1. Get data and create DataFrame

```python
In [2]:  from IPython.core.interactiveshell import InteractiveShell
         InteractiveShell.ast_node_interactivity = "all"

         import cx_Oracle
         import numpy as np ; import modin.pandas as pd
         # import pandas_profiling as pp
         import sys
         import timeit

         start = timeit.default_timer()


         connection = cx_Oracle.connect('tony.fernandez/Kerrdental70$!@PDW')
         cursor = connection.cursor()

         querystring =   "SELECT      Prod Cat L1 Desc, \
                                      Data Source, \
                                      Prod Cat L3 Desc,\
                                      Trx Date,\
                                      Mdm Cust Key,\
                                      Company,\
                                      Acct Office Name,\
                                      Addr Streetaddr,\
                                      Addr City,\
                                      Addr Zip,\
                                      Addr State,\
                                      Product Number,\
                                      Product Desc,\
                                      Serial Number,\
                                      Bus Unit,\
                                      Ext Value Eud,\
                         FROM \
                                      PDW.MDM_MIM_EUDDRCT_ASSET_SLA_VALL"
                 #       WHERE \
                  #             CAL_YYYY = 2019  AND (DEALER_NAME) NOT IN ('PROMO REDEMPTION

         cursor.execute(querystring)

         df_ora = pd.read_sql(querystring, con=connection)

         stop = timeit.default_timer()
         total_time = stop - start

         # output running time in a nice format.
         mins, secs = divmod(total_time, 60)
         hours, mins = divmod(mins, 60)

         df_ora.shape
         df_ora.head()

         sys.stdout.write("Total running time: %d:%d:%d.\n" % (hours, mins, secs))
```

```
---------------------------------------------------------------------------
DatabaseError                             Traceback (most recent call last)
<ipython-input-2-4d8146f15701> in <module>
     11
     12
---> 13 connection = cx_Oracle.connect('tony.fernandez/Kerrdental70$!@PDW')
     14 cursor = connection.cursor()
```

```
        15

DatabaseError: DPI-1047: Cannot locate a 64-bit Oracle Client library: "libclntsh.so: ca
nnot open shared object file: No such file or directory". See https://oracle.github.io/o
dpi/doc/installation.html#linux for help
```

In [4]: `df_ora['REBATE_PERIOD'].max()`

Out[4]: `Timestamp('2019-12-16 00:00:00')`

In [2]:
```
df_ora.shape
df_ora.head()
```

Out[2]: `(5048926, 17)`

Out[2]:

	L1_DESC_NEW	DEALER_NAME	L3_DESC_NEW	REBATE_PERIOD	CRM_CUST_KEY	COMPANY	CRM_ADDR_STREET
0	FINISHING AND POLISHING	SCHEIN	NTI POLISHER	2019-01-02	Master-CM090337	AXIS	1018 Obe
1	CARBIDES	SCHEIN	BVR SPECIALTY CARBIDE	2019-01-02	Master-CM197424	AXIS	1450 Sam D
2	DIAMONDS	PATTERSON	NTI	2019-01-02	Master-CM120216	AXIS	4940 Norm
3	CARBIDES	SCHEIN	EDENTA OPERATIVE CARBIDE	2019-01-02	Master-CM087022	AXIS	784 W Army
4	DIAMONDS	DARBY	NTI	2019-01-02	Master-CM1421316	AXIS	4816

2. Send DataFrame to pickled file

In [5]: `df_ora.to_pickle('2019_All_HDS_L3.pickle')`

3. Load pickled file

In [78]:
```
from IPython.core.interactiveshell import InteractiveShell
InteractiveShell.ast_node_interactivity = "all"

import numpy as np
import pandas as pd
#import modin.pandas as pd
import turicreate as tc
from sklearn.model_selection import train_test_split

df_ora = pd.read_pickle('2019_ALL_HDS.pickle')

%time
```

```
CPU times: user 0 ns, sys: 0 ns, total: 0 ns
Wall time: 15 µs
```

In [79]:
```
df_ora.shape
df_ora.head()
```

Out[79]: `(4748735, 19)`

Out[79]:

	L1_DESC_NEW	DEALER_NAME	SDS_PROD_NUM	SDS_PROD_DESC	L3_DESC_NEW	REBATE_PERIOD	CRM_CUST_
0	DIAMONDS	SCHEIN	C836-010	NTI Diamond Coarse FG	NTI	2019-01-02	Mas CM236
1	ALL OTHER	SCHEIN	EC-1200	AXIS Diamond-ZYME Solution	ACCESSORIES	2019-01-02	Mas CM217
2	FINISHING AND POLISHING	DHP	FS3-MX	NTI Serrated Diamond Strip - M	NTI STRIPS	2019-01-02	Mas CM083
3	CARBIDES	BENCO	H379-023	NTI OA-1/7408 Carbide (RED)	BVR T&F CARBIDE	2019-01-02	Mas CM1187
4	CARBIDES	BENCO	H135-014	NTI TDF-9 Carbide (RED)	BVR SPECIALTY CARBIDE	2019-01-02	Mas CM1187

4. Data prep

In [80]:
```python
type(df_ora)
```

Out[80]:
```
pandas.core.frame.DataFrame
```

In [81]:
```python
#create new column for product
df_ora['PRODUCT'] = df_ora['SDS_PROD_NUM'] + '|' + df_ora['SDS_PROD_DESC']
df_ora.shape
```

Out[81]:
```
(4748735, 20)
```

In [82]:
```python
df_ora['CRM_CUST_KEY'].isna().sum()
```

Out[82]:
```
20
```

In [83]:
```python
df_ora = df_ora.dropna(subset=['CRM_CUST_KEY'])
df_ora.shape
```

Out[83]:
```
(4748715, 20)
```

In [84]:
```python
# filter for matched keys

df_ = df_ora.loc[df_ora['CRM_CUST_KEY'].str.contains('Master-CM*'),:]
df_.shape
```

Out[84]:
```
(4495785, 20)
```

In [15]:
```python
#df_.to_csv('auditCRM_CUST_KEY.csv')
```

In [85]:
```python
dfFilter = df_.loc[(df_['COMPANY'] == 'AXIS') |
                   (df_['COMPANY'] == 'KERR') |
                   (df_['COMPANY'] == 'PENTRON') |
                   (df_['COMPANY'] == 'SYBRONENDO') |
                   (df_['COMPANY'] == 'DEXIS') |
                   (df_['COMPANY'] == 'DCIE') |
                   (df_['COMPANY'] == 'MARUS') |
                   (df_['COMPANY'] == 'GENDEX') |
                   (df_['COMPANY'] == 'INSTRUMENTARIUM') |
                   (df_['COMPANY'] == 'ISI') |
                   (df_['COMPANY'] == 'KAVO IMAGING') |
                   (df_['COMPANY'] == 'KAVO US') |
```

```
                            (df_['COMPANY'] == 'NOMAD') |
                            (df_['COMPANY'] == 'PELTON')
                            ,:]
            dfFilter.shape
            dfFilter['COMPANY'].unique()
```

Out[85]: (2262441, 20)

Out[85]:
```
array(['AXIS', 'KERR', 'PENTRON', 'SYBRONENDO', 'DEXIS', 'MARUS',
       'PELTON', 'DCIE', 'GENDEX', 'INSTRUMENTARIUM', 'ISI',
       'KAVO IMAGING', 'KAVO US', 'NOMAD'], dtype=object)
```

In [86]:
```
df_ = dfFilter
```

In [87]:
```
df_.shape
```

Out[87]: (2262441, 20)

In [88]:
```
dfRec = df_[['CRM_CUST_KEY','PRODUCT', 'IVC_QTY' ]].sort_values(by=['CRM_CUST_KEY'])
dfRec.shape
dfRec.head()
```

Out[88]: (2262441, 3)

Out[88]:

	CRM_CUST_KEY	PRODUCT	IVC_QTY
288290	Master-CM045451	P1932-3|AXIS Pink DiaGloss - RA	1.0
296292	Master-CM045451	P19032-3|AXIS White DiaGloss - RA	1.0
1255175	Master-CM045452	33872|REFILL- MAXCEM ELITE CLEAR	1.0
1006795	Master-CM045452	33872|REFILL- MAXCEM ELITE CLEAR	1.0
1299216	Master-CM045452	00370|TEMP BOND STANDARD PACKAGE	1.0

In [12]:
```
def createDataDummy(dfRec):
    dataDummy = dfRec.copy()
    dataDummy['purchaseDummy'] = 1
    return dataDummy
```

In [13]:
```
dataDummy = createDataDummy(dfRec)
```

In [14]:
```
# if crash then filter data
dfRec_ = dfRec[:500000]
```

In [17]:
```
who
```

```
InteractiveShell      createDataDummy      dataDummy      dfRec   dfRec_   df_
np        pd       tc
train_test_split
```

In [16]:
```
# clear space for memory
del(df_ora)
del(dfFilter)
```

In [18]:
```
#pivot the data
#
#
#
dfRecMatrix = pd.pivot_table(dfRec_, values = 'IVC_QTY', index = 'CRM_CUST_KEY', columns
dfRecMatrix.shape
dfRecMatrix.head()
```

Out[18]:

PRODUCT	0.553.1210|MultiFlex Coupling 457	00008|ARM ASSEMBLY-STANDARD ARM	00027|CRUCIBLE-CLAY SMALL #16, TWO	00028|CRUCIBLE-CLAY LARGE #18, ONE	001-005|U.T. GINGIVAL BLADE GREEN (ex PN:001-005)	010|REPLACEM ALUMIN HAN
CRM_CUST_KEY						
Master-CM045451	NaN	NaN	NaN	NaN	NaN	
Master-CM045452	NaN	NaN	NaN	NaN	NaN	
Master-CM045453	NaN	NaN	NaN	NaN	NaN	
Master-CM045456	NaN	NaN	NaN	NaN	NaN	
Master-CM045458	NaN	NaN	NaN	NaN	NaN	

5 rows × 8175 columns

In [19]:
```python
dfMatrixNorm = (dfRecMatrix - dfRecMatrix.min()) / (dfRecMatrix.max() - dfRecMatrix.min(
#dfMatrixNorm.shape
#dfMatrixNorm.head()
```

In [20]:
```python
# create table for input to model
```

In [21]:
```python
d = dfMatrixNorm.reset_index()
```

In [22]:
```python
d.index.names = ['scaledPurchaseFreq']
```

In [23]:
```python
d.shape
d.head()
```

Out[23]: (26227, 8176)

Out[23]:

	PRODUCT	CRM_CUST_KEY	0.553.1210|MultiFlex Coupling 457	00008|ARM ASSEMBLY-STANDARD ARM	00027|CRUCIBLE-CLAY SMALL #16, TWO	00028|CRUCIBLE-CLAY LARGE #18, ONE	005 GING BL GR PN:
scaledPurchaseFreq							
0	Master-CM045451		NaN	NaN	NaN	NaN	
1	Master-CM045452		NaN	NaN	NaN	NaN	
2	Master-CM045453		NaN	NaN	NaN	NaN	

3	Master-CM045456	NaN	NaN	NaN	NaN	
4	Master-CM045458	NaN	NaN	NaN	NaN	

5 rows × 8176 columns

```
In [27]:   #del(df_)
           del(dfRec)
```

```
In [29]:   who
```

```
InteractiveShell      createDataDummy      d         dataDummy      dfMatrixNorm
dfRecMatrix      dfRec_      np      pd
tc         train_test_split
```

```
In [30]:   dfNorm = pd.melt(d, id_vars = ['CRM_CUST_KEY'], value_name = 'scaledPurchaseFreq').dropn
           dfNorm.shape
           dfNorm.head()
```

```
Out[30]:   (248478, 3)
```

Out[30]:

	CRM_CUST_KEY	PRODUCT	scaledPurchaseFreq
91721	Master-CM069375	00028|CRUCIBLE-CLAY LARGE #18, ONE	0.5
92221	Master-CM070352	00028|CRUCIBLE-CLAY LARGE #18, ONE	0.0
99319	Master-CM084598	00028|CRUCIBLE-CLAY LARGE #18, ONE	1.0
105492	Master-CM046442	001-005|U.T. GINGIVAL BLADE GREEN (ex PN:001-005)	1.0
108056	Master-CM051009	001-005|U.T. GINGIVAL BLADE GREEN (ex PN:001-005)	0.0

```
In [31]:   # Define a function for normalizing data

           def normalizeData(dfRec_):
               dfRecMatrix = pd.pivot_table(dfRec_, values = 'IVC_QTY', index = 'CRM_CUST_KEY', col
               dfMatrixNorm = (dfRecMatrix - dfRecMatrix.min()) / (dfRecMatrix.max() - dfRecMatrix.
               d = dfMatrixNorm.reset_index()
               d.index.names = ['scaledPurchaseFreq']
               return pd.melt(d,id_vars = ['CRM_CUST_KEY'],value_name = 'scaledPurchaseFreq').dropn
```

5. Split train and test set

```
In [32]:   d.head()
```

Out[32]:

	PRODUCT	CRM_CUST_KEY	0.553.1210|MultiFlex Coupling 457	00008|ARM ASSEMBLY-STANDARD ARM	00027|CRUCIBLE-CLAY SMALL #16, TWO	00028|CRUCIBLE-CLAY LARGE #18, ONE	005 GING BL GR PN:
scaledPurchaseFreq							
0		Master-CM045451	NaN	NaN	NaN	NaN	

		NaN	NaN	NaN	NaN
1	Master-CM045452	NaN	NaN	NaN	NaN
2	Master-CM045453	NaN	NaN	NaN	NaN
3	Master-CM045456	NaN	NaN	NaN	NaN
4	Master-CM045458	NaN	NaN	NaN	NaN

5 rows × 8176 columns

```
In [33]: train, test = train_test_split(dfRec_, test_size = .2)
         train.shape
         test.shape
```

```
Out[33]: (400000, 3)
```

```
Out[33]: (100000, 3)
```

```
In [34]: trainData = tc.SFrame(train)
         testData = tc.SFrame(test)
```

```
In [35]: type(trainData)
```

```
Out[35]: turicreate.data_structures.sframe.SFrame
```

```
In [36]: trainData
```

Out[36]:

CRM_CUST_KEY	PRODUCT	IVC_QTY
Master-CM069268	821-4125|K-FLEX FILES 25MM SERIES 2 SST ASST ...	2.0
Master-CM072168	33361|REFILL - TEMPBOND MIXING TIPS, 50PK ...	1.0
Master-CM060418	34696|Take 1 Adv Tray FS	1.0
Master-CM064252	N69CB|REFILL - TEMPSPAN TRANSPARENT ...	3.0
Master-CM080235	830-0257|K3 ENG FILE .25/.10 17MM ...	2.0
Master-CM061808	00370|TEMP BOND STANDARD PACKAGE ...	3.0
Master-CM095676	13150|HEMODETTES BOX OF 25 UNIT DOSE CUPS ...	1.0
Master-CM074550	31377|TEMPBOND 50 PACK UNIDOSE ...	1.0
Master-CM055877	FS2-SF|NTI Diamond Strip 2.5mm - SF ...	2.0
Master-CM047528	29888|REFILL - SYRINGE POINT 4 - C4 ...	1.0

[400000 rows x 3 columns]

Note: Only the head of the SFrame is printed.

You can use print_rows(num_rows=m, num_columns=n) to print more rows and columns.

```
In [37]:  testData
```

Out[37]:

CRM_CUST_KEY	PRODUCT	IVC_QTY
Master-CM095925	C379-023|NTI Diamond Coarse FG ...	4.0
Master-CM049910	34778|REFILL - HC ULTRA C2 ENAMEL UNIDOSE ...	1.0
Master-CM060656	817-8253|TF ADAPTIVE FILE ML1 23MM LENGTH ...	3.0
Master-CM045789	952-0004|100-502 Fine Buchanan Plugger ...	1.0
Master-CM082308	27045DX|Zone A1 Large Dual Barrel Syringe Kit ...	2.0
Master-CM050394	33215|TEMP BOND SYRINGE, 5ml, STD PKG ...	1.0
Master-CM067445	09246|ORTHO TRAY WAX-48 STICKS ...	2.0
Master-CM076773	08400021|SHEILD	14.0
Master-CM089662	34338|REFILL - HC ULTRA A2 ENAMEL SYRINGE ...	2.0
Master-CM095120	34418|KIT - MAXCEM ELITE BULK ...	1.0

[100000 rows x 3 columns]

Note: Only the head of the SFrame is printed.

You can use print_rows(num_rows=m, num_columns=n) to print more rows and columns.

```
In [38]:  #Define a splitData function for splitting data to training and test set

          def splitData(dfRec_):
              '''
              Splits data into training and test set.
              Args:
                  data (pandas.DataFrame)
              Returns
                  trainData (tc.SFrame)
                  testData (tc.Sframe)
              '''
              train, test = train_test_split(dfRec_, test_size = .2)
              trainData = tc.SFrame(train)
              testData = tc.SFrame(test)
              return trainData, testData
```

```
In [39]:  who
```

```
InteractiveShell        createDataDummy        d         dataDummy        dfMatrixNorm
dfNorm     dfRecMatrix      dfRec_   normalizeData
np        pd       splitData      tc        test      testData         train      trainData
train_test_split
```

```
In [40]:  trainDataDummy, testDataDummy = splitData(dataDummy)
          trainDataNorm, testDataNorm = splitData(dfNorm)
```

6. Baseline Model

In [41]: `# Popularity Model`

In [42]:
```
#define field names

userID = 'CRM_CUST_KEY'
itemID = 'PRODUCT'
target = 'IVC_QTY'

usersToRecommend = list(d[userID])
#usersToRecommend = list(df_ora_[user_id])
nRec = 10
nDisplay = 30
```

In [43]:
```
# unique list of keys
#df_ora_ = pd.DataFrame(df_ora,columns=['CRM_CUST_KEY']).drop_duplicates()
```

In [44]:
```
popularityModel = tc.popularity_recommender.create(trainData,
                                                    user_id=userID,
                                                    item_id=itemID,
                                                    target=target)
```

Preparing data set.

   Data has 400000 observations with 25663 users and 7854 items.

   Data prepared in: 0.320188s

400000 observations to process; with 7854 unique items.

In [45]:
```
# Get recommened output for a list of users

popularityRecommend = popularityModel.recommend(users=usersToRecommend,
                                                k=nRec)
popularityRecommend.print_rows(nDisplay)
```

recommendations finished on 1000/26227 queries. users per second: 67526.5

recommendations finished on 2000/26227 queries. users per second: 78293.2

recommendations finished on 3000/26227 queries. users per second: 84676.4

recommendations finished on 4000/26227 queries. users per second: 88560.2

recommendations finished on 5000/26227 queries. users per second: 91207.6

recommendations finished on 6000/26227 queries. users per second: 92738.6

recommendations finished on 7000/26227 queries. users per second: 93967.3

recommendations finished on 8000/26227 queries. users per second: 95138.4

recommendations finished on 9000/26227 queries. users per second: 95767.1

recommendations finished on 10000/26227 queries. users per second: 96582

recommendations finished on 11000/26227 queries. users per second: 96971.8

recommendations finished on 12000/26227 queries. users per second: 97439

recommendations finished on 13000/26227 queries. users per second: 97866.5

recommendations finished on 14000/26227 queries. users per second: 96659

recommendations finished on 15000/26227 queries. users per second: 95768.9

recommendations finished on 16000/26227 queries. users per second: 95367.5

```
recommendations finished on 17000/26227 queries. users per second: 95627

recommendations finished on 18000/26227 queries. users per second: 95568.3

recommendations finished on 19000/26227 queries. users per second: 93811.4

recommendations finished on 20000/26227 queries. users per second: 93697

recommendations finished on 21000/26227 queries. users per second: 92921.6

recommendations finished on 22000/26227 queries. users per second: 92970.6

recommendations finished on 23000/26227 queries. users per second: 92211

recommendations finished on 24000/26227 queries. users per second: 91707.7

recommendations finished on 25000/26227 queries. users per second: 91708.5

recommendations finished on 26000/26227 queries. users per second: 89678.7
```

```
+----------------+------------------------------+--------------------+------+
|  CRM_CUST_KEY  |            PRODUCT           |       score        | rank |
+----------------+------------------------------+--------------------+------+
| Master-CM045451 |       02006219|O-Ring 11x1    |       200.0        |  1   |
| Master-CM045451 | 06221431|DPS- Mask with ad... |       94.0         |  2   |
| Master-CM045451 |      06223882|DPS-FACE MASK    |       73.0         |  3   |
| Master-CM045451 | 06221421|DPS-JAW SIMULATOR G40 |       68.0         |  4   |
| Master-CM045451 |          07644053|SLIDE         |       50.0         |  5   |
| Master-CM045451 |       LA8-KC0|LA8 CARBIDE      | 48.67857142857143  |  6   |
| Master-CM045451 | 952-0011|500-014 Medium-Fi... | 39.53846153846154  |  7   |
| Master-CM045451 | 734|Adapt Luciwedge Ultra ... | 37.166666666666664 |  8   |
| Master-CM045451 |    FG7902-KC0|FG7902 CARBIDE   |       33.86        |  9   |
| Master-CM045451 | 08431078|3800 O-RING, VACU... |       31.25        |  10  |
| Master-CM045452 |       02006219|O-Ring 11x1    |       200.0        |  1   |
| Master-CM045452 | 06221431|DPS- Mask with ad... |       94.0         |  2   |
| Master-CM045452 |      06223882|DPS-FACE MASK    |       73.0         |  3   |
| Master-CM045452 | 06221421|DPS-JAW SIMULATOR G40 |       68.0         |  4   |
| Master-CM045452 |          07644053|SLIDE         |       50.0         |  5   |
| Master-CM045452 |       LA8-KC0|LA8 CARBIDE      | 48.67857142857143  |  6   |
| Master-CM045452 | 952-0011|500-014 Medium-Fi... | 39.53846153846154  |  7   |
| Master-CM045452 | 734|Adapt Luciwedge Ultra ... | 37.166666666666664 |  8   |
| Master-CM045452 |    FG7902-KC0|FG7902 CARBIDE   |       33.86        |  9   |
| Master-CM045452 | 08431078|3800 O-RING, VACU... |       31.25        |  10  |
| Master-CM045453 |       02006219|O-Ring 11x1    |       200.0        |  1   |
| Master-CM045453 | 06221431|DPS- Mask with ad... |       94.0         |  2   |
| Master-CM045453 |      06223882|DPS-FACE MASK    |       73.0         |  3   |
| Master-CM045453 | 06221421|DPS-JAW SIMULATOR G40 |       68.0         |  4   |
| Master-CM045453 |          07644053|SLIDE         |       50.0         |  5   |
| Master-CM045453 |       LA8-KC0|LA8 CARBIDE      | 48.67857142857143  |  6   |
| Master-CM045453 | 952-0011|500-014 Medium-Fi... | 39.53846153846154  |  7   |
| Master-CM045453 | 734|Adapt Luciwedge Ultra ... | 37.166666666666664 |  8   |
| Master-CM045453 |    FG7902-KC0|FG7902 CARBIDE   |       33.86        |  9   |
| Master-CM045453 | 08431078|3800 O-RING, VACU... |       31.25        |  10  |
+----------------+------------------------------+--------------------+------+
[262270 rows x 4 columns]
```

In [46]:
```python
# Define model selection

def model(trainData, name, user_id, item_id, target, usersToRecommned,nRec,nDisplay):
    if name == 'popularity':
        model = tc.popularity_recommender.create(trainData,
                                                 user_id=userID,
                                                 item_id=itemID,
                                                 target=target)

    elif name == 'cosine':
        model = tc.item_similarity_recommender.create(trainData,
                                                 user_id=userID,
                                                 item_id=itemID,
```

```
                                                    target=target,
                                                    similarity_type='cosine')
        elif name == 'pearson':
            model = tc.item_similarity_recommender.create(trainData,
                                                    user_id=userID,
                                                    item_id=itemID,
                                                    target=target,
                                                    similarity_type='pearson')
        recomm = model.recommend(users=usersToRecommned, k=nRec)
        recomm.print_rows(nDisplay)
        return model
```

In [47]:
```
user_id = 'CRM_CUST_KEY'
item_id = 'PRODUCT'

#usersToRecommend = list(df_ora_[user_id])
nRec=10
nDisplay=30
```

In [48]:
```
#Using purchase dummy
name='popularity'
target = 'purchaseDummy'

popularityDummy = model(trainDataDummy,name,user_id,item_id,target,usersToRecommend,nRec
```

Warning: Ignoring columns IVC_QTY;

    To use these columns in scoring predictions, use a model that allows the use of additional features.

Preparing data set.

    Data has 1809952 observations with 144223 users and 11020 items.

    Data prepared in: 1.28658s

1809952 observations to process; with 11020 unique items.

recommendations finished on 1000/26227 queries. users per second: 33883.4

recommendations finished on 2000/26227 queries. users per second: 43006.1

recommendations finished on 3000/26227 queries. users per second: 47158.7

recommendations finished on 4000/26227 queries. users per second: 50257.6

recommendations finished on 5000/26227 queries. users per second: 52979

recommendations finished on 6000/26227 queries. users per second: 53300.2

recommendations finished on 7000/26227 queries. users per second: 55236.8

recommendations finished on 8000/26227 queries. users per second: 55962.8

recommendations finished on 9000/26227 queries. users per second: 57139.2

recommendations finished on 10000/26227 queries. users per second: 58556.2

recommendations finished on 11000/26227 queries. users per second: 58865.1

recommendations finished on 12000/26227 queries. users per second: 58989.2

recommendations finished on 13000/26227 queries. users per second: 59071.6

recommendations finished on 14000/26227 queries. users per second: 59998.5

recommendations finished on 15000/26227 queries. users per second: 60616.1

recommendations finished on 16000/26227 queries. users per second: 60833.3

recommendations finished on 17000/26227 queries. users per second: 61518.2

recommendations finished on 18000/26227 queries. users per second: 61386.9

```
recommendations finished on 19000/26227 queries. users per second: 61578.5

recommendations finished on 20000/26227 queries. users per second: 61303.2

recommendations finished on 21000/26227 queries. users per second: 61220.4

recommendations finished on 22000/26227 queries. users per second: 61229.7

recommendations finished on 23000/26227 queries. users per second: 61069.8

recommendations finished on 24000/26227 queries. users per second: 60954.1

recommendations finished on 25000/26227 queries. users per second: 60015.1

recommendations finished on 26000/26227 queries. users per second: 57854.1
```

```
+----------------+------------------------------+-------+------+
|  CRM_CUST_KEY  |            PRODUCT           | score | rank |
+----------------+------------------------------+-------+------+
| Master-CM045451 | 00455|COMPOUND STICKS-GREY... |  1.0  |  1   |
| Master-CM045451 | 821-8025|K-FILES 25MM SERI... |  1.0  |  2   |
| Master-CM045451 | 815-1542|TF ADAPTIVE GUTTA... |  1.0  |  3   |
| Master-CM045451 | 13499|GINGIKNIT 00n NON IM... |  1.0  |  4   |
| Master-CM045451 | H557RZ-FG100|AXIS Razor 55... |  1.0  |  5   |
| Master-CM045451 |  P343|NTI Green CeraGlaze-HP  |  1.0  |  6   |
| Master-CM045451 | 29836|REFILL - UNID  XRVE ... |  1.0  |  7   |
| Master-CM045451 |   33643|REFILL - NX3, CLEAR  |  1.0  |  8   |
| Master-CM045451 | 31377|TEMPBOND 50 PACK UNIDOSE |  1.0  |  9   |
| Master-CM045451 | 10131099|Holder, Horiz BW,... |  1.0  |  10  |
| Master-CM045452 | 00455|COMPOUND STICKS-GREY... |  1.0  |  1   |
| Master-CM045452 | 821-8025|K-FILES 25MM SERI... |  1.0  |  2   |
| Master-CM045452 | 815-1542|TF ADAPTIVE GUTTA... |  1.0  |  3   |
| Master-CM045452 | 13499|GINGIKNIT 00n NON IM... |  1.0  |  4   |
| Master-CM045452 | H557RZ-FG100|AXIS Razor 55... |  1.0  |  5   |
| Master-CM045452 |  P343|NTI Green CeraGlaze-HP  |  1.0  |  6   |
| Master-CM045452 | 29836|REFILL - UNID  XRVE ... |  1.0  |  7   |
| Master-CM045452 |   33643|REFILL - NX3, CLEAR  |  1.0  |  8   |
| Master-CM045452 | 31377|TEMPBOND 50 PACK UNIDOSE |  1.0  |  9   |
| Master-CM045452 | 10131099|Holder, Horiz BW,... |  1.0  |  10  |
| Master-CM045453 | 00455|COMPOUND STICKS-GREY... |  1.0  |  1   |
| Master-CM045453 | 821-8025|K-FILES 25MM SERI... |  1.0  |  2   |
| Master-CM045453 | 815-1542|TF ADAPTIVE GUTTA... |  1.0  |  3   |
| Master-CM045453 | 13499|GINGIKNIT 00n NON IM... |  1.0  |  4   |
| Master-CM045453 | H557RZ-FG100|AXIS Razor 55... |  1.0  |  5   |
| Master-CM045453 |  P343|NTI Green CeraGlaze-HP  |  1.0  |  6   |
| Master-CM045453 | 29836|REFILL - UNID  XRVE ... |  1.0  |  7   |
| Master-CM045453 |   33643|REFILL - NX3, CLEAR  |  1.0  |  8   |
| Master-CM045453 | 31377|TEMPBOND 50 PACK UNIDOSE |  1.0  |  9   |
| Master-CM045453 | 10131099|Holder, Horiz BW,... |  1.0  |  10  |
+----------------+------------------------------+-------+------+
[262270 rows x 4 columns]
```

In [49]:
```python
# Using Normalized Purchase Count

name='cosine'
target='scaledPurchaseFreq'
popularityNormalized = model(trainDataNorm, name,user_id, item_id, target, usersToRecomm
```

```
Preparing data set.

    Data has 198782 observations with 25407 users and 5261 items.

    Data prepared in: 0.183761s

Training model from provided data.

Gathering per-item and per-user statistics.

+--------------------------------+------------+
| Elapsed Time (Item Statistics) | % Complete |
```

```
+--------------------------------+------------+
| 2.045ms                        | 3.75       |
| 5.192ms                        | 100        |
+--------------------------------+------------+
```
Setting up lookup tables.

Processing data in one pass using dense lookup tables.
```
+------------------------------------+------------------+------------------+
| Elapsed Time (Constructing Lookups) | Total % Complete | Items Processed |
+------------------------------------+------------------+------------------+
| 170.063ms                          | 0                | 0                |
| 260.099ms                          | 100              | 5261             |
+------------------------------------+------------------+------------------+
```
Finalizing lookup tables.

Generating candidate set for working with new users.

Finished training in 1.27837s

recommendations finished on 1000/26227 queries. users per second: 66168.2

recommendations finished on 2000/26227 queries. users per second: 81459.8

recommendations finished on 3000/26227 queries. users per second: 86783

recommendations finished on 4000/26227 queries. users per second: 89641.9

recommendations finished on 5000/26227 queries. users per second: 92950.6

recommendations finished on 6000/26227 queries. users per second: 94917.2

recommendations finished on 7000/26227 queries. users per second: 95908.8

recommendations finished on 8000/26227 queries. users per second: 97212.4

recommendations finished on 9000/26227 queries. users per second: 97449

recommendations finished on 10000/26227 queries. users per second: 95150.2

recommendations finished on 11000/26227 queries. users per second: 94224.1

recommendations finished on 12000/26227 queries. users per second: 94210.7

recommendations finished on 13000/26227 queries. users per second: 94989.7

recommendations finished on 14000/26227 queries. users per second: 94857.4

recommendations finished on 15000/26227 queries. users per second: 95511.6

recommendations finished on 16000/26227 queries. users per second: 94741.8

recommendations finished on 17000/26227 queries. users per second: 94866.6

recommendations finished on 18000/26227 queries. users per second: 94194.5

recommendations finished on 19000/26227 queries. users per second: 93089.8

recommendations finished on 20000/26227 queries. users per second: 92615.3

recommendations finished on 21000/26227 queries. users per second: 92963.5

recommendations finished on 22000/26227 queries. users per second: 93225.5

recommendations finished on 23000/26227 queries. users per second: 92690

recommendations finished on 24000/26227 queries. users per second: 92180.4

recommendations finished on 25000/26227 queries. users per second: 90283.7

recommendations finished on 26000/26227 queries. users per second: 85861.6
```
   +----------------+-------------------------------+----------------------+------+
```

| CRM_CUST_KEY | PRODUCT | score | rank |
+----------------+------------------------------+----------------------+------+
Master-CM045451	10075082|BITE PIECE, PANORAMIC	0.049581676721572876	1
Master-CM045451	825-2355|K3 ENG FILE .35/....	0.049581676721572876	2
Master-CM045451	P19035-3|AXIS White DiaGlo...	0.026875227689743042	3
Master-CM045451	F833-021|NTI Diamond Fine FG	0.026372045278549194	4
Master-CM045451	C879K-018|NTI Diamond Coar...	0.025229156017303467	5
Master-CM045451	SC368-023|NTI Diamond Supe...	0.025206178426742554	6
Master-CM045451	SC847-012|NTI Diamond Supe...	0.022707998752593994	7
Master-CM045451	P0143-150|AXIS Polisher - ...	0.02217361330986023	8
Master-CM045451	SC909-037|NTI Diamond Supe...	0.020665884017944336	9
Master-CM045451	825-2201|K3 ENG FILE .20/....	0.0205610990524292	10
Master-CM045452	33361|REFILL - TEMPBOND MI...	0.013834372162818909	1
Master-CM045452	33351|KIT- TEMPBOND CLEAR ...	0.011326998472213745	2
Master-CM045452	N18AD|REFILL- KOR 1.25 30PK	0.009290352463722229	3
Master-CM045452	N18AF|REFILL- KOR 1.50 30PK	0.008865907788276672	4
Master-CM045452	33873|REFILL - MAXCEM ELIT...	0.00886586308479309	5
Master-CM045452	32862|REFILL - MAXCEM MIXI...	0.008714839816093445	6
Master-CM045452	33217|TEMP BOND N.E. SYRIN...	0.008596375584602356	7
Master-CM045452	34418|KIT - MAXCEM ELITE BULK	0.00835445523262024	8
Master-CM045452	33875|REFILL - MAXCEM ELIT...	0.008318856358528137	9
Master-CM045452	N32FE|BFR OPWHT MINI MIX	0.008231133222579956	10
Master-CM045453	08467627|COVER STRIP LONG ...	0.03628619909286499	1
Master-CM045453	FG7408-KC0|FG7408 CARBIDE	0.03219393491744995	2
Master-CM045453	08427096|WATER VALVE - DEL...	0.032057130336761476	3
Master-CM045453	08457774|VALVE-3 WAY TOGGL...	0.02962754964828491	4
Master-CM045453	08423962|ARM REST SLINGS-U...	0.0270879864692688	5
Master-CM045453	C848L-014|NTI Diamond Coar...	0.023476600646972656	6
Master-CM045453	08406929|PIN ROLL 1/8 OD X...	0.021960353851318358	7
Master-CM045453	08305356|InVivo Software -...	0.020998120307922363	8
Master-CM045453	08405137|SWITCH MICRO	0.01868692636489868	9
Master-CM045453	FG7901-KC0|FG7901 CARBIDE	0.01776597499847412	10
+----------------+------------------------------+----------------------+------+

[262270 rows x 4 columns]

In [50]:
```python
train.shape
train.groupby(by=item_id)['IVC_QTY'].mean().sort_values(ascending=False).head(10)
```

Out[50]: (400000, 3)

Out[50]:
```
PRODUCT
02006219|O-Ring 11x1                              200.000000
06221431|DPS- Mask with adaptor                    94.000000
06223882|DPS-FACE MASK                             73.000000
06221421|DPS-JAW SIMULATOR G40                     68.000000
07644053|SLIDE                                     50.000000
LA8-KC0|LA8 CARBIDE                                48.678571
952-0011|500-014 Medium-Fine Gutta Percha Box 100  39.538462
734|Adapt Luciwedge Ultra small                    37.166667
FG7902-KC0|FG7902 CARBIDE                           33.860000
08431078|3800 O-RING, VACUUM STEAL                  31.250000
Name: IVC_QTY, dtype: float64
```

7. Collaborative Filtering

In [51]:
```python
# Using Purchase Count
name = 'cosine'
target = 'IVC_QTY'
usersToRecommend = list(d[user_id])
cos = model(trainData,name,user_id,item_id,target,usersToRecommend,nRec,nDisplay)
```

Preparing data set.

```
     Data has 400000 observations with 25663 users and 7854 items.

     Data prepared in: 0.324649s
Training model from provided data.
Gathering per-item and per-user statistics.

+------------------------------+------------+
| Elapsed Time (Item Statistics) | % Complete |
+------------------------------+------------+
| 1.425ms                      | 3.75       |
| 5.632ms                      | 100        |
+------------------------------+------------+

Setting up lookup tables.
Processing data in one pass using dense lookup tables.

+-----------------------------------+-----------------+-----------------+
| Elapsed Time (Constructing Lookups) | Total % Complete | Items Processed |
+-----------------------------------+-----------------+-----------------+
| 284.257ms                         | 0               | 0               |
| 453.125ms                         | 100             | 7854            |
+-----------------------------------+-----------------+-----------------+

Finalizing lookup tables.
Generating candidate set for working with new users.
Finished training in 0.470367s
recommendations finished on 1000/26227 queries. users per second: 44812.9
recommendations finished on 2000/26227 queries. users per second: 52441.1
recommendations finished on 3000/26227 queries. users per second: 57752.3
recommendations finished on 4000/26227 queries. users per second: 60610.7
recommendations finished on 5000/26227 queries. users per second: 63085.1
recommendations finished on 6000/26227 queries. users per second: 64836.1
recommendations finished on 7000/26227 queries. users per second: 66107.6
recommendations finished on 8000/26227 queries. users per second: 66760.1
recommendations finished on 9000/26227 queries. users per second: 67801.2
recommendations finished on 10000/26227 queries. users per second: 66796.3
recommendations finished on 11000/26227 queries. users per second: 66745.5
recommendations finished on 12000/26227 queries. users per second: 65607.1
recommendations finished on 13000/26227 queries. users per second: 66151.4
recommendations finished on 14000/26227 queries. users per second: 66034.3
recommendations finished on 15000/26227 queries. users per second: 65909.7
recommendations finished on 16000/26227 queries. users per second: 65246.5
recommendations finished on 17000/26227 queries. users per second: 65019
recommendations finished on 18000/26227 queries. users per second: 64772.2
recommendations finished on 19000/26227 queries. users per second: 64659.9
recommendations finished on 20000/26227 queries. users per second: 64821.2
recommendations finished on 21000/26227 queries. users per second: 64657.6
```

recommendations finished on 22000/26227 queries. users per second: 64669.7

recommendations finished on 23000/26227 queries. users per second: 64690.1

recommendations finished on 24000/26227 queries. users per second: 64665.1

recommendations finished on 25000/26227 queries. users per second: 63956

recommendations finished on 26000/26227 queries. users per second: 61456.3

```
+-----------------+----------------------------+----------------------+------+
|   CRM_CUST_KEY  |          PRODUCT           |        score         | rank |
+-----------------+----------------------------+----------------------+------+
| Master-CM045451 | 821-4021|K-FLEX FILES 21MM...|   0.7863507270812988 |  1   |
| Master-CM045451 | 821-8021|K-FILES 21MM SERI... |   0.325080931186676  |  2   |
| Master-CM045451 | P19035-3|AXIS White DiaGlo...| 0.30654042959213257  |  3   |
| Master-CM045451 | P19038-3|AXIS White DiaGlo...|  0.3001031279563904  |  4   |
| Master-CM045451 |        10035656|O-RING       | 0.21944952011108398  |  5   |
| Master-CM045451 |  F833-021|NTI Diamond Fine FG | 0.20547699928283691  |  6   |
| Master-CM045451 | P1932-3|AXIS Pink DiaGloss... | 0.17792975902557373  |  7   |
| Master-CM045451 | 821-8025|K-FILES 25MM SERI... | 0.16858583688735962  |  8   |
| Master-CM045451 | P0143-150|AXIS Polisher - ... | 0.14629971981048584  |  9   |
| Master-CM045451 | 32430|EXPA-SYL CAPSULE 20P... | 0.14629971981048584  |  10  |
| Master-CM045452 | 823-4301|K3XF FILE .30/.04...  | 0.09455010890960694  |  1   |
| Master-CM045452 | 35266|REFILL - OPTIBOND FL...  | 0.07553204894065857  |  2   |
| Master-CM045452 | 29817|REFILL - XRVD   A4, USA |  0.0673599362373352  |  3   |
| Master-CM045452 | 973-0602-TYPEB|elements IC...  | 0.06350125670433045  |  4   |
| Master-CM045452 | 33879|REFILL - AUTOMIX TIP...  |  0.0585671603679657  |  5   |
| Master-CM045452 | 08414439|TUBING 5/8"I.D.AE... | 0.050572174787521365 |  6   |
| Master-CM045452 | 08487264|SYRINGE - QUICK CLEAN | 0.04748042225837708  |  7   |
| Master-CM045452 | 08430481|ADAPTER-KERR SEAL... | 0.04358722567558289  |  8   |
| Master-CM045452 | 08050058|LONG CONE RECTANGULAR | 0.04344356656074524  |  9   |
| Master-CM045452 | H331RZ-FG100|AXIS Razor 33... | 0.04262787103652954  |  10  |
| Master-CM045453 | 15162|K-FLEX FILES 25MM SZ...  | 0.26937058568000793  |  1   |
| Master-CM045453 | 15170|K-FLEX FILES 25MM SZ...  | 0.20151907205581665  |  2   |
| Master-CM045453 |   FG7408-KC0|FG7408 CARBIDE   | 0.19179999828338623  |  3   |
| Master-CM045453 | 08055406|HYGIENE ACCESSORI...  | 0.13783350586891174  |  4   |
| Master-CM045453 | 08485844|SCR SHLDR 4-40 X 3/8  | 0.12833070755004883  |  5   |
| Master-CM045453 | 15154|K-FLEX FILES 25MM SZ...  | 0.10877621173858643  |  6   |
| Master-CM045453 | 08409803|TUBING-SYRINGE-LT...  | 0.08247379958629608  |  7   |
| Master-CM045453 | 33879|REFILL - AUTOMIX TIP...  | 0.08210927248001099  |  8   |
| Master-CM045453 | 08427729|PCB & HARNESS ASS...  |  0.0780114084482193  |  9   |
| Master-CM045453 | 08055407|HYGIENE ACCESSORI...  | 0.07704778015613556  |  10  |
+-----------------+----------------------------+----------------------+------+
[262270 rows x 4 columns]
```

```
In [52]:  # Using Purchase Dummy

          name = 'cosine'
          target = 'purchaseDummy'
          cosDummy = model(trainDataDummy,name,user_id,item_id,target,usersToRecommend,nRec,nDispl
```

Warning: Ignoring columns IVC_QTY;

    To use these columns in scoring predictions, use a model that allows the use of add
itional features.

Preparing data set.

    Data has 1809952 observations with 144223 users and 11020 items.

    Data prepared in: 1.20494s

Training model from provided data.

Gathering per-item and per-user statistics.

```
+--------------------------------+------------+
| Elapsed Time (Item Statistics) | % Complete |
```

```
+--------------------------------+------------+
| 1.808ms                        | 0.5        |
| 21.002ms                       | 100        |
+--------------------------------+------------+
```

Setting up lookup tables.

Processing data in one pass using dense lookup tables.

```
+------------------------------------+-----------------+-----------------+
| Elapsed Time (Constructing Lookups) | Total % Complete | Items Processed |
+------------------------------------+-----------------+-----------------+
| 503.753ms                          | 0               | 0               |
| 1.05s                              | 100             | 11020           |
+------------------------------------+-----------------+-----------------+
```

Finalizing lookup tables.

Generating candidate set for working with new users.

Finished training in 1.10759s

recommendations finished on 1000/26227 queries. users per second: 24902.9

recommendations finished on 2000/26227 queries. users per second: 32789.6

recommendations finished on 3000/26227 queries. users per second: 34758.4

recommendations finished on 4000/26227 queries. users per second: 33441.2

recommendations finished on 5000/26227 queries. users per second: 35037.8

recommendations finished on 6000/26227 queries. users per second: 36142

recommendations finished on 7000/26227 queries. users per second: 37286.2

recommendations finished on 8000/26227 queries. users per second: 37912.5

recommendations finished on 9000/26227 queries. users per second: 38499.5

recommendations finished on 10000/26227 queries. users per second: 38789.5

recommendations finished on 11000/26227 queries. users per second: 39294

recommendations finished on 12000/26227 queries. users per second: 39839.8

recommendations finished on 13000/26227 queries. users per second: 40083

recommendations finished on 14000/26227 queries. users per second: 40656.3

recommendations finished on 15000/26227 queries. users per second: 40976

recommendations finished on 16000/26227 queries. users per second: 41098.4

recommendations finished on 17000/26227 queries. users per second: 41167.3

recommendations finished on 18000/26227 queries. users per second: 40159.8

recommendations finished on 19000/26227 queries. users per second: 40581.4

recommendations finished on 20000/26227 queries. users per second: 40784.7

recommendations finished on 21000/26227 queries. users per second: 40853.9

recommendations finished on 22000/26227 queries. users per second: 40788.8

recommendations finished on 23000/26227 queries. users per second: 40998.4

recommendations finished on 24000/26227 queries. users per second: 40749.3

recommendations finished on 25000/26227 queries. users per second: 40137.8

recommendations finished on 26000/26227 queries. users per second: 39419.5

```
 +----------------+-----------------------------+----------------------+------+
```

CRM_CUST_KEY	PRODUCT	score	rank
Master-CM045451	P1935-3|AXIS Pink DiaGloss...	0.22167864441871643	1
Master-CM045451	P19035-3|AXIS White DiaGlo...	0.18390876054763794	2
Master-CM045451	P1938-3|AXIS Pink DiaGloss...	0.1309148073196411	3
Master-CM045451	P19038-3|AXIS White DiaGlo...	0.10432299971580505	4
Master-CM045451	P19033-3|AXIS White DiaGlo...	0.09515869617462158	5
Master-CM045451	P1933-3|AXIS Pink DiaGloss...	0.08920526504516602	6
Master-CM045451	10013434|Spray Tube	0.05050763487815857	7
Master-CM045451	05343262|Thrust piece	0.05050763487815857	8
Master-CM045451	F368-023G|AXIS Gold Pack (...	0.04587346315383911	9
Master-CM045451	08420787|SCREW .500-28 X	0.04123929142951965	10
Master-CM045452	33879|REFILL - AUTOMIX TIP...	0.050448563363817006	1
Master-CM045452	33351|KIT- TEMPBOND CLEAR ...	0.04676900969611274	2
Master-CM045452	10054524|QUATTROcare plus ...	0.041759212811787925	3
Master-CM045452	34418|KIT - MAXCEM ELITE BULK	0.04048660066392687	4
Master-CM045452	33361|REFILL - TEMPBOND MI...	0.03769167926576403	5
Master-CM045452	32862|REFILL - MAXCEM MIXI...	0.03317566050423516	6
Master-CM045452	33873|REFILL - MAXCEM ELIT...	0.03154269191953871	7
Master-CM045452	33881|REFILL - ROOT CANAL ...	0.03140658802456326	8
Master-CM045452	10073580|GENTLEpower Lux C...	0.027888019879659016	9
Master-CM045452	36441|Harmonize A2 Enamel ...	0.024836149480607774	10
Master-CM045453	08455707|SET RPLCMNT LIGHT...	0.08333435654640198	1
Master-CM045453	32862|REFILL - MAXCEM MIXI...	0.07958461344242096	2
Master-CM045453	08405844|SWITCH MEMBRANE -...	0.07177115976810455	3
Master-CM045453	08458720|PLATE LABEL VENTED	0.069893479347229	4
Master-CM045453	08451205|NAMEPLATE DCIE LI...	0.06236627697944641	5
Master-CM045453	33879|REFILL - AUTOMIX TIP...	0.05653531849384308	6
Master-CM045453	08453075|PIN SHIELD RELEASE	0.055649325251579285	7
Master-CM045453	08451228|RING RETAINING EX...	0.05088233947753906	8
Master-CM045453	08451224|SPRING COMPRESSIO...	0.04906997084617615	9
Master-CM045453	33351|KIT- TEMPBOND CLEAR ...	0.04385967552661896	10

[262270 rows x 4 columns]

In [53]:
```python
# Using Normalized Purchase Count
name = 'cosine'
target = 'scaledPurchaseFreq'
cosNormalized = model(trainDataNorm,name,user_id,item_id,target,usersToRecommend,nRec,nD
```

Preparing data set.

    Data has 198782 observations with 25407 users and 5261 items.

    Data prepared in: 0.185637s

Training model from provided data.

Gathering per-item and per-user statistics.

Elapsed Time (Item Statistics)	% Complete
1.88ms	3.75
5.159ms	100

Setting up lookup tables.

Processing data in one pass using dense lookup tables.

Elapsed Time (Constructing Lookups)	Total % Complete	Items Processed

| 139.471ms | 0 | 0 |
| 246.919ms | 100 | 5261 |
+-------------------------------------+------------------+-----------------+

Finalizing lookup tables.

Generating candidate set for working with new users.

Finished training in 0.266107s

recommendations finished on 1000/26227 queries. users per second: 32831

recommendations finished on 2000/26227 queries. users per second: 48804.3

recommendations finished on 3000/26227 queries. users per second: 57644.6

recommendations finished on 4000/26227 queries. users per second: 60821.7

recommendations finished on 5000/26227 queries. users per second: 65884.8

recommendations finished on 6000/26227 queries. users per second: 69545.1

recommendations finished on 7000/26227 queries. users per second: 71519.8

recommendations finished on 8000/26227 queries. users per second: 73647.9

recommendations finished on 9000/26227 queries. users per second: 75459.7

recommendations finished on 10000/26227 queries. users per second: 77566.9

recommendations finished on 11000/26227 queries. users per second: 78115.6

recommendations finished on 12000/26227 queries. users per second: 78968.7

recommendations finished on 13000/26227 queries. users per second: 79830.5

recommendations finished on 14000/26227 queries. users per second: 80250.4

recommendations finished on 15000/26227 queries. users per second: 79535.5

recommendations finished on 16000/26227 queries. users per second: 80113

recommendations finished on 17000/26227 queries. users per second: 80113.5

recommendations finished on 18000/26227 queries. users per second: 79644.6

recommendations finished on 19000/26227 queries. users per second: 79716.7

recommendations finished on 20000/26227 queries. users per second: 79698.4

recommendations finished on 21000/26227 queries. users per second: 79124.4

recommendations finished on 22000/26227 queries. users per second: 79587

recommendations finished on 23000/26227 queries. users per second: 79966.1

recommendations finished on 24000/26227 queries. users per second: 79226

recommendations finished on 25000/26227 queries. users per second: 79511.2

recommendations finished on 26000/26227 queries. users per second: 76775.7

```
+----------------+-----------------------------+---------------------+------+
|  CRM_CUST_KEY  |           PRODUCT           |        score        | rank |
+----------------+-----------------------------+---------------------+------+
| Master-CM045451 | 10075082|BITE PIECE, PANORAMIC | 0.0495816767721572876 |  1  |
| Master-CM045451 | 825-2355|K3 ENG FILE .35/.... | 0.0495816767721572876 |  2  |
| Master-CM045451 | P19035-3|AXIS White DiaGlo... | 0.026875227689743042  |  3  |
| Master-CM045451 |  F833-021|NTI Diamond Fine FG | 0.026372045278549194  |  4  |
| Master-CM045451 | C879K-018|NTI Diamond Coar... | 0.025229156017303467  |  5  |
| Master-CM045451 | SC368-023|NTI Diamond Supe... | 0.025206178426742554  |  6  |
| Master-CM045451 | SC847-012|NTI Diamond Supe... | 0.022707998752593994  |  7  |
| Master-CM045451 | P0143-150|AXIS Polisher - ... | 0.02217361330986023   |  8  |
| Master-CM045451 | SC909-037|NTI Diamond Supe... | 0.020665884017944336  |  9  |
| Master-CM045451 | 825-2201|K3 ENG FILE .20/.... | 0.0205610990524292    | 10  |
| Master-CM045452 | 33361|REFILL - TEMPBOND MI... | 0.013834372162818909  |  1  |
| Master-CM045452 | 33351|KIT- TEMPBOND CLEAR ... | 0.011326998472213745  |  2  |
| Master-CM045452 |  N18AD|REFILL- KOR 1.25 30PK | 0.009290352463722229  |  3  |
```

```
| Master-CM045452 |     N18AF|REFILL- KOR 1.50 30PK   | 0.008865907788276672 | 4  |
| Master-CM045452 | 33873|REFILL - MAXCEM ELIT...    | 0.00886586308479309  | 5  |
| Master-CM045452 | 32862|REFILL - MAXCEM MIXI...    | 0.008714839816093445 | 6  |
| Master-CM045452 | 33217|TEMP BOND N.E. SYRIN...    | 0.008596375584602356 | 7  |
| Master-CM045452 | 34418|KIT - MAXCEM ELITE BULK    | 0.00835445523262024  | 8  |
| Master-CM045452 | 33875|REFILL - MAXCEM ELIT...    | 0.008318856358528137 | 9  |
| Master-CM045452 |     N32FE|BFR OPWHT MINI MIX    | 0.008231133222579956 | 10 |
| Master-CM045453 | 08467627|COVER STRIP LONG ...   | 0.03628619909286499  | 1  |
| Master-CM045453 |    FG7408-KC0|FG7408 CARBIDE   | 0.03219393491744995  | 2  |
| Master-CM045453 | 08427096|WATER VALVE - DEL...   | 0.032057130336761476 | 3  |
| Master-CM045453 | 08457774|VALVE-3 WAY TOGGL...   | 0.02962754964828491  | 4  |
| Master-CM045453 | 08423962|ARM REST SLINGS-U...   |  0.0270879864692688  | 5  |
| Master-CM045453 | C848L-014|NTI Diamond Coar...   | 0.023476600646972656 | 6  |
| Master-CM045453 | 08406929|PIN ROLL 1/8 OD X...   | 0.021960353851318358 | 7  |
| Master-CM045453 | 08305356|InVivo Software -...   | 0.020998120307922363 | 8  |
| Master-CM045453 |       08405137|SWITCH MICRO    | 0.01868692636489868  | 9  |
| Master-CM045453 |    FG7901-KC0|FG7901 CARBIDE   | 0.01776597499847412  | 10 |
+----------------+----------------------------+---------------------+------+
[262270 rows x 4 columns]
```

In [54]:
```python
# Pearson Similarity
# Using Purchase Count
```

In [55]:
```python
name = 'pearson'
target = 'IVC_QTY'
kPear = model(trainData,name,user_id,item_id,target,usersToRecommend,nRec,nDisplay)
```

Preparing data set.

    Data has 400000 observations with 25663 users and 7854 items.

    Data prepared in: 0.300246s

Training model from provided data.

Gathering per-item and per-user statistics.

```
+--------------------------------+------------+
| Elapsed Time (Item Statistics) | % Complete |
+--------------------------------+------------+
| 2.665ms                        | 3.75       |
| 10.059ms                       | 100        |
+--------------------------------+------------+
```

Setting up lookup tables.

Processing data in one pass using dense lookup tables.

```
+-----------------------------------+-----------------+-----------------+
| Elapsed Time (Constructing Lookups) | Total % Complete | Items Processed |
+-----------------------------------+-----------------+-----------------+
| 291.073ms                         | 0               | 0               |
| 484.146ms                         | 100             | 7854            |
+-----------------------------------+-----------------+-----------------+
```

Finalizing lookup tables.

Generating candidate set for working with new users.

Finished training in 0.501901s

recommendations finished on 1000/26227 queries. users per second: 35310.7

recommendations finished on 2000/26227 queries. users per second: 44811.9

```
recommendations finished on 3000/26227 queries. users per second: 49249
recommendations finished on 4000/26227 queries. users per second: 52792.7
recommendations finished on 5000/26227 queries. users per second: 55538.3
recommendations finished on 6000/26227 queries. users per second: 57567.8
recommendations finished on 7000/26227 queries. users per second: 59142.1
recommendations finished on 8000/26227 queries. users per second: 60467.7
recommendations finished on 9000/26227 queries. users per second: 61581.8
recommendations finished on 10000/26227 queries. users per second: 61060.5
recommendations finished on 11000/26227 queries. users per second: 60735.6
recommendations finished on 12000/26227 queries. users per second: 60817.7
recommendations finished on 13000/26227 queries. users per second: 60976.5
recommendations finished on 14000/26227 queries. users per second: 60939
recommendations finished on 15000/26227 queries. users per second: 60257.4
recommendations finished on 16000/26227 queries. users per second: 60203.3
recommendations finished on 17000/26227 queries. users per second: 60169.7
recommendations finished on 18000/26227 queries. users per second: 59851.4
recommendations finished on 19000/26227 queries. users per second: 59914
recommendations finished on 20000/26227 queries. users per second: 60162.3
recommendations finished on 21000/26227 queries. users per second: 60337.4
recommendations finished on 22000/26227 queries. users per second: 60125.2
recommendations finished on 23000/26227 queries. users per second: 59954.1
recommendations finished on 24000/26227 queries. users per second: 59824.6
recommendations finished on 25000/26227 queries. users per second: 57984.2
recommendations finished on 26000/26227 queries. users per second: 56427
```

CRM_CUST_KEY	PRODUCT	score	rank
Master-CM045451	02006219|O-Ring 11x1	200.0	1
Master-CM045451	06221431|DPS- Mask with ad...	94.0	2
Master-CM045451	06223882|DPS-FACE MASK	73.0	3
Master-CM045451	06221421|DPS-JAW SIMULATOR G40	68.0	4
Master-CM045451	07644053|SLIDE	50.0	5
Master-CM045451	08431078|3800 O-RING, VACU...	41.22222222222222	6
Master-CM045451	734|Adapt Luciwedge Ultra ...	37.166666666666664	7
Master-CM045451	720|Cervical Matrices Metal	32.16666666666667	8
Master-CM045451	76019|REFILL - UNIDOSE 40 ...	30.0	9
Master-CM045451	742|*Adapt Sectional Matri...	30.0	10
Master-CM045452	02006219|O-Ring 11x1	200.0	1
Master-CM045452	06221431|DPS- Mask with ad...	94.0	2
Master-CM045452	06223882|DPS-FACE MASK	73.0	3
Master-CM045452	06221421|DPS-JAW SIMULATOR G40	68.0	4
Master-CM045452	07644053|SLIDE	50.0	5
Master-CM045452	08431078|3800 O-RING, VACU...	41.22222222222222	6
Master-CM045452	734|Adapt Luciwedge Ultra ...	37.166666666666664	7
Master-CM045452	720|Cervical Matrices Metal	32.16666666666667	8
Master-CM045452	76019|REFILL - UNIDOSE 40 ...	30.0	9
Master-CM045452	742|*Adapt Sectional Matri...	30.0	10
Master-CM045453	02006219|O-Ring 11x1	200.0	1
Master-CM045453	06221431|DPS- Mask with ad...	94.0	2
Master-CM045453	06223882|DPS-FACE MASK	73.0	3
Master-CM045453	06221421|DPS-JAW SIMULATOR G40	68.0	4
Master-CM045453	07644053|SLIDE	50.0	5

```
| Master-CM045453 | 08431078|3800 O-RING, VACU... | 41.22222222222222 | 6   |
| Master-CM045453 | 734|Adapt Luciwedge Ultra ... | 37.166666666666664 | 7   |
| Master-CM045453 |  720|Cervical Matrices Metal | 32.16666666666667 | 8   |
| Master-CM045453 | 76019|REFILL - UNIDOSE 40 ... |        30.0       | 9   |
| Master-CM045453 | 742|*Adapt Sectional Matri... |        30.0       | 10  |
+-----------------+-----------------------------+--------------------+------+
[262270 rows x 4 columns]
```

In [56]:
```
# Using Purshase Dummy
name = 'pearson'
target = 'purchaseDummy'
kPearDummy = model(trainDataDummy,name,user_id,item_id,target,usersToRecommend,nRec,nDis
```

Warning: Ignoring columns IVC_QTY;

    To use these columns in scoring predictions, use a model that allows the use of add
itional features.

Preparing data set.

    Data has 1809952 observations with 144223 users and 11020 items.

    Data prepared in: 1.20025s

Training model from provided data.

Gathering per-item and per-user statistics.

```
+--------------------------------+------------+
| Elapsed Time (Item Statistics) | % Complete |
+--------------------------------+------------+
| 2.019ms                        | 0.5        |
| 31.021ms                       | 100        |
+--------------------------------+------------+
```

Setting up lookup tables.

Processing data in one pass using dense lookup tables.

```
+-----------------------------------+-----------------+-----------------+
| Elapsed Time (Constructing Lookups) | Total % Complete | Items Processed |
+-----------------------------------+-----------------+-----------------+
| 502.763ms                         | 0               | 0               |
| 995.284ms                         | 100             | 11020           |
+-----------------------------------+-----------------+-----------------+
```

Finalizing lookup tables.

Generating candidate set for working with new users.

Finished training in 1.04983s

recommendations finished on 1000/26227 queries. users per second: 20774

recommendations finished on 2000/26227 queries. users per second: 26143.1

recommendations finished on 3000/26227 queries. users per second: 28306.7

recommendations finished on 4000/26227 queries. users per second: 29522.9

recommendations finished on 5000/26227 queries. users per second: 29671.5

recommendations finished on 6000/26227 queries. users per second: 29642.5

recommendations finished on 7000/26227 queries. users per second: 29385.7

recommendations finished on 8000/26227 queries. users per second: 28499.1

recommendations finished on 9000/26227 queries. users per second: 28578.3

```
recommendations finished on 10000/26227 queries. users per second: 28584.2

recommendations finished on 11000/26227 queries. users per second: 28540.1

recommendations finished on 12000/26227 queries. users per second: 28861.9

recommendations finished on 13000/26227 queries. users per second: 28538.2

recommendations finished on 14000/26227 queries. users per second: 27886.5

recommendations finished on 15000/26227 queries. users per second: 27219.9

recommendations finished on 16000/26227 queries. users per second: 27050.8

recommendations finished on 17000/26227 queries. users per second: 27162

recommendations finished on 18000/26227 queries. users per second: 27239.1

recommendations finished on 19000/26227 queries. users per second: 27293.3

recommendations finished on 20000/26227 queries. users per second: 27363.9

recommendations finished on 21000/26227 queries. users per second: 27331.3

recommendations finished on 22000/26227 queries. users per second: 27119.9

recommendations finished on 23000/26227 queries. users per second: 26985.9

recommendations finished on 24000/26227 queries. users per second: 26519.2

recommendations finished on 25000/26227 queries. users per second: 26041.9

recommendations finished on 26000/26227 queries. users per second: 25593.6
```

```
+----------------+-------------------------------+-------+------+
|  CRM_CUST_KEY  |            PRODUCT            | score | rank |
+----------------+-------------------------------+-------+------+
| Master-CM045451 | 00455|COMPOUND STICKS-GREY... |  0.0  |  1   |
| Master-CM045451 | 821-8025|K-FILES 25MM SERI... |  0.0  |  2   |
| Master-CM045451 | 815-1542|TF ADAPTIVE GUTTA... |  0.0  |  3   |
| Master-CM045451 | 13499|GINGIKNIT 00n NON IM... |  0.0  |  4   |
| Master-CM045451 | H557RZ-FG100|AXIS Razor 55... |  0.0  |  5   |
| Master-CM045451 |  P343|NTI Green CeraGlaze-HP  |  0.0  |  6   |
| Master-CM045451 | 29836|REFILL - UNID  XRVE ... |  0.0  |  7   |
| Master-CM045451 |   33643|REFILL - NX3, CLEAR  |  0.0  |  8   |
| Master-CM045451 | 31377|TEMPBOND 50 PACK UNIDOSE |  0.0  |  9   |
| Master-CM045451 | 10131099|Holder, Horiz BW,... |  0.0  |  10  |
| Master-CM045452 | 00455|COMPOUND STICKS-GREY... |  0.0  |  1   |
| Master-CM045452 | 821-8025|K-FILES 25MM SERI... |  0.0  |  2   |
| Master-CM045452 | 815-1542|TF ADAPTIVE GUTTA... |  0.0  |  3   |
| Master-CM045452 | 13499|GINGIKNIT 00n NON IM... |  0.0  |  4   |
| Master-CM045452 | H557RZ-FG100|AXIS Razor 55... |  0.0  |  5   |
| Master-CM045452 |  P343|NTI Green CeraGlaze-HP  |  0.0  |  6   |
| Master-CM045452 | 29836|REFILL - UNID  XRVE ... |  0.0  |  7   |
| Master-CM045452 |   33643|REFILL - NX3, CLEAR  |  0.0  |  8   |
| Master-CM045452 | 31377|TEMPBOND 50 PACK UNIDOSE |  0.0  |  9   |
| Master-CM045452 | 10131099|Holder, Horiz BW,... |  0.0  |  10  |
| Master-CM045453 | 00455|COMPOUND STICKS-GREY... |  0.0  |  1   |
| Master-CM045453 | 821-8025|K-FILES 25MM SERI... |  0.0  |  2   |
| Master-CM045453 | 815-1542|TF ADAPTIVE GUTTA... |  0.0  |  3   |
| Master-CM045453 | 13499|GINGIKNIT 00n NON IM... |  0.0  |  4   |
| Master-CM045453 | H557RZ-FG100|AXIS Razor 55... |  0.0  |  5   |
| Master-CM045453 |  P343|NTI Green CeraGlaze-HP  |  0.0  |  6   |
| Master-CM045453 | 29836|REFILL - UNID  XRVE ... |  0.0  |  7   |
| Master-CM045453 |   33643|REFILL - NX3, CLEAR  |  0.0  |  8   |
| Master-CM045453 | 31377|TEMPBOND 50 PACK UNIDOSE |  0.0  |  9   |
| Master-CM045453 | 10131099|Holder, Horiz BW,... |  0.0  |  10  |
+----------------+-------------------------------+-------+------+
[262270 rows x 4 columns]
```

In [57]: `# Using normalized purchase count`

```
In [58]: name = 'pearson'
         target = 'scaledPurchaseFreq'
         kPearNomralization = model(trainDataNorm,name,user_id,item_id,target,usersToRecommend,nR
```

Preparing data set.

    Data has 198782 observations with 25407 users and 5261 items.

    Data prepared in: 0.199869s

Training model from provided data.

Gathering per-item and per-user statistics.

```
+--------------------------------+------------+
| Elapsed Time (Item Statistics) | % Complete |
+--------------------------------+------------+
| 2.644ms                        | 3.75       |
| 7.592ms                        | 100        |
+--------------------------------+------------+
```

Setting up lookup tables.

Processing data in one pass using dense lookup tables.

```
+-------------------------------------+------------------+------------------+
| Elapsed Time (Constructing Lookups) | Total % Complete | Items Processed |
+-------------------------------------+------------------+------------------+
| 149.551ms                           | 0                | 0               |
| 254.964ms                           | 100              | 5261            |
+-------------------------------------+------------------+------------------+
```

Finalizing lookup tables.

Generating candidate set for working with new users.

Finished training in 0.270773s

recommendations finished on 1000/26227 queries. users per second: 33088.5

recommendations finished on 2000/26227 queries. users per second: 45612.1

recommendations finished on 3000/26227 queries. users per second: 52179.4

recommendations finished on 4000/26227 queries. users per second: 57281.2

recommendations finished on 5000/26227 queries. users per second: 62426.6

recommendations finished on 6000/26227 queries. users per second: 65919.6

recommendations finished on 7000/26227 queries. users per second: 69069

recommendations finished on 8000/26227 queries. users per second: 72022.8

recommendations finished on 9000/26227 queries. users per second: 74490.4

recommendations finished on 10000/26227 queries. users per second: 76615.4

recommendations finished on 11000/26227 queries. users per second: 77956.7

recommendations finished on 12000/26227 queries. users per second: 77993

recommendations finished on 13000/26227 queries. users per second: 78276.9

recommendations finished on 14000/26227 queries. users per second: 79180.1

recommendations finished on 15000/26227 queries. users per second: 79844.1

recommendations finished on 16000/26227 queries. users per second: 80721.2

recommendations finished on 17000/26227 queries. users per second: 81050

```
recommendations finished on 18000/26227 queries. users per second: 81733.5

recommendations finished on 19000/26227 queries. users per second: 82104.3

recommendations finished on 20000/26227 queries. users per second: 81892

recommendations finished on 21000/26227 queries. users per second: 82169.3

recommendations finished on 22000/26227 queries. users per second: 82418

recommendations finished on 23000/26227 queries. users per second: 81983.3

recommendations finished on 24000/26227 queries. users per second: 82315.5

recommendations finished on 25000/26227 queries. users per second: 81643.6

recommendations finished on 26000/26227 queries. users per second: 77992.4
```

```
+----------------+------------------------------+-------+------+
|  CRM_CUST_KEY  |            PRODUCT           | score | rank |
+----------------+------------------------------+-------+------+
| Master-CM045451 | 900-0301|973-0234 VITALITY... | 1.0  |  1   |
| Master-CM045451 |    08425638|RATCHET MECHANISM | 1.0  |  2   |
| Master-CM045451 | 10134103|NCP-Premier-Month... | 1.0  |  3   |
| Master-CM045451 |        30001874|Cap mounted   | 1.0  |  4   |
| Master-CM045451 | 10131115|Universal Sensor ... | 1.0  |  5   |
| Master-CM045451 | H1S-010|NTI #2 One Pc Oper... | 1.0  |  6   |
| Master-CM045451 | 5092|SWIVEL, REPLACEMENT Q... | 1.0  |  7   |
| Master-CM045451 | 35666|DEMI ULTRA CHARGER R... | 1.0  |  8   |
| Master-CM045451 | GF661-HP|AXIS Green Stone ... | 1.0  |  9   |
| Master-CM045451 | 08447956|HANDLE,BRAKE,SYST... | 1.0  |  10  |
| Master-CM045452 | 900-0301|973-0234 VITALITY... | 1.0  |  1   |
| Master-CM045452 |    08425638|RATCHET MECHANISM | 1.0  |  2   |
| Master-CM045452 | 10134103|NCP-Premier-Month... | 1.0  |  3   |
| Master-CM045452 |        30001874|Cap mounted   | 1.0  |  4   |
| Master-CM045452 | 10131115|Universal Sensor ... | 1.0  |  5   |
| Master-CM045452 | H1S-010|NTI #2 One Pc Oper... | 1.0  |  6   |
| Master-CM045452 | 5092|SWIVEL, REPLACEMENT Q... | 1.0  |  7   |
| Master-CM045452 | 35666|DEMI ULTRA CHARGER R... | 1.0  |  8   |
| Master-CM045452 | GF661-HP|AXIS Green Stone ... | 1.0  |  9   |
| Master-CM045452 | 08447956|HANDLE,BRAKE,SYST... | 1.0  |  10  |
| Master-CM045453 | 900-0301|973-0234 VITALITY... | 1.0  |  1   |
| Master-CM045453 |    08425638|RATCHET MECHANISM | 1.0  |  2   |
| Master-CM045453 | 10134103|NCP-Premier-Month... | 1.0  |  3   |
| Master-CM045453 |        30001874|Cap mounted   | 1.0  |  4   |
| Master-CM045453 | 10131115|Universal Sensor ... | 1.0  |  5   |
| Master-CM045453 | H1S-010|NTI #2 One Pc Oper... | 1.0  |  6   |
| Master-CM045453 | 5092|SWIVEL, REPLACEMENT Q... | 1.0  |  7   |
| Master-CM045453 | 35666|DEMI ULTRA CHARGER R... | 1.0  |  8   |
| Master-CM045453 | GF661-HP|AXIS Green Stone ... | 1.0  |  9   |
| Master-CM045453 | 08447956|HANDLE,BRAKE,SYST... | 1.0  |  10  |
+----------------+------------------------------+-------+------+
[262270 rows x 4 columns]
```

8. Model Evaluation

```
In [59]:  who
```

```
InteractiveShell        cos     cosDummy      cosNormalized    createDataDummy
d         dataDummy        dfMatrixNorm    dfNorm
dfRecMatrix     dfRec_   itemID  item_id      kPear   kPearDummy      kPearNomralizat
ion     model   nDisplay
nRec     name    normalizeData    np      pd      popularityDummy      popularityModel
        popularityNormalized    popularityRecommend
splitData        target  tc      test    testData      testDataDummy    testDataNorm
train    trainData
```

```
   trainDataDummy    trainDataNorm    train_test_split        userID   user_id        usersTo
   Recommend
```

In [60]:
```
modelsWcounts = [popularityModel, cos, kPear]
modelsWdummy = [popularityDummy, cosDummy, kPearDummy]
modelsWNormalization = [popularityNormalized, cosNormalized, kPearNomralization]

names_w_counts = ['Popularity Model on Purchase Counts', 'Cosine Similarity on Purchase
names_w_dummy = ['Popularity Model on Purchase Dummy', 'Cosine Similarity on Purchase Du
names_w_norm = ['Popularity Model on Scaled Purchase Counts', 'Cosine Similarity on Scal
```

Models on Purchase Counts

In [61]:
```
evalCounts = tc.recommender.util.compare_models(testData,modelsWcounts,model_names= name
```

```
PROGRESS: Evaluate model Popularity Model on Purchase Counts
recommendations finished on 1000/20525 queries. users per second: 21855.1

recommendations finished on 2000/20525 queries. users per second: 29076.5

recommendations finished on 3000/20525 queries. users per second: 33454.9

recommendations finished on 4000/20525 queries. users per second: 35838.4

recommendations finished on 5000/20525 queries. users per second: 37625.1

recommendations finished on 6000/20525 queries. users per second: 37935.8

recommendations finished on 7000/20525 queries. users per second: 39093

recommendations finished on 8000/20525 queries. users per second: 39254.9

recommendations finished on 9000/20525 queries. users per second: 39418.9

recommendations finished on 10000/20525 queries. users per second: 39364.7

recommendations finished on 11000/20525 queries. users per second: 39598.3

recommendations finished on 12000/20525 queries. users per second: 39559.3

recommendations finished on 13000/20525 queries. users per second: 40008.4

recommendations finished on 14000/20525 queries. users per second: 40250.2

recommendations finished on 15000/20525 queries. users per second: 40263.8

recommendations finished on 16000/20525 queries. users per second: 40573

recommendations finished on 17000/20525 queries. users per second: 40842

recommendations finished on 18000/20525 queries. users per second: 41131.8

recommendations finished on 19000/20525 queries. users per second: 40715.6

recommendations finished on 20000/20525 queries. users per second: 39648.6
```

```
Precision and recall summary statistics by cutoff
+--------+------------------------+------------------------+
| cutoff |     mean_precision     |       mean_recall      |
+--------+------------------------+------------------------+
|   1    | 4.872107186358064e-05  |  8.12017864393011e-06  |
|   2    | 2.436053593179032e-05  |  8.12017864393011e-06  |
|   3    | 3.2480714575720583e-05 | 1.1867953402667015e-05 |
|   4    | 2.436053593179358e-05  | 1.1867953402667015e-05 |
|   5    | 1.9488428745432526e-05 | 1.1867953402667015e-05 |
|   6    | 7.308160779537128e-05  | 0.00011248434878154827 |
|   7    | 6.960153123368718e-05  | 0.000161205420645120  |
|   8    | 6.699147381242402e-05  | 0.0001640713660488698 |
|   9    | 8.661523886858837e-05  | 0.0002141458010197714 |
|   10   | 7.795371498172993e-05  | 0.0002141458010197714 |
+--------+------------------------+------------------------+
[10 rows x 3 columns]
```

```
Overall RMSE: 3.5706824197731297

Per User RMSE (best)
+-----------------+------+-------+
|   CRM_CUST_KEY  | rmse | count |
+-----------------+------+-------+
| Master-CM085613 | 0.0  |   1   |
+-----------------+------+-------+
[1 rows x 3 columns]


Per User RMSE (worst)
+-----------------+--------------------+-------+
|   CRM_CUST_KEY  |        rmse        | count |
+-----------------+--------------------+-------+
| Master-CM077836 | 188.31252566735114 |   1   |
+-----------------+--------------------+-------+
[1 rows x 3 columns]


Per Item RMSE (best)
+-----------------------------+------+-------+
|            PRODUCT          | rmse | count |
+-----------------------------+------+-------+
| C885-012G|AXIS Gold Pack (... | 0.0  |   1   |
+-----------------------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (worst)
+--------------------+-------+-------+
|       PRODUCT      | rmse  | count |
+--------------------+-------+-------+
| 02006219|O-Ring 11x1 | 199.0 |   1   |
+--------------------+-------+-------+
[1 rows x 3 columns]

PROGRESS: Evaluate model Cosine Similarity on Purchase Counts
recommendations finished on 1000/20525 queries. users per second: 43694.8
recommendations finished on 2000/20525 queries. users per second: 45787.5
recommendations finished on 3000/20525 queries. users per second: 46262.7
recommendations finished on 4000/20525 queries. users per second: 47308.7
recommendations finished on 5000/20525 queries. users per second: 47786.1
recommendations finished on 6000/20525 queries. users per second: 47006.8
recommendations finished on 7000/20525 queries. users per second: 46342.3
recommendations finished on 8000/20525 queries. users per second: 45260.6
recommendations finished on 9000/20525 queries. users per second: 44566.6
recommendations finished on 10000/20525 queries. users per second: 43987.6
recommendations finished on 11000/20525 queries. users per second: 43912.7
recommendations finished on 12000/20525 queries. users per second: 43135.1
recommendations finished on 13000/20525 queries. users per second: 42959.4
recommendations finished on 14000/20525 queries. users per second: 42787.4
recommendations finished on 15000/20525 queries. users per second: 42142.9
recommendations finished on 16000/20525 queries. users per second: 42007.8
recommendations finished on 17000/20525 queries. users per second: 42002.2
recommendations finished on 18000/20525 queries. users per second: 41641
```

recommendations finished on 19000/20525 queries. users per second: 41444.8

recommendations finished on 20000/20525 queries. users per second: 39862.6

Precision and recall summary statistics by cutoff

cutoff	mean_precision	mean_recall
1	0.03098660170523736	0.010831601444125233
2	0.030012180267965823	0.01970621761836745
3	0.02799837596427129	0.026211909499347468
4	0.026930572472594352	0.03266919786982515
5	0.025461632155907438	0.0375094313428567
6	0.024279334145351127	0.042189486990330226
7	0.02294066469462336	0.04593967957263513
8	0.021924482338611277	0.04927109561274184
9	0.020782243876031926	0.052039175242293935
10	0.019868453105968336	0.05498466922126765

[10 rows x 3 columns]

Overall RMSE: 4.074918288135176

Per User RMSE (best)

CRM_CUST_KEY	rmse	count
Master-CM058660	0.0	1

[1 rows x 3 columns]

Per User RMSE (worst)

CRM_CUST_KEY	rmse	count
Master-CM077836	190.0	1

[1 rows x 3 columns]

Per Item RMSE (best)

PRODUCT	rmse	count
10117335|COMFORTbase 1750	0.0	1

[1 rows x 3 columns]

Per Item RMSE (worst)

PRODUCT	rmse	count
FG245-KC0|FG245 CARBIDE	65.136178705031	19

[1 rows x 3 columns]

PROGRESS: Evaluate model Pearson Similarity on Purchase Counts

recommendations finished on 1000/20525 queries. users per second: 38516.4

recommendations finished on 2000/20525 queries. users per second: 41996.5

recommendations finished on 3000/20525 queries. users per second: 41088.6

recommendations finished on 4000/20525 queries. users per second: 40641.3

```
recommendations finished on 5000/20525 queries. users per second: 41119.1

recommendations finished on 6000/20525 queries. users per second: 41101.2

recommendations finished on 7000/20525 queries. users per second: 41423.1

recommendations finished on 8000/20525 queries. users per second: 41256.7

recommendations finished on 9000/20525 queries. users per second: 41118.6

recommendations finished on 10000/20525 queries. users per second: 41081.6

recommendations finished on 11000/20525 queries. users per second: 41081.9

recommendations finished on 12000/20525 queries. users per second: 40294.3

recommendations finished on 13000/20525 queries. users per second: 40000.4

recommendations finished on 14000/20525 queries. users per second: 39717

recommendations finished on 15000/20525 queries. users per second: 39330.7

recommendations finished on 16000/20525 queries. users per second: 39069

recommendations finished on 17000/20525 queries. users per second: 39087.6

recommendations finished on 18000/20525 queries. users per second: 38769

recommendations finished on 19000/20525 queries. users per second: 38639

recommendations finished on 20000/20525 queries. users per second: 37691
```

```
Precision and recall summary statistics by cutoff
+--------+-----------------------+-----------------------+
| cutoff |    mean_precision     |      mean_recall      |
+--------+-----------------------+-----------------------+
|   1    | 4.872107186358074e-05 |  8.12017864393011e-06 |
|   2    | 2.436053593179037e-05 |  8.12017864393011e-06 |
|   3    | 3.248071457572053e-05 | 1.1867953402666997e-05 |
|   4    | 2.4360535931790358e-05 | 1.1867953402666997e-05 |
|   5    | 1.9488428745432542e-05 |  1.1867953402667e-05  |
|   6    | 1.6240357287860265e-05 |  1.1867953402667e-05  |
|   7    | 2.0880459370106258e-05 | 1.473389880640703e-05 |
|   8    | 1.8270401948842804e-05 | 1.473389880640703e-05 |
|   9    | 1.624035728786034e-05 | 1.473389880640703e-05 |
|   10   | 1.948842874543254e-05 | 2.6914166772302416e-05 |
+--------+-----------------------+-----------------------+
[10 rows x 3 columns]


Overall RMSE: 3.407882805905065

Per User RMSE (best)
+----------------+------+-------+
|  CRM_CUST_KEY  | rmse | count |
+----------------+------+-------+
| Master-CM085613 | 0.0 |   1   |
+----------------+------+-------+
[1 rows x 3 columns]


Per User RMSE (worst)
+----------------+------------------+-------+
|  CRM_CUST_KEY  |       rmse       | count |
+----------------+------------------+-------+
| Master-CM077836 | 188.4577385449225 |   1   |
+----------------+------------------+-------+
[1 rows x 3 columns]


Per Item RMSE (best)
+------------------------------+------+-------+
|           PRODUCT            | rmse | count |
```

```
+-----------------------------+------+-------+
| C885-012G|AXIS Gold Pack (... | 0.0  |   1   |
+-----------------------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (worst)
+---------------------+-------+-------+
|       PRODUCT       | rmse  | count |
+---------------------+-------+-------+
| 02006219|O-Ring 11x1 | 199.0 |   1   |
+---------------------+-------+-------+
[1 rows x 3 columns]
```

Models on Purchase Dummy

```
In [62]: evalDummy = tc.recommender.util.compare_models(testDataDummy,modelsWdummy,model_names=na
```

```
PROGRESS: Evaluate model Popularity Model on Purchase Dummy
recommendations finished on 1000/106191 queries. users per second: 33992.8
recommendations finished on 2000/106191 queries. users per second: 42976.6
recommendations finished on 3000/106191 queries. users per second: 46623.7
recommendations finished on 4000/106191 queries. users per second: 48934.5
recommendations finished on 5000/106191 queries. users per second: 49894.7
recommendations finished on 6000/106191 queries. users per second: 49689.4
recommendations finished on 7000/106191 queries. users per second: 50518.2
recommendations finished on 8000/106191 queries. users per second: 50861.5
recommendations finished on 9000/106191 queries. users per second: 51296.1
recommendations finished on 10000/106191 queries. users per second: 51404.6
recommendations finished on 11000/106191 queries. users per second: 50612.6
recommendations finished on 12000/106191 queries. users per second: 50278.2
recommendations finished on 13000/106191 queries. users per second: 49611.1
recommendations finished on 14000/106191 queries. users per second: 48670.9
recommendations finished on 15000/106191 queries. users per second: 47476.9
recommendations finished on 16000/106191 queries. users per second: 47292.6
recommendations finished on 17000/106191 queries. users per second: 46213.4
recommendations finished on 18000/106191 queries. users per second: 46130.2
recommendations finished on 19000/106191 queries. users per second: 46071.4
recommendations finished on 20000/106191 queries. users per second: 46131.4
recommendations finished on 21000/106191 queries. users per second: 46072
recommendations finished on 22000/106191 queries. users per second: 45227.1
recommendations finished on 23000/106191 queries. users per second: 45487.4
recommendations finished on 24000/106191 queries. users per second: 44684.8
recommendations finished on 25000/106191 queries. users per second: 44487.2
recommendations finished on 26000/106191 queries. users per second: 44050.4
recommendations finished on 27000/106191 queries. users per second: 43816.8
recommendations finished on 28000/106191 queries. users per second: 43479.3
recommendations finished on 29000/106191 queries. users per second: 43146.3
```

```
recommendations finished on 30000/106191 queries. users per second: 42974.2
recommendations finished on 31000/106191 queries. users per second: 42660.4
recommendations finished on 32000/106191 queries. users per second: 42264.6
recommendations finished on 33000/106191 queries. users per second: 42133.5
recommendations finished on 34000/106191 queries. users per second: 42087.2
recommendations finished on 35000/106191 queries. users per second: 41758.5
recommendations finished on 36000/106191 queries. users per second: 41401.2
recommendations finished on 37000/106191 queries. users per second: 40698.5
recommendations finished on 38000/106191 queries. users per second: 40340.5
recommendations finished on 39000/106191 queries. users per second: 40268.7
recommendations finished on 40000/106191 queries. users per second: 40278.3
recommendations finished on 41000/106191 queries. users per second: 40296.7
recommendations finished on 42000/106191 queries. users per second: 39870.1
recommendations finished on 43000/106191 queries. users per second: 39812.1
recommendations finished on 44000/106191 queries. users per second: 39758.1
recommendations finished on 45000/106191 queries. users per second: 39696.4
recommendations finished on 46000/106191 queries. users per second: 39298.5
recommendations finished on 47000/106191 queries. users per second: 39173.6
recommendations finished on 48000/106191 queries. users per second: 38951.9
recommendations finished on 49000/106191 queries. users per second: 38685.7
recommendations finished on 50000/106191 queries. users per second: 38507.4
recommendations finished on 51000/106191 queries. users per second: 38201
recommendations finished on 52000/106191 queries. users per second: 38088.8
recommendations finished on 53000/106191 queries. users per second: 38102.7
recommendations finished on 54000/106191 queries. users per second: 38046.2
recommendations finished on 55000/106191 queries. users per second: 37925
recommendations finished on 56000/106191 queries. users per second: 37867.7
recommendations finished on 57000/106191 queries. users per second: 37773.3
recommendations finished on 58000/106191 queries. users per second: 37649
recommendations finished on 59000/106191 queries. users per second: 37553.6
recommendations finished on 60000/106191 queries. users per second: 37540.4
recommendations finished on 61000/106191 queries. users per second: 37516.4
recommendations finished on 62000/106191 queries. users per second: 37404.3
recommendations finished on 63000/106191 queries. users per second: 37347.4
recommendations finished on 64000/106191 queries. users per second: 37308.1
recommendations finished on 65000/106191 queries. users per second: 37304.1
recommendations finished on 66000/106191 queries. users per second: 37267.2
recommendations finished on 67000/106191 queries. users per second: 37244
recommendations finished on 68000/106191 queries. users per second: 37308.2
recommendations finished on 69000/106191 queries. users per second: 37327
recommendations finished on 70000/106191 queries. users per second: 37389.2
recommendations finished on 71000/106191 queries. users per second: 37384.5
```

```
recommendations finished on 72000/106191 queries. users per second: 37451.9

recommendations finished on 73000/106191 queries. users per second: 37486.4

recommendations finished on 74000/106191 queries. users per second: 37538

recommendations finished on 75000/106191 queries. users per second: 37492.7

recommendations finished on 76000/106191 queries. users per second: 37517.9

recommendations finished on 77000/106191 queries. users per second: 37434.5

recommendations finished on 78000/106191 queries. users per second: 37447.2

recommendations finished on 79000/106191 queries. users per second: 37482.5

recommendations finished on 80000/106191 queries. users per second: 37478.7

recommendations finished on 81000/106191 queries. users per second: 37481

recommendations finished on 82000/106191 queries. users per second: 37499.2

recommendations finished on 83000/106191 queries. users per second: 37555.5

recommendations finished on 84000/106191 queries. users per second: 37619.2

recommendations finished on 85000/106191 queries. users per second: 37674.2

recommendations finished on 86000/106191 queries. users per second: 37729.1

recommendations finished on 87000/106191 queries. users per second: 37651.3

recommendations finished on 88000/106191 queries. users per second: 37704.9

recommendations finished on 89000/106191 queries. users per second: 37762.8

recommendations finished on 90000/106191 queries. users per second: 37822.7

recommendations finished on 91000/106191 queries. users per second: 37870.3

recommendations finished on 92000/106191 queries. users per second: 37918.6

recommendations finished on 93000/106191 queries. users per second: 37943.1

recommendations finished on 94000/106191 queries. users per second: 37929.3

recommendations finished on 95000/106191 queries. users per second: 37892

recommendations finished on 96000/106191 queries. users per second: 37883.5

recommendations finished on 97000/106191 queries. users per second: 37858.8

recommendations finished on 98000/106191 queries. users per second: 37810.4

recommendations finished on 99000/106191 queries. users per second: 37858.2

recommendations finished on 100000/106191 queries. users per second: 37891.7

recommendations finished on 101000/106191 queries. users per second: 37939.8

recommendations finished on 102000/106191 queries. users per second: 38001

recommendations finished on 103000/106191 queries. users per second: 38068.4

recommendations finished on 104000/106191 queries. users per second: 38130.8

recommendations finished on 105000/106191 queries. users per second: 38156.3

recommendations finished on 106000/106191 queries. users per second: 38091.7
```

Precision and recall summary statistics by cutoff

cutoff	mean_precision	mean_recall
1	2.8250981721614868e-05	6.773627196410612e-06
2	2.354248476801213e-05	1.1796023946919817e-05
3	1.883397814409806e-05	1.258077343918696e-05
4	1.412549086080756e-05	1.258077343918696e-05
5	1.5067190251527824e-05	1.6068548960374075e-05
6	1.5694989845341525e-05	1.8191988762979088e-05
7	1.4798133282750248e-05	2.2900485716581614e-05

```
|   8    | 1.4125490860807258e-05 | 2.4077609954982322e-05 |
|   9    | 1.3602324532629344e-05 | 2.7216607924050538e-05 |
|   10   | 1.506719025152787e-05  | 3.147236478596042e-05  |
+--------+------------------------+------------------------+
[10 rows x 3 columns]


Overall RMSE: 0.0

Per User RMSE (best)
+----------------+------+-------+
|  CRM_CUST_KEY  | rmse | count |
+----------------+------+-------+
| Master-CM978491 | 0.0 |   1   |
+----------------+------+-------+
[1 rows x 3 columns]


Per User RMSE (worst)
+-----------------+------+-------+
|  CRM_CUST_KEY   | rmse | count |
+-----------------+------+-------+
| Master-CM1138599 | 0.0 |   3   |
+-----------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (best)
+------------------------------+------+-------+
|           PRODUCT            | rmse | count |
+------------------------------+------+-------+
| 08201573|DISPOSABLE BITE G... | 0.0 |  165  |
+------------------------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (worst)
+------------------------------+------+-------+
|           PRODUCT            | rmse | count |
+------------------------------+------+-------+
| 08411053|MOUNT-ELLIPSE (NO... | 0.0 |   1   |
+------------------------------+------+-------+
[1 rows x 3 columns]

PROGRESS: Evaluate model Cosine Similarity on Purchase Dummy
recommendations finished on 1000/106191 queries. users per second: 23112.8
recommendations finished on 2000/106191 queries. users per second: 25804.1
recommendations finished on 3000/106191 queries. users per second: 25996.5
recommendations finished on 4000/106191 queries. users per second: 26414
recommendations finished on 5000/106191 queries. users per second: 26336
recommendations finished on 6000/106191 queries. users per second: 26615.9
recommendations finished on 7000/106191 queries. users per second: 27028.9
recommendations finished on 8000/106191 queries. users per second: 27108.2
recommendations finished on 9000/106191 queries. users per second: 27355.4
recommendations finished on 10000/106191 queries. users per second: 27341.4
recommendations finished on 11000/106191 queries. users per second: 27360.5
recommendations finished on 12000/106191 queries. users per second: 27475.9
recommendations finished on 13000/106191 queries. users per second: 27336.2
```

```
recommendations finished on 14000/106191 queries. users per second: 27337.4
recommendations finished on 15000/106191 queries. users per second: 27527.8
recommendations finished on 16000/106191 queries. users per second: 27531.5
recommendations finished on 17000/106191 queries. users per second: 27601.3
recommendations finished on 18000/106191 queries. users per second: 27543.3
recommendations finished on 19000/106191 queries. users per second: 27548.5
recommendations finished on 20000/106191 queries. users per second: 27632.8
recommendations finished on 21000/106191 queries. users per second: 27684.8
recommendations finished on 22000/106191 queries. users per second: 27568.8
recommendations finished on 23000/106191 queries. users per second: 27571.1
recommendations finished on 24000/106191 queries. users per second: 27613.5
recommendations finished on 25000/106191 queries. users per second: 27603.3
recommendations finished on 26000/106191 queries. users per second: 27674.6
recommendations finished on 27000/106191 queries. users per second: 27726.2
recommendations finished on 28000/106191 queries. users per second: 27739.9
recommendations finished on 29000/106191 queries. users per second: 27727.4
recommendations finished on 30000/106191 queries. users per second: 27797.6
recommendations finished on 31000/106191 queries. users per second: 27721.1
recommendations finished on 32000/106191 queries. users per second: 27687.6
recommendations finished on 33000/106191 queries. users per second: 27720.9
recommendations finished on 34000/106191 queries. users per second: 27689.1
recommendations finished on 35000/106191 queries. users per second: 27724.1
recommendations finished on 36000/106191 queries. users per second: 27714.3
recommendations finished on 37000/106191 queries. users per second: 27520.1
recommendations finished on 38000/106191 queries. users per second: 27571.9
recommendations finished on 39000/106191 queries. users per second: 27537.8
recommendations finished on 40000/106191 queries. users per second: 27505.8
recommendations finished on 41000/106191 queries. users per second: 27412.8
recommendations finished on 42000/106191 queries. users per second: 27361.7
recommendations finished on 43000/106191 queries. users per second: 27349
recommendations finished on 44000/106191 queries. users per second: 27281.6
recommendations finished on 45000/106191 queries. users per second: 27242.4
recommendations finished on 46000/106191 queries. users per second: 27078.9
recommendations finished on 47000/106191 queries. users per second: 26976
recommendations finished on 48000/106191 queries. users per second: 26838.7
recommendations finished on 49000/106191 queries. users per second: 26562.7
recommendations finished on 50000/106191 queries. users per second: 26460
recommendations finished on 51000/106191 queries. users per second: 26376.3
recommendations finished on 52000/106191 queries. users per second: 26261.5
recommendations finished on 53000/106191 queries. users per second: 26150.6
recommendations finished on 54000/106191 queries. users per second: 26070.4
recommendations finished on 55000/106191 queries. users per second: 26068.6
```

```
recommendations finished on 56000/106191 queries. users per second: 26007.3
recommendations finished on 57000/106191 queries. users per second: 25943.3
recommendations finished on 58000/106191 queries. users per second: 25852.4
recommendations finished on 59000/106191 queries. users per second: 25792.3
recommendations finished on 60000/106191 queries. users per second: 25719
recommendations finished on 61000/106191 queries. users per second: 25616.8
recommendations finished on 62000/106191 queries. users per second: 25554.6
recommendations finished on 63000/106191 queries. users per second: 25524.4
recommendations finished on 64000/106191 queries. users per second: 25491.9
recommendations finished on 65000/106191 queries. users per second: 25395.5
recommendations finished on 66000/106191 queries. users per second: 25384.9
recommendations finished on 67000/106191 queries. users per second: 25309.5
recommendations finished on 68000/106191 queries. users per second: 25238.7
recommendations finished on 69000/106191 queries. users per second: 25206.7
recommendations finished on 70000/106191 queries. users per second: 25157.8
recommendations finished on 71000/106191 queries. users per second: 25010.6
recommendations finished on 72000/106191 queries. users per second: 24918.6
recommendations finished on 73000/106191 queries. users per second: 24885.3
recommendations finished on 74000/106191 queries. users per second: 24703.8
recommendations finished on 75000/106191 queries. users per second: 24648
recommendations finished on 76000/106191 queries. users per second: 24598.4
recommendations finished on 77000/106191 queries. users per second: 24538.7
recommendations finished on 78000/106191 queries. users per second: 24516.1
recommendations finished on 79000/106191 queries. users per second: 24468.7
recommendations finished on 80000/106191 queries. users per second: 24418
recommendations finished on 81000/106191 queries. users per second: 24285.6
recommendations finished on 82000/106191 queries. users per second: 24264.6
recommendations finished on 83000/106191 queries. users per second: 24252.5
recommendations finished on 84000/106191 queries. users per second: 24225
recommendations finished on 85000/106191 queries. users per second: 24189
recommendations finished on 86000/106191 queries. users per second: 24166.4
recommendations finished on 87000/106191 queries. users per second: 24137.5
recommendations finished on 88000/106191 queries. users per second: 24104.3
recommendations finished on 89000/106191 queries. users per second: 24051.7
recommendations finished on 90000/106191 queries. users per second: 23997.2
recommendations finished on 91000/106191 queries. users per second: 23903.6
recommendations finished on 92000/106191 queries. users per second: 23836.7
recommendations finished on 93000/106191 queries. users per second: 23814.4
recommendations finished on 94000/106191 queries. users per second: 23775.5
recommendations finished on 95000/106191 queries. users per second: 23737.1
recommendations finished on 96000/106191 queries. users per second: 23710.4
recommendations finished on 97000/106191 queries. users per second: 23703
```

```
recommendations finished on 98000/106191 queries. users per second: 23663.8

recommendations finished on 99000/106191 queries. users per second: 23635

recommendations finished on 100000/106191 queries. users per second: 23603.6

recommendations finished on 101000/106191 queries. users per second: 23559.8

recommendations finished on 102000/106191 queries. users per second: 23508.8

recommendations finished on 103000/106191 queries. users per second: 23444.5

recommendations finished on 104000/106191 queries. users per second: 23323.1

recommendations finished on 105000/106191 queries. users per second: 23169.7

recommendations finished on 106000/106191 queries. users per second: 22994
```

```
Precision and recall summary statistics by cutoff
+--------+--------------------+--------------------+
| cutoff |   mean_precision   |    mean_recall     |
+--------+--------------------+--------------------+
|   1    | 0.13488902072680037 | 0.04773521547326018 |
|   2    | 0.10435912647964603 | 0.07057629240840006 |
|   3    | 0.08576998050682257 | 0.08434406094588112 |
|   4    | 0.07337721652494132 | 0.09450466451587974 |
|   5    | 0.06465142997052438 | 0.10260472224217154 |
|   6    | 0.05790038703844897 | 0.10920561523613649 |
|   7    | 0.05260736382017855 | 0.11468415496716702 |
|   8    | 0.04835861796197414 | 0.11975112371442972 |
|   9    | 0.04488662462502063 | 0.12434687945152417 |
|   10   | 0.04191880667853236 | 0.1284612816043999  |
+--------+--------------------+--------------------+
[10 rows x 3 columns]


Overall RMSE: 0.9604138869581377

Per User RMSE (best)
+-----------------+--------------------+-------+
|   CRM_CUST_KEY  |        rmse        | count |
+-----------------+--------------------+-------+
| Master-CM296828 | 0.08712905645370483 |   1   |
+-----------------+--------------------+-------+
[1 rows x 3 columns]


Per User RMSE (worst)
+-----------------+------+-------+
|   CRM_CUST_KEY  | rmse | count |
+-----------------+------+-------+
| Master-CM184618 | 1.0  |   1   |
+-----------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (best)
+-----------------------------+--------------------+-------+
|           PRODUCT           |        rmse        | count |
+-----------------------------+--------------------+-------+
| 06231254|premolar 2.5, pac... | 0.0994533254550054 |   1   |
+-----------------------------+--------------------+-------+
[1 rows x 3 columns]


Per Item RMSE (worst)
+-----------------------------+------+-------+
|           PRODUCT           | rmse | count |
+-----------------------------+------+-------+
```

```
        | 5082|SWIVEL, REPLACEMENT Q... | 1.0 |   4   |
        +-----------------------------+------+-------+
        [1 rows x 3 columns]

        PROGRESS: Evaluate model Pearson Similarity on Purchase Dummy
        recommendations finished on 1000/106191 queries. users per second: 21297.4

        recommendations finished on 2000/106191 queries. users per second: 24410.5

        recommendations finished on 3000/106191 queries. users per second: 25194

        recommendations finished on 4000/106191 queries. users per second: 25553.4

        recommendations finished on 5000/106191 queries. users per second: 25642.5

        recommendations finished on 6000/106191 queries. users per second: 24954.3

        recommendations finished on 7000/106191 queries. users per second: 24339.8

        recommendations finished on 8000/106191 queries. users per second: 23399.3

        recommendations finished on 9000/106191 queries. users per second: 22846.4

        recommendations finished on 10000/106191 queries. users per second: 22346.6

        recommendations finished on 11000/106191 queries. users per second: 21737.8

        recommendations finished on 12000/106191 queries. users per second: 21407.3

        recommendations finished on 13000/106191 queries. users per second: 21083

        recommendations finished on 14000/106191 queries. users per second: 20853.9

        recommendations finished on 15000/106191 queries. users per second: 20661.8

        recommendations finished on 16000/106191 queries. users per second: 20284.5

        recommendations finished on 17000/106191 queries. users per second: 20157

        recommendations finished on 18000/106191 queries. users per second: 20064.2

        recommendations finished on 19000/106191 queries. users per second: 19851

        recommendations finished on 20000/106191 queries. users per second: 19782

        recommendations finished on 21000/106191 queries. users per second: 19694.4

        recommendations finished on 22000/106191 queries. users per second: 19592.9

        recommendations finished on 23000/106191 queries. users per second: 19557.4

        recommendations finished on 24000/106191 queries. users per second: 19501.9

        recommendations finished on 25000/106191 queries. users per second: 19423.7

        recommendations finished on 26000/106191 queries. users per second: 19403.9

        recommendations finished on 27000/106191 queries. users per second: 19392.7

        recommendations finished on 28000/106191 queries. users per second: 19343.8

        recommendations finished on 29000/106191 queries. users per second: 19337.4

        recommendations finished on 30000/106191 queries. users per second: 19299

        recommendations finished on 31000/106191 queries. users per second: 19237.7

        recommendations finished on 32000/106191 queries. users per second: 19172.3

        recommendations finished on 33000/106191 queries. users per second: 19129.1

        recommendations finished on 34000/106191 queries. users per second: 18990.9

        recommendations finished on 35000/106191 queries. users per second: 18960.6

        recommendations finished on 36000/106191 queries. users per second: 18984.8

        recommendations finished on 37000/106191 queries. users per second: 18957.9

        recommendations finished on 38000/106191 queries. users per second: 18921.4

        recommendations finished on 39000/106191 queries. users per second: 18883.2
```

```
recommendations finished on 40000/106191 queries. users per second: 18809.3
recommendations finished on 41000/106191 queries. users per second: 18744.4
recommendations finished on 42000/106191 queries. users per second: 18721.1
recommendations finished on 43000/106191 queries. users per second: 18713
recommendations finished on 44000/106191 queries. users per second: 18695.7
recommendations finished on 45000/106191 queries. users per second: 18677.8
recommendations finished on 46000/106191 queries. users per second: 18674.4
recommendations finished on 47000/106191 queries. users per second: 18680.7
recommendations finished on 48000/106191 queries. users per second: 18675.7
recommendations finished on 49000/106191 queries. users per second: 18677.9
recommendations finished on 50000/106191 queries. users per second: 18626.7
recommendations finished on 51000/106191 queries. users per second: 18650.3
recommendations finished on 52000/106191 queries. users per second: 18591.5
recommendations finished on 53000/106191 queries. users per second: 18592.9
recommendations finished on 54000/106191 queries. users per second: 18595.1
recommendations finished on 55000/106191 queries. users per second: 18589
recommendations finished on 56000/106191 queries. users per second: 18595.7
recommendations finished on 57000/106191 queries. users per second: 18615.2
recommendations finished on 58000/106191 queries. users per second: 18597.5
recommendations finished on 59000/106191 queries. users per second: 18581.6
recommendations finished on 60000/106191 queries. users per second: 18589.2
recommendations finished on 61000/106191 queries. users per second: 18596.1
recommendations finished on 62000/106191 queries. users per second: 18615.8
recommendations finished on 63000/106191 queries. users per second: 18611.6
recommendations finished on 64000/106191 queries. users per second: 18580.4
recommendations finished on 65000/106191 queries. users per second: 18581.9
recommendations finished on 66000/106191 queries. users per second: 18606.1
recommendations finished on 67000/106191 queries. users per second: 18606.7
recommendations finished on 68000/106191 queries. users per second: 18607.3
recommendations finished on 69000/106191 queries. users per second: 18593.7
recommendations finished on 70000/106191 queries. users per second: 18550
recommendations finished on 71000/106191 queries. users per second: 18554.8
recommendations finished on 72000/106191 queries. users per second: 18551.1
recommendations finished on 73000/106191 queries. users per second: 18546.7
recommendations finished on 74000/106191 queries. users per second: 18529.5
recommendations finished on 75000/106191 queries. users per second: 18531.5
recommendations finished on 76000/106191 queries. users per second: 18521.9
recommendations finished on 77000/106191 queries. users per second: 18504.9
recommendations finished on 78000/106191 queries. users per second: 18507.7
recommendations finished on 79000/106191 queries. users per second: 18494.3
recommendations finished on 80000/106191 queries. users per second: 18460.1
recommendations finished on 81000/106191 queries. users per second: 18458.8
```

recommendations finished on 82000/106191 queries. users per second: 18471.5

recommendations finished on 83000/106191 queries. users per second: 18470.8

recommendations finished on 84000/106191 queries. users per second: 18459.6

recommendations finished on 85000/106191 queries. users per second: 18464.1

recommendations finished on 86000/106191 queries. users per second: 18474.9

recommendations finished on 87000/106191 queries. users per second: 18486.7

recommendations finished on 88000/106191 queries. users per second: 18456

recommendations finished on 89000/106191 queries. users per second: 18446.5

recommendations finished on 90000/106191 queries. users per second: 18452.2

recommendations finished on 91000/106191 queries. users per second: 18454.3

recommendations finished on 92000/106191 queries. users per second: 18446.4

recommendations finished on 93000/106191 queries. users per second: 18459.6

recommendations finished on 94000/106191 queries. users per second: 18431.8

recommendations finished on 95000/106191 queries. users per second: 18411.5

recommendations finished on 96000/106191 queries. users per second: 18360.5

recommendations finished on 97000/106191 queries. users per second: 18312.7

recommendations finished on 98000/106191 queries. users per second: 18274.6

recommendations finished on 99000/106191 queries. users per second: 18254.1

recommendations finished on 100000/106191 queries. users per second: 18237.4

recommendations finished on 101000/106191 queries. users per second: 18226.1

recommendations finished on 102000/106191 queries. users per second: 18213

recommendations finished on 103000/106191 queries. users per second: 18211.5

recommendations finished on 104000/106191 queries. users per second: 18200.3

recommendations finished on 105000/106191 queries. users per second: 18146

recommendations finished on 106000/106191 queries. users per second: 18064.1

```
Precision and recall summary statistics by cutoff
+--------+----------------------+-----------------------+
| cutoff |    mean_precision    |      mean_recall      |
+--------+----------------------+-----------------------+
|   1    | 1.883398781440979e-05 | 5.650196344322974e-06  |
|   2    | 9.416993907204895e-06 | 5.650196344322974e-06  |
|   3    | 6.277995938136548e-06 | 5.650196344322974e-06  |
|   4    | 9.416993907204913e-06 | 6.6166772979572106e-06 |
|   5    | 9.416993907204862e-06 | 1.1325174251559609e-05 |
|   6    | 7.847494922670722e-06 | 1.1325174251559609e-05 |
|   7    | 8.071709063318395e-06 | 1.2371506907915673e-05 |
|   8    | 1.5302615099208086e-05 | 2.979702225698425e-05  |
|   9    | 1.4648657188985473e-05 | 3.4505519210586156e-05 |
|   10   | 1.4125490860807305e-05 | 3.568264344898681e-05  |
+--------+----------------------+-----------------------+
[10 rows x 3 columns]


Overall RMSE: 1.0

Per User RMSE (best)
+-----------------+------+-------+
|   CRM_CUST_KEY  | rmse | count |
+-----------------+------+-------+
| Master-CM978491 | 1.0  |   1   |
+-----------------+------+-------+
```

```
[1 rows x 3 columns]


Per User RMSE (worst)
+------------------+------+-------+
|   CRM_CUST_KEY   | rmse | count |
+------------------+------+-------+
| Master-CM1138599 | 1.0  |   3   |
+------------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (best)
+------------------------------+------+-------+
|           PRODUCT            | rmse | count |
+------------------------------+------+-------+
| 08201573|DISPOSABLE BITE G... | 1.0  |  165  |
+------------------------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (worst)
+------------------------------+------+-------+
|           PRODUCT            | rmse | count |
+------------------------------+------+-------+
| 08411053|MOUNT-ELLIPSE (NO... | 1.0  |   1   |
+------------------------------+------+-------+
[1 rows x 3 columns]
```

Models on Normalized Purchase Frequency

In [63]: `evalNorm = tc.recommender.util.compare_models(testDataNorm, modelsWNormalization,model_n`

```
PROGRESS: Evaluate model Popularity Model on Scaled Purchase Counts
recommendations finished on 1000/18130 queries. users per second: 42324.5

recommendations finished on 2000/18130 queries. users per second: 51254.5

recommendations finished on 3000/18130 queries. users per second: 54647.8

recommendations finished on 4000/18130 queries. users per second: 56353.1

recommendations finished on 5000/18130 queries. users per second: 56821.4

recommendations finished on 6000/18130 queries. users per second: 56363.4

recommendations finished on 7000/18130 queries. users per second: 55844.5

recommendations finished on 8000/18130 queries. users per second: 55408.6

recommendations finished on 9000/18130 queries. users per second: 52539.1

recommendations finished on 10000/18130 queries. users per second: 51442.4

recommendations finished on 11000/18130 queries. users per second: 47756.7

recommendations finished on 12000/18130 queries. users per second: 48588.3

recommendations finished on 13000/18130 queries. users per second: 48373.2

recommendations finished on 14000/18130 queries. users per second: 48779

recommendations finished on 15000/18130 queries. users per second: 49318.4

recommendations finished on 16000/18130 queries. users per second: 49536.5

recommendations finished on 17000/18130 queries. users per second: 49075.4

recommendations finished on 18000/18130 queries. users per second: 47591.9

Precision and recall summary statistics by cutoff
+--------+---------------------+--------------------+
```

```
| cutoff |   mean_precision    |    mean_recall     |
+--------+---------------------+--------------------+
|   1    | 0.12482073910645448 | 0.05139155835781497 |
|   2    |  0.0993105350248208 |  0.078247199813744 |
|   3    | 0.08266225409082528 | 0.09600160320179227 |
|   4    | 0.07155267512410336 |  0.1088586854683452 |
|   5    | 0.06380584666299013 | 0.11994082406730659 |
|   6    | 0.057924250781393974 | 0.12925327312064316 |
|   7    | 0.053273973682137085 |  0.1375155212271436 |
|   8    | 0.049593215664644516 |  0.1449018991658424 |
|   9    |  0.0464730036158608 | 0.15279958336433047 |
|   10   |  0.0436624379481525 |  0.1583599027281388 |
+--------+---------------------+--------------------+
[10 rows x 3 columns]


Overall RMSE: 0.3343371205186998

Per User RMSE (best)
+----------------+------+-------+
|  CRM_CUST_KEY  | rmse | count |
+----------------+------+-------+
| Master-CM045979 | 0.0 |   1   |
+----------------+------+-------+
[1 rows x 3 columns]


Per User RMSE (worst)
+----------------+------+-------+
|  CRM_CUST_KEY  | rmse | count |
+----------------+------+-------+
| Master-CM093435 | 1.0 |   1   |
+----------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (best)
+------------------------------+------+-------+
|           PRODUCT            | rmse | count |
+------------------------------+------+-------+
| H50A-010|NTI Finishing Car... | 0.0 |   1   |
+------------------------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (worst)
+---------------------------+------+-------+
|          PRODUCT          | rmse | count |
+---------------------------+------+-------+
| 10017860|COUPLING BIEN-AIR | 1.0 |   1   |
+---------------------------+------+-------+
[1 rows x 3 columns]

PROGRESS: Evaluate model Cosine Similarity on Scaled Purchase Counts
recommendations finished on 1000/18130 queries. users per second: 52651
recommendations finished on 2000/18130 queries. users per second: 56439.8
recommendations finished on 3000/18130 queries. users per second: 56964.9
recommendations finished on 4000/18130 queries. users per second: 56346
recommendations finished on 5000/18130 queries. users per second: 55573.5
recommendations finished on 6000/18130 queries. users per second: 52198
recommendations finished on 7000/18130 queries. users per second: 51141.9
```

```
recommendations finished on 8000/18130 queries. users per second: 49977.2

recommendations finished on 9000/18130 queries. users per second: 49411.5

recommendations finished on 10000/18130 queries. users per second: 49132.1

recommendations finished on 11000/18130 queries. users per second: 45563.7

recommendations finished on 12000/18130 queries. users per second: 45729.6

recommendations finished on 13000/18130 queries. users per second: 45691.8

recommendations finished on 14000/18130 queries. users per second: 45125.9

recommendations finished on 15000/18130 queries. users per second: 45338.6

recommendations finished on 16000/18130 queries. users per second: 45276.3

recommendations finished on 17000/18130 queries. users per second: 45492

recommendations finished on 18000/18130 queries. users per second: 44637.2
```

```
Precision and recall summary statistics by cutoff
+--------+---------------------+--------------------+
| cutoff |   mean_precision    |    mean_recall     |
+--------+---------------------+--------------------+
|   1    | 0.12482073910645411 | 0.05118844376694547 |
|   2    | 0.09914506343077743 |  0.0779260326075068 |
|   3    | 0.08238646810075376 | 0.09567156475950876 |
|   4    | 0.07126309983452878 | 0.10854486857558104 |
|   5    | 0.06348593491450631 | 0.11947940110588377 |
|   6    | 0.05766685052399306 | 0.12894267883045732 |
|   7    | 0.05302182649121425 | 0.13719569636918807 |
|   8    | 0.04937258687258683 | 0.14439809769802364 |
|   9    | 0.04617270331556059 | 0.15172566229309467 |
|  10    | 0.043381136238279175 | 0.15726700584442488 |
+--------+---------------------+--------------------+
[10 rows x 3 columns]


Overall RMSE: 0.33433353643365915

Per User RMSE (best)
+----------------+------+-------+
|  CRM_CUST_KEY  | rmse | count |
+----------------+------+-------+
| Master-CM045979 | 0.0  |   1   |
+----------------+------+-------+
[1 rows x 3 columns]


Per User RMSE (worst)
+----------------+------+-------+
|  CRM_CUST_KEY  | rmse | count |
+----------------+------+-------+
| Master-CM093435 | 1.0  |   1   |
+----------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (best)
+------------------------------+------+-------+
|           PRODUCT            | rmse | count |
+------------------------------+------+-------+
| H50A-010|NTI Finishing Car... | 0.0  |   1   |
+------------------------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (worst)
```

```
+----------------------------+------+-------+
|           PRODUCT          | rmse | count |
+----------------------------+------+-------+
| 10017860|COUPLING BIEN-AIR | 1.0  |   1   |
+----------------------------+------+-------+
[1 rows x 3 columns]
```

PROGRESS: Evaluate model Pearson Similarity on Scaled Purchase Counts

recommendations finished on 1000/18130 queries. users per second: 49875.3

recommendations finished on 2000/18130 queries. users per second: 53287.9

recommendations finished on 3000/18130 queries. users per second: 54949.1

recommendations finished on 4000/18130 queries. users per second: 55246.3

recommendations finished on 5000/18130 queries. users per second: 53485.1

recommendations finished on 6000/18130 queries. users per second: 51661.3

recommendations finished on 7000/18130 queries. users per second: 51936.9

recommendations finished on 8000/18130 queries. users per second: 51858.8

recommendations finished on 9000/18130 queries. users per second: 52209.9

recommendations finished on 10000/18130 queries. users per second: 52780.2

recommendations finished on 11000/18130 queries. users per second: 52596.8

recommendations finished on 12000/18130 queries. users per second: 52652.8

recommendations finished on 13000/18130 queries. users per second: 52814.8

recommendations finished on 14000/18130 queries. users per second: 53005.2

recommendations finished on 15000/18130 queries. users per second: 53040.6

recommendations finished on 16000/18130 queries. users per second: 53289.1

recommendations finished on 17000/18130 queries. users per second: 53396.2

recommendations finished on 18000/18130 queries. users per second: 52425.4

```
 Precision and recall summary statistics by cutoff
+--------+-----------------------+------------------------+
| cutoff |    mean_precision     |      mean_recall       |
+--------+-----------------------+------------------------+
|   1    |          0.0          |          0.0           |
|   2    | 5.515719801434054e-05 | 8.273579702151091e-05  |
|   3    | 3.677146534289374e-05 | 8.273579702151091e-05  |
|   4    | 2.757859900717027e-05 | 8.273579702151091e-05  |
|   5    | 4.412575841147293e-05 | 0.00011819399574501627 |
|   6    | 4.5964331678617184e-05| 0.0001319832952486009  |
|   7    | 3.9397998581672066e-05| 0.0001319832952486009  |
|   8    | 4.826254826254844e-05 | 0.0002055262259343883  |
|   9    | 5.515719801434048e-05 | 0.0002606834239487309  |
|   10   | 6.0672917815774666e-05|  0.000292504884341619  |
+--------+-----------------------+------------------------+
[10 rows x 3 columns]
```


Overall RMSE: 0.1849699805664271

Per User RMSE (best)
```
+-----------------+------+-------+
|   CRM_CUST_KEY  | rmse | count |
+-----------------+------+-------+
| Master-CM057826 | 0.0  |   2   |
+-----------------+------+-------+
[1 rows x 3 columns]
```

```
Per User RMSE (worst)
+-----------------+------+-------+
|   CRM_CUST_KEY  | rmse | count |
+-----------------+------+-------+
| Master-CM074018 | 1.0  |   1   |
+-----------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (best)
+-----------------------------+------+-------+
|           PRODUCT           | rmse | count |
+-----------------------------+------+-------+
| 08422948|TRY:TRAY MULTI-PO... | 0.0  |   1   |
+-----------------------------+------+-------+
[1 rows x 3 columns]


Per Item RMSE (worst)
+-----------------------------+------+-------+
|           PRODUCT           | rmse | count |
+-----------------------------+------+-------+
| 29856|REFILL - UNID  XRVD ... | 1.0  |   1   |
+-----------------------------+------+-------+
[1 rows x 3 columns]
```

9. Model Selection

In [ ]:

Final Output

In [74]:
```
userID
itemID
#purchaseDummy
dataDummy
#print(usersToRecommend)
```

Out[74]: `'CRM_CUST_KEY'`

Out[74]: `'PRODUCT'`

Out[74]:

	CRM_CUST_KEY	PRODUCT	IVC_QTY	purchaseDummy
288290	Master-CM045451	P1932-3|AXIS Pink DiaGloss - RA	1.0	1
296292	Master-CM045451	P19032-3|AXIS White DiaGloss - RA	1.0	1
1255175	Master-CM045452	33872|REFILL- MAXCEM ELITE CLEAR	1.0	1
1006795	Master-CM045452	33872|REFILL- MAXCEM ELITE CLEAR	1.0	1
1299216	Master-CM045452	00370|TEMP BOND STANDARD PACKAGE	1.0	1
...	...	...	...	...
1661910	Master-CM999916	089-0384|Zone Large Dual Barrel Syringe Kit, P...	1.0	1
1667177	Master-CM999949	815-1412|No.2 ROUND CARBIDE BUR 5 PK	5.0	1
1667178	Master-CM999949	815-1414|No. 4 ROUND CARBIDE BUR 5 PK	5.0	1

| 1667179 | Master-CM999949 | 815-1416\|No.6 ROUND CARBIDE BUR 5 PK | 5.0 | 1 |
| 1667176 | Master-CM999949 | 22936\|PATHFINDER CS 21MM SZ K1 BROWN PK6 | 1.0 | 1 |

2262441 rows × 4 columns

In [76]:
```
who
```

```
InteractiveShell          cos        cosDummy        cosNormalized      createDataDummy
d          dataDummy        dfMatrixNorm      dfNorm
dfRecMatrix      dfRec_     evalCounts        evalDummy        evalNorm        itemID   item_id
        kPear      kPearDummy
kPearNomralization        model      modelsWNormalization      modelsWcounts      modelsWdummy
nDisplay          nRec      name        names_w_counts
names_w_dummy      names_w_norm      normalizeData    np        pd        popularityDummy
popularityModel  popularityNormalized      popularityRecommend
splitData        target  tc        test      testData        testDataDummy      testDataNorm
train      trainData
trainDataDummy    trainDataNorm    train_test_split        userID   user_id        usersTo
Recommend
```

In [89]:
```
UsersToRecommend = list(dfRec[user_id])

finalModel = tc.item_similarity_recommender.create(tc.SFrame(dataDummy),
                                                    user_id=userID,
                                                    item_id=itemID,
                                                    target='purchaseDummy',
                                                    similarity_type='cosine')
recom = finalModel.recommend(users=usersToRecommend,k=nRec)
recom.print_rows(nDisplay)
```

Warning: Ignoring columns IVC_QTY;

    To use these columns in scoring predictions, use a model that allows the use of add
itional features.

Preparing data set.

    Data has 2262441 observations with 149170 users and 11420 items.

    Data prepared in: 1.29949s

Training model from provided data.

Gathering per-item and per-user statistics.

+-------------------------------+------------+
| Elapsed Time (Item Statistics) | % Complete |
+-------------------------------+------------+
| 1.299ms | 0.5 |
| 42.738ms | 100 |
+-------------------------------+------------+

Setting up lookup tables.

Processing data in one pass using dense lookup tables.

+------------------------------------+-----------------+-----------------+
| Elapsed Time (Constructing Lookups) | Total % Complete | Items Processed |
+------------------------------------+-----------------+-----------------+
| 812.288ms | 0 | 0 |
| 1.35s | 100 | 11420 |
+------------------------------------+-----------------+-----------------+

```
Finalizing lookup tables.
Generating candidate set for working with new users.
Finished training in 1.4224s
recommendations finished on 1000/26227 queries. users per second: 40671.9
recommendations finished on 2000/26227 queries. users per second: 40316.9
recommendations finished on 3000/26227 queries. users per second: 39815.8
recommendations finished on 4000/26227 queries. users per second: 39771.3
recommendations finished on 5000/26227 queries. users per second: 38820.8
recommendations finished on 6000/26227 queries. users per second: 38876
recommendations finished on 7000/26227 queries. users per second: 39080.8
recommendations finished on 8000/26227 queries. users per second: 38646
recommendations finished on 9000/26227 queries. users per second: 38764.5
recommendations finished on 10000/26227 queries. users per second: 38760.7
recommendations finished on 11000/26227 queries. users per second: 38757.8
recommendations finished on 12000/26227 queries. users per second: 38788.8
recommendations finished on 13000/26227 queries. users per second: 38874.1
recommendations finished on 14000/26227 queries. users per second: 38240.4
recommendations finished on 15000/26227 queries. users per second: 38017.2
recommendations finished on 16000/26227 queries. users per second: 38153.7
recommendations finished on 17000/26227 queries. users per second: 38111.9
recommendations finished on 18000/26227 queries. users per second: 37732.6
recommendations finished on 19000/26227 queries. users per second: 37362
recommendations finished on 20000/26227 queries. users per second: 37349.4
recommendations finished on 21000/26227 queries. users per second: 37107.7
recommendations finished on 22000/26227 queries. users per second: 36882.3
recommendations finished on 23000/26227 queries. users per second: 36383.3
recommendations finished on 24000/26227 queries. users per second: 35927.2
recommendations finished on 25000/26227 queries. users per second: 35335.7
recommendations finished on 26000/26227 queries. users per second: 33430.5
```

CRM_CUST_KEY	PRODUCT	score	rank
Master-CM045451	P1935-3|AXIS Pink DiaGloss...	0.23660516738891602	1
Master-CM045451	P19035-3|AXIS White DiaGlo...	0.21700653433799744	2
Master-CM045451	P1938-3|AXIS Pink DiaGloss...	0.17781558632850647	3
Master-CM045451	P19038-3|AXIS White DiaGlo...	0.1307530701160431	4
Master-CM045451	P19033-3|AXIS White DiaGlo...	0.11993256211280823	5
Master-CM045451	P1933-3|AXIS Pink DiaGloss...	0.1113947331905365	6
Master-CM045451	32430|EXPA-SYL CAPSULE 20P...	0.04949462413787842	7
Master-CM045451	10025988|spare part knee s...	0.047036051750183105	8
Master-CM045451	P1953-3|AXIS Pink DiaGloss...	0.04694181680679321	9
Master-CM045451	P19053-3|AXIS White DiaGlo...	0.040101468563079834	10
Master-CM045452	35266|REFILL - OPTIBOND FL...	0.08090128681876442	1
Master-CM045452	33351|KIT- TEMPBOND CLEAR ...	0.0582443963397633	2
Master-CM045452	10054524|QUATTROcare plus ...	0.04975143345919522	3
Master-CM045452	33879|REFILL - AUTOMIX TIP...	0.04425668174570257	4
Master-CM045452	33361|REFILL - TEMPBOND MI...	0.03895004229112105	5
Master-CM045452	34418|KIT - MAXCEM ELITE BULK	0.03659071163697676	6
Master-CM045452	36712|Refill - SonicFill 3 A2	0.0320213491266424	7

```
| Master-CM045452 | 04119660|CRTN. KaVo Spray ... | 0.031248607418753883 |  8   |
| Master-CM045452 | 32862|REFILL - MAXCEM MIXI... | 0.03099656105041504  |  9   |
| Master-CM045452 | 10073049|Dexis Posterior H... | 0.030005238272927025 |  10  |
| Master-CM045453 | 08455707|SET RPLCMNT LIGHT... | 0.07046902179718018  |  1   |
| Master-CM045453 |  08458720|PLATE LABEL VENTED  | 0.0689550757408142   |  2   |
| Master-CM045453 | 32862|REFILL - MAXCEM MIXI... | 0.0659328818321228   |  3   |
| Master-CM045453 | 08451205|NAMEPLATE DCIE LI... | 0.061444008350372316 |  4   |
| Master-CM045453 |  08453075|PIN SHIELD RELEASE | 0.05889936685562134  |  5   |
| Master-CM045453 | 08451228|RING RETAINING EX... | 0.056077849864959714 |  6   |
| Master-CM045453 | 08451224|SPRING COMPRESSIO... | 0.051932120323181154 |  7   |
| Master-CM045453 | 33879|REFILL - AUTOMIX TIP... | 0.04691469669342041  |  8   |
| Master-CM045453 | 33872|REFILL- MAXCEM ELITE... | 0.04017130136489868  |  9   |
| Master-CM045453 | 33351|KIT- TEMPBOND CLEAR ... | 0.0360684871673584   |  10  |
+----------------+---------------------------+---------------------+------+
[262270 rows x 4 columns]
```

In [90]:
```python
# send to CSV
dfRecCSV = recom.to_dataframe()
dfRecCSV.shape
dfRecCSV.head()
dfRecCSV.to_csv('FinalOutput.csv')
```

Out[90]: (262270, 4)

Out[90]:

	CRM_CUST_KEY	PRODUCT	score	rank
0	Master-CM045451	P1935-3|AXIS Pink DiaGloss - RA	0.236605	1
1	Master-CM045451	P19035-3|AXIS White DiaGloss - RA	0.217007	2
2	Master-CM045451	P1938-3|AXIS Pink DiaGloss - RA	0.177816	3
3	Master-CM045451	P19038-3|AXIS White DiaGloss - RA	0.130753	4
4	Master-CM045451	P19033-3|AXIS White DiaGloss - RA	0.119933	5

In [ ]: