how='inner', left_on=['drugname'], right_on = ['drugname'])
top_10_drugs_avg=top_10_drugs.groupby(['drugname']).mean()['rating'].reset_index()
top_10_drugs_avg=top_10_drugs_avg.sort_values(by='rating', ascending=False)

##plot top 10 drugs and avg.review rating


drugname_avg = list(top_10_drugs_avg.drugname)
drug_rating_avg = list(top_10_drugs_avg.rating)
plt.figure(figsize=(10,6))
plt.xticks(rotation=70)
plt.tight_layout()
plt_rating = sns.barplot(x = drugname_avg, y =drug_rating_avg)
plt.xlabel("Drug Name", size=15)
plt.ylabel("avg.review rating", size=15)
plt.title("Top 10 rating - Drugs",size=20)
```

```
Out[169]: Text(0.5, 1, 'Top 10 rating - Drugs')
```



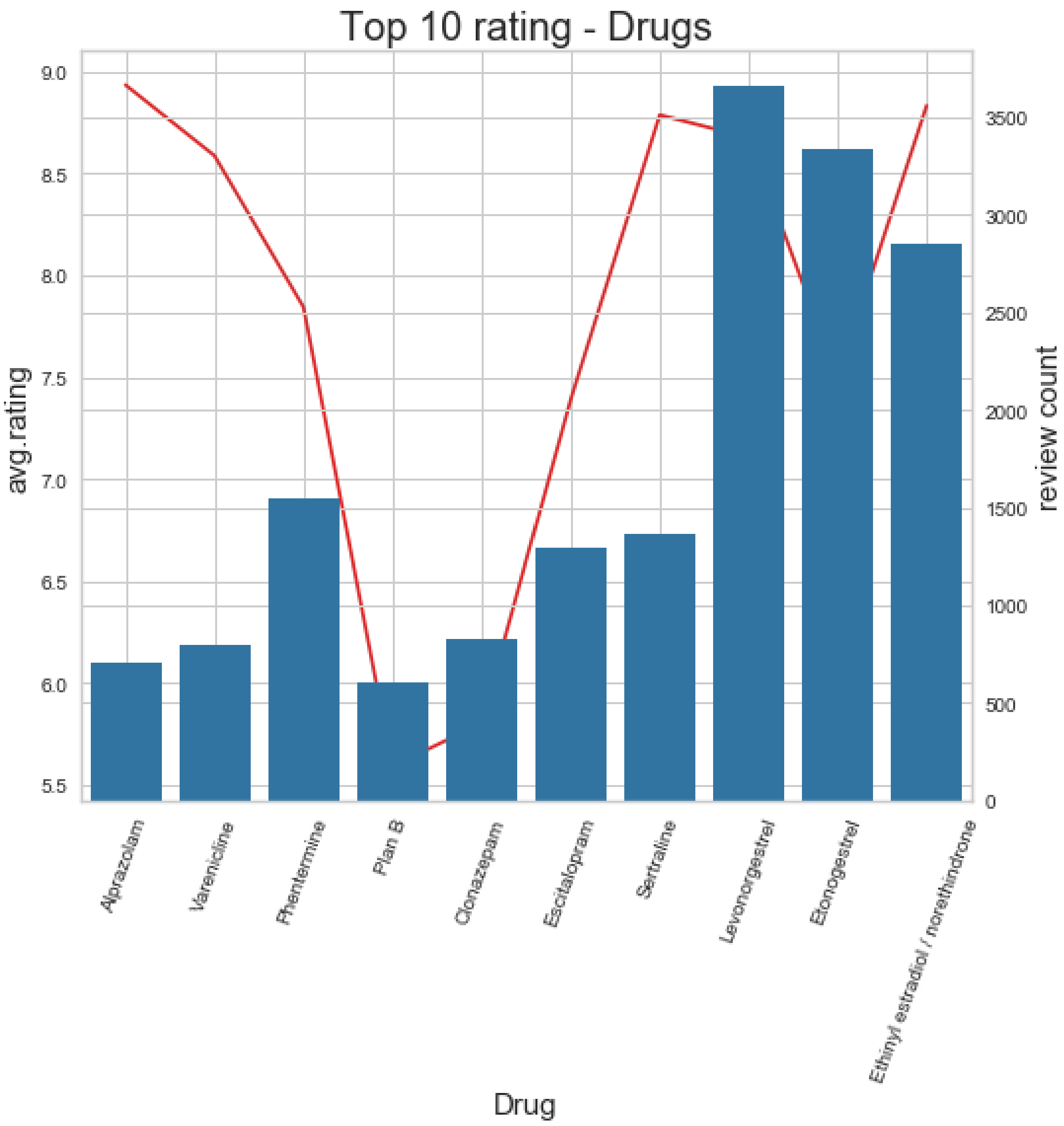
```
In [170]: #merge datasets to get combined view of avg.ratings and review counts
          top_10_drugs_avg=pd.merge(top_10_drugs_avg,df_drug_review_10,how='inner', left
          _on=['drugname'], right_on = ['drugname'])
          #top_10_drugs_avg.head(10)
```

Alprazolam,Varencline,phentermine,Plan B,Clonazepham,Escitalopram,Sertaline are some of top 10 drugs as per the avg. review ratings

What are the review counts for the top 10 drugs?

In [171]:

```
#plot the line chart for review count

plt.figure(figsize=(7,6))
plt.xticks(rotation=70)
color1 = 'tab:red'
plt.tight_layout()
plt_rating = sns.lineplot(x='drugname', y='rating_x', data = top_10_drugs_avg,
color=color1)
plt.xlabel("Drug", size=15)
plt.ylabel("avg.rating", size=15)
plt.title("Top 10 rating - Drugs",size=20)

#line chart for avg ratings for top 10 drugs

ax2 = plt_rating.twinx()
color = 'tab:blue'
#line plot creation
ax2.set_ylabel('Avg rating', fontsize=16)
ax2 =  sns.barplot(x='drugname', y='rating_y', data = top_10_drugs_avg, color=
color)
plt.ylabel("review count", size=15)
#show plot
plt.show()
```



Etonogestrel drug is having highest number of review counts, review rating is low on the other hand Alprazolam drug is having highest review rating, less review count, this is an intuitive insight

Which Drug reviews are found useful?

In [172]:

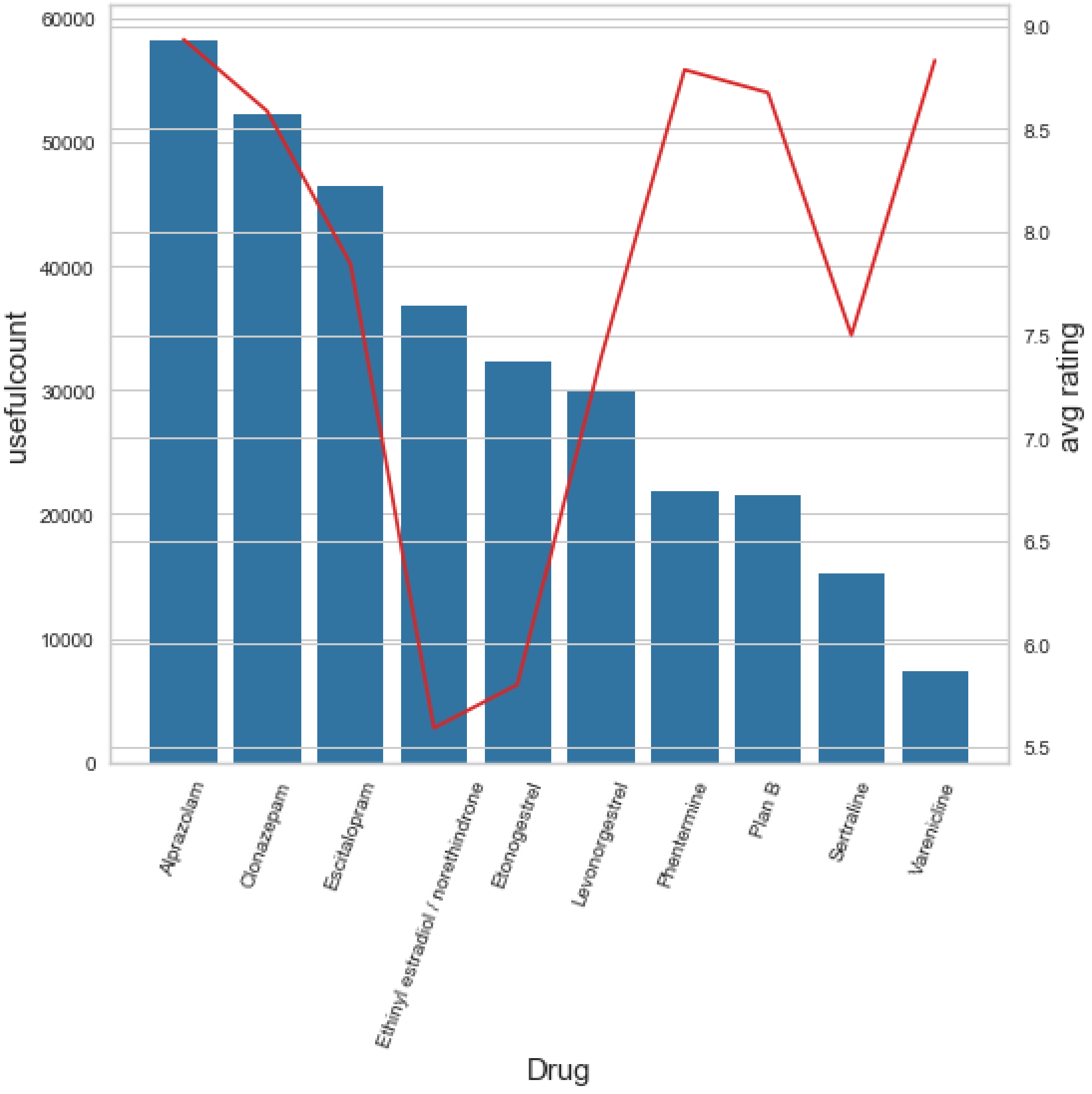
```
##Look at the top 10 drugs which are having highest useful counts
top_10_drugs_usefulcount=top_10_drugs.groupby(['drugname']).sum()['usefulcount'].reset_index().sort_values(by='usefulcount', ascending=False)
top_10_drugs_count_avgrating=top_10_drugs.groupby(['drugname']).mean()['rating'].reset_index().sort_values(by='rating', ascending=False)
drugs_count_avgrating=pd.merge(top_10_drugs_usefulcount,top_10_drugs_count_avgrating,how='inner', left_on=['drugname'], right_on = ['drugname'])
drugs_count_avgrating=drugs_count_avgrating.sort_values(by='usefulcount', ascending=False)
```

```
In [173]: drugs_count_avgrating.head(10)
```

```
Out[173]:
                          drugname  usefulcount    rating
   0                    Sertraline        58154  7.497794
   1                  Escitalopram        52280  7.843653
   2                   Phentermine        46494  8.786131
   3                 Levonorgestrel        36769  7.391031
   4                    Clonazepam        32339  8.586041
   5                    Alprazolam        29826  8.933144
   6                  Etonogestrel        21917  5.802458
   7 Ethinyl estradiol / norethindrone    21510  5.591930
   8                   Varenicline        15184  8.831234
   9                        Plan B         7322  8.674917
```

In [174]:

```
drugname_count = list(drugs_count_avgrating.drugname)
drug_usefulcount = list(drugs_count_avgrating.usefulcount)
plt.figure(figsize=(7,6))
plt.xticks(rotation=70)
plt.tight_layout()
color1 = 'tab:blue'
plt_rating = sns.barplot(x='drugname', y='usefulcount', data = drugs_count_avg
rating, color=color1)
plt.xlabel("Drug", size=15)
plt.ylabel("usefulcount", size=15)
#plt.title("Top 10 drugs useful reviews and avg.ratings",size=20)

#line chart for avg ratings for top 10 drugs

ax2 = plt_rating.twinx()
color = 'tab:red'
#line plot creation
ax2.set_ylabel('Avg rating', fontsize=16)
ax2 = sns.lineplot(x='drugname', y='rating', data = drugs_count_avgrating, col
or=color)
plt.ylabel("avg rating", size=15)
#show plot
plt.show()
```



Intersting Insight : People are found some of the drug reviews are useful eventhough thier avg.review ratings are less.As we see,"Sertaline" drug reviews are found useful eventhough it has avg.review rating between 7-7.5 .But this scnerio is different for the drugs which are having highest avg.review ratings ex:Alprazolam

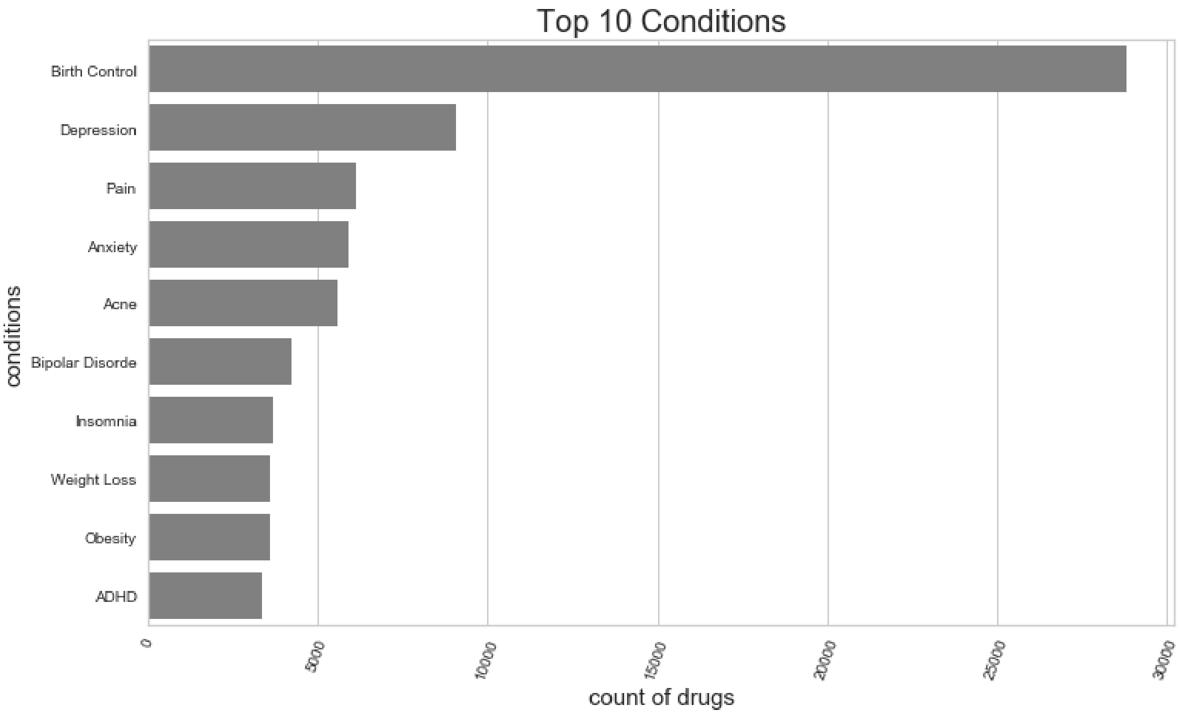
What are the Top 10 conditions in the dataset?

In [175]:

```python
## Find out top 10 conditions
df_condition=df_drug_review.groupby(['condition']).count()['rating'].reset_index().sort_values(by='rating',ascending=False)
df_condition=df_condition[0:10]
df_condition

## Plot top 10 conditions
plt.figure(figsize=(10,6))
plt.xticks(rotation=70)
plt.tight_layout()
chart=sns.barplot(x="rating", y="condition",
            data=df_condition,order=df_condition.sort_values('rating',ascending = False).condition,color='grey')
plt.xlabel("count of drugs", size=15)
plt.ylabel("conditions", size=15)
plt.title("Top 10 Conditions",size=20)
```

Out[175]:

```
Text(0.5, 1, 'Top 10 Conditions')
```



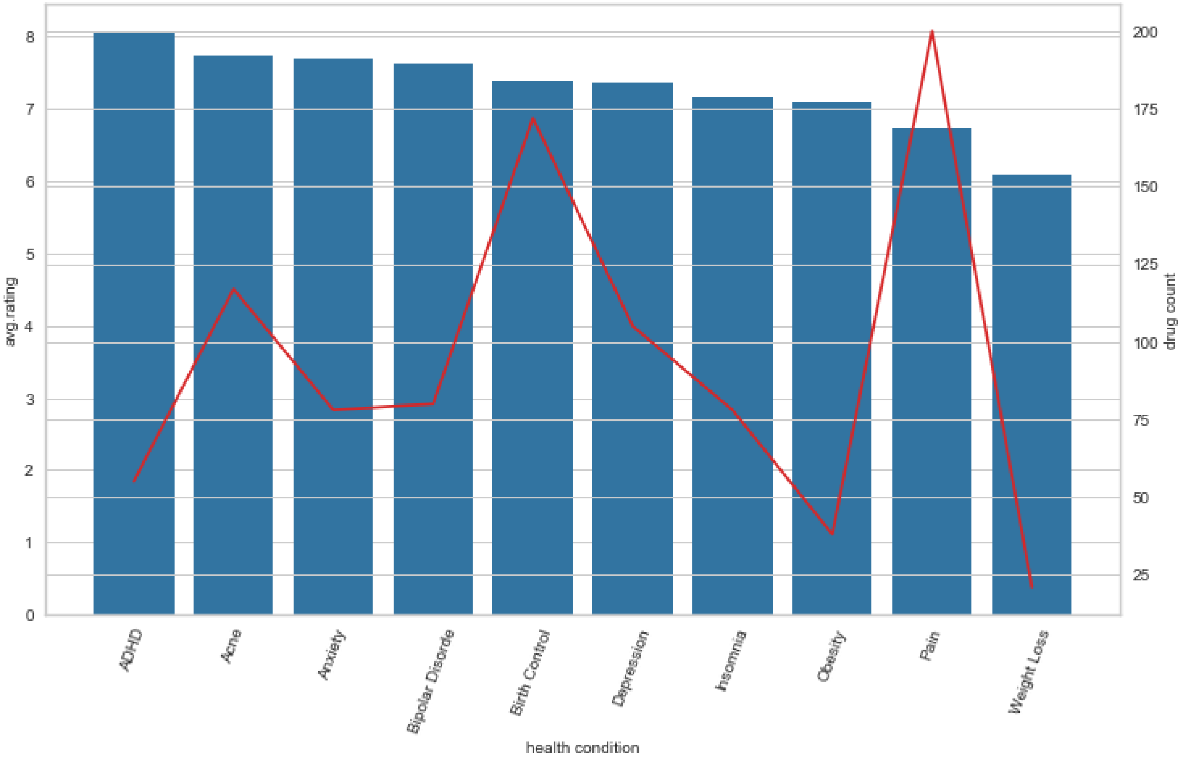
Birth Control,Depression and Pain are the top 3 health conditions out of top 10.

What is the avg drug review rating and number of drugs available for each top 10 health conditions?

```
In [176]: df_drug_condition=df_drug_review.groupby(['condition'])['drugname'].nunique().reset_index()
```

In [177]:

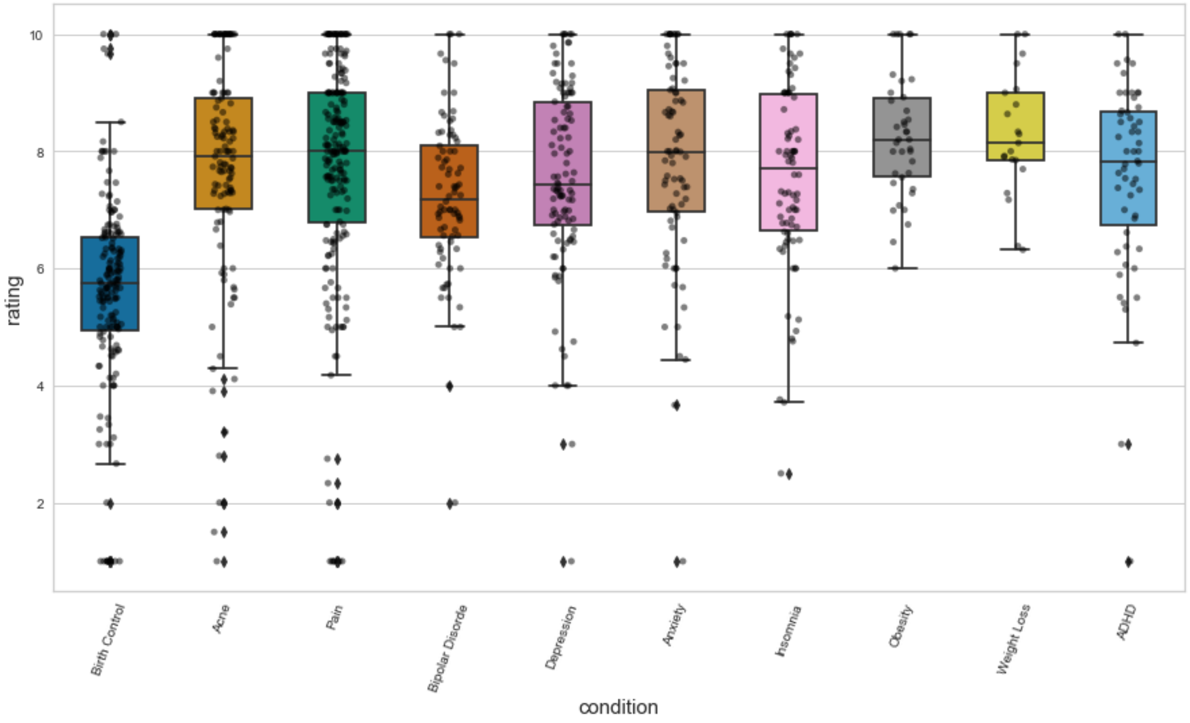
```
## Find out top 10 conditions and avg drug ratings for these conditions
df_condition_avgrating=df_drug_review.groupby(['condition']).mean()['rating'].reset_index().sort_values(by='rating',ascending=False)
df_condition_avgrating=pd.merge(df_condition_avgrating,df_condition,how='inner', left_on=['condition'], right_on = ['condition'])


##find the drug counts for each condition

condition_drug_count=pd.merge(df_condition,df_drug_condition,how='inner', left_on=['condition'], right_on = ['condition'])
condition_drug_count=condition_drug_count.rename(columns={"rating": "count"})
#print(condition_drug_count)

##combined avg rating and drug count

df_condition_avgrating=pd.merge(df_condition_avgrating,condition_drug_count,how='inner', left_on=['condition'], right_on = ['condition'])
df_condition_avgrating.head(10)
df_condition_avgrating.rename(columns={"rating_x":"avg_rating","rating_y":"count_y","drugname":"drug_count"},inplace=True)
## Plot top 10 conditions anf avg.review ratings
topcondition_count = list(df_condition_avgrating.condition)
condition_avgrating = list(df_condition_avgrating.avg_rating)
plt.figure(figsize=(10,6))
plt.xticks(rotation=70)
plt.tight_layout()
color = 'tab:blue'
plt_rating = sns.barplot(x='condition', y='avg_rating', data = df_condition_avgrating,color=color)
plt.xlabel("health condition", size=10)
plt.ylabel("avg.rating", size=10)
#plt.title("Top 10 conditions avgreviews and drug counts",size=20)

#line chart for avg ratings for top 10 drugs

ax2 = plt_rating.twinx()
color = 'tab:red'
#line plot creation
ax2.set_ylabel('drug count', fontsize=14)
ax2 = sns.lineplot(x='condition', y='drug_count', data = df_condition_avgrating,color=color)
plt.ylabel("drug count", size=10)
#show plot
plt.show()
```



Intersting Insight 2: Some of the top health conditions avg review rating is high eventhough very few drugs available,ex:Weight loss,Obesity.At the same time,some health conditions are having less avg review rating but available drugs are very high example: Birth control

In [178]:
```
## Find drugs ratings for top 10 health conditions
condition_drug3_count=pd.merge(df_condition,df_drug_review,how='inner', left_on=['condition'], right_on = ['condition'])
condition_drug3_count=condition_drug3_count.rename(columns={"rating_y": "rating"})
df_condition_top3_avgrating=condition_drug3_count.groupby(['condition','drugname']).mean()['rating'].reset_index().sort_values(by='rating',ascending=False)

##Plot the ratings for all top 10 conditions and see how many drugs are having highest ratings and lowest ratings for each condition

plt.figure(figsize=(15,8))
plt.xticks(rotation=70)
plt_box=sns.boxplot(y='rating', x='condition',
                   data=df_condition_top3_avgrating,
                   width=0.5,
                   palette="colorblind")
plt_box=sns.stripplot(y='rating', x='condition',
                   data=df_condition_top3_avgrating,
                   jitter=True,
                   marker='o',
                   alpha=0.5,
                   color='black')
plt.xlabel("condition", size=15)
plt.ylabel("rating", size=15)
#plt.title("Top 10 Conditions - Drugs and ratings",size=20)
```

Out[178]:
```
Text(0, 0.5, 'rating')
```



Insight 3: Birth control conditions is having around 170 drugs but small number of drugs are having highest reviews but in case of weigh all the drugs are having very good review ratings

What are the bottom 10 health conditions?

In [179]:

```
## Find out bottom 10 conditions
df_condition_bottom=df_drug_review.groupby(['condition']).count()['rating'].re
set_index().sort_values(by='rating',ascending=False)
df_condition_bottom=df_condition_bottom.tail(10)
df_condition_bottom
##find the drug counts for each condition

bottomcondition_drug_count=pd.merge(df_condition_bottom,df_drug_condition,how=
'inner', left_on=['condition'], right_on = ['condition'])
bottomcondition_drug_count=bottomcondition_drug_count.rename(columns={"rating"
: "count"})
bottomcondition_drug_count

##combined avg rating and drug count

df_condition_bottom_avgrating=pd.merge(df_condition_bottom,bottomcondition_dru
g_count,how='inner', left_on=['condition'], right_on = ['condition'])
df_condition_bottom_avgrating.head(10)
df_condition_bottom_avgrating.rename(columns={"rating_x":"avg_rating","rating_
y":"count_y","drugname":"drug_count"},inplace=True)
df_condition_bottom_avgrating
```

Out[179]:

	condition	rating	count	drug_count
0	Syringomyelia	1	1	1
1	Systemic Candidiasis	1	1	1
2	95</span> users found this comment helpful.	1	1	1
3	Cerebrovascular Insufficiency	1	1	1
4	Ramsay Hunt Syndrome	1	1	1
5	Radionuclide Myocardial Perfusion Study	1	1	1
6	Rabies Prophylaxis	1	1	1
7	Q Feve	1	1	1
8	Bartonellosis	1	1	1
9	Anti NMDA Receptor Encephalitis	1	1	1

Syringomyelia,Systemic Candidiasis,Cerebrovascular Insufficiency ,Ramsay Hunt Syndrome,Radionuclide Myocardial Perfusion Study, Rabies Prophylaxis,Q Feve,Bartonellosis,Anti NMDA Receptor Encephalitis are bottom 10 health condtions.

Insight 4: All bottom health conditions are having only one drug and review count available.

Time analysis

In [180]:

```
# create new data frame for time analysis
drug_review_date=df_drug_review[["drugname","date", "rating","usefulcount"]]
#add month variable to the dataframe
drug_review_date['month'] = pd.DatetimeIndex(drug_review_date['date']).month
#add year variable to the dataframe
drug_review_date['year'] = pd.DatetimeIndex(drug_review_date['date']).year
#convert year variable to string for charing purpose
drug_review_date['year'] = drug_review_date['year'].apply(str)

#create data frame to see the data by year

drug_review_year=drug_review_date.groupby(['year']).count()['rating'].reset_index()

drug_review_year['year'] = drug_review_year['year'].apply(str)
drug_review_year=drug_review_year.set_index('year')
drug_review_year
```

```
C:\ProgramData\Anaconda3\lib\site-packages\ipykernel_launcher.py:4: SettingWi
thCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy
  after removing the cwd from sys.path.
C:\ProgramData\Anaconda3\lib\site-packages\ipykernel_launcher.py:6: SettingWi
thCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy

C:\ProgramData\Anaconda3\lib\site-packages\ipykernel_launcher.py:8: SettingWi
thCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy
```

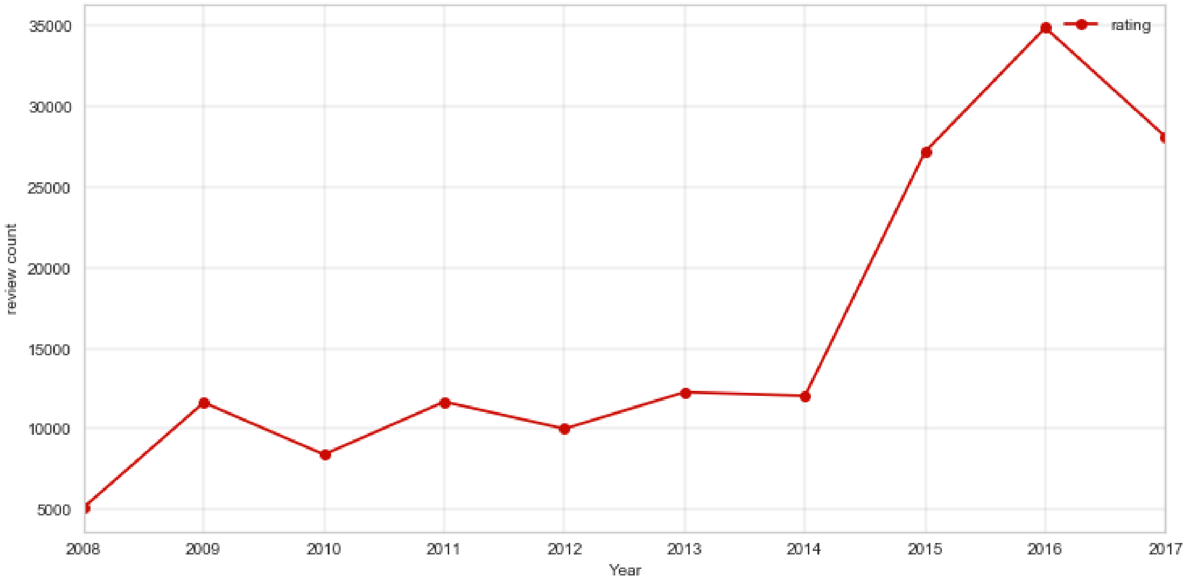
Out[180]:

	rating
year	
2008	5137
2009	11636
2010	8413
2011	11682
2012	10007
2013	12278
2014	12051
2015	27164
2016	34842
2017	28087

How the review rating counts changed year over year?

In [181]:

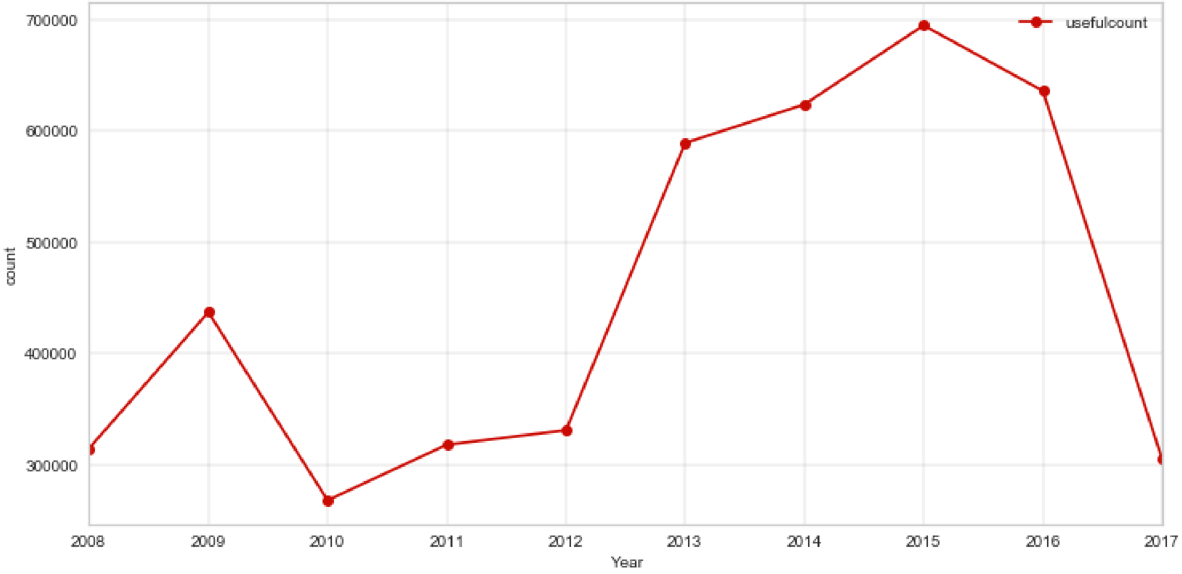
```
#plot the review count over the years
ax = drug_review_year.plot(figsize=(12,6), color='r', marker='o')
ax.set_yticklabels(pd.Series(ax.get_yticks()).map(lambda x: '{:.0f}'.format(x)))
#ax.set_title("Ratings count by year",size=20)
ax.set_xlabel("Year",size=10)
ax.set_ylabel("review count",size=10)
ax.grid(color='grey', linestyle='-', linewidth=0.2)
```



Insight 5: As we see,reviews for the drugs gradually increased from 2010 to 2014 with few fluctuations and peaked in the year of 2016 beore it sees sudden drop of review count in 2017.

How usefulcounts were changed year over year?

In [182]:
```
##create new dataframe to get the YOY useful counts
drug_usefulcount_year=drug_review_date.groupby(['year']).sum()['usefulcount'].
reset_index()
drug_usefulcount_year['year'] = drug_usefulcount_year['year'].apply(str)
drug_usefulcount_year=drug_usefulcount_year.set_index('year')

#plot the useful count over the years
ax = drug_usefulcount_year.plot(figsize=(12,6), color='r', marker='o')
ax.set_yticklabels(pd.Series(ax.get_yticks()).map(lambda x: '{:.0f}'.format(x
)))
#ax.set_title("usefulcount by year",size=20)
ax.set_xlabel("Year",size=10)
ax.set_ylabel("count",size=10)
ax.grid(color='grey', linestyle='-', linewidth=0.2)
```

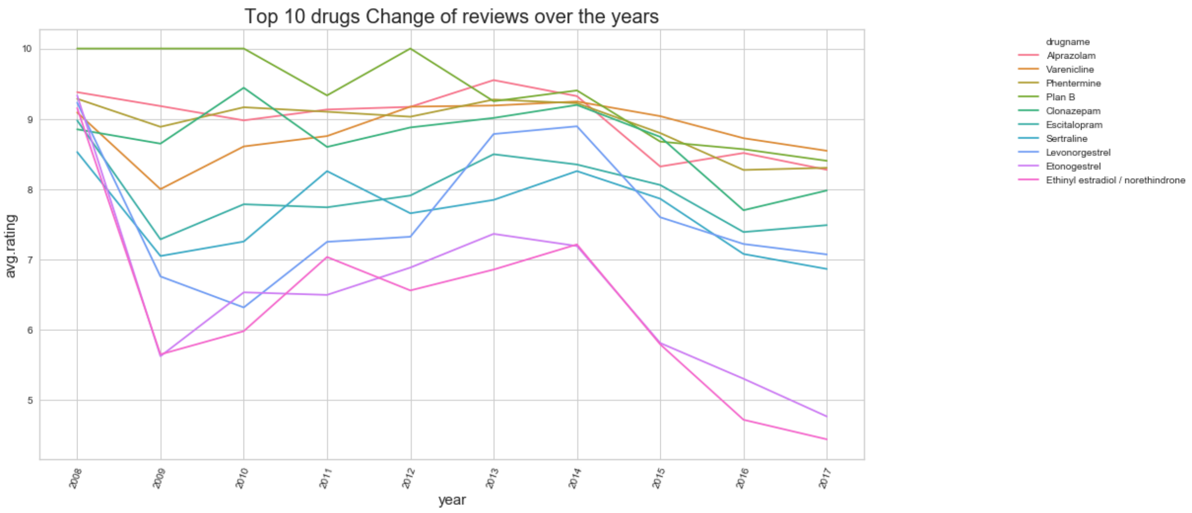


Insight 6 : Number of people gradually increased who found drug reviews are useful from 2010 to 2014 and this count is peaked in 2015 before it sees sudden drop in subsequesnt years..Looks like,number of reviews for the drugs are decreased from 2016 so usage of drug reviews also decreased

How top 10 drugs ratings changed year over year?

```
In [183]: ##create new dataframe to answer this question
          drug_review_year=drug_review_date.groupby(["drugname",'year']).mean()['rating'
          ].reset_index()
          top_10_drugs_avg=top_10_drugs_avg['drugname']
          drug_review_year=pd.merge(top_10_drugs_avg,drug_review_year,how='inner', left_
          on=['drugname'], right_on = ['drugname'])

          ##display sample records of this dataframe
          drug_review_year.head(120)

          ##Plot the ratings for all top 10 conditions and see how many drugs are having
          highest ratings and lowest ratings for each condition

          plt.figure(figsize=(15,8))
          plt.xticks(rotation=70)
          plt_box=sns.lineplot(data=drug_review_year, x="year", y="rating", hue="drugnam
          e")
          plt.xlabel("year", size=15)
          plt.ylabel("avg.rating", size=15)
          plt.title("Top 10 drugs Change of reviews over the years",size=20)
          plt_box.legend(loc='upper right', bbox_to_anchor=(1.4, 1))
```

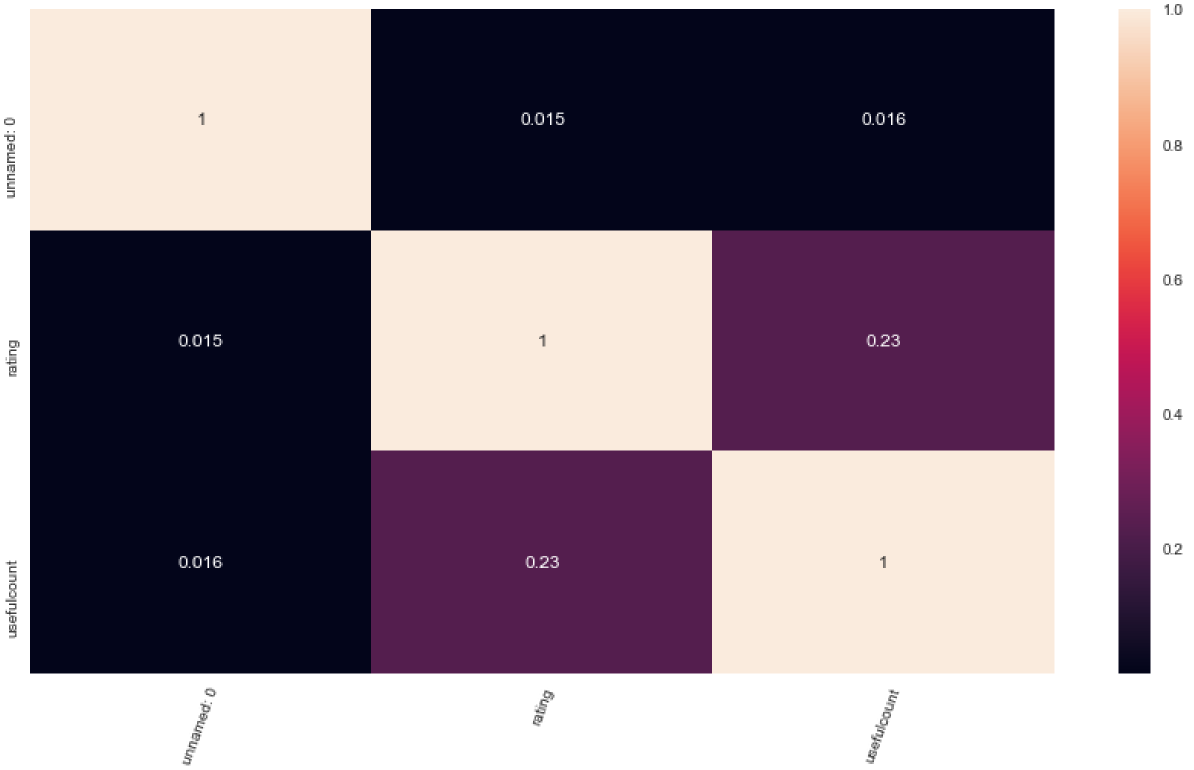
```
Out[183]: <matplotlib.legend.Legend at 0x20451b20cf8>
```



Insight 7: ratings for the top 10 drugs from 2014-2015 and gradually decreased in the following years.Ex:ethinyl estrodiol,etc

What is the correlation between ratings and useful count?

In [184]:
```
corr = df_drug_review.corr()
# Plot heatmap to show correlation

plt.figure(figsize=(15,8))
plt.xticks(rotation=70)
plt_box=sns.heatmap(corr, annot=True)
```



Insight 8:correlation between rating and useful count is positive but it is very small i.e 0.23..we same same insight in top drugs avg.review and useful counts.

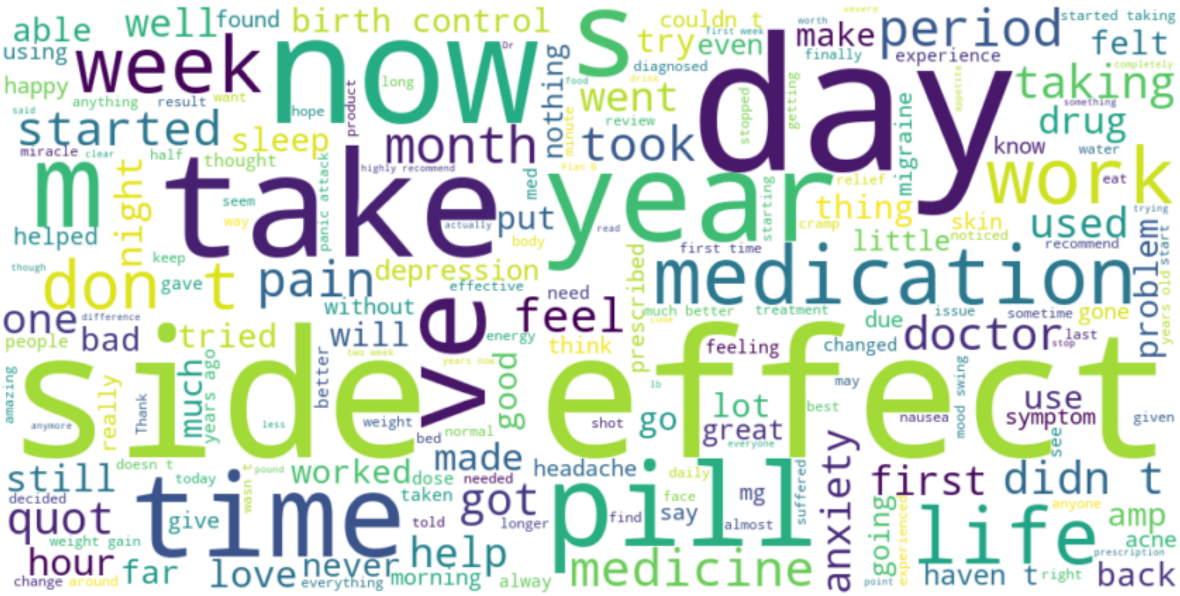
In [185]:
```
!pip install wordcloud
```

```
Requirement already satisfied: wordcloud in c:\programdata\anaconda3\lib\site
-packages (1.8.1)
Requirement already satisfied: pillow in c:\programdata\anaconda3\lib\site-pa
ckages (from wordcloud) (6.0.0)
Requirement already satisfied: numpy>=1.6.1 in c:\programdata\anaconda3\lib\s
ite-packages (from wordcloud) (1.16.4)
Requirement already satisfied: matplotlib in c:\programdata\anaconda3\lib\sit
e-packages (from wordcloud) (3.1.0)
Requirement already satisfied: cycler>=0.10 in c:\programdata\anaconda3\lib\s
ite-packages (from matplotlib->wordcloud) (0.10.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\programdata\anaconda3
\lib\site-packages (from matplotlib->wordcloud) (1.1.0)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in
c:\programdata\anaconda3\lib\site-packages (from matplotlib->wordcloud) (2.4.
0)
Requirement already satisfied: python-dateutil>=2.1 in c:\programdata\anacond
a3\lib\site-packages (from matplotlib->wordcloud) (2.8.0)
Requirement already satisfied: six in c:\programdata\anaconda3\lib\site-packa
ges (from cycler>=0.10->matplotlib->wordcloud) (1.12.0)
Requirement already satisfied: setuptools in c:\programdata\anaconda3\lib\sit
e-packages (from kiwisolver>=1.0.1->matplotlib->wordcloud) (41.0.1)
```

In [186]:
```
from wordcloud import WordCloud
```

What are the most influential words for top 10 drugs?

```
In [187]: df_wordcloud_10 = df_drug_review.loc[df_drug_review.rating == 10, 'review']
          k = (' '.join(df_wordcloud_10))

          wordcloud = WordCloud(width = 1000, height = 500, background_color = 'white').
          generate(k)
          plt.figure(figsize=(15, 10))
          plt.imshow(wordcloud, interpolation="bilinear")
          plt.axis('off');
```

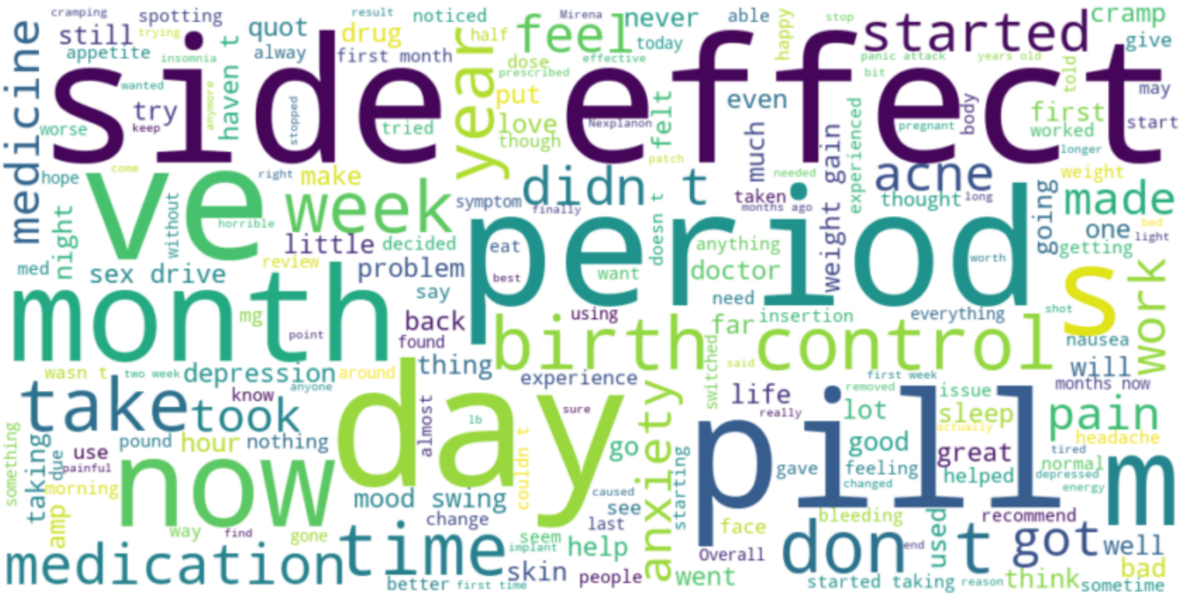


Insight 9: It appears most of top 10 drug reviews shows side effects

What are the most influential words for top 10 health conditions?

In [188]:

```python
df_condition=pd.merge(df_condition,df_drug_review,how='inner', left_on=['condition'], right_on = ['condition'])
df_condition_review=df_condition['review']
k = (' '.join(df_condition_review))

wordcloud = WordCloud(width = 1000, height = 500, background_color = 'white').generate(k)
plt.figure(figsize=(15, 10))
plt.imshow(wordcloud, interpolation="bilinear")
plt.axis('off');
```



insight 10: top 10 conditions reviews shows side effect is most occuring word.

Sentiment Analysis

In [12]:

```
!pip install nltk
```

```
Requirement already satisfied: nltk in c:\programdata\anaconda3\lib\site-packages (3.4.1)
Requirement already satisfied: six in c:\programdata\anaconda3\lib\site-packages (from nltk) (1.12.0)
```

In [13]:
```
import nltk
nltk.download(['punkt','stopwords'])
```

```
[nltk_data] Downloading package punkt to
[nltk_data]     C:\Users\adari\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\adari\AppData\Roaming\nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
```

Out[13]:
```
True
```

The attribute "review" is analyzed below in greater detail

Count the words in each review

In [14]:
```
df['wordcount']=df['review'].apply(lambda x:len(x.split()))
```

Count the characters in each review

In [15]:
```
df['charcount'] =df['review'].apply(lambda x:len(x))
```

Convert all the words in the review to lower case

In [16]:
```
 df['lowercase']= df['review'].apply(lambda x: " ".join(word.lower() for word
in x.split()))
```

Remove all the punctuation

In [17]:
```
df['punctuation'] = df['lowercase'].str.replace('[^\w\s]','')
```

Porter stemmer is installed however the approach to removed stop words and lemmatize is expected to be a better approach for text analysis

In [18]:

```
from nltk.stem import PorterStemmer
from nltk.corpus import stopwords
nltk.download('wordnet')
```

```
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\adari\AppData\Roaming\nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
```

Out[18]:

```
True
```

Remove the stop words in english

In [19]:

```
stop_words = stopwords.words('english')
```

In [20]:

```
df['stopwords'] = df['punctuation'].apply(lambda x: " ".join(word for word in x.split() if word not in stop_words))
```

In [21]:
```
#pd.Series(" ".join(df['stopwords']).split()).value_counts()[45:100]
pd.Series(" ".join(df['stopwords']).split()).value_counts()[0:45]
```

Out[21]:
```
day           74226
i039m         71694
side          69978
taking        68233
years         61929
i039ve        61260
first         59838
pain          59660
effects       58930
take          58291
months        56681
started       56428
like          55493
get           55013
days          53468
time          51291
feel          47361
2             44971
would         44305
back          41324
pill          40974
3             40334
one           39930
weeks         39457
it039s        38813
week          37749
took          37379
also          37242
period        36779
medication    36742
doctor        36573
weight        36401
got           36145
month         34800
since         33729
life          33212
don039t       32544
still         32459
bad           32430
really        31692
much          31142
anxiety       30593
never         29855
went          29120
better        29049
dtype: int64
```

Create additional wrds that can be cleaned

In [22]:
```
other_stopwords = ['don039t','it039s','2','3','get','would','i039m','i039ve',
'4','5','10','6','two','getting','didn039t','also']
```

In [23]:
```
df['clean_review'] = df['stopwords'].apply(lambda x: " ".join(word for word in
x.split() if word not in other_stopwords))
```

In [24]:
```
df.dropna().shape
```

Out[24]:
```
(213869, 13)
```

Lemmatization is performed using text blob

In [25]:
```
!pip install -U textblob
```

```
Requirement already up-to-date: textblob in c:\programdata\anaconda3\lib\site
-packages (0.15.3)
Requirement already satisfied, skipping upgrade: nltk>=3.1 in c:\programdata
\anaconda3\lib\site-packages (from textblob) (3.4.1)
Requirement already satisfied, skipping upgrade: six in c:\programdata\anacon
da3\lib\site-packages (from nltk>=3.1->textblob) (1.12.0)
```

In [26]:
```
#import text blob
from textblob import Word
```

In [27]:
```
df['lemmatize']= df['clean_review'].apply(lambda x: " ".join(Word(word).lemmat
ize() for word in x.split()))
```

calculate the sentiment ('Polarity') and subjectivity of each review)

In [28]:
```
from textblob import TextBlob
```

In [29]:
```
df['sentiment'] = df['lemmatize'].apply(lambda x: TextBlob(x).sentiment[0])
```

In [30]:
```
df['subjectivity'] = df['lemmatize'].apply(lambda x:TextBlob(x).sentiment[1])
```

In [31]:
```
df.head()
```

Out[31]:

	Unnamed: 0	drugName	condition	review	rating	date	usefulCount	wordcoun
0	206461	Valsartan	Left Ventricular Dysfunction	"It has no side effect, I take it in combinati...	9.0	May 20, 2012	27	1
1	95260	Guanfacine	ADHD	"My son is halfway through his fourth week of ...	8.0	April 27, 2010	192	14
2	92703	Lybrel	Birth Control	"I used to take another oral contraceptive, wh...	5.0	December 14, 2009	17	13
3	138000	Ortho Evra	Birth Control	"This is my first time using any form of birth...	8.0	November 3, 2015	10	8
4	35696	Buprenorphine / naloxone	Opiate Dependence	"Suboxone has completely turned my life around...	9.0	November 27, 2016	37	12

In [32]:
```
df.drop(['date','lowercase','punctuation','stopwords','clean_review'], axis =
1,inplace = True)
```

In [33]:
```
df.head()
```

Out[33]:

	Unnamed: 0	drugName	condition	review	rating	usefulCount	wordcount	charcou
0	206461	Valsartan	Left Ventricular Dysfunction	"It has no side effect, I take it in combinati...	9.0	27	17	1
1	95260	Guanfacine	ADHD	"My son is halfway through his fourth week of ...	8.0	192	141	74
2	92703	Lybrel	Birth Control	"I used to take another oral contraceptive, wh...	5.0	17	134	75
3	138000	Ortho Evra	Birth Control	"This is my first time using any form of birth...	8.0	10	89	44
4	35696	Buprenorphine / naloxone	Opiate Dependence	"Suboxone has completely turned my life around...	9.0	37	124	71

In [ ]:
```
dfsent = df.sort_values(by ='sentiment')
```

Create a class label based on sentiment

In [34]:
```
df["class_label"]=df["sentiment"].apply(lambda x: 'neutral' if x==0 else ('neg
ative' if x<0 else 'positive'))
```

In [35]:

```
df.tail()
```

Out[35]:

	Unnamed: 0	drugName	condition	review	rating	usefulCount	wordcount	ch
53761	159999	Tamoxifen	Breast Cancer, Prevention	"I have taken Tamoxifen for 5 years. Side effe...	10.0	43	97	
53762	140714	Escitalopram	Anxiety	"I&#039;ve been taking Lexapro (escitaploprgra...	9.0	11	130	
53763	130945	Levonorgestrel	Birth Control	"I&#039;m married, 34 years old and I have no ...	8.0	7	149	
53764	47656	Tapentadol	Pain	"I was prescribed Nucynta for severe neck/shou...	1.0	20	34	
53765	113712	Arthrotec	Sciatica	"It works!!!"	9.0	46	2	

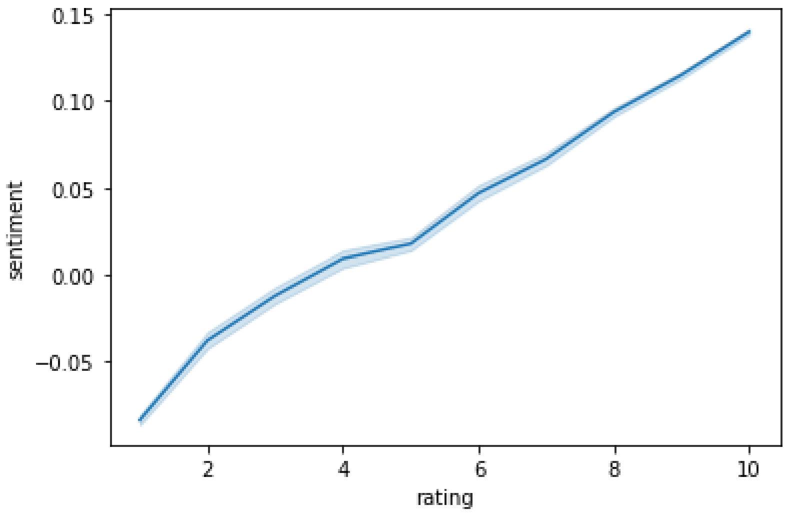
Correlation plot between sentiment and the rating

In [36]:

```
import seaborn as sns
plt = sns.lineplot(data=df,x='rating',y='sentiment')
plt
```

Out[36]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x20454231da0>
```



We can see that there is positive correlation, as the rating increases the sentiment is also increased.Showing the positive sentiment associated with higher rating

```
In [83]: df2 = df.iloc[:,10:12]
```

```
In [84]: df2.head()
```

Out[84]:

	subjectivity	class_label
0	0.000000	neutral
1	0.482812	positive
2	0.367599	positive
3	0.618750	positive
4	0.384359	positive

```
In [85]: df2.groupby('class_label').size()
```

```
Out[85]: class_label
         negative     70105
         neutral      11661
         positive    133297
         dtype: int64
```

```
In [ ]: df2.groupby('class_label').count().plot.bar()
```

negative reviews account to 32 %,positive 61.9% and neutral reviews to 5 % of the data

Calculate term frequency and inverse document frequency of the review that is lemmatized using tfidfVectorizer

```
In [87]: from sklearn.feature_extraction.text import TfidfVectorizer
```

```
In [90]: v = TfidfVectorizer()
         attribute = v.fit_transform(df['lemmatize'])
         claslabel = df.class_label
         #print(claslabel)
```

```
In [ ]: attribute
```

```
In [ ]: df.head
```

Machine learning to predict sentiment based on review

1.Logistic Regression

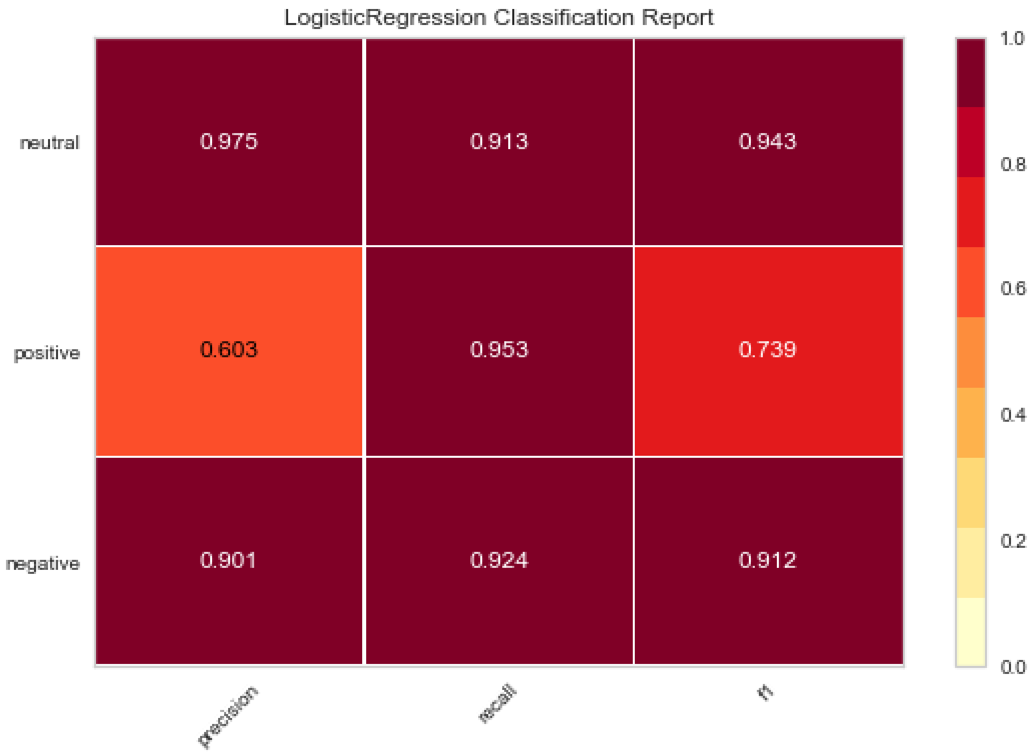
In [92]:

```
x_train,x_test,y_train,y_test = train_test_split(attribute,claslabel,test_size
=0.30,random_state=0)
```

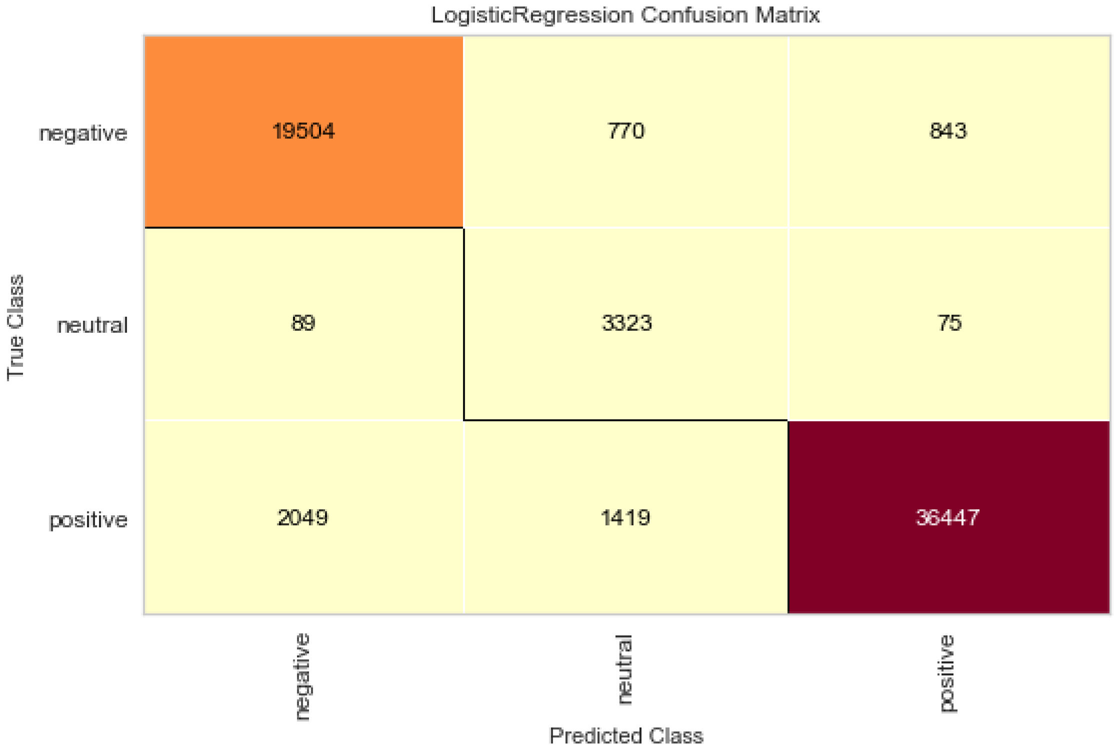
In [97]:

```
##Build logistic regression
from yellowbrick.classifier import ConfusionMatrix
model = LogisticRegression(multi_class='multinomial',solver ='newton-cg',class
_weight = "balanced")
#visualizer = ROCAUC(model, classes=['negative','positive','neutral'])
visualizer = ClassificationReport(model, classes=['negative','positive','neutr
al'])


#confusion matrix
log_cm = ConfusionMatrix(model)
log_cm.fit(x_train, y_train)        # Fit the training data to the visualizer
log_cm.score(x_test, y_test)        # Evaluate the model on the test data
log_cm.show()

##classification report

log_cr = ClassificationReport(model, classes=['negative','positive','neutral'
], support=True)
log_cr.fit(x_train, y_train)        # Fit the training data to the visualizer
log_cr.score(x_test, y_test)        # Evaluate the model on the test data
log_cr.show()

##ROC curve

ROC = ROCAUC(model, classes=['negative','positive','neutral'])
ROC.fit(x_train, y_train)        # Fit the training data to the visualizer
ROC.score(x_test, y_test)        # Evaluate the model on the test data
ROC.show()
```

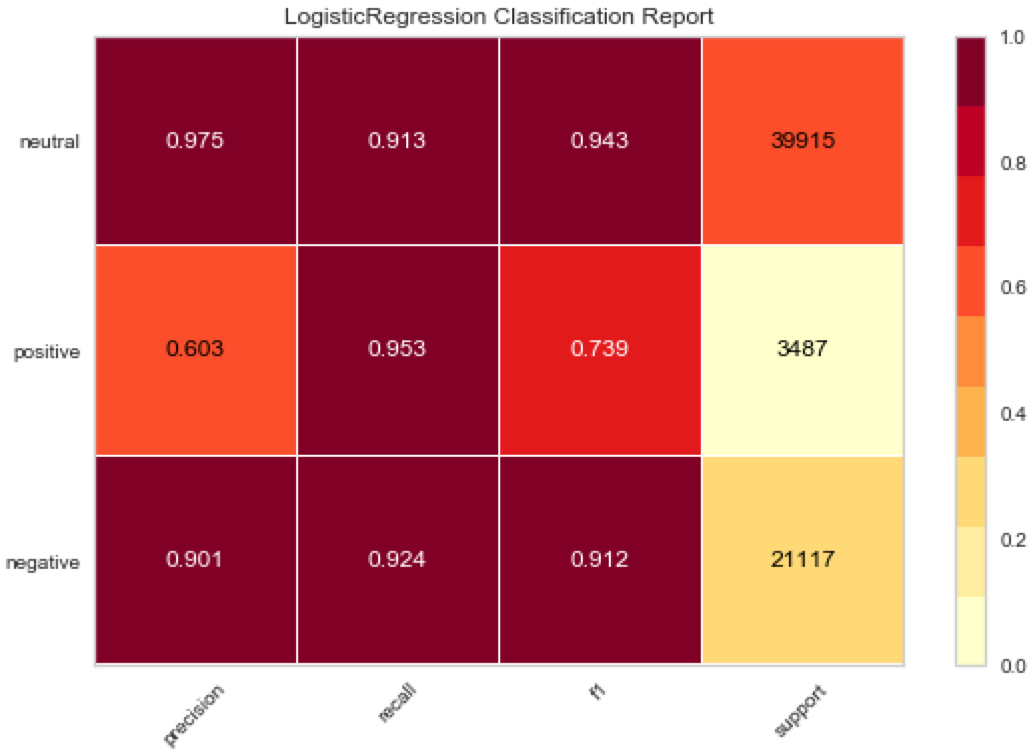
```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



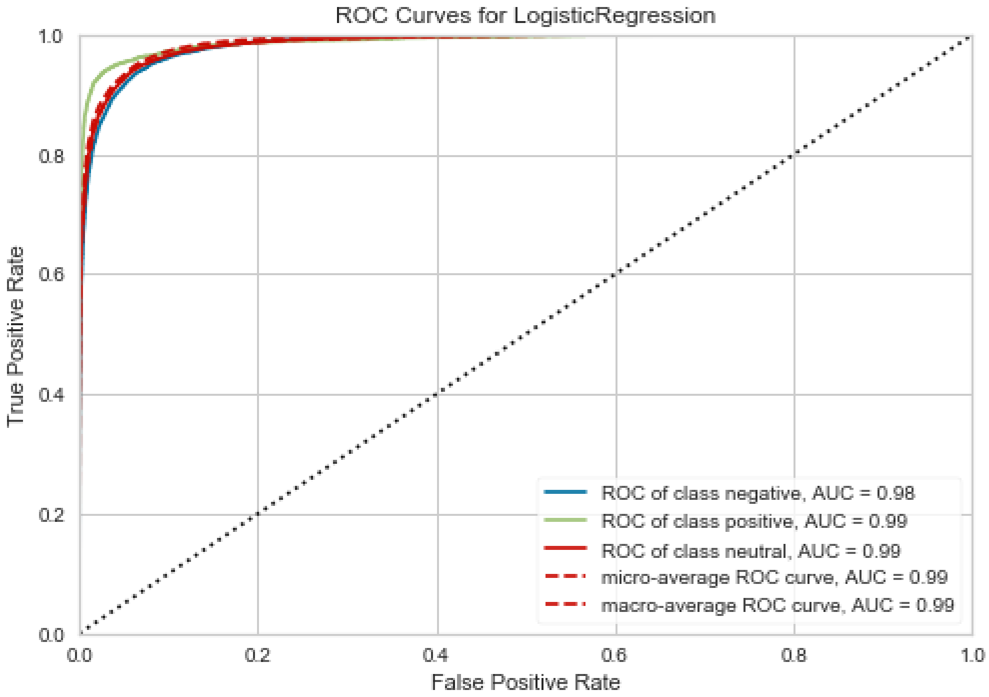
```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



Out[97]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x204962902e8>
```

In [149]:
```
y_pred_lr=model.predict(x_test)
print("Accuracy_logreg:",metrics.accuracy_score(y_test,y_pred_lr))
```

```
Accuracy_logreg: 0.9187061175777678
```

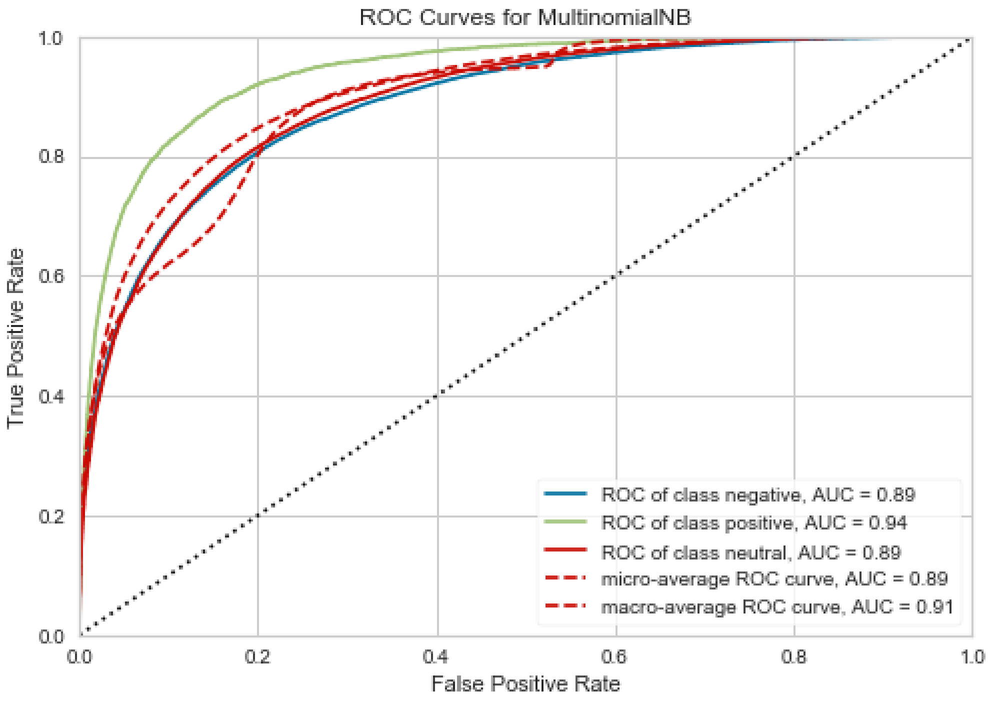
2. Multinomial Naive Bayes

In [95]:
```
from sklearn.naive_bayes import MultinomialNB
mnb = MultinomialNB().fit(x_train, y_train)
y_predmnb = mnb.predict(x_test)
```

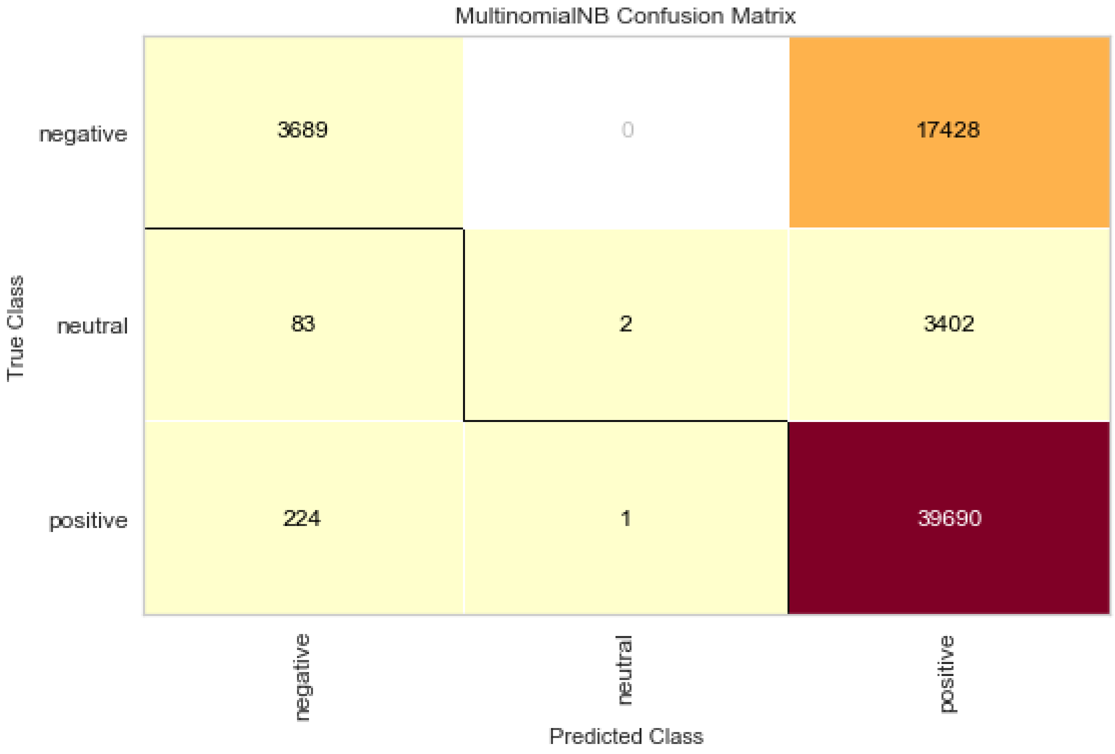
In [96]:

```
mnb_roc = ROCAUC(mnb, classes=['negative','positive','neutral'])
#ROC
mnb_roc.fit(x_train, y_train)        # Fit the training data to the visualizer
mnb_roc.score(x_train, y_train)        # Evaluate the model on the test data
mnb_roc.show()

#confusion matrix
mnb_cm = ConfusionMatrix(mnb)
mnb_cm.fit(x_train, y_train)        # Fit the training data to the visualizer
mnb_cm.score(x_test, y_test)        # Evaluate the model on the test data
mnb_cm.show()

##classification report

mnb_cr = ClassificationReport(mnb, classes=['negative','positive','neutral'],
support=True)
mnb_cr.fit(x_train, y_train)        # Fit the training data to the visualizer
mnb_cr.score(x_test, y_test)        # Evaluate the model on the test data
mnb_cr.show()
```

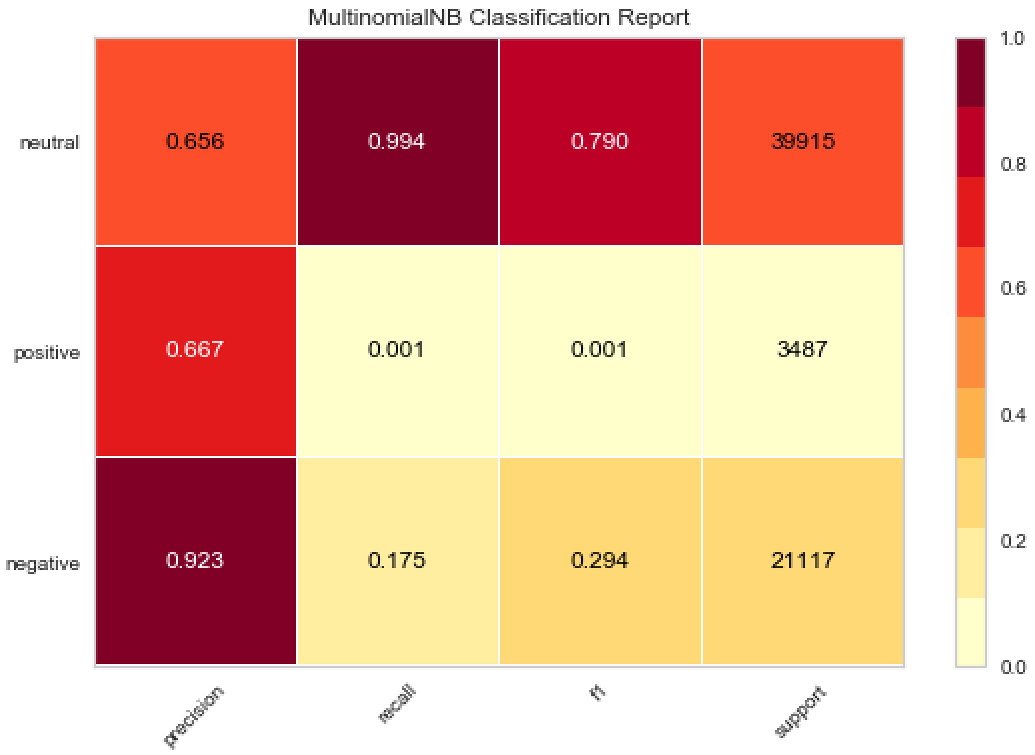
```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



```
Out[96]: <matplotlib.axes._subplots.AxesSubplot at 0x2049387b128>
```

```
In [153]: #y_pred_lr=model.predict(x_test)
          print("Accuracy_navibayes:",metrics.accuracy_score(y_test,y_predmnb))
```

```
Accuracy_navibayes: 0.6723755792867218
```

3. Decision Tree Classifier

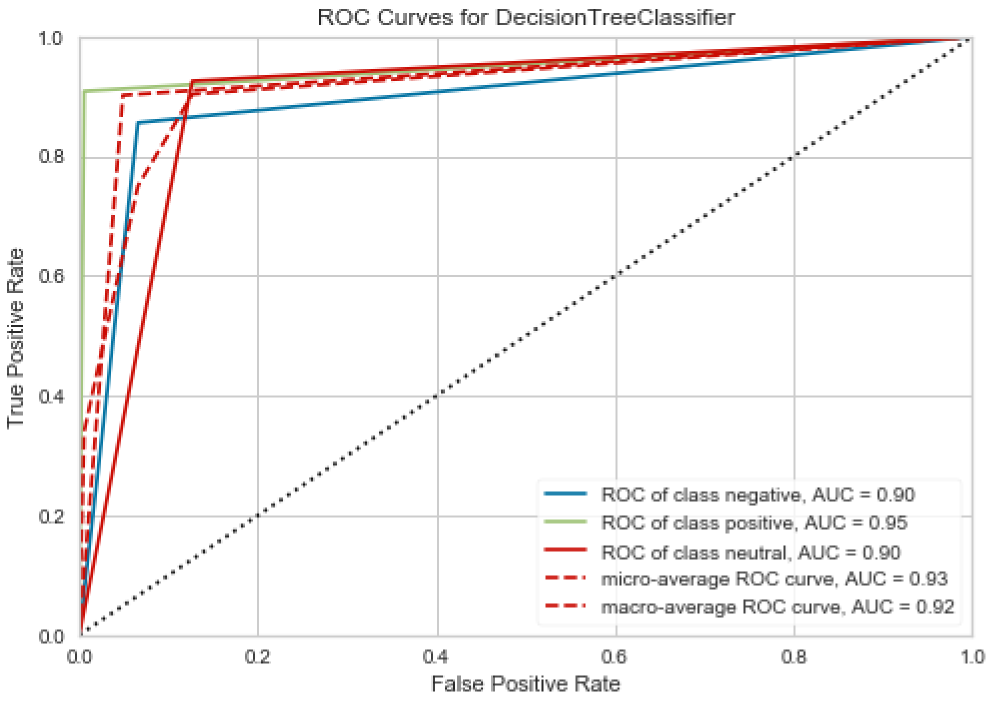
```
In [99]: import sklearn.metrics as metrics
         from sklearn.tree import DecisionTreeClassifier
         dt = DecisionTreeClassifier()
         dt = dt.fit(x_train,y_train)

         #Predict the response for test dataset
         y_predtree = dt.predict(x_test)
         print("Accuracy:tree",metrics.accuracy_score(y_test, y_predtree))
```

```
Accuracy:tree 0.9020288597157426
```

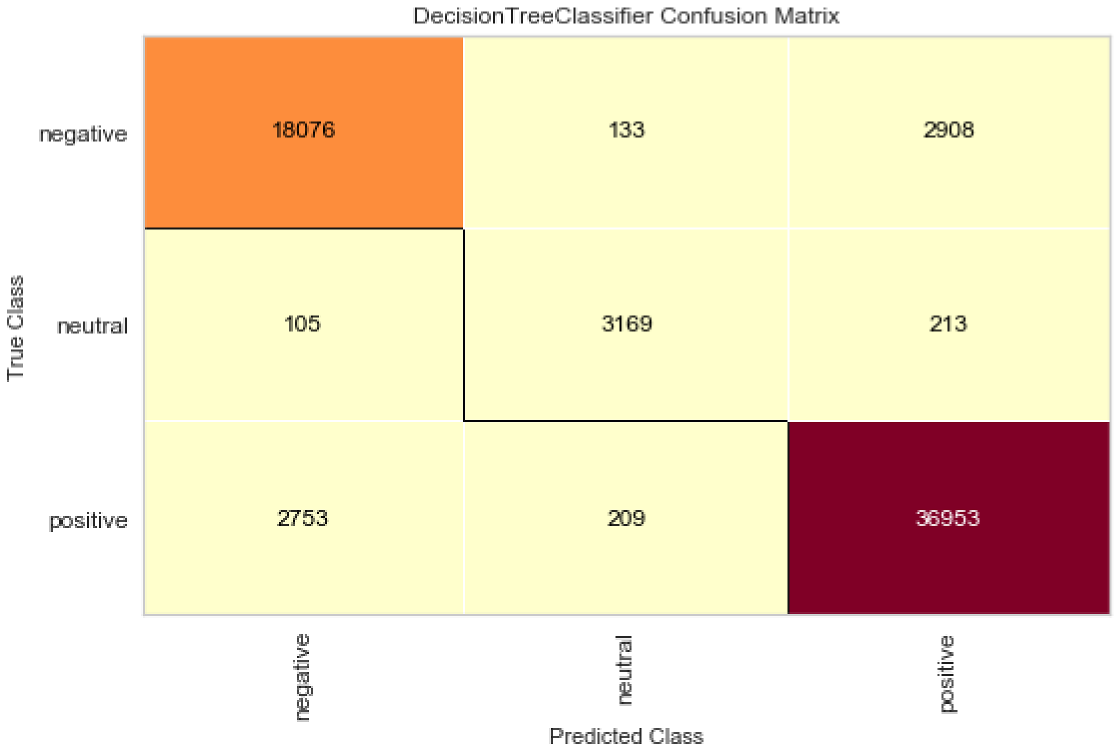
In [100]:

```
dt_roc = ROCAUC(dt, classes=['negative','positive','neutral'])
dt_roc.fit(x_train, y_train)        # Fit the training data to the visualizer
dt_roc.score(x_test, y_test)        # Evaluate the model on the test data
dt_roc.show()

#confusion matrix
dt_cm = ConfusionMatrix(dt)
dt_cm.fit(x_train, y_train)        # Fit the training data to the visualizer
dt_cm.score(x_test, y_test)        # Evaluate the model on the test data
dt_cm.show()

##classification report

dt_cr = ClassificationReport(dt, classes=['negative','positive','neutral'], su
pport=True)
dt_cr.fit(x_train, y_train)        # Fit the training data to the visualizer
dt_cr.score(x_test, y_test)        # Evaluate the model on the test data
dt_cr.show()
```

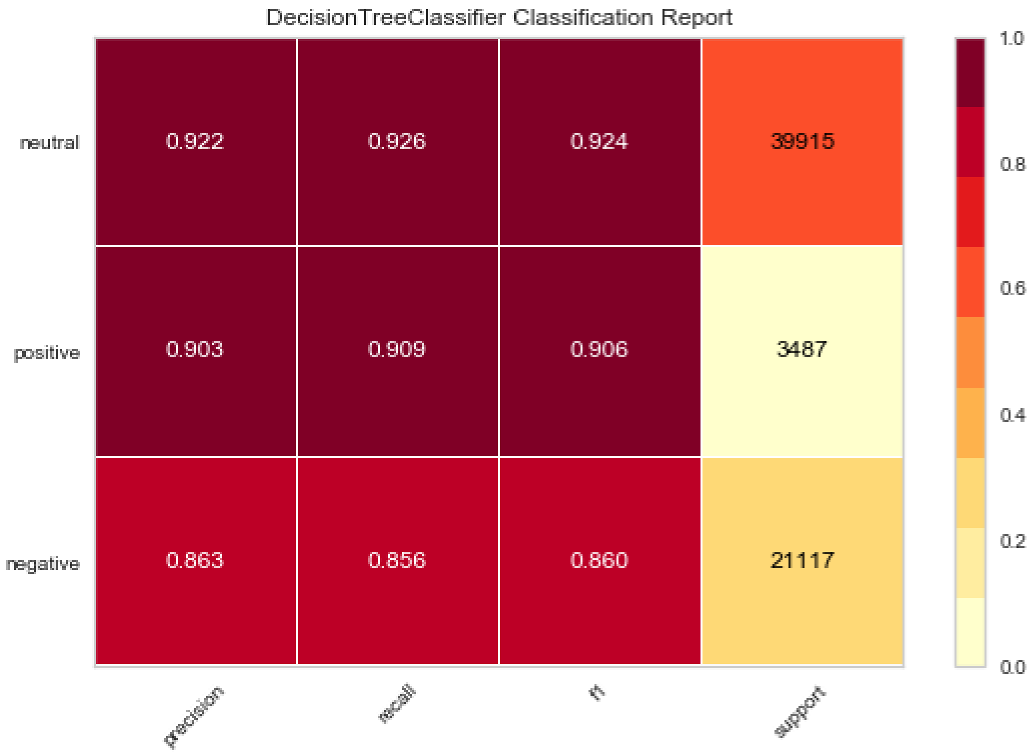
```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



```
Out[100]: <matplotlib.axes._subplots.AxesSubplot at 0x204d872de48>
```

```
In [154]: print("Accuracy_Decisiontree:",metrics.accuracy_score(y_test,y_predtree))
```

```
Accuracy_Decisiontree: 0.9020288597157426
```

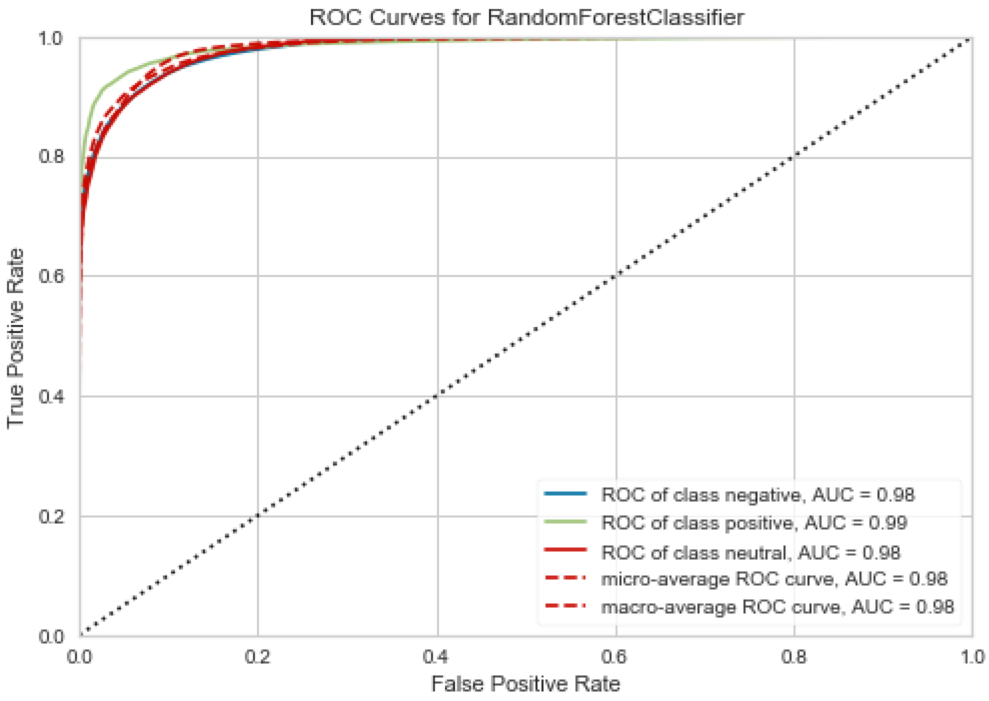
4. Random Forest

```
In [102]: from sklearn.ensemble import RandomForestClassifier
          rf = RandomForestClassifier(n_estimators=100)
```

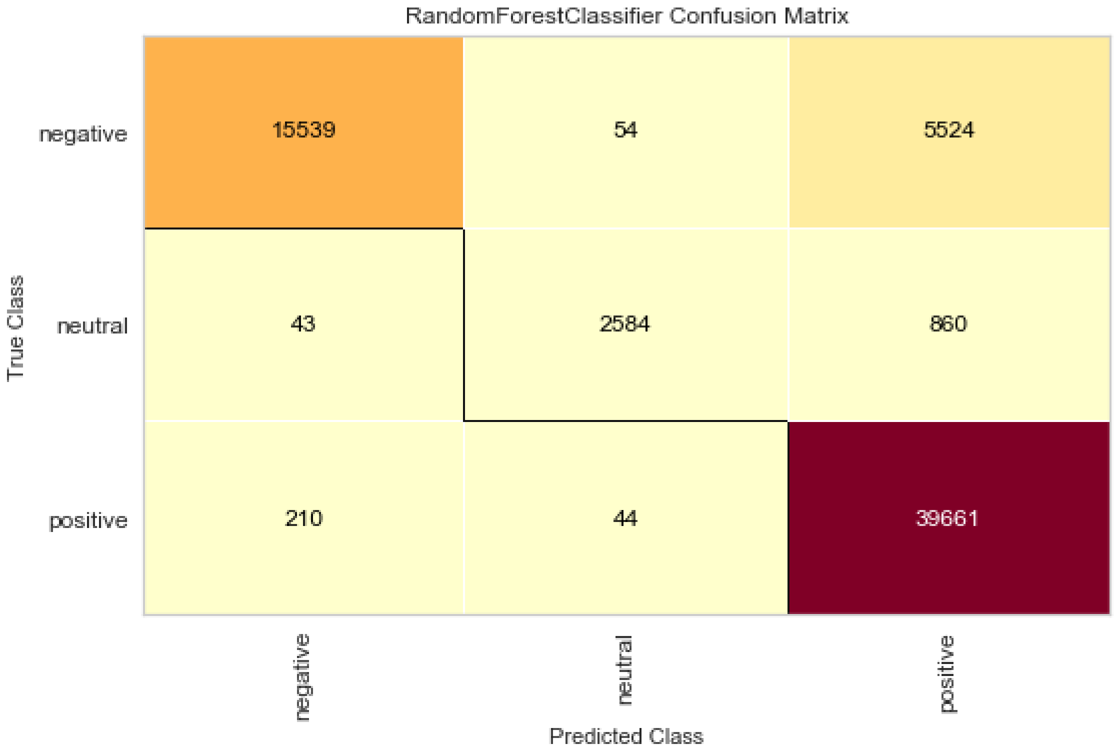
In [106]:

```
rf_roc = ROCAUC(rf, classes=['negative','positive','neutral'])
rf_roc.fit(x_train, y_train)        # Fit the training data to the visualizer
rf_roc.score(x_test, y_test)        # Evaluate the model on the test data
rf_roc.show()

#confusion matrix
rf_cm = ConfusionMatrix(rf)
rf_cm.fit(x_train, y_train)        # Fit the training data to the visualizer
rf_cm.score(x_test, y_test)        # Evaluate the model on the test data
rf_cm.show()

##classification report

rf_cr = ClassificationReport(rf, classes=['negative','positive','neutral'], su
pport=True)
rf_cr.fit(x_train, y_train)        # Fit the training data to the visualizer
rf_cr.score(x_test, y_test)        # Evaluate the model on the test data
rf_cr.show()
```

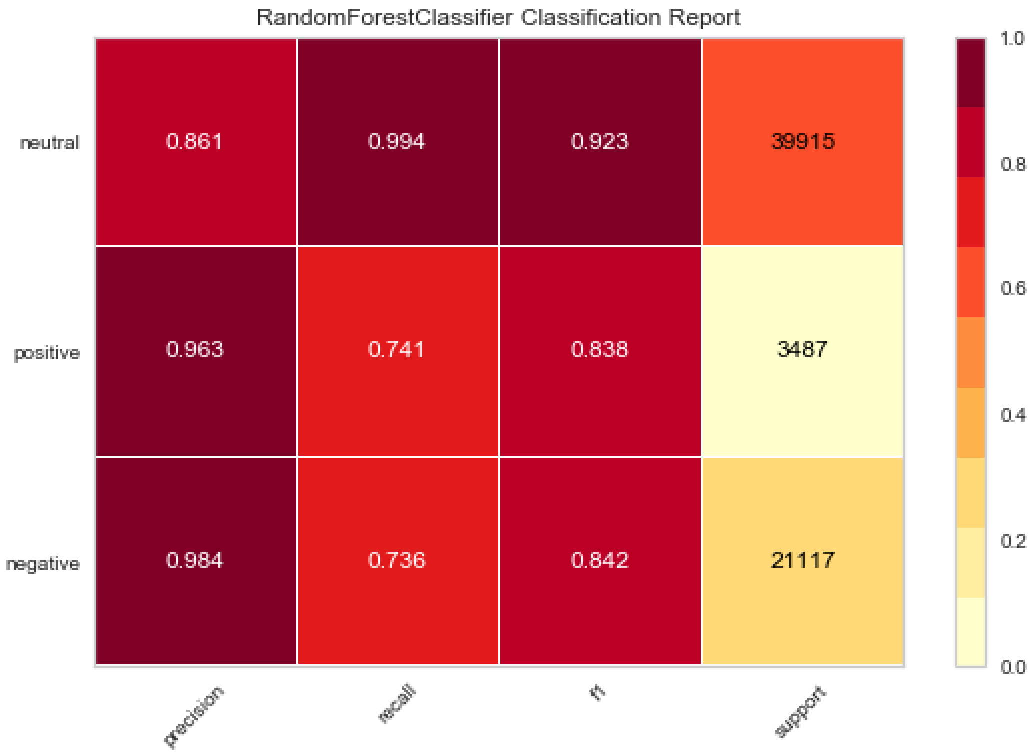
```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



```
Out[106]: <matplotlib.axes._subplots.AxesSubplot at 0x204404a4358>
```

```
In [155]: y_pred_rf=rf.predict(x_test)
          print("Accuracy_randomforsest:",metrics.accuracy_score(y_test,y_pred_rf))
```

```
Accuracy_randomforsest: 0.8956121452595359
```

5. Support Vector Machines

```
In [107]: from sklearn import svm
          clf = svm.SVC(kernel='linear',probability = True) # Linear Kernel

          #Train the model using the training sets
          svm = clf.fit(x_train, y_train)
```

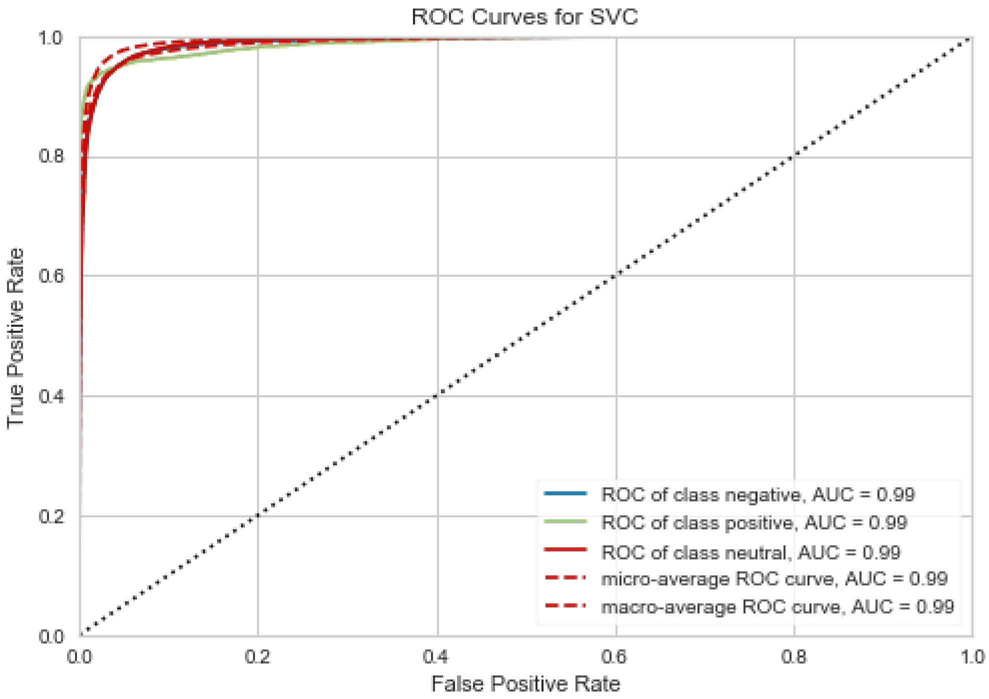
```
In [108]: #Predict the response for test dataset
          y_pred_svm = clf.predict(x_test)
```

```
In [117]: print("Accuracy_svm:",metrics.accuracy_score(y_test,y_pred_svm))
```

```
Accuracy_svm: 0.9501697174475736
```

In [110]:
```
svm_roc = ROCAUC(svm, classes=['negative','positive','neutral'])
svm_roc.fit(x_train, y_train)        # Fit the training data to the visualizer
svm_roc.score(x_test, y_test)        # Evaluate the model on the test data
svm_roc.show()
```

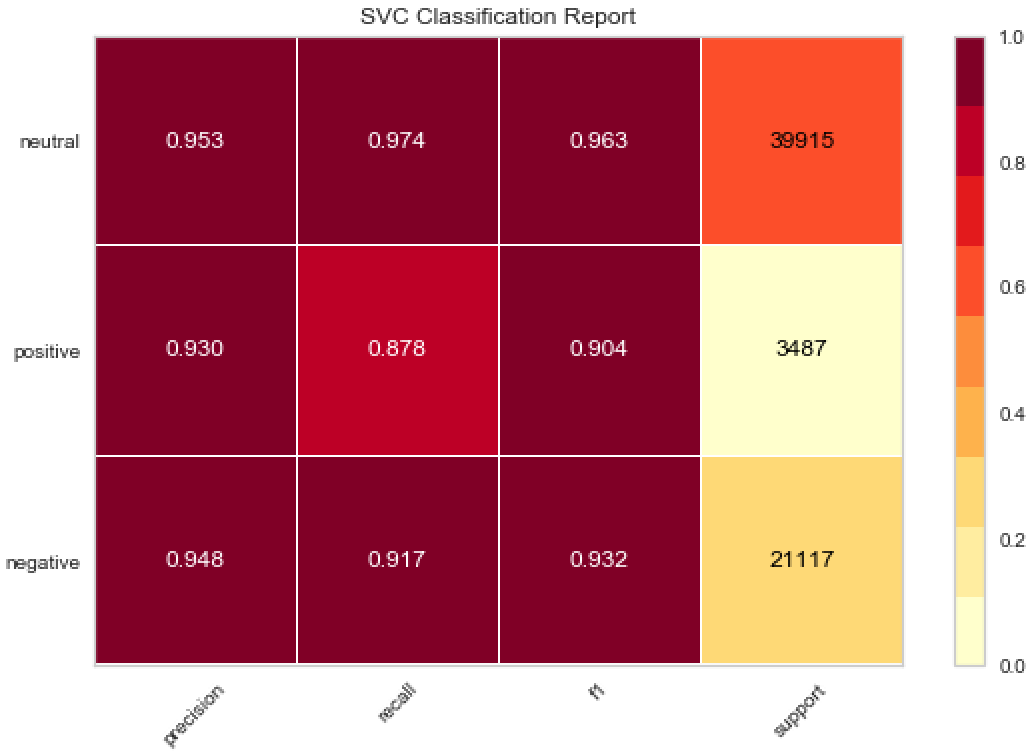
```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



Out[110]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x204cba53438>
```

In [115]:
```
svm_cr = ClassificationReport(svm, classes=['negative','positive','neutral'],
support=True)
svm_cr.score(x_test, y_test)        # Evaluate the model on the test data
svm_cr.show()
```

```
C:\ProgramData\Anaconda3\lib\site-packages\yellowbrick\classifier\base.py:23
2: YellowbrickWarning: could not determine class_counts_ from previously fitt
ed classifier
  YellowbrickWarning,
```

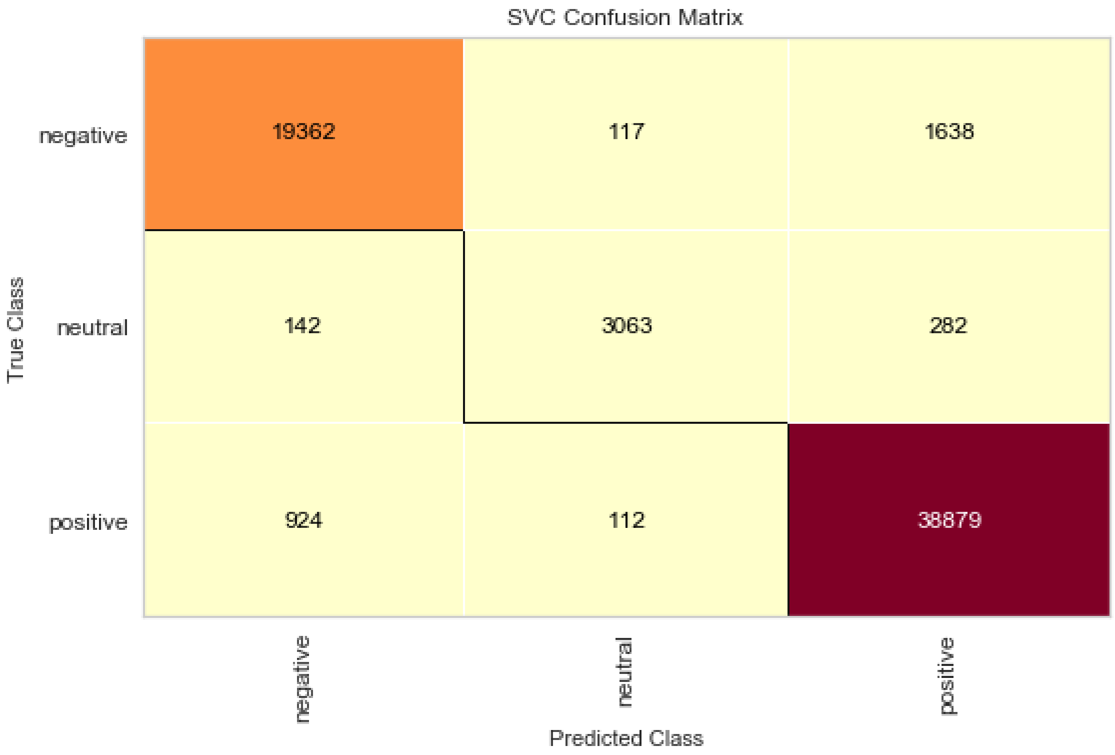


Out[115]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2043f130748>
```

In [118]:

```
#confusion matrix
svm_cm = ConfusionMatrix(svm)
svm_cm.fit(x_train, y_train)        # Fit the training data to the visualizer
svm_cm.score(x_test, y_test)        # Evaluate the model on the test data
svm_cm.show()
```

```
C:\Users\adari\AppData\Roaming\Python\Python37\site-packages\sklearn\base.py:
213: FutureWarning: From version 0.24, get_params will raise an AttributeErro
r if a parameter cannot be retrieved as an instance attribute. Previously it
would return None.
  FutureWarning)
```



Out[118]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x204cc008a90>
```

Feature importance

In [136]:

```
from yellowbrick.model_selection import FeatureImportances
```

In [139]:

```
feature_importances = pd.DataFrame(dt.feature_importances_,
                                   columns=['importance']).sort_value
s('importance', ascending=False)
```

In [141]:
```
feature_importances.head(5)
```

Out[141]:

	importance
16449	0.044340
39901	0.042791
37404	0.030712
84651	0.028394
37083	0.027371

In [140]:
```
feature_imp_rf = pd.DataFrame(rf.feature_importances_,
                                                   columns=['importance']).sort_value
s('importance', ascending=False)
```

In [143]:
```
feature_imp_rf.head(6)
```

Out[143]:

	importance
16449	0.014443
39901	0.011668
37404	0.011634
84651	0.010440
37083	0.008879
76637	0.008822

In [145]:
```
wordtf = pd.DataFrame(v.get_feature_names(),columns = ['wrd'])
```

In [147]:
```
wordtf.iloc[[16449,39901,37404,84651,37083,76637],]
```

Out[147]:

	wrd
16449	bad
39901	horrible
37404	great
84651	worst
37083	good
76637	terrible

In [ ]:
```

```