Problem-2

April 21, 2017

1 PART 1 - Loading & Pre Processing

1.0.1 Platforms: Shell Scripting, Python 3

Steps: *All of this can be automated using wget command, but due to NDA, the data cannot be put on public Github repository and as such cannot utilize wget. 1. Visit www.datanotebook.org (Password: simplex) 2. On the upper right corner, select 'Upload' to upload 'Problem-2.ipynb' + all accompanying csv files. 3. Double click on Problem-2.ipynb to start notebook 4. On the toggle bar, select Run > Run All

```
 * Load some python visualization libraries
 * Run 'csvstat' - to get descriptive stats of each file + observe any missing or N
```

```
In [1]: from bokeh.plotting import figure, show, output_file
        from bokeh.io import push_notebook, show, output_notebook
        from bokeh.plotting import figure
        from bokeh.charts import Bar
        output_notebook()
```

```
In [2]: !csvstat dim_acct.csv
```

```
  1. ACCT_ID
        <class 'int'>
        Nulls: False
        Min: 112110616977376
        Max: 4611679791824819900
        Sum: 22730670545637110906347
        Mean: 2.2953317727594778e+18
        Median: 2316664370354537529
        Standard Deviation: 1.333126148041693e+18
        Unique values: 9903
  2. COUNTRY_CODE
        <class 'str'>
        Nulls: False
        Unique values: 11
        5 most frequent values:
                US:        8010
                CA:        1254
```

```
                BR:         335
                MX:         131
                AR:         87
        Max length: 2
  3. LANGUAGE_CODE
        <class 'str'>
        Nulls: False
        Values: es, fr, en, pt
  4. OPT_IN_FLAG
        <class 'int'>
        Nulls: False
        Values: 0, 1

Row count: 9903


In [3]: !csvstat dim_product.csv

  1. sku
        <class 'int'>
        Nulls: False
        Min: 24996
        Max: 76813
        Sum: 47339896
        Mean: 63886.49932523617
        Median: 63589
        Standard Deviation: 8827.863736954238
        Unique values: 709
        5 most frequent values:
                73404:        3
                56032:        2
                59574:        2
                73827:        2
                73690:        2
  2. game_name
        <class 'str'>
        Nulls: False
        Values: Fifa 15, Fifa 16, Destiny

Row count: 741


In [4]: !csvstat fct_transaction.csv

  1. ACCT_ID
        <class 'int'>
        Nulls: False
        Min: 112110616977376
        Max: 4611679791824819900
```

```
      Sum: 22832397974228024195145
      Mean: 2.2958670662873833e+18
      Median: 2318601711805822924
      Standard Deviation: 1.3333984314874568e+18
      Unique values: 9903
      5 most frequent values:
              897924179274989253:        2
              3974400860039657607:        2
              3302592783285312504:        2
              2316930479434432568:        2
              603030439962872616:        2
2. TRANSACTION_TIMESTAMP
      <class 'datetime.datetime'>
      Nulls: False
      Min: 2015-10-18 00:00:00
      Max: 2015-11-16 16:24:00
      Unique values: 8469
      5 most frequent values:
              2015-10-18 00:00:00:        6
              2015-10-18 00:50:00:        4
              2015-11-16 01:30:00:        4
              2015-11-06 01:53:00:        4
              2015-10-29 20:54:00:        4
3. TRANSACTION_VALUE
      <class 'float'>
      Nulls: False
      Min: 0.36567
      Max: 149.99
      Sum: 189099.6233399983
      Mean: 19.01454231674191
      Median: 9.99
      Standard Deviation: 22.599633708954638
      Unique values: 385
      5 most frequent values:
              9.99:        1122
              1.99:        990
              19.99:        951
              59.99:        742
              4.99:        731
4. SKU
      <class 'int'>
      Nulls: False
      Min: 21
      Max: 77067
      Sum: 598997067
      Mean: 60230.977073906484
      Median: 69549
      Standard Deviation: 20198.105056513952
```

```
        Unique values: 1741
        5 most frequent values:
                35589:        413
                35514:        379
                74475:        301
                35590:        299
                73123:        256

Row count: 9945
```

2 PART 2 - Creating Db (using PostgreSQL)

2.0.2 Platforms: PostgreSQL, Python 3

Steps:

```
1. Load SQL to Kernel and create a localhost postgresql server
   -Any server can be used (mySQL, sqlite, etc.)
   -I personally prefer PostgreSQL due to its object oriented structure
2. Create TABLES and populate with respective csv files
3. Run sanity check to see if all data has loaded appropriately onto the local serv
```

```
In [5]: %load_ext sql
```

```
/opt/conda/lib/python3.5/site-packages/IPython/config.py:13: ShimWarning: The `IPyt
  "You should import from traitlets.config instead.", ShimWarning)
/opt/conda/lib/python3.5/site-packages/IPython/utils/traitlets.py:5: UserWarning: I
  warn("IPython.utils.traitlets has moved to a top-level traitlets package.")
```

```
In [6]: !echo 'redspot' | sudo -S service postgresql restart
```

```
[sudo] password for jovyan: Restarting PostgreSQL 9.5 database server: main.
```

```
In [7]: !createdb -U dbuser CRM
```

```
In [8]: %sql postgresql://dbuser@localhost:5432/CRM
```

```
Out[8]: 'Connected: dbuser@CRM'
```

2.1 2a. Account TABLE

```
In [9]: %%sql
        DROP TABLE IF EXISTS account;
        CREATE TABLE account (
            ACCT_ID FLOAT,
            COUNTRY_CODE VARCHAR(2),
```

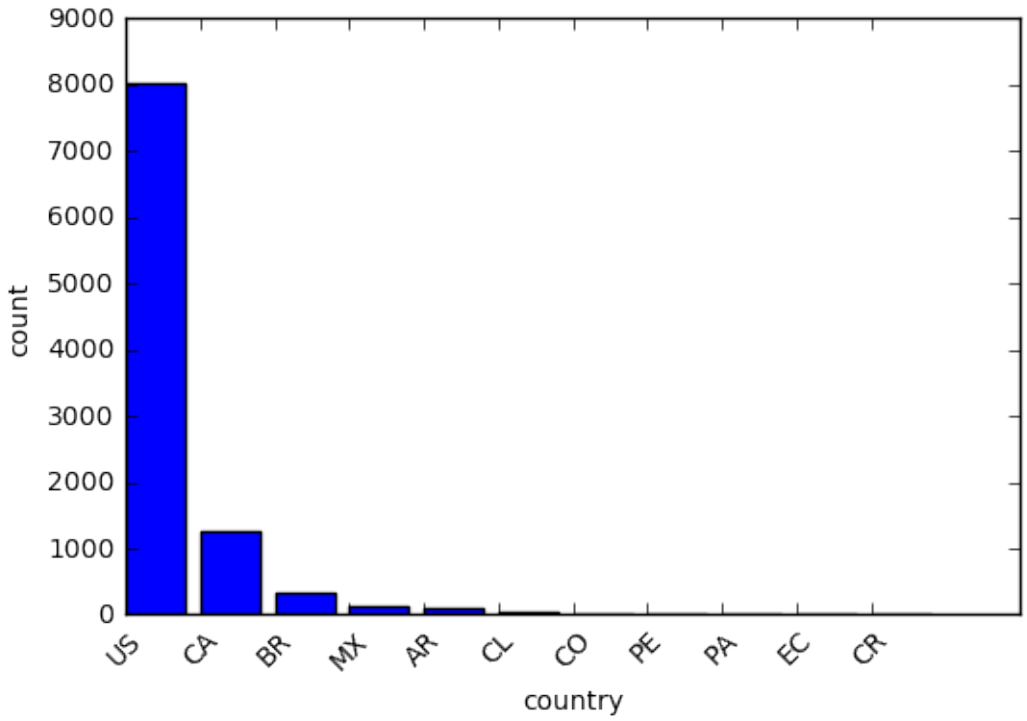
```
            LANGUAGE_CODE VARCHAR(2),
            OPT_IN_FLAG INT,
            PRIMARY KEY (ACCT_ID)
            )

Done.
Done.


Out[9]: []

In [10]: !pwd

/home/jovyan/work


In [11]: %%sql
         COPY account FROM '/home/jovyan/work/dim_acct.csv'
         CSV
         HEADER
         QUOTE '"'
         DELIMITER ',';

9903 rows affected.


Out[11]: []

In [12]: %%sql
         SELECT count(account.ACCT_ID) FROM account;

1 rows affected.


Out[12]: [(9903,)]

In [13]: %%sql
         SELECT COUNT(DISTINCT(ACCT_ID)) from account

1 rows affected.


Out[13]: [(9903,)]
```

Sanity Check:

The DISTINCT query is to check if all account_id's are unique. Since that is the case, we can safely use that as the PRIMARY KEY. If such wasn't the case, we would have gotten an error during table initialization also. However, this is a good sanity check

Basic data exploration: Let's see where most of our customers are located, what language they speak and whether they have opted-in to receive marketing offers.

```
In [14]: %%sql
         SELECT COUNTRY_CODE as Country, COUNT(COUNTRY_CODE) as Count
         FROM account
         GROUP BY Country
         ORDER BY count DESC;

11 rows affected.


Out[14]: [('US', 8010),
          ('CA', 1254),
          ('BR', 335),
          ('MX', 131),
          ('AR', 87),
          ('CL', 51),
          ('CO', 14),
          ('PE', 12),
          ('PA', 4),
          ('EC', 3),
          ('CR', 2)]

In [15]: from pandas import DataFrame
         import matplotlib
         %matplotlib inline

         q1_results = _
         q1_results.bar()
         !echo 'Account Distribution by Country'

/opt/conda/lib/python3.5/site-packages/matplotlib/font_manager.py:273: UserWarning:
  warnings.warn('Matplotlib is building the font cache using fc-list. This may take
/opt/conda/lib/python3.5/site-packages/matplotlib/font_manager.py:273: UserWarning:
  warnings.warn('Matplotlib is building the font cache using fc-list. This may take


Account Distribution by Country
```



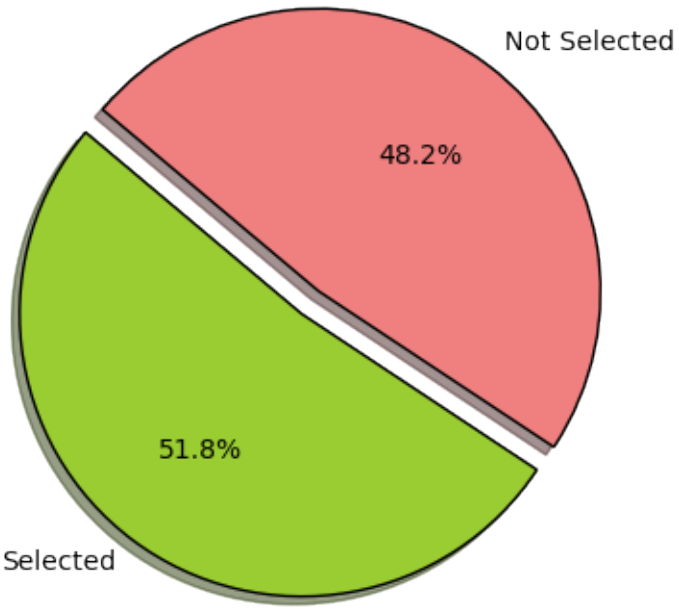
So most of our customer base in the US

```
In [16]: %%sql
         SELECT LANGUAGE_CODE as Language, COUNT(LANGUAGE_CODE) as Count
         FROM account
         WHERE COUNTRY_CODE = 'US'
         GROUP BY Language
         ORDER BY count DESC;

1 rows affected.


Out[16]: [('en', 8010)]
```

And NOT surprisingly they all speak English

```
In [17]: %%sql
         SELECT OPT_IN_FLAG as OptIn, COUNT(OPT_IN_FLAG) as Count
         FROM account
         WHERE COUNTRY_CODE = 'US'
         AND LANGUAGE_CODE = 'en'
         GROUP BY OptIn
         ORDER BY count DESC;

2 rows affected.
```

```
Out[17]: [(1, 4150), (0, 3860)]

In [18]: q2= _
         df=q2.DataFrame()

         import matplotlib.pyplot as plt

         # Data to plot
         labels = 'Selected', 'Not Selected'
         sizes = df['count']
         colors = ['yellowgreen', 'lightcoral']
         explode = (0.1, 0)  # explode 1st slice

         # Plot
         plt.pie(sizes, explode=explode, labels=labels, colors=colors,
                 autopct='%1.1f%%', shadow=True, startangle=140)

         plt.axis('equal')
         plt.show()
```



And about half of our customers have chosen the option of 'Opt-in' marketing. Assumption: The sample data in accounts in representative of actual population

```
In [19]: %%sql
         SELECT COUNT(DISTINCT(ACCT_ID))
         FROM account
         WHERE COUNTRY_CODE = 'US'
```

```
        AND LANGUAGE_CODE = 'en'
        AND OPT_IN_FLAG = 1;
```

```
1 rows affected.
```

```
Out[19]: [(4150,)]
```

This is the number of accounts that follow the baseline criteria that is requested

2.2 2b. Product TABLE

```
In [20]: %%sql
         DROP TABLE IF EXISTS product;
         CREATE TABLE product (
             SKU INT,
             GAME_NAME VARCHAR(10)
             )
```

```
Done.
Done.
```

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

```
In [21]: %%sql
         COPY product FROM '/home/jovyan/work/dim_product.csv'
         CSV
         HEADER
         QUOTE '"'
         DELIMITER ',';
```

```
741 rows affected.
```

```
Out[21]: []
```

```
In [22]: %%sql
         SELECT count(product.SKU) FROM product;
```

```
1 rows affected.
```

```
Out[22]: [(741,)]
```

```
In [23]: %%sql
         SELECT COUNT(DISTINCT(SKU)) from product
```

```
1 rows affected.
```

```
Out[23]: [(709,)]
```

Clrearly not all SKU's are unique and as such cannot be used as a PRIMARY KEY. *Assumption: Here my role is to do a query and not change the table structre. I would communicate this to the Data Engineer / ETL engineer, to have them add a serial unique identifier to the product table. In this particular case, the fact table is already pre-populated but were it not we would need to populate using Primary and Foreign Keys.

```
In [24]: %%sql
         SELECT *
         FROM product
         LIMIT 5;

5 rows affected.


Out[24]: [(55813, 'Fifa 15'),
          (58624, 'Fifa 15'),
          (59574, 'Destiny'),
          (63145, 'Destiny'),
          (68179, 'Destiny')]

In [25]: %%sql
         SELECT GAME_NAME, COUNT(GAME_NAME) as Count
         FROM product
         GROUP BY GAME_NAME
         ORDER BY Count DESC;

3 rows affected.


Out[25]: [('Destiny', 402), ('Fifa 15', 235), ('Fifa 16', 104)]

In [26]: result= _
         df=result.DataFrame()

         p = Bar(df, label='game_name', values='count',
                 title="Game Sales Distribution", legend = False, width=400, height
         show(p)

Out[26]: <bokeh.io._CommsHandle at 0x7f4241042828>
```

Clearly Destiny is the winner here. Although, my initial hunch was FIFA would be leading the charts; perhaps I'm biased!

2.3 2c. Transaction TABLE

```
In [27]: %%sql
         DROP TABLE IF EXISTS transaction_fct;
         CREATE TABLE transaction_fct (
             ACCT_ID FLOAT,
```

```
            TIME_STAMP TIMESTAMP,
            TRANSACTION_VALUE FLOAT,
            SKU INT
            )
```

```
Done.
Done.
```

```
Out[27]: []
```

```
In [28]: %%sql
         COPY transaction_fct FROM '/home/jovyan/work/fct_transaction.csv'
         CSV
         HEADER
         QUOTE '"'
         DELIMITER ',';
```

```
9945 rows affected.
```

```
Out[28]: []
```

```
In [29]: %%sql
         SELECT COUNT(*) from transaction_fct;
```

```
1 rows affected.
```

```
Out[29]: [(9945,)]
```

```
In [30]: %%sql
         SELECT COUNT(DISTINCT(ACCT_ID)) from transaction_fct;
```

```
1 rows affected.
```

```
Out[30]: [(9903,)]
```

So we have 9945 transactions in this sample. But recall that we only have 9903 unique account_id's. Which means, some accounts have more than one transaction.

```
In [31]: %%sql
         SELECT * from transaction_fct
         LIMIT 5;
```

```
5 rows affected.
```

```
Out[31]: [(2.08792477285357e+18, datetime.datetime(2015, 10, 19, 1, 52), 1.99, 6468
          (4.58339593175159e+18, datetime.datetime(2015, 10, 18, 23, 40), 4.19024,
          (2.64588535429658e+18, datetime.datetime(2015, 10, 28, 4, 47), 1.99, 7463
          (2.04508480427123e+18, datetime.datetime(2015, 10, 31, 22, 53), 19.99, 74
          (1.54692428793931e+18, datetime.datetime(2015, 11, 3, 19, 21), 19.99, 589
```

Let's do a breakdown of Sales, aggregated by month:

```
In [32]: %%sql
         SELECT
             date_trunc('month', time_stamp) as month,
             FLOOR(SUM(TRANSACTION_VALUE)) as Revenue
         from transaction_fct
         GROUP BY month
         ORDER BY month ASC;

2 rows affected.


Out[32]: [(datetime.datetime(2015, 10, 1, 0, 0), 77692.0),
          (datetime.datetime(2015, 11, 1, 0, 0), 111407.0)]

In [33]: q4= _
         df=q4.DataFrame()

         import pandas as pd

         df['Labels'] = ['October', 'November']

         p = Bar(df, label='Labels', values='revenue',
                 title="Total Monthly Sales Distribution", legend = False, width=50
         show(p)

Out[33]: <bokeh.io._CommsHandle at 0x7f423f366358>
```

3 Part 3: Final Query

3.0.1 Platforms: PostgreSQL, Python 3

FINAL QUERY: "AND" vs. "NESTED QUERY"

- **And**: In this case, where we have a small sample data, the 'AND' command works well with INNER JOINS on the entire tables. However, JOINS always cost processing power and we may often be dealing with 'Big-Data'. For such instances, performing a JOIN on the whole table would be unwise and require more than neccessary processing power
- **Nested Query:** This is much more efficient in terms of processing power. Using nested query structure, we can only join the pre-filtered table. For example, instead of joining the entire ACCOUNT TABLE to TRANSACTION table, we can only join the accoounts which fit the baseline criteria. That way the processor deals only with what is neccessary.

** The AND Structure**: Inefficient for Big-data

```
In [34]: %%sql
         SELECT DISTINCT(transaction_fct.ACCT_ID)
         FROM transaction_fct
```

```
          INNER JOIN account ON transaction_fct.ACCT_ID = account.ACCT_ID
          INNER JOIN product ON transaction_fct.SKU = product.SKU
          WHERE COUNTRY_CODE = 'US'
          AND LANGUAGE_CODE = 'en'
          AND OPT_IN_FLAG = 1
          AND GAME_NAME = 'Destiny'
          AND TRANSACTION_VALUE >= 40
          AND EXTRACT(MONTH FROM transaction_fct.TIME_STAMP) = 10;
```

```
41 rows affected.
```

```
Out[34]: [(8.73549407001291e+17,),
          (4.84156930539824e+17,),
          (4.10324015967931e+17,),
          (2.93454984205782e+18,),
          (3.88987255340883e+18,),
          (4.2587074691973e+18,),
          (1.14943101197984e+18,),
          (3.13533498366877e+18,),
          (1.70042680937506e+18,),
          (2.8224207565406e+18,),
          (4.43027921003096e+18,),
          (2.85738299498462e+17,),
          (4.0600501012741e+18,),
          (1.52275518729664e+18,),
          (6.19727474748374e+17,),
          (2.79041747260156e+18,),
          (2.3121377836969e+18,),
          (3.00610139056554e+18,),
          (1.10825865438648e+18,),
          (2.79686346456339e+18,),
          (1.86491691186808e+18,),
          (3.82267836203756e+18,),
          (1.60746167241603e+18,),
          (4.49223853061593e+18,),
          (2.53830636358851e+18,),
          (8.08635496132221e+17,),
          (1.04409882563959e+18,),
          (2.97415212552033e+18,),
          (4.35460981397881e+18,),
          (3.393782123067e+18,),
          (1.46343691806454e+18,),
          (2.33297264010803e+18,),
          (2.08048489208458e+17,),
          (5.73774350803868e+17,),
          (1.91379585224953e+18,),
          (2.84484022874967e+18,),
```

```
(7.79830521881711e+17,),
(3.47421748230121e+18,),
(8.62068587972456e+17,),
(3.26731043298497e+18,),
(6.25879160959013e+17,)]
```

The NESTED QUERY Structure: Efficient

How does this work?

- **qr1 (TRANSACTION)** = This is query 1 filtering out all accounts that fit the transaction criterions
- **qr2 (PRODUCT)** = This is query 2 for filtering out ONLY 'Destiny' SKUs
- **q3 (JOIN: TRANSACTION + PRODUCT)**: Here, I am joining only the filtered transactions with filtered SKUs
- **q4 (ACCOUNT)**: This is query 4 for filtering out the baseline account specific criterions
- **q4 (JOIN: q4 + q3)**: Here, I am joining the already filtered q3 to filtered account id's

In [35]:
```
%%sql
SELECT DISTINCT(qr3.ACCT_ID)
FROM(
    SELECT qr1.ACCT_ID
    FROM(
        SELECT DISTINCT(transaction_fct.ACCT_ID), transaction_fct.TRANSACT
        FROM transaction_fct
        WHERE transaction_fct.TRANSACTION_VALUE >= 40
        AND EXTRACT(MONTH FROM transaction_fct.TIME_STAMP) = 10
    ) qr1
    INNER JOIN
    (
        SELECT product.SKU
        FROM product
        WHERE GAME_NAME = 'Destiny'

    ) qr2 ON qr1.SKU = qr2.SKU
) qr3
INNER JOIN
(
    SELECT account.ACCT_ID
    FROM account
    WHERE COUNTRY_CODE = 'US'
        AND LANGUAGE_CODE = 'en'
        AND OPT_IN_FLAG = 1
)qr4 ON qr3.ACCT_ID = qr4.ACCT_ID
```

```
41 rows affected.
```

```
Out[35]: [(8.73549407001291e+17,),
          (4.84156930539824e+17,),
          (2.93454984205782e+18,),
          (4.10324015967931e+17,),
          (3.88987255340883e+18,),
          (4.2587074691973e+18,),
          (3.13533498366877e+18,),
          (1.14943101197984e+18,),
          (1.70042680937506e+18,),
          (2.8224207565406e+18,),
          (4.43027921003096e+18,),
          (2.85738299498462e+17,),
          (4.0600501012741e+18,),
          (6.19727474748374e+17,),
          (2.79041747260156e+18,),
          (1.52275518729664e+18,),
          (2.3121377836969e+18,),
          (3.00610139056554e+18,),
          (1.10825865438648e+18,),
          (2.79686346456339e+18,),
          (1.86491691186808e+18,),
          (3.82267836203756e+18,),
          (1.60746167241603e+18,),
          (2.53830636358851e+18,),
          (4.49223853061593e+18,),
          (8.08635496132221e+17,),
          (3.393782123067e+18,),
          (2.97415212552033e+18,),
          (4.35460981397881e+18,),
          (1.04409882563959e+18,),
          (2.33297264010803e+18,),
          (1.46343691806454e+18,),
          (2.08048489208458e+17,),
          (5.73774350803868e+17,),
          (1.91379585224953e+18,),
          (2.84484022874967e+18,),
          (7.79830521881711e+17,),
          (3.47421748230121e+18,),
          (8.62068587972456e+17,),
          (3.26731043298497e+18,),
          (6.25879160959013e+17,)]

In [36]: from pandas import DataFrame

         final_q = _
         df=final_q.DataFrame()
         df.to_csv('target_accounts.csv')
```