Nojoto-Tasks-Programming

May 19, 2020

1 Programming Tasks for Nojoto

1.1 Recommendation Engine

[1]:
```
# importing libraries

import pandas as pd
import numpy as np
import datetime as dt
import matplotlib.pyplot as plt
import seaborn as sns
```

[2]:
```
data = pd.read_excel('data/RecommendationEngineData.xlsx', sheet_name =␣
 ↪'Recommendation EnginDataSet')
```

[3]:
```
data.head(5)
```

[3]:
```
   POST_ID              POST_STRING_UNIQUE_ID          CREATED_AT  \
0  5251588  ec7e9ef3246874618d617623ee07451c 2020-04-22 19:51:00
1  5539448  e38e34aa65c0c7c2ed42426fe92e6419 2020-05-10 18:00:00
2  5503440  01e4dc698aba6a4561739c58906838cc 2020-05-08 07:33:00
3  5538585  87d93e56b144f5ba7557663b2fb6218c 2020-05-10 15:18:00
4  5540220  4b20839183de924a7bc8e4bcdc9c20a2 2020-05-10 17:11:00

      Creator_Name                                          Caption  Length  \
0      Nojoto News  Know who loved your story | Tag Nojotians #Noj…      51
1      Nojoto News  Details for Day 1 (Monday) :- \nExpress Karo N…     168
2  Anand Mohan Jha  Anshh only 4 youðŸ˜, sorry #Nojoto #story #Poe…       0
3  Anand Mohan Jha  #krishna_flute à¤®à¤¾à¤  à¤¤à¥‹ à¤®à¤¾à¤  à¤¹à…      0
4    Bhawna Mishra  #SuperMom #chitthi #letter #originalmess #message     116

   Watch_Views  Total_Watch_time  Average_Watch_time  10_Sec_Watch_Time  …  \
0        61196            732610                12.0             584192  …
1         2751             33002                12.0              25716  …
2         7086            126534                17.9             110171  …
3         1119             19908                17.8              17109  …
4         1075             15966                14.9              13091  …
```

```
   Execution_Reach  Spammy_Views  Love  Comment  Share  Report_Abuse  \
0          1000000         28445  1720      108     35             0
1            50000          1037   130       10      4             0
2            50000          2606   337      113      9             0
3            10000           447   114       34      2             0
4            10000           376   143       49      1             0

   Repost_Count  Creation_type ContentType LANGUAGE_NAME
0            73       Uploaded       Video       English
1            17       Uploaded       Video       English
2            21       Uploaded       Video       English
3            12        Created       Video       English
4            13        Created       Video       English

[5 rows x 21 columns]
```

```
[4]: data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 21 columns):
POST_ID                  1000 non-null int64
POST_STRING_UNIQUE_ID    1000 non-null object
CREATED_AT               1000 non-null datetime64[ns]
Creator_Name             1000 non-null object
Caption                  996 non-null object
Length                   1000 non-null int64
Watch_Views              1000 non-null int64
Total_Watch_time         1000 non-null int64
Average_Watch_time       1000 non-null float64
10_Sec_Watch_Time        1000 non-null int64
10_Sec_Views             1000 non-null int64
Execution_Reach          1000 non-null int64
Spammy_Views             1000 non-null int64
Love                     1000 non-null int64
Comment                  1000 non-null int64
Share                    1000 non-null int64
Report_Abuse             1000 non-null int64
Repost_Count             1000 non-null int64
Creation_type            1000 non-null object
ContentType              1000 non-null object
LANGUAGE_NAME            1000 non-null object
dtypes: datetime64[ns](1), float64(1), int64(13), object(6)
memory usage: 164.2+ KB
```

1.1.1 What should be the Top 10 Content pieces for a new user & Why?

```
[5]: from sklearn import preprocessing

     scaler = preprocessing.MinMaxScaler()
```

Scaling all the metrics The MinMaxScaler will scale the metrics in the range of 0 - 1. We can then add and subtract the metrics to obtain a score.

```
[6]: data['scaled_Watch_Views'] = scaler.fit_transform(data[['Watch_Views']])
     data['scaled_Average_Watch_time'] = scaler.
      ↪fit_transform(data[['Average_Watch_time']])
     data['scaled_10_Sec_Views'] = scaler.fit_transform(data[['10_Sec_Views']])
     data['scaled_Execution_Reach'] = scaler.fit_transform(data[['Execution_Reach']])
     data['scaled_Spammy_Views'] = scaler.fit_transform(data[['Spammy_Views']])
     data['scaled_Love'] = scaler.fit_transform(data[['Love']])
     data['scaled_Comment'] = scaler.fit_transform(data[['Comment']])
     data['scaled_Share'] = scaler.fit_transform(data[['Share']])
     data['scaled_Repost_Count'] = scaler.fit_transform(data[['Repost_Count']])
     data['scaled_Report_Abuse'] = scaler.fit_transform(data[['Report_Abuse']])
```

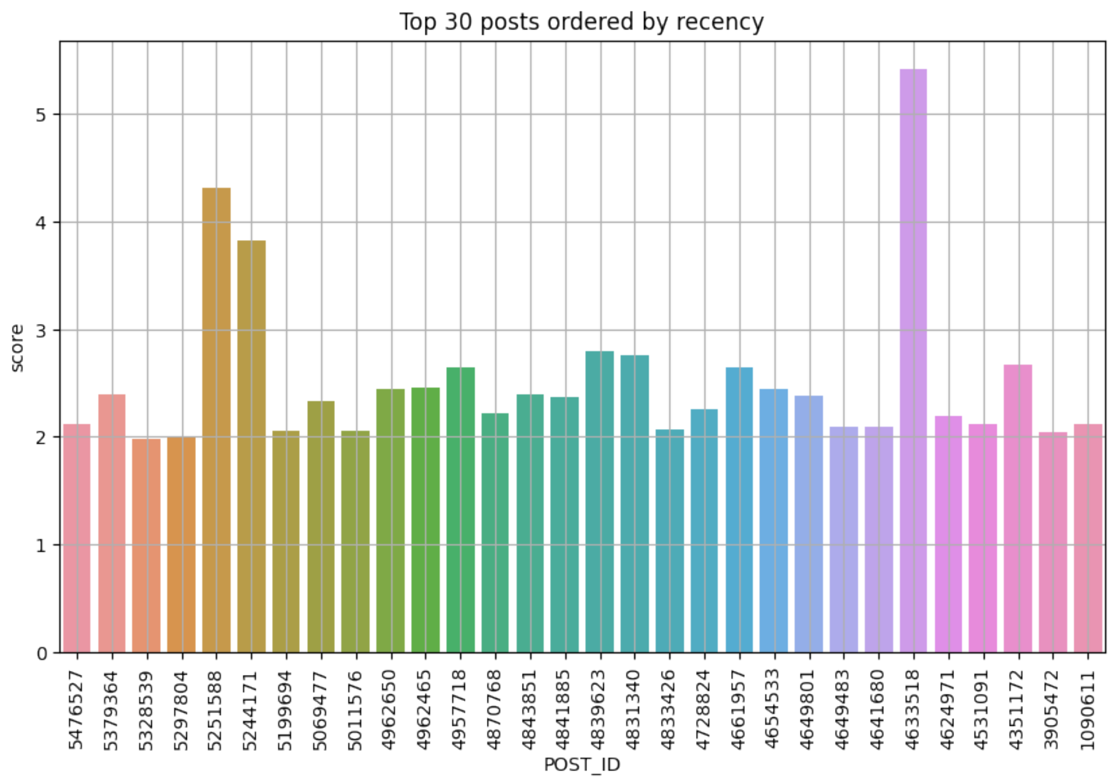
```
[7]: data['score'] = data['scaled_Watch_Views'] + data['scaled_Average_Watch_time']␣
      ↪+ data['scaled_10_Sec_Views'] +\
     data['scaled_Execution_Reach'] - data['scaled_Spammy_Views'] +␣
      ↪data['scaled_Love'] + data['scaled_Comment'] +\
     data['scaled_Share'] + data['scaled_Repost_Count'] - data['scaled_Report_Abuse']
```

Getting the top 10 scores and then sorting them by receny.

```
[8]: top_30 = data.sort_values('score', ascending = False).head(30)
```

```
[9]: plt.figure(figsize=(10, 6), dpi = 100)
     sns.barplot(x = 'POST_ID', y = 'score', data = top_30,
                 order = top_30.sort_values(by = 'CREATED_AT', ascending =␣
      ↪False)['POST_ID'])
     plt.grid()
     plt.title("Top 30 posts ordered by recency")
     plt.xticks(rotation=90)
```

```
[9]: (array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
             17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29]),
      <a list of 30 Text major ticklabel objects>)
```



Taking a look at top 10 post IDs by receny. Since these posts are the most recent ones and have the highest scores, we can present them to a new user.

```
[10]: top_10 = data[data.POST_ID.isin(top_30.sort_values(by = 'CREATED_AT', ascending␣
      ↪= False).head(10)['POST_ID']\
                                          .to_list())]
```

```
[11]: top_10.reset_index(drop = True, inplace = True)
      top_10.iloc[:,0:18]
```

```
[11]:    POST_ID              POST_STRING_UNIQUE_ID          CREATED_AT  \
      0  5251588  ec7e9ef3246874618d617623ee07451c 2020-04-22 19:51:00
      1  5476527  be65e3d72d5e21b5d2b324adf5d08730 2020-05-06 11:15:00
      2  5379364  6e44130461633f7b43456469c6355703 2020-04-30 14:00:00
      3  5199694  0c49aa0598481823a3d81fff5adfaba2 2020-04-19 20:07:00
      4  5244171  fb6d818f7bf2bd153c69897b8f299ce0 2020-04-22 12:19:00
      5  5297804  74a1d289f818f4ee6c48178f5b6a54e7 2020-04-25 15:28:00
      6  5328539  875b097e3bc79fd2bcbc60dc8fcaaf24 2020-04-27 13:27:00
      7  5069477  679715d4c44fed79150d3ff2e7e601a9 2020-04-12 20:00:00
      8  4962650  066ca277b6748b1f230d954463ca6155 2020-04-06 17:39:00
      9  5011576  092b940d8c01ec06a79efe7dfa1cbd4e 2020-04-09 14:01:00
```

```
                Creator_Name  \
0                Nojoto News
1  à¤•à¤µà¤¿ à¤°à¤¾à¤¹à¥ à¤² à¤ªà¤¾à¤²
2                Nojoto News
3            Sourabh shresth
4  à¤•à¤µà¤¿ à¤°à¤¾à¤¹à¥ à¤² à¤ªà¤¾à¤²
5  à¤•à¤µà¤¿ à¤°à¤¾à¤¹à¥ à¤² à¤ªà¤¾à¤²
6              Bhawna Mishra
7                Nojoto News
8                     Nalini
9         Swati shikha laxmi

                                             Caption  Length  Watch_Views  \
0  Know who loved your story | Tag Nojotians #Noj…      51        61196
1  Old Man - Lost Smile\n#StoryOnline \n#nojotofi…     187         1901
2  à¤…à¤à¥€ à¤¤à¥‹ à¤¬à¤¸ à¤œà¤¼à¤¿à¤¨à¥ à¤¦à¤–à…      67        10808
3  https://instagram.com/sourabh_shresth?igshid=1…       0        12512
4  #MessageForModi\ncomedy -only for fun \nà¤¨à¤¿…     236        19197
5  " à¤†à¤ˆà¤¨à¥‡ à¤¸à¥‡ à¤¦à¥ à¤µà¤¸à¤¦à¥ à¤µ"\n…       0         6353
6                   #lovebeat #PoetryOnline #shadi     154         3057
7  Details for Day 1 (Monday):-\nExpress Karo Na\…     128        24508
8  #poetryonline #kinnar #nojotohindi #hindipoetr…     137        16897
9                   â ¤ #nojotovideo #hindipoetry       0         9798

   Total_Watch_time  Average_Watch_time  10_Sec_Watch_Time  10_Sec_Views  \
0            732610                12.0             584192         21149
1             40310                21.2              35967           776
2            138849                12.8             111024          3418
3            267545                21.4             239129          5140
4            483765                25.2             436495          8274
5            118239                18.6             103216          2465
6             77706                25.4              71139          1400
7            440849                18.0             383910         10203
8            244298                14.5             197238          6810
9            190784                19.5             164774          4033

   Execution_Reach  Spammy_Views  Love  Comment  Share  Report_Abuse  \
0          1000000         28445  1720      108     35             0
1            10000           668   336      209      8             0
2            50000          3444   716      115    107             0
3            50000          3696   950      123     16             0
4            50000          4965  1052      283     58             0
5            25000          2045   504      183      6             0
6            10000           714   485      128     21             0
7            80000          8419   917       66     25             0
8            50000          3646  1183      163     35             0
9            25000          2159   867      104     40             0
```

```
   Repost_Count
0            73
1            51
2            42
3            17
4            65
5            42
6            33
7            41
8            30
9            24
```

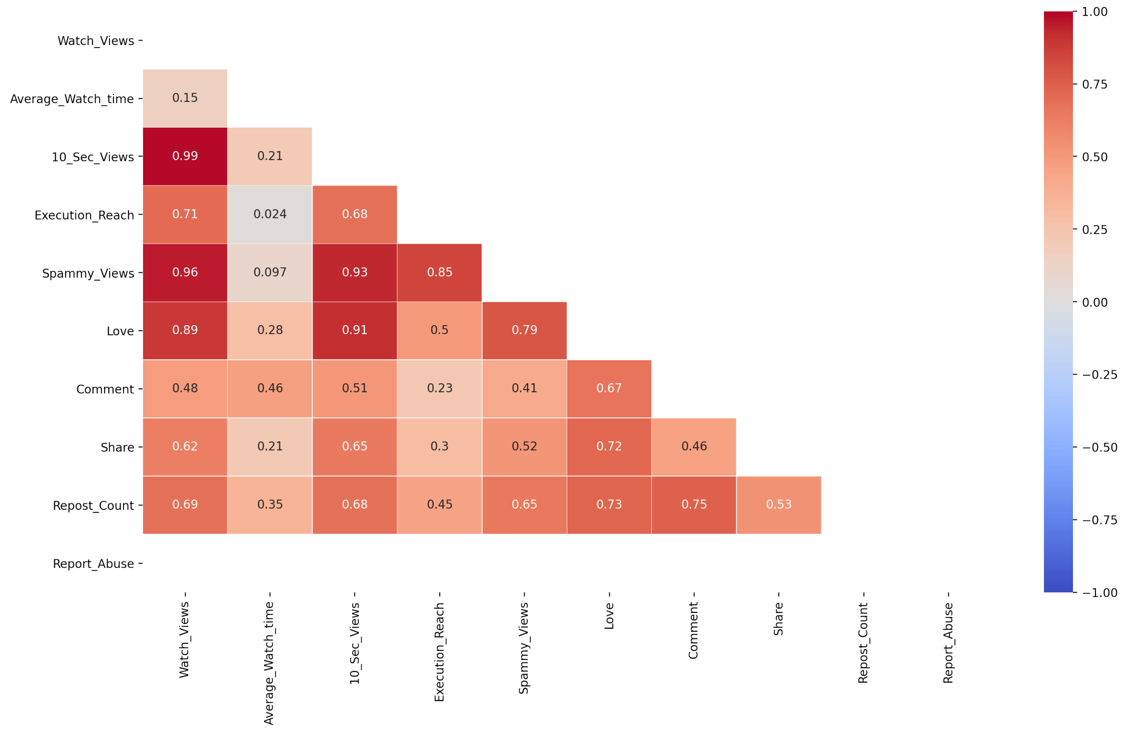
1.1.2 Which are the Recommendation Engine Variables that should be used to improve the current algorithm which can serve the content better

The following metrics are important towards the contribution of a better recommendation engine: 1. Watch_Views 2. Average_Watch_time 3. 10_Sec_Views 4. Execution_Reach 5. Love 6. Comment 7. Share 8. Repost_Count

Whereas the following can be reduced to decrease the importance of a video: 1. Spammy_Views 2. Report_Abuse

The correlation among these variables can also be obtained:

[12]:
```
plt.figure(figsize=(16, 9), dpi = 200)

corr_plot = data[['Watch_Views', 'Average_Watch_time', '10_Sec_Views',
                  'Execution_Reach', 'Spammy_Views', 'Love', 'Comment',
                  'Share', 'Repost_Count', 'Report_Abuse']].corr()
mask = np.zeros_like(corr_plot, dtype=np.bool)
mask[np.triu_indices_from(mask)] = True
sns.heatmap(corr_plot,
            square=False,
            linewidth=.1,
            vmin=-1,
            vmax=1,
            cmap='coolwarm',
            annot=True,
            mask = mask)
plt.show()
```



As shown in the correlation plot above, a lot of these variables are highly correlation with watch views. Thus stating that they're important as metrics in a recommendation system.

1.1.3 Is there any other insights that you can pick up, apart from those asked above

1. Watch views seems to be very poorly correlated with watch time and highly correlated with spammy views - suggesting that a lot of videos might be spam.
2. Views with a more 'Love' tend to be 'Shared' and 'Reposted' more often.
3. Metrics such as spammy views and report abuse can be used to detect anomalies and misbehaving users.

1.2 Cohort Analysis

```
[13]: df = pd.read_excel('data/Online_Retail.xlsx')
      df.head(5)
```

```
[13]:   InvoiceNo StockCode                          Description  Quantity  \
      0    536365    85123A   WHITE HANGING HEART T-LIGHT HOLDER         6
      1    536365     71053                  WHITE METAL LANTERN         6
      2    536365    84406B       CREAM CUPID HEARTS COAT HANGER         8
      3    536365    84029G  KNITTED UNION FLAG HOT WATER BOTTLE         6
      4    536365    84029E       RED WOOLLY HOTTIE WHITE HEART.         6

                InvoiceDate  UnitPrice  CustomerID         Country
```

```
0 2010-12-01 08:26:00       2.55     17850.0  United Kingdom
1 2010-12-01 08:26:00       3.39     17850.0  United Kingdom
2 2010-12-01 08:26:00       2.75     17850.0  United Kingdom
3 2010-12-01 08:26:00       3.39     17850.0  United Kingdom
4 2010-12-01 08:26:00       3.39     17850.0  United Kingdom
```

[14]:
```
df.isna().sum()
```

[14]:
```
InvoiceNo            0
StockCode            0
Description       1454
Quantity             0
InvoiceDate          0
UnitPrice            0
CustomerID      135080
Country              0
dtype: int64
```

[15]:
```
df1 = df.dropna(subset=['CustomerID'])
```

[16]:
```
def get_month(x):
    return dt.datetime(x.year, x.month, 1)
df1['InvoiceMonth'] = df1['InvoiceDate'].apply(get_month)
df1['CohortMonth'] = df1.groupby('CustomerID')['InvoiceMonth'].transform('min')
```

```
/Users/jacob1.ext/Codes/covid-19/.venv/lib/python3.7/site-
packages/ipykernel_launcher.py:3: SettingWithCopyWarning:
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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  This is separate from the ipykernel package so we can avoid doing imports
until
/Users/jacob1.ext/Codes/covid-19/.venv/lib/python3.7/site-
packages/ipykernel_launcher.py:4: SettingWithCopyWarning:
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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  after removing the cwd from sys.path.
```

[17]:
```
def get_date(df, column):
    year = df[column].dt.year
    month = df[column].dt.month
    day = df[column].dt.day
    return year, month, day
invoice_year, invoice_month, _ = get_date(df1, 'InvoiceMonth')
cohort_year, cohort_month, _ = get_date(df1, 'CohortMonth')
year_diff = invoice_year - cohort_year
month_diff = invoice_month - cohort_month
df1['CohortIndex'] = year_diff * 12 + month_diff + 1
```

```
/Users/jacob1.ext/Codes/covid-19/.venv/lib/python3.7/site-
packages/ipykernel_launcher.py:10: SettingWithCopyWarning:
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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  # Remove the CWD from sys.path while we load stuff.
```

1.2.1 Create 1st Cohort: User number & Retention Rate

[18]:
```
cohort_data = df1.groupby(['CohortMonth', 'CohortIndex'])['CustomerID'].
 ↪apply(pd.Series.nunique).reset_index()
cohort_count = cohort_data.pivot_table(index = 'CohortMonth',
                                       columns = 'CohortIndex',
                                       values = 'CustomerID')
cohort_count
```

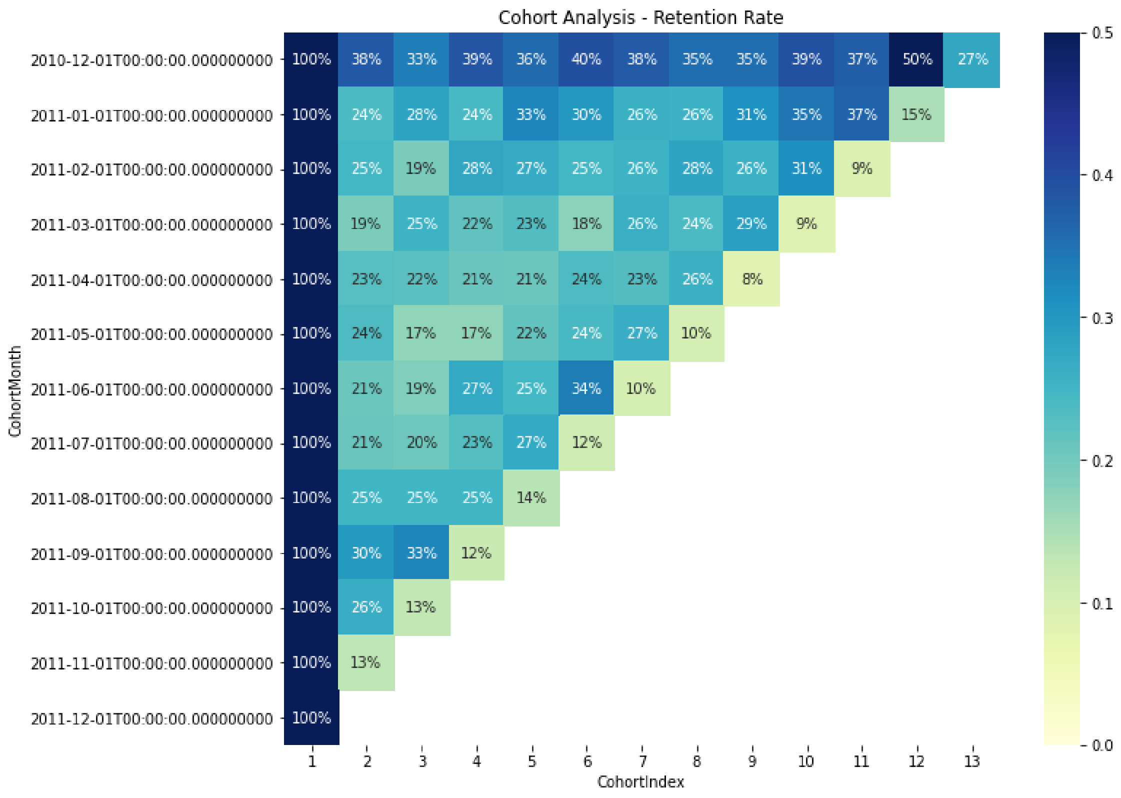
[18]:
```
CohortIndex     1      2      3      4      5      6      7      8      9   \
CohortMonth
2010-12-01   948.0  362.0  317.0  367.0  341.0  376.0  360.0  336.0  336.0
2011-01-01   421.0  101.0  119.0  102.0  138.0  126.0  110.0  108.0  131.0
2011-02-01   380.0   94.0   73.0  106.0  102.0   94.0   97.0  107.0   98.0
2011-03-01   440.0   84.0  112.0   96.0  102.0   78.0  116.0  105.0  127.0
2011-04-01   299.0   68.0   66.0   63.0   62.0   71.0   69.0   78.0   25.0
2011-05-01   279.0   66.0   48.0   48.0   60.0   68.0   74.0   29.0    NaN
2011-06-01   235.0   49.0   44.0   64.0   58.0   79.0   24.0    NaN    NaN
2011-07-01   191.0   40.0   39.0   44.0   52.0   22.0    NaN    NaN    NaN
2011-08-01   167.0   42.0   42.0   42.0   23.0    NaN    NaN    NaN    NaN
2011-09-01   298.0   89.0   97.0   36.0    NaN    NaN    NaN    NaN    NaN
2011-10-01   352.0   93.0   46.0    NaN    NaN    NaN    NaN    NaN    NaN
2011-11-01   321.0   43.0    NaN    NaN    NaN    NaN    NaN    NaN    NaN
2011-12-01    41.0    NaN    NaN    NaN    NaN    NaN    NaN    NaN    NaN

CohortIndex     10     11     12     13
CohortMonth
2010-12-01   374.0  354.0  474.0  260.0
2011-01-01   146.0  155.0   63.0    NaN
2011-02-01   119.0   35.0    NaN    NaN
2011-03-01    39.0    NaN    NaN    NaN
```

```
2011-04-01     NaN    NaN    NaN    NaN
2011-05-01     NaN    NaN    NaN    NaN
2011-06-01     NaN    NaN    NaN    NaN
2011-07-01     NaN    NaN    NaN    NaN
2011-08-01     NaN    NaN    NaN    NaN
2011-09-01     NaN    NaN    NaN    NaN
2011-10-01     NaN    NaN    NaN    NaN
2011-11-01     NaN    NaN    NaN    NaN
2011-12-01     NaN    NaN    NaN    NaN
```

[19]:
```
# as percentages

cohort_size = cohort_count.iloc[:,0]
retention = cohort_count.divide(cohort_size, axis = 0)
retention.round(3) * 100
```

[19]:
```
CohortIndex     1     2     3     4     5     6     7     8     9    10  \
CohortMonth
2010-12-01   100.0  38.2  33.4  38.7  36.0  39.7  38.0  35.4  35.4  39.5
2011-01-01   100.0  24.0  28.3  24.2  32.8  29.9  26.1  25.7  31.1  34.7
2011-02-01   100.0  24.7  19.2  27.9  26.8  24.7  25.5  28.2  25.8  31.3
2011-03-01   100.0  19.1  25.5  21.8  23.2  17.7  26.4  23.9  28.9   8.9
2011-04-01   100.0  22.7  22.1  21.1  20.7  23.7  23.1  26.1   8.4   NaN
2011-05-01   100.0  23.7  17.2  17.2  21.5  24.4  26.5  10.4   NaN   NaN
2011-06-01   100.0  20.9  18.7  27.2  24.7  33.6  10.2   NaN   NaN   NaN
2011-07-01   100.0  20.9  20.4  23.0  27.2  11.5   NaN   NaN   NaN   NaN
2011-08-01   100.0  25.1  25.1  25.1  13.8   NaN   NaN   NaN   NaN   NaN
2011-09-01   100.0  29.9  32.6  12.1   NaN   NaN   NaN   NaN   NaN   NaN
2011-10-01   100.0  26.4  13.1   NaN   NaN   NaN   NaN   NaN   NaN   NaN
2011-11-01   100.0  13.4   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN
2011-12-01   100.0   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN

CohortIndex    11    12    13
CohortMonth
2010-12-01   37.3  50.0  27.4
2011-01-01   36.8  15.0   NaN
2011-02-01    9.2   NaN   NaN
2011-03-01    NaN   NaN   NaN
2011-04-01    NaN   NaN   NaN
2011-05-01    NaN   NaN   NaN
2011-06-01    NaN   NaN   NaN
2011-07-01    NaN   NaN   NaN
2011-08-01    NaN   NaN   NaN
2011-09-01    NaN   NaN   NaN
2011-10-01    NaN   NaN   NaN
2011-11-01    NaN   NaN   NaN
2011-12-01    NaN   NaN   NaN
```

```
[20]: plt.figure(figsize = (11,9))
      plt.title('Cohort Analysis - Retention Rate')
      sns.heatmap(data = retention,
                  annot = True,
                  fmt = '.0%',
                  vmin = 0.0,
                  vmax = 0.5,
                  cmap = "YlGnBu")
      plt.show()
```



CohortMonth	1	2	3	4	5	6	7	8	9	10	11	12	13
2010-12-01T00:00:00.000000000	100%	38%	33%	39%	36%	40%	38%	35%	35%	39%	37%	50%	27%
2011-01-01T00:00:00.000000000	100%	24%	28%	24%	33%	30%	26%	26%	31%	35%	37%	15%	
2011-02-01T00:00:00.000000000	100%	25%	19%	28%	27%	25%	26%	28%	26%	31%	9%		
2011-03-01T00:00:00.000000000	100%	19%	25%	22%	23%	18%	26%	24%	29%	9%			
2011-04-01T00:00:00.000000000	100%	23%	22%	21%	21%	24%	23%	26%	8%				
2011-05-01T00:00:00.000000000	100%	24%	17%	17%	22%	24%	27%	10%					
2011-06-01T00:00:00.000000000	100%	21%	19%	27%	25%	34%	10%						
2011-07-01T00:00:00.000000000	100%	21%	20%	23%	27%	12%							
2011-08-01T00:00:00.000000000	100%	25%	25%	25%	14%								
2011-09-01T00:00:00.000000000	100%	30%	33%	12%									
2011-10-01T00:00:00.000000000	100%	26%	13%										
2011-11-01T00:00:00.000000000	100%	13%											
2011-12-01T00:00:00.000000000	100%												

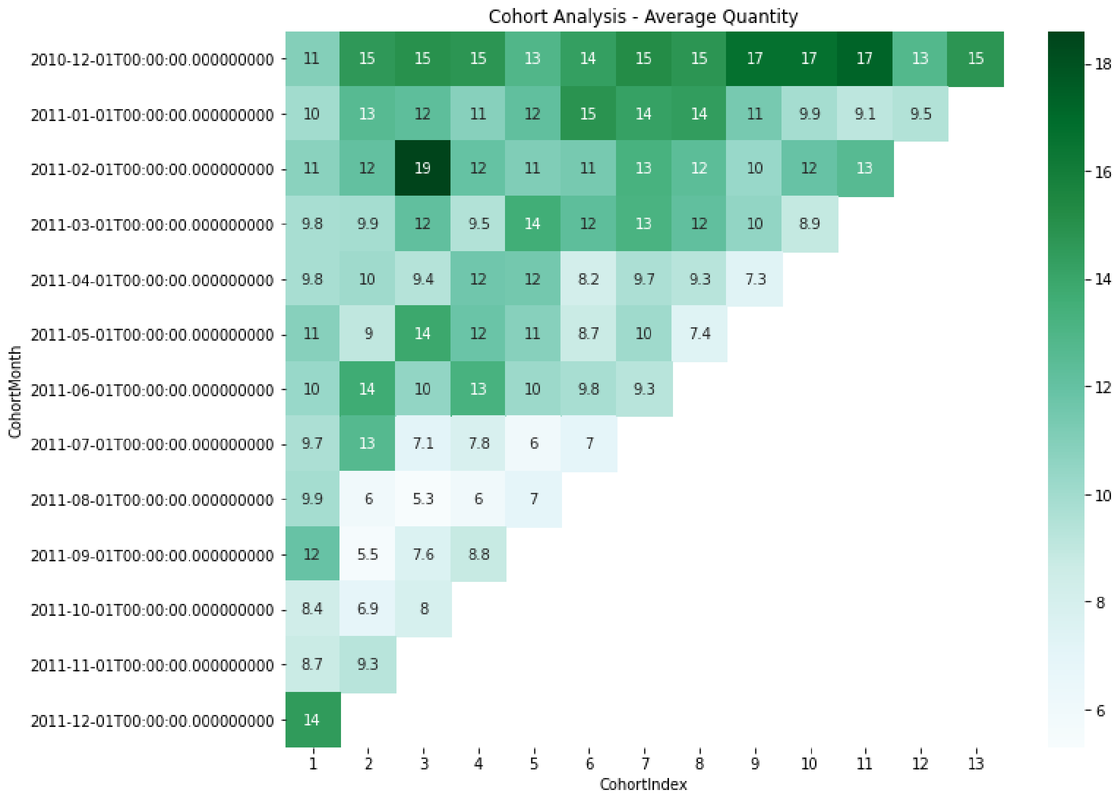
1.2.2 Create the 2nd Cohort: Average Quantity Sold

```
[21]: cohort_data2 = df1.groupby(['CohortMonth', 'CohortIndex'])['Quantity'].mean().
       ↪reset_index()
      average_quantity  = cohort_data2.pivot_table(index = 'CohortMonth',
                                                  columns = 'CohortIndex',
                                             values = 'Quantity').round(1)
      average_quantity
```

```
[21]: CohortIndex    1     2     3     4     5     6     7     8     9     10    11  \
      CohortMonth
```

```
2010-12-01   11.0  14.6  15.0  14.8  12.9  14.3  15.2  14.8  16.7  16.7  17.3
2011-01-01   10.0  12.6  12.3  10.9  12.2  14.9  14.2  14.4  11.4   9.9   9.1
2011-02-01   10.8  12.1  18.6  12.0  11.1  11.4  13.3  12.4  10.3  11.9  12.6
2011-03-01    9.8   9.9  12.2   9.5  13.6  12.3  13.2  12.2  10.5   8.9   NaN
2011-04-01    9.8  10.1   9.4  11.6  11.5   8.2   9.7   9.3   7.3   NaN   NaN
2011-05-01   10.9   9.0  13.9  11.8  10.9   8.7  10.1   7.4   NaN   NaN   NaN
2011-06-01   10.3  13.7  10.5  13.3  10.2   9.8   9.3   NaN   NaN   NaN   NaN
2011-07-01    9.7  12.7   7.1   7.8   6.0   7.0   NaN   NaN   NaN   NaN   NaN
2011-08-01    9.9   6.0   5.3   6.0   7.0   NaN   NaN   NaN   NaN   NaN   NaN
2011-09-01   11.9   5.5   7.6   8.8   NaN   NaN   NaN   NaN   NaN   NaN   NaN
2011-10-01    8.4   6.9   8.0   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN
2011-11-01    8.7   9.3   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN
2011-12-01   14.5   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN

CohortIndex    12    13
CohortMonth
2010-12-01   12.8  14.8
2011-01-01    9.5   NaN
2011-02-01    NaN   NaN
2011-03-01    NaN   NaN
2011-04-01    NaN   NaN
2011-05-01    NaN   NaN
2011-06-01    NaN   NaN
2011-07-01    NaN   NaN
2011-08-01    NaN   NaN
2011-09-01    NaN   NaN
2011-10-01    NaN   NaN
2011-11-01    NaN   NaN
2011-12-01    NaN   NaN
```

[22]:
```
plt.figure(figsize = (11,9))
plt.title('Cohort Analysis - Average Quantity')
sns.heatmap(data = average_quantity,
            annot = True,
            cmap = "BuGn")
plt.show()
```



1.2.3 Create the 3rd Cohort: Average Sales

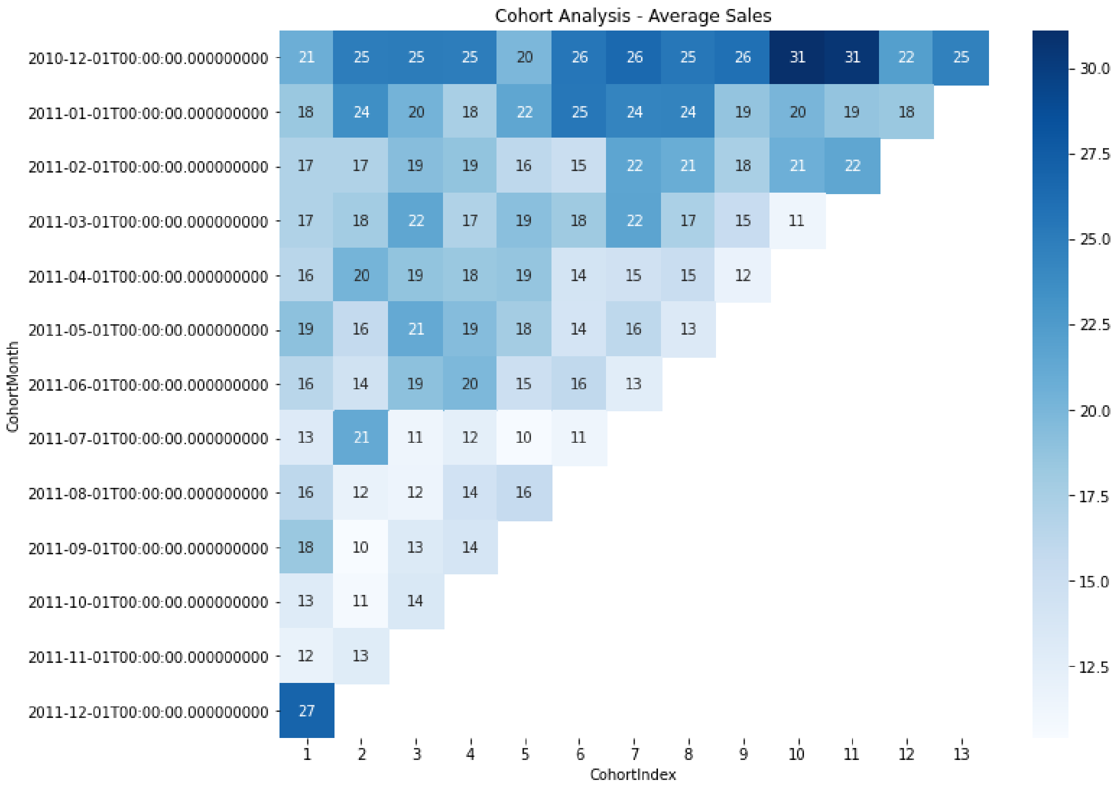
[23]:
```
df1['TotalSale'] = df1['Quantity'] * df1['UnitPrice']
cohort_data3 = df1.groupby(['CohortMonth', 'CohortIndex'])['TotalSale'].mean().
 ↪reset_index()
average_sales  = cohort_data3.pivot_table(index = 'CohortMonth',
                                          columns = 'CohortIndex',
                                     values = 'TotalSale').round(1)
average_sales
```

```
/Users/jacob1.ext/Codes/covid-19/.venv/lib/python3.7/site-
packages/ipykernel_launcher.py:1: SettingWithCopyWarning:
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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  """Entry point for launching an IPython kernel.
```

[23]:
```
CohortIndex     1     2     3     4     5     6     7     8     9     10    11  \
CohortMonth
```

```
2010-12-01   20.7  25.0  25.1  25.0  19.9  25.5  26.5  25.4  26.0  31.1  30.6
2011-01-01   18.4  23.5  20.3  17.5  21.5  25.4  24.4  24.5  18.7  20.1  18.7
2011-02-01   17.0  17.0  19.3  18.8  16.1  15.1  21.6  20.9  17.5  20.6  21.5
2011-03-01   17.0  17.9  21.5  17.0  19.2  18.1  21.7  17.3  15.4  11.4   NaN
2011-04-01   16.4  20.2  18.8  18.4  18.6  14.2  14.6  15.3  11.8   NaN   NaN
2011-05-01   19.0  15.7  21.2  19.4  17.8  14.1  16.1  13.3   NaN   NaN   NaN
2011-06-01   16.4  14.5  19.0  19.8  15.0  15.9  12.7   NaN   NaN   NaN   NaN
2011-07-01   13.1  21.2  11.4  12.4  10.5  11.4   NaN   NaN   NaN   NaN   NaN
2011-08-01   16.1  11.9  11.5  14.4  15.6   NaN   NaN   NaN   NaN   NaN   NaN
2011-09-01   18.4  10.4  13.2  14.0   NaN   NaN   NaN   NaN   NaN   NaN   NaN
2011-10-01   13.0  10.8  13.5   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN
2011-11-01   11.9  12.9   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN
2011-12-01   26.9   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN

CohortIndex    12    13
CohortMonth
2010-12-01   22.2  24.7
2011-01-01   18.4   NaN
2011-02-01    NaN   NaN
2011-03-01    NaN   NaN
2011-04-01    NaN   NaN
2011-05-01    NaN   NaN
2011-06-01    NaN   NaN
2011-07-01    NaN   NaN
2011-08-01    NaN   NaN
2011-09-01    NaN   NaN
2011-10-01    NaN   NaN
2011-11-01    NaN   NaN
2011-12-01    NaN   NaN
```

[24]:
```
plt.figure(figsize = (11,9))
plt.title('Cohort Analysis - Average Sales')
sns.heatmap(data = average_sales,
            annot = True,
            cmap = "Blues")
plt.show()
```


Cohort Analysis - Average Sales
CohortMonth
CohortIndex
2010-12-01T00:00:00.000000000 21 25 25 25 20 26 26 25 26 31 31 22 25
2011-01-01T00:00:00.000000000 18 24 20 18 22 25 24 24 19 20 19 18
2011-02-01T00:00:00.000000000 17 17 19 19 16 15 22 21 18 21 22
2011-03-01T00:00:00.000000000 17 18 22 17 19 18 22 17 15 11
2011-04-01T00:00:00.000000000 16 20 19 18 19 14 15 15 12
2011-05-01T00:00:00.000000000 19 16 21 19 18 14 16 13
2011-06-01T00:00:00.000000000 16 14 19 20 15 16 13
2011-07-01T00:00:00.000000000 13 21 11 12 10 11
2011-08-01T00:00:00.000000000 16 12 12 14 16
2011-09-01T00:00:00.000000000 18 10 13 14
2011-10-01T00:00:00.000000000 13 11 14
2011-11-01T00:00:00.000000000 12 13
2011-12-01T00:00:00.000000000 27
1 2 3 4 5 6 7 8 9 10 11 12 13
30.0 27.5 25.0 22.5 20.0 17.5 15.0 12.5