

Data Analysis Synopsis:

For this data analysis I am using the 'No-show appointments' dataset.

This dataset is information regarding whether patients were listed as show or no-show for medical appointments in Brazil.

For additional clarity -the following data definitions are applicable:

- Age = Age of patient
- Gender = Gender of patient
- Diagnosis = Medical term used to define illness

- For this dataset evaluation, I am going to analyze attendance data regarding Age, Gender, and Diagnosis attributes to see if there are correlations, relevant statistics or other patterns.

Introduction

In the healthcare industry the ability to analyze appointment data is beneficial in multiple ways:

1. It is helpful to the health care providers to identify trends, which can be used to create a plan of action regarding possible solutions to increase appointment attendance.

2. The data can be used as a tool to measure or determine if there is an issue regarding staff scheduling procedures.

3. The analysis can be used to identify potential gaps in scheduling software capabilities.

Analysis Questions:

1. Is patient attendance effected by Gender ?
2. Is patient attendance effected by Age ?

In order to process and analyze this data, the following Python libraries are used:

- numpy
- pandas
- matplotlib
- plotly

Data load process:

At this stage, I am importing the necessary packages listed above; in order to load, view, examine, clean, analyze and graph the data for my analysis.

```
In [1]: import numpy as np
import pandas as p
import matplotlib.pyplot as plt
import plotly.express as px
from plotly.offline import iplot, plot
from plotly.subplots import make_subplots

%matplotlib inline
```

```
In [2]: df = p.read_csv('KaggleV2-May-2016_2.csv')
```

Data review -1st pass:

Now that the data has been loaded, I will take a look at 10 records to examine the data format, column names and column values.

```
In [3]: df.head(10) # using head with a parameter of 10 to view the first 10 rows of
```

Out[3]:

	PatientId	AppointmentID	Gender	ScheduledDay	AppointmentDay	Age	Neig
0	2.987250e+13	5642903	F	2016-04-29T18:38:08Z	2016-04-29T00:00:00Z	62	
1	5.589978e+14	5642503	M	2016-04-29T16:08:27Z	2016-04-29T00:00:00Z	56	
2	4.262962e+12	5642549	F	2016-04-29T16:19:04Z	2016-04-29T00:00:00Z	62	MAT
3	8.679512e+11	5642828	F	2016-04-29T17:29:31Z	2016-04-29T00:00:00Z	8	
4	8.841186e+12	5642494	F	2016-04-29T16:07:23Z	2016-04-29T00:00:00Z	56	
5	9.598513e+13	5626772	F	2016-04-27T08:36:51Z	2016-04-29T00:00:00Z	76	
6	7.336882e+14	5630279	F	2016-04-27T15:05:12Z	2016-04-29T00:00:00Z	23	C
7	3.449833e+12	5630575	F	2016-04-27T15:39:58Z	2016-04-29T00:00:00Z	39	C
8	5.639473e+13	5638447	F	2016-04-29T08:02:16Z	2016-04-29T00:00:00Z	21	AN
9	7.812456e+13	5629123	F	2016-04-27T12:48:25Z	2016-04-29T00:00:00Z	19	C

Data review results - 1st pass:

After examining some of the records, some of the column diagnosis headers looked incorrect.

I will take a closer look at the column header data and data type using `dtype`.

In [4]:

```
df.dtypes
```

```
Out[4]: 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
```

Data review results - further analysis - 1st pass:

The following errors (errant information) have been identified in the data:

1A. Incorrect diagnosis column spellings:

- Hipertension, which should be Hypertenstion.
- Handcap, which should be Handicap.

1B. Incorrect data types (the column has date/time values but the datatypes are listed as string objects):

- ScheduleDay
- AppointmentDay

1C. Incorrect data types (the column has a data type of float but seems like it should be int64):

- PatientId

Data Correction: 1A. Incorrect diagnosis column spellings:

```
In [5]: df = df.rename(columns={'Hipertension': 'Hypertension',
                                'Handcap': 'Handicap'})
```

Data Correction: 1B. Incorrect data types (the column has date/time values but the datatypes are listed as string objects):

```
In [6]: df['ScheduledDay'] = pd.to_datetime(df.ScheduledDay)
```

```
In [7]: df['AppointmentDay'] = pd.to_datetime(df.AppointmentDay)
```

Data Correction: 1C. Incorrect data types (the column has a data type of float but seems like it should be int64):

```
In [8]: df['PatientId'] = df['PatientId'].astype(int)
```

Data Verification - 1st pass :

In this section I am verifying the data wrangling and cleaning using dtypes to see the column names and datatypes.

```
In [9]: df.dtypes
```

```
Out[9]: PatientId          int64
AppointmentID      int64
Gender            object
ScheduledDay     datetime64[ns, UTC]
AppointmentDay    datetime64[ns, UTC]
Age              int64
Neighbourhood     object
Scholarship        int64
Hypertension       int64
Diabetes          int64
Alcoholism         int64
Handicap           int64
SMS_received       int64
No-show           object
dtype: object
```

Data review - 2nd pass:

Now that the data has been cleaned and reviewed, I will take a look at the following to get further insight to determine next steps:

- The total number of records and columns using shape.
- Statistical info using describe.
- Null values (if any), Total Data Types, and Total file size using info with deep as parameter.

```
In [10]: df.shape
```

```
Out[10]: (110527, 14)
```

```
In [11]: df.describe()
```

Out[11]:

	PatientId	AppointmentID	Age	Scholarship	Hypertension	
count	1.105270e+05	1.105270e+05	110527.000000	110527.000000	110527.000000	1
mean	1.474963e+14	5.675305e+06	37.088874	0.098266	0.197246	
std	2.560949e+14	7.129575e+04	23.110205	0.297675	0.397921	
min	3.921700e+04	5.030230e+06	-1.000000	0.000000	0.000000	
25%	4.172614e+12	5.640286e+06	18.000000	0.000000	0.000000	
50%	3.173184e+13	5.680573e+06	37.000000	0.000000	0.000000	
75%	9.439172e+13	5.725524e+06	55.000000	0.000000	0.000000	
max	9.999816e+14	5.790484e+06	115.000000	1.000000	1.000000	

In [12]: `df.info(memory_usage='deep') # using this function to determine the datatype`

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 110527 entries, 0 to 110526
Data columns (total 14 columns):
 #   Column           Non-Null Count  Dtype  
--- 
 0   PatientId       110527 non-null   int64  
 1   AppointmentID   110527 non-null   int64  
 2   Gender          110527 non-null   object  
 3   ScheduledDay    110527 non-null   datetime64[ns, UTC]
 4   AppointmentDay  110527 non-null   datetime64[ns, UTC]
 5   Age              110527 non-null   int64  
 6   Neighbourhood   110527 non-null   object  
 7   Scholarship      110527 non-null   int64  
 8   Hypertension     110527 non-null   int64  
 9   Diabetes         110527 non-null   int64  
 10  Alcoholism       110527 non-null   int64  
 11  Handicap         110527 non-null   int64  
 12  SMS_received    110527 non-null   int64  
 13  No-show          110527 non-null   object  
dtypes: datetime64[ns, UTC](2), int64(9), object(3)
memory usage: 29.8 MB
```

Data review results - 2nd pass:

2A. The min value in the Age column is -1, which is incorrect. Values less than zero will be removed.

2B. Shape indicates that there are 110527 rows, info shows the same number for each column = No Null values found.

2C. For analysis only the specified columns will be evaluated:

- Gender
- Age
- Hypertension

- Diabetes
- Alcoholism
- Handicap
- SMS_recieved
- No-show

Data Correction: 2A. Age column values updated to values greater than or equal to 0.

```
In [13]: df = df.loc[df['Age'] >= 0]
```

Data Correction: 2B. Since no null values were found there is no update is needed for nulls.

Data Correction: 2C. Only the specified columns have been selected.
Initially I did this using drop but after looking the size of the data creating a new variable reduced the data size from 21 to 17 mb, so I am going with the size reduced approach for now.

```
In [14]: # df.drop(['PatientId',
#           'AppointmentID',
#           'ScheduledDay',
#           'AppointmentDay',
#           'Neighbourhood',
#           'Scholarship'],
#           axis = 1,
#           inplace = True)
```

```
In [15]: cols = ['Gender',
             'Age',
             'Hypertension',
             'Diabetes',
             'Alcoholism',
             'Handicap',
             'SMS_received',
             'No-show']
```

```
In [16]: df[cols].head(2)
```

```
Out[16]:
```

	Gender	Age	Hypertension	Diabetes	Alcoholism	Handicap	SMS_received	No-show	
0	F	62		1	0	0	0	0	No
1	M	56		0	0	0	0	0	No

```
In [17]: df[cols].info(memory_usage='deep')
```

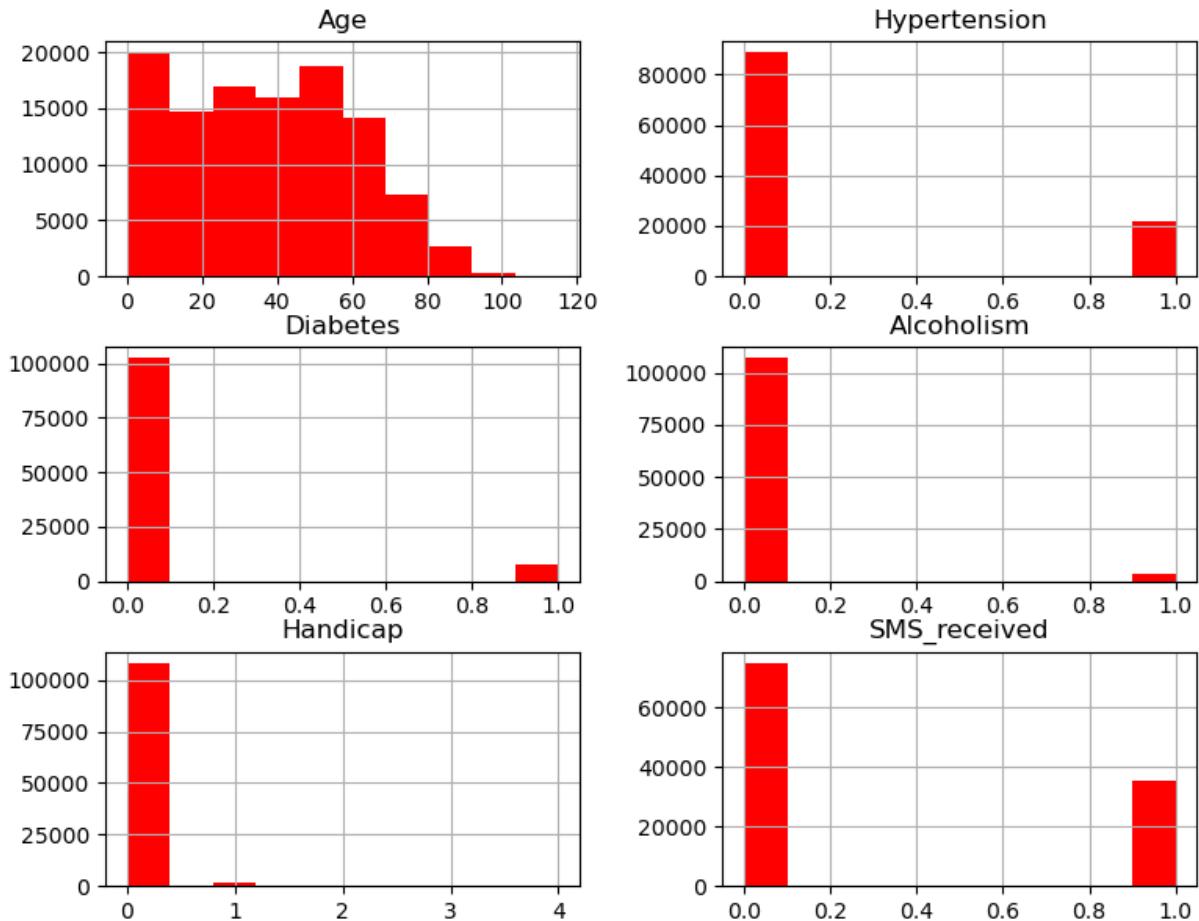
```
<class 'pandas.core.frame.DataFrame'>
Index: 110526 entries, 0 to 110526
Data columns (total 8 columns):
 #   Column      Non-Null Count  Dtype  
--- 
 0   Gender       110526 non-null   object 
 1   Age          110526 non-null   int64  
 2   Hypertension 110526 non-null   int64  
 3   Diabetes     110526 non-null   int64  
 4   Alcoholism   110526 non-null   int64  
 5   Handicap     110526 non-null   int64  
 6   SMS_received 110526 non-null   int64  
 7   No-show      110526 non-null   object 
dtypes: int64(6), object(2)
memory usage: 18.3 MB
```

Data Analysis:

I shall begin the data analysis now that the data has been cleaned and prepared.

I will now take a look at the data statistics and create data visualizations to analyze the data from a visual and statistical perspective.

```
In [18]: df[cols].hist(figsize=(9,7), color="red");
```

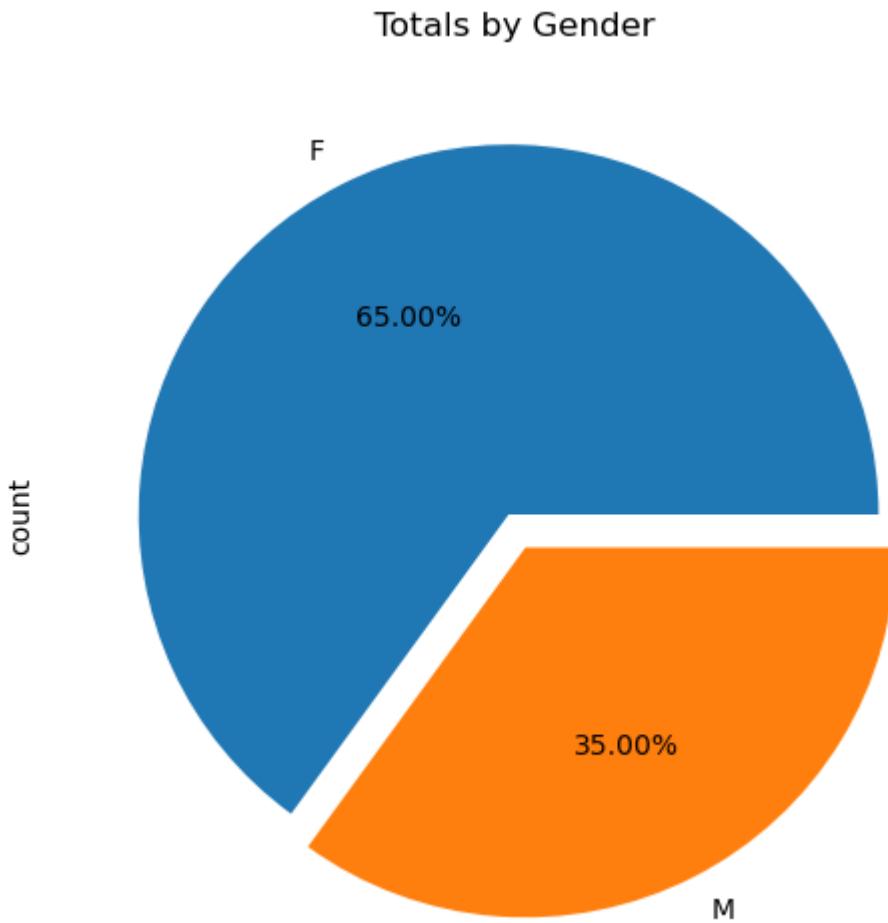


- The right skewing of the Age data, indicates that the majority of the appointments were setup for younger patients.
- There does not appear to be a significant number of patients with any of the Medical Diagnoses.
- SMS recieval was approximately 25%.

Analysis Question #1:

- 1. Is patient attendance effected by Gender ?

```
In [19]: df['Gender'].value_counts().plot(kind='pie', title=' Totals by Gender '\
, figsize=(14,6), explode=[0,0.1], autopct='%1
```



Single Variable Distribution -1D

For this analysis, the total number of patients ratio based on gender attendance was calculated.

This graph is showing the patient / member - percentage totals by Gender:

Based on previous studies from Federal aid based regulatory agencies like the Center for Medicare and Medicaid Services, the number of females that are on certain medical programs are typically higher than the total number of males.

This data can be useful in the event that further drill down is required in regard to infants 0-1 yrs/old and moms appointment data.

The number of females is approximately 54% higher than the number of males.

At this stage I can't tell if there is a correlation so I will take a another look using a 2 variable distributiiion (shown in the bar chart below).

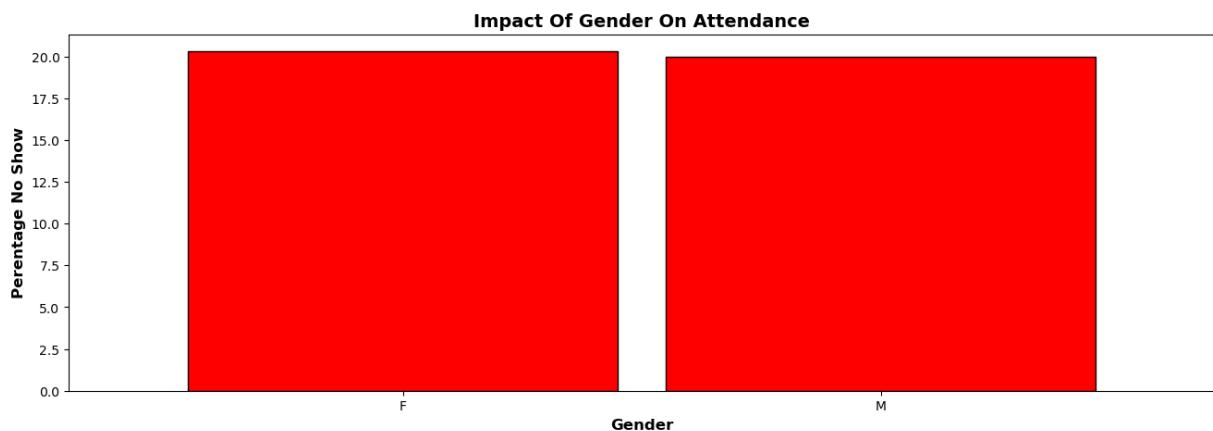
```
In [20]: df['No Show']=(df['No-show'] == 'Yes').astype(int)
df['No Show'].value_counts() # converting No-show value from string to int
```

```
Out[20]: No Show
0    88207
1    22319
Name: count, dtype: int64
```

```
In [21]: def attendance_grp(df,var_grp, yax='No Show', stat='mean', mul=100, figsize=(10,5)):
    ''' This function is used to populate graph data based on attendance'''
    df.groupby(var_grp)[yax].agg(stat).mul(mul).plot.bar(edgecolor='black',figsize=figsize)
    plt.title(f'Impact of {var_grp} on {"Attendance" if yax=="No Show" else "Percentage"}')
    plt.xlabel(var_grp.title(), fontsize=12, weight="bold")
    plt.ylabel(f'{"Percentage" if yax=="No Show" else stat} {yax}'.title(), fontweight="bold")
```

creating a function to accept variables and plot data.

```
In [22]: attendance_grp(df,'Gender')
```



1st - Multi-variable Distribution -2D

For this analysis, I was trying to determine if attendance was effected by Gender.

This graph is showing the percentage of appointment no-shows by Gender:

I was analyzing this data to see if there was a greater no-show rate for one gender vs the other . The number of female no-shows is approximately 5% higher than the male no-shows. There is no significant difference in gender no-show rates.

Had there been a significant discrepancy, then one of the groups could have been targeted for follow-up.

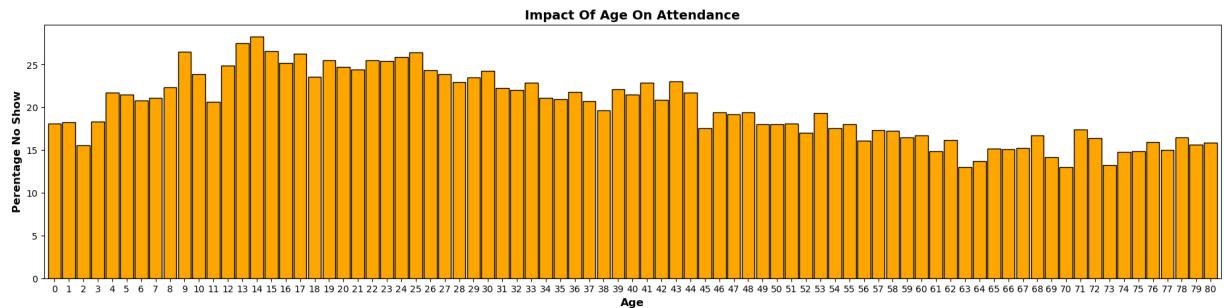
Based on this histogram, Gender does not impact attendance in any significant way as there is no correlation indicated.

However, the ratio of show vs no-show for each Gender seems similiar.

Analysis Question #2:

2. Is patient attendance effected by Age ?

```
In [23]: attendance_grp(df.query('Age<81'), 'Age', figsize=[23, 5], color = 'orange')
```



```
In [24]: df.Age.describe()
```

```
Out[24]: count    110526.000000
mean        37.089219
std         23.110026
min         0.000000
25%        18.000000
50%        37.000000
75%        55.000000
max       115.000000
Name: Age, dtype: float64
```

2nd - Multi-Variable Distribution -2D

For this analysis, I was trying to determine if attendance was effected by age.

This graph is showing the percentage of appointment no-shows by age:

The average age for this patient list is 37. The minimum age is 0, which indicates that there are newborns in this list.

Based on the data used for this analysis, proportionately it seems that ages 40+ have the least amount of no-shows. This result seems reasonable as the perception of health and the accountability to maintain health would impact decisions to make and show for appointments.

This indicates that attendance is effected by age.

There does not seem to be a strong pattern or proportion identified for any of the specified diagnosis.

Conclusions

Based on the dataset and the columns chosen, I could not identify a significant factor that impacted the attendance. I initially was under the impression that diagnosis would have a greater impact as patients who

may have chronic illnesses would have more appointments and would be more likely to show up out of extreme necessity. However the correlation to no show was insignificant.

The second factor I thought would have an impact was age as it would seem that a more mature or elderly person would attend more based on need or participating in proactive initiatives. However, the data did not indicate that this was the case as more appointments were attended by a younger group.

Limitation

Since the columns chosen for this analysis did not yield any significant results, I would re-evaluate this analysis using additional columns such as the appointmentment and schedule dates as well as the neighborhood and scholarship columns to see what results are obtained.