Investigate_a_Dataset

May 30, 2021

1 Project: Investigate a Dataset (No-show Appointments)

1.1 Table of Contents

## Introduction

In this project this dataset collects information from 100k medical appointments in Brazil provided on (Kaggle) and is focused on the question of whether or not patients show up for their appointment. And the mean question that should we find the answer about is what factors are important for us to know in order to predict if a patient will show up for their scheduled appointment?

1.2 Questions

- What is the total percentage of no show ?
- Are no-show appointments associated with a certain gender?
- How is age affecting the patient's absence?
- Is scholarship a factor in decreasing the number of absences?
- Is alcoholism a prominent factor in patient's absences?
- Do SMS reminders decrease the number of absences?

```
In [123]: # Use this cell to set up import statements for all of the packages that you
          #   plan to use.

          # Remember to include a 'magic word' so that your visualizations are plotted
          #   inline with the notebook. See this page for more:
          #   http://ipython.readthedocs.io/en/stable/interactive/magics.html
          import pandas as pd
          import numpy as np
          import matplotlib.pyplot as plt
          import seaborn as sns
          % matplotlib inline
```

## Data Wrangling

In the next step I'm going to assess the dataset by some of the assessment methods to building intuition about a dataset and check if some data need to be cleaned.

1.2.1 General Properties

```
In [124]: # Load your data and print out a few lines. Perform operations to inspect data
          #   types and look for instances of missing or possibly errant data.
          df = pd.read_csv('noshowappointments-kagglev2-may-2016.csv')
          df.head()
```

```
Out[124]:       PatientId  AppointmentID Gender          ScheduledDay  \
          0  2.987250e+13        5642903      F  2016-04-29T18:38:08Z
          1  5.589978e+14        5642503      M  2016-04-29T16:08:27Z
          2  4.262962e+12        5642549      F  2016-04-29T16:19:04Z
          3  8.679512e+11        5642828      F  2016-04-29T17:29:31Z
          4  8.841186e+12        5642494      F  2016-04-29T16:07:23Z

                   AppointmentDay  Age      Neighbourhood  Scholarship  Hipertension  \
          0  2016-04-29T00:00:00Z   62    JARDIM DA PENHA            0             1
          1  2016-04-29T00:00:00Z   56    JARDIM DA PENHA            0             0
          2  2016-04-29T00:00:00Z   62      MATA DA PRAIA            0             0
          3  2016-04-29T00:00:00Z    8  PONTAL DE CAMBURI            0             0
          4  2016-04-29T00:00:00Z   56    JARDIM DA PENHA            0             1

             Diabetes  Alcoholism  Handcap  SMS_received No-show
          0         0           0        0             0      No
          1         0           0        0             0      No
          2         0           0        0             0      No
          3         0           0        0             0      No
          4         1           0        0             0      No
```

```
In [125]: # Dataset shape (check the numbers of samples(rows) and columns)
          df.shape
```

```
Out[125]: (110527, 14)
```

```
In [126]: # Checking the dataset data types of each column
          df.dtypes
```

```
Out[126]: PatientId         float64
          AppointmentID       int64
          Gender             object
          ScheduledDay       object
          AppointmentDay     object
          Age                 int64
          Neighbourhood      object
          Scholarship         int64
          Hipertension        int64
          Diabetes            int64
          Alcoholism          int64
          Handcap             int64
          SMS_received        int64
          No-show            object
          dtype: object
```

```
In [127]: # Dataset info (checking whether there is a missing values)
          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
```

```
In [128]: # Checking the number of unique values in each column of the dataset
          df.nunique()
```

```
Out[128]: PatientId          62299
          AppointmentID     110527
          Gender                 2
          ScheduledDay      103549
          AppointmentDay        27
          Age                  104
          Neighbourhood         81
          Scholarship            2
          Hipertension           2
          Diabetes               2
          Alcoholism             2
          Handcap                5
          SMS_received           2
          No-show                2
          dtype: int64
```

```
In [129]: # Checking whether there is a duplicate rows in the dataset
          sum(df.duplicated())

Out[129]: 0

In [130]: # View a basic statistic about the dataset
          df.describe()

Out[130]:           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
```

According to the previous assessing in the next step I'm going to clean and fixe some points of the data.

- Change the data type of (PatientId) column to integer as I think it should include only integer numbers not float.
- Change the data type of (ScheduledDay & AppointmentDay) columns to datetime instead of object as they includes dates and times.
- Use the datype method again to insure that the data types of the mentioned columns have been changed successfuly.
- Rename the following columns to be more clear and understode (PatientId, AppointmentID, ScheduledDay, AppointmentDay, Neighbourhood, Handcap, No-show).

- As apeared in the describtion above the min age is (-1), so I will drop any rows contain (-1 in age) because it's an invalid data.
- Chech how many rows contain (-1) under age column by query function then drop the row/s by drop method.
- Use query function again to insure that there is no any row with (-1) under the age column.

1.2.2 Data Cleaning (Replace this with more specific notes!)

```
In [131]: # Changing the data type of the (PatientId) column to integer instead of float
          df['PatientId'] = df['PatientId'].astype(int)
          df['PatientId'].dtypes

Out[131]: dtype('int64')

In [132]: # Changing the data type of the (Scheduled_Day & Appointment_Day) columns to datetime
          df['ScheduledDay'] = pd.to_datetime(df['ScheduledDay'])
          df['AppointmentDay'] = pd.to_datetime(df['AppointmentDay'])

In [133]: # Confirm that the changes have been done
          df.dtypes

Out[133]: PatientId                  int64
          AppointmentID              int64
          Gender                    object
          ScheduledDay      datetime64[ns]
          AppointmentDay    datetime64[ns]
          Age                        int64
          Neighbourhood             object
          Scholarship                int64
          Hipertension               int64
          Diabetes                   int64
          Alcoholism                 int64
          Handcap                    int64
          SMS_received               int64
          No-show                   object
          dtype: object

In [134]: # Rename some columns of dataset
          df.rename(columns={'PatientId':'Patient_ID','AppointmentID':'Appointment_ID','Schedule
          df.head()

Out[134]:         Patient_ID  Appointment_ID Gender       Scheduled_Day Appointment_Day  \
          0   29872499824296         5642903      F 2016-04-29 18:38:08      2016-04-29
          1  558997776694438         5642503      M 2016-04-29 16:08:27      2016-04-29
          2    4262962299951         5642549      F 2016-04-29 16:19:04      2016-04-29
          3     867951213174         5642828      F 2016-04-29 17:29:31      2016-04-29
          4    8841186448183         5642494      F 2016-04-29 16:07:23      2016-04-29

             Age  Hospital_location  Scholarship  Hipertension  Diabetes  Alcoholism  \
0   62    JARDIM DA PENHA            0             1          0            0
1   56    JARDIM DA PENHA            0             0          0            0
2   62      MATA DA PRAIA            0             0          0            0
3    8  PONTAL DE CAMBURI            0             0          0            0
4   56    JARDIM DA PENHA            0             1          1            0

   Handicap  SMS_received No_show
0         0             0      No
1         0             0      No
2         0             0      No
3         0             0      No
4         0             0      No
```

```
In [135]: # As appeared in the basic statistic there is a (-1) value in the age column, (chechki
          df.query('Age == "-1"')
```

```
Out[135]:            Patient_ID  Appointment_ID Gender       Scheduled_Day  \
          99832  465943158731293         5775010      F 2016-06-06 08:58:13

                Appointment_Day  Age Hospital_location  Scholarship  Hipertension  \
          99832      2016-06-06   -1             ROMÃO            0             0

                 Diabetes  Alcoholism  Handicap  SMS_received No_show
          99832         0           0         0             0      No
```

```
In [136]: # Remove this row that include invalid age value
          df.drop([99832], inplace=True)
```

```
In [137]: # Confirm that it has been removed
          df.query('Age == "-1"')
```

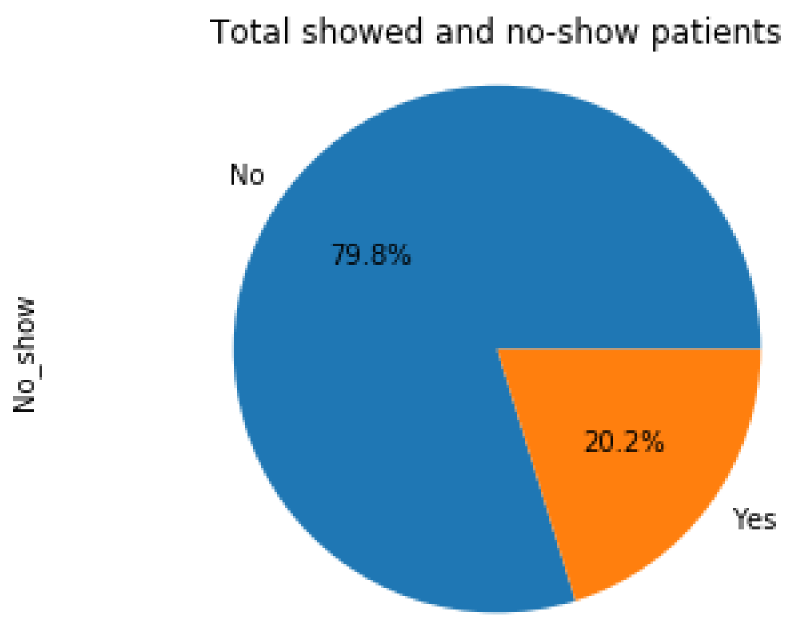
```
Out[137]: Empty DataFrame
          Columns: [Patient_ID, Appointment_ID, Gender, Scheduled_Day, Appointment_Day, Age, Hos
          Index: []
```

## Exploratory Data Analysis

1.2.3 Research Question 1 (What is the overall percentage of show and no-show patients?)

```
In [138]: # Count the total number of showed and no show patients and create a pie chart to visu
          total = df['No_show'].value_counts().plot(kind='pie',autopct='%1.1f%%');
          print(total)
          plt.title ('Total showed and no-show patients')
          plt.axis('equal')
          plt.show()
```

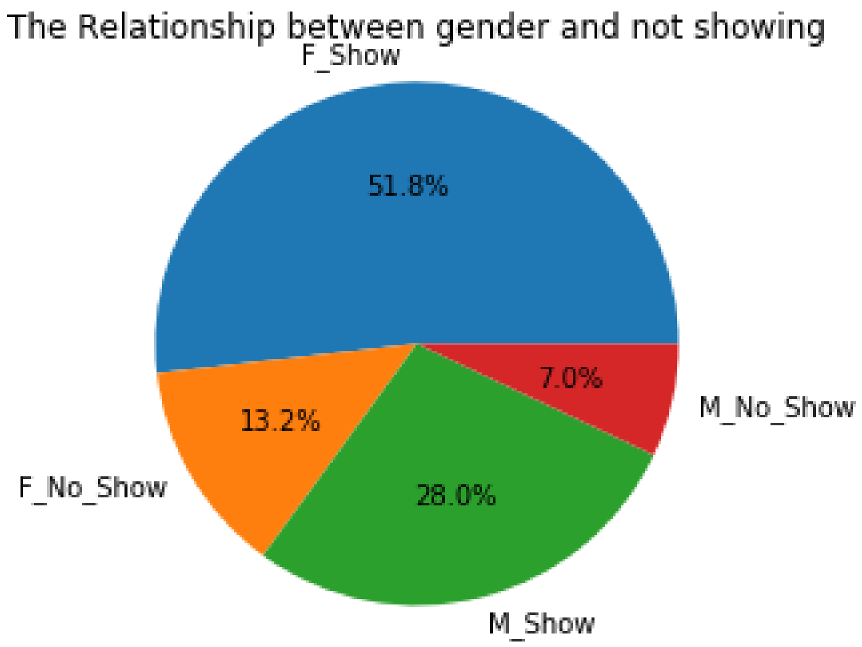
```
AxesSubplot(0.125,0.125;0.775x0.755)
```



Result: Overall (110526) patients there are 79.8% showed and 20.2% no show.

1.2.4 Research Question 2 (Is there is a relationship between the gender and no showing ?)

```
In [139]: # Exploring the relation between the gender and not showing
          df.groupby(["Gender", "No_show"]).size()

Out[139]: Gender  No_show
          F       No         57245
                  Yes        14594
          M       No         30962
                  Yes         7725
          dtype: int64

In [140]: # Creat a pie chart according to the result (Relationship between gender and not showi
          labels = 'F_Show', 'F_No_Show', 'M_Show', 'M_No_Show'
          Results = [57245, 14594, 30961, 7725]

          plt.pie(Results, labels=labels, autopct='%1.1f%%')
          plt.title ('The Relationship between gender and not showing')
          plt.axis('equal')
          plt.show()
```



Result:

- Overall (71.839) female patients there are 51.8% showed and 13.2% no show.
- And overall (38.687) male patients there are 28% showed and 7% no show.
- So the total result is 19.9% no show of males and 20.3% no show of females
- (Males showed up 1% more than the females).

1.2.5 Research Question 3 (Is there a relation between the no show and the age of the patient)?

```
In [141]: # Create a group of ages to summarize the patients into some groups of ages
          def Ages_re (Age):
              if Age <= 20:
                  return 1
              elif Age <= 40 > 20:
                  return 2
              elif Age <= 60 > 40:
                  return 3
              elif Age <= 80 > 60:
                  return 4
              elif Age >=80:
                  return 5
          df['Ages_re'] = df.apply(lambda x: Ages_re(x['Age']), axis=1)
```

```
In [142]: # Print the head to make sure that the new column (Ages_re) has been created successfu
          df.head(1)
```

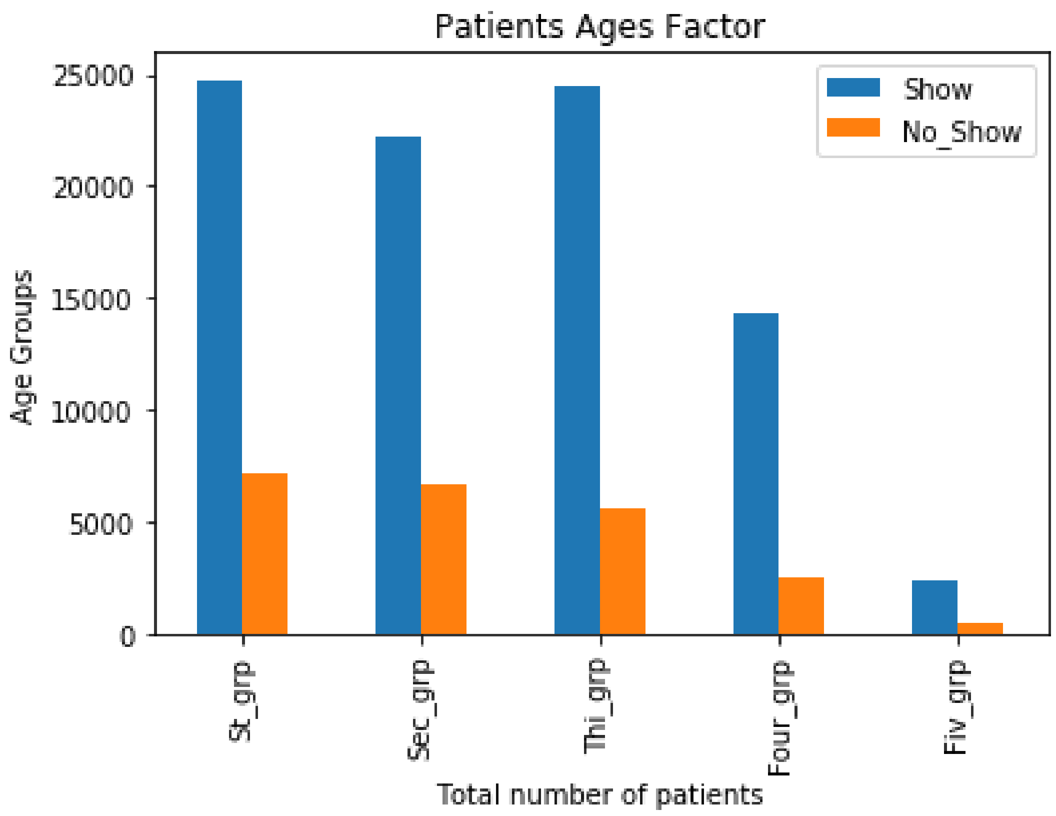
```
Out[142]:        Patient_ID  Appointment_ID Gender       Scheduled_Day Appointment_Day  \
         0  29872499824296         5642903      F 2016-04-29 18:38:08      2016-04-29

            Age Hospital_location  Scholarship  Hipertension  Diabetes  Alcoholism  \
         0   62   JARDIM DA PENHA            0             1         0           0

            Handicap  SMS_received No_show  Ages_re
         0         0             0      No        4
```

```
In [144]: # Exploring the relation between patients age groups and show or not show
          df.groupby(['Ages_re', 'No_show']).size()
```

```
Out[144]: Ages_re  No_show
          1        No         24752
                   Yes         7096
          2        No         22209
                   Yes         6626
          3        No         24490
                   Yes         5591
          4        No         14373
                   Yes         2537
          5        No          2383
                   Yes          469
          dtype: int64
```

```
In [145]: # Create a bar chart to visualize the relation between patients age groups and show or
          Age_viz = pd.DataFrame({"Show": [24752, 22209,24490, 14373,2383], "No_Show": [7096,662
                                index=["St_grp", "Sec_grp", "Thi_grp", "Four_grp", "Fiv_grp"])
          Age_viz.plot(kind="bar")
          plt.title ('Patients Ages Factor')
          plt.xlabel ('Total number of patients')
          plt.ylabel('Age Groups')
          plt.legend()
```

```
Out[145]: <matplotlib.legend.Legend at 0x7f6dccb6b550>
```



Result:

- 28% of patients are in the first group of age (0 to 20) years old which is the most and 27% are in the third group of age (40 to 60) years old.
- 2.6% of patients are in the fifth group (80 years old or more).
- The highest percentage of no shows are in first (0-20) & second groups (20-40).
- The lowest percentage of no shows are in the fourth group (60-80).
- So patients in the fourth group (60-80) show up more than the other patients.

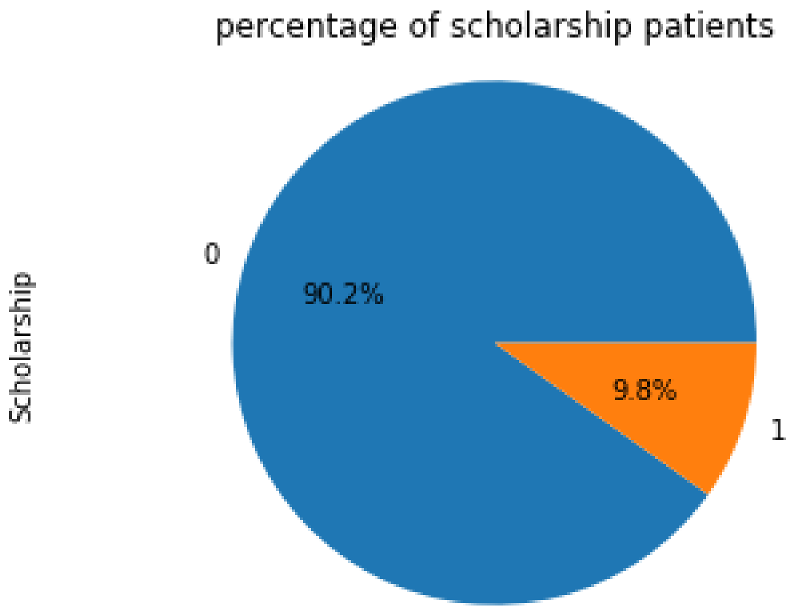
1.2.6 Research Question 4 (What is the most common hospital location)?

```
In [146]: # Find the most common location of the hospitals
          df['Hospital_location'].mode()

Out[146]: 0    JARDIM CAMBURI
          dtype: object
```

Result: The most common hospital location is (JARDIM CAMBURI).

1.2.7 Research Question 5 (Which patients showed up more, who have a scholarship or not ?)

```
In [147]: # Check the percentage of patients who have scholarship and who don't
          df['Scholarship'].value_counts().plot(kind='pie',autopct='%1.1f%%');
          plt.title ('percentage of scholarship patients')
          plt.axis('equal')
          plt.show()
```



Result: 9.8% of the patients have scholarships.

```
In [148]: # Exploring the relation between patients who have scholarship and show or not show
          df.groupby(['Scholarship', 'No_show']).size()

Out[148]: Scholarship  No_show
          0            No         79924
                       Yes        19741
          1            No          8283
                       Yes         2578
          dtype: int64

In [149]: # Creat a bar chart of the relationship between patients who have scholarship and shou
          df.groupby(['Scholarship', 'No_show']).size()

Out[149]: Scholarship  No_show
          0            No         79924
                       Yes        19741
          1            No          8283
                       Yes         2578
          dtype: int64
```

Result:

- 23.7% of patients who have scholarships are no show.
- 19.8% of patients who don't have a scholarship are no show.
- So patients who don't have scholarships showed up 4% more than those who have scholarships.

1.2.8 Research Question 6 (Are the alcoholic patients not show more than the not alcoholic patients ?)

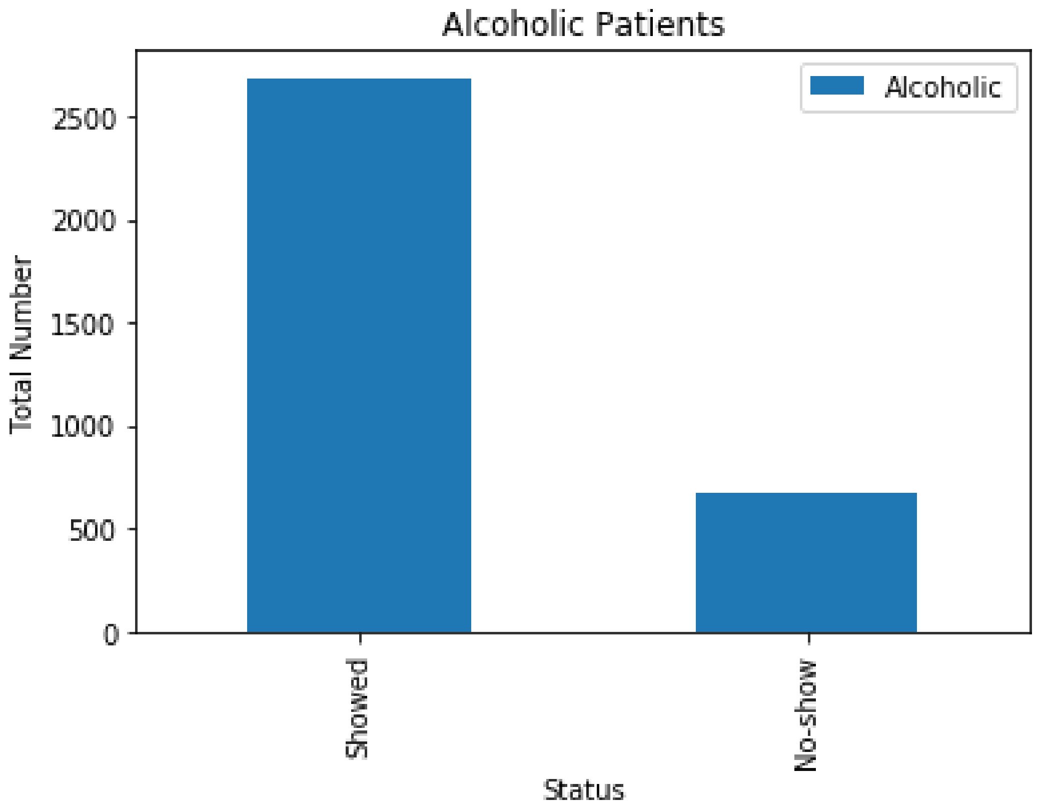
```
In [150]: # Exploring the relation between alcoholic & not alcoholic patients and not show
          df.groupby(["Alcoholism", "No_show"]).size()
```

```
Out[150]: Alcoholism  No_show
          0           No         85524
                      Yes        21642
          1           No          2683
                      Yes          677
          dtype: int64
```

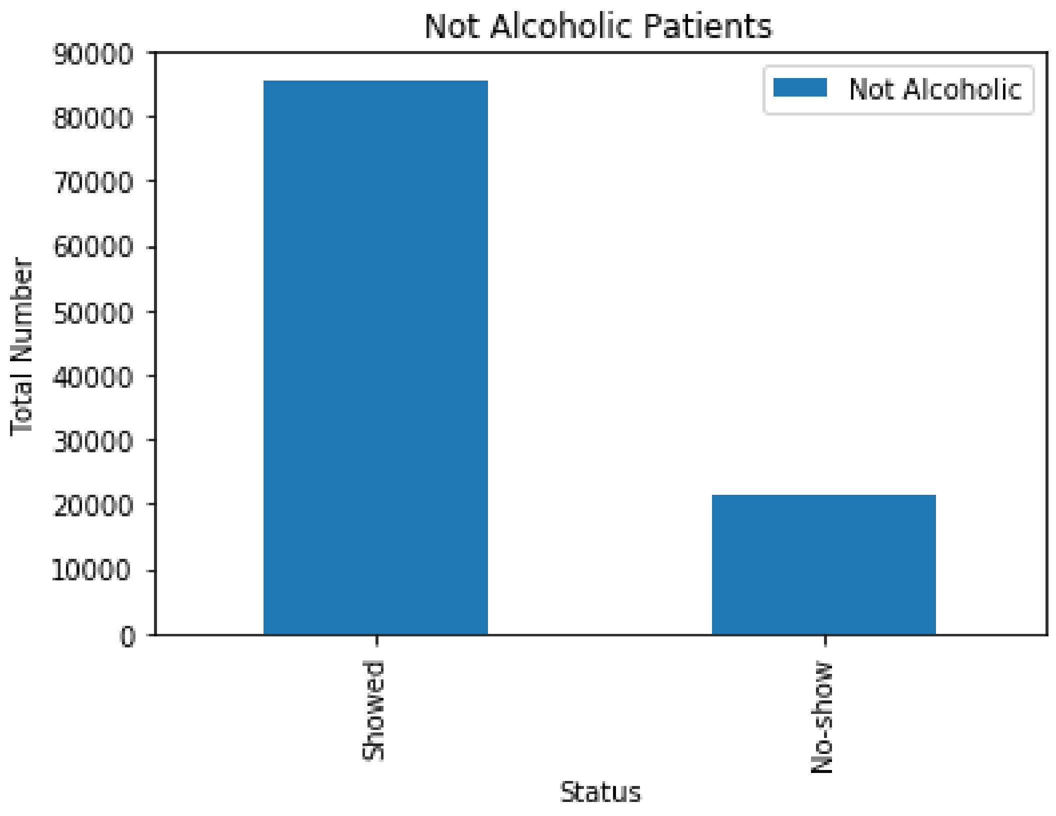
Result: 3% of the patients are alcoholic.

```
In [151]: # Creat a bar chart of the total numbers of showed and not showed alcoholic patients
          Al_bar = pd.DataFrame({"Alcoholic": [2683, 677]},
                                index=["Showed", "No-show"])
          Al_bar.plot(kind='bar');
          plt.xlabel("Status")
          plt.ylabel("Total Number")
          plt.title ('Alcoholic Patients')
```

```
Out[151]: Text(0.5,1,'Alcoholic Patients')
```



```
In [152]: # Creat a bar chart of the total numbers of showed and not showed not alcoholic patien
          Free_bar = pd.DataFrame({"Not Alcoholic": [85524, 21642,]},
                                  index=["Showed", "No-show",])
          Free_bar.plot(kind='bar');
          plt.xlabel("Status")
          plt.ylabel("Total Number")
          plt.title ('Not Alcoholic Patients')

Out[152]: Text(0.5,1,'Not Alcoholic Patients')
```



Result: There is no obvious difference in percentages between the no show whether alcoholic or not alcoholic patient (It almost the same percentage of no show).

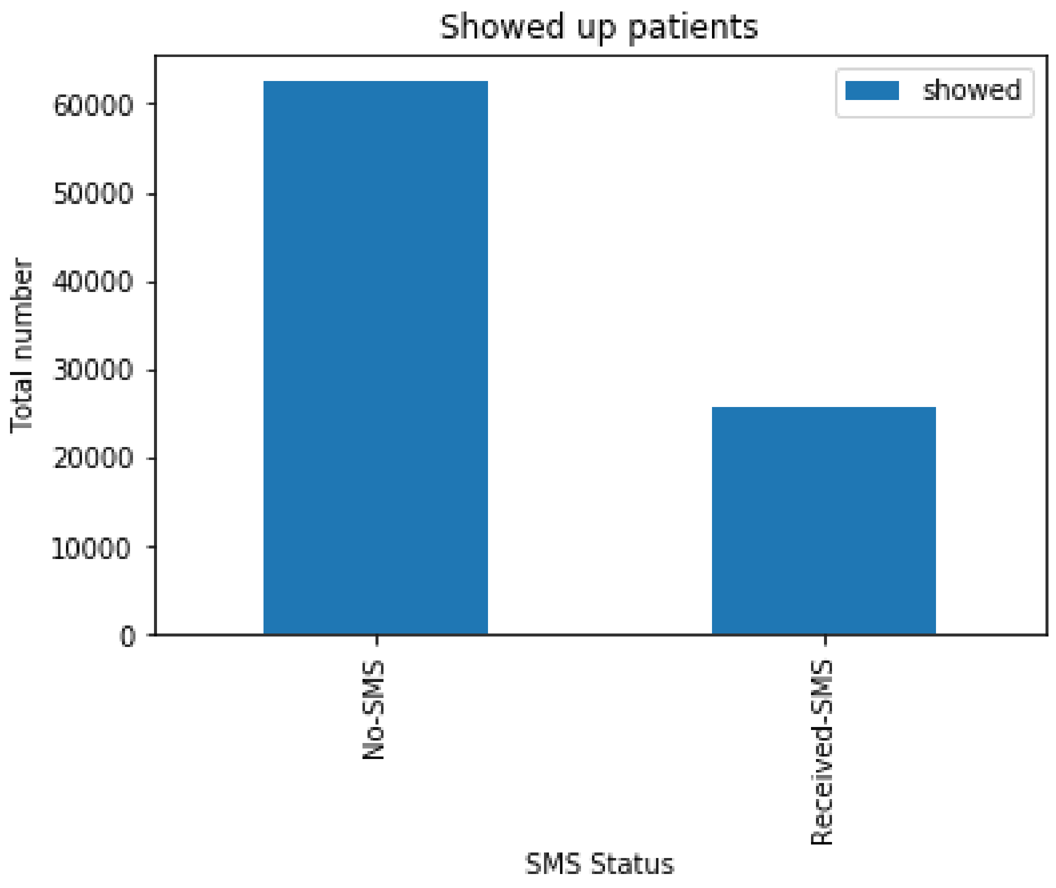
1.2.9 Research Question 7 (Which patients showed up more, who received SMS or not?)

```
In [153]: # Exploring the relation between SMS receiving and patients show or not show
          # Create a bar chart of showed patients whether received SMS or not
          SMS_Show = df.groupby(["SMS_received", "No_show"]).size()
          print(SMS_Show)
          showed = pd.DataFrame({"showed": [62509, 25698,]},
                                index=["No-SMS", "Received-SMS",])
          showed.plot(kind='bar')
          plt.xlabel("SMS Status")
          plt.ylabel("Total number")
          plt.title ('Showed up patients')
```

```
SMS_received  No_show
0             No         62509
              Yes        12535
1             No         25698
              Yes         9784
```

```
dtype: int64
```

```
Out[153]: Text(0.5,1,'Showed up patients')
```



Result:

- 16.7% of patients who didn't receive SMS didn't show.
- 26.2% of patients who received SMS didn't show.
- So patients who didn't receive SMS showed up almost 10% more than those who received SMS.

## Conclusions

Results:

1)

- Overall (110526) patients there are 79.8% showed and 20.2% no show.

2)

- Overall (71.839) female patients there are 51.8% showed and 13.2% no show.
- Overall (38.687) male patients there are 28% showed and 7% no show.
- So the total result is 19.9% no show of males and 20.3% no show of females (Males showed up 1% more than the females).

3)

- 28% of patients are in the first group of age (0 to 20) years old which is the most and 27% are in the third group of age (40 to 60) years old.
- 2.6% of patients are in the fifth group (80 years old or more).
- The highest percentage of no shows are in first (0-20) & second groups (20-40).
- The lowest percentage of no shows are in the fourth group (60-80).
- So patients in the fourth group (60-80) show up more than the other patients.

4)

- The most common hospital location is (JARDIM CAMBURI).

5)

- 9.8% of the patients have scholarships.
- 23.7% of patients who have scholarships are no show.
- 19.8% of patients who don't have a scholarship are no show.
- So patients who don't have scholarships showed up 4% more than those who have scholarships.

6)

- 3% of the patients are alcoholic.
- There is no obvious difference in percentages between the no show whether alcoholic or not alcoholic patient (It almost the same percentage of no show).

7)

- 16.7% of patients who didn't receive SMS didn't show.
- 26.2% of patients who received SMS didn't show.
- So patients who didn't receive SMS showed up almost 10% more than those who received SMS.

Limitations:

- The time in the scheduled day and appointment day are not clear enough. It sounds like Missy can't build statistics about it.
- Patients who are 0 years old are not clear if this means that they are less than one year or this is a missing data.
- The condition of sending not clear to know how patients who didn't receive it show up more than who received it

```
In [154]: from subprocess import call
          call(['python', '-m', 'nbconvert', 'Investigate_a_Dataset.ipynb'])

Out[154]: 0
```