Investigate_a_Dataset

January 21, 2023

1 Investigate a Dataset - [No-Show Appointments]

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Introduction

1.1.1 Dataset Description

This dataset collects information from 100k medical appointments in Brazil and is focused on the question of whether or not patients show up for their appointment. A number of characteristics about the patient are included in each row.

'ScheduledDay' tells us on what day the patient set up their appointment.

'Neighborhood' indicates the location of the hospital.

'Scholarship' indicates whether or not the patient is enrolled in Brasilian welfare program Bolsa Família.

Be careful about the encoding of the last column: it says 'No' if the patient showed up to their appointment, and 'Yes' if they didn't show up

1.1.2 Question(s) for Analysis

Does age affect the attendance?
Does age and chronic diaseases comined affect?
Does gender affect the attendance?
Does receiving SMS affect the attenddance?
Does neighbourhood affect the attendance?

```
In [68]: import pandas as pd
         import numpy as np
         import matplotlib.pyplot as plt
         import seaborn as sns
         % matplotlib inline
         pd.options.display.max_rows = 99999
```

```
In [69]: # Upgrade pandas to use dataframe.explode() function.
         !pip install --upgrade pandas==0.25.0

Collecting pandas==0.25.0
  Downloading https://files.pythonhosted.org/packages/1d/9a/7eb9952f4b4d73fbd75ad1d5d6112f407e69
    100% || 10.5MB 3.3MB/s eta 0:00:01   19% |                          | 2.1MB 28.0MB/s eta 0:00
Requirement already satisfied, skipping upgrade: pytz>=2017.2 in /opt/conda/lib/python3.6/site-p
Collecting numpy>=1.13.3 (from pandas==0.25.0)
  Downloading https://files.pythonhosted.org/packages/45/b2/6c7545bb7a38754d63048c7696804a0d9473
    100% || 13.4MB 2.5MB/s eta 0:00:01   15% |                           | 2.0MB 28.6MB/s eta 0:
Requirement already satisfied, skipping upgrade: python-dateutil>=2.6.1 in /opt/conda/lib/python
Requirement already satisfied, skipping upgrade: six>=1.5 in /opt/conda/lib/python3.6/site-packa
tensorflow 1.3.0 requires tensorflow-tensorboard<0.2.0,>=0.1.0, which is not installed.
Installing collected packages: numpy, pandas
  Found existing installation: numpy 1.12.1
    Uninstalling numpy-1.12.1:
      Successfully uninstalled numpy-1.12.1
  Found existing installation: pandas 0.23.3
    Uninstalling pandas-0.23.3:
      Successfully uninstalled pandas-0.23.3
Successfully installed numpy-1.19.5 pandas-0.25.0
```

Data Wrangling

```
In [70]: df = pd.read_csv("NoShow.csv")

In [71]: df.head()
```

Out[71]:

	PatientId	AppointmentID	Gender	ScheduledDay	AppointmentDay	Age	Neighbourhood	Scholarship	Hipertension	Diabetes	Alcoholism	Handcap	SMS_received	No-show
0	2.987250e+13	5642903	F	2016-04-29T18:38:08Z	2016-04-29T00:00:00Z	62	JARDIM DA PENHA	0	1	0	0	0	0	No
1	5.589978e+14	5642503	M	2016-04-29T16:08:27Z	2016-04-29T00:00:00Z	56	JARDIM DA PENHA	0	0	0	0	0	0	No
2	4.262962e+12	5642549	F	2016-04-29T16:19:04Z	2016-04-29T00:00:00Z	62	MATA DA PRAIA	0	0	0	0	0	0	No
3	8.679512e+11	5642828	F	2016-04-29T17:29:31Z	2016-04-29T00:00:00Z	8	PONTAL DE CAMBURI	0	0	0	0	0	0	No
4	8.841186e+12	5642494	F	2016-04-29T16:07:23Z	2016-04-29T00:00:00Z	56	JARDIM DA PENHA	0	1	1	0	0	0	No

```
In [72]: df.shape
```

```
Out[72]: (110527, 14)
```

The data contains 110527 appointments(rows) and 14 columns

```
In [73]: sum(df.duplicated())
```

```
Out[73]: 0
```

There's no duplicated rows

```
In [74]: df["PatientId"].duplicated().sum()
```

```
Out[74]: 48228
```

48228 Patient ID are duplicated

```
In [75]: df.duplicated(["PatientId", "No-show"]).sum()
```

```
Out[75]: 38710
```

There are 38710 Patient ID have the same No-show status

```
In [76]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 110527 entries, 0 to 110526
Data columns (total 14 columns):
PatientId         110527 non-null float64
AppointmentID     110527 non-null int64
Gender            110527 non-null object
ScheduledDay      110527 non-null object
AppointmentDay    110527 non-null object
Age               110527 non-null int64
Neighbourhood     110527 non-null object
Scholarship       110527 non-null int64
Hipertension      110527 non-null int64
Diabetes          110527 non-null int64
Alcoholism        110527 non-null int64
Handcap           110527 non-null int64
SMS_received      110527 non-null int64
No-show           110527 non-null object
dtypes: float64(1), int64(8), object(5)
memory usage: 11.8+ MB
```

There's no missing values

```
In [77]: df.describe()
```

Out[77]:

	PatientId	AppointmentID	Age	Scholarship	\
count	1.105270e+05	1.105270e+05	110527.000000	110527.000000	
mean	1.474963e+14	5.675305e+06	37.088874	0.098266	
std	2.560949e+14	7.129575e+04	23.110205	0.297675	
min	3.921784e+04	5.030230e+06	-1.000000	0.000000	
25%	4.172614e+12	5.640286e+06	18.000000	0.000000	
50%	3.173184e+13	5.680573e+06	37.000000	0.000000	
75%	9.439172e+13	5.725524e+06	55.000000	0.000000	
max	9.999816e+14	5.790484e+06	115.000000	1.000000	

	Hipertension	Diabetes	Alcoholism	Handcap	\
count	110527.000000	110527.000000	110527.000000	110527.000000	
mean	0.197246	0.071865	0.030400	0.022248	
std	0.397921	0.258265	0.171686	0.161543	
min	0.000000	0.000000	0.000000	0.000000	
25%	0.000000	0.000000	0.000000	0.000000	
50%	0.000000	0.000000	0.000000	0.000000	
75%	0.000000	0.000000	0.000000	0.000000	
max	1.000000	1.000000	1.000000	4.000000	

	SMS_received
count	110527.000000
mean	0.321026
std	0.466873
min	0.000000
25%	0.000000
50%	0.000000
75%	1.000000
max	1.000000

The mean age is 37 the max is 115 and the min is -1 and that's a mistake so we will deal with it later in the data cleaning

1.1.3 Data Cleaning

In [78]:
```
#Searching for the row that has -1 age with query
mask = df.query('Age == -1')
mask
```

Out[78]:

	PatientId	AppointmentID	Gender	ScheduledDay	\
99832	4.659432e+14	5775010	F	2016-06-06T08:58:13Z	

	AppointmentDay	Age	Neighbourhood	Scholarship	Hipertension	\
99832	2016-06-06T00:00:00Z	-1	ROMÃO	0	0	

	Diabetes	Alcoholism	Handcap	SMS_received	No-show
99832	0	0	0	0	No

In [79]:
```
#Removing the -1 value row
df.drop(index= 99832, inplace= True)
```

In [80]:
```
df.describe()
```

Out[80]:

	PatientId	AppointmentID	Age	Scholarship
count	1.105260e+05	1.105260e+05	110526.000000	110526.000000
mean	1.474934e+14	5.675304e+06	37.089219	0.098266
std	2.560943e+14	7.129544e+04	23.110026	0.297676
min	3.921784e+04	5.030230e+06	0.000000	0.000000
25%	4.172536e+12	5.640285e+06	18.000000	0.000000
50%	3.173184e+13	5.680572e+06	37.000000	0.000000
75%	9.438963e+13	5.725523e+06	55.000000	0.000000
max	9.999816e+14	5.790484e+06	115.000000	1.000000

	Hipertension	Diabetes	Alcoholism	Handcap
count	110526.000000	110526.000000	110526.000000	110526.000000
mean	0.197248	0.071865	0.030400	0.022248
std	0.397923	0.258266	0.171686	0.161543
min	0.000000	0.000000	0.000000	0.000000
25%	0.000000	0.000000	0.000000	0.000000
50%	0.000000	0.000000	0.000000	0.000000
75%	0.000000	0.000000	0.000000	0.000000
max	1.000000	1.000000	1.000000	4.000000

	SMS_received
count	110526.000000
mean	0.321029
std	0.466874
min	0.000000
25%	0.000000
50%	0.000000
75%	1.000000
max	1.000000

In [81]:
```
#renamming column name
df.rename(columns = {"Hipertension" : "hypertension"},inplace = True)
df.rename(columns = {"No-show" : "no_show"}, inplace= True)
df.head(1)
```

Out[81]:

	PatientId	AppointmentID	Gender	ScheduledDay
0	2.987250e+13	5642903	F	2016-04-29T18:38:08Z

	AppointmentDay	Age	Neighbourhood	Scholarship	hypertension
0	2016-04-29T00:00:00Z	62	JARDIM DA PENHA	0	1

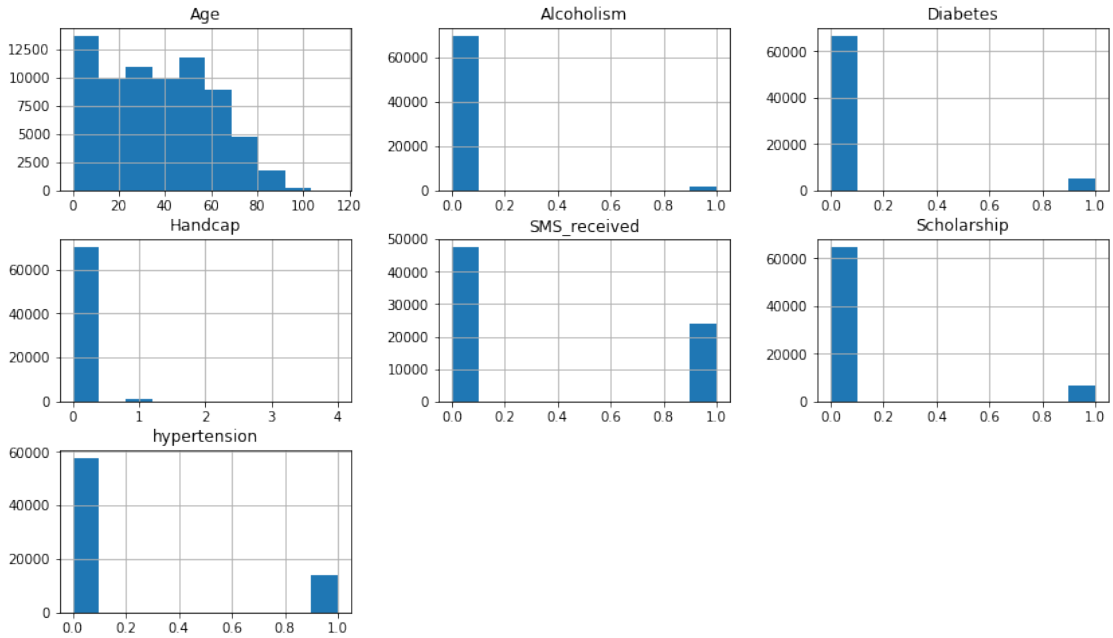
	Diabetes	Alcoholism	Handcap	SMS_received	no_show
0	0	0	0	0	No

```
In [82]: #dropping patintId with the same no show status
         df.drop_duplicates(["PatientId", "no_show"], inplace= True)
         df.shape

Out[82]: (71816, 14)

In [83]: #removing unuseful data
         df.drop(["PatientId", "AppointmentID", "ScheduledDay", "AppointmentDay"], axis = 1, inp
         df.head()

Out[83]:   Gender  Age      Neighbourhood  Scholarship  hypertension  Diabetes  \
         0      F   62    JARDIM DA PENHA            0             1         0
         1      M   56    JARDIM DA PENHA            0             0         0
         2      F   62      MATA DA PRAIA            0             0         0
         3      F    8  PONTAL DE CAMBURI            0             0         0
         4      F   56    JARDIM DA PENHA            0             1         1

            Alcoholism  Handcap  SMS_received no_show
         0           0        0             0      No
         1           0        0             0      No
         2           0        0             0      No
         3           0        0             0      No
         4           0        0             0      No
```

Exploratory Data Analysis

1.1.4 General Look

```
In [84]: df.hist(figsize= (14,8));
```



```
In [85]: #Spliting the patints into two groups according their No-Show status
         came = df.no_show == "No"
         noshow = df.no_show == "Yes"
         df[came].count(), df[noshow].count()
```

```
Out[85]: (Gender           54153
          Age              54153
          Neighbourhood    54153
          Scholarship      54153
          hypertension     54153
          Diabetes         54153
          Alcoholism       54153
          Handcap          54153
          SMS_received     54153
          no_show          54153
          dtype: int64, Gender           17663
          Age              17663
          Neighbourhood    17663
          Scholarship      17663
          hypertension     17663
          Diabetes         17663
          Alcoholism       17663
          Handcap          17663
          SMS_received     17663
          no_show          17663
          dtype: int64)
```

54153 patient came to their appiontment and 17663 didn't

```
In [86]: df[came].mean(), df[noshow].mean()
```

```
Out[86]: (Age             37.229166
          Scholarship      0.091334
          hypertension     0.202944
          Diabetes         0.072868
          Alcoholism       0.023600
          Handcap          0.020904
          SMS_received     0.297232
          dtype: float64, Age             34.376267
          Scholarship      0.108419
          hypertension     0.170922
          Diabetes         0.065108
          Alcoholism       0.029440
          Handcap          0.017777
          SMS_received     0.453094
          dtype: float64)
```

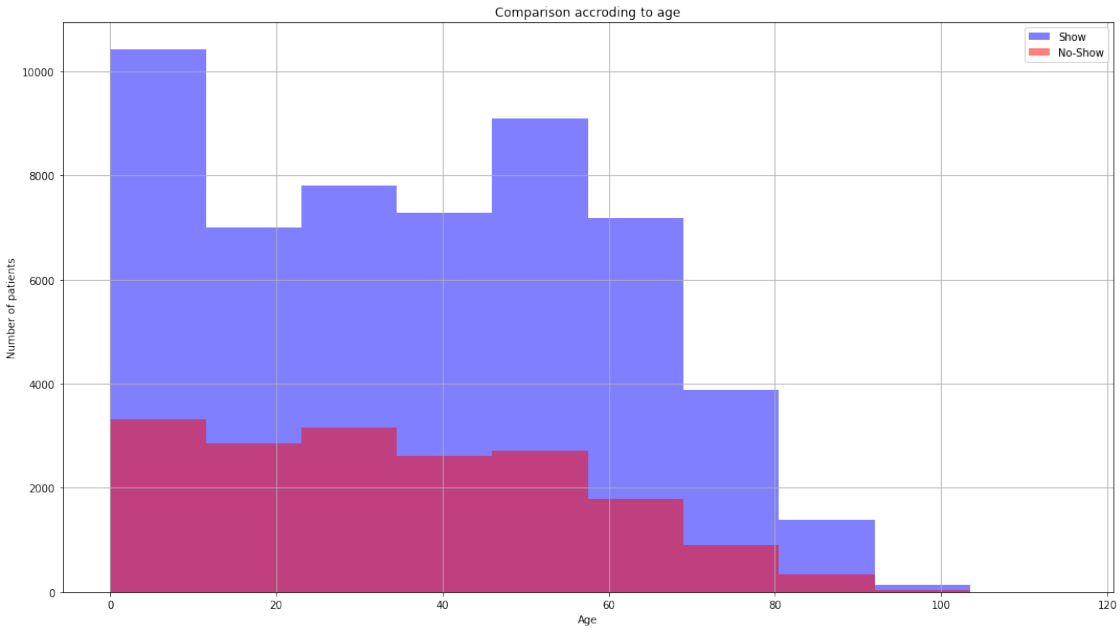
Mean age for patients who came is 37, patients who didn't is 34. patienta who came recieved less sms than patienta who didn't came(that means there's a proplem in the sms campaign)

1.2 Investigation for the influencing factors on the attendance rate

1.2.1 Question 1

1.2.2 Does age affect the attendance?

```
In [87]: def attendance(df,col_name,attend,absent):

             plt.figure(figsize = [18,10])
             df[col_name][came].hist(alpha = .5, bins= 10, color = "b", label= "Show")
             df[col_name][noshow].hist(alpha= .5,bins= 10,color= 'red', label= "No-Show")
             plt.legend();
             plt.title("Comparison accroding to age")
             plt.xlabel("Age")
             plt.ylabel("Number of patients")

         attendance(df,"Age",came,noshow)
```



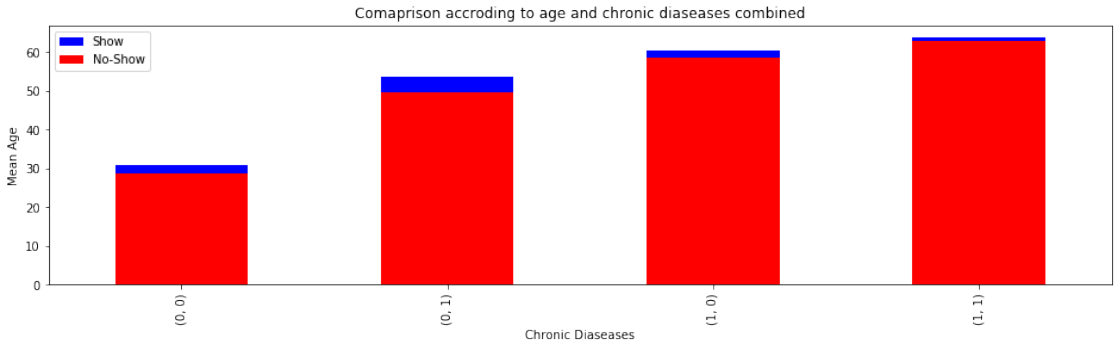
ages from 0:8 are the most showing to their appointments then patients from 45:55 and the least attending are whom above 65 years old

1.2.3 Question 2

1.2.4 Does age and chronic diaseases combined affect the attendance?

```
In [88]: plt.figure(figsize= [16,4])
         df[came].groupby(["hypertension", "Diabetes"]).mean()["Age"].plot(kind= "bar", color =
```

```
df[noshow].groupby(["hypertension", "Diabetes"]).mean()["Age"].plot(kind= "bar", color=
plt.legend();
plt.title("Comaprison accroding to age and chronic diaseases combined")
plt.xlabel("Chronic Diaseases")
plt.ylabel("Mean Age");
```




```
In [89]: df[came].groupby(["hypertension", "Diabetes"]).mean()["Age"],df[noshow].groupby(["hyper
```

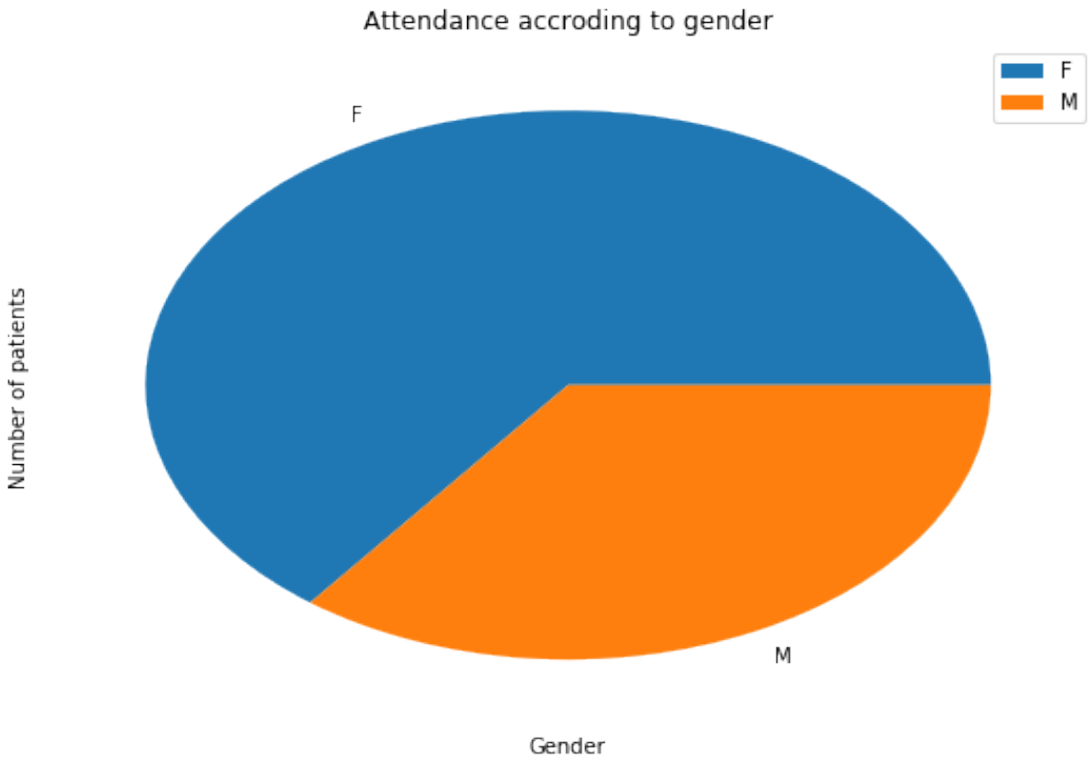
```
Out[89]: (hypertension  Diabetes
          0             0           30.713360
                        1           53.701370
          1             0           60.270517
                        1           63.764303
          Name: Age, dtype: float64, hypertension  Diabetes
          0             0           28.768691
                        1           49.481172
          1             0           58.650380
                        1           62.913282
          Name: Age, dtype: float64)
```

Mean age of non chronic diaseases patienta who came is 30 and who didn't is 28. Mean age of hypertensive diabetic showing is around 64 and non showing is about 63 which means there's no correlation between chronic diaseases and attending.

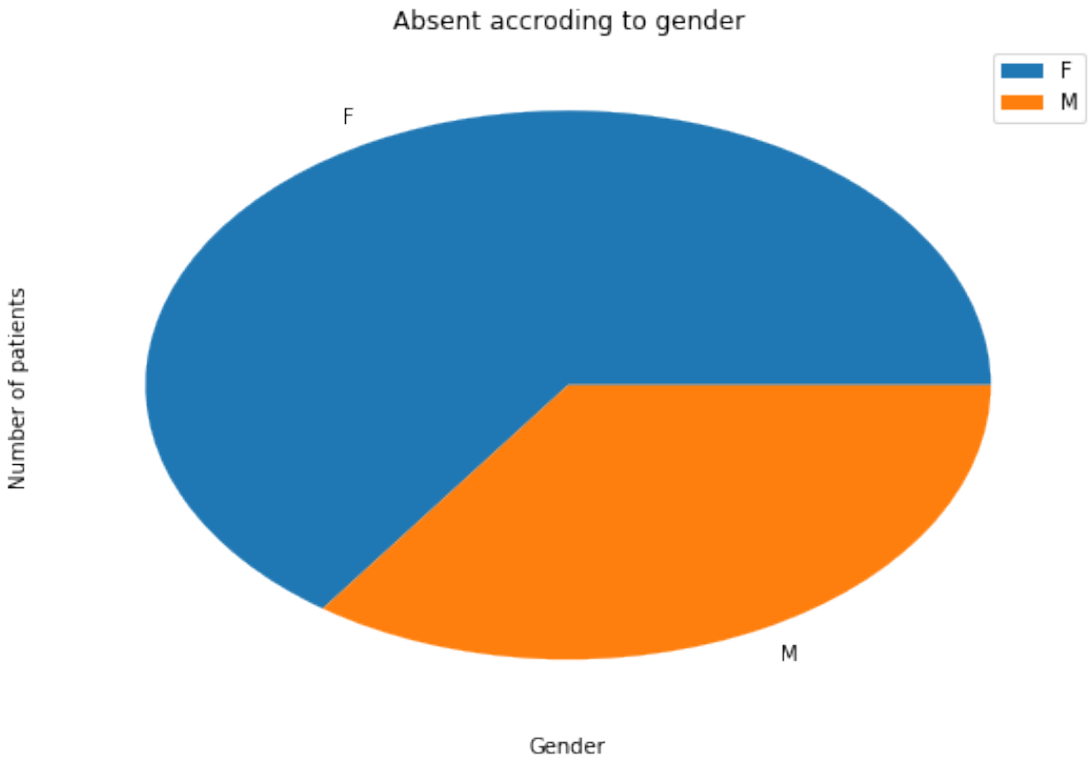
1.2.5 Questions 3

1.2.6 Does gender affect the attendance?

```
In [90]: def attendance(df,col_name,attend,absent):
             plt.figure(figsize= [9,6])
             df[col_name][came].value_counts(normalize= True).plot(kind = "pie",label= "Show")
             plt.legend();
             plt.title("Attendance accroding to gender")
             plt.xlabel("Gender")
             plt.ylabel("Number of patients")
         attendance(df,"Gender",came,noshow);
```




```
In [91]: def attendance(df,col_name,attend,absent):
             plt.figure(figsize= [9,6])
             df[col_name][noshow].value_counts(normalize= True).plot(kind= "pie",label= "No-Show
             plt.legend();
             plt.title("Absent accroding to gender")
             plt.xlabel("Gender")
             plt.ylabel("Number of patients")
         attendance(df,"Gender",came,noshow);
```

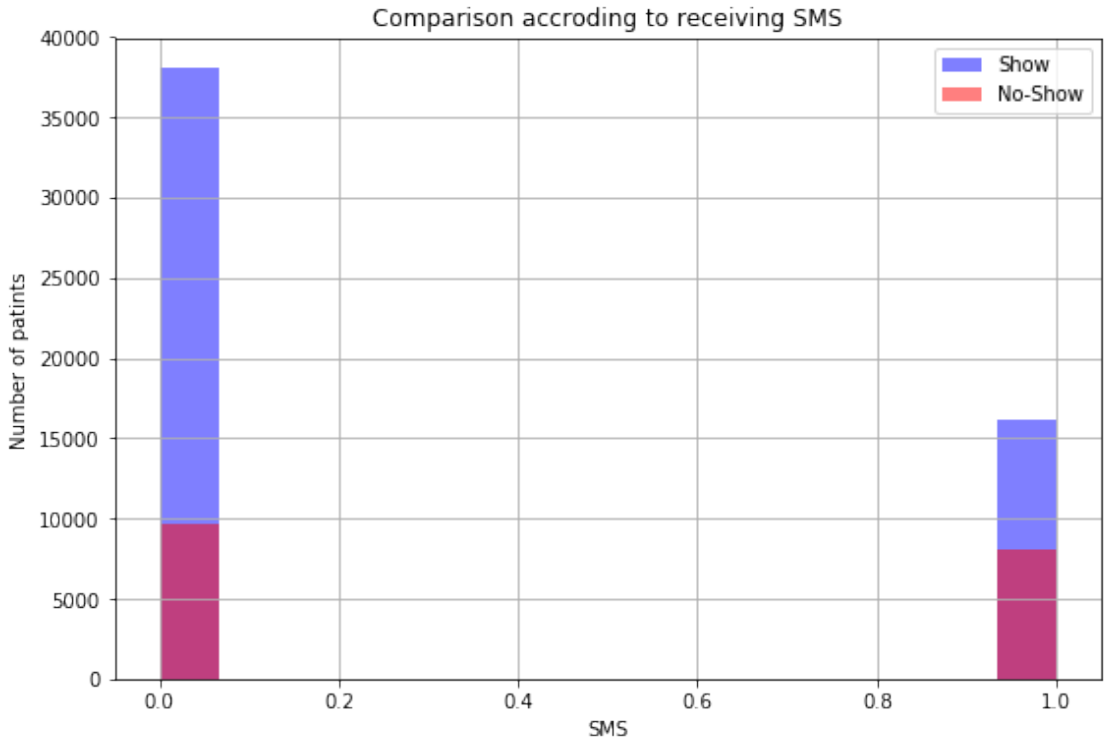


Gender doesn't affect the attendance

1.2.7 Question 4

1.2.8 Does receiving SMS affect the attendance?

```
In [92]: def attendance(df,col_name,attend,absent):
             plt.figure(figsize= [9,6])
             df[col_name][came].hist(alpha = .5,bins = 15,color= "b",label= "Show")
             df[col_name][noshow].hist(alpha = .5, bins= 15, color= "r", label= "No-Show")
             plt.legend();
             plt.title("Comparison accroding to receiving SMS")
             plt.xlabel("SMS")
             plt.ylabel("Number of patints")
         attendance(df,"SMS_received",came,noshow);
```

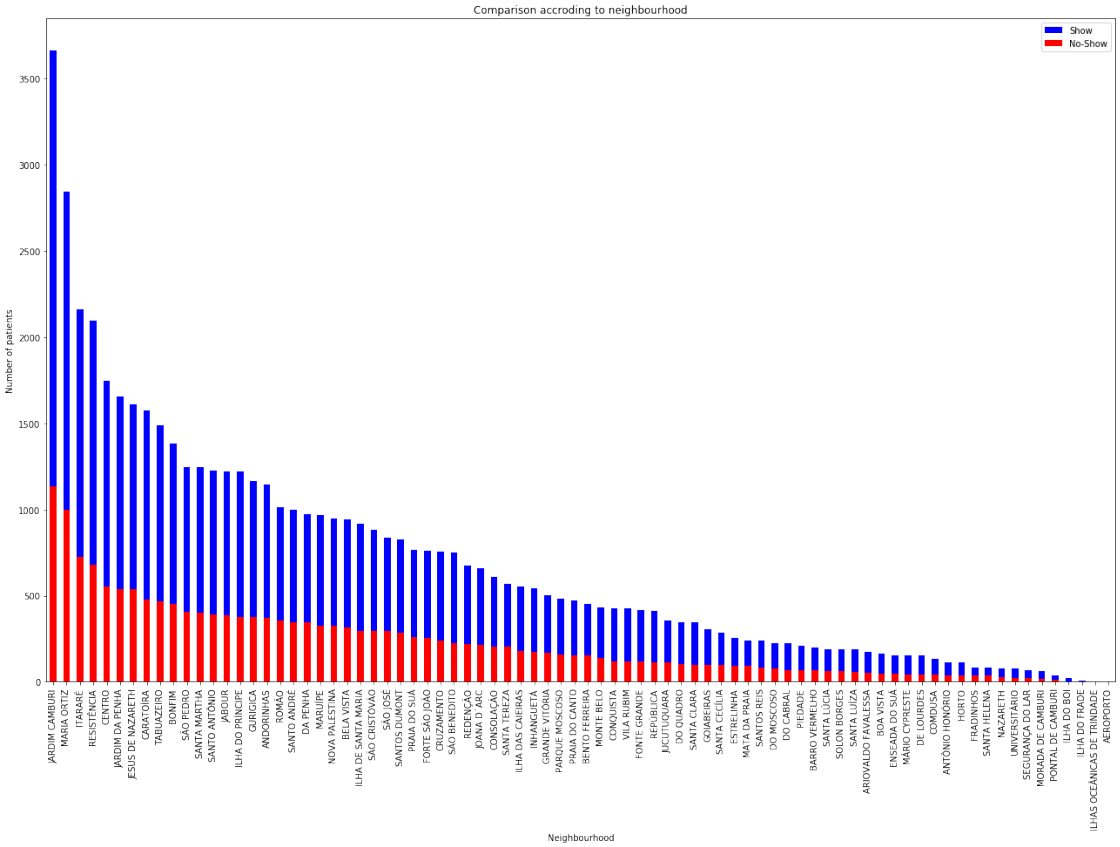


Number of showing patients without receiving SMS is greater than patients who received SMS and came

1.2.9 Question 5

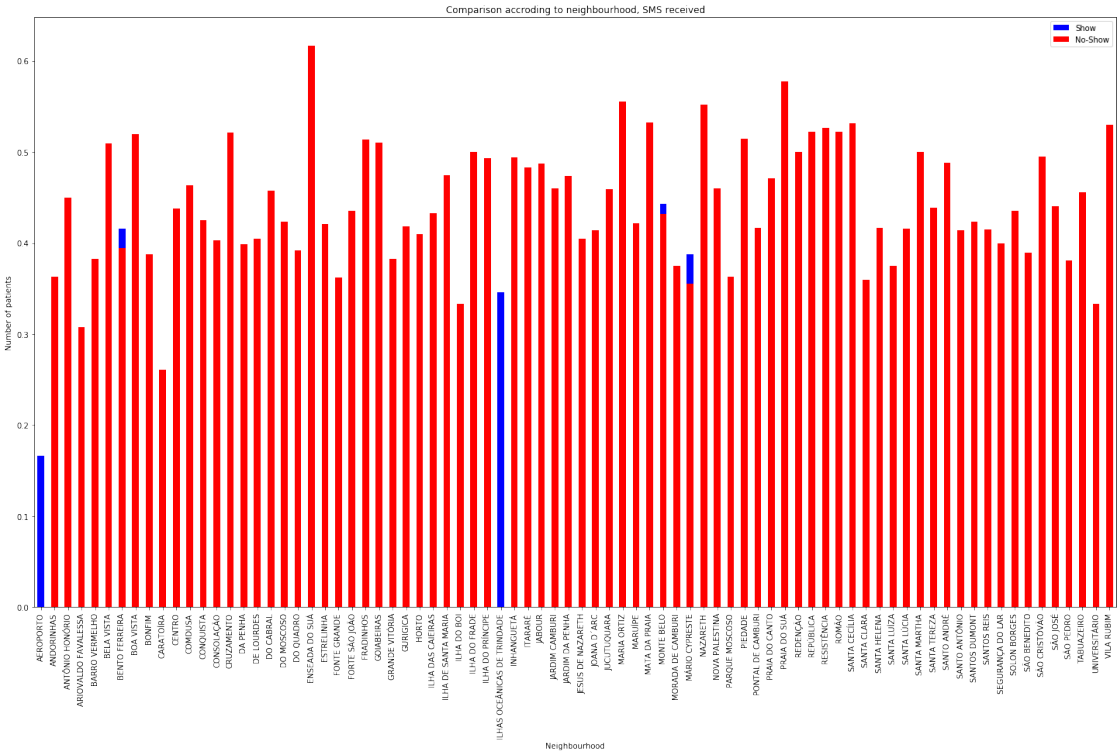
1.2.10 Does neighbourhood affect the attendance?

```
In [93]: plt.figure(figsize= [22,14])
         df.Neighbourhood[came].value_counts().plot(kind= "bar",color= "b", label= "Show")
         df.Neighbourhood[noshow].value_counts().plot(kind= "bar", color= "r", label = "No-Show"
         plt.legend();
         plt.title("Comparison accroding to neighbourhood")
         plt.xlabel("Neighbourhood")
         plt.ylabel("Number of patients");
```



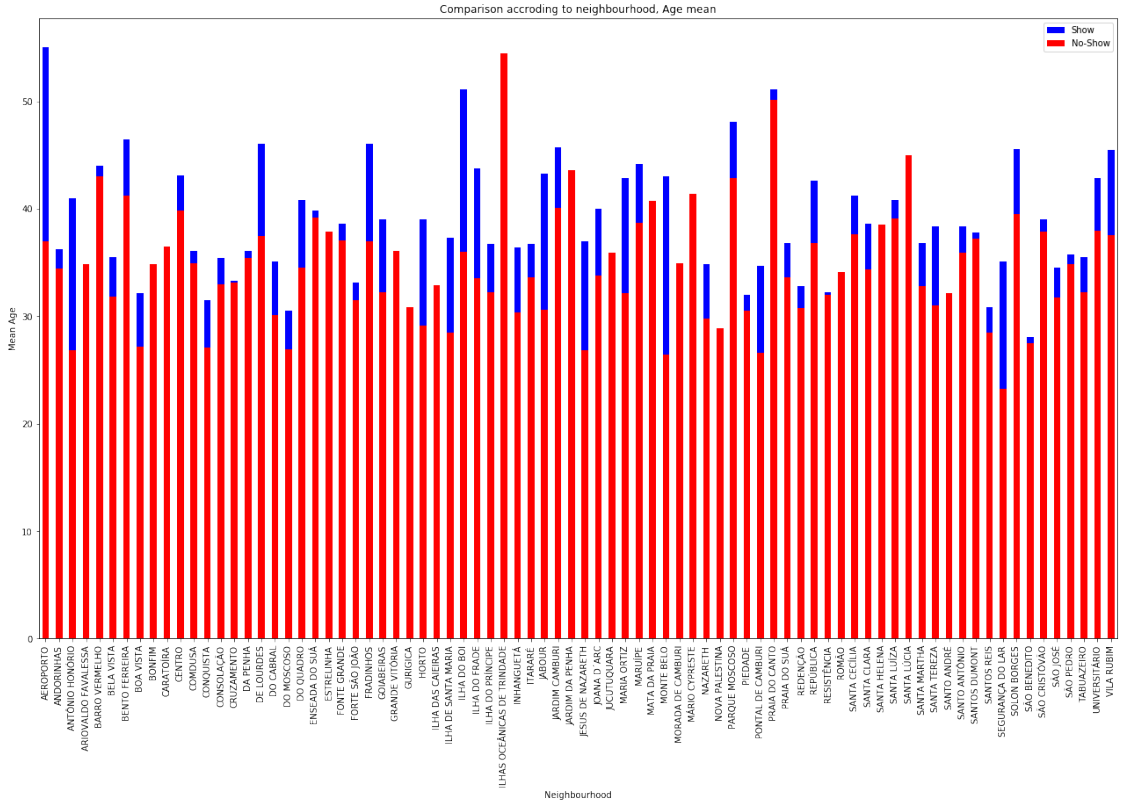
Neighbourhoods has a clear impact on attendance, JARDAIM CAMBURI has the greatest number of patients and also the greatest showing rate

```
In [94]: plt.figure(figsize= [25,14])
         df[came].groupby("Neighbourhood").SMS_received.mean().plot(kind= "bar", color= "b",labe
         df[noshow].groupby("Neighbourhood").SMS_received.mean().plot(kind= "bar", color = 'r',
         plt.legend();
         plt.title("Comparison accroding to neighbourhood, SMS received")
         plt.xlabel("Neighbourhood")
         plt.ylabel("Number of patients");
```



SMS has reaponse in only 5 neighbourhoods, ILHAS OCEANICAS DE TRINDADE is the most responsive neighbourhood to SMS

```
In [95]: plt.figure(figsize= [22,13])
         df[came].groupby("Neighbourhood").Age.mean().plot(kind = "bar", color= "b",label= "Show
         df[noshow].groupby("Neighbourhood").Age.mean().plot(kind = "bar", color= 'r', label= "N
         plt.legend();
         plt.title("Comparison accroding to neighbourhood, Age mean")
         plt.xlabel("Neighbourhood")
         plt.ylabel("Mean Age");
```



Patients attendance from specific neighbourhoods, AEROPORTO then ILHA DO BOI are with high ages attendance

In [ ]:

Conclusions

Neighbourhoods has a great affect on attendance, JARDAIM CAMBURI has the greatest number of patients and also the greatest showing rate.

Number of showing patients from specific neighbourhood affected by SMS received and ages

Age has a clear impact on the showing rate, Ages from 0:8 are the most showing then from 45:55 and the least attending are whom above 65 years

Number of patients who came without receiving SMS is greater than showing patients who received SMS(we have to improve rhe SMS campaign

1.3 limitations

No clear correlation between showing and gender, chronic diaseases, enrollment in the wellfare program

In [ ]:
```
from subprocess import call
call(['python', '-m', 'nbconvert', 'Investigate_a_Dataset.ipynb'])
```