Siddikov _ Exercise 4 version b

August 16, 2019

1 Deliverables:

- Submit two files that has the name: YourLastName_Exercise_4:

1. Your **PDF document** that has your Source code and output
2. Your **ipynb script** that has your Source code and output
3. You may zip these 2 files and submit

2 Objectives:

In this exercise, you will:

- Analyze the dataset in the given CSV file
- Clean the given dataset
- Load the dataset into sqlite database engine
- Execute different SQL queries

Formatting Python Code When programming in Python, refer to Kenneth Reitz' PEP 8: The Style Guide for Python Code: http://pep8.org/ (Links to an external site.)Links to an external site. There is the Google style guide for Python at https://google.github.io/styleguide/pyguide.html (Links to an external site.)Links to an external site. Comment often and in detail.

2.0.1 Data Preparation

As a data scientist for BestDeal retailer, you have been tasked with improving their revenue and the effectiveness of the marketing campaign of their electronic products. The given dataset has 10,000 records for the purchases of their customers and is used to predict customers shopping patterns and to provide answers for ad-hoc queries. The dataset DirtyData4BestDeal10000.csv is drawn from its database of customers.

[1]:
```
import pandas as pd  # panda's nickname is pd

import numpy as np  # numpy as np

from pandas import DataFrame, Series     # for convenience

import sqlalchemy

```

```
from sqlalchemy import create_engine

from sqlalchemy import inspect

%matplotlib inline
# ignore all future warnings
from warnings import simplefilter
simplefilter(action='ignore', category=FutureWarning)
import warnings
warnings.filterwarnings("ignore")
```

2.0.2 Lets ead the dirtydata4bestdeal CSV and load into a dataframe object

[2]:
```
dirtydata4bestdeal=pd.read_csv('DirtyData4BestDeal10000.csv')
```

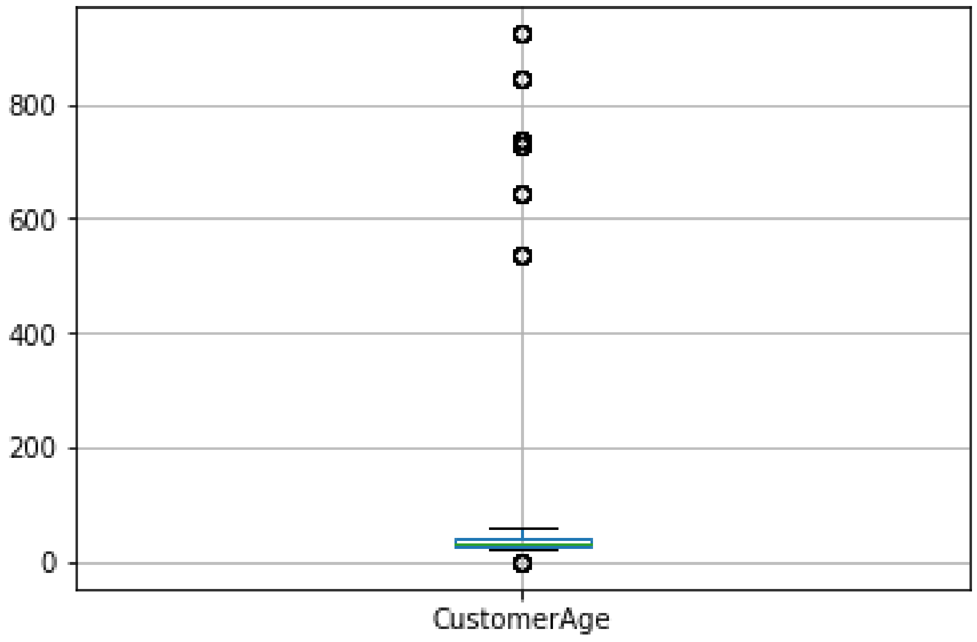
[3]:
```
# Do you see NaN values below?

dirtydata4bestdeal.head()
```

[3]:
```
   ZipCode  CustomerAge  SamsungTV46LED SonyTV42LED XBOX360 DellLaptop  \
0  30134.0         35.0               1           1       1          0
1  62791.0         43.0               0           1       0          0
2  60611.0         23.0               1         NaN       0          1
3  60616.0         56.0               0           1       1          1
4  30303.0         25.0               1         NaN       0        NaN

  BoseSoundSystem  BoseHeadSet  SonyHeadSet  iPod         ...           \
0               0          1.0          1.0   0.0         ...
1               1          0.0          1.0   0.0         ...
2               0          NaN          1.0   1.0         ...
3               0          0.0          1.0   1.0         ...
4               1          1.0          1.0   0.0         ...

   GalaxyTablet  SurfaceTablet  HPLaptop  HDMICable  SpeakerCable  \
0             1            0.0       1.0        1.0           1.0
1             1            0.0       1.0        0.0           1.0
2             0            0.0       1.0        0.0           1.0
3             0            0.0       1.0        0.0           1.0
4             1            0.0       1.0        1.0           1.0

   CallOfDutyGame  GrandTheftAutoGame  ASUSLaptop  LenevoLaptop  \
0             1.0                 0.0         1.0           1.0
1             1.0                 0.0         1.0           1.0
2             1.0                 0.0         NaN           1.0
3             0.0                 0.0         1.0           0.0
4             1.0                 0.0         1.0          10.0
```

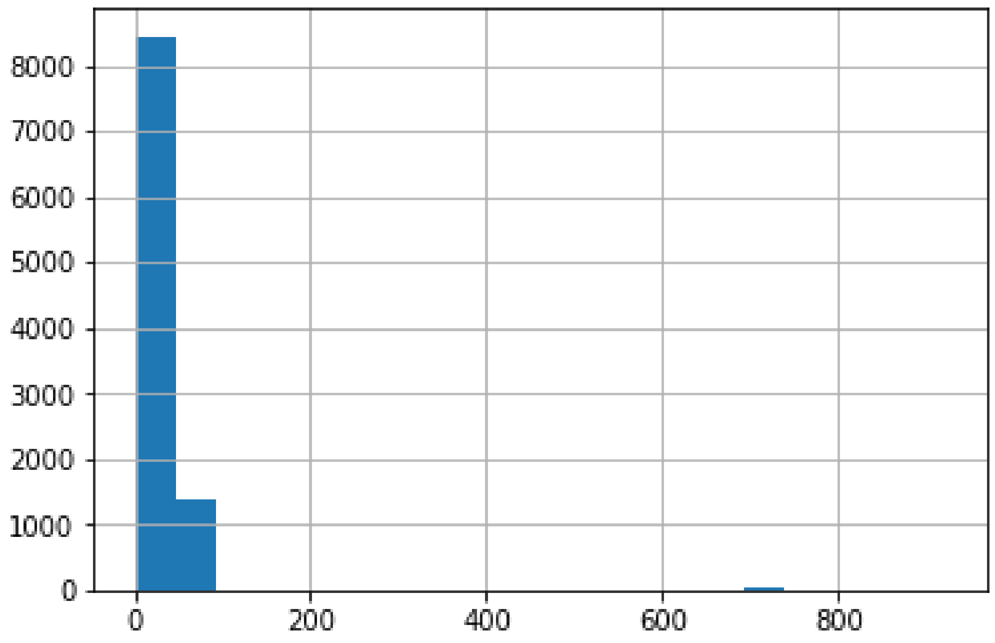
```
   TVStandWallMount
0                 1
1                 1
2                 1
3                 0
4                 0

[5 rows x 34 columns]
```

2.0.3 Lets use boxplot to visualize the data and get an idea if there are dirty/messy/invalid data

[4]:
```python
# check out customer age
dirtydata4bestdeal.boxplot(column='CustomerAge');
```



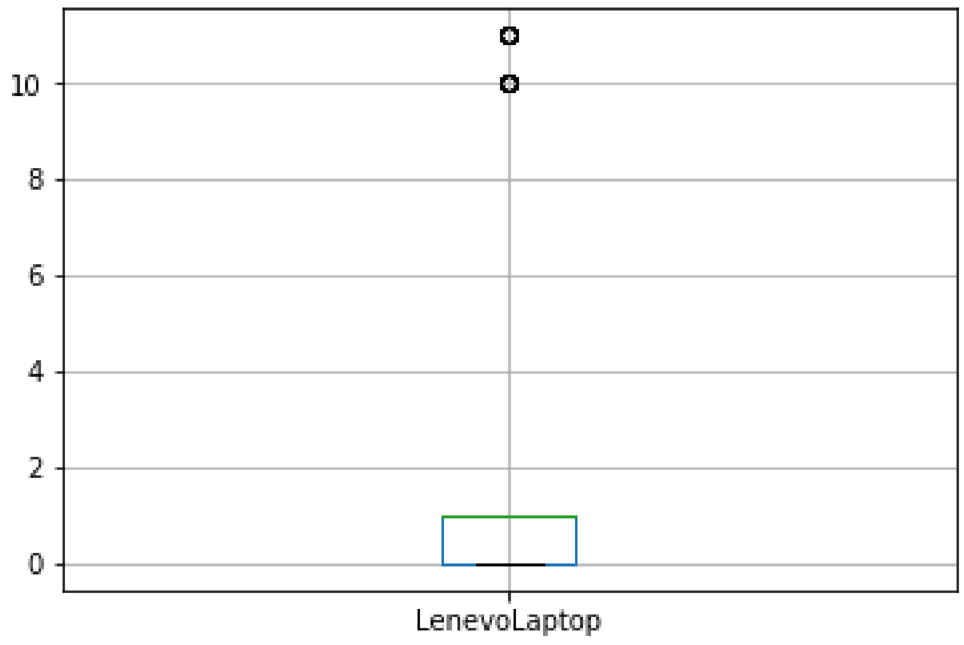
[5]:
```python
# check out customer age with a histogram
dirtydata4bestdeal['CustomerAge'].hist(bins=20);
```



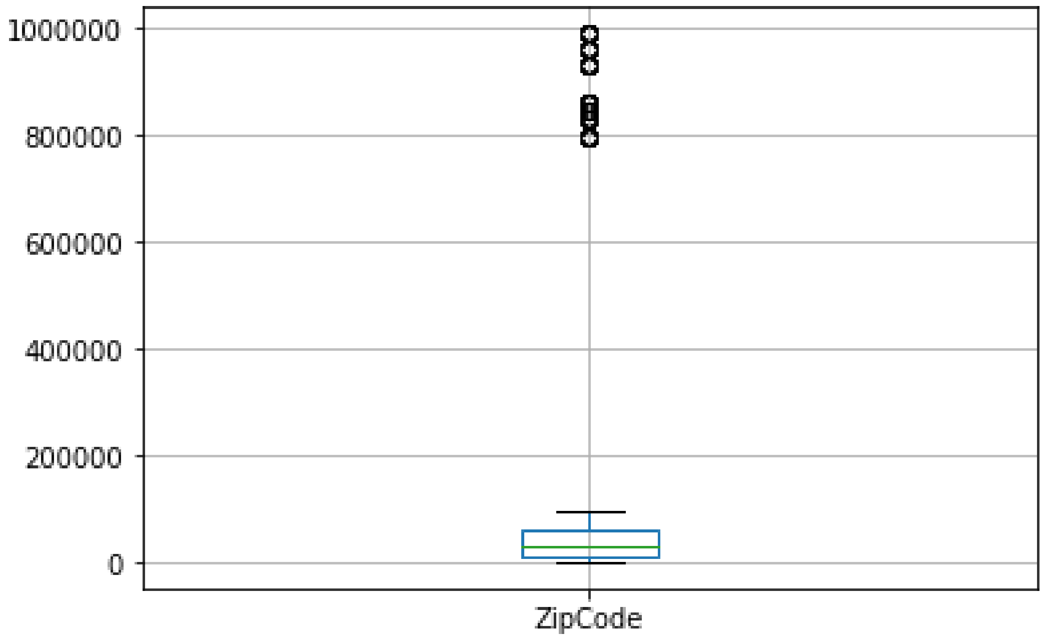
[6]:
```
# look at details of LenenovaLaptop
dirtydata4bestdeal.LenevoLaptop.describe()
```

[6]:
```
count    9976.000000
mean        0.629711
std         0.627375
min         0.000000
25%         0.000000
50%         1.000000
75%         1.000000
max        11.000000
Name: LenevoLaptop, dtype: float64
```

[7]:
```
dirtydata4bestdeal.boxplot(column='LenevoLaptop');
```



[8]:
```
# look at zip codes
dirtydata4bestdeal.boxplot(column='ZipCode');
```



2.0.4 Lets clean the dirty/messy data in the dirtydata4bestdeal dataframe object

You need to write your python code such that: 1. rows/records/tuples/transactions in the data frame that have missing values for fields/columns will be removed 2. rows/records/tuples/transactions in the data frame that have invalid/abnormal values for fields/columns will be removed

Examples of invalid/dirty/messy data: 1. NaN values in the dataframe (Blank/Empty cells in the CSV file)

2. Every product has a value 1 which means bought or 0 which means NOT bought; values like 11, 10, 9 are examples of invalid data

3. CustomerAge value range could be from 18 to 150; values like 723, 634 are examples of invalid data

4. Zipcode should have at least 5 digits

[9]:
```
dirtydata4bestdeal.head()
```

[9]:
```
   ZipCode  CustomerAge  SamsungTV46LED SonyTV42LED XBOX360 DellLaptop  \
0  30134.0         35.0               1           1       1          0
1  62791.0         43.0               0           1       0          0
2  60611.0         23.0               1         NaN       0          1
3  60616.0         56.0               0           1       1          1
4  30303.0         25.0               1         NaN       0        NaN

  BoseSoundSystem  BoseHeadSet  SonyHeadSet  iPod          ...         \
0               0          1.0          1.0   0.0          ...
1               1          0.0          1.0   0.0          ...
2               0          NaN          1.0   1.0          ...
3               0          0.0          1.0   1.0          ...
4               1          1.0          1.0   0.0          ...

   GalaxyTablet  SurfaceTablet  HPLaptop  HDMICable  SpeakerCable  \
0             1            0.0       1.0        1.0           1.0
1             1            0.0       1.0        0.0           1.0
2             0            0.0       1.0        0.0           1.0
3             0            0.0       1.0        0.0           1.0
4             1            0.0       1.0        1.0           1.0

   CallOfDutyGame  GrandTheftAutoGame  ASUSLaptop  LenevoLaptop  \
0             1.0                 0.0         1.0           1.0
1             1.0                 0.0         1.0           1.0
2             1.0                 0.0         NaN           1.0
3             0.0                 0.0         1.0           0.0
4             1.0                 0.0         1.0          10.0

   TVStandWallMount
0                 1
1                 1
2                 1
3                 0
```

```
4                 0

[5 rows x 34 columns]
```

[10]:
```
dirtydata4bestdeal.shape
```

[10]:
```
(10000, 34)
```

[11]:
```
#␣
 ↪-----------------------------------------------------------------------------------

# Add the rest of your code here to clean the data

# steps you must take
# - eliminate NA's
# - product values should only be either a 0 or a 1
# - customer's age needs to be valid
# - zipcodes should have at least 5 digits

# Optional steps
# - if there are other things you want to clean, clearly document them
#   and run them in this section before you create a database


#␣
 ↪-----------------------------------------------------------------------------------
```

[12]:
```
# Drop the NaN values

cleandata4bestdeal=dirtydata4bestdeal.dropna()
cleandata4bestdeal.head()

# Do you see NaN values dropped below?
```

[12]:
```
   ZipCode  CustomerAge  SamsungTV46LED  SonyTV42LED  XBOX360  DellLaptop  \
0  30134.0         35.0               1            1        1           0
1  62791.0         43.0               0            1        0           0
3  60616.0         56.0               0            1        1           1
5   2108.0         55.0               1            1        1           1
6  90033.0         44.0               1            1        1           1

  BoseSoundSystem  BoseHeadSet  SonyHeadSet  iPod        ...          \
0               0          1.0          1.0   0.0        ...
1               1          0.0          1.0   0.0        ...
3               0          0.0          1.0   1.0        ...
5              10          0.0          0.0   0.0        ...
6               0          0.0          0.0   0.0        ...

   GalaxyTablet  SurfaceTablet  HPLaptop  HDMICable  SpeakerCable  \
0              1             0.0        1.0         1.0            1.0
1              1             0.0        1.0         0.0            1.0
3              0             0.0        1.0         0.0            1.0
5              1             1.0        1.0         1.0            1.0
6              1             1.0        1.0         1.0            0.0

   CallOfDutyGame  GrandTheftAutoGame  ASUSLaptop  LenevoLaptop  \
0             1.0                 0.0         1.0           1.0
1             1.0                 0.0         1.0           1.0
3             0.0                 0.0         1.0           0.0
5             1.0                 0.0         1.0           0.0
6             1.0                 1.0         0.0           0.0

   TVStandWallMount
0                 1
1                 1
3                 0
5                 0
6                 1

[5 rows x 34 columns]
```

[13]:
```
cleandata4bestdeal.shape
```

[13]:
```
(9432, 34)
```

[14]:
```
# convert objects and floats into integers
cleandata4bestdeal['SonyTV42LED'] = pd.
 ↪to_numeric(cleandata4bestdeal['SonyTV42LED'], errors='coerce').fillna(0).
 ↪astype(int)
cleandata4bestdeal['XBOX360'] = pd.to_numeric(cleandata4bestdeal['XBOX360'],␣
 ↪errors='coerce').fillna(0).astype(int)
cleandata4bestdeal['DellLaptop'] = pd.
 ↪to_numeric(cleandata4bestdeal['DellLaptop'], errors='coerce').fillna(0).
 ↪astype(int)
cleandata4bestdeal['BoseSoundSystem'] = pd.
 ↪to_numeric(cleandata4bestdeal['BoseSoundSystem'], errors='coerce').fillna(0).
 ↪astype(int)

cleandata4bestdeal = cleandata4bestdeal.astype('int32')
```

[15]:
```
# product values should only be either a 0 or a 1
##cleandata4bestdeal.loc[:,'SamsungTV46LED':'TVStandWallMount'] = \
##cleandata4bestdeal.loc[:,'SamsungTV46LED':'TVStandWallMount']\
##[cleandata4bestdeal.loc[:,'SamsungTV46LED':'TVStandWallMount']\
##.isin([0, 1])].fillna(0).astype(int)

cleandata4bestdeal = \
cleandata4bestdeal[(cleandata4bestdeal.iloc[:,2:] <= 1).all(1)]
```

[16]:
```
cleandata4bestdeal.shape
```

[16]:
```
(9206, 34)
```

[17]:
```
cleandata4bestdeal.loc[:,'SamsungTV46LED':'TVStandWallMount'].apply(pd.
 ↪value_counts)
```

[17]:
```
   SamsungTV46LED  SonyTV42LED  XBOX360  DellLaptop  BoseSoundSystem  \
0            3067         1762     1742        4436             4763
1            6139         7444     7464        4770             4443

   BoseHeadSet  SonyHeadSet  iPod  iPhone  Panasonic50LED        ...         \
0         4501         1490  7620    5924            7018        ...
1         4705         7716  1586    3282            2188        ...

   GalaxyTablet  SurfaceTablet  HPLaptop  HDMICable  SpeakerCable  \
0          2814           8567       NaN       4717          2984
1          6392            639    9206.0       4489          6222

   CallOfDutyGame  GrandTheftAutoGame  ASUSLaptop  LenevoLaptop  \
0            2537                6066        3821          3518
1            6669                3140        5385          5688

   TVStandWallMount
0              2659
1              6547

[2 rows x 32 columns]
```

[18]:
```
#There are ages zero and over 500; which are invalid
cleandata4bestdeal.loc[:,'CustomerAge'].value_counts().sort_index()
```

[18]:
```
0        8
21     201
22     267
23     735
24     184
25     472
26     343
27     505
28     494
29     462
30      16
31     210
32     184
33     168
34     480
35     373
36     192
```

```
37     511
38     457
39     104
41      96
42     183
43     464
44     528
45     128
46     151
47     104
49     184
51      81
53      24
54     296
55      66
56     184
57     144
59     119
61      32
536      8
643      8
727      8
737     16
843      8
923      8
Name: CustomerAge, dtype: int64
```

[19]:
```
#customer's age needs to be valid

cleandata4bestdeal_1 = cleandata4bestdeal[
    cleandata4bestdeal['CustomerAge'].between(20,100)]

cleandata4bestdeal_1.loc[:,'CustomerAge'].value_counts().sort_index()
```

[19]:
```
21    201
22    267
23    735
24    184
25    472
26    343
27    505
28    494
29    462
30     16
31    210
32    184
33    168
34    480
```

```
35     373
36     192
37     511
38     457
39     104
41      96
42     183
43     464
44     528
45     128
46     151
47     104
49     184
51      81
53      24
54     296
55      66
56     184
57     144
59     119
61      32
Name: CustomerAge, dtype: int64
```

[20]:
```
# zipcodes should have at least 5 digits

cleandata4bestdeal.loc[:,'ZipCode'].astype('int').value_counts().sort_index()
```

[20]:
```
2108       613
2109       930
2110       224
10065      762
30134     1141
30303      985
33129      539
33130      280
44114      510
60532      243
60585      240
60603      224
60611       62
60616      960
62791        3
90024      144
90033      639
94102      164
94158      495
794158       8
830134       8
```

```
844114       8
860616       8
960616       8
990033       8
Name: ZipCode, dtype: int64
```

[21]:
```
#zipcodes should have at least 5 digits

cleandata4bestdeal_2 = cleandata4bestdeal_1[
    cleandata4bestdeal_1['ZipCode'] < 100000]
cleandata4bestdeal_2['ZipCode'].value_counts().sort_index()
```

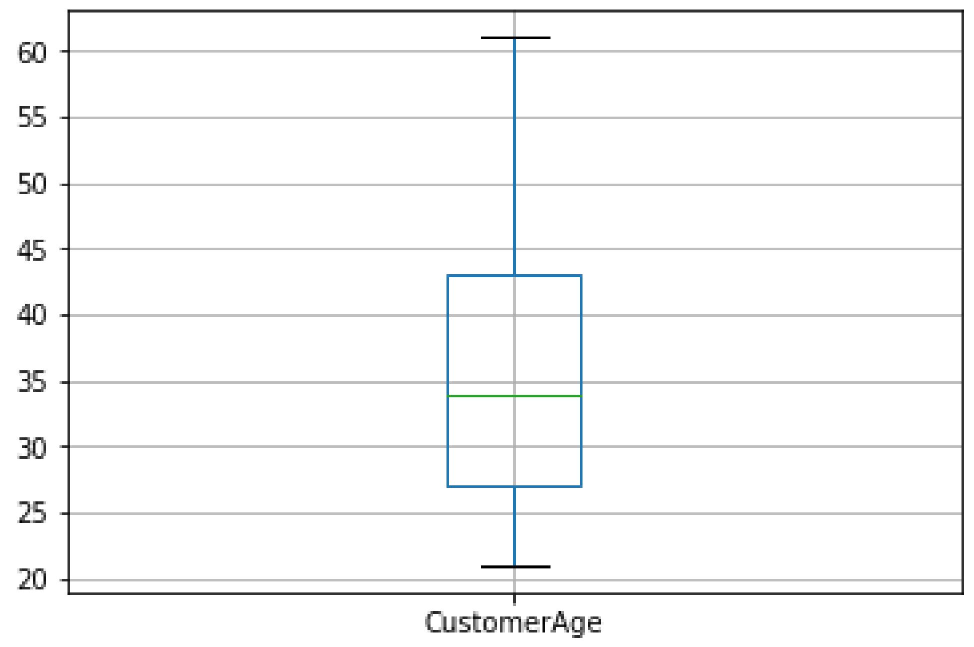
[21]:
```
2108      613
2109      918
2110      224
10065     750
30134    1133
30303     985
33129     531
33130     280
44114     510
60532     243
60585     240
60603     224
60611      62
60616     952
62791       3
90024     144
90033     631
94102     164
94158     487
Name: ZipCode, dtype: int64
```

[22]:
```
# check the df shape after cleaning the data

print(cleandata4bestdeal.shape)
print(cleandata4bestdeal_2.shape)
```

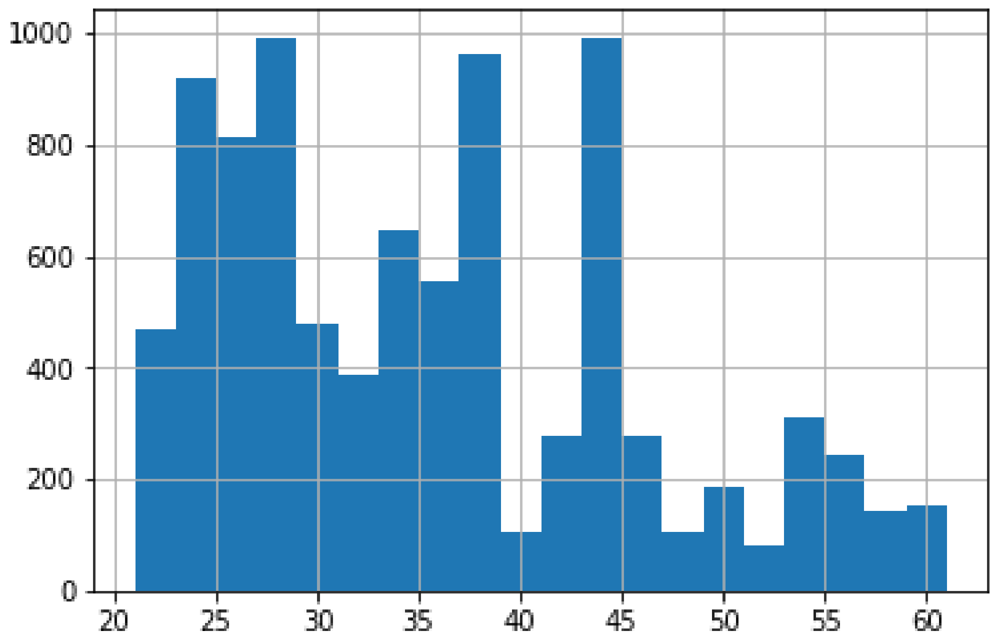
```
(9206, 34)
(9094, 34)
```

[ ]:
```

```

[23]:
```
# after cleaning the customer age - does the boxplot still show outliers?
# how does the histogram look?
# if this does not look better - you are not ready to proceed
cleandata4bestdeal_2.boxplot(column='CustomerAge');
```

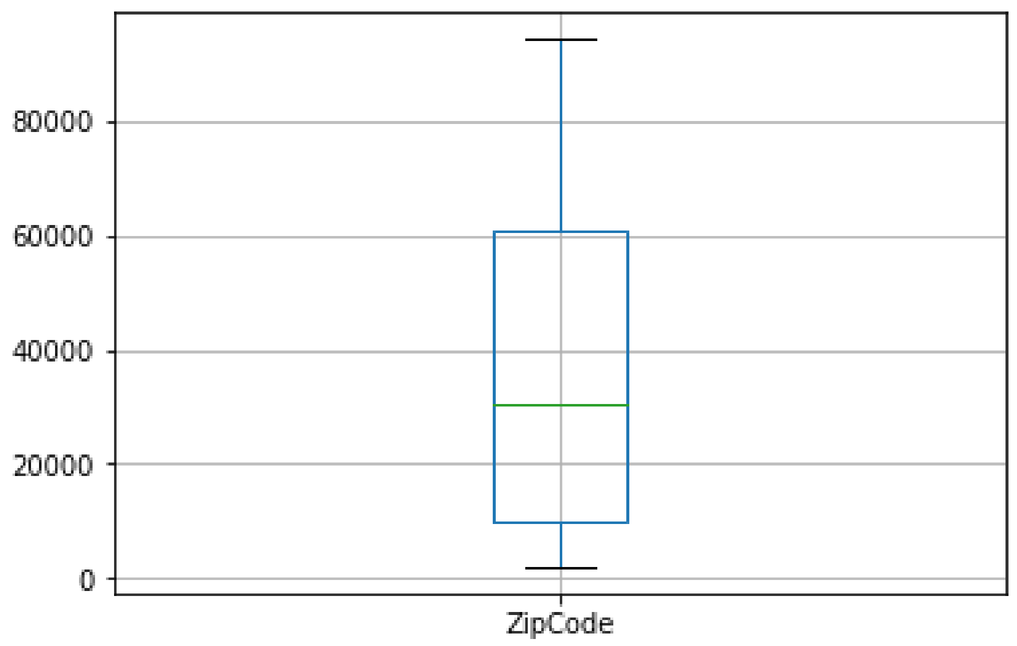


[24]:
```
cleandata4bestdeal_2['CustomerAge'].hist(bins=20);
```



[25]:
```
# boxplot after cleaning the zip code
```

```
cleandata4bestdeal_2.boxplot(column='ZipCode');
```



2.0.5 Lets store the cleaned data into the Database

[26]:
```
# how many records did you end up with after the data cleaning?
cleandata4bestdeal = cleandata4bestdeal_2
cleandata4bestdeal.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 9094 entries, 0 to 9999
Data columns (total 34 columns):
ZipCode                 9094 non-null int32
CustomerAge             9094 non-null int32
SamsungTV46LED          9094 non-null int32
SonyTV42LED             9094 non-null int32
XBOX360                 9094 non-null int32
DellLaptop              9094 non-null int32
BoseSoundSystem         9094 non-null int32
BoseHeadSet             9094 non-null int32
SonyHeadSet             9094 non-null int32
iPod                    9094 non-null int32
iPhone                  9094 non-null int32
Panasonic50LED          9094 non-null int32
SonyPS4                 9094 non-null int32
WiiU                    9094 non-null int32
```

```
WDexternalHD          9094 non-null int32
SamsungTV55LED        9094 non-null int32
SonyTV60LED           9094 non-null int32
SandiskMemoryCard     9094 non-null int32
SonySoundSystem       9094 non-null int32
SonyCamera            9094 non-null int32
PanasonicCamera       9094 non-null int32
HPPrinter             9094 non-null int32
SonyDVDplayer         9094 non-null int32
ToshibaDVDplayer      9094 non-null int32
GalaxyTablet          9094 non-null int32
SurfaceTablet         9094 non-null int32
HPLaptop              9094 non-null int32
HDMICable             9094 non-null int32
SpeakerCable          9094 non-null int32
CallOfDutyGame        9094 non-null int32
GrandTheftAutoGame    9094 non-null int32
ASUSLaptop            9094 non-null int32
LenevoLaptop          9094 non-null int32
TVStandWallMount      9094 non-null int32
dtypes: int32(34)
memory usage: 1.2 MB
```

[27]:
```
# now that your data has been cleaned, lets store it in a database

# NOTE - if you run this code more than once, the database will exist and this␣
↪section will fail
# NOTE - to run this more than once, you need to delete the database first
#      OR - change the database name to create a new database

engine = create_engine('sqlite:///bestdeal1.db')
```

[28]:
```
cleandata4bestdeal.to_sql('trans4cust', engine)
```

** Sanity Test: Did it create the table in bestdeal.db? Check!!**

[29]:
```
insp=inspect(engine)
```

[30]:
```
 insp.get_table_names()
```

[30]:
```
['trans4cust']
```

[31]:
```
pd.read_sql_table('trans4cust', engine).columns
```

[31]:
```
Index(['index', 'ZipCode', 'CustomerAge', 'SamsungTV46LED', 'SonyTV42LED',
       'XBOX360', 'DellLaptop', 'BoseSoundSystem', 'BoseHeadSet',
       'SonyHeadSet', 'iPod', 'iPhone', 'Panasonic50LED', 'SonyPS4', 'WiiU',
       'WDexternalHD', 'SamsungTV55LED', 'SonyTV60LED', 'SandiskMemoryCard',
       'SonySoundSystem', 'SonyCamera', 'PanasonicCamera', 'HPPrinter',
       'SonyDVDplayer', 'ToshibaDVDplayer', 'GalaxyTablet', 'SurfaceTablet',
       'HPLaptop', 'HDMICable', 'SpeakerCable', 'CallOfDutyGame',
       'GrandTheftAutoGame', 'ASUSLaptop', 'LenevoLaptop', 'TVStandWallMount'],
      dtype='object')
```

should produce the columns of the DataFrame you wrote to the db.

2.0.6 Now we are ready to query the Database

Query example #1: get the transactions for the customers in zipCode 60616

[32]:
```
# =====================================================================
# *********************************************************************
#
# WARNING - this pre-run notebook is using dirty data
# WARNING - after cleaning the data, your output should look different
#
# =====================================================================
# *********************************************************************
```

[33]:
```
resultsForBestDealCustTrans=pd.read_sql_query("SELECT * FROM trans4cust WHERE␣
 ↪ZipCode='60616'", engine)
```

[34]:
```
resultsForBestDealCustTrans.head()
```

[34]:
```
   index  ZipCode  CustomerAge  SamsungTV46LED  SonyTV42LED  XBOX360  \
0      3    60616           56               0            1        1
1     16    60616           43               0            1        1
2     18    60616           54               1            0        0
3     23    60616           43               1            1        1
4     34    60616           31               0            1        1

   DellLaptop  BoseSoundSystem  BoseHeadSet  SonyHeadSet        ...         \
0           1                0            0            1        ...
1           0                1            0            1        ...
2           1                0            1            1        ...
3           0                1            1            1        ...
4           1                0            0            1        ...

   GalaxyTablet  SurfaceTablet  HPLaptop  HDMICable  SpeakerCable  \
0             0              0         1          0             1
1             1              0         1          1             1
2             0              1         1          0             1
3             1              1         1          1             0
4             1              0         1          1             1

   CallOfDutyGame  GrandTheftAutoGame  ASUSLaptop  LenevoLaptop  \
0               0                   0           1             0
1               1                   0           1             1
2               1                   0           1             1
3               1                   0           1             1
4               1                   1           0             0
```

```
   TVStandWallMount
0                 0
1                 1
2                 1
3                 1
4                 1

[5 rows x 35 columns]
```

Query example #2: get the transactions for ALL customers

[35]:
```
resultsForBestDealCustTrans=pd.read_sql_query("SELECT * \
    FROM trans4cust", engine)
```

[36]:
```
resultsForBestDealCustTrans.head()
```

[36]:
```
   index  ZipCode  CustomerAge  SamsungTV46LED  SonyTV42LED  XBOX360  \
0      0    30134           35               1            1        1
1      1    62791           43               0            1        0
2      3    60616           56               0            1        1
3      6    90033           44               1            1        1
4      9     2109           37               0            1        1

   DellLaptop  BoseSoundSystem  BoseHeadSet  SonyHeadSet        ...          \
0           0                0            1            1        ...
1           0                1            0            1        ...
2           1                0            0            1        ...
3           1                0            0            0        ...
4           0                1            0            1        ...

   GalaxyTablet  SurfaceTablet  HPLaptop  HDMICable  SpeakerCable  \
0             1              0         1          1             1
1             1              0         1          0             1
2             0              0         1          0             1
3             1              1         1          1             0
4             0              0         1          0             1

   CallOfDutyGame  GrandTheftAutoGame  ASUSLaptop  LenevoLaptop  \
0               1                   0           1             1
1               1                   0           1             1
2               0                   0           1             0
3               1                   1           0             0
4               0                   0           1             1

   TVStandWallMount
0                 1
1                 1
```

```
2                 0
3                 1
4                 0

[5 rows x 35 columns]
```

Query example #3: get the number of customers in every ZipCode sorted by ZipCode

[37]:
```
resultsForBestDealCustTrans=pd.read_sql_query("SELECT ZipCode , COUNT(*) as␣
 ↪'num_customers' \
            FROM trans4cust \
            GROUP BY ZipCode \
            ORDER BY ZipCode", engine)
```

[38]:
```
resultsForBestDealCustTrans
```

[38]:
```
    ZipCode  num_customers
0      2108            613
1      2109            918
2      2110            224
3     10065            750
4     30134           1133
5     30303            985
6     33129            531
7     33130            280
8     44114            510
9     60532            243
10    60585            240
11    60603            224
12    60611             62
13    60616            952
14    62791              3
15    90024            144
16    90033            631
17    94102            164
18    94158            487
```

Query example #4: get the number of customers for every Age Group in ZipCode 60616 sorted by CustomerAge

[39]:
```
resultsForBestDealCustTrans=pd.read_sql_query(
"SELECT CustomerAge , COUNT(*) as 'num_customers' \
    FROM trans4cust \
    WHERE ZipCode=60616 \
    GROUP BY CustomerAge  \
    ORDER BY CustomerAge", engine)
```

[40]:
```
resultsForBestDealCustTrans
```

[40]:
```
    CustomerAge  num_customers
0            21             56
1            22             32
2            23             40
3            25             88
4            26             48
5            27             32
6            28             32
7            29             56
8            31             16
9            32             16
10           34             96
11           35             72
12           37             64
13           38             24
14           39              8
15           43             48
16           44             88
17           45             24
18           46             24
19           51              8
20           54             48
21           56             32
```

Query example #5: Plot in a stacked-bar figure the number of customers who bought SonyTV60LED and/or BoseSoundSystem in every zipcode that has more than 400 customers who bought these two products(either bought one of these products or the two products)

[41]:
```
SonyTV60LEDCustTrans=pd.read_sql_query(
"SELECT ZipCode , COUNT(*) as 'num_customers' FROM trans4cust \
    WHERE SonyTV60LED=1  GROUP BY ZipCode HAVING COUNT(*) > 400", engine)

BoseSoundSystemCustTrans=pd.read_sql_query(
"SELECT ZipCode , COUNT(*) as 'num_customers' FROM trans4cust \
    WHERE BoseSoundSystem=1 GROUP BY ZipCode HAVING COUNT(*) > 400", engine)
```

[42]:
```
SonyTV60LEDCustTrans
```

[42]:
```
   ZipCode  num_customers
0     2108            402
1     2109            579
2    10065            439
3    30134            757
4    30303            517
5    60616            689
```

[43]:
```
BoseSoundSystemCustTrans
```

[43]:
```
   ZipCode  num_customers
0     2109            424
1    30134            799
2    30303            464
3    60616            466
4    90033            404
```

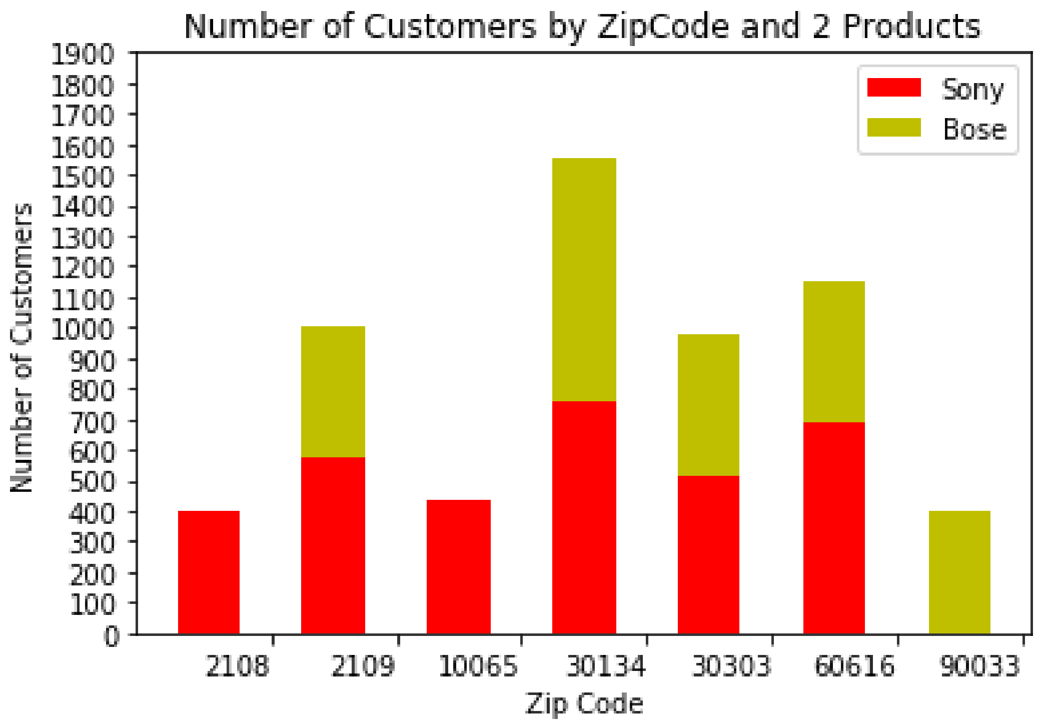
[44]:
```
SonyTV60LEDCustTrans.ZipCode
```

[44]:
```
0     2108
1     2109
2    10065
3    30134
4    30303
5    60616
Name: ZipCode, dtype: int64
```

[45]:
```
import numpy

#   There are zipcodes that Sony got bought but not Bose
#   but there are also zipcodes that Bose got bought but not Sony
#
#   AND we need to use stacked-bar graph and we have a potentially asymmetrical␣
 ↪set  of zipcode values
#   So, we need to do somework to create the symmteric set of zipcode values␣
 ↪for Sony and Bose


sonyZipCodeTuples=tuple(SonyTV60LEDCustTrans.ZipCode.astype(numpy.int))
sony_num_customersTuples=tuple(SonyTV60LEDCustTrans.num_customers.astype(numpy.
 ↪int))

boseZipCodeTuples=tuple(BoseSoundSystemCustTrans.ZipCode.astype(numpy.int))
bose_num_customersTuples=tuple(BoseSoundSystemCustTrans.num_customers.
 ↪astype(numpy.int))

sony_dict = dict(zip(sonyZipCodeTuples, sony_num_customersTuples))
bose_dict = dict(zip(boseZipCodeTuples, bose_num_customersTuples))

for key in bose_dict.keys():
    if ((key in sony_dict.keys()) == False): sony_dict[key]=0

for key in sony_dict.keys():
    if ((key in bose_dict.keys()) == False): bose_dict[key]=0

bose_zip= sorted(bose_dict.keys())

sony_zip= sorted(sony_dict.keys())
```

```
bose_zip_tuple=tuple(bose_zip)

sony_zip_tuple=tuple(sony_zip)

bose_customer_list=[]

for bose in bose_zip_tuple:
    bose_customer_list.append(bose_dict[bose])

sony_customer_list=[]

for sony in sony_zip_tuple:
    sony_customer_list.append(sony_dict[sony])

bose_customer_tuple=tuple(bose_customer_list)
sony_customer_tuple=tuple(sony_customer_list)
```

[46]:
```
# See docs for bar_stack at the URL
# http://matplotlib.org/examples/pylab_examples/bar_stacked.html

import numpy as np
import matplotlib.pyplot as plt

%matplotlib inline

ind = np.arange(len(sony_customer_tuple))

# the width of the bars: can also be len(x) sequence
width = .5

p1 = plt.bar(ind, sony_customer_tuple, width,  color='r')
p2 = plt.bar(ind, bose_customer_tuple, width, color='y',␣
 ↪bottom=sony_customer_tuple)

plt.ylabel('Number of Customers')
plt.xlabel('Zip Code')

plt.title('Number of Customers by ZipCode and 2 Products')

plt.xticks(ind + width, sony_zip_tuple, horizontalalignment='right')

plt.yticks(np.arange(0, 2000, 100))
plt.legend((p1[0], p2[0]), ('Sony', 'Bose'))

plt.show()
```



3 Requirements :

1. (Use SQL/SQlite): show the top 3 zip codes with the most customers
2. (Use SQL/SQlite): selecting the customers from the top 3 zip codes (results from question 1), what are ages of the customers? Sort output by most customers. You can show all 3 zip codes combined or show ages by zip codes.
3. (Use SQL/SQlite): get the number of customers who bought DellLaptop and HPPrinter for every Age group sorted by CustomerAge.
4. (Use SQL/SQlite): Get the list of ZipCodes where no customer bought XBOX360 (this query means NOT even a single csutomer in that zip code bought XBOX360).
5. (Use SQL/SQlite/Matplotlib): Plot in a stacked-bar figure the number of customers who bought HPLaptop and/or HPPrinter but did NOT buy WDexternalHD for every Customer-Age group that has more than 100 customers who bought these two products(either bought one of these products or the two products but didn't buy WDexternalHD).

[47]:
```python
# Write your python code that meets the above requirements in this cell
# Question 1
# (Use SQL/SQlite): show the top 3 zip codes with the most customers

Ans_1 = pd.read_sql_query(
    "SELECT ZipCode, COUNT(*) as 'num_customers' \
    FROM trans4cust \
    GROUP BY ZipCode \
    ORDER BY num_customers DESC\
    Limit 3;", engine)
Ans_1
```

[47]:
```
   ZipCode  num_customers
0    30134           1133
1    30303            985
2    60616            952
```

[48]:
```
# Question 2
# (Use SQL/SQlite): selecting the customers from the top 3 zip codes
# (results from question 1), what are ages of the customers?
# Sort output by most customers. You can show all 3 zip codes combined
# or show ages by zip codes.

Ans_2 = pd.read_sql_query(
    "SELECT ZipCode, CustomerAge, COUNT(*) as 'num_customers' \
    FROM trans4cust \
    WHERE ZipCode in (30134, 30303, 60616)\
    GROUP BY ZipCode, CustomerAge \
    ORDER BY num_customers DESC", engine)
Ans_2
```

[48]:
```
    ZipCode  CustomerAge  num_customers
0     30134           25            154
1     60616           34             96
2     60616           25             88
3     60616           44             88
4     30134           29             84
5     30303           26             83
6     30303           27             81
7     30303           44             77
8     30134           43             75
9     30134           34             74
10    30303           29             74
11    30303           23             73
12    60616           35             72
13    30303           43             68
14    30134           28             67
15    60616           37             64
16    30303           34             61
17    30134           32             58
18    30134           44             58
19    30134           37             56
20    60616           21             56
21    60616           29             56
22    30303           41             49
23    30134           22             48
```

```
24    30134          31          48
25    60616          26          48
26    60616          43          48
27    60616          54          48
28    30134          38          45
29    30303          38          42
..      ...         ...         ...
47    30303          37          28
48    30303          54          28
49    30303          24          27
50    30303          31          27
51    30303          49          27
52    30303          61          27
53    30303          56          26
54    60616          38          24
55    60616          45          24
56    60616          46          24
57    30303          59          21
58    30134          45          19
59    60616          31          16
60    60616          32          16
61    30303          33          14
62    30303          45          14
63    30303          55          14
64    30134          42          10
65    30134          51           9
66    30134          54           8
67    60616          39           8
68    60616          51           8
69    30303          30           7
70    30303          35           7
71    30303          51           7
72    30134          26           2
73    30134          33           2
74    30134          39           2
75    30134          59           2
76    30134          46           1

[77 rows x 3 columns]
```

[49]:
```
# Question 3
# (Use SQL/SQlite): get the number of customers who bought DellLaptop
# and HPPrinter for every Age group sorted by CustomerAge.

Ans_3 = pd.read_sql_query(
"SELECT CustomerAge, COUNT(*) as 'num_customers' \
    FROM trans4cust \
    WHERE DellLaptop = 1\
    AND HPPrinter = 1\
    GROUP BY CustomerAge \
    ORDER BY CustomerAge", engine)
Ans_3
```

[49]:
```
    CustomerAge  num_customers
0            21            201
1            22            203
2            23            304
3            25             64
4            26            183
5            27            272
6            28             56
7            29            143
8            31            194
9            32            184
10           34            120
11           35            136
12           36            192
13           38             16
14           39             88
15           42             72
16           44            184
17           45             32
18           46             63
19           47             32
20           51             16
21           53             24
22           54            127
23           56            176
24           57             64
25           59             80
26           61             32
```

[50]:
```
# Question 4
# (Use SQL/SQlite): Get the list of ZipCodes where no customer bought XBOX360
# (this query means NOT even a single csutomer in that zip code bought XBOX360).

Ans_4 = pd.read_sql_query(
"SELECT ZipCode, COUNT(*) as 'num_customers' \
    FROM trans4cust \
    WHERE XBOX360 = 0\
    GROUP BY ZipCode", engine)
Ans_4
```

[50]:
```
   ZipCode  num_customers
0     2108             49
```

```
1     2109         210
2     2110          96
3    10065         164
4    30134         248
5    30303         220
6    33129          67
7    33130          40
8    44114          81
9    60532          32
10   60585          96
11   60603          88
12   60611           8
13   60616          81
14   62791           3
15   90024          16
16   90033          87
17   94102          36
18   94158         112
```

[51]:
```
# Question 5
# (Use SQL/SQlite/Matplotlib): Plot in a stacked-bar figure the number of␣
 ↪customers
# who bought HPLaptop and/or HPPrinter but did NOT buy WDexternalHD for every␣
 ↪CustomerAge
# group that has more than 100 customers who bought these two products
# (either bought one of these products or the two products but didn't buy␣
 ↪WDexternalHD).

Ans_5 = pd.read_sql_query(
"SELECT CustomerAge , COUNT(*) as 'num_customers' \
    FROM trans4cust \
    WHERE HPLaptop = 1 \
    AND HPPrinter = 1 \
    AND WDexternalHD = 0 \
    GROUP BY CustomerAge HAVING COUNT(*) > 100", engine)

Ans_5_HPLaptop = pd.read_sql_query(
"SELECT CustomerAge , COUNT(*) as 'num_customers' \
    FROM trans4cust \
    WHERE HPLaptop = 1 \
    AND WDexternalHD = 0 \
    GROUP BY CustomerAge HAVING COUNT(*) > 100", engine)

Ans_5_HPPrinter = pd.read_sql_query(
"SELECT CustomerAge , COUNT(*) as 'num_customers' \
    FROM trans4cust \
    WHERE HPPrinter = 1 \
    AND WDexternalHD = 0 \
    GROUP BY CustomerAge HAVING COUNT(*) > 100", engine)
```

[52]:
```
Ans_5_HPLaptop
```

[52]:
```
    CustomerAge  num_customers
0            21            192
1            22            203
2            23            437
3            25            147
4            26            205
5            27            307
6            28            126
7            29            290
8            31            196
9            32            176
10           34            178
11           35            348
12           36            183
13           42            177
14           43            104
15           44            319
16           54            148
17           56            162
```

[53]:
```
Ans_5_HPPrinter
```

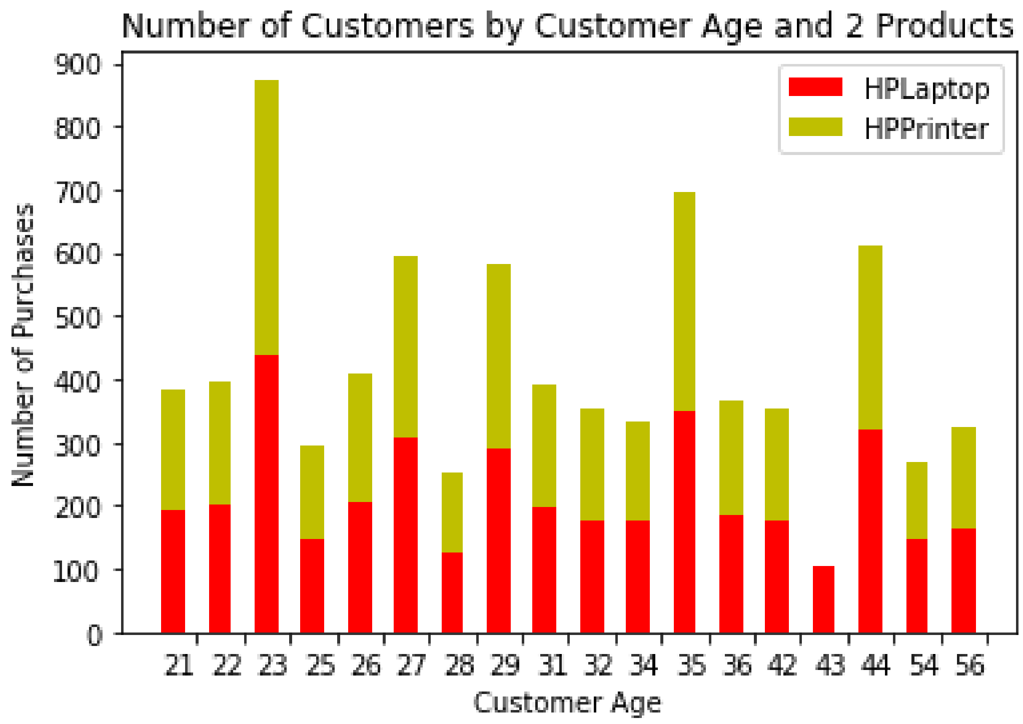
[53]:
```
    CustomerAge  num_customers
0            21            192
1            22            193
2            23            437
3            25            147
4            26            205
5            27            288
6            28            126
7            29            290
8            31            196
9            32            176
10           34            156
11           35            348
12           36            183
13           42            177
14           44            292
15           54            121
16           56            162
```

[54]:
```
HPLaptop_cusage = tuple(Ans_5_HPLaptop.CustomerAge.astype(numpy.int))
HPLaptop_cus = tuple(Ans_5_HPLaptop.num_customers.astype(numpy.int))
```

```
HPPrinter_cusage = tuple(Ans_5_HPPrinter.CustomerAge.astype(numpy.int))
HPPrinter_cus = tuple(Ans_5_HPPrinter.num_customers.astype(numpy.int))

HPLaptop_dict = dict(zip(HPLaptop_cusage, HPLaptop_cus))
HPPrinter_dict = dict(zip(HPPrinter_cusage, HPPrinter_cus))

for key in HPPrinter_dict.keys():
    if ((key in HPLaptop_dict.keys()) == False): HPLaptop_dict[key]=0

for key in HPLaptop_dict.keys():
    if ((key in HPPrinter_dict.keys()) == False): HPPrinter_dict[key]=0

HPPrinter_cusage= sorted(HPPrinter_dict.keys())

HPLaptop_cusage= sorted(HPLaptop_dict.keys())

HPPrinter_cusage_tuple=tuple(HPPrinter_cusage)

HPLaptop_cusage_tuple=tuple(HPLaptop_cusage)

HPPrinter_customer_list=[]

for HPPrinter in HPPrinter_cusage_tuple:
    HPPrinter_customer_list.append(HPPrinter_dict[HPPrinter])

HPLaptop_customer_list=[]

for HPLaptop in HPLaptop_cusage_tuple:
    HPLaptop_customer_list.append(HPLaptop_dict[HPLaptop])

HPPrinter_customer_tuple=tuple(HPPrinter_customer_list)
HPLaptop_customer_tuple=tuple(HPLaptop_customer_list)
```

[55]:
```
import numpy as np
import matplotlib.pyplot as plt

%matplotlib inline

ind = np.arange(len(HPLaptop_customer_tuple))

# the width of the bars: can also be len(x) sequence
width = 0.5

p1 = plt.bar(ind, HPLaptop_customer_tuple, width,  color='r')
p2 = plt.bar(ind, HPPrinter_customer_tuple, width, color='y', bottom =␣
 ↪HPLaptop_customer_tuple)
```

```
plt.ylabel('Number of Purchases')
plt.xlabel('Customer Age')

plt.title('Number of Customers by Customer Age and 2 Products')

plt.xticks(ind + width, HPLaptop_cusage_tuple, horizontalalignment='right')

plt.yticks(np.arange(0, 1000, 100))
plt.legend((p1[0], p2[0]), ('HPLaptop', 'HPPrinter'))

plt.show();
```


Number of Customers by Customer Age and 2 Products
HPLaptop
HPPrinter
Number of Purchases
Customer Age