In [1]:
```
import numpy as np
import pandas as pd
from mpl_toolkits.mplot3d import Axes3D
from sklearn.preprocessing import StandardScaler
import matplotlib.pyplot as plt
```

In [2]:
```
NonNurse = pd.concat(map(pd.read_csv, ['NonQ1.csv', 'NonQ2.csv','NonQ3.csv', 'NonQ4.csv']))
Nurse = pd.concat(map(pd.read_csv, ['NurQ1.csv', 'NurQ2.csv','NurQ3.csv', 'NurQ4.csv']))
prov_num = pd.read_csv('prov_num.csv')
```

```
/anaconda3/lib/python3.6/site-packages/IPython/core/interactiveshell.py:3267: DtypeWarning: Columns (0) have mixed types. Specify dtype option on import or set low_memory=False.
  exec(code_obj, self.user_global_ns, self.user_ns)
```

In [3]:
```
NonNurse.head()
```

Out[3]:

	PROVNUM	PROVNAME	CITY	STATE	COUNTY_NAME	COUNTY_FIPS	CY_Qtr	Wor
0	15009	BURNS NURSING HOME, INC.	RUSSELLVILLE	AL	Franklin	59	2020Q1	202
1	15009	BURNS NURSING HOME, INC.	RUSSELLVILLE	AL	Franklin	59	2020Q1	202
2	15009	BURNS NURSING HOME, INC.	RUSSELLVILLE	AL	Franklin	59	2020Q1	202
3	15009	BURNS NURSING HOME, INC.	RUSSELLVILLE	AL	Franklin	59	2020Q1	202
4	15009	BURNS NURSING HOME, INC.	RUSSELLVILLE	AL	Franklin	59	2020Q1	202

5 rows × 81 columns

In [4]:
```
nRow, nCol = NonNurse.shape
print(f'There are {nRow} rows and {nCol} columns')
```

```
There are 5122558 rows and 81 columns
```

In [5]:
```
Nurse.head()
```

Out[5]:

	PROVNUM	PROVNAME	CITY	STATE	COUNTY_NAME	COUNTY_FIPS	CY_Qtr	Wor
0	15009	BURNS NURSING HOME, INC.	RUSSELLVILLE	AL	Franklin	59	2020Q1	202
1	15009	BURNS NURSING HOME, INC.	RUSSELLVILLE	AL	Franklin	59	2020Q1	202
2	15009	BURNS NURSING HOME, INC.	RUSSELLVILLE	AL	Franklin	59	2020Q1	202
3	15009	BURNS NURSING HOME, INC.	RUSSELLVILLE	AL	Franklin	59	2020Q1	202
4	15009	BURNS NURSING HOME, INC.	RUSSELLVILLE	AL	Franklin	59	2020Q1	202

5 rows × 33 columns

In [6]:
```
nRow, nCol = Nurse.shape
print(f'There are {nRow} rows and {nCol} columns')
```

```
There are 5158867 rows and 33 columns
```

In [7]:
```
prov_num.head()
```

Out[7]:

	our_provnum
0	56360
1	465072
2	55505
3	65321
4	55744

In [8]:
```
prov_num.describe()
```

Out[8]:

	our_provnum
count	218.000000
mean	338487.509174
std	255630.410026
min	35014.000000
25%	56342.750000
50%	440483.500000
75%	555707.500000
max	676426.000000

In [21]:
```
NonNurseDf = pd.merge(prov_num,NonNurse,left_on='our_provnum',right_on=
'PROVNUM')
del NonNurseDf['our_provnum']
NonNurseDf.head()
```

Out[21]:

	PROVNUM	PROVNAME	CITY	STATE	COUNTY_NAME	COUNTY_FIPS	CY_Qtr	WorkDa
0	56360	ARBOR GLEN CARE CENTER	GLENDORA	CA	Los Angeles	37	2020Q1	202001
1	56360	ARBOR GLEN CARE CENTER	GLENDORA	CA	Los Angeles	37	2020Q1	202001
2	56360	ARBOR GLEN CARE CENTER	GLENDORA	CA	Los Angeles	37	2020Q1	202001
3	56360	ARBOR GLEN CARE CENTER	GLENDORA	CA	Los Angeles	37	2020Q1	202001
4	56360	ARBOR GLEN CARE CENTER	GLENDORA	CA	Los Angeles	37	2020Q1	202001

5 rows × 81 columns

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

Out[11]:

	COUNTY_FIPS	WorkDate	MDScensus	Hrs_Admin	Hrs_Admin_emp	Hrs_Admin_ctr
count	56021.000000	5.602100e+04	56021.000000	56021.000000	56021.000000	56021.0
mean	105.521626	2.020068e+07	77.974635	5.154014	5.154014	0.0
std	108.505046	3.428332e+02	32.162763	4.032845	4.032845	0.0
min	1.000000	2.020010e+07	4.000000	0.000000	0.000000	0.0
25%	37.000000	2.020041e+07	54.000000	0.000000	0.000000	0.0
50%	71.000000	2.020071e+07	76.000000	8.000000	8.000000	0.0
75%	135.000000	2.020100e+07	93.000000	8.000000	8.000000	0.0
max	469.000000	2.020123e+07	234.000000	16.330000	16.330000	0.0

8 rows × 75 columns

In [22]:
```
NurseDf = pd.merge(prov_num,Nurse,left_on='our_provnum',right_on='PROVNUM')
del NurseDf['our_provnum']
NurseDf.describe()
```

Out[22]:

	COUNTY_FIPS	WorkDate	MDScensus	Hrs_RNDON	Hrs_RNDON_emp	Hrs_RNDON_
count	38101.000000	3.810100e+04	38101.000000	38101.000000	38101.000000	38101.0000
mean	126.242015	2.020069e+07	78.104932	5.476742	5.475651	0.0010
std	117.159477	3.507833e+02	31.111128	4.021543	4.020250	0.0699
min	1.000000	2.020010e+07	13.000000	0.000000	0.000000	0.0000
25%	45.000000	2.020040e+07	55.000000	0.000000	0.000000	0.0000
50%	73.000000	2.020072e+07	77.000000	8.000000	8.000000	0.0000
75%	167.000000	2.020101e+07	92.000000	8.000000	8.000000	0.0000
max	469.000000	2.020123e+07	234.000000	16.000000	16.000000	8.0000

8 rows × 27 columns

In [23]:
```
NurseDf.head()
```

Out[23]:

	PROVNUM	PROVNAME	CITY	STATE	COUNTY_NAME	COUNTY_FIPS	CY_Qtr	WorkDate
0	55505	ARROYO VISTA NURSING CENTER	SAN DIEGO	CA	San Diego	73	2020Q1	20200101
1	55505	ARROYO VISTA NURSING CENTER	SAN DIEGO	CA	San Diego	73	2020Q1	20200102
2	55505	ARROYO VISTA NURSING CENTER	SAN DIEGO	CA	San Diego	73	2020Q1	20200103
3	55505	ARROYO VISTA NURSING CENTER	SAN DIEGO	CA	San Diego	73	2020Q1	20200104
4	55505	ARROYO VISTA NURSING CENTER	SAN DIEGO	CA	San Diego	73	2020Q1	20200105

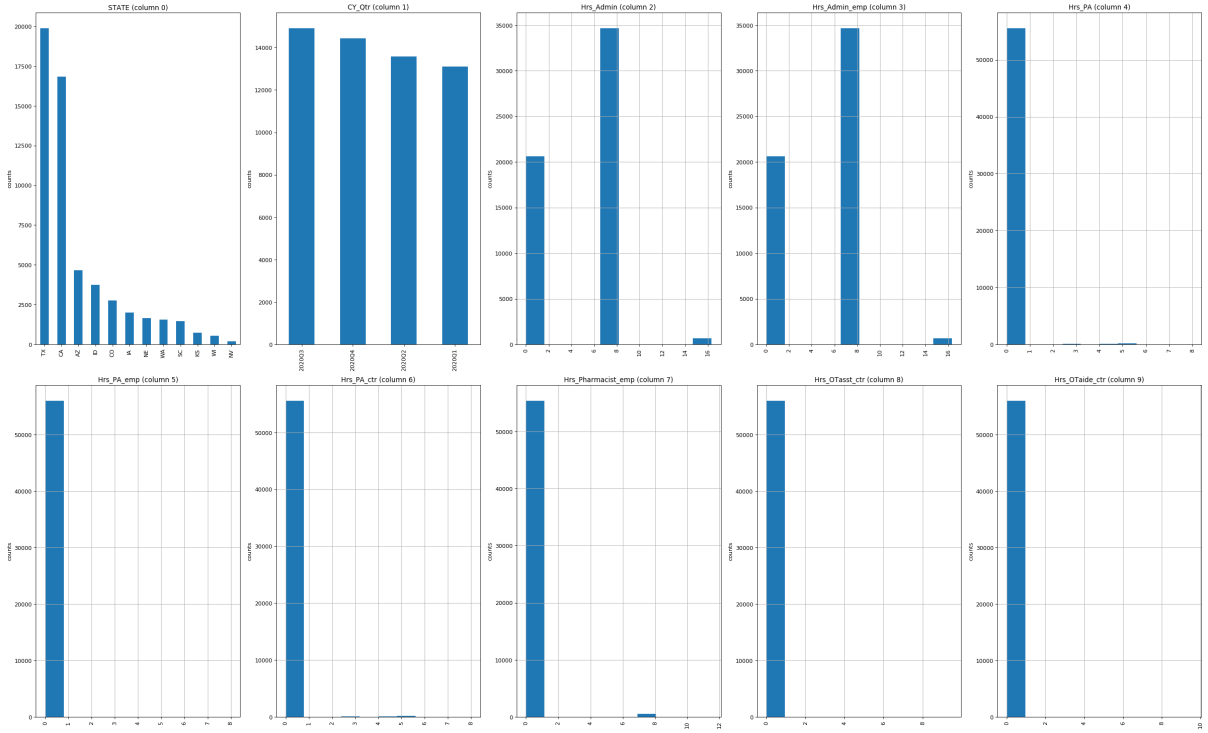
5 rows × 33 columns

In [24]:
```
# Distribution graphs (histogram/bar graph) of column data
def plotPerColumnDistribution(df, nGraphShown, nGraphPerRow):
    nunique = df.nunique()
    df = df[[col for col in df if nunique[col] > 1 and nunique[col] < 50
]] # For displaying purposes, pick columns that have between 1 and 50 un
ique values
    nRow, nCol = df.shape
    columnNames = list(df)
    nGraphRow = (nCol + nGraphPerRow - 1) / nGraphPerRow
    plt.figure(num = None, figsize = (6 * nGraphPerRow, 8 * nGraphRow),
dpi = 80, facecolor = 'w', edgecolor = 'k')
    for i in range(min(nCol, nGraphShown)):
        plt.subplot(nGraphRow, nGraphPerRow, i + 1)
        columnDf = df.iloc[:, i]
        if (not np.issubdtype(type(columnDf.iloc[0]), np.number)):
            valueCounts = columnDf.value_counts()
            valueCounts.plot.bar()
        else:
            columnDf.hist()
        plt.ylabel('counts')
        plt.xticks(rotation = 90)
        plt.title(f'{columnNames[i]} (column {i})')
    plt.tight_layout(pad = 1.0, w_pad = 1.0, h_pad = 1.0)
    plt.show()
```

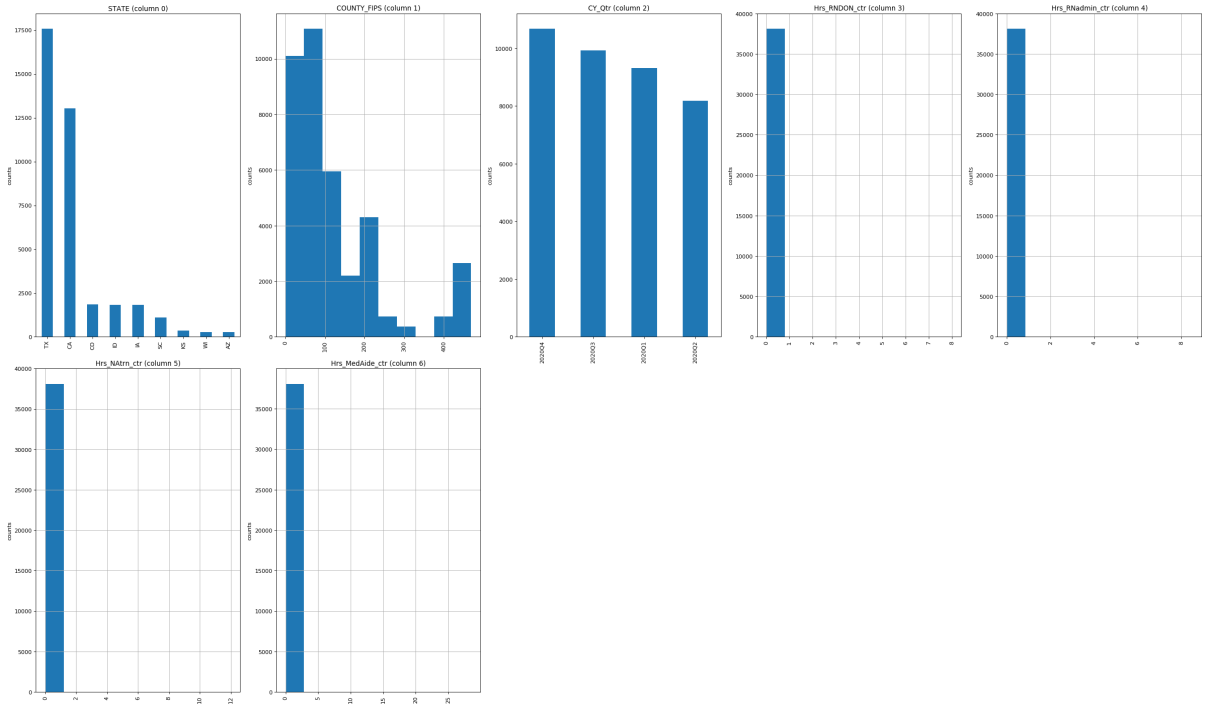
In [38]:
```
# Correlation matrix
def plotCorrelationMatrix(df, graphWidth):
    df = df.dropna('columns') # drop columns with NaN
    df = df[[col for col in df if df[col].nunique() > 1]] # keep columns
where there are more than 1 unique values
    if df.shape[1] < 2:
        print(f'No correlation plots shown: The number of non-NaN or con
stant columns ({df.shape[1]}) is less than 2')
        return
    corr = df.corr()
    plt.figure(num=None, figsize=(graphWidth, graphWidth), dpi=80, facec
olor='w', edgecolor='k')
    corrMat = plt.matshow(corr, fignum = 1)
    plt.xticks(range(len(corr.columns)), corr.columns, rotation=90)
    plt.yticks(range(len(corr.columns)), corr.columns)
    plt.gca().xaxis.tick_bottom()
    plt.colorbar(corrMat)
    plt.title(f'Correlation Matrix', fontsize=15)
    plt.show()
```

In [26]:
```
# Scatter and density plots
def plotScatterMatrix(df, plotSize, textSize):
    df = df.select_dtypes(include =[np.number]) # keep only numerical co
lumns
    # Remove rows and columns that would lead to df being singular
    df = df.dropna('columns')
    df = df[[col for col in df if df[col].nunique() > 1]] # keep columns
where there are more than 1 unique values
    columnNames = list(df)
    if len(columnNames) > 10: # reduce the number of columns for matrix
 inversion of kernel density plots
        columnNames = columnNames[:10]
    df = df[columnNames]
    ax = pd.plotting.scatter_matrix(df, alpha=0.75, figsize=[plotSize, p
lotSize], diagonal='kde')
    corrs = df.corr().values
    for i, j in zip(*plt.np.triu_indices_from(ax, k = 1)):
        ax[i, j].annotate('Corr. coef = %.3f' % corrs[i, j], (0.8, 0.2),
xycoords='axes fraction', ha='center', va='center', size=textSize)
    plt.suptitle('Scatter and Density Plot')
    plt.show()
```

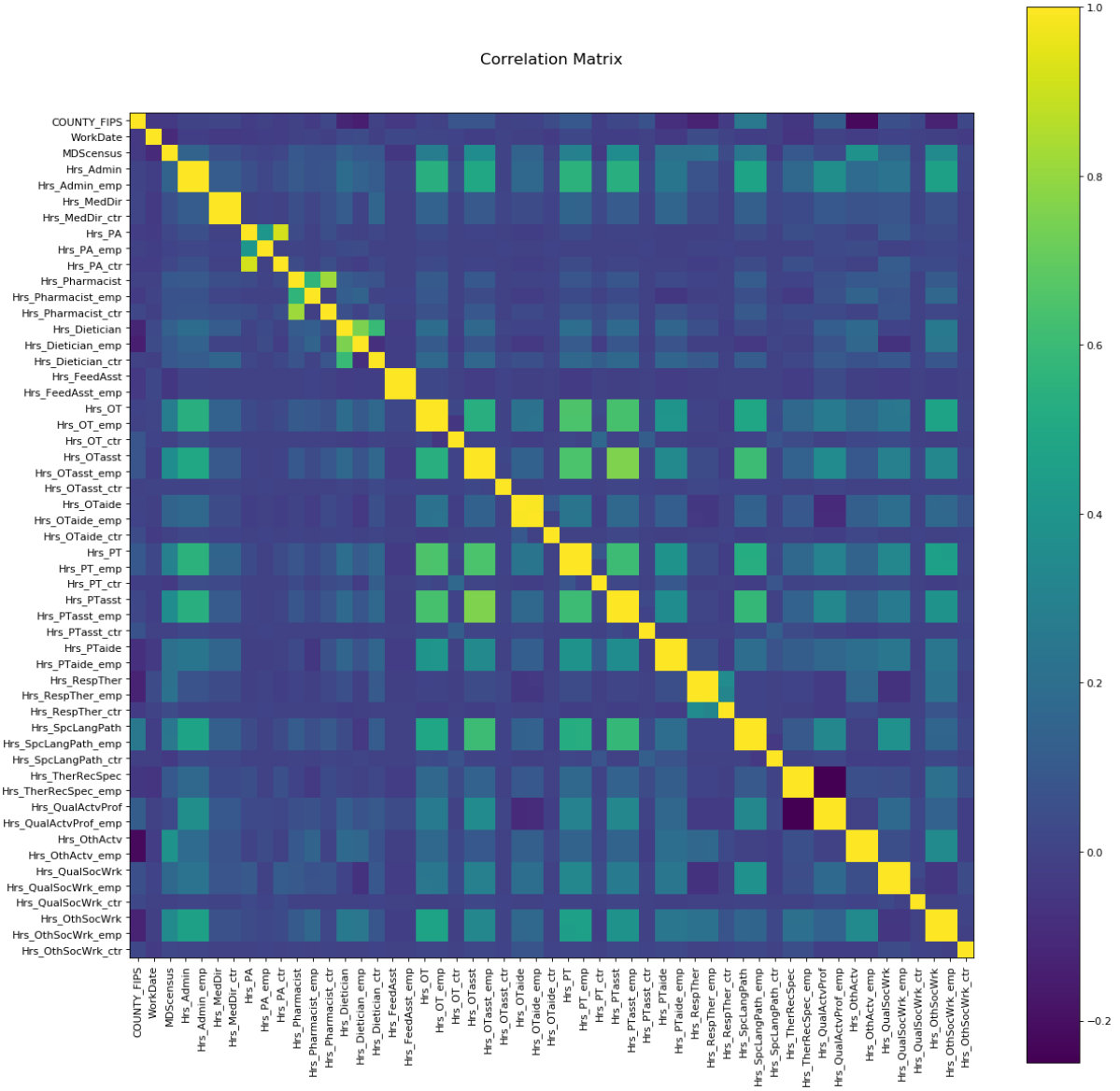
In [27]:
```
plotPerColumnDistribution(NonNurseDf, 10, 5)
```



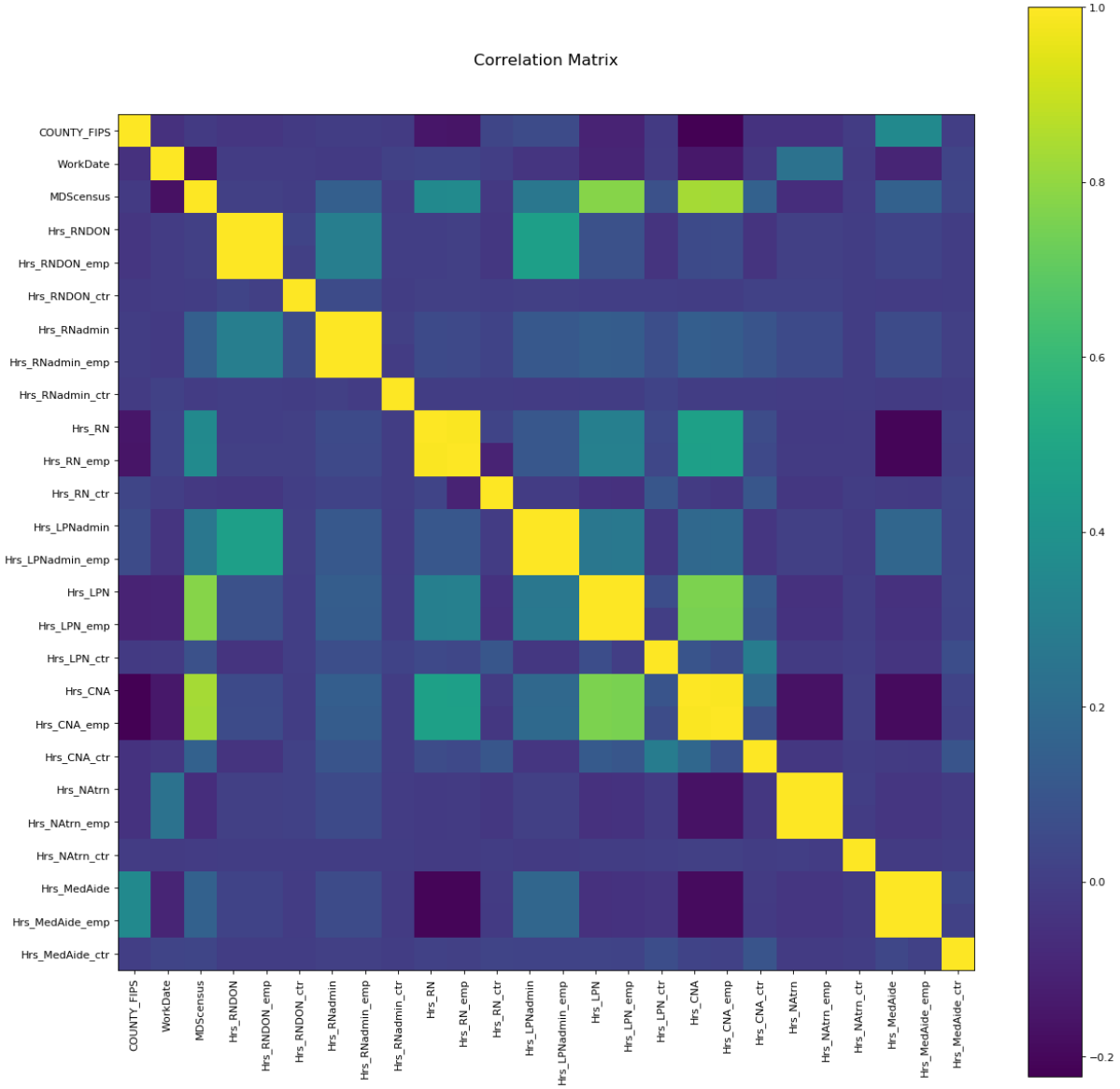
In [28]:
```
plotPerColumnDistribution(NurseDf, 10, 5)
```



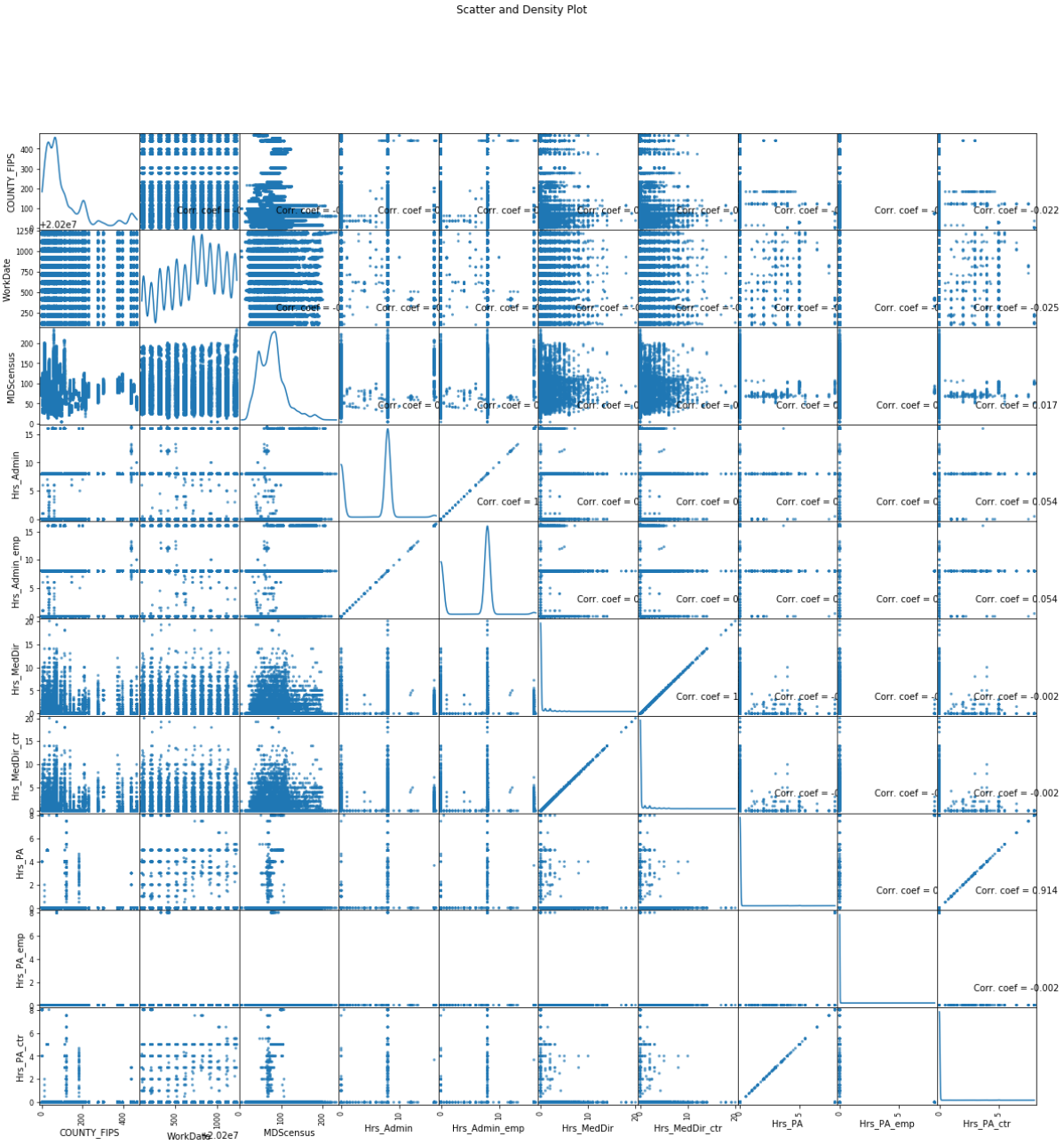
In [39]:
```
plotCorrelationMatrix(NonNurseDf, 18)
```



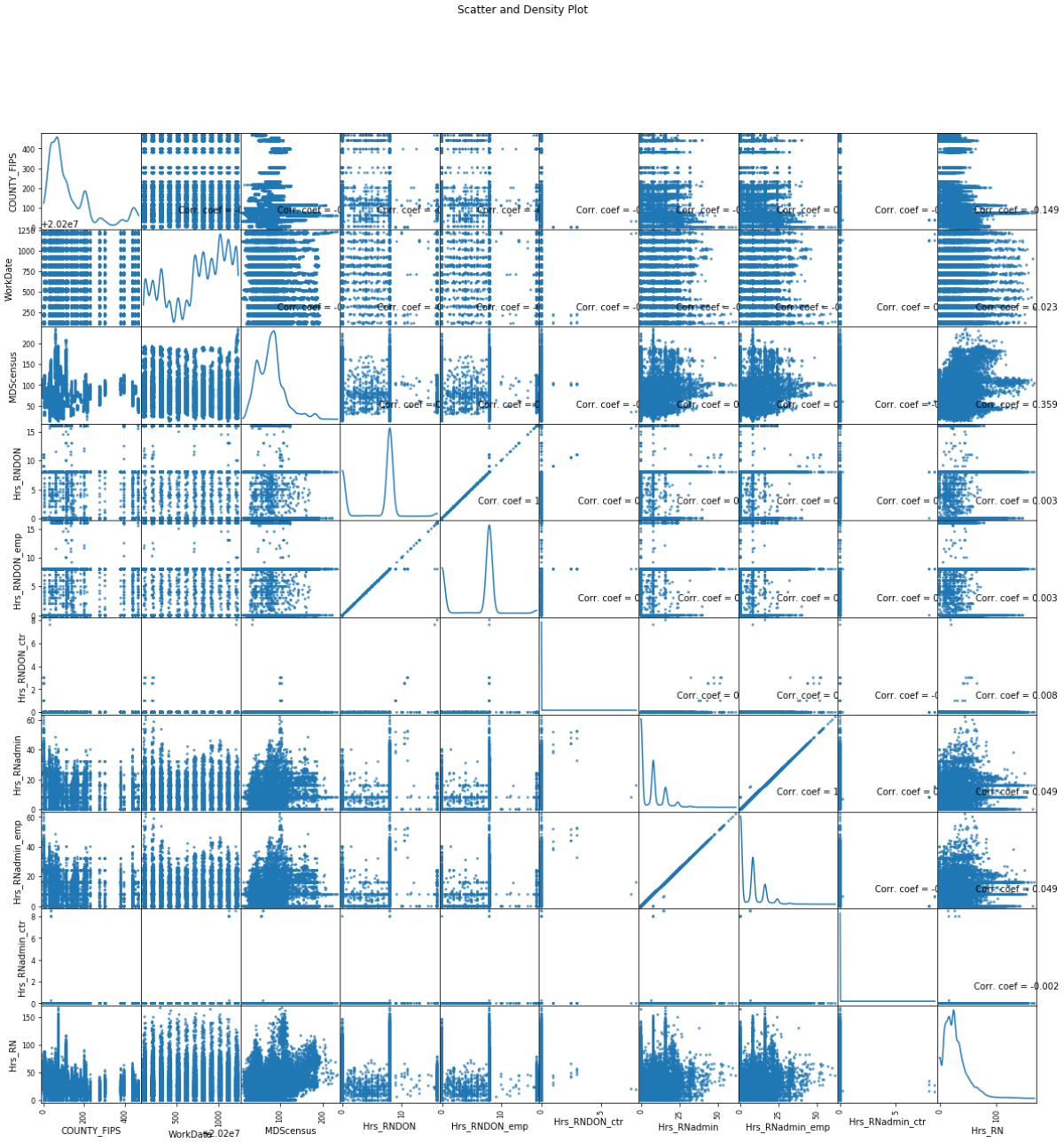
In [40]:
```
plotCorrelationMatrix(NurseDf, 18)
```



In [41]:
```
plotScatterMatrix(NonNurseDf, 20, 10)
```



In [42]:
```
plotScatterMatrix(NurseDf, 20, 10)
```



In [45]:
```
NonNurseDf.to_excel('NonNurse.xlsx')
NurseDf.to_excel('Nurse.xlsx')
```