Google Analytics

March 24, 2019

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from pandas.io.json import json_normalize
import json
%matplotlib inline
```

In [2]:
```
#%reset -f
#del train
```

In [3]:
```
json_cols = ['device', 'geoNetwork', 'totals', 'trafficSource']
json_conv = {col: json.loads for col in (json_cols)}
train = pd.read_csv("train.csv",
                    #nrows = 10000,
                    dtype={'fullVisitorId': str},
                    converters={'device': json.loads,
                                'geoNetwork': json.loads,
                                'totals': json.loads,
                                'trafficSource': json.loads,
                               })
```

In [4]:
```
train.head()
```

Out[4]:

	channelGrouping	date	device	fullVisitorId
0	Organic Search	20160902	{'browser': 'Chrome', 'browserVersion': 'not a...	1131660440785968503
1	Organic Search	20160902	{'browser': 'Firefox', 'browserVersion': 'not ...	377306020877927890
2	Organic Search	20160902	{'browser': 'Chrome', 'browserVersion': 'not a...	3895546263509774583
3	Organic Search	20160902	{'browser': 'UC Browser', 'browserVersion': 'n...	4763447161404445595
4	Organic Search	20160902	{'browser': 'Chrome', 'browserVersion': 'not a...	27294437909732085

```
                                                 geoNetwork  \
0  {'continent': 'Asia', 'subContinent': 'Western...
1  {'continent': 'Oceania', 'subContinent': 'Aust...
2  {'continent': 'Europe', 'subContinent': 'South...
3  {'continent': 'Asia', 'subContinent': 'Southea...
4  {'continent': 'Europe', 'subContinent': 'North...

                          sessionId  socialEngagementType  \
0  1131660440785968503_1472830385  Not Socially Engaged
1   377306020877927890_1472880147  Not Socially Engaged
2  3895546263509774583_1472865386  Not Socially Engaged
3  4763447161404445595_1472881213  Not Socially Engaged
4    27294437909732085_1472822600  Not Socially Engaged

                                               totals  \
0  {'visits': '1', 'hits': '1', 'pageviews': '1',...
1  {'visits': '1', 'hits': '1', 'pageviews': '1',...
2  {'visits': '1', 'hits': '1', 'pageviews': '1',...
3  {'visits': '1', 'hits': '1', 'pageviews': '1',...
4  {'visits': '1', 'hits': '1', 'pageviews': '1',...

                                        trafficSource     visitId  visitNumber  \
0  {'campaign': '(not set)', 'source': 'google', ...  1472830385            1
1  {'campaign': '(not set)', 'source': 'google', ...  1472880147            1
2  {'campaign': '(not set)', 'source': 'google', ...  1472865386            1
3  {'campaign': '(not set)', 'source': 'google', ...  1472881213            1
4  {'campaign': '(not set)', 'source': 'google', ...  1472822600            2

   visitStartTime
0      1472830385
1      1472880147
2      1472865386
3      1472881213
4      1472822600
```

In [5]:
```
train.describe()
```

Out[5]:

	date	visitId	visitNumber	visitStartTime
count	9.036530e+05	9.036530e+05	903653.000000	9.036530e+05
mean	2.016589e+07	1.485007e+09	2.264897	1.485007e+09
std	4.697698e+03	9.022124e+06	9.283735	9.022124e+06
min	2.016080e+07	1.470035e+09	1.000000	1.470035e+09
25%	2.016103e+07	1.477561e+09	1.000000	1.477561e+09
50%	2.017011e+07	1.483949e+09	1.000000	1.483949e+09
75%	2.017042e+07	1.492759e+09	1.000000	1.492759e+09
max	2.017080e+07	1.501657e+09	395.000000	1.501657e+09

In [6]:
```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 903653 entries, 0 to 903652
Data columns (total 12 columns):
channelGrouping         903653 non-null object
date                    903653 non-null int64
device                  903653 non-null object
fullVisitorId           903653 non-null object
geoNetwork              903653 non-null object
sessionId               903653 non-null object
socialEngagementType    903653 non-null object
totals                  903653 non-null object
trafficSource           903653 non-null object
visitId                 903653 non-null int64
visitNumber             903653 non-null int64
visitStartTime          903653 non-null int64
dtypes: int64(4), object(8)
memory usage: 82.7+ MB
```

```
In [7]: def extractJsonColumns(df):
            for col in json_cols:
                print('Working on :' + col)
                jsonCol = json_normalize(df[col].tolist())
                jsonCol.columns = [col+'_'+jcol for jcol in jsonCol.columns]
                df = df.merge(jsonCol,left_index=True,right_index=True)
                df.drop(col,axis=1,inplace=True)
            return(df)
```

```
In [8]: train = extractJsonColumns(train)
        train.columns
```

```
Working on :device
Working on :geoNetwork
Working on :totals
Working on :trafficSource
```

```
Out[8]: Index(['channelGrouping', 'date', 'fullVisitorId', 'sessionId',
               'socialEngagementType', 'visitId', 'visitNumber', 'visitStartTime',
               'device_browser', 'device_browserSize', 'device_browserVersion',
               'device_deviceCategory', 'device_flashVersion', 'device_isMobile',
               'device_language', 'device_mobileDeviceBranding',
               'device_mobileDeviceInfo', 'device_mobileDeviceMarketingName',
               'device_mobileDeviceModel', 'device_mobileInputSelector',
               'device_operatingSystem', 'device_operatingSystemVersion',
               'device_screenColors', 'device_screenResolution', 'geoNetwork_city',
               'geoNetwork_cityId', 'geoNetwork_continent', 'geoNetwork_country',
               'geoNetwork_latitude', 'geoNetwork_longitude', 'geoNetwork_metro',
               'geoNetwork_networkDomain', 'geoNetwork_networkLocation',
```

```
       'geoNetwork_region', 'geoNetwork_subContinent', 'totals_bounces',
       'totals_hits', 'totals_newVisits', 'totals_pageviews',
       'totals_transactionRevenue', 'totals_visits', 'trafficSource_adContent',
       'trafficSource_adwordsClickInfo.adNetworkType',
       'trafficSource_adwordsClickInfo.criteriaParameters',
       'trafficSource_adwordsClickInfo.gclId',
       'trafficSource_adwordsClickInfo.isVideoAd',
       'trafficSource_adwordsClickInfo.page',
       'trafficSource_adwordsClickInfo.slot', 'trafficSource_campaign',
       'trafficSource_campaignCode', 'trafficSource_isTrueDirect',
       'trafficSource_keyword', 'trafficSource_medium',
       'trafficSource_referralPath', 'trafficSource_source'],
      dtype='object')
```

```
In [9]: len(train)
```

```
Out[9]: 903653
```

```
In [10]: def generateColumnInfo(df):
             cls = []
             nullCount = []
             nonNullCount = []
             nullsPct = []
             uniqCount = []
             dataType = []
             for i,col in enumerate(df.columns):
                 cls.append(col)
                 nullCount.append(df[col].isnull().sum())
                 nonNullCount.append(len(df)-df[col].isnull().sum())
                 nullsPct.append((df[col].isnull().sum())*(100)/len(df))
                 uniqCount.append(df[col].nunique())
                 dataType.append(df[col].dtype)

             column_info = pd.DataFrame(
                 {'ColumnName': cls,
                  'NullCount': nullCount,
                  'NonNullCount': nonNullCount,
                  'NullPercent': nullsPct,
                  'UniqueValueCount': uniqCount,
                  'DataType':dataType
                 })
             return(column_info)
```

```
In [11]: generateColumnInfo(train)
```

```
Out[11]:                                        ColumnName  NullCount  \
         0                                channelGrouping          0
         1                                           date          0
         2                                  fullVisitorId          0
```

3	sessionId	0
4	socialEngagementType	0
5	visitId	0
6	visitNumber	0
7	visitStartTime	0
8	device_browser	0
9	device_browserSize	0
10	device_browserVersion	0
11	device_deviceCategory	0
12	device_flashVersion	0
13	device_isMobile	0
14	device_language	0
15	device_mobileDeviceBranding	0
16	device_mobileDeviceInfo	0
17	device_mobileDeviceMarketingName	0
18	device_mobileDeviceModel	0
19	device_mobileInputSelector	0
20	device_operatingSystem	0
21	device_operatingSystemVersion	0
22	device_screenColors	0
23	device_screenResolution	0
24	geoNetwork_city	0
25	geoNetwork_cityId	0
26	geoNetwork_continent	0
27	geoNetwork_country	0
28	geoNetwork_latitude	0
29	geoNetwork_longitude	0
30	geoNetwork_metro	0
31	geoNetwork_networkDomain	0
32	geoNetwork_networkLocation	0
33	geoNetwork_region	0
34	geoNetwork_subContinent	0
35	totals_bounces	453023
36	totals_hits	0
37	totals_newVisits	200593
38	totals_pageviews	100
39	totals_transactionRevenue	892138
40	totals_visits	0
41	trafficSource_adContent	892707
42	trafficSource_adwordsClickInfo.adNetworkType	882193
43	trafficSource_adwordsClickInfo.criteriaParameters	0
44	trafficSource_adwordsClickInfo.gclId	882092
45	trafficSource_adwordsClickInfo.isVideoAd	882193
46	trafficSource_adwordsClickInfo.page	882193
47	trafficSource_adwordsClickInfo.slot	882193
48	trafficSource_campaign	0
49	trafficSource_campaignCode	903652
50	trafficSource_isTrueDirect	629648

51	trafficSource_keyword	502929
52	trafficSource_medium	0
53	trafficSource_referralPath	572712
54	trafficSource_source	0

	NonNullCount	NullPercent	UniqueValueCount	DataType
0	903653	0.000000	8	object
1	903653	0.000000	366	int64
2	903653	0.000000	714167	object
3	903653	0.000000	902755	object
4	903653	0.000000	1	object
5	903653	0.000000	886303	int64
6	903653	0.000000	384	int64
7	903653	0.000000	887159	int64
8	903653	0.000000	54	object
9	903653	0.000000	1	object
10	903653	0.000000	1	object
11	903653	0.000000	3	object
12	903653	0.000000	1	object
13	903653	0.000000	2	bool
14	903653	0.000000	1	object
15	903653	0.000000	1	object
16	903653	0.000000	1	object
17	903653	0.000000	1	object
18	903653	0.000000	1	object
19	903653	0.000000	1	object
20	903653	0.000000	20	object
21	903653	0.000000	1	object
22	903653	0.000000	1	object
23	903653	0.000000	1	object
24	903653	0.000000	649	object
25	903653	0.000000	1	object
26	903653	0.000000	6	object
27	903653	0.000000	222	object
28	903653	0.000000	1	object
29	903653	0.000000	1	object
30	903653	0.000000	94	object
31	903653	0.000000	28064	object
32	903653	0.000000	1	object
33	903653	0.000000	376	object
34	903653	0.000000	23	object
35	450630	50.132407	1	object
36	903653	0.000000	274	object
37	703060	22.198012	1	object
38	903553	0.011066	213	object
39	11515	98.725728	5332	object
40	903653	0.000000	1	object
41	10946	98.788694	44	object

```
42         21460    97.625195                2   object
43        903653     0.000000                1   object
44         21561    97.614018            17774   object
45         21460    97.625195                1   object
46         21460    97.625195                8   object
47         21460    97.625195                2   object
48        903653     0.000000               10   object
49             1    99.999889                1   object
50        274005    69.678073                1   object
51        400724    55.655102             3659   object
52        903653     0.000000                7   object
53        330941    63.377425             1475   object
54        903653     0.000000              380   object
```

0.0.1 Test

```
In [12]: json_cols = ['device', 'geoNetwork', 'totals', 'trafficSource']
         json_conv = {col: json.loads for col in (json_cols)}
         test = pd.read_csv("test.csv",
                            #nrows = 10000,
                            dtype={'fullVisitorId': str},
                            converters={'device': json.loads,
                                        'geoNetwork': json.loads,
                                        'totals': json.loads,
                                        'trafficSource': json.loads,
                                       })

In [13]: len(test)

Out[13]: 804684

In [14]: test.head()

Out[14]:   channelGrouping      date  \
         0  Organic Search  20171016
         1  Organic Search  20171016
         2  Organic Search  20171016
         3  Organic Search  20171016
         4  Organic Search  20171016

                                                    device        fullVisitorId  \
         0  {'browser': 'Chrome', 'browserVersion': 'not a...  6167871330617112363
         1  {'browser': 'Chrome', 'browserVersion': 'not a...  0643697640977915618
         2  {'browser': 'Chrome', 'browserVersion': 'not a...  6059383810968229466
         3  {'browser': 'Safari', 'browserVersion': 'not a...  2376720078563423631
         4  {'browser': 'Safari', 'browserVersion': 'not a...  2314544520795440038

                                                 geoNetwork  \
         0  {'continent': 'Asia', 'subContinent': 'Southea...
```

```
1  {'continent': 'Europe', 'subContinent': 'South...
2  {'continent': 'Europe', 'subContinent': 'Weste...
3  {'continent': 'Americas', 'subContinent': 'Nor...
4  {'continent': 'Americas', 'subContinent': 'Nor...

                        sessionId  socialEngagementType  \
0  6167871330617112363_1508151024  Not Socially Engaged
1  0643697640977915618_1508175522  Not Socially Engaged
2  6059383810968229466_1508143220  Not Socially Engaged
3  2376720078563423631_1508193530  Not Socially Engaged
4  2314544520795440038_1508217442  Not Socially Engaged

                                            totals  \
0    {'visits': '1', 'hits': '4', 'pageviews': '4'}
1  {'visits': '1', 'hits': '5', 'pageviews': '5',...
2  {'visits': '1', 'hits': '7', 'pageviews': '7',...
3  {'visits': '1', 'hits': '8', 'pageviews': '4',...
4  {'visits': '1', 'hits': '9', 'pageviews': '4',...

                                      trafficSource     visitId  visitNumber  \
0  {'campaign': '(not set)', 'source': 'google', ...  1508151024            2
1  {'campaign': '(not set)', 'source': 'google', ...  1508175522            1
2  {'campaign': '(not set)', 'source': 'google', ...  1508143220            1
3  {'campaign': '(not set)', 'source': 'google', ...  1508193530            1
4  {'campaign': '(not set)', 'source': 'google', ...  1508217442            1

   visitStartTime
0      1508151024
1      1508175522
2      1508143220
3      1508193530
4      1508217442
```

```
In [15]: test = extractJsonColumns(test)
         test.columns

Working on :device
Working on :geoNetwork
Working on :totals
Working on :trafficSource


Out[15]: Index(['channelGrouping', 'date', 'fullVisitorId', 'sessionId',
                'socialEngagementType', 'visitId', 'visitNumber', 'visitStartTime',
                'device_browser', 'device_browserSize', 'device_browserVersion',
                'device_deviceCategory', 'device_flashVersion', 'device_isMobile',
                'device_language', 'device_mobileDeviceBranding',
                'device_mobileDeviceInfo', 'device_mobileDeviceMarketingName',
```

```
       'device_mobileDeviceModel', 'device_mobileInputSelector',
       'device_operatingSystem', 'device_operatingSystemVersion',
       'device_screenColors', 'device_screenResolution', 'geoNetwork_city',
       'geoNetwork_cityId', 'geoNetwork_continent', 'geoNetwork_country',
       'geoNetwork_latitude', 'geoNetwork_longitude', 'geoNetwork_metro',
       'geoNetwork_networkDomain', 'geoNetwork_networkLocation',
       'geoNetwork_region', 'geoNetwork_subContinent', 'totals_bounces',
       'totals_hits', 'totals_newVisits', 'totals_pageviews', 'totals_visits',
       'trafficSource_adContent',
       'trafficSource_adwordsClickInfo.adNetworkType',
       'trafficSource_adwordsClickInfo.criteriaParameters',
       'trafficSource_adwordsClickInfo.gclId',
       'trafficSource_adwordsClickInfo.isVideoAd',
       'trafficSource_adwordsClickInfo.page',
       'trafficSource_adwordsClickInfo.slot', 'trafficSource_campaign',
       'trafficSource_isTrueDirect', 'trafficSource_keyword',
       'trafficSource_medium', 'trafficSource_referralPath',
       'trafficSource_source'],
      dtype='object')
```

In [16]:
```
generateColumnInfo(test)
```

Out[16]:

	ColumnName	NullCount
0	channelGrouping	0
1	date	0
2	fullVisitorId	0
3	sessionId	0
4	socialEngagementType	0
5	visitId	0
6	visitNumber	0
7	visitStartTime	0
8	device_browser	0
9	device_browserSize	0
10	device_browserVersion	0
11	device_deviceCategory	0
12	device_flashVersion	0
13	device_isMobile	0
14	device_language	0
15	device_mobileDeviceBranding	0
16	device_mobileDeviceInfo	0
17	device_mobileDeviceMarketingName	0
18	device_mobileDeviceModel	0
19	device_mobileInputSelector	0
20	device_operatingSystem	0
21	device_operatingSystemVersion	0
22	device_screenColors	0
23	device_screenResolution	0
24	geoNetwork_city	0

25	geoNetwork_cityId	0
26	geoNetwork_continent	0
27	geoNetwork_country	0
28	geoNetwork_latitude	0
29	geoNetwork_longitude	0
30	geoNetwork_metro	0
31	geoNetwork_networkDomain	0
32	geoNetwork_networkLocation	0
33	geoNetwork_region	0
34	geoNetwork_subContinent	0
35	totals_bounces	383736
36	totals_hits	0
37	totals_newVisits	200314
38	totals_pageviews	139
39	totals_visits	0
40	trafficSource_adContent	750893
41	trafficSource_adwordsClickInfo.adNetworkType	750870
42	trafficSource_adwordsClickInfo.criteriaParameters	0
43	trafficSource_adwordsClickInfo.gclId	750822
44	trafficSource_adwordsClickInfo.isVideoAd	750870
45	trafficSource_adwordsClickInfo.page	750870
46	trafficSource_adwordsClickInfo.slot	750870
47	trafficSource_campaign	0
48	trafficSource_isTrueDirect	544171
49	trafficSource_keyword	391032
50	trafficSource_medium	0
51	trafficSource_referralPath	569361
52	trafficSource_source	0

	NonNullCount	NullPercent	UniqueValueCount	DataType
0	804684	0.000000	8	object
1	804684	0.000000	272	int64
2	804684	0.000000	617242	object
3	804684	0.000000	803863	object
4	804684	0.000000	1	object
5	804684	0.000000	779504	int64
6	804684	0.000000	446	int64
7	804684	0.000000	780264	int64
8	804684	0.000000	109	object
9	804684	0.000000	1	object
10	804684	0.000000	1	object
11	804684	0.000000	3	object
12	804684	0.000000	1	object
13	804684	0.000000	2	bool
14	804684	0.000000	1	object
15	804684	0.000000	1	object
16	804684	0.000000	1	object
17	804684	0.000000	1	object

18	804684	0.000000	1	object
19	804684	0.000000	1	object
20	804684	0.000000	22	object
21	804684	0.000000	1	object
22	804684	0.000000	1	object
23	804684	0.000000	1	object
24	804684	0.000000	732	object
25	804684	0.000000	1	object
26	804684	0.000000	6	object
27	804684	0.000000	219	object
28	804684	0.000000	1	object
29	804684	0.000000	1	object
30	804684	0.000000	109	object
31	804684	0.000000	25750	object
32	804684	0.000000	1	object
33	804684	0.000000	376	object
34	804684	0.000000	23	object
35	420948	47.687788	1	object
36	804684	0.000000	229	object
37	604370	24.893499	1	object
38	804545	0.017274	160	object
39	804684	0.000000	1	object
40	53791	93.315264	51	object
41	53814	93.312406	3	object
42	804684	0.000000	1	object
43	53862	93.306441	41317	object
44	53814	93.312406	1	object
45	53814	93.312406	10	object
46	53814	93.312406	3	object
47	804684	0.000000	31	object
48	260513	67.625428	1	object
49	413652	48.594479	2415	object
50	804684	0.000000	7	object
51	235323	70.755850	2197	object
52	804684	0.000000	324	object

0.1 Drop Columns

```
In [17]: set(train.columns).difference(set(test.columns))
```

```
Out[17]: {'totals_transactionRevenue', 'trafficSource_campaignCode'}
```

```
In [18]: train.drop('trafficSource_campaignCode',axis=1,inplace=True)
```

```
In [19]: trn_colInfo = generateColumnInfo(train)
         trn_colInfo[(trn_colInfo['NullCount'] == 0) & (trn_colInfo['UniqueValueCount'] == 1)]
```

```
Out[19]:                                        ColumnName  NullCount  \
         4                          socialEngagementType          0
```

```
9                                    device_browserSize          0
10                                 device_browserVersion         0
12                                   device_flashVersion         0
14                                       device_language         0
15                            device_mobileDeviceBranding        0
16                                device_mobileDeviceInfo        0
17                       device_mobileDeviceMarketingName        0
18                               device_mobileDeviceModel        0
19                             device_mobileInputSelector        0
21                          device_operatingSystemVersion        0
22                                   device_screenColors        0
23                                device_screenResolution       0
25                                      geoNetwork_cityId        0
28                                   geoNetwork_latitude        0
29                                  geoNetwork_longitude        0
32                             geoNetwork_networkLocation       0
40                                        totals_visits         0
43  trafficSource_adwordsClickInfo.criteriaParameters          0

    NonNullCount  NullPercent  UniqueValueCount DataType
4         903653          0.0                 1   object
9         903653          0.0                 1   object
10        903653          0.0                 1   object
12        903653          0.0                 1   object
14        903653          0.0                 1   object
15        903653          0.0                 1   object
16        903653          0.0                 1   object
17        903653          0.0                 1   object
18        903653          0.0                 1   object
19        903653          0.0                 1   object
21        903653          0.0                 1   object
22        903653          0.0                 1   object
23        903653          0.0                 1   object
25        903653          0.0                 1   object
28        903653          0.0                 1   object
29        903653          0.0                 1   object
32        903653          0.0                 1   object
40        903653          0.0                 1   object
43        903653          0.0                 1   object
```

These columns have a single unique value. They can be dropped.

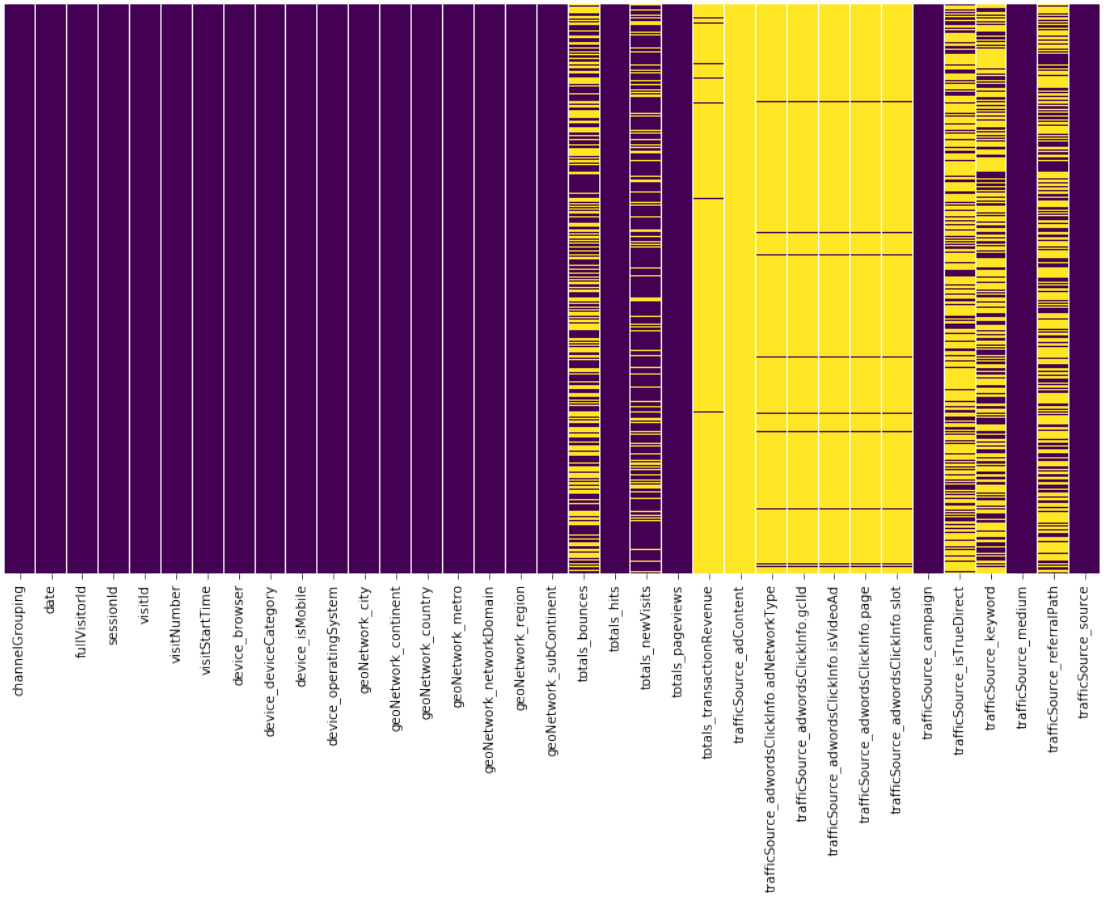
```
In [20]: train.drop(['socialEngagementType',
         'device_browserSize',
         'device_browserVersion',
         'device_flashVersion',
         'device_language',
         'device_mobileDeviceBranding',
```

```
        'device_mobileDeviceInfo',
        'device_mobileDeviceMarketingName',
        'device_mobileDeviceModel',
        'device_mobileInputSelector',
        'device_operatingSystemVersion',
        'device_screenColors',
        'device_screenResolution',
        'geoNetwork_cityId',
        'geoNetwork_latitude',
        'geoNetwork_longitude',
        'geoNetwork_networkLocation',
        'totals_visits',
        'trafficSource_adwordsClickInfo.criteriaParameters'],axis=1,inplace=True)
```

0.2 Missing Values and EDA

```
In [21]: plt.figure(figsize=(15,8))
         sns.heatmap(train.isnull(),yticklabels=False,cbar=False,cmap='viridis')
```

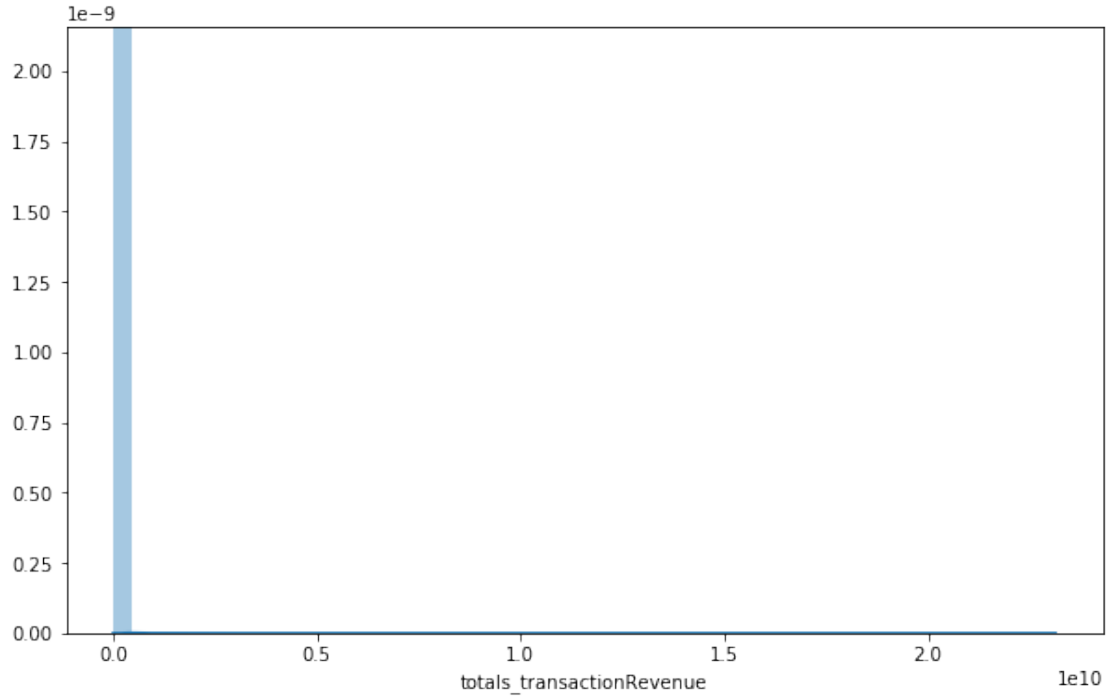
```
Out[21]: <matplotlib.axes._subplots.AxesSubplot at 0x1d984634320>
```



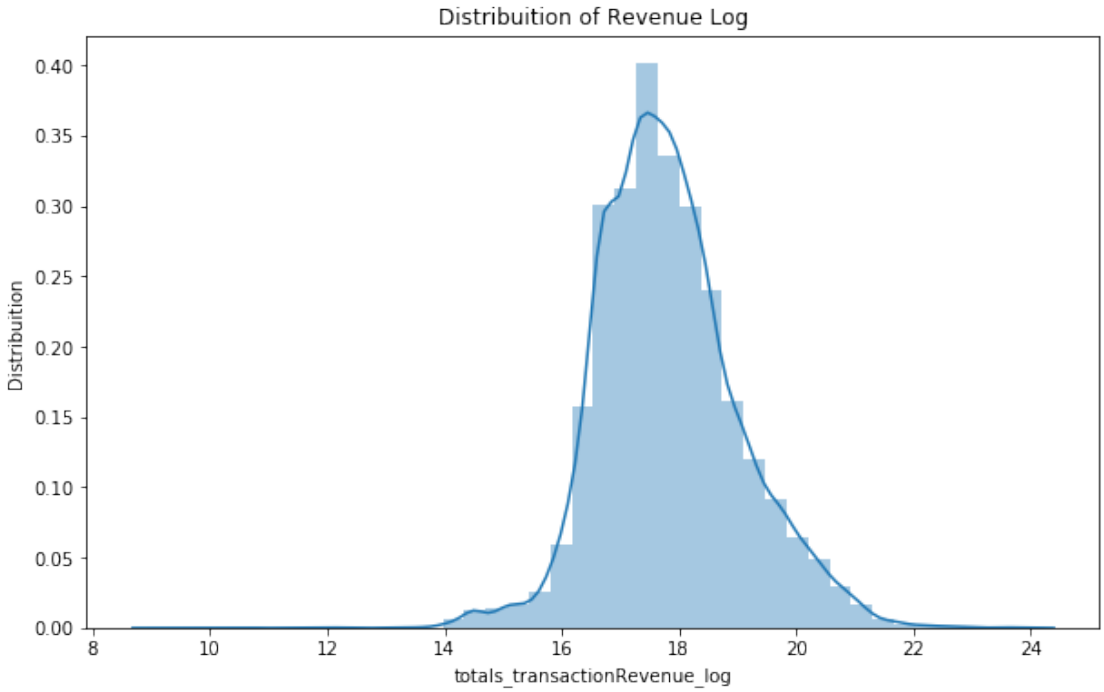
```
In [22]: def plot_colCount(df,col,xtick=0,w=12,h=7):
             plt.figure(figsize=(w,h))
             p = sns.countplot(data =df,x=col)
             plt.xticks(rotation=xtick)
             plt.title('Count of ' + col)
             plt.show()

         def plot_totalRevenue(df,col,xtick=0,w=12,h=7):
             groupedDf = df.groupby(col,as_index=False)['totals_transactionRevenue'].sum()
             groupedDf = groupedDf[groupedDf['totals_transactionRevenue']>0]
             plt.figure(figsize=(w,h))
             p = sns.barplot(data=groupedDf,x=col,y='totals_transactionRevenue')
             plt.xticks(rotation=xtick)
             plt.title('Total revenue by ' + col)
             plt.show()

         def plot_revenuePerUnitCol(df,col,xtick=0,w=12,h=7):
             plt.figure(figsize=(w,h))
             plt.ylim()
             p = sns.barplot(data =df,x=col,y='totals_transactionRevenue',ci=False)
             plt.xticks(rotation=xtick)
             plt.title('Revenue per visit')
             plt.show()
```

0.2.1 Target Column

```
In [134]: print(train['totals_transactionRevenue'].isnull().sum())

0


In [135]: train['totals_transactionRevenue'].fillna(0,inplace=True)
          train['totals_transactionRevenue'] = train['totals_transactionRevenue'].astype('int64

In [145]: plt.figure(figsize=[10,6])
          ax.set_ylabel('Distribuition')
          sns.distplot(train['totals_transactionRevenue'])

Out[145]: <matplotlib.axes._subplots.AxesSubplot at 0x1d877e149e8>
```



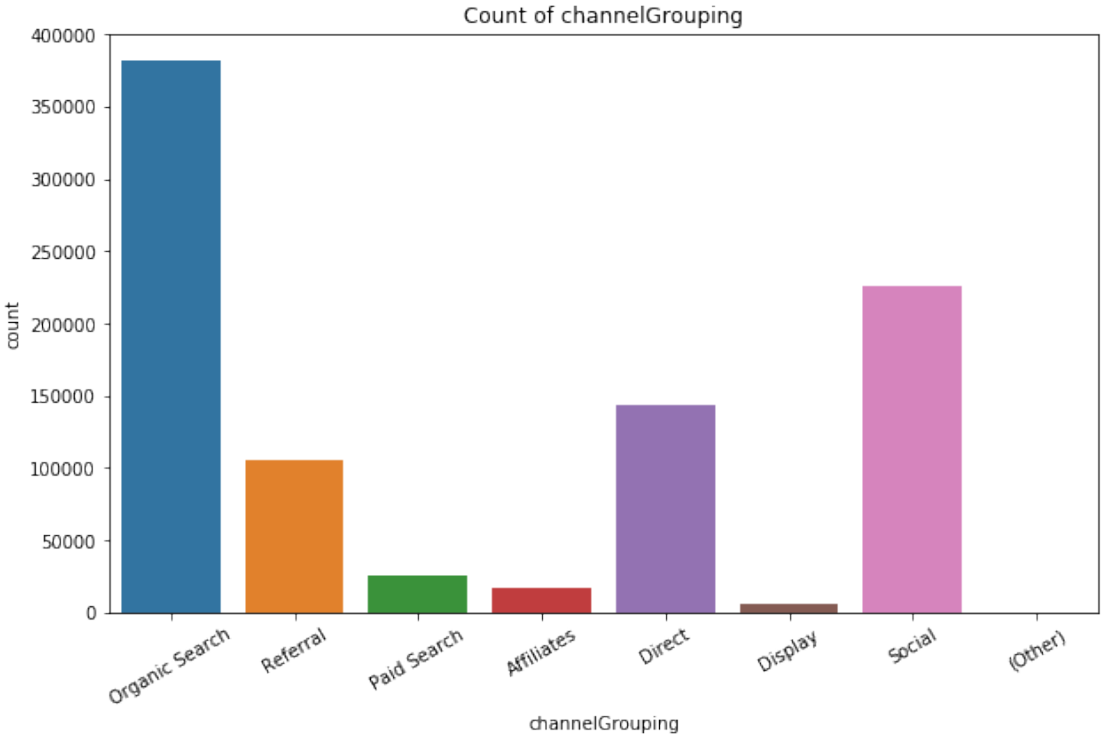

```
In [147]: plt.figure(figsize=[10,6])
          ax = sns.distplot(np.log(train[train['totals_transactionRevenue'] > 0]["totals_transa
          ax.set_xlabel('totals_transactionRevenue_log') #seting the xlabel and size of font
          ax.set_ylabel('Distribuition') #seting the ylabel and size of font
          ax.set_title("Distribuition of Revenue Log") #seting the title and size of font

Out[147]: Text(0.5,1,'Distribuition of Revenue Log')
```

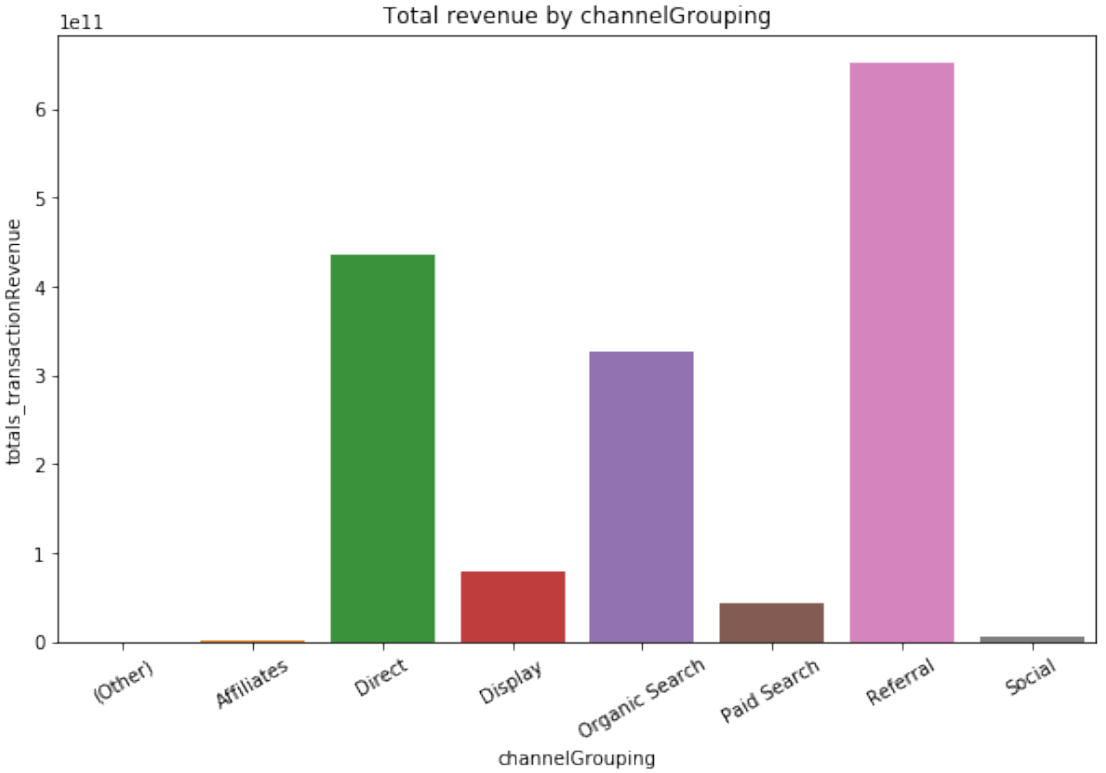


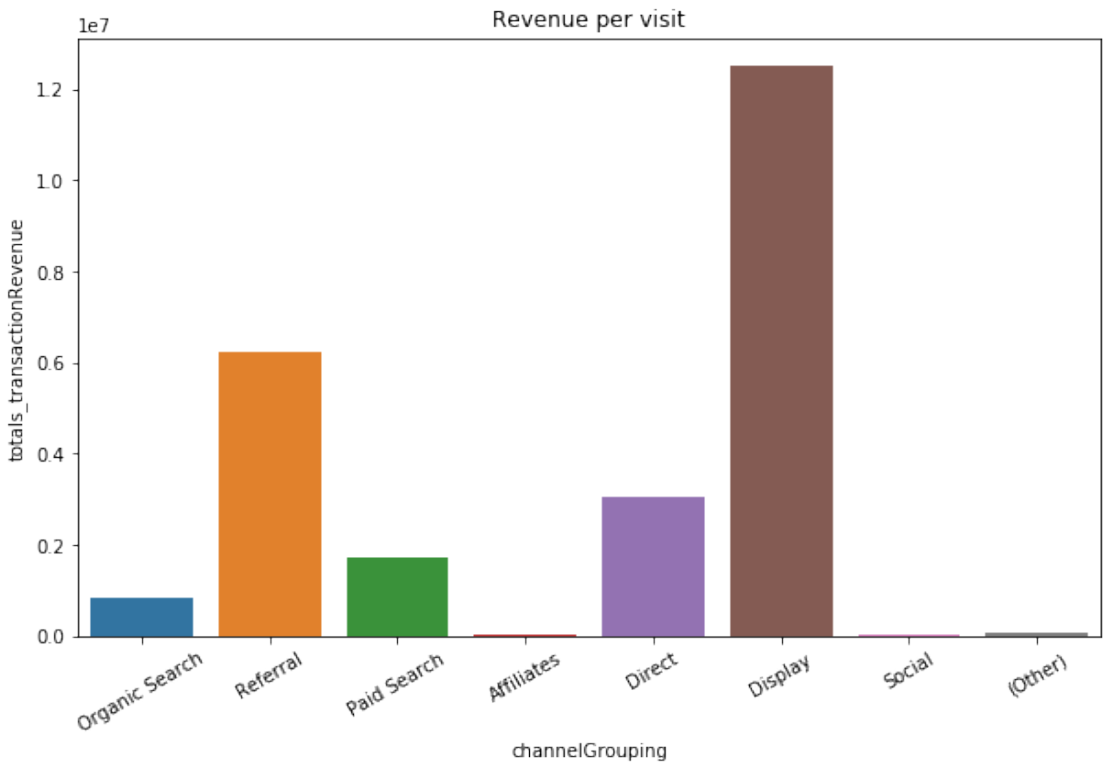

```
In [ ]: ax = sns.distplot(np.log(df_train[df_train['totals.transactionRevenue'] > 0]["totals.t
        ax.set_xlabel('Transaction RevenueLog', fontsize=15) #seting the xlabel and size of fo
        ax.set_ylabel('Distribuition', fontsize=15) #seting the ylabel and size of font
        ax.set_title("Distribuition of Revenue Log", fontsize=20) #seting the title and size o
```

0.2.2 Channel Grouping

```
In [26]: plot_colCount(train,'channelGrouping',30,10,6)
         plot_totalRevenue(train,'channelGrouping',30,10,6)
         plot_revenuePerUnitCol(train,'channelGrouping',30,10,6)
```


Count of channelGrouping
count
channelGrouping
Organic Search
Referral
Paid Search
Affiliates
Direct
Display
Social
(Other)

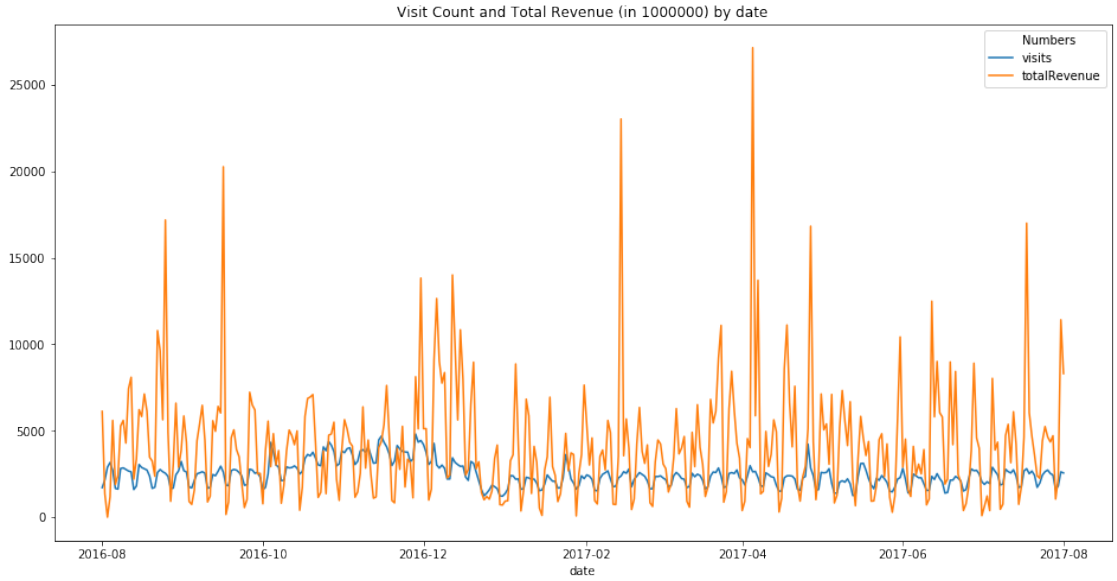

Total revenue by channelGrouping
1e11
totals_transactionRevenue
channelGrouping
(Other)
Affiliates
Direct
Display
Organic Search
Paid Search
Referral
Social



- Organic search generates the most number of visits
- Referral generates the 4th most number of visits but generates the most revenue
- Display generates the most revenue per visit

0.2.3 Date

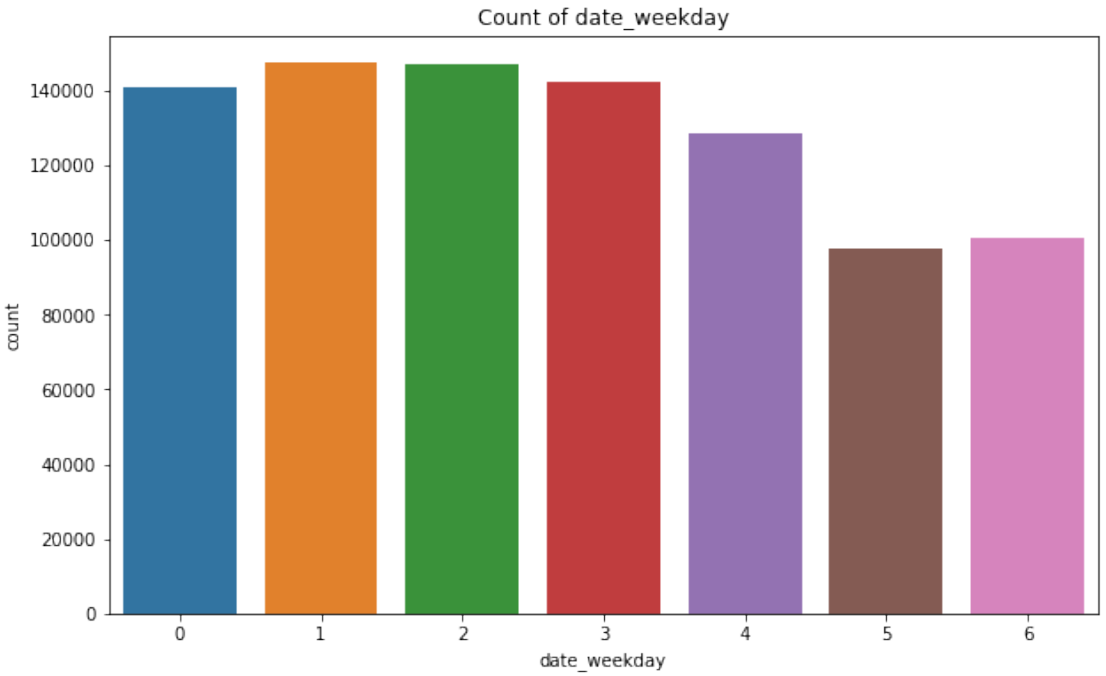
```
In [27]: train['date'] = pd.to_datetime(train['date'],format='%Y%m%d')

In [28]: import math
         byDate = train.groupby('date',as_index=False).agg({'visitId':'count','totals_transacti
         byDate['totalRevenue'] = byDate['totalRevenue']/1000000
         byDateFlat = byDate.melt('date',var_name ='Numbers',value_name='values')

In [29]: plt.figure(figsize=(16,8))
         new_labels = ['label 1', 'label 2']
         sns.lineplot(data=byDateFlat,x='date',y='values',hue='Numbers')
         plt.title('Visit Count and Total Revenue (in 1000000) by date')
         plt.ylabel('')
         plt.show()
         del byDateFlat
         del byDate
```



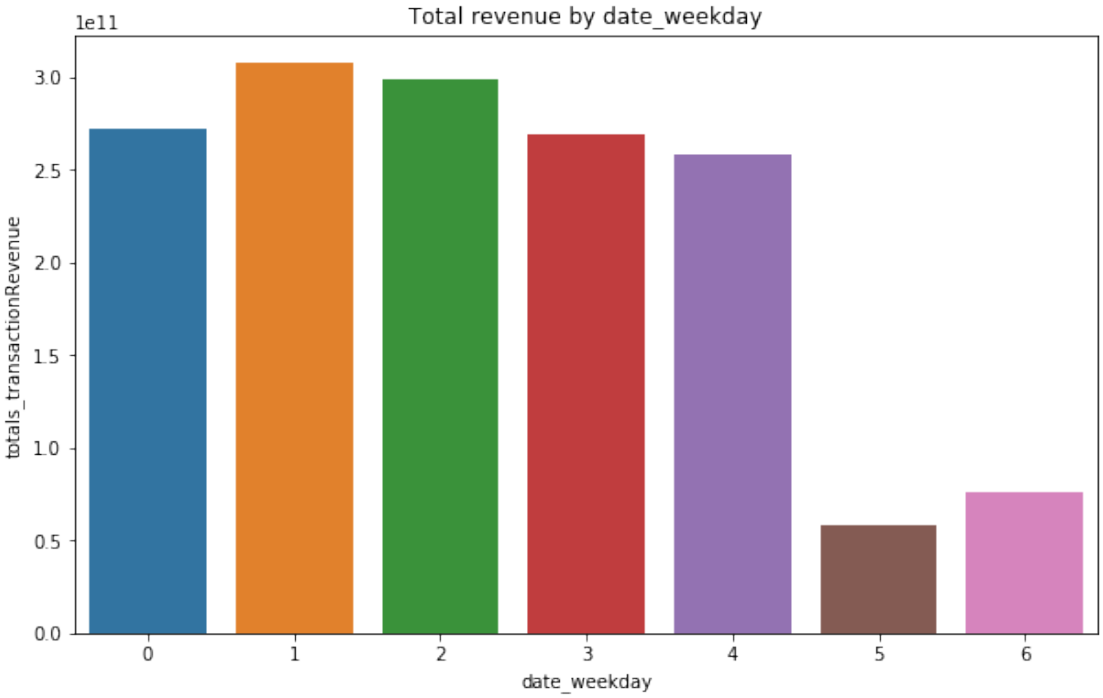
- There is an increase in visits during the holiday period
- There is an increase in the revenue during the same period

```
In [30]: train['date_year'],train['date_month'],train['date_weekday'] = train['date'].dt.year,t
         train.drop('date',axis=1,inplace=True)
```

```
In [31]: plot_colCount(train,'date_weekday',0,10,6)
```

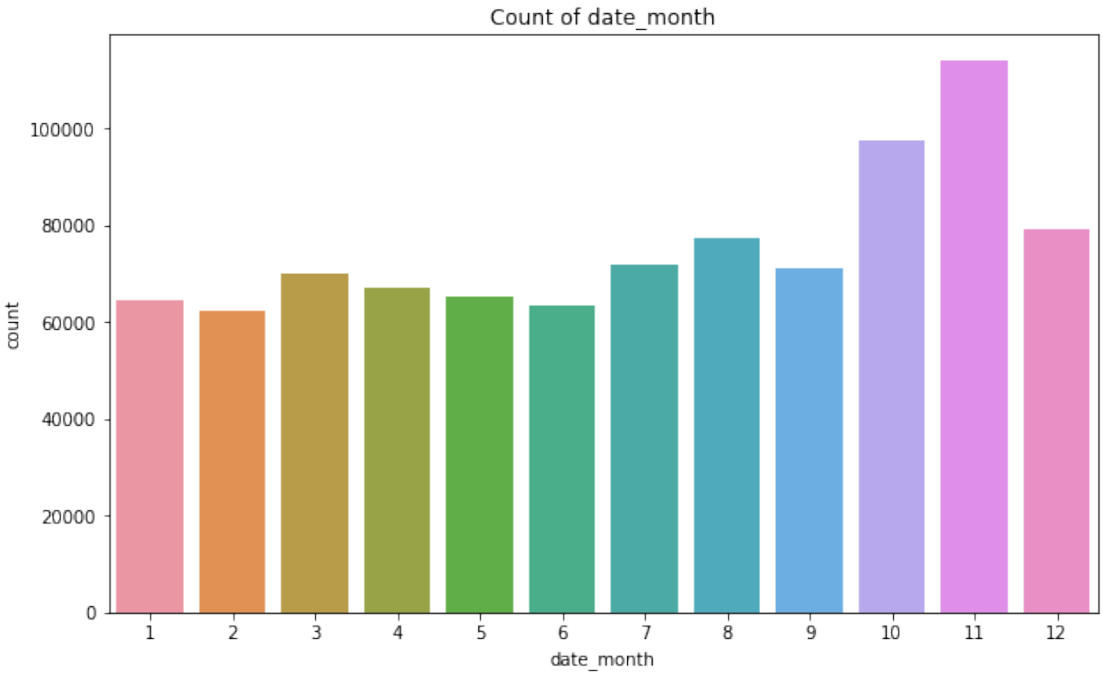


```
In [32]: plot_totalRevenue(train,'date_weekday',0,10,6)
         #Monday=0, Sunday=6
```



- Tuesdays, Wednesdays and Thursdays generate the most visits and revenue

```
In [33]: plot_colCount(train,'date_month',0,10,6)
```



In [34]: `plot_totalRevenue(train,'date_month',0,10,6)`

- October and November have the highest traffic
- April, Agust and December generate the most revenue

0.2.4 fullVisitorId

```
In [35]: train['fullVisitorId'].value_counts().head(10)

Out[35]: 1957458976293878100    278
         0824839726118485274    255
         3608475193341679870    201
         1856749147915772585    199
         3269834865385146569    155
         0720311197761340948    153
         7634897085866546110    148
         4038076683036146727    138
         0232377434237234751    135
         3694234028523165868    129
         Name: fullVisitorId, dtype: int64

In [36]: train.groupby('fullVisitorId').sum()['totals_transactionRevenue'].sort_values(ascendi

Out[36]: fullVisitorId
         1957458976293878100    77113430000
         5632276788326171571    16023750000
         9417857471295131045    15170120000
         4471415710206918415    11211100000
         4984366501121503466     9513900000
         9089132392240687728     8951970000
         9029794295932939024     7846350000
         7463172420271311409     7225100000
         7311242886083854158     7143250000
         79204932396995037       7047150000
         Name: totals_transactionRevenue, dtype: int64
```

- Visitor ID 1957458976293878100 has 278 visits and generates the most revenue

0.2.5 visitNumber

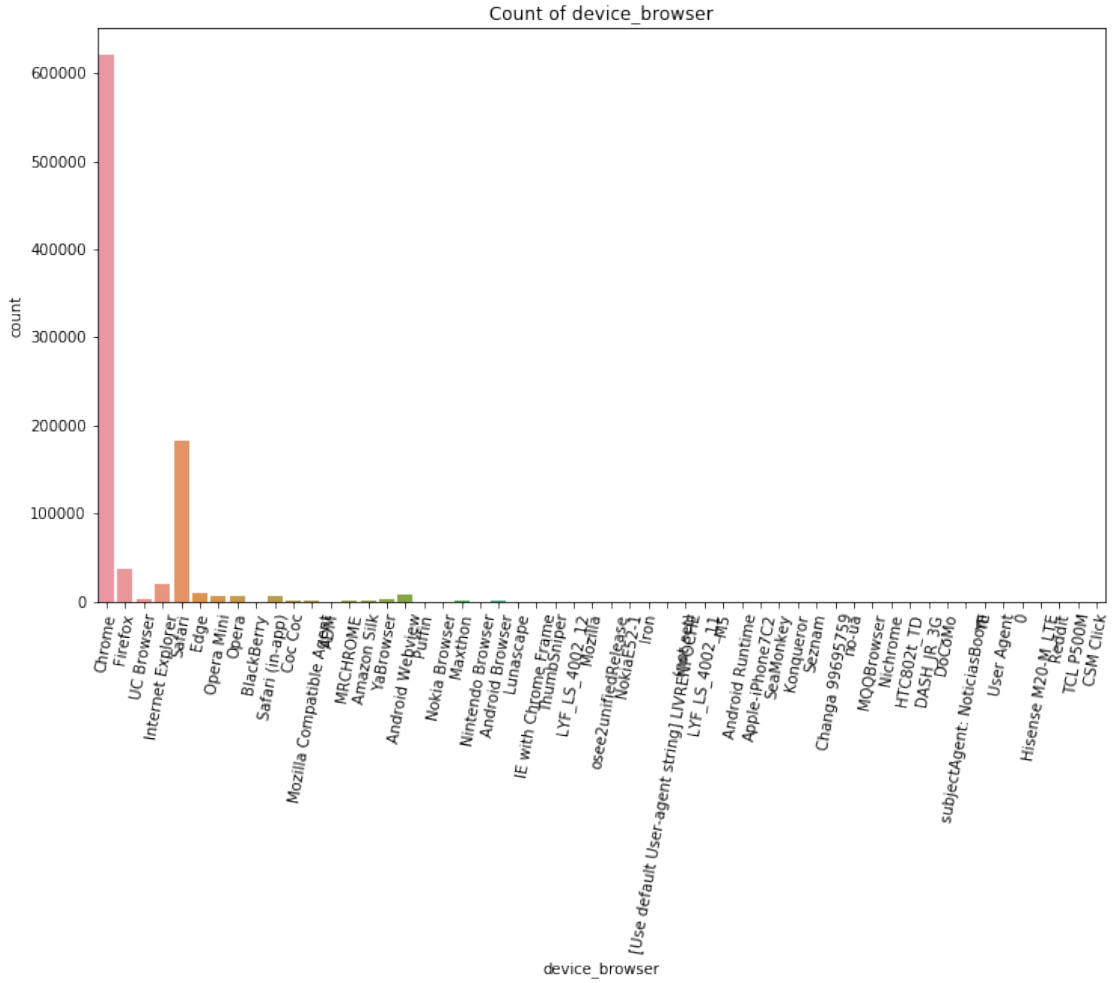
```
In [37]: train['visitNumber'].value_counts().head()

Out[37]: 1    703060
         2     92548
         3     35843
         4     19157
         5     11615
         Name: visitNumber, dtype: int64
```

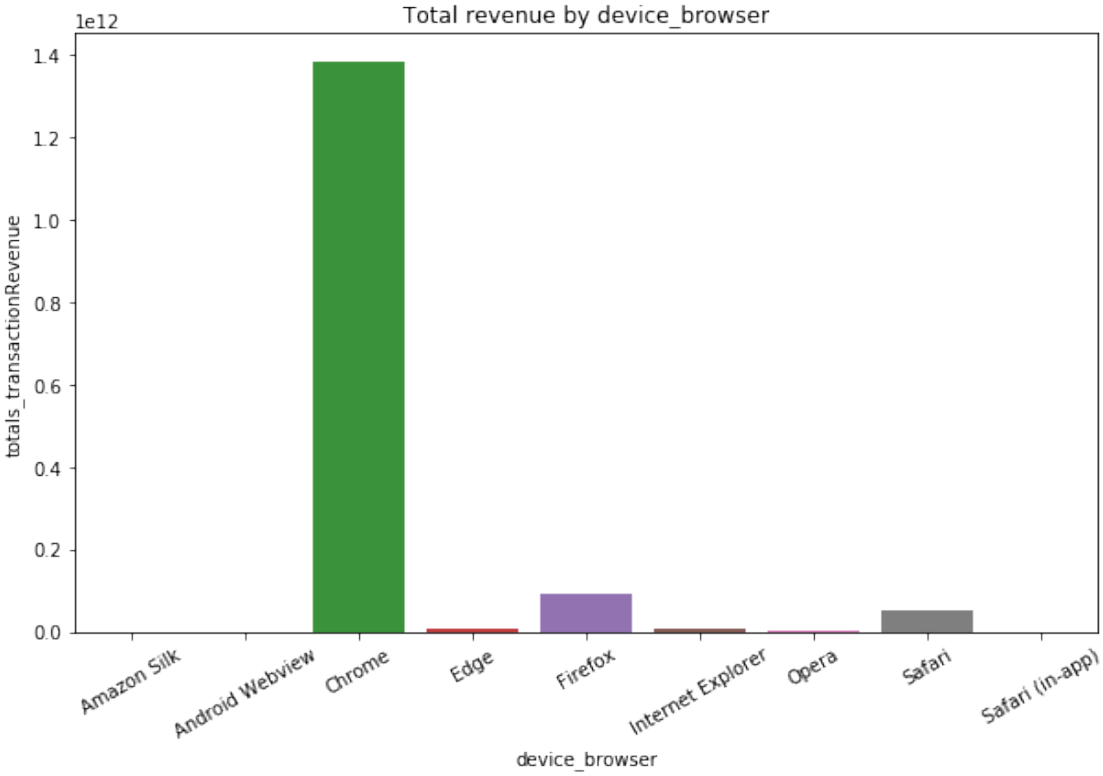
0.2.6 device_browser

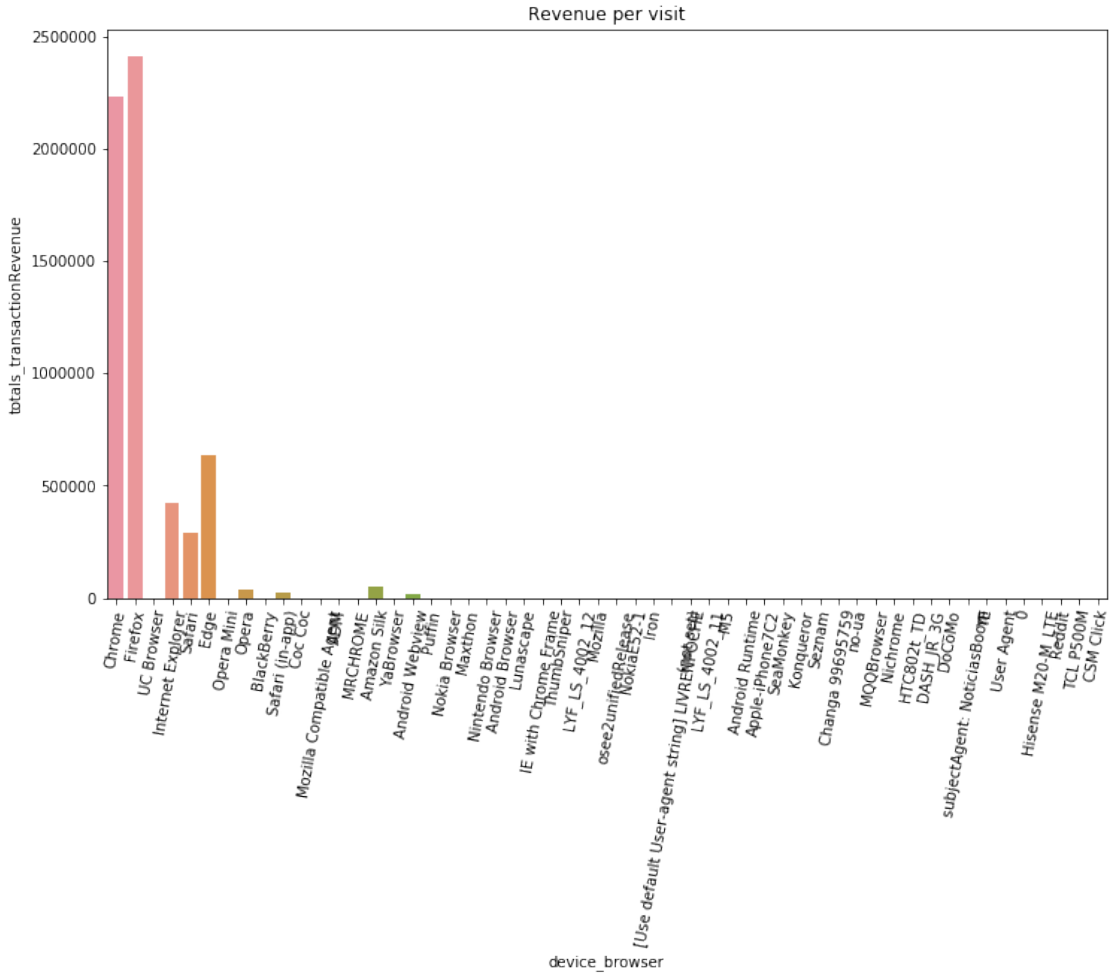
```
In [38]: train['device_browser'].value_counts().head(10)
```

```
Out[38]: Chrome                620364
         Safari                182245
         Firefox                37069
         Internet Explorer      19375
         Edge                   10205
         Android Webview         7865
         Safari (in-app)         6850
         Opera Mini              6139
         Opera                   5643
         UC Browser              2427
         Name: device_browser, dtype: int64
```

```
In [39]: plot_colCount(train,'device_browser',80)
         plot_totalRevenue(train,'device_browser',30,10,6)
         plot_revenuePerUnitCol(train,'device_browser',80)
```




Total revenue by device_browser
1e12
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
totals_transactionRevenue
Amazon Silk
Android Webview
Chrome
Edge
Firefox
Internet Explorer
Opera
Safari
Safari (in-app)
device_browser



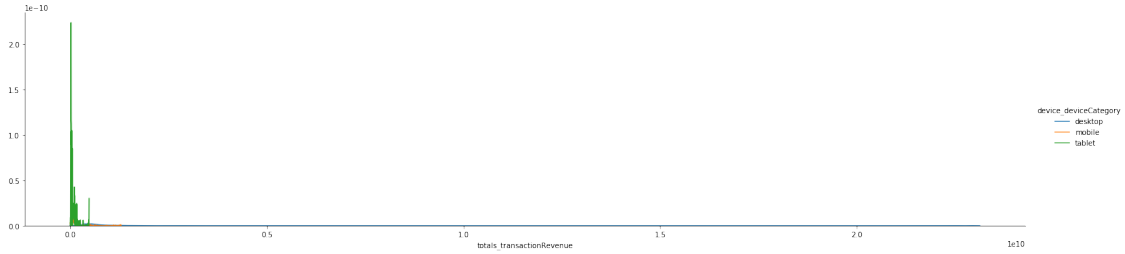
- Chrome generates a significant majority of the visits and revenue

0.2.7 device_deviceCategory

```
In [40]: f = sns.FacetGrid(train,hue='device_deviceCategory',size=5,aspect=4)
         plt.figure(figsize=(15,10))
         f.map(sns.kdeplot,'totals_transactionRevenue',shade= True)
         f.add_legend()
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\axisgrid.py:230: UserWarning: The `size` pa
  warnings.warn(msg, UserWarning)
```

```
Out[40]: <seaborn.axisgrid.FacetGrid at 0x1d8311be278>
```

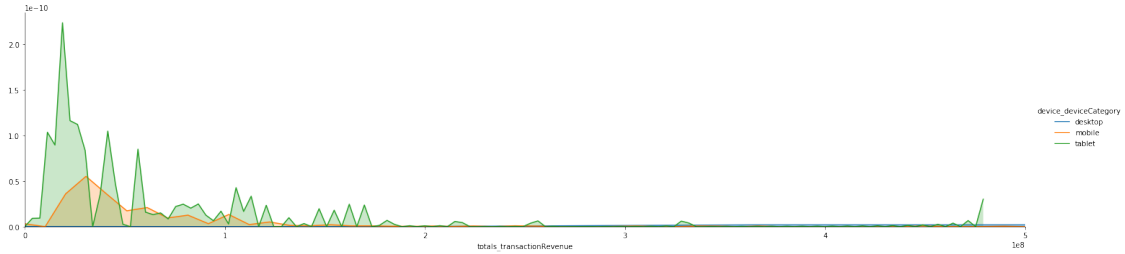



```
<Figure size 1080x720 with 0 Axes>
```

```
In [41]: f = sns.FacetGrid(train,hue='device_deviceCategory',size=5,aspect=4)
         plt.xlim(0, 500000000)
         plt.figure(figsize=(15,10))
         f.map(sns.kdeplot,'totals_transactionRevenue',shade= True)
         f.add_legend()
```

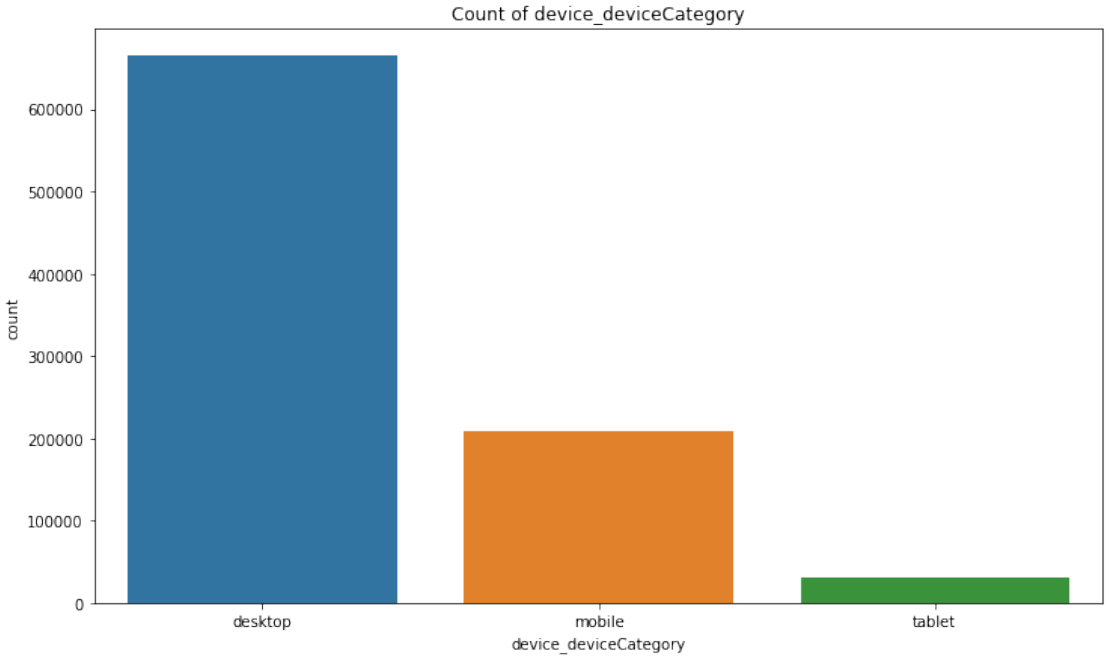
```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\axisgrid.py:230: UserWarning: The `size` pa
  warnings.warn(msg, UserWarning)
```

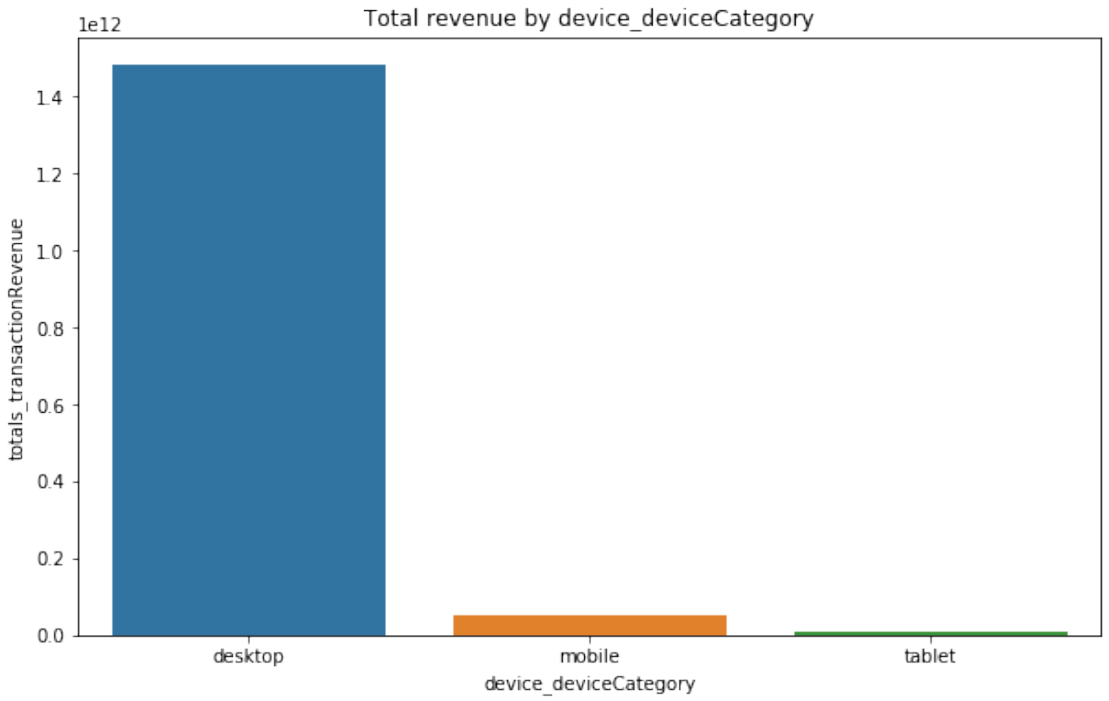
```
Out[41]: <seaborn.axisgrid.FacetGrid at 0x1d9c21c44a8>
```

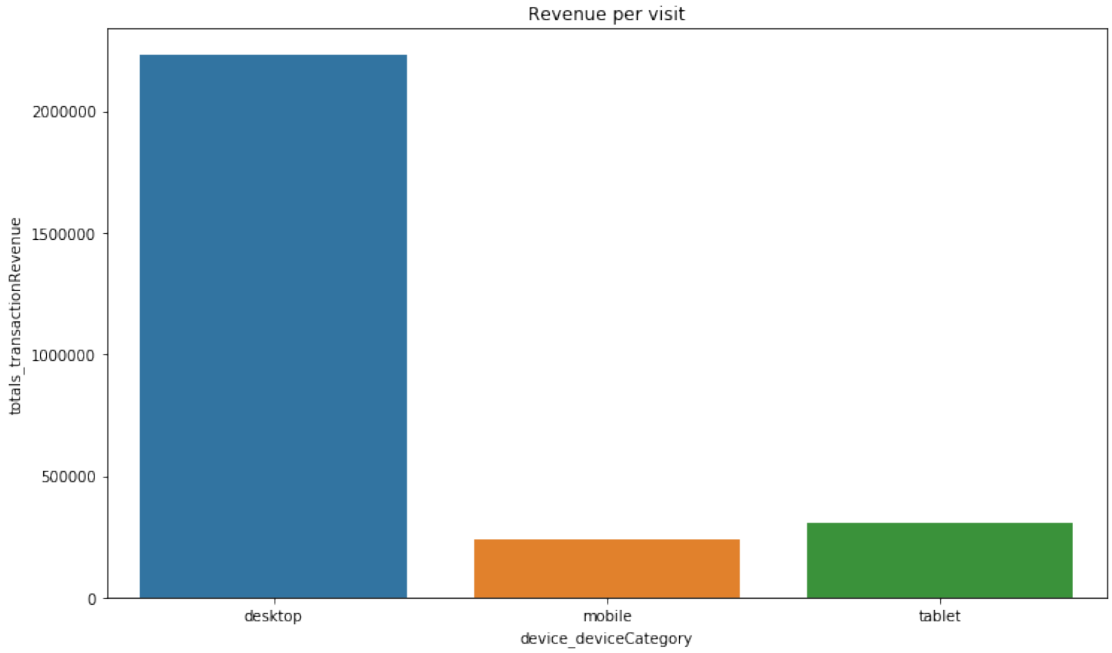



```
<Figure size 1080x720 with 0 Axes>
```

```
In [42]: plot_colCount(train,'device_deviceCategory',0)
         plot_totalRevenue(train,'device_deviceCategory',0,10,6)
         plot_revenuePerUnitCol(train,'device_deviceCategory',0)
```


Count of device_deviceCategory
count
600000
500000
400000
300000
200000
100000
0
desktop
mobile
tablet
device_deviceCategory

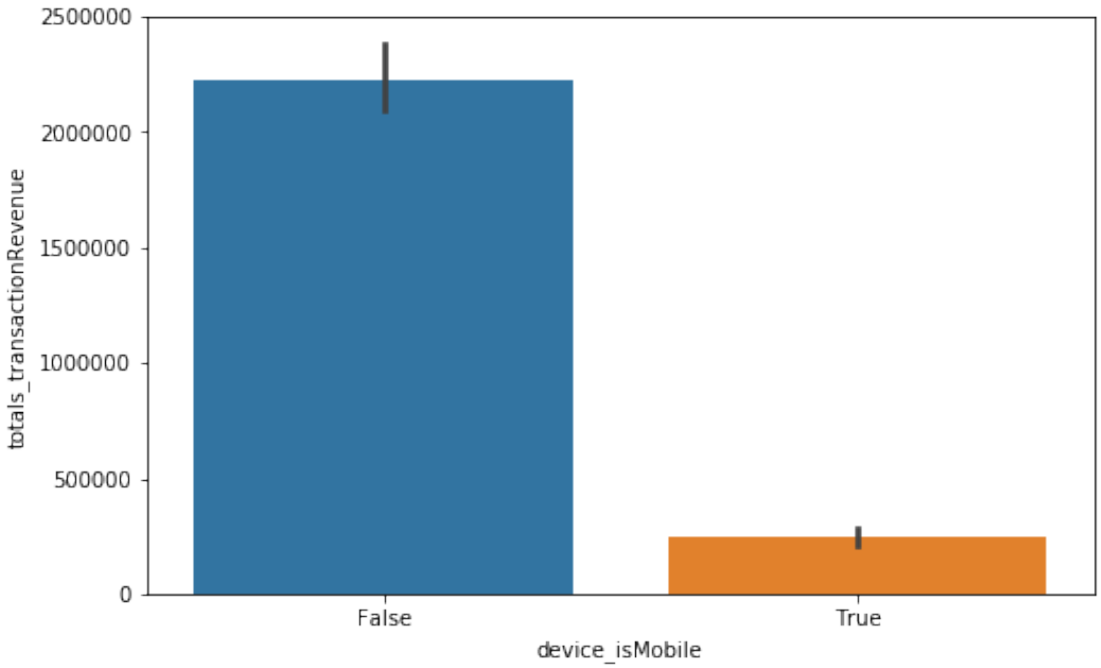

Total revenue by device_deviceCategory
1e12
totals_transactionRevenue
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
desktop
mobile
tablet
device_deviceCategory



- Desktops generate the highest visits and revenue
- Desktops generate the most high revenue transactions
- Desktops generate almost 8 times the revenue per visit compared to tablets and mobile
- Tablets generate the least total revenue
- Tablets generate a high number of low revenue transactions

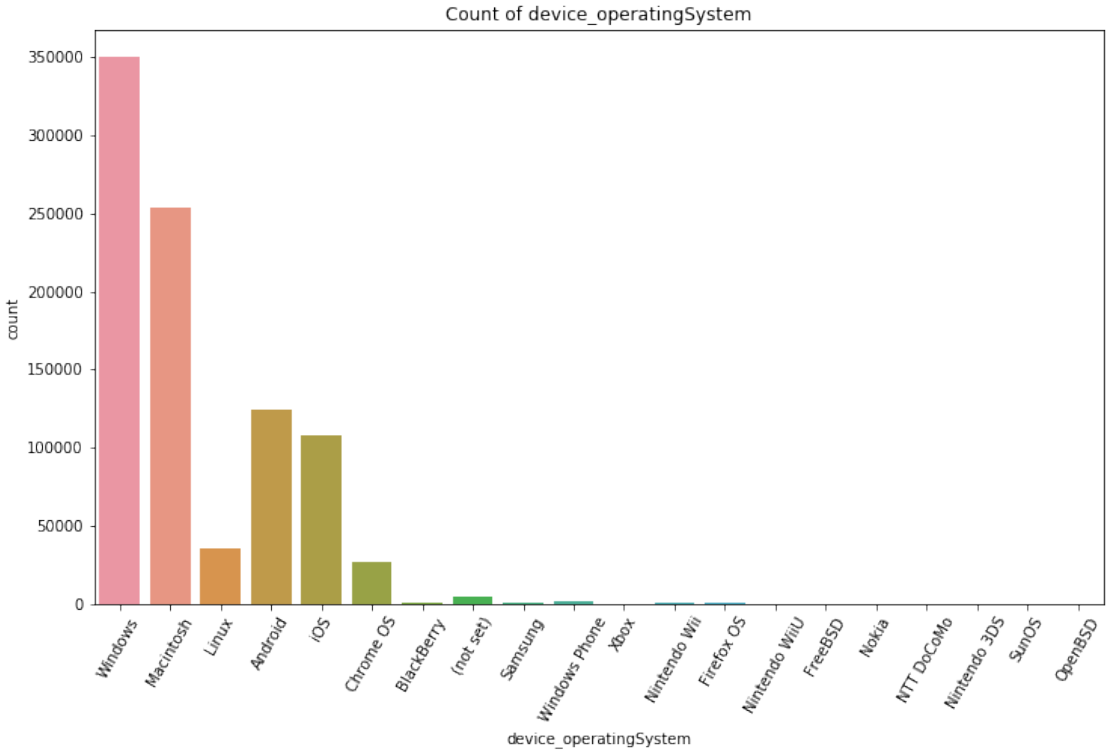
0.2.8 device_isMobile

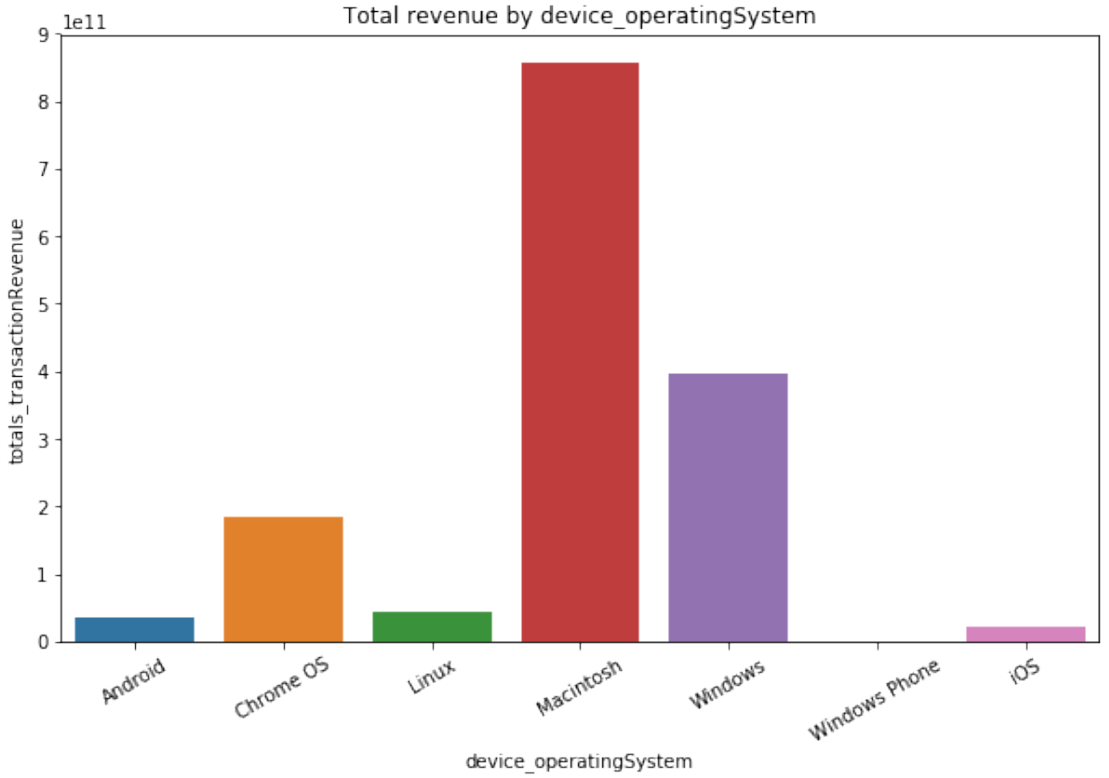
```
In [43]: plt.figure(figsize=(8,5))
         sns.barplot(data =train,x='device_isMobile',y='totals_transactionRevenue')

Out[43]: <matplotlib.axes._subplots.AxesSubplot at 0x1d831f9b5f8>
```

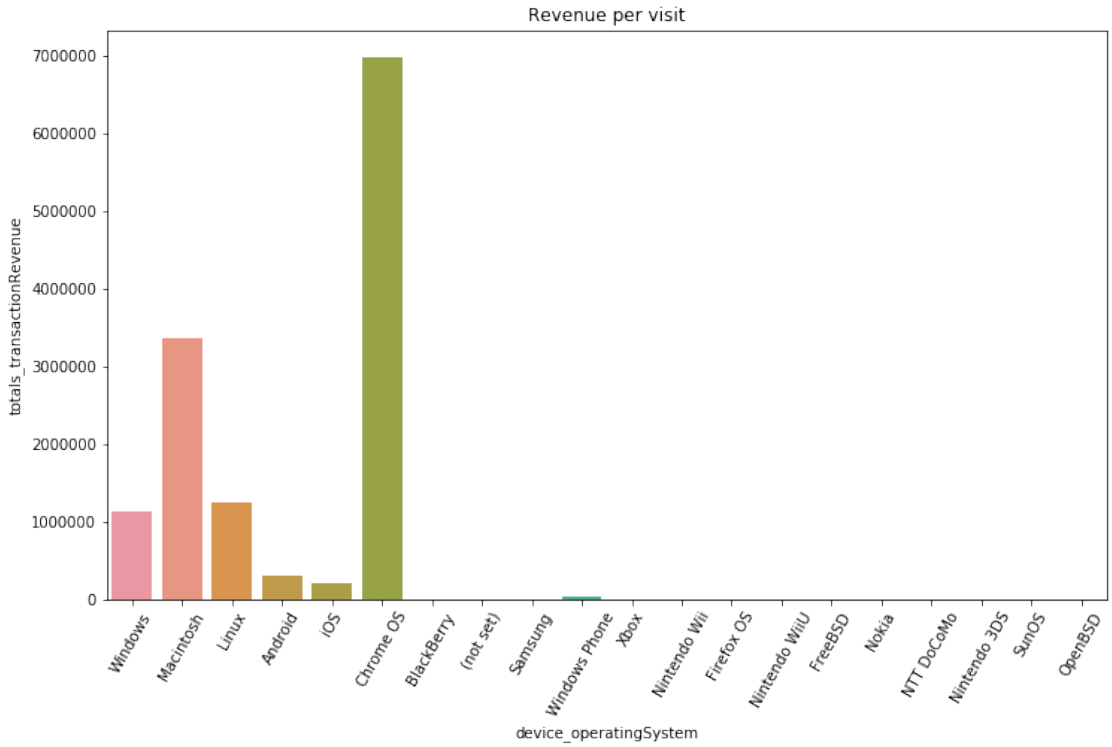


0.2.9 device_operatingSystem

```
In [44]: plot_colCount(train,'device_operatingSystem',60)
         plot_totalRevenue(train,'device_operatingSystem',30,10,6)
         plot_revenuePerUnitCol(train,'device_operatingSystem',60)
```


Count of device_operatingSystem
count
350000
300000
250000
200000
150000
100000
50000
0
Windows
Macintosh
Linux
Android
iOS
Chrome OS
BlackBerry
(not set)
Samsung
Windows Phone
Xbox
Nintendo Wii
Firefox OS
Nintendo WiiU
FreeBSD
Nokia
NTT DoCoMo
Nintendo 3DS
SunOS
OpenBSD
device_operatingSystem

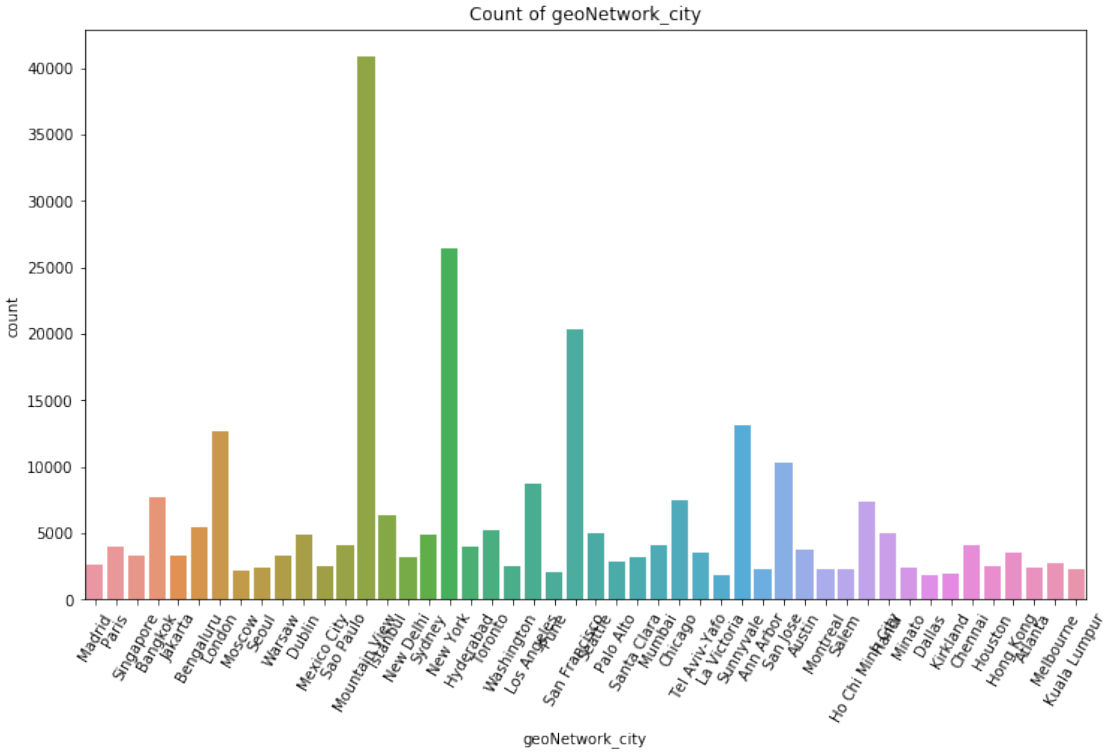

Total revenue by device_operatingSystem
1e11
totals_transactionRevenue
9
8
7
6
5
4
3
2
1
0
Android
Chrome OS
Linux
Macintosh
Windows
Windows Phone
iOS
device_operatingSystem

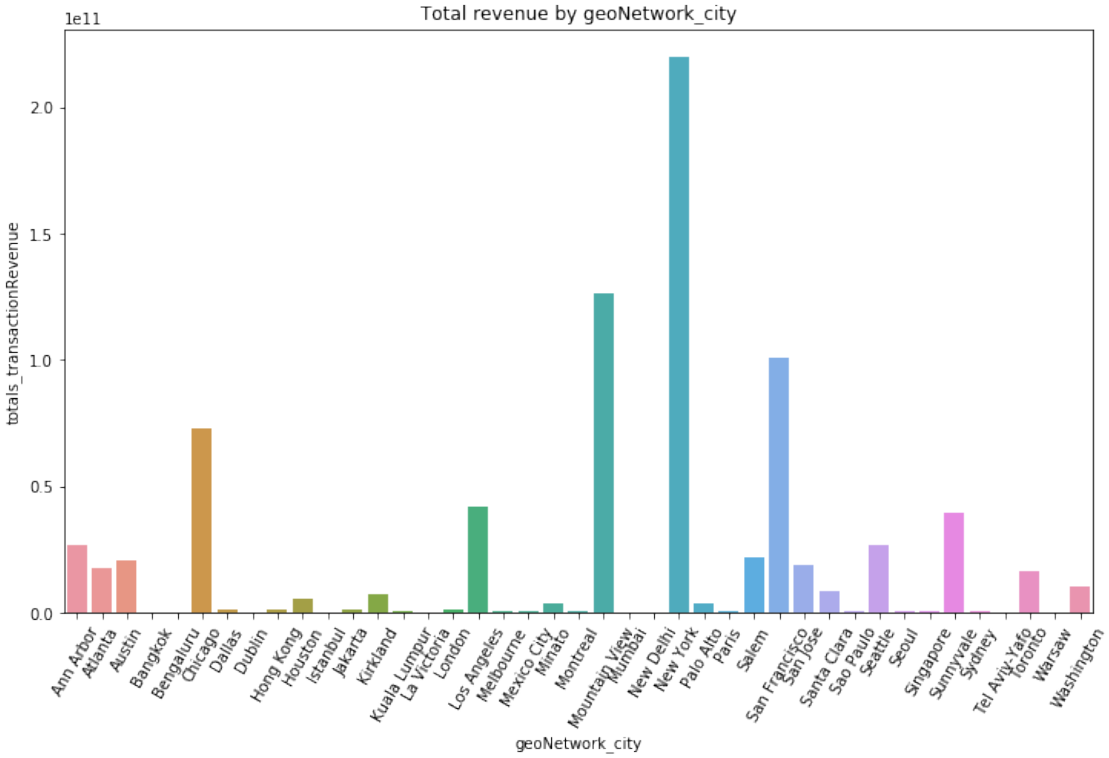


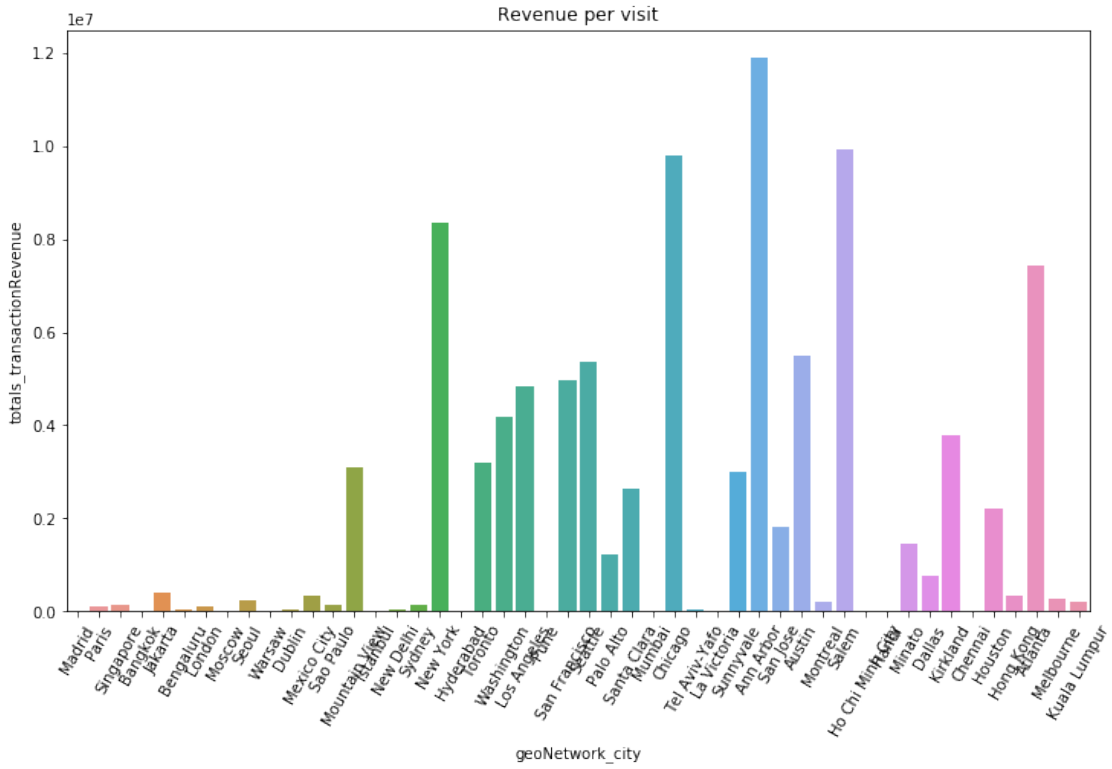
Windows is the most popular operating system but Mac generates more revenue. Chrome generates more revenue per visit.

0.2.10 geoNetwork_city

```
In [45]: topCities = train['geoNetwork_city'].value_counts().head(50).reset_index()
         topCities.columns = ['city','count']
         topCities = topCities[topCities.city !='not available in demo dataset']
         topCities = topCities[topCities.city !='(not set)']
         topCitiesTrain = train[train['geoNetwork_city'].isin(topCities['city'])]

In [46]: plot_colCount(topCitiesTrain,'geoNetwork_city',60)
         plot_totalRevenue(topCitiesTrain,'geoNetwork_city',60)
         plot_revenuePerUnitCol(topCitiesTrain,'geoNetwork_city',60)
         del topCities
         del topCitiesTrain
```

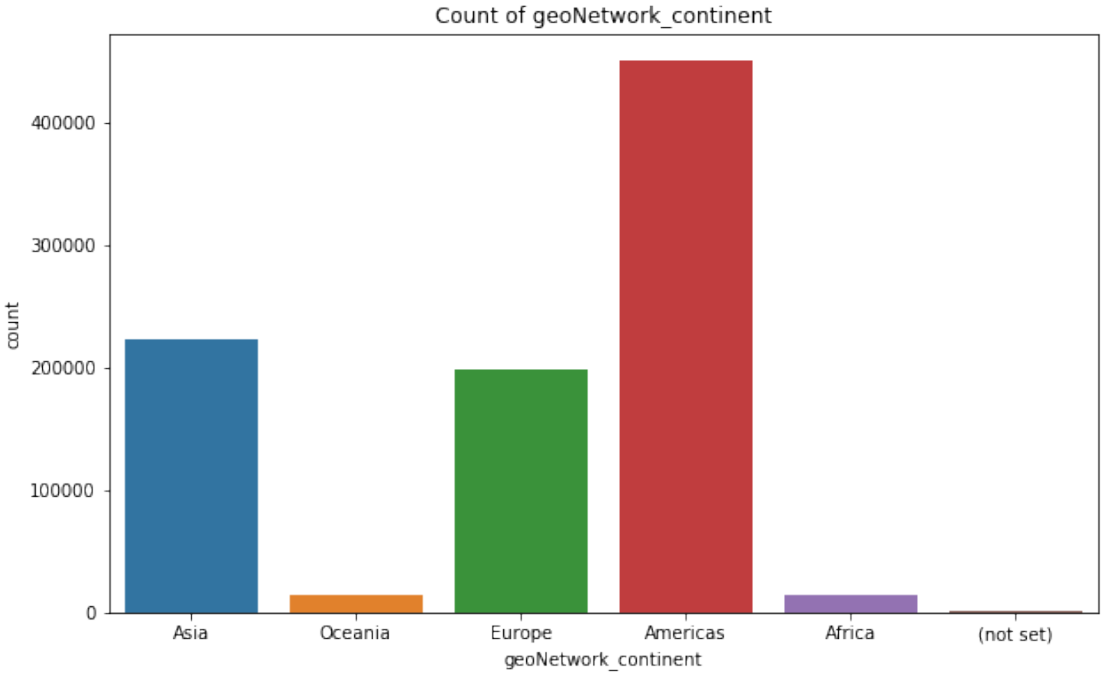

Count of geoNetwork_city
count
geoNetwork_city
0
5000
10000
15000
20000
25000
30000
35000
40000
Madrid
Paris
Singapore
Bangkok
Jakarta
Bengaluru
London
Moscow
Seoul
Warsaw
Dublin
Mexico City
Sao Paulo
Mountain View
Istanbul
New Delhi
Sydney
New York
Hyderabad
Toronto
Washington
Los Angeles
Seattle
Palo Alto
Santa Clara
Mumbai
Chicago
Tel Aviv-Yafo
La Victoria
Sunnyvale
Ann Arbor
San Jose
Austin
Montreal
Salem
Minato
Dallas
Kirkland
Chennai
Houston
Hong Kong
Atlanta
Melbourne
Kuala Lumpur

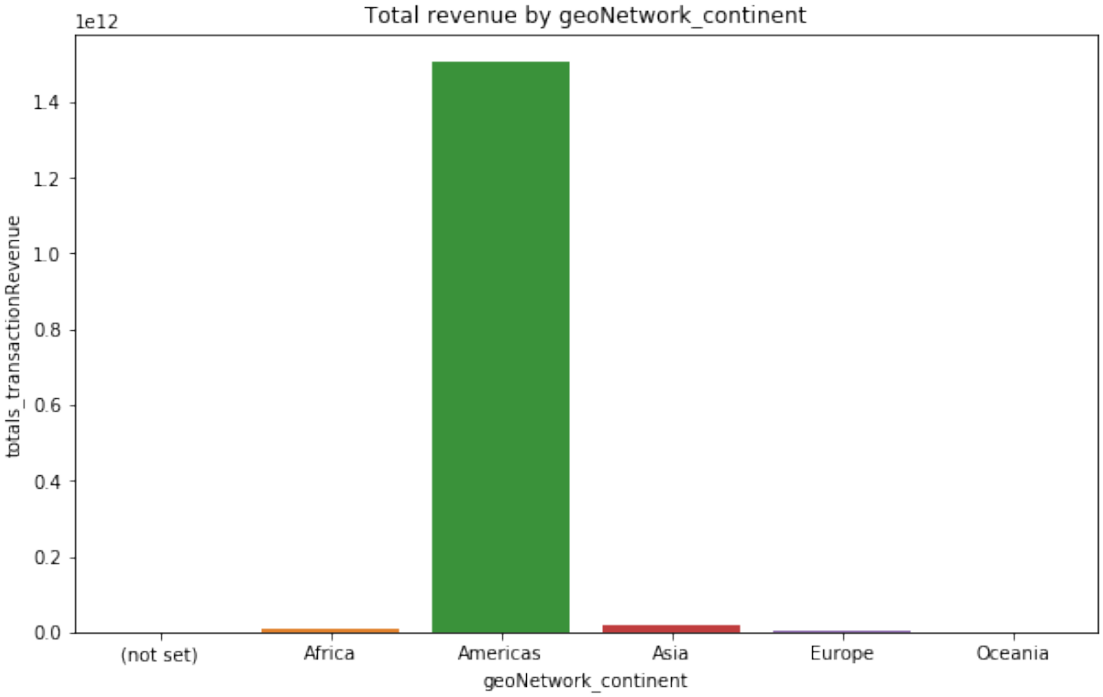

Total revenue by geoNetwork_city
1e11
totals_transactionRevenue
geoNetwork_city
0.0
0.5
1.0
1.5
2.0
Ann Arbor
Atlanta
Austin
Bangkok
Bengaluru
Chicago
Dallas
Dublin
Hong Kong
Houston
Istanbul
Jakarta
Kirkland
Kuala Lumpur
La Victoria
London
Los Angeles
Melbourne
Mexico City
Minato
Montreal
Mountain View
Mumbai
New Delhi
New York
Palo Alto
Paris
Salem
San Francisco
San Jose
Santa Clara
Sao Paulo
Seattle
Seoul
Singapore
Sunnyvale
Sydney
Tel Aviv-Yafo
Toronto
Warsaw
Washington

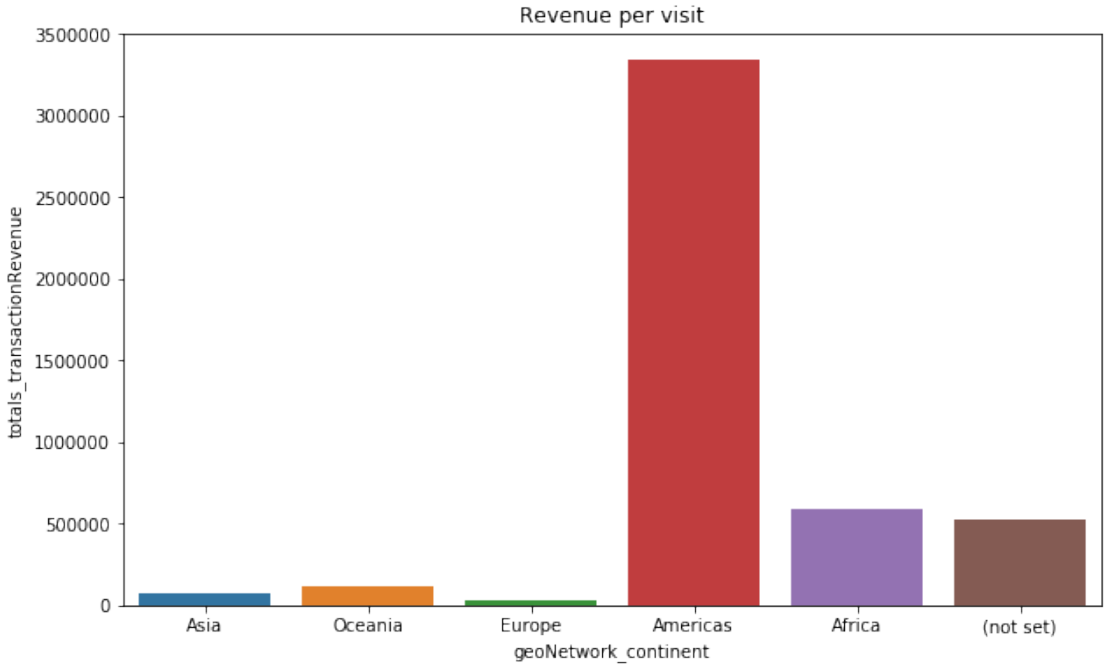


0.2.11 geoNetwork_continent

```
In [47]: plot_colCount(train,'geoNetwork_continent',0,10,6)
         plot_totalRevenue(train,'geoNetwork_continent',0,10,6)
         plot_revenuePerUnitCol(train,'geoNetwork_continent',0,10,6)
```


Count of geoNetwork_continent
count
400000
300000
200000
100000
0
Asia
Oceania
Europe
Americas
Africa
(not set)
geoNetwork_continent

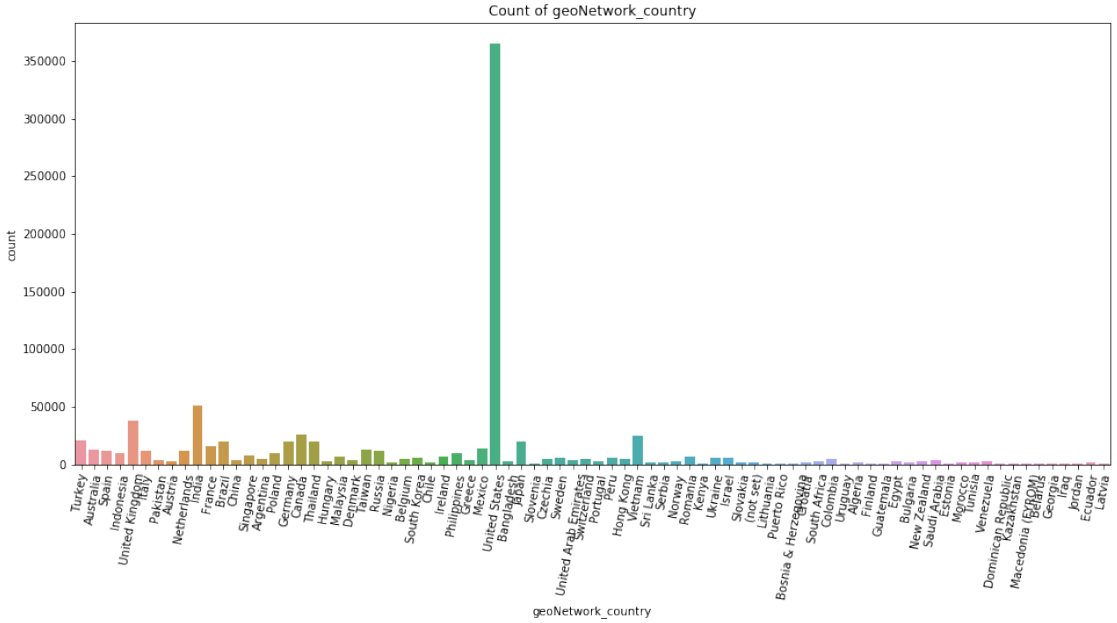

Total revenue by geoNetwork_continent
1e12
totals_transactionRevenue
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
(not set)
Africa
Americas
Asia
Europe
Oceania
geoNetwork_continent

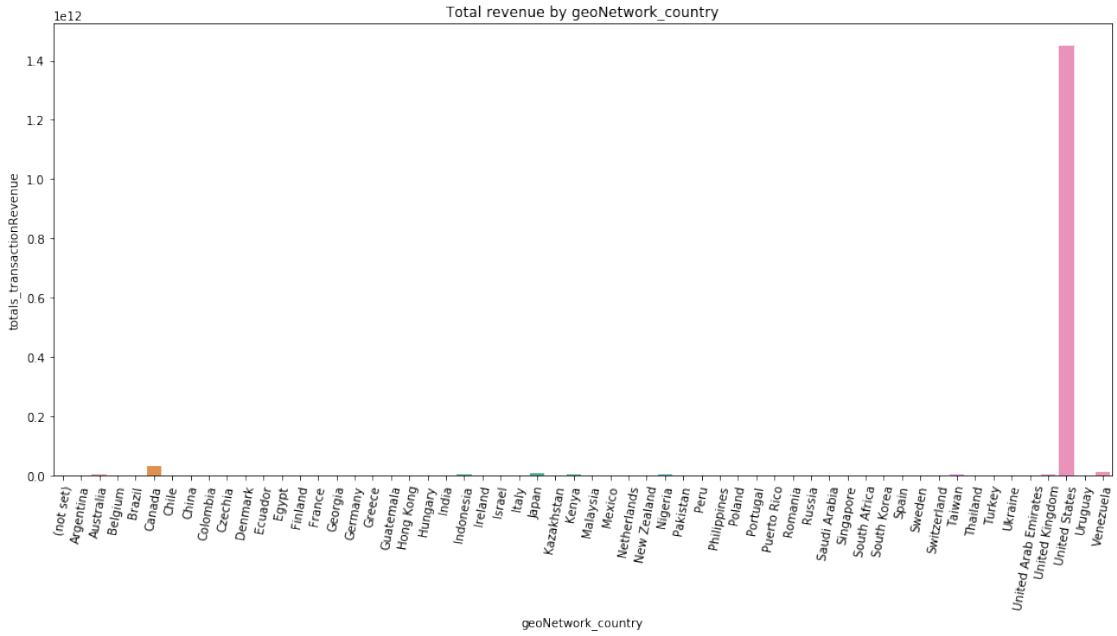


0.2.12 geoNetwork_country

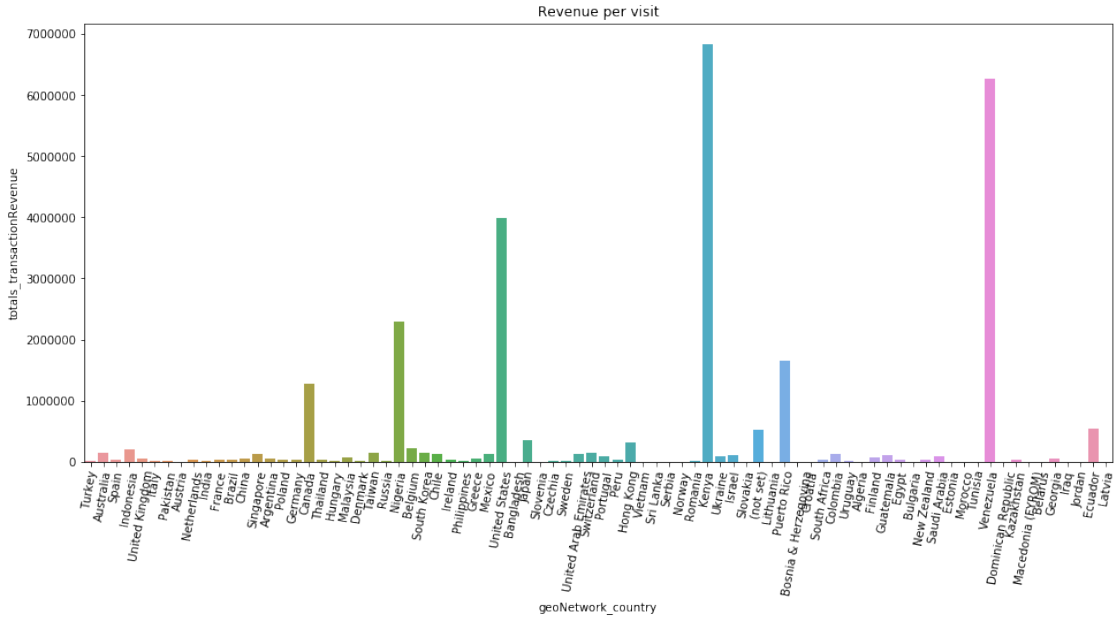
```
In [48]: byCountry = train.groupby('geoNetwork_country',as_index=False).agg({'visitId':'count'

In [49]: import matplotlib.pyplot as plt
         from plotly.offline import download_plotlyjs, init_notebook_mode,plot,iplot
         import plotly.graph_objs as go
         import cufflinks as cf

In [50]: init_notebook_mode(connected=True)
         cf.go_offline()

In [51]: data=dict(type='choropleth',
                   locations = byCountry['geoNetwork_country'],
                   locationmode = 'country names',
                   colorscale = 'Blues',
                   reversescale=True,
                   text = ['text 1','text 2','text 3'],
                   z=byCountry['visits'],
                   colorbar={'title':'Total visits'})

         layout = dict(title='Visit count by Country')

         choromap = go.Figure(data=[data])
         iplot(choromap)
```

```
In [52]: data=dict(type='choropleth',
                   locations = byCountry['geoNetwork_country'],
                   locationmode = 'country names',
                   colorscale = 'Blues',
                   reversescale=True,
                   text = ['text 1','text 2','text 3'],
                   z=byCountry['totalRevenue'],
                   colorbar={'title':'Total revenue'})

         layout = dict(title='Total revenue by Country')

         choromap = go.Figure(data=[data])
         iplot(choromap)

In [53]: topCountries = train['geoNetwork_country'].value_counts().head(80).reset_index()
         topCountries.columns = ['country','count']
         topCountriesTrain = train[train['geoNetwork_country'].isin(topCountries['country'])]

In [54]: plot_colCount(topCountriesTrain,'geoNetwork_country',80,16)
         plot_totalRevenue(topCountriesTrain,'geoNetwork_country',80,16)
```






```
In [55]: plot_revenuePerUnitCol(topCountriesTrain,'geoNetwork_country',80,16)
         del topCountries
         del topCountriesTrain
```



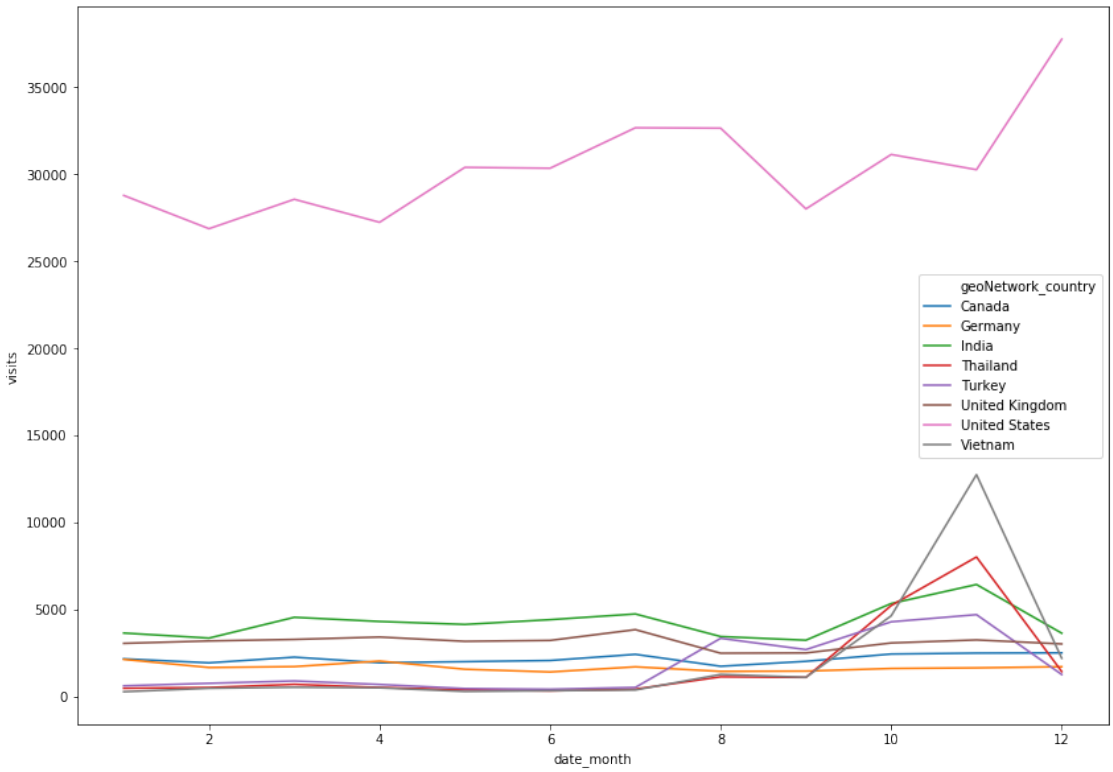
- United States generates the highest number of visits and revenue

- Surprisingly, Venezuela and Kenya generate the highest revenue per visit

```
In [56]: topCountries = train['geoNetwork_country'].value_counts().head(8).index
```

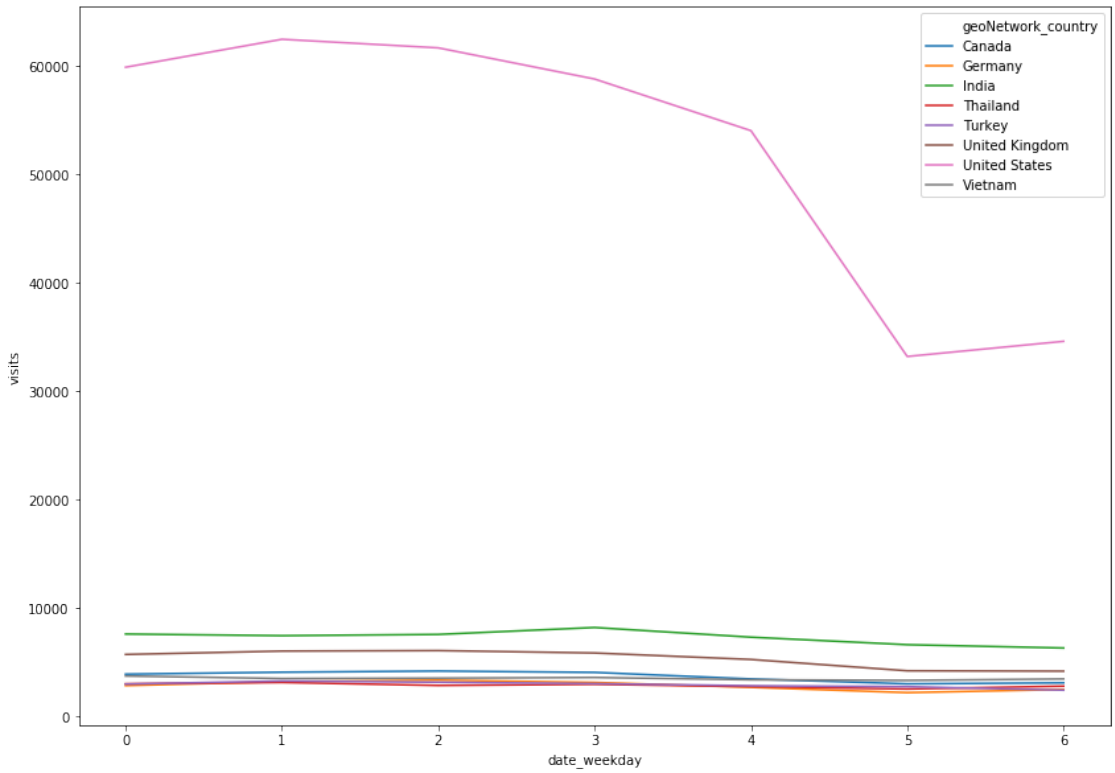
```
In [57]: def plotByCountry(plotCol,n_labels = 0, xtick=0,plotType = 'line',order=0):
             groupByCountry = train.groupby(['geoNetwork_country',plotCol],as_index=False).cou
             groupByCountry = groupByCountry[groupByCountry['geoNetwork_country'].isin(topCount
             if n_labels != 0:
                 topLabels = train[plotCol].value_counts().head(n_labels).index
                 groupByCountry = groupByCountry[groupByCountry[plotCol].isin(topLabels)]
             groupByCountry.columns = ['geoNetwork_country', plotCol, 'visits']
             plt.figure(figsize=[14,10])
             plt.xticks(rotation=xtick)
             if plotType == 'line':
                 sns.lineplot(data=groupByCountry,x=plotCol,y='visits',hue='geoNetwork_country
             if plotType == 'bar':
                 if order == 0:
                     sns.barplot(data=groupByCountry,x=plotCol,y='visits',hue='geoNetwork_coun
                 if order == 1:
                     sns.barplot(data=groupByCountry,x='geoNetwork_country',y='visits',hue=plo
```

```
In [58]: plotByCountry('date_month')
```



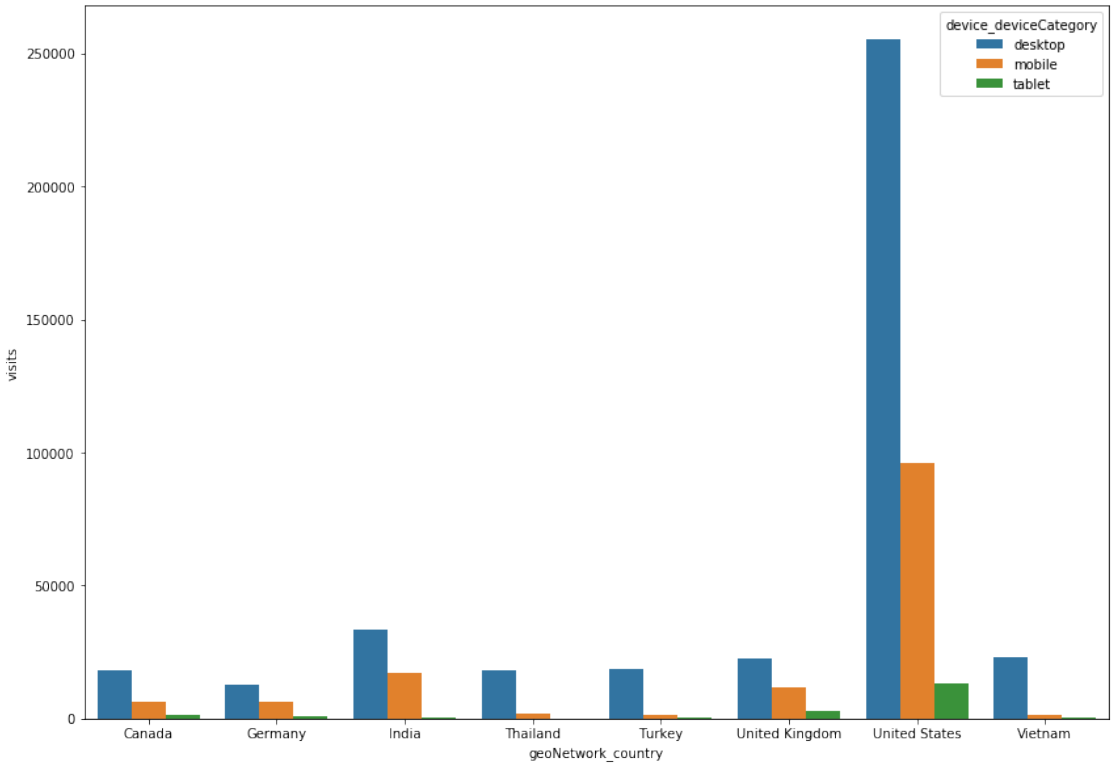
- There is a significant spike in traffic from Vietnam between October and December
- Thailand also shows a similar pattern
- Most countries show a spike in summer and holiday season
- Germany and Canada show very little seasonal fluctuation
- United Kingdom is the only country where the most visits occur outside the November to January period

```
In [59]: plotByCountry('date_weekday')
```



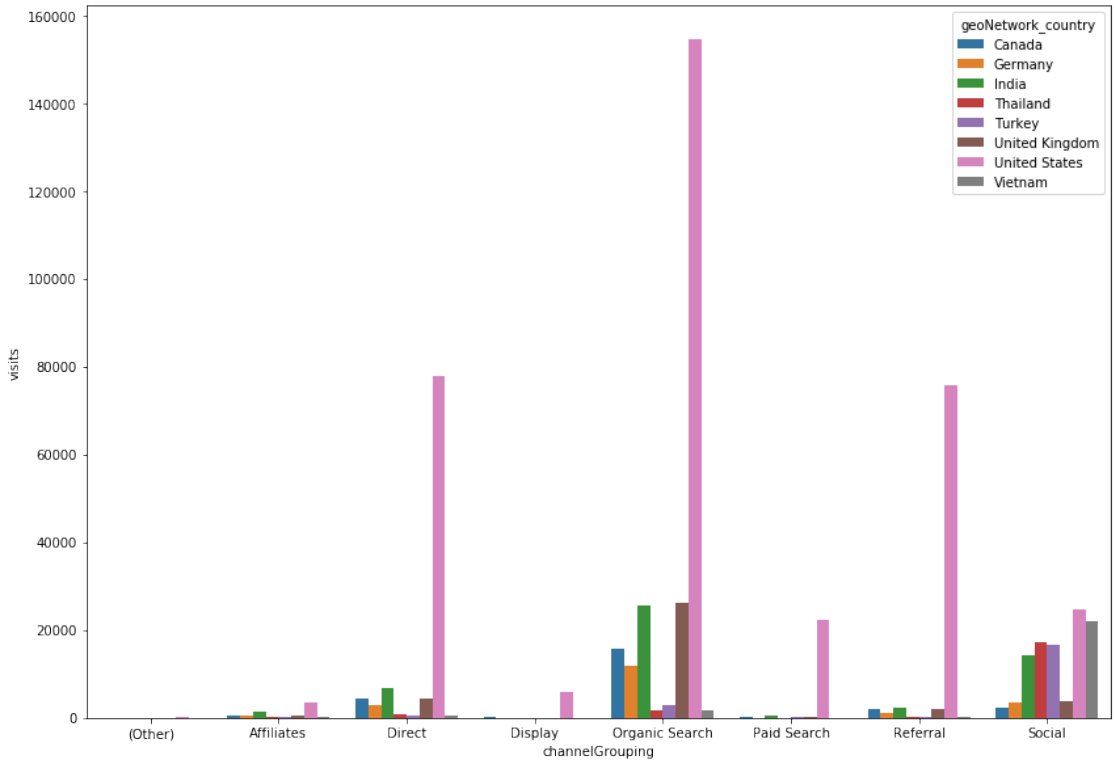
- There is a significant difference in traffic from United States between weedkays and weekends. Other countries do not show this pattern

```
In [60]: plotByCountry('device_deviceCategory',plotType='bar',order=1)
```

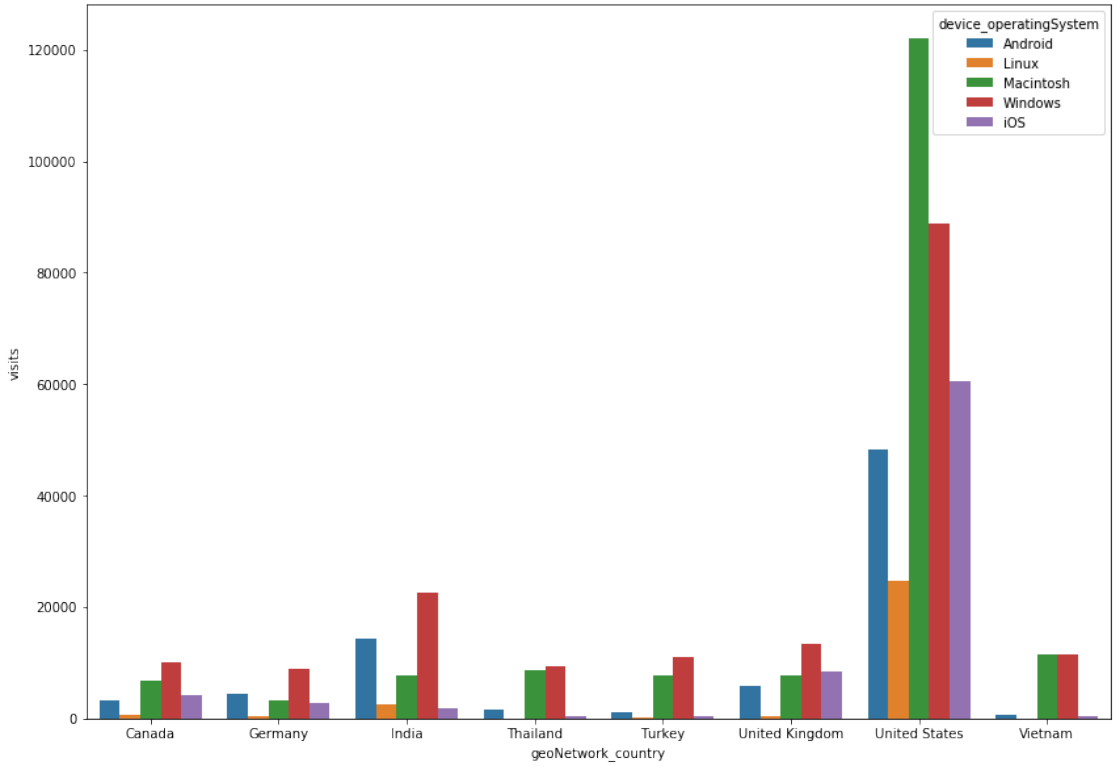


- India and Thailand have very low desktop to tablet ratio. Tablets don't seem to be popular in these countries
- Vietnam has the least desktop to mobile ratio

```
In [61]: plotByCountry('channelGrouping',plotType='bar')
```

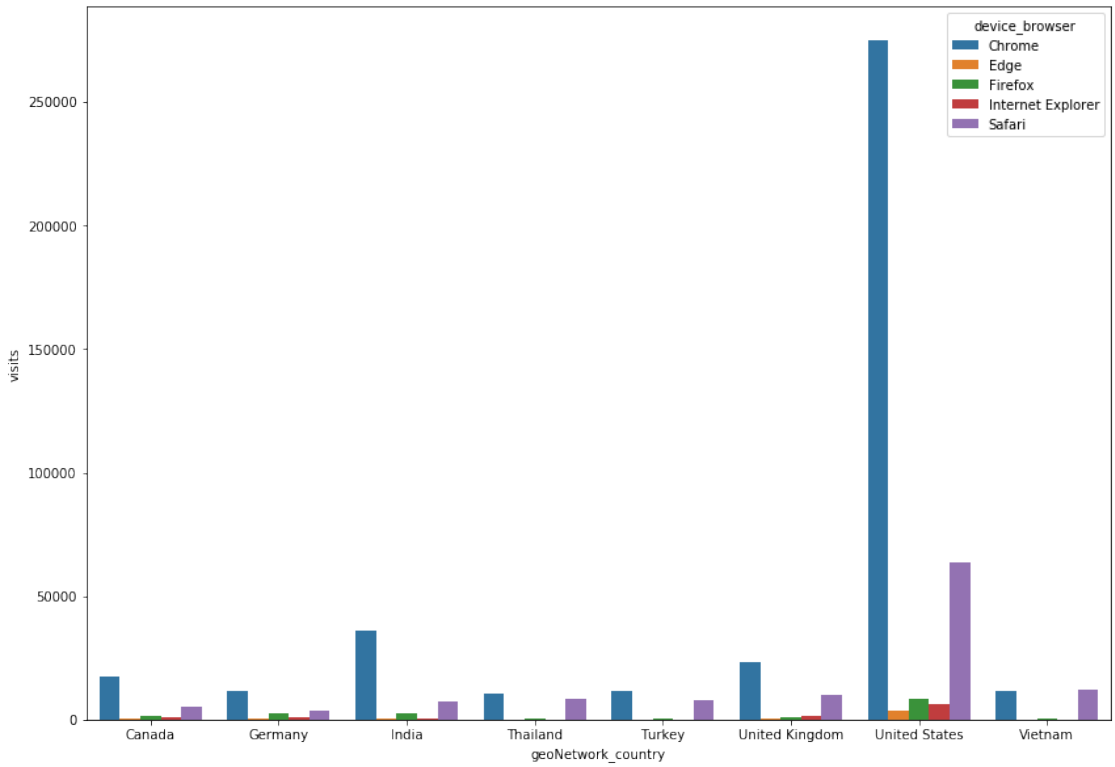



```
In [62]: plotByCountry('device_operatingSystem',n_labels=5,plotType='bar',order=1)
```



- Mac is the leader in United States.It has a significant presence in Thailand and Vietnam but lags in other countries
- Windows is the leader in all countries except United States
- Countries with more iOS traffic than Android: United States, Canada, United Kingdom

```
In [63]: plotByCountry('device_browser',plotType='bar',n_labels=5,order=1)
```

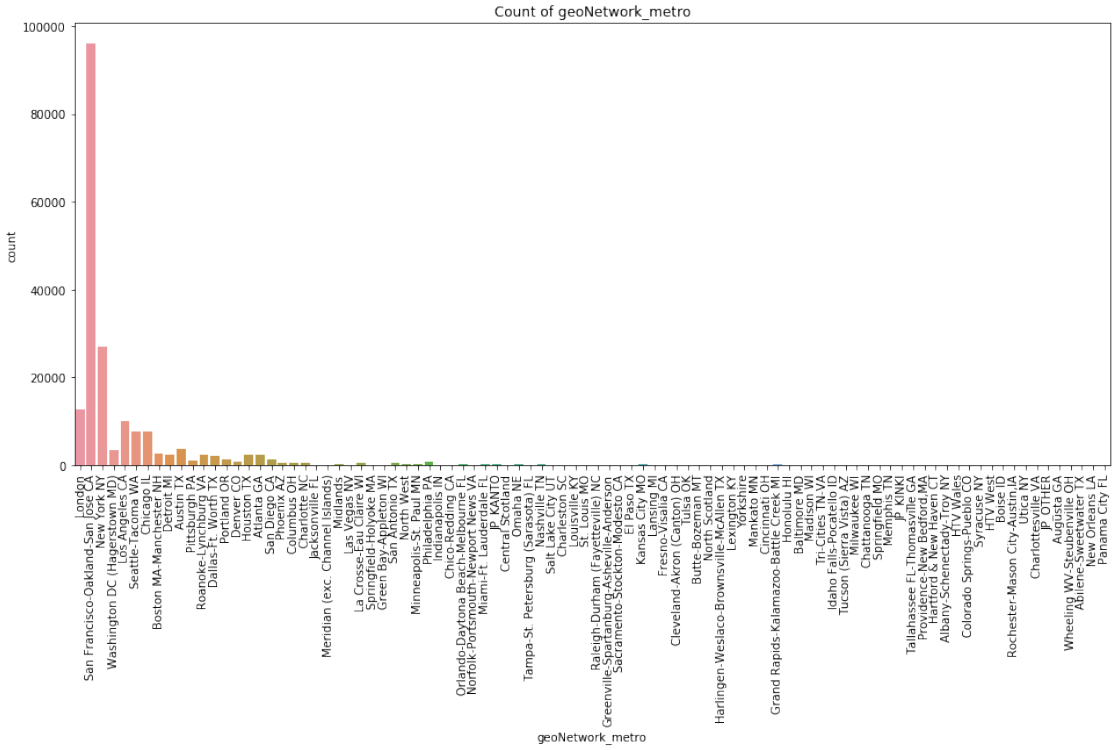


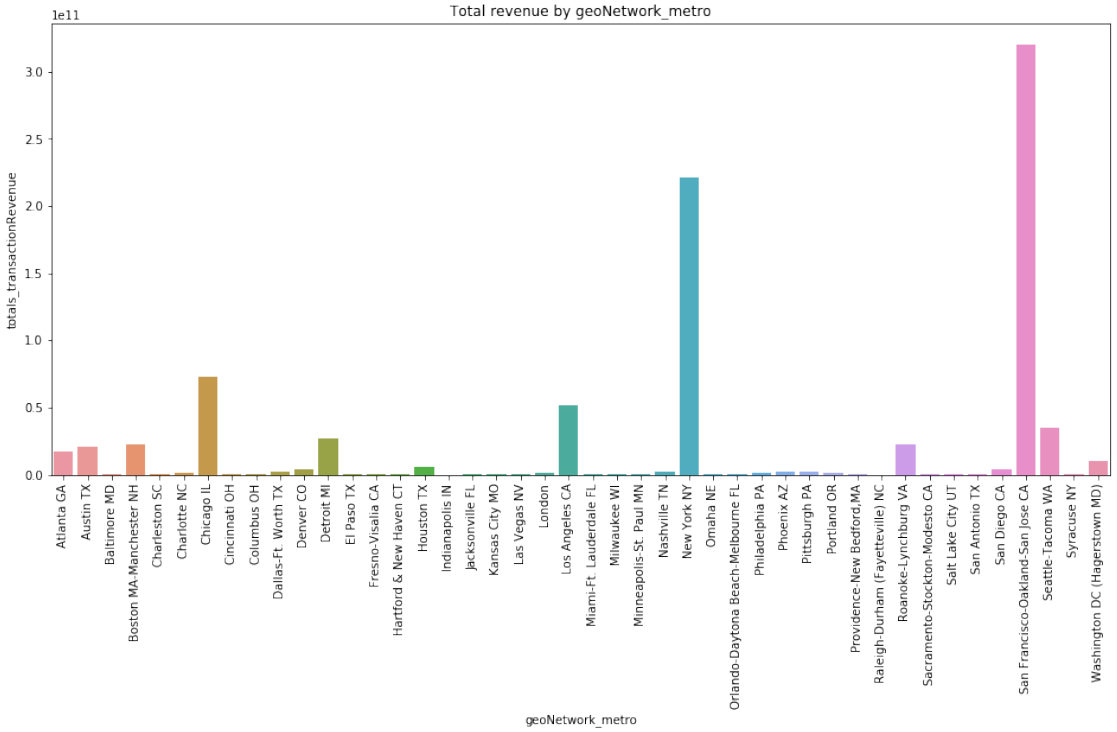
- As discussed above, Vietnam and Thailand have high Mac adoption and this could be the reason why they have almost equal traffic from Chrome and Safari

0.2.13 geoNetwork_metro

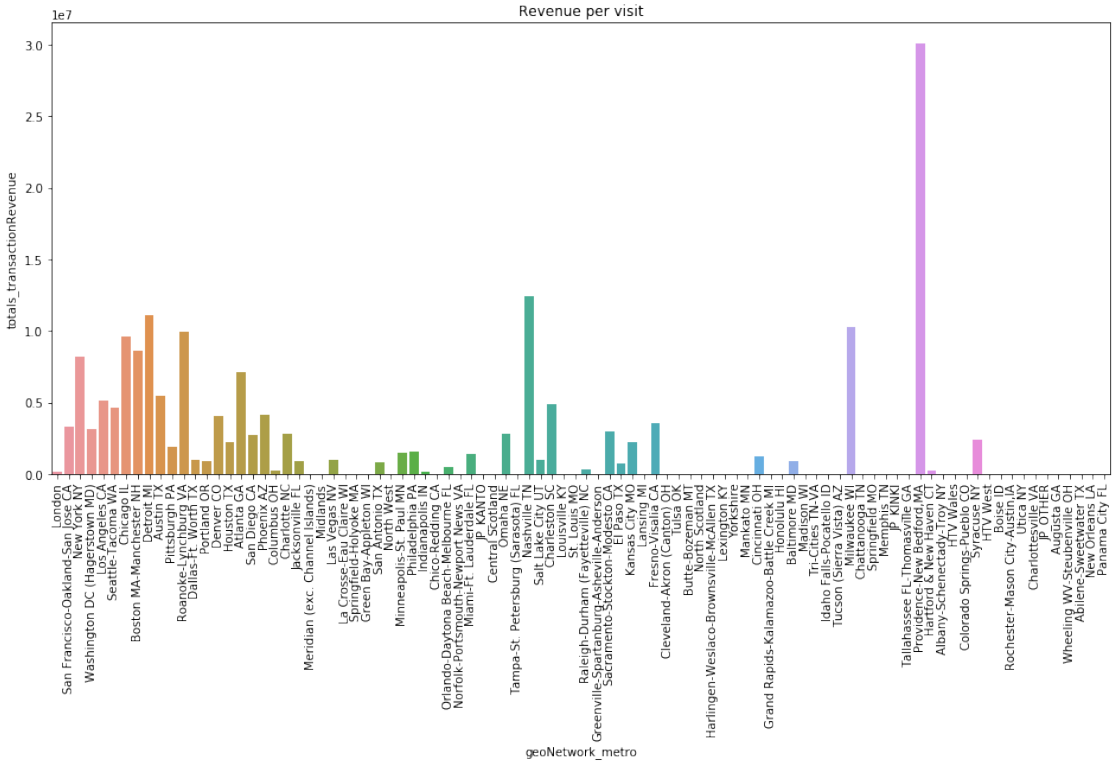
```
In [64]: topMetrosTrain = train[~train['geoNetwork_metro'].isin(['not available in demo dataset
```

```
In [65]: plot_colCount(topMetrosTrain,'geoNetwork_metro',90,16)
         plot_totalRevenue(topMetrosTrain,'geoNetwork_metro',90,16)
```


Count of geoNetwork_metro
count
geoNetwork_metro


Total revenue by geoNetwork_metro
1e11
totals_transactionRevenue
geoNetwork_metro

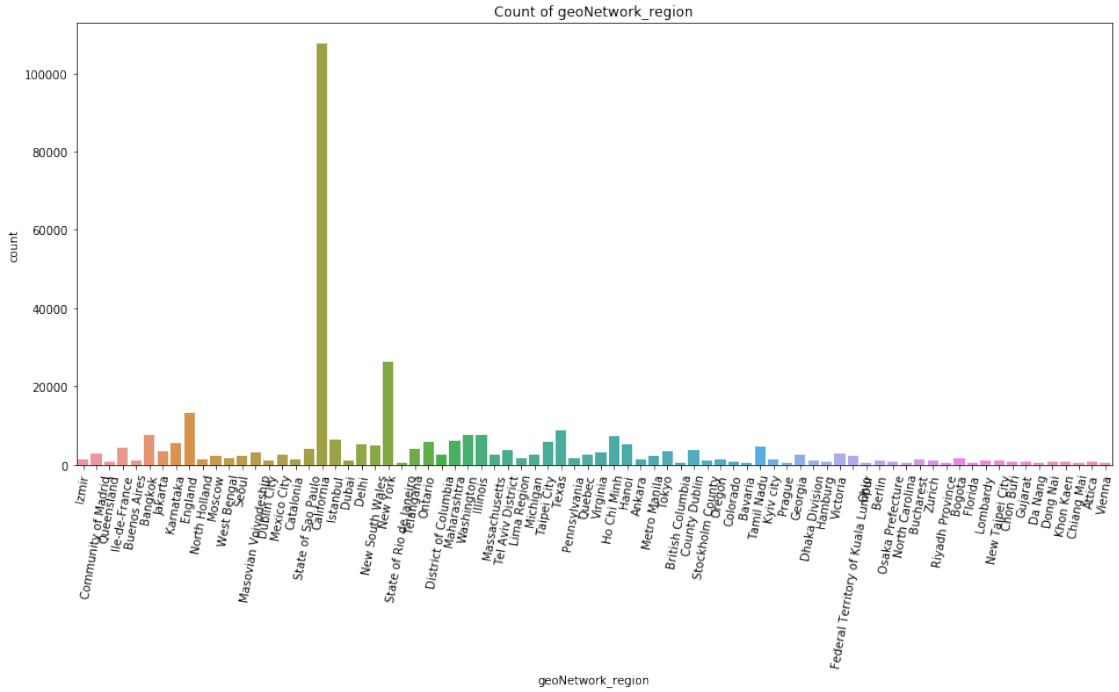
In [66]: plot_revenuePerUnitCol(topMetrosTrain,'geoNetwork_metro',90,16)

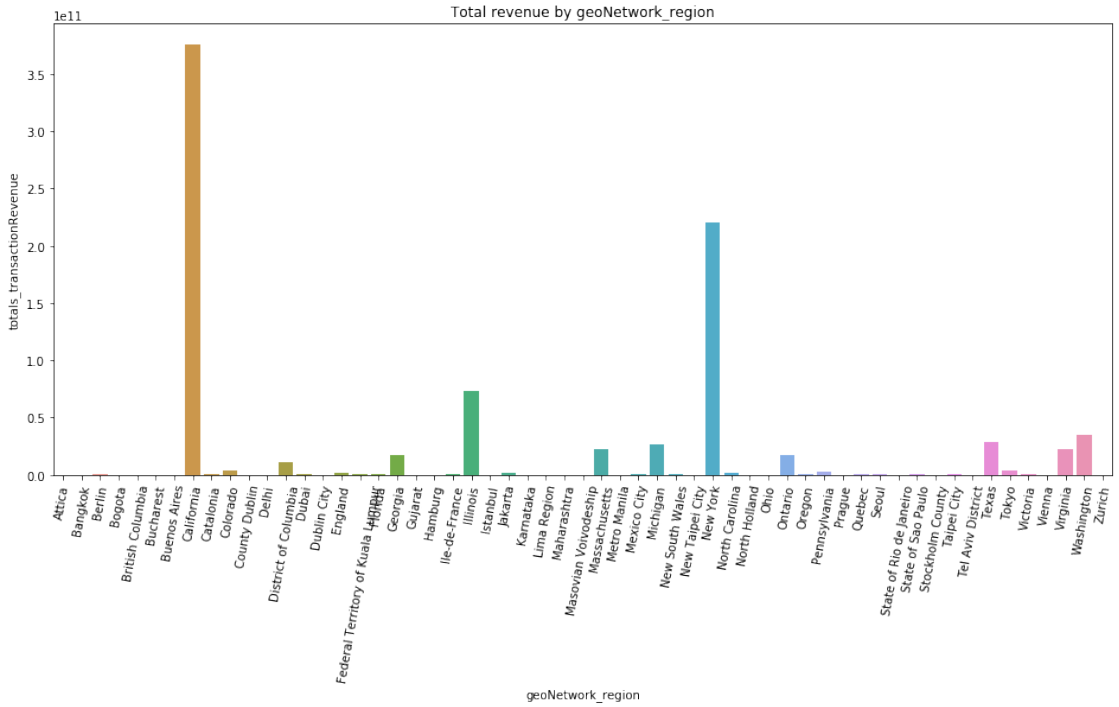


0.2.14 geoNetwork_region

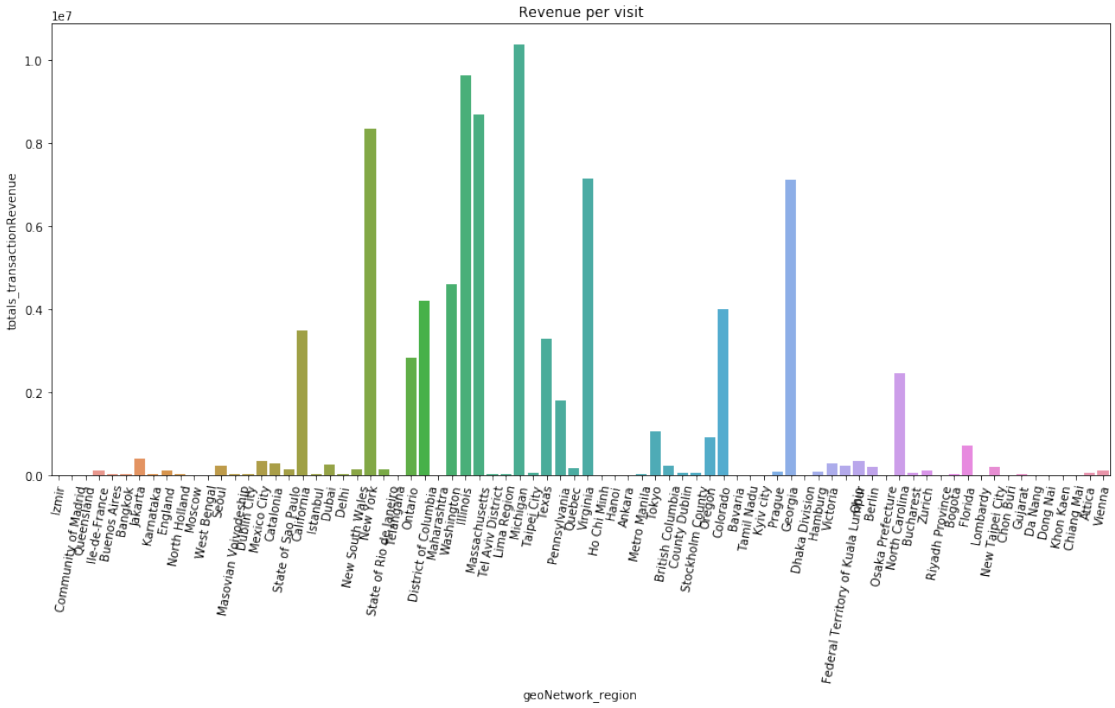
In [67]:
```
topRegions = train['geoNetwork_region'].value_counts().head(80).reset_index()
topRegions.columns = ['region','count']
topRegions = topRegions[(topRegions.region !='not available in demo dataset') &(topReg
topRegionsTrain = train[train['geoNetwork_region'].isin(topRegions['region'])]
```

In [68]:
```
plot_colCount(topRegionsTrain,'geoNetwork_region',80,16)
plot_totalRevenue(topRegionsTrain,'geoNetwork_region',80,16)
```



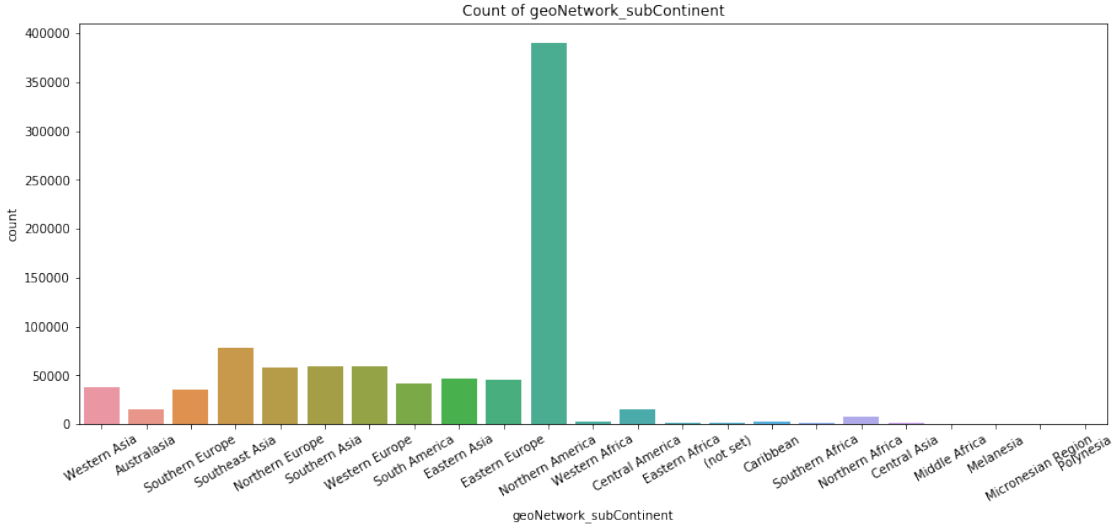


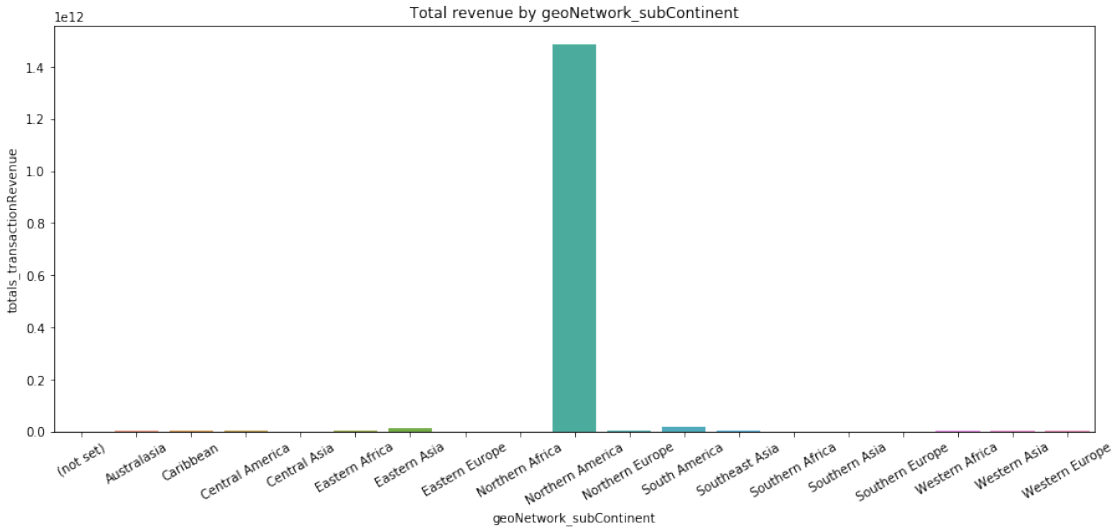

```
In [69]: plot_revenuePerUnitCol(topRegionsTrain,'geoNetwork_region',80,16)
         del topRegions
         del topRegionsTrain
```

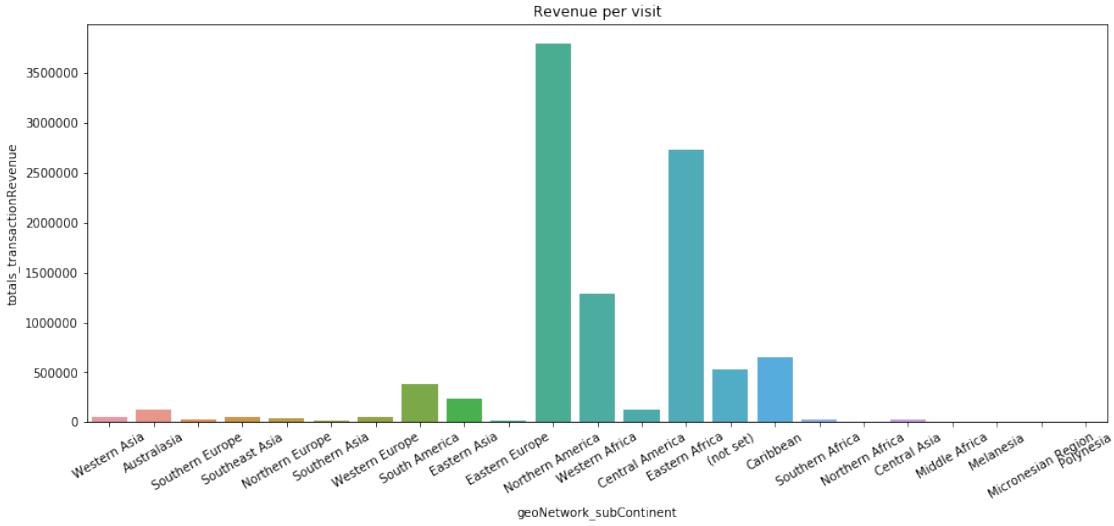


0.2.15 geoNetwork_subContinent

```
In [70]: plot_colCount(train,'geoNetwork_subContinent',30,15,6)
         plot_totalRevenue(train,'geoNetwork_subContinent',30,15,6)
         plot_revenuePerUnitCol(train,'geoNetwork_subContinent',30,15,6)
```







0.2.16 totals_bounces

```
In [71]: train['totals_bounces'].fillna(0,inplace=True)
         train['totals_bounces'] = train['totals_bounces'].astype('int64')
```

0.2.17 totals_newVisits

```
In [72]: train['totals_newVisits'].fillna(0,inplace=True)
         train['totals_newVisits'] = train['totals_newVisits'].astype('int64')
```

0.2.18 totals_hits

```
In [73]: train['totals_hits'] = train['totals_hits'].astype('int64')
```

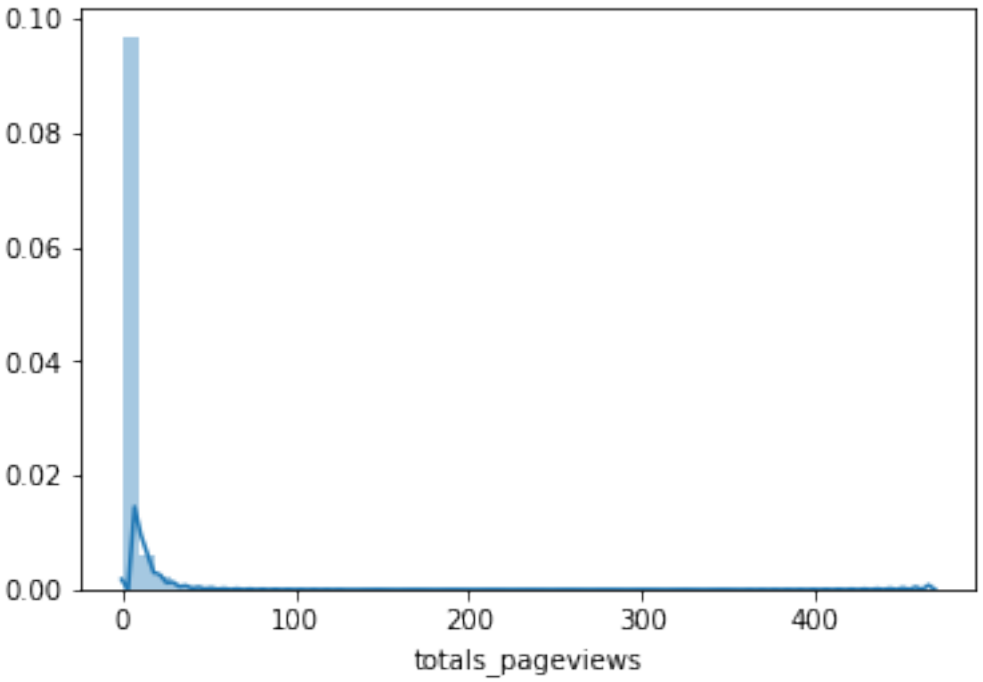
0.2.19 totals_pageviews

```
In [74]: #totals_pageviews
         train['totals_pageviews'] = train['totals_pageviews'].astype(float)
         print(train['totals_pageviews'].min())
         print(train['totals_pageviews'].max())
         train['totals_pageviews'].fillna(0,inplace=True)
```

```
1.0
469.0
```

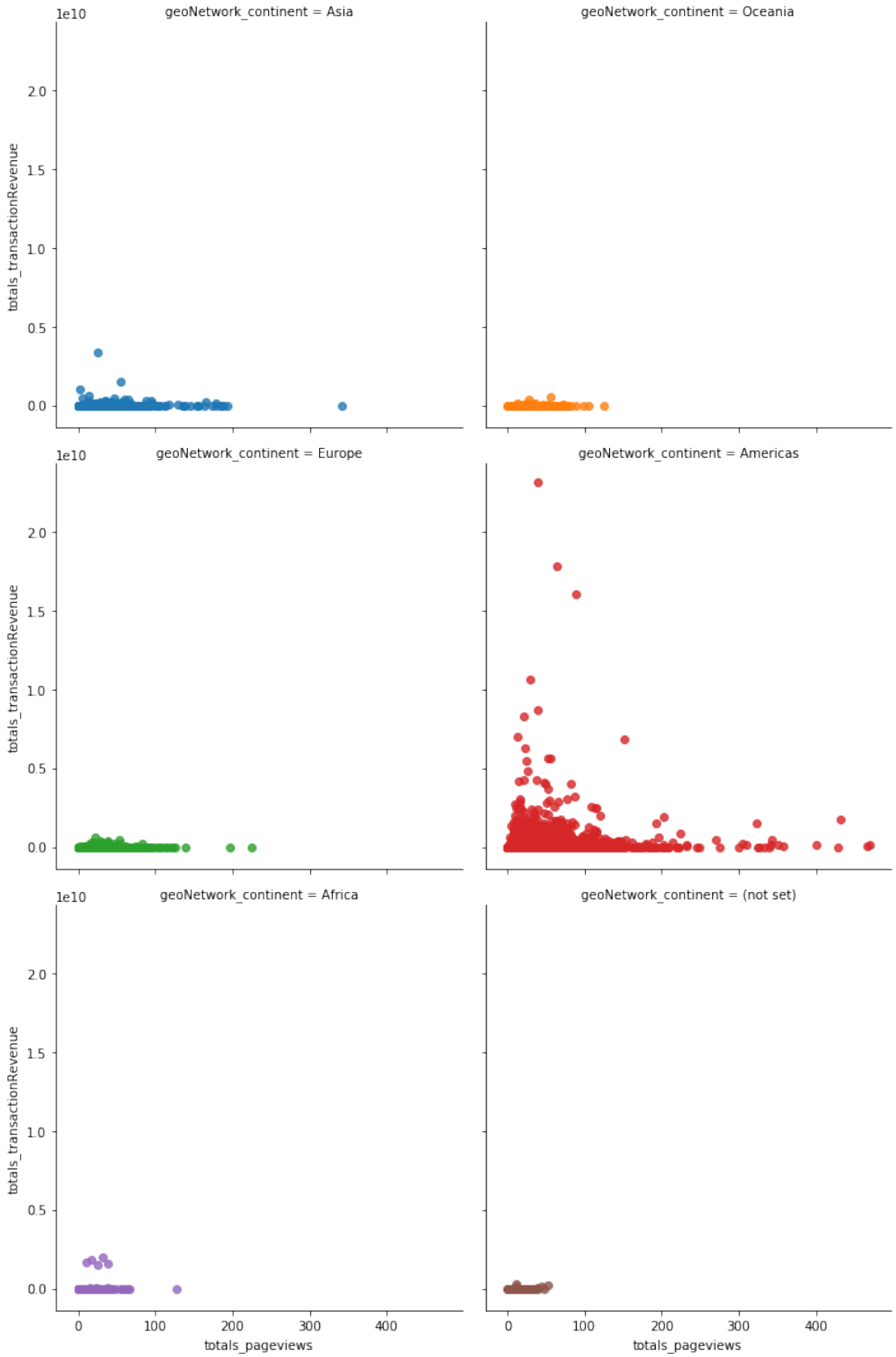
```
In [75]: sns.distplot(train['totals_pageviews'])
```

```
Out[75]: <matplotlib.axes._subplots.AxesSubplot at 0x1d875edfc18>
```




```
In [76]: sns.lmplot(data=train,x='totals_pageviews',y='totals_transactionRevenue',
                    hue='geoNetwork_continent',col='geoNetwork_continent',col_wrap=2,fit_reg=Fa
```

```
Out[76]: <seaborn.axisgrid.FacetGrid at 0x1d876173dd8>
```


geoNetwork_continent = Asia
geoNetwork_continent = Oceania
geoNetwork_continent = Europe
geoNetwork_continent = Americas
geoNetwork_continent = Africa
geoNetwork_continent = (not set)
1e10
totals_transactionRevenue
totals_pageviews
0.0
0.5
1.0
1.5
2.0
0
100
200
300
400

0.2.20 Traffic Source Columns

There are 3 Traffic Source related columns that do not have any null values. trafficSource_campaign trafficSource_medium trafficSource_source

```
In [77]: train['trafficSource_campaign'].value_counts()
```

```
Out[77]: (not set)                                        865347
         Data Share Promo                                  16403
         AW - Dynamic Search Ads Whole Site                14244
         AW - Accessories                                   7070
         test-liyuhz                                         392
         AW - Electronics                                     96
         Retail (DO NOT EDIT owners nophakun and tianyu)      50
         AW - Apparel                                         46
         All Products                                          4
         Data Share                                            1
         Name: trafficSource_campaign, dtype: int64
```

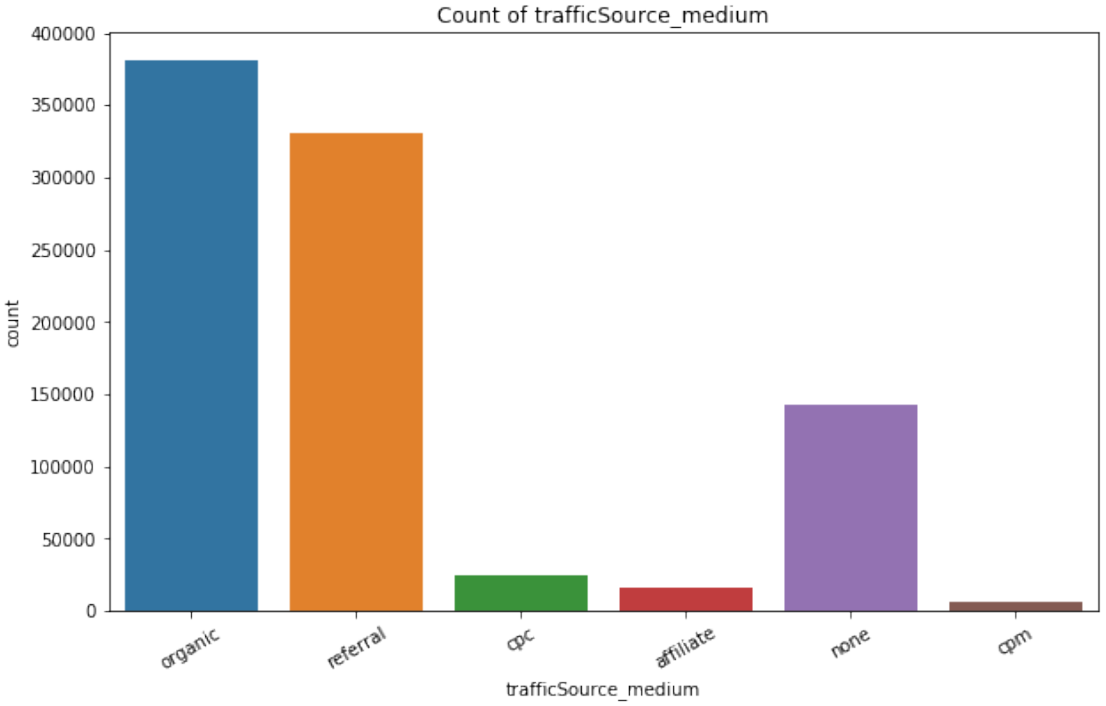
Though trafficsource_campaign does not contain any null values, there are many unknowns.

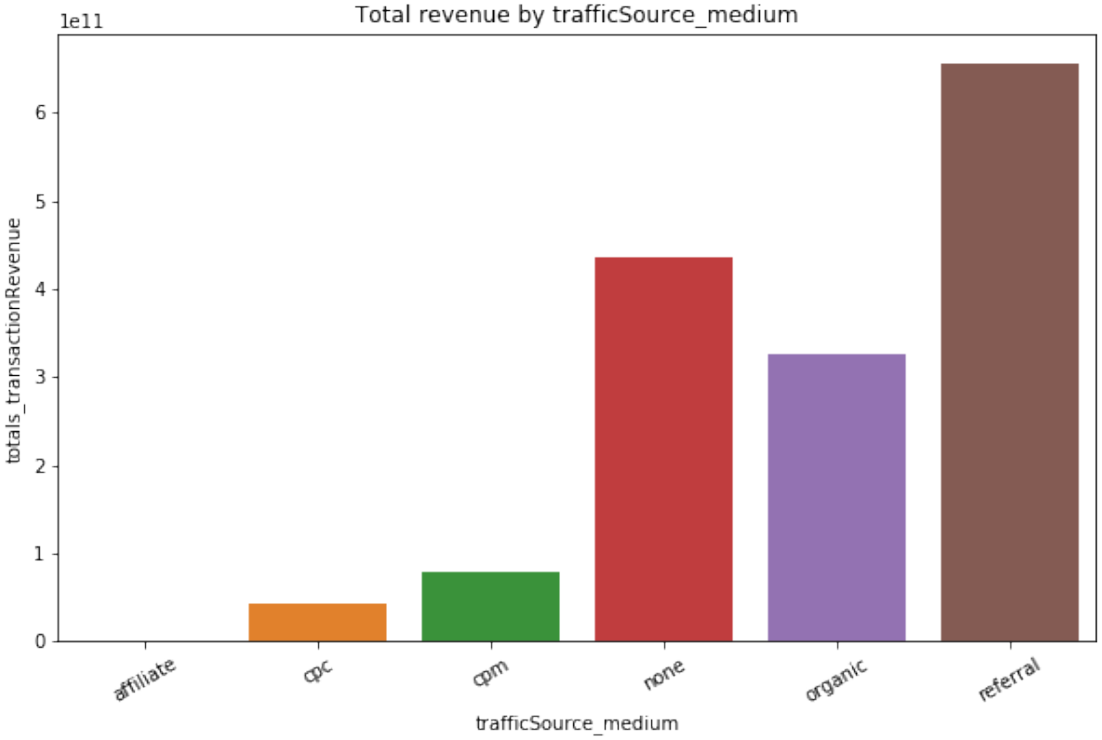
```
In [78]: train['trafficSource_medium'].value_counts()
```

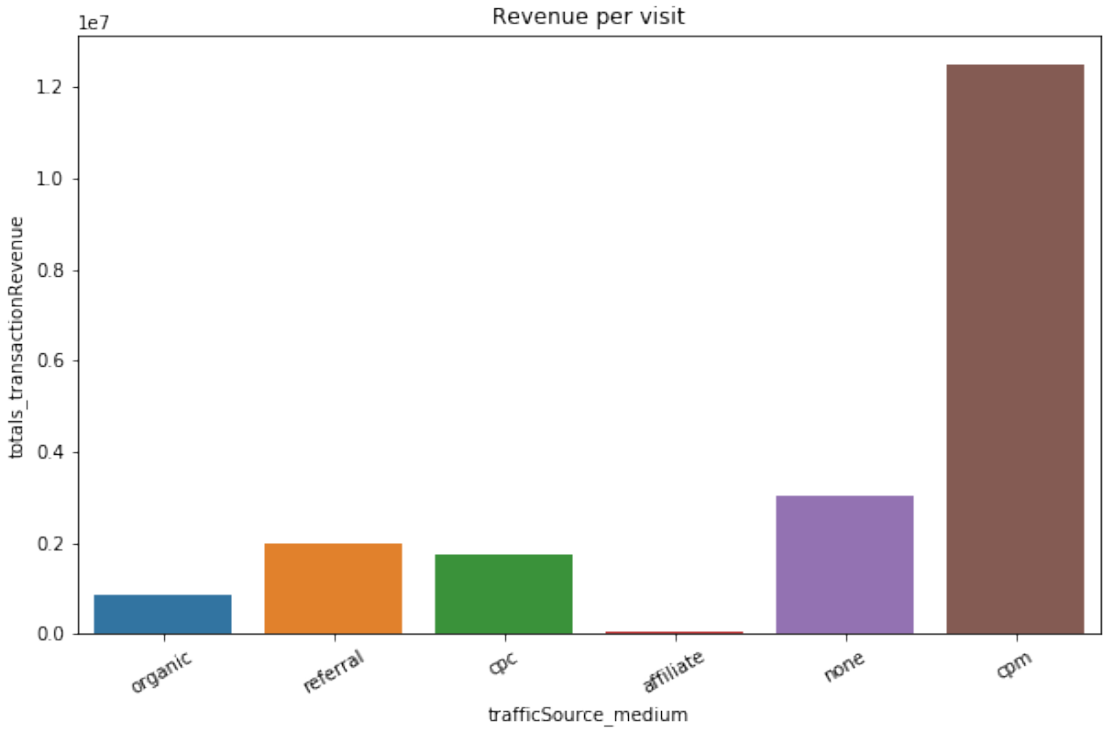
```
Out[78]: organic      381561
         referral     330955
         (none)       143026
         cpc           25326
         affiliate     16403
         cpm            6262
         (not set)       120
         Name: trafficSource_medium, dtype: int64
```

```
In [79]: train['trafficSource_medium'].replace('(not set)','none',inplace=True)
         train['trafficSource_medium'].replace('(none)','none',inplace=True)
```

```
In [80]: plot_colCount(train,'trafficSource_medium',30,10,6)
         plot_totalRevenue(train,'trafficSource_medium',30,10,6)
         plot_revenuePerUnitCol(train,'trafficSource_medium',30,10,6)
```


Count of trafficSource_medium
count
400000
350000
300000
250000
200000
150000
100000
50000
0
organic
referral
cpc
affiliate
none
cpm
trafficSource_medium


Total revenue by trafficSource_medium
1e11
totals_transactionRevenue
6
5
4
3
2
1
0
affiliate
cpc
cpm
none
organic
referral
trafficSource_medium




```
In [81]: train['trafficSource_source'].value_counts().head()

Out[81]: google                 400788
         youtube.com            212602
         (direct)               143028
         mall.googleplex.com     66416
         Partners                16411
         Name: trafficSource_source, dtype: int64

In [82]: #trafficSource_adwordsClickInfo.isVideoAd
         train['trafficSource_adwordsClickInfo.isVideoAd'].unique()

Out[82]: array([nan, False], dtype=object)
```

Not enough information. All non-values are 'False'. Dropping column.

```
In [83]: train.drop(['trafficSource_adwordsClickInfo.isVideoAd'],axis=1,inplace=True)

In [84]: #trafficSource_isTrueDirect
         train['trafficSource_isTrueDirect'].fillna(0,inplace=True)
         train['trafficSource_isTrueDirect'].replace(True,1,inplace=True)
         train['trafficSource_isTrueDirect']=train['trafficSource_isTrueDirect'].astype(bool)

In [85]: #trafficSource_adContent
         train['trafficSource_adContent'].fillna('Unknown',inplace=True)
```

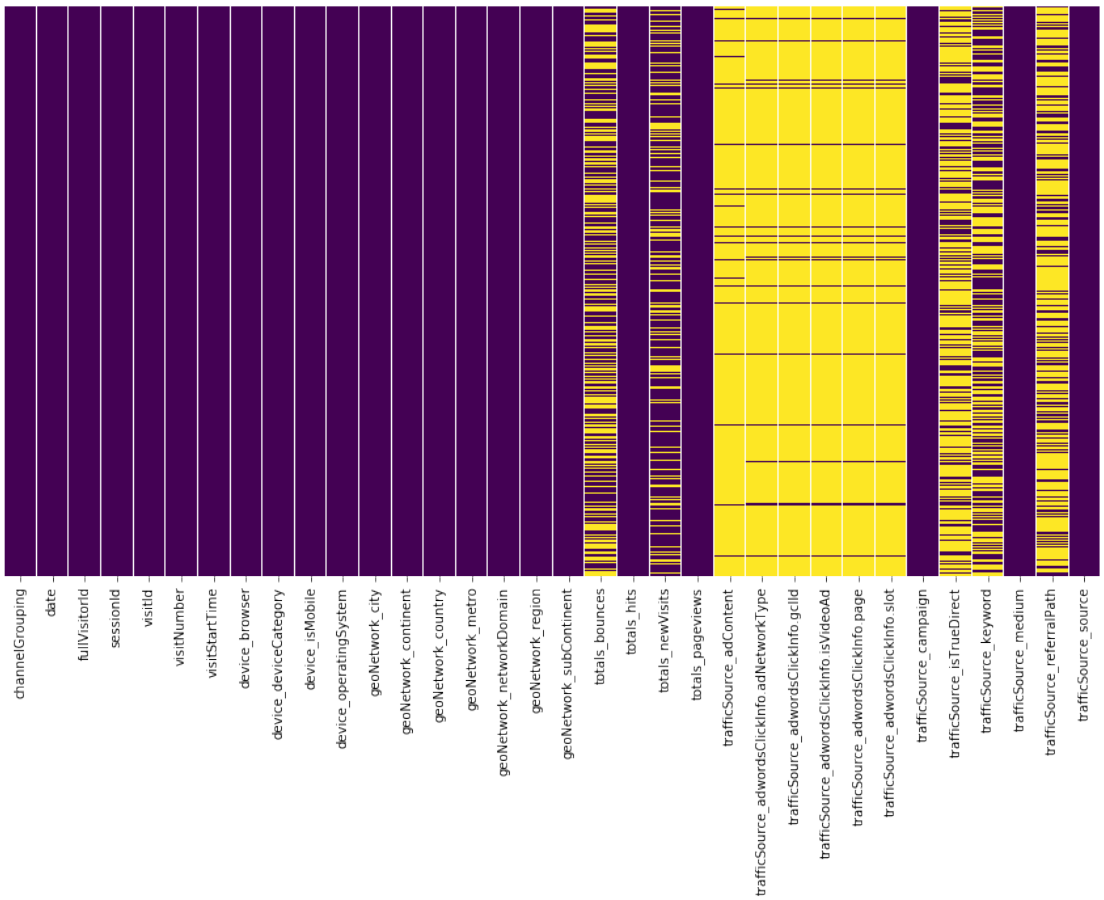
```
In [86]: #trafficSource_adwordsClickInfo.adNetworkType
         train['trafficSource_adwordsClickInfo.adNetworkType'].value_counts()
         train['trafficSource_adwordsClickInfo.adNetworkType'].fillna('Unknown',inplace=True)

In [87]: #trafficSource_adwordsClickInfo.gclId
         train['trafficSource_adwordsClickInfo.gclId'].fillna('Unknown',inplace=True)

In [88]: #trafficSource_adwordsClickInfo.page
         train['trafficSource_adwordsClickInfo.page'].fillna(0,inplace=True)
         train['trafficSource_adwordsClickInfo.page'] = train['trafficSource_adwordsClickInfo.p

In [89]: #trafficSource_referralPath
         train['trafficSource_referralPath'].fillna(0,inplace=True)

In [90]: #trafficSource_adwordsClickInfo.slot
         train['trafficSource_adwordsClickInfo.slot'].value_counts()

Out[90]: Top    20956
         RHS      504
         Name: trafficSource_adwordsClickInfo.slot, dtype: int64

In [91]: train.drop(['trafficSource_adwordsClickInfo.slot'],axis=1,inplace=True)

In [92]: #trafficSource_keyword
         train['trafficSource_keyword'].fillna(0,inplace=True)

In [93]: train.drop(['sessionId',
                     'visitId','visitStartTime',
                     'geoNetwork_region'],axis=1,inplace=True)
```

0.2.21 Test Set

```
In [94]: test.drop(['socialEngagementType',
         'device_browserSize',
         'device_browserVersion',
         'device_flashVersion',
         'device_language',
         'device_mobileDeviceBranding',
         'device_mobileDeviceInfo',
         'device_mobileDeviceMarketingName',
         'device_mobileDeviceModel',
         'device_mobileInputSelector',
         'device_operatingSystemVersion',
         'device_screenColors',
         'device_screenResolution',
         'geoNetwork_cityId',
         'geoNetwork_latitude',
         'geoNetwork_longitude',
         'geoNetwork_networkLocation',
```

```
        'totals_visits',
        'trafficSource_adwordsClickInfo.criteriaParameters'],axis=1,inplace=True)

        plt.figure(figsize=(15,8))
        sns.heatmap(test.isnull(),yticklabels=False,cbar=False,cmap='viridis')
```

Out[94]: <matplotlib.axes._subplots.AxesSubplot at 0x1d98462a7b8>




```
In [95]: test['date'] = pd.to_datetime(test['date'],format='%Y%m%d')
         test['date_year'],test['date_month'],test['date_weekday'] = test['date'].dt.year,test
         test.drop('date',axis=1,inplace=True)

In [96]: test['totals_bounces'].fillna(0,inplace=True)
         test['totals_bounces'] = test['totals_bounces'].astype('int64')
         test['totals_newVisits'].fillna(0,inplace=True)
         test['totals_newVisits'] = test['totals_newVisits'].astype('int64')
         test['totals_hits'] = test['totals_hits'].astype('int64')
         test['totals_pageviews'] = test['totals_pageviews'].astype(float)
         test['totals_pageviews'].fillna(0,inplace=True)
```

```
test['trafficSource_medium'].replace('(not set)','none',inplace=True)
test['trafficSource_medium'].replace('(none)','none',inplace=True)
test.drop(['trafficSource_adwordsClickInfo.isVideoAd'],axis=1,inplace=True)
test['trafficSource_isTrueDirect'].fillna(0,inplace=True)
test['trafficSource_isTrueDirect'].replace(True,1,inplace=True)
test['trafficSource_isTrueDirect']=test['trafficSource_isTrueDirect'].astype(bool)
test['trafficSource_adContent'].fillna('Unknown',inplace=True)
test['trafficSource_adwordsClickInfo.adNetworkType'].fillna('Unknown',inplace=True)
test['trafficSource_adwordsClickInfo.gclId'].fillna('Unknown',inplace=True)
test['trafficSource_adwordsClickInfo.page'].fillna(0,inplace=True)
test['trafficSource_adwordsClickInfo.page'] = test['trafficSource_adwordsClickInfo.pag
test['trafficSource_referralPath'].fillna(0,inplace=True)
test.drop(['trafficSource_adwordsClickInfo.slot'],axis=1,inplace=True)
test['trafficSource_keyword'].fillna(0,inplace=True)
test.drop(['sessionId',
           'visitId','visitStartTime',
           'geoNetwork_region'],axis=1,inplace=True)
```

```
In [97]: test.columns
```

```
Out[97]: Index(['channelGrouping', 'fullVisitorId', 'visitNumber', 'device_browser',
                'device_deviceCategory', 'device_isMobile', 'device_operatingSystem',
                'geoNetwork_city', 'geoNetwork_continent', 'geoNetwork_country',
                'geoNetwork_metro', 'geoNetwork_networkDomain',
                'geoNetwork_subContinent', 'totals_bounces', 'totals_hits',
                'totals_newVisits', 'totals_pageviews', 'trafficSource_adContent',
                'trafficSource_adwordsClickInfo.adNetworkType',
                'trafficSource_adwordsClickInfo.gclId',
                'trafficSource_adwordsClickInfo.page', 'trafficSource_campaign',
                'trafficSource_isTrueDirect', 'trafficSource_keyword',
                'trafficSource_medium', 'trafficSource_referralPath',
                'trafficSource_source', 'date_year', 'date_month', 'date_weekday'],
               dtype='object')
```

0.3 Categorical Variables

```
In [100]: from sklearn import preprocessing
          encoder = preprocessing.OneHotEncoder()
```

```
In [101]: train.columns
```

```
Out[101]: Index(['channelGrouping', 'fullVisitorId', 'visitNumber', 'device_browser',
                 'device_deviceCategory', 'device_isMobile', 'device_operatingSystem',
                 'geoNetwork_city', 'geoNetwork_continent', 'geoNetwork_country',
                 'geoNetwork_metro', 'geoNetwork_networkDomain',
                 'geoNetwork_subContinent', 'totals_bounces', 'totals_hits',
                 'totals_newVisits', 'totals_pageviews', 'totals_transactionRevenue',
                 'trafficSource_adContent',
                 'trafficSource_adwordsClickInfo.adNetworkType',
```

```
                'trafficSource_adwordsClickInfo.gclId',
                'trafficSource_adwordsClickInfo.page', 'trafficSource_campaign',
                'trafficSource_isTrueDirect', 'trafficSource_keyword',
                'trafficSource_medium', 'trafficSource_referralPath',
                'trafficSource_source', 'date_year', 'date_month', 'date_weekday'],
               dtype='object')
```

```
In [102]: test.columns
```

```
Out[102]: Index(['channelGrouping', 'fullVisitorId', 'visitNumber', 'device_browser',
                 'device_deviceCategory', 'device_isMobile', 'device_operatingSystem',
                 'geoNetwork_city', 'geoNetwork_continent', 'geoNetwork_country',
                 'geoNetwork_metro', 'geoNetwork_networkDomain',
                 'geoNetwork_subContinent', 'totals_bounces', 'totals_hits',
                 'totals_newVisits', 'totals_pageviews', 'trafficSource_adContent',
                 'trafficSource_adwordsClickInfo.adNetworkType',
                 'trafficSource_adwordsClickInfo.gclId',
                 'trafficSource_adwordsClickInfo.page', 'trafficSource_campaign',
                 'trafficSource_isTrueDirect', 'trafficSource_keyword',
                 'trafficSource_medium', 'trafficSource_referralPath',
                 'trafficSource_source', 'date_year', 'date_month', 'date_weekday'],
                dtype='object')
```

0.3.1 One Hot Encoding Variables

```
In [103]: #combined = pd.get_dummies(pd.concat([train,test],keys=['tr','ts']),columns=['device_
          #                                          'trafficSource_adwordsClickInfo.adNetworkType
          #                                          'channelGrouping','date_month','date_weekday'
```

```
In [104]: #combined.drop(['geoNetwork_continent_(not set)','trafficSource_adwordsClickInfo.adN
```

0.3.2 Label Encoding

```
In [105]: combined = pd.concat([train,test],keys=['tr','ts'])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: FutureWarning:

Sorting because non-concatenation axis is not aligned. A future version
of pandas will change to not sort by default.

To accept the future behavior, pass 'sort=True'.

To retain the current behavior and silence the warning, pass sort=False
```

```
In [106]: leColumns = ['device_deviceCategory','geoNetwork_continent','trafficSource_adwordsCli
                       'channelGrouping','date_month','date_weekday','geoNetwork_subContinen
```

```
                        'geoNetwork_city','geoNetwork_networkDomain','trafficSource_adContent
                        'trafficSource_keyword','trafficSource_source','device_operatingSyste
                    'geoNetwork_metro','geoNetwork_country','trafficSource_referralPath' ,
                    'trafficSource_adwordsClickInfo.gclId']


        for col in leColumns:
            print('Processing column ' + col)
            le = preprocessing.LabelEncoder()
            le.fit(combined[col].astype(str))
            combined[col] = le.transform(combined[col].astype(str))
```

```
Processing column device_deviceCategory
Processing column geoNetwork_continent
Processing column trafficSource_adwordsClickInfo.adNetworkType
Processing column channelGrouping
Processing column date_month
Processing column date_weekday
Processing column geoNetwork_subContinent
Processing column trafficSource_medium
Processing column geoNetwork_city
Processing column geoNetwork_networkDomain
Processing column trafficSource_adContent
Processing column trafficSource_campaign
Processing column trafficSource_keyword
Processing column trafficSource_source
Processing column device_operatingSystem
Processing column device_browser
Processing column geoNetwork_metro
Processing column geoNetwork_country
Processing column trafficSource_referralPath
Processing column trafficSource_adwordsClickInfo.gclId
```

```
In [107]: train,test = combined.xs('tr'),combined.xs('ts')
          del combined

In [108]: train.columns

Out[108]: Index(['channelGrouping', 'date_month', 'date_weekday', 'date_year',
                 'device_browser', 'device_deviceCategory', 'device_isMobile',
                 'device_operatingSystem', 'fullVisitorId', 'geoNetwork_city',
                 'geoNetwork_continent', 'geoNetwork_country', 'geoNetwork_metro',
                 'geoNetwork_networkDomain', 'geoNetwork_subContinent', 'totals_bounces',
                 'totals_hits', 'totals_newVisits', 'totals_pageviews',
                 'totals_transactionRevenue', 'trafficSource_adContent',
                 'trafficSource_adwordsClickInfo.adNetworkType',
                 'trafficSource_adwordsClickInfo.gclId',
                 'trafficSource_adwordsClickInfo.page', 'trafficSource_campaign',
```

```
                'trafficSource_isTrueDirect', 'trafficSource_keyword',
                'trafficSource_medium', 'trafficSource_referralPath',
                'trafficSource_source', 'visitNumber'],
               dtype='object')
```

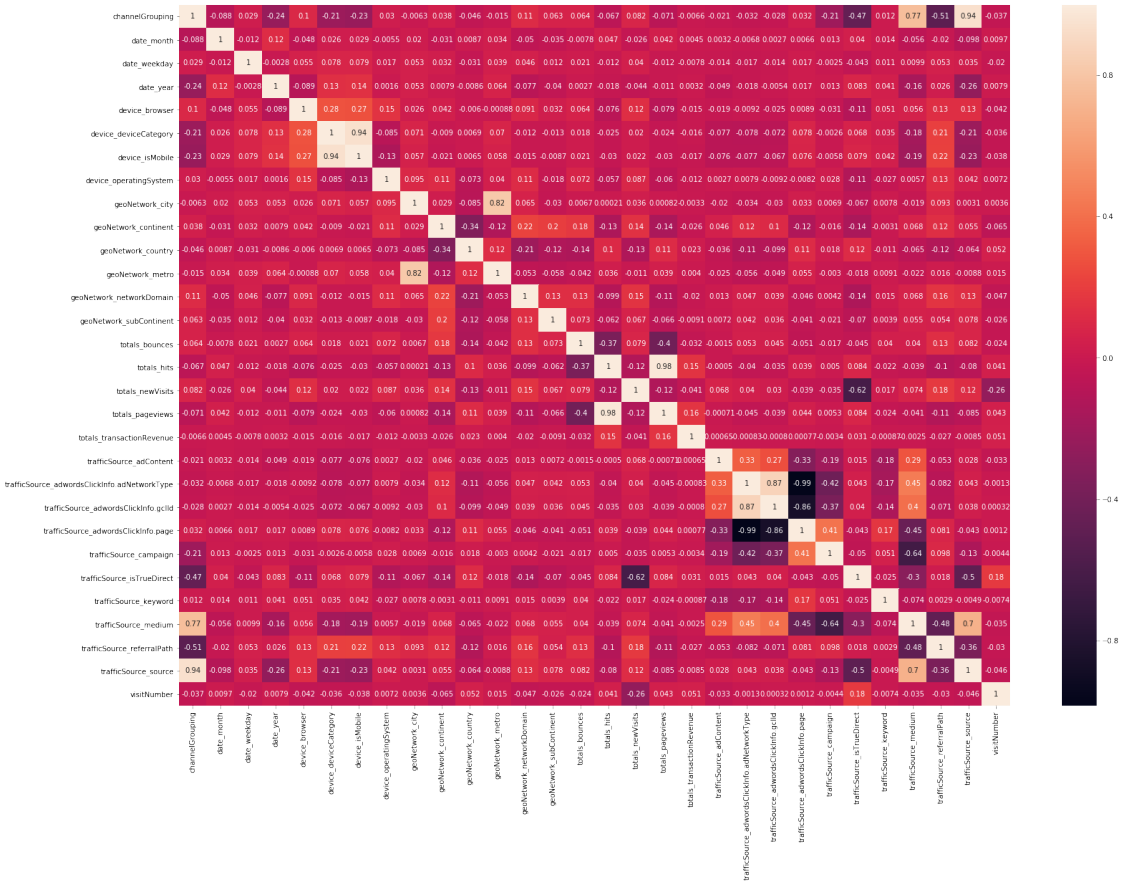
```
In [109]: test.columns
```

```
Out[109]: Index(['channelGrouping', 'date_month', 'date_weekday', 'date_year',
                 'device_browser', 'device_deviceCategory', 'device_isMobile',
                 'device_operatingSystem', 'fullVisitorId', 'geoNetwork_city',
                 'geoNetwork_continent', 'geoNetwork_country', 'geoNetwork_metro',
                 'geoNetwork_networkDomain', 'geoNetwork_subContinent', 'totals_bounces',
                 'totals_hits', 'totals_newVisits', 'totals_pageviews',
                 'totals_transactionRevenue', 'trafficSource_adContent',
                 'trafficSource_adwordsClickInfo.adNetworkType',
                 'trafficSource_adwordsClickInfo.gclId',
                 'trafficSource_adwordsClickInfo.page', 'trafficSource_campaign',
                 'trafficSource_isTrueDirect', 'trafficSource_keyword',
                 'trafficSource_medium', 'trafficSource_referralPath',
                 'trafficSource_source', 'visitNumber'],
                dtype='object')
```

0.4 Correlation

```
In [110]: plt.figure(figsize=(26,18))
          sns.heatmap(train.corr(),annot=True)
```

```
Out[110]: <matplotlib.axes._subplots.AxesSubplot at 0x1d86cb354e0>
```




```
In [111]: pd.DataFrame(train.corr()['totals_transactionRevenue']).abs().sort_values('totals_tra
```

Out[111]:

	totals_transactionRevenue
totals_transactionRevenue	1.000000
totals_pageviews	0.155589
totals_hits	0.154333
visitNumber	0.051366
totals_newVisits	0.041164
totals_bounces	0.032206
trafficSource_isTrueDirect	0.030819
trafficSource_referralPath	0.026763
geoNetwork_continent	0.025523
geoNetwork_country	0.022578
geoNetwork_networkDomain	0.020199
device_isMobile	0.016555
device_deviceCategory	0.015580
device_browser	0.015088
device_operatingSystem	0.011925
geoNetwork_subContinent	0.009144
trafficSource_source	0.008508

```
date_weekday                                        0.007812
channelGrouping                                     0.006644
date_month                                          0.004527
geoNetwork_metro                                    0.003989
trafficSource_campaign                              0.003375
geoNetwork_city                                     0.003328
date_year                                           0.003194
trafficSource_medium                                0.002520
trafficSource_keyword                               0.000875
trafficSource_adwordsClickInfo.adNetworkType        0.000835
trafficSource_adwordsClickInfo.gclId                0.000797
trafficSource_adwordsClickInfo.page                 0.000775
trafficSource_adContent                             0.000648
```

In [112]:
```
#train.drop(['trafficSource_source','geoNetwork_city','totals_hits'],axis=1,inplace=
#test.drop(['trafficSource_source','geoNetwork_city','totals_hits'],axis=1,inplace=T
```

In [113]:
```
train.columns
```

Out[113]:
```
Index(['channelGrouping', 'date_month', 'date_weekday', 'date_year',
       'device_browser', 'device_deviceCategory', 'device_isMobile',
       'device_operatingSystem', 'fullVisitorId', 'geoNetwork_city',
       'geoNetwork_continent', 'geoNetwork_country', 'geoNetwork_metro',
       'geoNetwork_networkDomain', 'geoNetwork_subContinent', 'totals_bounces',
       'totals_hits', 'totals_newVisits', 'totals_pageviews',
       'totals_transactionRevenue', 'trafficSource_adContent',
       'trafficSource_adwordsClickInfo.adNetworkType',
       'trafficSource_adwordsClickInfo.gclId',
       'trafficSource_adwordsClickInfo.page', 'trafficSource_campaign',
       'trafficSource_isTrueDirect', 'trafficSource_keyword',
       'trafficSource_medium', 'trafficSource_referralPath',
       'trafficSource_source', 'visitNumber'],
      dtype='object')
```

0.5 Extract X and y

In [115]:
```
import math
from sklearn.model_selection import train_test_split
```

In [116]:
```
X = train.drop(['totals_transactionRevenue','fullVisitorId'],axis=1)
y = train['totals_transactionRevenue'].apply(lambda x:0 if x==0 else math.log(x))
```

In [117]:
```
X_train, X_val, y_train, y_val = train_test_split(X, y, test_size=0.33, random_state=
#X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.00001,random_
```

In [118]:
```
print(len(X_train))
print(len(X_val))
```

```
605447
298206
```

0.5.1 LGBM

```
In [119]: params = {'objective' : 'regression',
                    'metric' :'rmse',
                    'bagging_fraction' :0.5,
                     'bagging_frequency':8 ,
                     'feature_fraction':0.7,
                     'learning_rate':0.01,
                      'max_bin' :100,
                      'max_depth' :7,
                       'num_leaves':30}
```

```
In [120]: import lightgbm as lgb
          from math import sqrt
          from sklearn.metrics import mean_squared_error

          lgbmReg = lgb.LGBMRegressor(**params,n_estimators=1000)
          lgbmReg.fit(X_train,y_train,eval_set=[(X_val,y_val)],early_stopping_rounds=100,verbos
```

```
Training until validation scores don't improve for 100 rounds.
[30]        valid_0's rmse: 1.88514
[60]        valid_0's rmse: 1.80972
[90]        valid_0's rmse: 1.75542
[120]        valid_0's rmse: 1.72287
[150]        valid_0's rmse: 1.69964
[180]        valid_0's rmse: 1.68307
[210]        valid_0's rmse: 1.67205
[240]        valid_0's rmse: 1.66493
[270]        valid_0's rmse: 1.65861
[300]        valid_0's rmse: 1.65364
[330]        valid_0's rmse: 1.64989
[360]        valid_0's rmse: 1.64696
[390]        valid_0's rmse: 1.64442
[420]        valid_0's rmse: 1.64253
[450]        valid_0's rmse: 1.64093
[480]        valid_0's rmse: 1.63962
[510]        valid_0's rmse: 1.63852
[540]        valid_0's rmse: 1.63734
[570]        valid_0's rmse: 1.63623
[600]        valid_0's rmse: 1.63549
[630]        valid_0's rmse: 1.63462
[660]        valid_0's rmse: 1.63369
[690]        valid_0's rmse: 1.63297
[720]        valid_0's rmse: 1.63234
[750]        valid_0's rmse: 1.63175
[780]        valid_0's rmse: 1.6311
[810]        valid_0's rmse: 1.63074
[840]        valid_0's rmse: 1.63028
[870]        valid_0's rmse: 1.62986
```

```
[900]        valid_0's rmse: 1.62952
[930]        valid_0's rmse: 1.62909
[960]        valid_0's rmse: 1.62841
[990]        valid_0's rmse: 1.62787
Did not meet early stopping. Best iteration is:
[1000]        valid_0's rmse: 1.62768
```

```
Out[120]: LGBMRegressor(bagging_fraction=0.5, bagging_frequency=8, boosting_type='gbdt',
                  class_weight=None, colsample_bytree=1.0, feature_fraction=0.7,
                  importance_type='split', learning_rate=0.01, max_bin=100,
                  max_depth=7, metric='rmse', min_child_samples=20,
                  min_child_weight=0.001, min_split_gain=0.0, n_estimators=1000,
                  n_jobs=-1, num_leaves=30, objective='regression', random_state=None,
                  reg_alpha=0.0, reg_lambda=0.0, silent=True, subsample=1.0,
                  subsample_for_bin=200000, subsample_freq=0)
```

```
In [122]: imp = pd.DataFrame({'Feature':X_val.columns,'Importance':lgbmReg.booster_.feature_imp
          imp.sort_values(by='Importance',ascending=False)
```

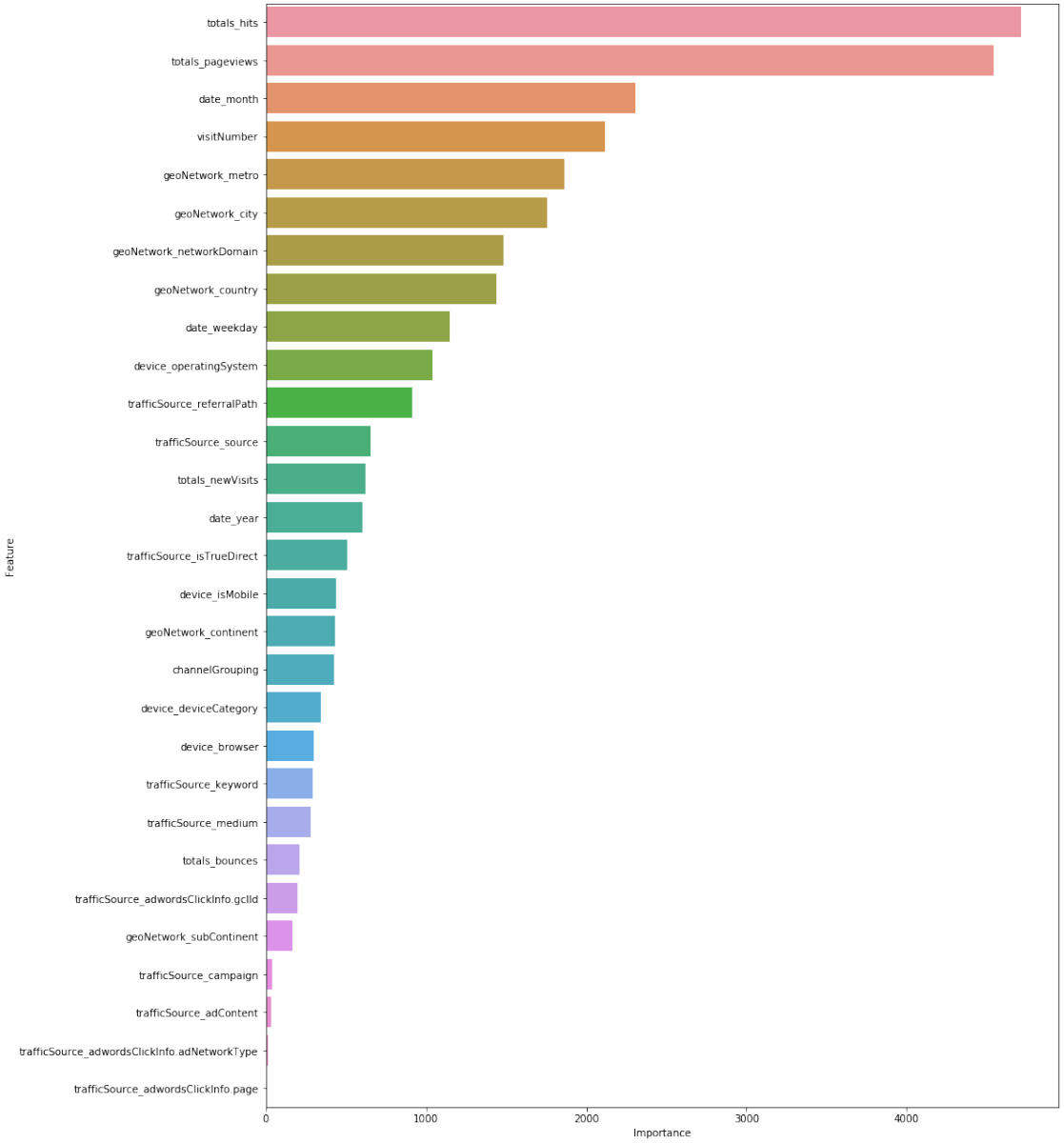
Out[122]:

	Feature	Importance
15	totals_hits	4715
17	totals_pageviews	4545
1	date_month	2308
28	visitNumber	2114
11	geoNetwork_metro	1866
8	geoNetwork_city	1756
12	geoNetwork_networkDomain	1481
10	geoNetwork_country	1441
2	date_weekday	1145
7	device_operatingSystem	1041
26	trafficSource_referralPath	915
27	trafficSource_source	650
16	totals_newVisits	620
3	date_year	604
23	trafficSource_isTrueDirect	506
6	device_isMobile	435
9	geoNetwork_continent	433
0	channelGrouping	428
5	device_deviceCategory	344
4	device_browser	299
24	trafficSource_keyword	289
25	trafficSource_medium	278
14	totals_bounces	212
20	trafficSource_adwordsClickInfo.gclId	197
13	geoNetwork_subContinent	164
22	trafficSource_campaign	39
18	trafficSource_adContent	34

```
19  trafficSource_adwordsClickInfo.adNetworkType          13
21           trafficSource_adwordsClickInfo.page           2
```

In [123]:
```
plt.figure(figsize=(14,20))
sns.barplot(data=imp.sort_values(by='Importance',ascending=False),x='Importance',y='
```

Out[123]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1d86c7a4a58>
```



In [251]:
```
XSub = test.drop(['totals_transactionRevenue','fullVisitorId'],axis=1)
ySubmission_gb_pred = lgbmReg.predict(XSub,num_iteration=lgbmReg.best_iteration_)
submission = pd.DataFrame({"fullVisitorId":test['fullVisitorId'],
```

```
                            "PredictedLogRevenue":ySubmission_gb_pred})
submission['PredictedLogRevenue'] = submission['PredictedLogRevenue'].apply(lambda x
submissionByVisitor = submission.groupby('fullVisitorId').sum()
submissionByVisitor.to_csv("submission.csv")
```