Assignment - 27 - MACHINE LEARNING - 7

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Problem Statement:

Predict how many points NBA players scored in the 2013-2014 season using the K-nearest neighbors algorithm

A look at the data

- Before we dive into the algorithm, let's take a look at our data. Each row in the data contains information on how a player performed in the 2013-2014 NBA season.
- Download 'nba_2013.csv' file from this link: https://www.dropbox.com/s/b3nv38jjo5dxcl6/nba_2013.csv?dl=0 (https://www.dropbox.com/s/b3nv38jjo5dxcl6/nba_2013.csv?dl=0)

Here are some selected columns from the data:
player - name of the player
pos - the position of the player
g - number of games the player was in
gs - number of games the player started
pts - total points the player scored

There are many more columns in the data, mostly containing information about average player game performance over the course of the season. See this site for an explanation of the rest of them.

We can read our dataset in and figure out which columns are present:

```
import pandas
with open("nba_2013.csv", 'r') as csvfile:
nba = pandas.read_csv(csvfile)
```

In [76]:
```
# Import Libraries
import numpy as np
import pandas as pd

import xgboost as xgb
import seaborn as sns
sns.set(font_scale = 1.5)
import matplotlib.pyplot as plt

from sklearn import metrics, model_selection, preprocessing, tree
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix
from sklearn.model_selection import GridSearchCV
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.preprocessing import Imputer
from sklearn.ensemble import GradientBoostingClassifier, RandomForestClassifier, AdaBoostClassifier
```

Load Data

In [77]:
```
# Read the dataset
csvfile="nba_2013.csv"
nba = pd.read_csv(csvfile)
```

In [79]:
```
nba.head(5)
```

Out[79]:

	player	pos	age	bref_team_id	g	gs	mp	fg	fga	fg.	...	drb	trb	ast	stl	blk	tov	pf	pts	season	season_end
0	Quincy Acy	SF	23	TOT	63	0	847	66	141	0.468	...	144	216	28	23	26	30	122	171	2013-2014	2013
1	Steven Adams	C	20	OKC	81	20	1197	93	185	0.503	...	190	332	43	40	57	71	203	265	2013-2014	2013
2	Jeff Adrien	PF	27	TOT	53	12	961	143	275	0.520	...	204	306	38	24	36	39	108	362	2013-2014	2013
3	Arron Afflalo	SG	28	ORL	73	73	2552	464	1011	0.459	...	230	262	248	35	3	146	136	1330	2013-2014	2013
4	Alexis Ajinca	C	25	NOP	56	30	951	136	249	0.546	...	183	277	40	23	46	63	187	328	2013-2014	2013

5 rows × 31 columns

In [80]:
```
# Rename the column name - remove . from the name
col_name=['player', 'pos', 'age', 'bref_team_id', 'g', 'gs', 'mp', 'fg', 'fga',
       'fg_2', 'x3p', 'x3pa', 'x3p_2', 'x2p', 'x2pa', 'x2p_2', 'efg_2', 'ft',
       'fta', 'ft_2', 'orb', 'drb', 'trb', 'ast', 'stl', 'blk', 'tov', 'pf',
       'pts', 'season', 'season_end']
nba.columns=col_name
```

Analyze Data

In [81]:
```
nba.describe()
```

Out[81]:

	age	g	gs	mp	fg	fga	fg_2	x3p	x3pa	x3p_2	...
count	481.000000	481.000000	481.000000	481.000000	481.000000	481.000000	479.000000	481.000000	481.000000	414.000000	...
mean	26.509356	53.253638	25.571726	1237.386694	192.881497	424.463617	0.436436	39.613306	110.130977	0.285111	...
std	4.198265	25.322711	29.658465	897.258840	171.832793	368.850833	0.098672	50.855639	132.751732	0.157633	...
min	19.000000	1.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...
25%	23.000000	32.000000	0.000000	388.000000	47.000000	110.000000	0.400500	0.000000	3.000000	0.234355	...
50%	26.000000	61.000000	10.000000	1141.000000	146.000000	332.000000	0.438000	16.000000	48.000000	0.330976	...
75%	29.000000	76.000000	54.000000	2016.000000	307.000000	672.000000	0.479500	68.000000	193.000000	0.375000	...
max	39.000000	83.000000	82.000000	3122.000000	849.000000	1688.000000	1.000000	261.000000	615.000000	1.000000	...

8 rows × 27 columns

In [82]:
```
nba.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 481 entries, 0 to 480
Data columns (total 31 columns):
player          481 non-null object
pos             481 non-null object
age             481 non-null int64
bref_team_id    481 non-null object
g               481 non-null int64
gs              481 non-null int64
mp              481 non-null int64
fg              481 non-null int64
fga             481 non-null int64
fg_2            479 non-null float64
x3p             481 non-null int64
x3pa            481 non-null int64
x3p_2           414 non-null float64
x2p             481 non-null int64
x2pa            481 non-null int64
x2p_2           478 non-null float64
efg_2           479 non-null float64
ft              481 non-null int64
fta             481 non-null int64
ft_2            461 non-null float64
orb             481 non-null int64
drb             481 non-null int64
trb             481 non-null int64
ast             481 non-null int64
stl             481 non-null int64
blk             481 non-null int64
tov             481 non-null int64
pf              481 non-null int64
pts             481 non-null int64
season          481 non-null object
season_end      481 non-null int64
dtypes: float64(5), int64(22), object(4)
memory usage: 116.6+ KB
```

Prepare Data

In [83]:
```
# Fill null values with mean
nba.fg_2.fillna(nba.fg_2.mean(), inplace=True)
nba.x3p_2.fillna(nba.x3p_2.mean(), inplace=True)
nba.x2p_2.fillna(nba.x2p_2.mean(), inplace=True)
nba.efg_2.fillna(nba.efg_2.mean(), inplace=True)
nba.ft_2.fillna(nba.ft_2.mean(), inplace=True)
```

In [84]:
```
nba.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 481 entries, 0 to 480
Data columns (total 31 columns):
player          481 non-null object
pos             481 non-null object
age             481 non-null int64
bref_team_id    481 non-null object
g               481 non-null int64
gs              481 non-null int64
mp              481 non-null int64
fg              481 non-null int64
fga             481 non-null int64
fg_2            481 non-null float64
x3p             481 non-null int64
x3pa            481 non-null int64
x3p_2           481 non-null float64
x2p             481 non-null int64
x2pa            481 non-null int64
x2p_2           481 non-null float64
efg_2           481 non-null float64
ft              481 non-null int64
fta             481 non-null int64
ft_2            481 non-null float64
orb             481 non-null int64
drb             481 non-null int64
trb             481 non-null int64
ast             481 non-null int64
stl             481 non-null int64
blk             481 non-null int64
tov             481 non-null int64
pf              481 non-null int64
pts             481 non-null int64
season          481 non-null object
season_end      481 non-null int64
dtypes: float64(5), int64(22), object(4)
memory usage: 116.6+ KB
```

In [85]:
```
# Convert Categorical Variable to Numerical Variable for Train Dataset
for feature in nba.columns:
    if nba[feature].dtype == 'object':
        nba[feature] = pd.Categorical(nba[feature]).codes

nba.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 481 entries, 0 to 480
Data columns (total 31 columns):
player          481 non-null int16
pos             481 non-null int8
age             481 non-null int64
bref_team_id    481 non-null int8
g               481 non-null int64
gs              481 non-null int64
mp              481 non-null int64
fg              481 non-null int64
fga             481 non-null int64
fg_2            481 non-null float64
x3p             481 non-null int64
x3pa            481 non-null int64
x3p_2           481 non-null float64
x2p             481 non-null int64
x2pa            481 non-null int64
x2p_2           481 non-null float64
efg_2           481 non-null float64
ft              481 non-null int64
fta             481 non-null int64
ft_2            481 non-null float64
orb             481 non-null int64
drb             481 non-null int64
trb             481 non-null int64
ast             481 non-null int64
stl             481 non-null int64
blk             481 non-null int64
tov             481 non-null int64
pf              481 non-null int64
pts             481 non-null int64
season          481 non-null int8
season_end      481 non-null int64
dtypes: float64(5), int16(1), int64(22), int8(3)
memory usage: 103.9 KB
```

In [86]:
```
# Drop unwanted features
nba.drop(['season','season_end','player','pos','bref_team_id'], axis=1, inplace=True)
```

In [87]:
```
nba.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 481 entries, 0 to 480
Data columns (total 26 columns):
age      481 non-null int64
g        481 non-null int64
gs       481 non-null int64
mp       481 non-null int64
fg       481 non-null int64
fga      481 non-null int64
fg_2     481 non-null float64
x3p      481 non-null int64
x3pa     481 non-null int64
x3p_2    481 non-null float64
x2p      481 non-null int64
x2pa     481 non-null int64
x2p_2    481 non-null float64
efg_2    481 non-null float64
ft       481 non-null int64
fta      481 non-null int64
ft_2     481 non-null float64
orb      481 non-null int64
drb      481 non-null int64
trb      481 non-null int64
ast      481 non-null int64
stl      481 non-null int64
blk      481 non-null int64
tov      481 non-null int64
pf       481 non-null int64
pts      481 non-null int64
dtypes: float64(5), int64(21)
memory usage: 97.8 KB
```

In [88]:
```
# Target and Feature selection
nba_y=nba.pop('pts')
nba_x=nba
```

In [89]:
```
nba_x.head(2)
```

Out[89]:

	age	g	gs	mp	fg	fga	fg_2	x3p	x3pa	x3p_2	...	fta	ft_2	orb	drb	trb	ast	stl	blk	tov	pf
0	23	63	0	847	66	141	0.468	4	15	0.266667	...	53	0.660	72	144	216	28	23	26	30	122
1	20	81	20	1197	93	185	0.503	0	0	0.285111	...	136	0.581	142	190	332	43	40	57	71	203

2 rows × 25 columns

In [90]:
```
# Split into train/test dataset (70%:30%)
x_train, x_test, y_train, y_test = model_selection.train_test_split(nba_x, nba_y, test_size = 0.3, random_state = 1)
```

In [91]:
```
x_train.head(5)
```

Out[91]:

	age	g	gs	mp	fg	fga	fg_2	x3p	x3pa	x3p_2	...	fta	ft_2	orb	drb	trb	ast	stl	blk	tov	pf
344	31	68	68	1997	456	914	0.499	25	67	0.373134	...	243	0.811	17	138	155	388	36	9	151	86
218	21	71	71	2496	532	1237	0.430	123	344	0.357558	...	338	0.861	52	207	259	433	108	23	190	163
343	34	29	0	242	52	118	0.441	24	60	0.400000	...	11	0.727	1	19	20	52	14	1	26	17
162	23	80	80	2898	577	1362	0.424	182	500	0.364000	...	464	0.864	64	478	542	283	151	22	224	198
98	33	81	0	1353	134	241	0.556	4	17	0.235294	...	93	0.710	116	177	293	104	30	28	71	187

5 rows × 25 columns

In [92]:
```
y_train.head(5)
```

Out[92]:
```
344    1134
218    1478
343     136
162    1737
98      338
Name: pts, dtype: int64
```

In [93]:
```
x_test.head(5)
```

Out[93]:

	age	g	gs	mp	fg	fga	fg_2	x3p	x3pa	x3p_2	...	fta	ft_2	orb	drb	trb	ast	stl	blk	tov	pf
293	22	45	10	897	113	300	0.377	22	59	0.372881	...	43	0.744	18	61	79	120	22	9	39	69
283	22	54	45	1564	170	419	0.406	71	178	0.398876	...	36	0.528	15	140	155	477	48	4	150	76
34	23	41	0	387	65	156	0.417	10	33	0.303030	...	32	0.813	16	58	74	33	9	7	18	31
399	25	70	1	1006	119	281	0.423	1	23	0.043478	...	39	0.564	31	98	129	179	49	13	65	66
432	28	64	9	1298	129	307	0.420	102	247	0.412955	...	41	0.805	33	135	168	42	19	15	23	82

5 rows × 25 columns

In [94]:
```
y_test.head(5)
```

Out[94]:
```
293    280
283    430
34     166
399    261
432    393
Name: pts, dtype: int64
```

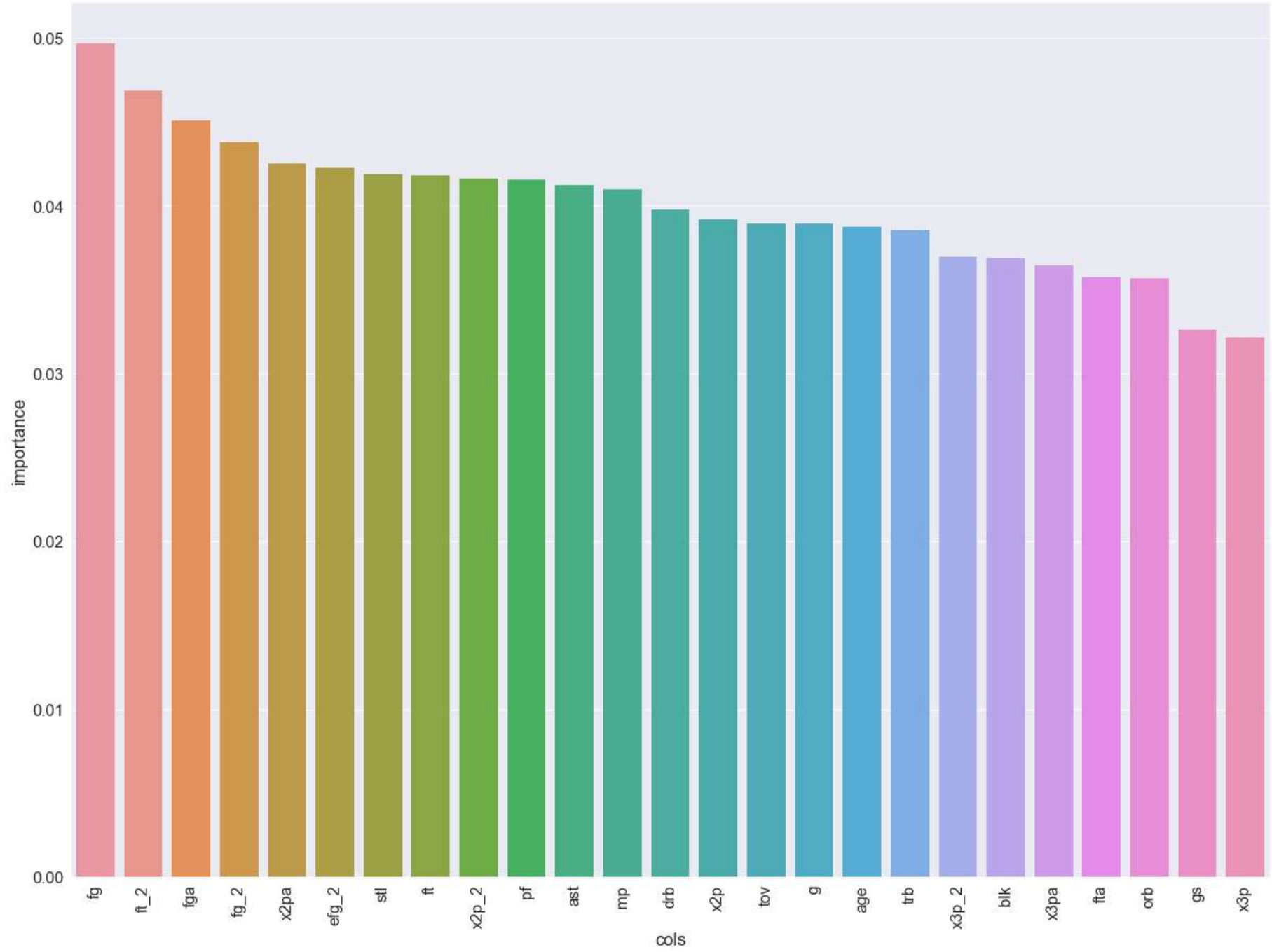
In [95]:
```
curr_col_name=nba.columns
curr_col_name
```

Out[95]:
```
Index(['age', 'g', 'gs', 'mp', 'fg', 'fga', 'fg_2', 'x3p', 'x3pa', 'x3p_2',
       'x2p', 'x2pa', 'x2p_2', 'efg_2', 'ft', 'fta', 'ft_2', 'orb', 'drb',
       'trb', 'ast', 'stl', 'blk', 'tov', 'pf'],
      dtype='object')
```

In [96]:
```
# Imp feature selection using Random Forest Classifier
rnd_forest_classifier = RandomForestClassifier(n_estimators=100)
rnd_forest_classifier.fit(x_train[curr_col_name], y_train)

rfc_importance = pd.DataFrame.from_dict({'cols':curr_col_name, 'importance': rnd_forest_classifier.feature_importances
_})
rfc_importance = rfc_importance.sort_values(by='importance', ascending=False)
plt.figure(figsize=(20,15))
sns.barplot(rfc_importance.cols, rfc_importance.importance)
plt.xticks(rotation=90)
```

```
Out[96]: (array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
                 17, 18, 19, 20, 21, 22, 23, 24]),
          <a list of 25 Text xticklabel objects>)
```


0.05
0.04
0.03
0.02
0.01
0.00
importance
fg
ft_2
fga
fg_2
x2pa
efg_2
stl
ft
x2p_2
pf
ast
mp
drb
x2p
tov
g
age
trb
x3p_2
blk
x3pa
fta
orb
gs
x3p
cols

In [97]:
```
important_features = importance[importance.importance >= 0.04].cols.values
print(important_features)
```

```
['fg' 'ft_2' 'fga' 'x2p' 'x2p_2' 'mp' 'stl' 'fg_2' 'efg_2']
```

K-nearest neighbors algorithm

In [99]:
```
# Accuracy for K Values
for K in range(6):
    K_value = K+1
    KNeighbors = KNeighborsClassifier(n_neighbors = K_value, weights='uniform', algorithm='auto')
    KNeighbors.fit(x_train[important_features], y_train)
    y_pred = KNeighbors.predict(x_test[important_features])
    print("K-Value: ", K_value, " :  Accuracy: ",(y_pred.sum()/y_test.sum())*100,"%")
```

```
K-Value:  1  :  Accuracy:  98.92334541549201 %
K-Value:  2  :  Accuracy:  92.8983756208887 %
K-Value:  3  :  Accuracy:  89.72882266075983 %
K-Value:  4  :  Accuracy:  87.6896227681568 %
K-Value:  5  :  Accuracy:  85.51080681970734 %
K-Value:  6  :  Accuracy:  84.31735803463553 %
```

In [100]:
```
KNeighbors = KNeighborsClassifier(n_neighbors = 2, weights='uniform', algorithm='auto')
KNeighbors.fit(x_train[important_features], y_train)
y_pred=KNeighbors.predict(x_test[important_features])
print("K-Value:  2  :  Accuracy: ", (y_pred.sum()/y_test.sum())*100,"%")
```

```
K-Value:  2  :  Accuracy:  92.8983756208887 %
```

In [101]:
```
x_test['Actual_PT']= y_test
x_test['Predicted_PT']= y_pred
```

```
C:\Users\praka\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
C:\Users\praka\Anaconda3\lib\site-packages\ipykernel_launcher.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html#indexing-view-versus-copy
```

In [102]:
```
# Actual and Predcited values
X_test.head(10)
```

Out[102]:

	age	g	gs	mp	fg	fga	fg_2	x3p	x3pa	x3p_2	...	trb	ast	stl	blk	tov	pf	Actual_pts	Predicted_pts	Actual_pts2	Pr
293	22	45	10	897	113	300	0.377	22	59	0.372881	...	79	120	22	9	39	69	280	273	280	27
283	22	54	45	1564	170	419	0.406	71	178	0.398876	...	155	477	48	4	150	76	430	378	430	37
34	23	41	0	387	65	156	0.417	10	33	0.303030	...	74	33	9	7	18	31	166	110	166	11
399	25	70	1	1006	119	281	0.423	1	23	0.043478	...	129	179	49	13	65	66	261	248	261	24
432	28	64	9	1298	129	307	0.420	102	247	0.412955	...	168	42	19	15	23	82	393	298	393	29
364	30	14	0	95	7	14	0.500	0	0	0.285111	...	25	1	3	1	5	15	20	14	20	14
349	29	62	62	1207	87	193	0.451	0	1	0.000000	...	305	67	26	32	90	177	211	265	211	26
66	23	26	0	224	26	86	0.302	3	30	0.100000	...	28	41	13	3	16	19	64	54	64	54
250	22	59	25	1312	157	371	0.423	48	142	0.338028	...	219	95	32	45	47	147	472	404	472	40
31	28	42	39	1257	222	502	0.442	30	108	0.277778	...	222	45	14	52	58	100	558	401	558	40

10 rows × 29 columns