D214_Capstone_JWillis

September 8, 2022

0.0.1 D214 - Capstone - PA2

0.0.2 Background Info:

– PA 1 is complete.
– PA 2: Prep data for ANOVA analysis and to export to Tableau.

A1 *Question: Is communication from a doctor more statistically significant to a patients overall hospital rating than a nurse?*

[1]:

```
# Standard libraries

import pandas as pd
import numpy as np
import scipy as sc
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
import statsmodels as stats
from pandas import DataFrame
from scipy.stats import kurtosis, skew
from matplotlib.ticker import StrMethodFormatter

# get ANOVA table
import statsmodels.api as sm
import statsmodels.formula.api as smf
from statsmodels.formula.api import ols

## Handle Warnings
import warnings
warnings.filterwarnings('ignore')
## Warnings filter
from warnings import simplefilter
# ignore all future warnings
simplefilter(action='ignore', category=FutureWarning)
#
## Timer for debugging
#%time
#%timeit
```

```
[2]: from platform import python_version
     print('The python version used is: %s' % python_version())
```

```
The python version used is: 3.9.13
```

** Load Data

```
[3]: # load data file
     df = pd.read_csv('HCAHPS-Hospital.csv')
     # quick test the data is present and see the shape
     df.head(5)  # DtypeWarning: Columns (12,14,17,19) have mixed types. Specify␣
      ↪dtype option on import or set low_memory=False.
```

```
[3]:   Facility ID                    Facility Name                Address  \
     0      010001  SOUTHEAST HEALTH MEDICAL CENTER  1108 ROSS CLARK CIRCLE
     1      010001  SOUTHEAST HEALTH MEDICAL CENTER  1108 ROSS CLARK CIRCLE
     2      010001  SOUTHEAST HEALTH MEDICAL CENTER  1108 ROSS CLARK CIRCLE
     3      010001  SOUTHEAST HEALTH MEDICAL CENTER  1108 ROSS CLARK CIRCLE
     4      010001  SOUTHEAST HEALTH MEDICAL CENTER  1108 ROSS CLARK CIRCLE

          City State  ZIP Code County Name    Phone Number      HCAHPS Measure ID  \
     0  DOTHAN    AL     36301     HOUSTON  (334) 793-8701           H_COMP_1_A_P
     1  DOTHAN    AL     36301     HOUSTON  (334) 793-8701          H_COMP_1_SN_P
     2  DOTHAN    AL     36301     HOUSTON  (334) 793-8701           H_COMP_1_U_P
     3  DOTHAN    AL     36301     HOUSTON  (334) 793-8701  H_COMP_1_LINEAR_SCORE
     4  DOTHAN    AL     36301     HOUSTON  (334) 793-8701   H_COMP_1_STAR_RATING

                                          HCAHPS Question  …  \
     0  Patients who reported that their nurses "Alway…  …
     1  Patients who reported that their nurses "Somet…  …
     2  Patients who reported that their nurses "Usual…  …
     3            Nurse communication - linear mean score  …
     4                  Nurse communication - star rating  …

       Patient Survey Star Rating Footnote HCAHPS Answer Percent  \
     0                                 NaN                    77
     1                                 NaN                     7
     2                                 NaN                    16
     3                                 NaN        Not Applicable
     4                                 NaN        Not Applicable

       HCAHPS Answer Percent Footnote HCAHPS Linear Mean Value  \
     0                            NaN           Not Applicable
     1                            NaN           Not Applicable
     2                            NaN           Not Applicable
     3                            NaN                       90
     4                            NaN           Not Applicable
```

```
  Number of Completed Surveys Number of Completed Surveys Footnote  \
0                         501                                  NaN
1                         501                                  NaN
2                         501                                  NaN
3                         501                                  NaN
4                         501                                  NaN

  Survey Response Rate Percent Survey Response Rate Percent Footnote  \
0                           19                                   NaN
1                           19                                   NaN
2                           19                                   NaN
3                           19                                   NaN
4                           19                                   NaN

   Start Date    End Date
0  10/01/2020  09/30/2021
1  10/01/2020  09/30/2021
2  10/01/2020  09/30/2021
3  10/01/2020  09/30/2021
4  10/01/2020  09/30/2021

[5 rows x 22 columns]
```

[4]:
```
df.columns
```

[4]:
```
Index(['Facility ID', 'Facility Name', 'Address', 'City', 'State', 'ZIP Code',
       'County Name', 'Phone Number', 'HCAHPS Measure ID', 'HCAHPS Question',
       'HCAHPS Answer Description', 'Patient Survey Star Rating',
       'Patient Survey Star Rating Footnote', 'HCAHPS Answer Percent',
       'HCAHPS Answer Percent Footnote', 'HCAHPS Linear Mean Value',
       'Number of Completed Surveys', 'Number of Completed Surveys Footnote',
       'Survey Response Rate Percent', 'Survey Response Rate Percent Footnote',
       'Start Date', 'End Date'],
      dtype='object')
```

[5]:
```
# Remove Unecessary Data Series
df_clean = df[['HCAHPS Answer Description', 'Patient Survey Star Rating']]

# Rename Columns
df_clean = df_clean.rename(columns={'HCAHPS Answer Description':'Questions',
                                     'Patient Survey Star Rating':'Ratings'})
```

[6]:
```
# DtypeWarning: Columns (12,14,17,19) have mixed types. Specify dtype option on␣
 ↪import or set low_memory=False.

df_clean = df_clean.drop(df_clean[df_clean['Ratings'].isin(['Not Applicable',␣
 ↪'Not Available'])].index)  # Index --> of row
```

```
df_clean['Ratings'] = df_clean['Ratings'].astype(int)

df_clean.sample(20)
```

[6]:

```
                                        Questions  Ratings
60224           Discharge information - star rating        5
16793           Discharge information - star rating        4
72249                       Quietness - star rating        2
281461  Communication about medicines - star rating        3
367289         Staff responsiveness - star rating        3
197055                      Quietness - star rating        5
95078          Staff responsiveness - star rating        1
87473           Discharge information - star rating        4
295924           Recommend hospital - star rating        4
220956                      Quietness - star rating        3
158455                    Cleanliness - star rating        3
425958         Doctor communication - star rating        3
254584  Communication about medicines - star rating        3
267                         Quietness - star rating        3
186649           Recommend hospital - star rating        4
218642                        Summary star rating        3
83218                     Cleanliness - star rating        2
178186           Recommend hospital - star rating        4
340619          Discharge information - star rating        5
148367         Staff responsiveness - star rating        2
```

[7]:

```
# Verify Ratins Series is of type integer
df_clean.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 36520 entries, 4 to 449747
Data columns (total 2 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Questions  36520 non-null  object
 1   Ratings    36520 non-null  int64
dtypes: int64(1), object(1)
memory usage: 855.9+ KB
```

[8]:

```
print("*******"*5)
print("* DataFrame Shape: ", df_clean.shape)
print("*******"*5)
df_clean.describe(include='all')
```

```
***********************************
* DataFrame Shape:  (36520, 2)
***********************************
```

[8]:

```
                                 Questions       Ratings
count                                36520  36520.000000
unique                                  11           NaN
top     Nurse communication - star rating           NaN
freq                                  3320           NaN
mean                                   NaN      3.158050
std                                    NaN      1.008707
min                                    NaN      1.000000
25%                                    NaN      2.000000
50%                                    NaN      3.000000
75%                                    NaN      4.000000
max                                    NaN      5.000000
```

[9]:

```python
df_clean.head(-5)
```

[9]:

```
                                           Questions  Ratings
4                  Nurse communication - star rating        3
18                Doctor communication - star rating        3
32                Staff responsiveness - star rating        2
43      Communication about medicines - star rating        3
53               Discharge information - star rating        4
…                                                ...      ...
449673            Doctor communication - star rating        4
449687            Staff responsiveness - star rating        3
449698  Communication about medicines - star rating        3
449708           Discharge information - star rating        4
449717                 Care transition - star rating        4

[36515 rows x 2 columns]
```

[10]:

```python
pd.unique(df_clean['Questions'])
```

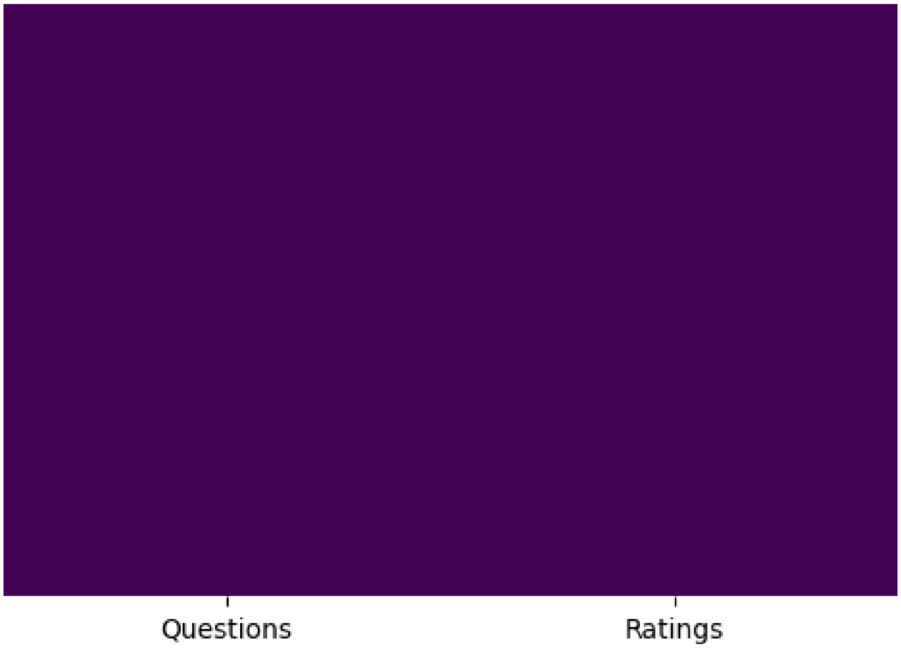
[10]:

```
array(['Nurse communication - star rating',
       'Doctor communication - star rating',
       'Staff responsiveness - star rating',
       'Communication about medicines - star rating',
       'Discharge information - star rating',
       'Care transition - star rating', 'Cleanliness - star rating',
       'Quietness - star rating', 'Overall hospital rating - star rating',
       'Recommend hospital - star rating', 'Summary star rating'],
      dtype=object)
```

0.0.3 Check for Missing or Null Values

[11]:

```python
# Mapping to view missing data...none present.
fig, ax = plt.subplots(figsize=(6,4))         # Sample figsize in inches
sns.heatmap(df_clean.isnull(), yticklabels=False, cbar=False, cmap='viridis');
```



[12]:

```python
# Drop any null columns
df_clean = df_clean.dropna()

print("*******"*5)
print("* Any Rows Missing: ",df_clean.isnull().all(axis=1).any())
print("*******"*5)
print("Any Null Values:\n", df_clean.isnull().any())
```

```
***********************************
* Any Rows Missing:  False
***********************************
Any Null Values:
 Questions    False
Ratings      False
dtype: bool
```

Explore Data

[13]:

```python
# Sample DataFrame Fields
df_clean.head()
```

[13]:

```
                                      Questions  Ratings
4               Nurse communication - star rating        3
18             Doctor communication - star rating        3
32             Staff responsiveness - star rating        2
43  Communication about medicines - star rating        3
53            Discharge information - star rating        4
```

[14]:

```
# Understand Columns, Shape and Types
print("*************"*5)
print("* DF Columns: ",df_clean.columns)
print("*************"*5)
df_clean.info()
```

```
*****************************************************************
* DF Columns:  Index(['Questions', 'Ratings'], dtype='object')
*****************************************************************
<class 'pandas.core.frame.DataFrame'>
Int64Index: 36520 entries, 4 to 449747
Data columns (total 2 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Questions  36520 non-null  object
 1   Ratings    36520 non-null  int64
dtypes: int64(1), object(1)
memory usage: 855.9+ KB
```

[15]:

```
# Export Cleaned data
pd.DataFrame(df_clean).to_csv('df_clean.csv')
```

[16]:

```
# Using lambda
df_clean = df_clean[df_clean["Questions"].isin(['Nurse communication - star␣
 ↪rating',
                                                'Doctor communication - star␣
 ↪rating',
                                                'Overall hospital rating - star␣
 ↪rating'])]
df_clean.dropna()
df_clean.sample(20)
```

[16]:

```
                                    Questions  Ratings
113267  Overall hospital rating - star rating        3
312019      Nurse communication - star rating        3
41750   Overall hospital rating - star rating        2
192224  Overall hospital rating - star rating        4
365     Overall hospital rating - star rating        4
190296     Doctor communication - star rating        3
164056      Nurse communication - star rating        4
```

```
207766      Nurse communication - star rating        4
444930     Doctor communication - star rating        4
281529     Doctor communication - star rating        3
336027     Doctor communication - star rating        3
376017     Doctor communication - star rating        4
334539     Doctor communication - star rating        2
147144     Doctor communication - star rating        4
286258      Nurse communication - star rating        2
55525       Nurse communication - star rating        5
330075     Doctor communication - star rating        4
146121     Doctor communication - star rating        4
147770   Overall hospital rating - star rating        3
116894   Overall hospital rating - star rating        3
```

[17]:

```
print('********'*5)
print('*** Describe Data ***')
print('********'*5)
print('* Median: ',df_clean.median())
print('********'*5)

print('Mode: ' + str(df_clean['Questions'].value_counts(ascending=True).
 ↪loc[lambda x : x>1].to_frame()) +
      '\n\n' + str(df_clean['Ratings'].value_counts(ascending=True).loc[lambda␣
 ↪x : x>1].to_frame()))
```

```
****************************************
*** Describe Data ***
****************************************
* Median:  Ratings    3.0
dtype: float64
****************************************
Mode:                                       Questions
Nurse communication - star rating          3320
Doctor communication - star rating         3320
Overall hospital rating - star rating      3320

   Ratings
1      374
5      995
2     1903
4     3189
3     3499
```

[18]:

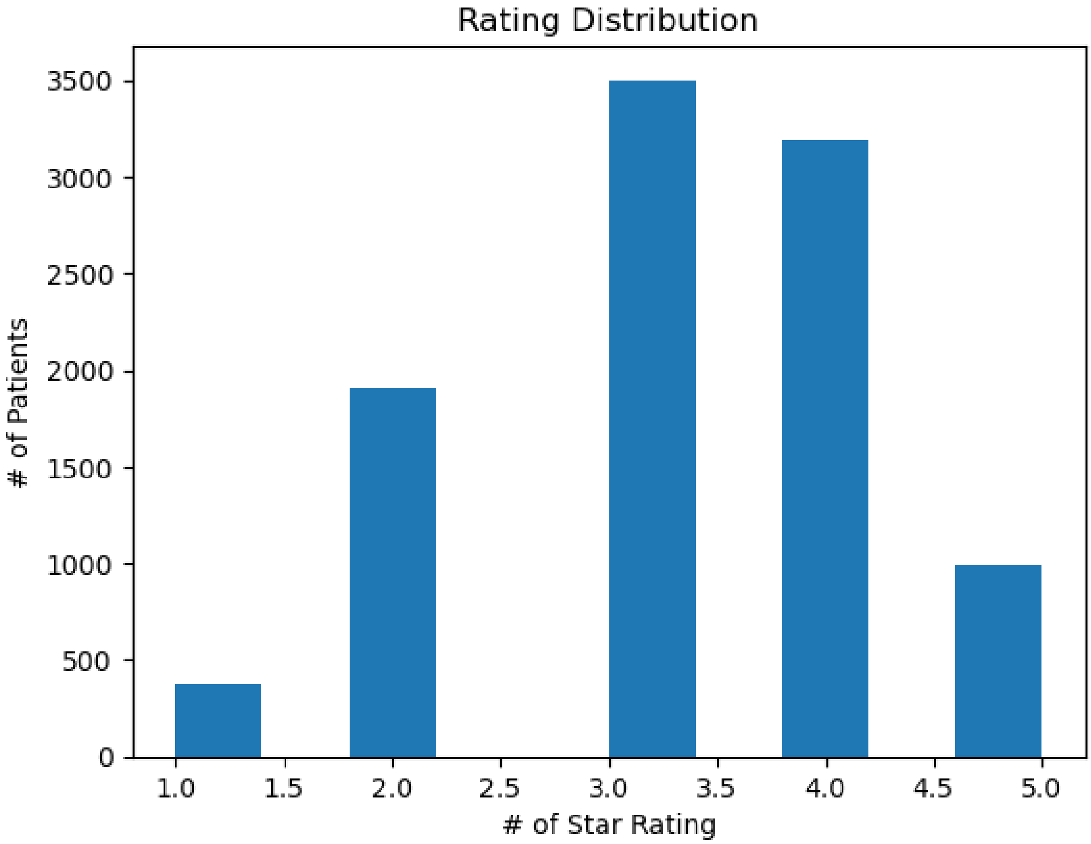
```
df_grouped = df_clean.groupby(['Questions'],as_index=False).mean()
print(df_grouped)
```

```
                               Questions   Ratings
```

```
0     Doctor communication - star rating  3.238253
1      Nurse communication - star rating  3.259940
2   Overall hospital rating - star rating  3.263253
```

[19]:
```
# Ratings Distribution
df_clean['Ratings'].plot.hist();

plt.xlabel('# of Star Rating')
plt.ylabel('# of Patients')
plt.title('Rating Distribution');
```

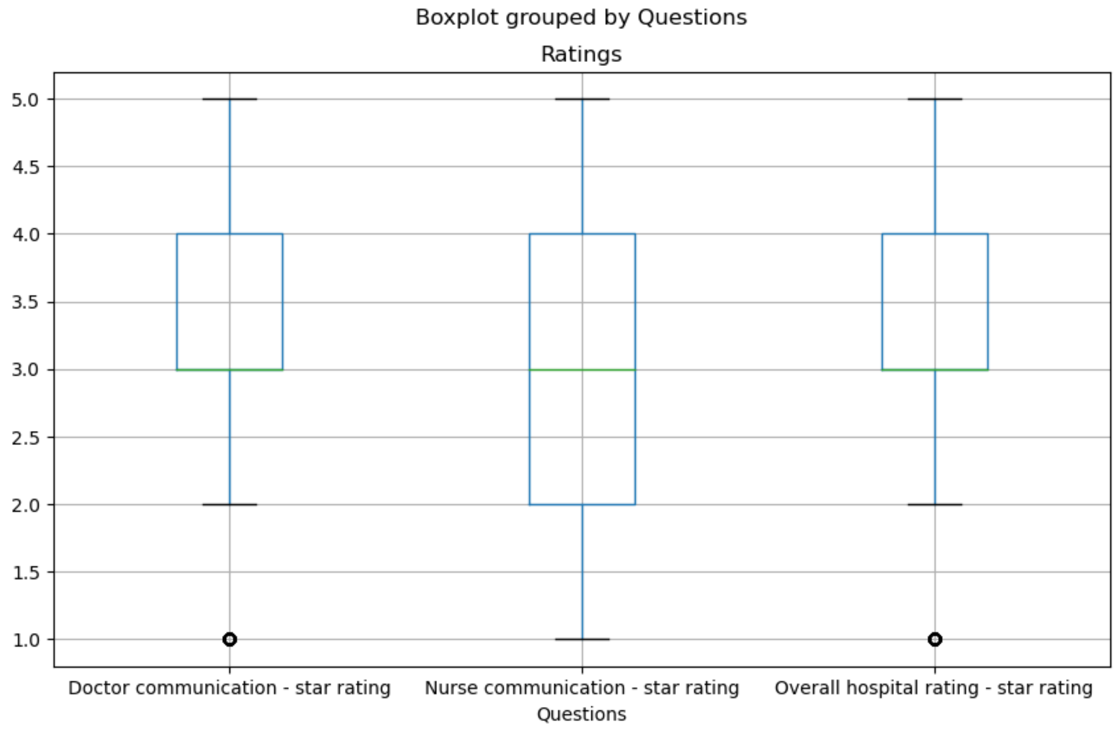


[20]:
```
# Create Boxplot
df_clean.boxplot('Ratings', by='Questions', figsize=(10, 6))

control = df_clean['Ratings'][df_clean['Questions'] == 'Overall hospital rating␣
 ↪- star rating']

grps = pd.unique(df_clean['Questions'].values)
d_data = {grp:df_clean['Ratings'][df_clean['Questions'] == grp] for grp in grps}
```

```
k = len(pd.unique(df_clean['Questions']))  # number of conditions
N = len(df_clean.values)  # conditions times participants
n = df_clean.groupby('Questions').size()[0] #Participants in each condition
```



[21]:
```
# Set up ANOVA Model
mod = ols('Ratings ~ C(Questions)', # Note the Catigorical Data C()
                data=df_clean).fit()

# Carry out the ANOVA
aov_table = sm.stats.anova_lm(mod)
print(aov_table)
```

```
                  df       sum_sq   mean_sq         F    PR(>F)
C(Questions)     2.0     1.224297  0.612149  0.614114  0.541141
Residual      9957.0  9925.130723  0.996799       NaN       NaN
```

[22]:
```
print(mod.summary()) # Print More Details
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                Ratings   R-squared:                       0.000
Model:                            OLS   Adj. R-squared:                 -0.000
Method:                 Least Squares   F-statistic:                    0.6141
Date:                Thu, 08 Sep 2022   Prob (F-statistic):              0.541
```

```
Time:                        09:57:52   Log-Likelihood:                -14115.
No. Observations:                9960   AIC:                         2.824e+04
Df Residuals:                    9957   BIC:                         2.826e+04
Df Model:                           2
Covariance Type:            nonrobust
================================================================================
=========================================
                                                            coef    std err
t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
-----------------------------------------
Intercept                                                 3.2383      0.017
186.886      0.000       3.204       3.272
C(Questions)[T.Nurse communication - star rating]         0.0217      0.025
0.885      0.376      -0.026       0.070
C(Questions)[T.Overall hospital rating - star rating]     0.0250      0.025
1.020      0.308      -0.023       0.073
==============================================================================
Omnibus:                      241.290   Durbin-Watson:                   0.859
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              147.053
Skew:                          -0.151   Prob(JB):                     1.17e-32
Kurtosis:                       2.487   Cond. No.                         3.73
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
```

0.1 End