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.

In [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
```

Lets ead the dirtydata4bestdeal CSV and load into a dataframe object

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

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

dirtydata4bestdeal.head()
```

Out[3]:

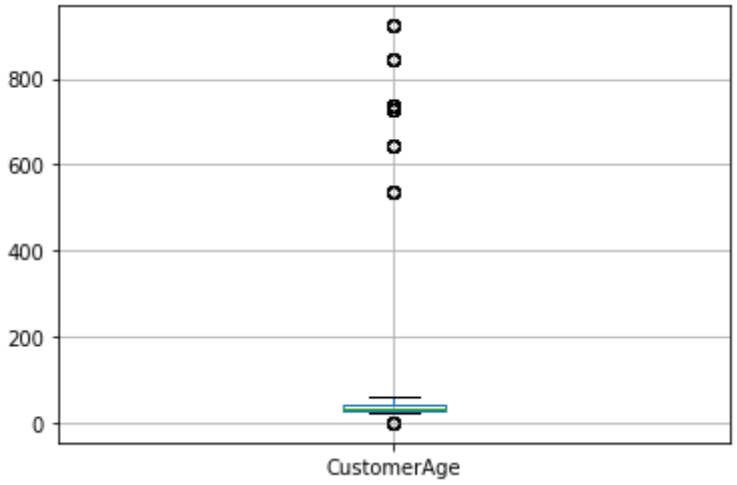
	ZipCode	CustomerAge	SamsungTV46LED	SonyTV42LED	XBOX360	DellLaptop	BoseSoundSy
0	30134.0	35.0	1	1	1	0	
1	62791.0	43.0	0	1	0	0	
2	60611.0	23.0	1	NaN	0	1	
3	60616.0	56.0	0	1	1	1	
4	30303.0	25.0	1	NaN	0	NaN	

5 rows × 34 columns

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

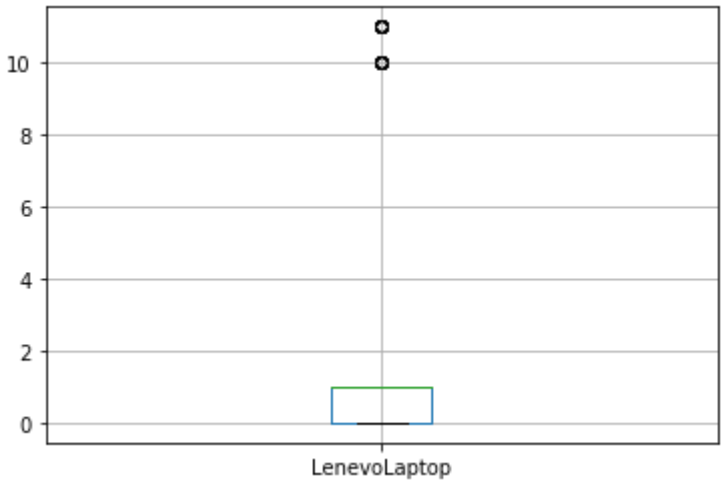
In [4]:
```
dirtydata4bestdeal.boxplot(column='CustomerAge')
```

Out[4]: <matplotlib.axes._subplots.AxesSubplot at 0x11d19ee80>



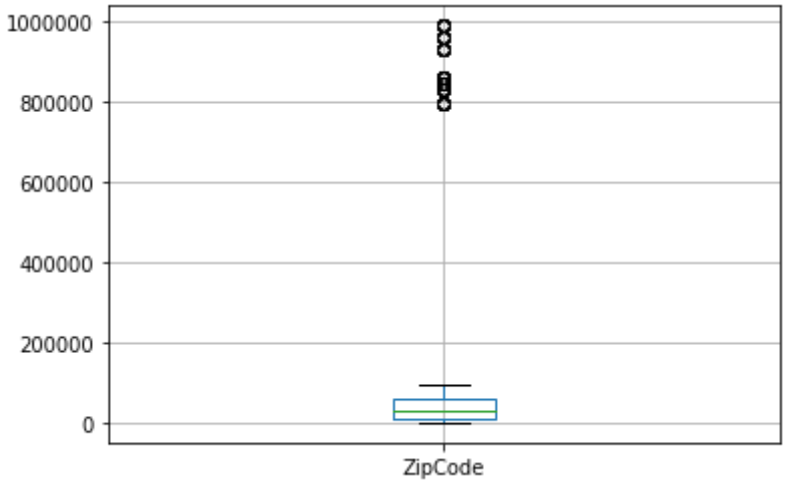
In [5]:
```
dirtydata4bestdeal.boxplot(column='LenevoLaptop')
```

Out[5]: <matplotlib.axes._subplots.AxesSubplot at 0x11d650908>



In [6]:
```
dirtydata4bestdeal.boxplot(column='ZipCode')
```

Out[6]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x11d754dd8>
```



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

In [7]:
```
# Drop the NaN values

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

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

Out[7]:

	ZipCode	CustomerAge	SamsungTV46LED	SonyTV42LED	XBOX360	DellLaptop	BoseSoundSy
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	

5 rows × 34 columns

In [8]:
```
# Add the rest of your code here to clean the data
```

I would perform the below on the code base

I am not sure I should be removing/manipulating data from the data set but along with outliers, I would also begin to edit or remove values where identifiers are not equal to 1 or 0 and ages look incorrect

In [9]:
```
# objects = ['SamsungTV46LED' , 'SonyTV42LED', 'XBOX360', 'DellLaptop',
 'BoseSoundSystem']

# for i in objects:
#     cleandata4bestdeal[i] = pd.to_numeric(cleandata4bestdeal[i], downc
ast='float', errors='coerce')

# cleandata4bestdeal.dtypes
```

In [10]:
```
# Add the rest of your code here to clean the data

# Remove duplicates
# cleandata4bestdeal = cleandata4bestdeal.drop_duplicates()
# cleandata4bestdeal = cleandata4bestdeal.dropna()
# print(cleandata4bestdeal.duplicated().sum())
# print(cleandata4bestdeal.isna().sum())
```

In [11]:
```
# experimenting with how to identify rows that have outliers greater tha
n sigma * 1.5 or 3. The below is supposed to only return values that are
less than 3 (extreme outliers)
# Need to explore in more detail

# from scipy import stats
# cleandata4bestdeal[(np.abs(stats.zscore(cleandata4bestdeal)) < 3).all
(axis=1)]
```

Lets store the cleaned data into the Database

In [12]:
```
engine=create_engine('sqlite:///bestdeal.db')
```

In [13]:
```
try:
    cleandata4bestdeal.to_sql('trans4cust', engine)
except ValueError:
    print('Table Already Exists')
```

```
Table Already Exists
```

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

In [14]:
```
insp=inspect(engine)
```

In [15]:
```
insp.get_table_names()
```

Out[15]:
```
['trans4cust', 'trans4cust_2']
```

In [16]:
```
pd.read_sql_table('trans4cust', engine).columns
```

Out[16]:
```
Index(['index', 'ZipCode', 'CustomerAge', 'SamsungTV46LED', 'SonyTV42LE
D',
       'XBOX360', 'DellLaptop', 'BoseSoundSystem', 'BoseHeadSet',
       'SonyHeadSet', 'iPod', 'iPhone', 'Panasonic50LED', 'SonyPS4', 'W
iiU',
       'WDexternalHD', 'SamsungTV55LED', 'SonyTV60LED', 'SandiskMemoryC
ard',
       'SonySoundSystem', 'SonyCamera', 'PanasonicCamera', 'HPPrinter',
       'SonyDVDplayer', 'ToshibaDVDplayer', 'GalaxyTablet', 'SurfaceTab
let',
       'HPLaptop', 'HDMICable', 'SpeakerCable', 'CallOfDutyGame',
       'GrandTheftAutoGame', 'ASUSLaptop', 'LenevoLaptop', 'TVStandWall
Mount'],
      dtype='object')
```

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

Now we are ready to query the Database

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

In [17]:
```
resultsForBestDealCustTrans=pd.read_sql_query("SELECT * FROM trans4cust
 WHERE ZipCode='60616'", engine)
```

In [18]:
```
resultsForBestDealCustTrans.head()
```

Out[18]:

	index	ZipCode	CustomerAge	SamsungTV46LED	SonyTV42LED	XBOX360	DellLaptop	BoseS
0	3	60616.0	56.0	0	1	1	1	
1	16	60616.0	43.0	0	1	1	0	
2	18	60616.0	54.0	1	0	0	1	
3	23	60616.0	43.0	1	1	1	0	
4	34	60616.0	31.0	0	1	1	1	

5 rows × 35 columns

Query example #2: get the transactions for ALL customers

In [19]:
```
resultsForBestDealCustTrans=pd.read_sql_query("SELECT * FROM trans4cust"
, engine)
```

In [20]:
```
resultsForBestDealCustTrans.head()
```

Out[20]:

	index	ZipCode	CustomerAge	SamsungTV46LED	SonyTV42LED	XBOX360	DellLaptop	BoseS
0	0	30134.0	35.0	1	1	1	0	
1	1	62791.0	43.0	0	1	0	0	
2	3	60616.0	56.0	0	1	1	1	
3	5	2108.0	55.0	1	1	1	1	
4	6	90033.0	44.0	1	1	1	1	

5 rows × 35 columns

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

In [21]:
```
resultsForBestDealCustTrans=pd.read_sql_query("SELECT ZipCode , COUNT(*)
as 'num_customers' FROM trans4cust GROUP BY ZipCode  ORDER BY ZipCode",
engine)
```

In [22]:
```
resultsForBestDealCustTrans
```

Out[22]:

	ZipCode	num_customers
0	2108.0	632
1	2109.0	955
2	2110.0	224
3	10065.0	788
4	30134.0	1173
5	30303.0	1001
6	33129.0	554
7	33130.0	280
8	44114.0	526
9	60532.0	243
10	60585.0	248
11	60603.0	240
12	60611.0	62
13	60616.0	960
14	62791.0	3
15	90024.0	144
16	90033.0	665
17	94102.0	166
18	94158.0	512
19	794158.0	8
20	830134.0	8
21	844114.0	8
22	860616.0	8
23	930134.0	8
24	960616.0	8
25	990033.0	8

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

In [23]:
```
resultsForBestDealCustTrans=pd.read_sql_query(
"SELECT CustomerAge , COUNT(*) as 'num_customers' FROM trans4cust WHERE
 ZipCode=60616 GROUP BY CustomerAge  ORDER BY CustomerAge", engine)
```

In [24]:
```
resultsForBestDealCustTrans
```

Out[24]:

	CustomerAge	num_customers
0	21.0	56
1	22.0	32
2	23.0	40
3	25.0	88
4	26.0	48
5	27.0	32
6	28.0	32
7	29.0	56
8	31.0	16
9	32.0	16
10	34.0	96
11	35.0	72
12	37.0	64
13	38.0	24
14	39.0	8
15	43.0	48
16	44.0	88
17	45.0	24
18	46.0	24
19	51.0	8
20	54.0	48
21	56.0	32
22	727.0	8

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)

In [25]:
```
SonyTV60LEDCustTrans=pd.read_sql_query(
"SELECT ZipCode , COUNT(*) as 'num_customers' FROM trans4cust WHERE Sony
TV60LED=1  GROUP BY ZipCode HAVING COUNT(*) > 400", engine)

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

In [26]:
```
SonyTV60LEDCustTrans
```

Out[26]:

	ZipCode	num_customers
0	2108.0	416
1	2109.0	611
2	10065.0	467
3	30134.0	774
4	30303.0	524
5	60616.0	697

In [27]:
```
BoseSoundSystemCustTrans
```

Out[27]:

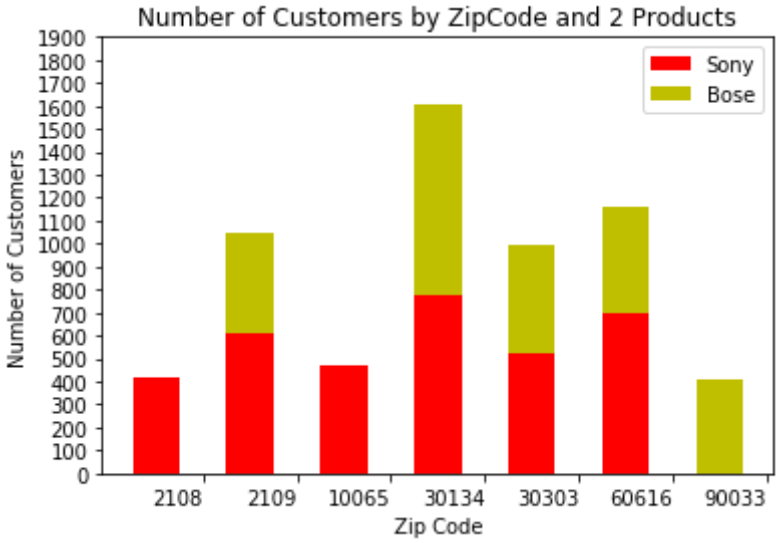
	ZipCode	num_customers
0	2109.0	436
1	30134.0	832
2	30303.0	472
3	60616.0	467
4	90033.0	406

In [28]:
```
SonyTV60LEDCustTrans.ZipCode
```

Out[28]:
```
0     2108.0
1     2109.0
2    10065.0
3    30134.0
4    30303.0
5    60616.0
Name: ZipCode, dtype: float64
```

In [29]:
```
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 asymm
etrical set  of zipcode values
#   So, we need to do somework to create the symmteric set of zipcode va
lues 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.in
t))
bose_num_customersTuples=tuple(BoseSoundSystemCustTrans.num_customers.as
type(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)
```

In [30]:
```
# 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_cus
tomer_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()
```



In [31]:
```
np.arange(len(sony_customer_tuple))
```

Out[31]:
```
array([0, 1, 2, 3, 4, 5, 6])
```

Requirements :

1. (Use SQL/SQlite): get the number of customers who bought DellLaptop and HPPrinter for every Age group sorted by CustomerAge
2. (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)
3. (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)

In [32]:
```
# Write your python code that meets the above requirements in this cell
```

1. (Use SQL/SQlite): get the number of customers who bought DellLaptop and HPPrinter for every Age group sorted by CustomerAge

In [40]:
```
dellLaptop_and_HPPrinter_trans=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)

dellLaptop_and_HPPrinter_trans
```

Out[40]:

	CustomerAge	num_customers
0	21.0	201
1	22.0	217
2	23.0	320
3	25.0	65
4	26.0	192
5	27.0	280
6	28.0	56
7	29.0	151
8	31.0	216
9	32.0	184
10	34.0	128
11	35.0	136
12	36.0	200
13	38.0	16
14	39.0	88
15	42.0	72
16	44.0	192
17	45.0	32
18	46.0	63
19	47.0	32
20	51.0	24
21	53.0	24
22	54.0	136
23	56.0	192
24	57.0	64
25	59.0	80
26	61.0	32
27	536.0	8
28	727.0	8

2. (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)

In [41]:
```
zipCodes_noXbox360_trans=pd.read_sql_query(
'''  select zipcode
     from trans4cust_2
     group by 1
     having sum(xbox360) = 0 ;  ''', engine)

zipCodes_noXbox360_trans
```

Out[41]:

	ZipCode
0	62791.0

3. (Use SQL/SQlite/Matplotlib): Plot in a stacked-bar figure the number of customers 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)

In [35]:
```
# 3. (Use SQL/SQlite/Matplotlib): Plot in a stacked-bar figure the numbe
r 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 bu
y WDexternalHD)

#created a new databases table that includes a primary key so I treat ev
ery row uniquely and perform joins confidentally

cleandata4bestdeal_with_pk = cleandata4bestdeal.copy()
cleandata4bestdeal_with_pk['pk'] = range(0,len(cleandata4bestdeal))

try:
    cleandata4bestdeal_with_pk.to_sql('trans4cust_2', engine)
except ValueError:
    print('Table Already Exists')
```

```
Table Already Exists
```

In [36]:
```
#Check Query logic
# Confirm data set does not include purchases of wdexternalhd

test =pd.read_sql_query(
''' select a.*
from trans4cust_2 a
inner join
 (
        select *
        from trans4cust_2 b
        where wdexternalhd = 0
 ) b
 on a.pk = b.pk
 where a.HPLaptop = 1
 or a.HPPrinter = 1 ''', engine)

test[test['WDexternalHD'] > 0]
```

Out[36]:

index	ZipCode	CustomerAge	SamsungTV46LED	SonyTV42LED	XBOX360	DellLaptop	BoseSc

0 rows × 36 columns

In [37]:
```
# Make the assumption that all values greater than 0 are meant to be a
 1, would confirm with business partners if possible

HP_printerOrLaptopTrans_noWDexternalHD_trans =pd.read_sql_query(
''' select *
    from (
        select a.customerAge
        , sum(case when a.HPLaptop >= 1 then 1 else 0 end) as HPLaptop_c
ust_ct
        , sum(case when a.HPPrinter >= 1 then 1 else 0 end) as HPPrinter
_cust_ct
        from trans4cust_2 a
        inner join
         (
            select *
            from trans4cust_2 b
            where wdexternalhd = 0
         ) b
         on a.pk = b.pk
         where a.HPLaptop = 1
         or a.HPPrinter = 1
         group by 1 )
    where (HPLaptop_cust_ct + HPPrinter_cust_ct) > 100 ''', engine)
```

In [44]:
```
ind2 = np.arange(len(HP_printerOrLaptopTrans_noWDexternalHD_trans))
width = .5

hpLaptop_cust = HP_printerOrLaptopTrans_noWDexternalHD_trans['HPLaptop_cust_ct']
hpPrinter_cust = HP_printerOrLaptopTrans_noWDexternalHD_trans['HPPrinter_cust_ct']
customerAge = HP_printerOrLaptopTrans_noWDexternalHD_trans['customerAge'].astype(int)

plt.bar(ind2, hpLaptop_cust, color = 'r')
plt.bar(ind2, hpPrinter_cust, bottom=hpPrinter_cust, color = 'y')
plt.xticks(np.arange(len(customerAge)) + width, tuple(customerAge), horizontalalignment='right')
plt.yticks(np.arange(0, 1100, 100))
plt.title('Customers who purchased a HP Printer or HP Laptop by Age')
plt.ylabel('Number of Customers')
plt.xlabel('Age Group')
plt.legend((p1[0], p2[0]), ('HPLaptop', 'HPPrinter'))
```

Out[44]: <matplotlib.legend.Legend at 0x11db91ba8>