```
import numpy as np # for mathematical caluclations
import pandas as pd
from datetime import datetime  # to access datetime
import scipy.stats as stats

# for data visualization
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px # for interactive plotting
import plotly.graph_objects as go # for interactive plotting

# set the plot style in matplotlib to ggplot and the firgure size to
15x5## Augmented Dickey Fuller Test for Assessing Stationarity
plt.style.use('ggplot')
plt.rcParams["figure.figsize"] = (10,5)

# for ingnoring warnings
import warnings # to ignore warning
warnings.filterwarnings('ignore')
pd.set_option('display.max_columns',None)
```

## Creating Data Frame for Analysis

```
# importing data
stats = pd.read_csv('nba_stats_cleaned.csv')
stats.head()

   Rk             Player Pos  Age   Tm   G  GS    MP   FG   FGA    FG%
3P  \
0   1  Precious Achiuwa   C   23  TOR  55  12  1140  196   404  0.485
29
1   2      Steven Adams   C   29  MEM  42  42  1133  157   263  0.597
0
2   3       Bam Adebayo   C   25  MIA  75  75  2598  602  1114  0.540
1
3   4      Ochai Agbaji  SG   22  UTA  59  22  1209  165   386  0.427
81
4   5      Santi Aldama  PF   22  MEM  77  20  1682  247   525  0.470
94

   3PA    3P%   2P   2PA    2P%   eFG%   FT  FTA    FT%  ORB  DRB  TRB
AST  \
0  108  0.269  167   296  0.564  0.521   87  124  0.702  100  228  328
50
1    1  0.000  157   262  0.599  0.597   47  129  0.364  214  271  485
97
2   12  0.083  601  1102  0.545  0.541  324  402  0.806  184  504  688
240
3  228  0.355   84   158  0.532  0.532   56   69  0.812   43   78  121
67
```

```
4  266  0.353  153   259  0.591  0.560  108  144  0.750   85  286  371
97

   STL  BLK  TOV   PF   PTS Player-additional
0   31   30   59  102   508          achiupr01
1   36   46   79   98   361          adamsst01
2   88   61  187  208  1529          adebaba01
3   16   15   41   99   467          agbajoc01
4   45   48   60  143   696          aldamsa01
```

```python
# creating data just for centers
center = stats[stats['Pos']=='C']
center.describe()
```

```
               Rk         Age           G          GS          MP  \
count  108.000000  108.000000  108.000000  108.000000  108.000000
mean   261.777778   26.222222   49.342593   23.731481 1014.648148
std    162.236146    4.405462   22.352387   27.835165  757.680046
min      1.000000   19.000000    1.000000    0.000000   20.000000
25%    120.500000   23.000000   36.000000    1.000000  353.250000
50%    255.500000   25.000000   52.000000    8.500000  858.000000
75%    409.250000   29.000000   68.000000   48.250000 1675.000000
max    539.000000   42.000000   82.000000   82.000000 2746.000000

               FG          FGA         FG%          3P         3PA
3P%  \
count  108.000000   108.000000  108.000000  108.000000  108.000000
98.000000
mean   184.268519   323.842593    0.560491   20.305556   58.000000
0.286429
std    169.746959   300.434923    0.099036   33.792788   89.994081
0.194323
min      2.000000     5.000000    0.250000    0.000000    0.000000
0.000000
25%     55.000000    89.000000    0.500000    0.000000    2.750000
0.170750
50%    126.000000   237.500000    0.551500    4.000000   13.500000
0.328500
75%    279.500000   487.250000    0.630500   21.500000   68.000000
0.381500
max    728.000000  1328.000000    0.819000  145.000000  364.000000
1.000000

               2P          2PA         2P%        eFG%          FT  \
count  108.000000   108.000000  108.000000  108.000000  108.000000
mean   163.962963   265.842593    0.603380    0.592139   83.611111
std    155.758375   254.689812    0.085346    0.084843  100.537605
min      1.000000     3.000000    0.250000    0.250000    0.000000
25%     46.750000    71.750000    0.571000    0.553500   19.750000
50%    121.000000   186.000000    0.614500    0.593500   44.000000
```

```
75%    236.750000   386.500000    0.650000    0.642750  113.750000
max    662.000000  1128.000000    0.819000    0.819000  661.000000

              FTA         FT%         ORB         DRB         TRB
AST  \
count  108.000000  108.000000  108.000000  108.000000  108.000000
108.000000
mean   116.333333    0.691898   95.398148  213.027778  308.425926
76.462963
std    125.268832    0.150064   76.243332  182.183253  249.990325
101.703842
min      2.000000    0.000000    1.000000    1.000000    2.000000
0.000000
25%     26.750000    0.626500   31.000000   72.250000  103.500000
15.000000
50%     71.500000    0.703000   85.000000  168.000000  261.000000
48.500000
75%    161.250000    0.778250  133.500000  329.750000  474.500000
90.750000
max    771.000000    1.000000  274.000000  744.000000  973.000000
678.000000

              STL         BLK         TOV          PF          PTS
count  108.000000  108.000000  108.000000  108.000000   108.000000
mean    26.120370   43.129630   57.564815  110.000000   472.453704
std     22.061392   42.469801   53.708850   73.871826   448.971501
min      0.000000    0.000000    0.000000    0.000000     6.000000
25%      6.750000   11.750000   19.500000   43.750000   136.750000
50%     19.500000   30.000000   41.000000  100.000000   321.500000
75%     43.250000   57.500000   82.000000  170.250000   696.750000
max     88.000000  193.000000  247.000000  279.000000  2183.000000

# setting indexes
center = center.reset_index(drop=True)
center.head()

   Rk            Player Pos  Age   Tm   G  GS    MP   FG   FGA    FG%
3P  \
0   1  Precious Achiuwa   C   23  TOR  55  12  1140  196   404  0.485
29
1   2      Steven Adams   C   29  MEM  42  42  1133  157   263  0.597
0
2   3       Bam Adebayo   C   25  MIA  75  75  2598  602  1114  0.540
1
3   8    Jarrett Allen   C   24  CLE  68  68  2220  403   626  0.644
1
4  17    Deandre Ayton   C   24  PHO  67  67  2035  522   887  0.589
7

   3PA    3P%   2P   2PA    2P%   eFG%   FT  FTA    FT%  ORB  DRB  TRB
```

```
AST  \
0  108  0.269  167   296  0.564  0.521   87  124  0.702  100  228  328
50
1    1  0.000  157   262  0.599  0.597   47  129  0.364  214  271  485
97
2   12  0.083  601  1102  0.545  0.541  324  402  0.806  184  504  688
240
3   10  0.100  402   616  0.653  0.645  162  221  0.733  221  445  666
113
4   24  0.292  515   863  0.597  0.592  152  200  0.760  172  495  667
115

   STL  BLK  TOV   PF   PTS Player-additional
0   31   30   59  102   508         achiupr01
1   36   46   79   98   361         adamsst01
2   88   61  187  208  1529         adebaba01
3   54   84   93  153   969         allenja01
4   37   53  120  190  1203         aytonde01

# dataframe for advanced player stats
advanced = pd.read_csv('NBA Advanced Cleaned Stats.csv')

# making advanced stat dataframe of only centers
ad_center=advanced[advanced['Pos']=='C']
ad_center = ad_center.reset_index()
ad_center.head()

   index  Rk            Player Pos  Age   Tm   G    MP   PER    TS%
3PAr  \
0      0   1  Precious Achiuwa   C   23  TOR  55  1140  15.2  0.554
0.267
1      1   2      Steven Adams   C   29  MEM  42  1133  17.5  0.564
0.004
2      2   3       Bam Adebayo   C   25  MIA  75  2598  20.1  0.592
0.011
3      7   8     Jarrett Allen   C   24  CLE  68  2220  19.9  0.670
0.016
4     16  17     Deandre Ayton   C   24  PHO  67  2035  19.9  0.617
0.027

     FTr  ORB%  DRB%  TRB%  AST%  STL%  BLK%  TOV%  USG%  Unnamed: 19
OWS  \
0  0.307   9.3  24.4  16.3   6.3   1.3   2.6  11.4  19.4          NaN
0.8
1  0.490  20.1  25.3  22.7  11.2   1.5   3.7  19.8  14.6          NaN
1.3
2  0.361   8.0  23.6  15.5  15.9   1.7   2.4  12.7  25.2          NaN
3.6
3  0.353  11.7  23.6  17.7   7.5   1.2   3.5  11.4  16.4          NaN
5.5
```

```
4  0.225   9.2  27.5  18.1   9.2   0.9   2.3  11.0  22.9          NaN
3.3

   DWS   WS  WS/48  Unnamed: 24  OBPM  DBPM  BPM  VORP Player-
additional
0  1.4  2.2  0.093          NaN  -1.4  -0.8 -2.3  -0.1
achiupr01
1  2.1  3.4  0.144          NaN  -0.3   0.9  0.6   0.7
adamsst01
2  3.8  7.4  0.137          NaN   0.8   0.8  1.5   2.3
adebaba01
3  4.0  9.5  0.205          NaN   1.3   1.0  2.4   2.4
allenja01
4  3.0  6.2  0.147          NaN   0.9   0.0  0.9   1.5
aytonde01
```

## Splitting centers up by team standing

```
# defining which teams are the top half and bottom half of the league
by total wins
top =
['MIL','BOS','PHI','DEN','MEM','CLE','SAC','NYK','PHO','BRK','MIA','LA
C','GSW','LAL','MIN']
bot =
['NOP','ATL','TOR','CHI','OKC','DAL','UTA','IND','WAS','ORL','POR','CH
O','HOU','SAS','DET']

# creating column to say which group a player belongs to
center['Standing']=0
for i in range(len(center)):
    if center.loc[i,'Tm'] in top:
        center.loc[i,'Standing']='Top'
    else:
        center.loc[i,'Standing']='Bottom'

center.describe()

               Rk         Age           G          GS           MP  \
count  108.000000  108.000000  108.000000  108.000000   108.000000
mean   261.777778   26.222222   49.342593   23.731481  1014.648148
std    162.236146    4.405462   22.352387   27.835165   757.680046
min      1.000000   19.000000    1.000000    0.000000    20.000000
25%    120.500000   23.000000   36.000000    1.000000   353.250000
50%    255.500000   25.000000   52.000000    8.500000   858.000000
75%    409.250000   29.000000   68.000000   48.250000  1675.000000
max    539.000000   42.000000   82.000000   82.000000  2746.000000

               FG         FGA         FG%          3P         3PA
3P%  \
count  108.000000  108.000000  108.000000  108.000000  108.000000
```

```
98.000000
mean   184.268519   323.842593    0.560491   20.305556   58.000000
0.286429
std    169.746959   300.434923    0.099036   33.792788   89.994081
0.194323
min      2.000000     5.000000    0.250000    0.000000    0.000000
0.000000
25%     55.000000    89.000000    0.500000    0.000000    2.750000
0.170750
50%    126.000000   237.500000    0.551500    4.000000   13.500000
0.328500
75%    279.500000   487.250000    0.630500   21.500000   68.000000
0.381500
max    728.000000  1328.000000    0.819000  145.000000  364.000000
1.000000

               2P          2PA          2P%        eFG%          FT  \
count  108.000000   108.000000  108.000000  108.000000  108.000000
mean   163.962963   265.842593    0.603380    0.592139   83.611111
std    155.758375   254.689812    0.085346    0.084843  100.537605
min      1.000000     3.000000    0.250000    0.250000    0.000000
25%     46.750000    71.750000    0.571000    0.553500   19.750000
50%    121.000000   186.000000    0.614500    0.593500   44.000000
75%    236.750000   386.500000    0.650000    0.642750  113.750000
max    662.000000  1128.000000    0.819000    0.819000  661.000000

              FTA         FT%         ORB         DRB         TRB
AST  \
count  108.000000  108.000000  108.000000  108.000000  108.000000
108.000000
mean   116.333333    0.691898   95.398148  213.027778  308.425926
76.462963
std    125.268832    0.150064   76.243332  182.183253  249.990325
101.703842
min      2.000000    0.000000    1.000000    1.000000    2.000000
0.000000
25%     26.750000    0.626500   31.000000   72.250000  103.500000
15.000000
50%     71.500000    0.703000   85.000000  168.000000  261.000000
48.500000
75%    161.250000    0.778250  133.500000  329.750000  474.500000
90.750000
max    771.000000    1.000000  274.000000  744.000000  973.000000
678.000000

              STL         BLK         TOV          PF          PTS
count  108.000000  108.000000  108.000000  108.000000   108.000000
mean    26.120370   43.129630   57.564815  110.000000   472.453704
std     22.061392   42.469801   53.708850   73.871826   448.971501
min      0.000000    0.000000    0.000000    0.000000     6.000000
```

```
25%      6.750000   11.750000   19.500000   43.750000   136.750000
50%     19.500000   30.000000   41.000000  100.000000   321.500000
75%     43.250000   57.500000   82.000000  170.250000   696.750000
max     88.000000  193.000000  247.000000  279.000000  2183.000000
```

```
# creating new data frame with only centers that play above a certain
threshold of minutes
center2=center[((center['MP']>=1500)&(center['Standing']=='Bottom'))|
               ((center['MP']>=1700)&(center['Standing']=='Top'))]

center2['Standing'].value_counts()
```

```
Standing
Top       15
Bottom    15
Name: count, dtype: int64
```

```
# Creating standing column in advanced stat dataframe
ad_center['Standing']=0
for i in range(len(ad_center)):
    if ad_center.loc[i,'Tm'] in top:
        ad_center.loc[i,'Standing']='Top'
    else:
        ad_center.loc[i,'Standing']='Bottom'
ad_center.head()
```

```
   index  Rk             Player Pos  Age   Tm   G    MP   PER    TS%
3PAr  \
0      0   1  Precious Achiuwa   C   23  TOR  55  1140  15.2  0.554
0.267
1      1   2      Steven Adams   C   29  MEM  42  1133  17.5  0.564
0.004
2      2   3       Bam Adebayo   C   25  MIA  75  2598  20.1  0.592
0.011
3      7   8     Jarrett Allen   C   24  CLE  68  2220  19.9  0.670
0.016
4     16  17     Deandre Ayton   C   24  PHO  67  2035  19.9  0.617
0.027

     FTr  ORB%  DRB%  TRB%  AST%  STL%  BLK%  TOV%  USG%  Unnamed: 19
OWS  \
0  0.307   9.3  24.4  16.3   6.3   1.3   2.6  11.4  19.4          NaN
0.8
1  0.490  20.1  25.3  22.7  11.2   1.5   3.7  19.8  14.6          NaN
1.3
2  0.361   8.0  23.6  15.5  15.9   1.7   2.4  12.7  25.2          NaN
3.6
3  0.353  11.7  23.6  17.7   7.5   1.2   3.5  11.4  16.4          NaN
5.5
4  0.225   9.2  27.5  18.1   9.2   0.9   2.3  11.0  22.9          NaN
```

```
3.3

   DWS   WS  WS/48  Unnamed: 24  OBPM  DBPM  BPM  VORP Player-
additional  \
0  1.4  2.2  0.093          NaN  -1.4  -0.8 -2.3  -0.1
achiupr01
1  2.1  3.4  0.144          NaN  -0.3   0.9  0.6   0.7
adamsst01
2  3.8  7.4  0.137          NaN   0.8   0.8  1.5   2.3
adebaba01
3  4.0  9.5  0.205          NaN   1.3   1.0  2.4   2.4
allenja01
4  3.0  6.2  0.147          NaN   0.9   0.0  0.9   1.5
aytonde01

  Standing
0   Bottom
1      Top
2      Top
3      Top
4      Top

# Filtering out players
ad_center2=ad_center[((ad_center['MP']>=1500)&(ad_center['Standing']==
'Bottom'))|

((ad_center['MP']>=1700)&(ad_center['Standing']=='Top'))]

ad_center2['Standing'].value_counts()

Standing
Top       15
Bottom    15
Name: count, dtype: int64
```

## Significance Testing

```
import scipy.stats as stats

# t test for basic stats at alpha level of 0.05
included=['FG', 'FGA', 'FG%', '3P', '3PA', '3P%', '2P', '2PA', '2P%',
       'eFG%', 'FT', 'FTA', 'FT%', 'ORB', 'DRB', 'TRB', 'AST', 'STL',
'BLK',
       'TOV', 'PF', 'PTS']
result=[]
import scipy.stats as stats
for i in included:
    bfg=center2[center2['Standing']=='Bottom'][i]
    tfg=center2[center2['Standing']=='Top'][i]
    result.append(stats.ttest_ind(a=bfg, b=tfg,equal_var=True).pvalue)
```

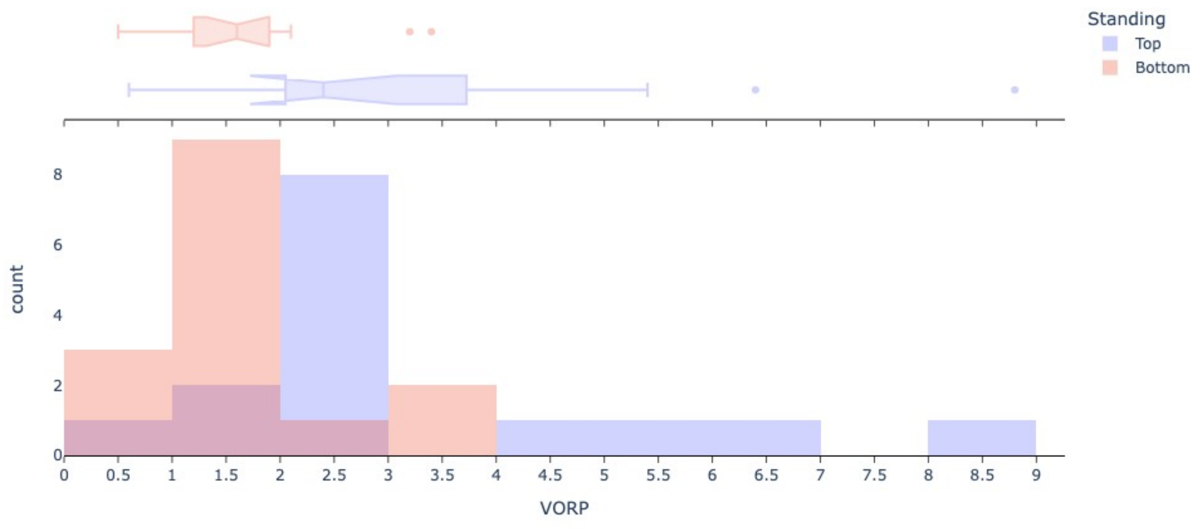
```
alpha=0.05
decision=[]
for i in result:
    if i < alpha:
        decision.append('Reject')
    else:
        decision.append('Accept')
final=pd.DataFrame(data={'Metrics':included,'P-
Value':result,'Decision':decision})
final[final['Decision']=='Reject'].sort_values(by='P-Value')
```

```
  Metrics   P-Value Decision
6      2P  0.043241   Reject
```

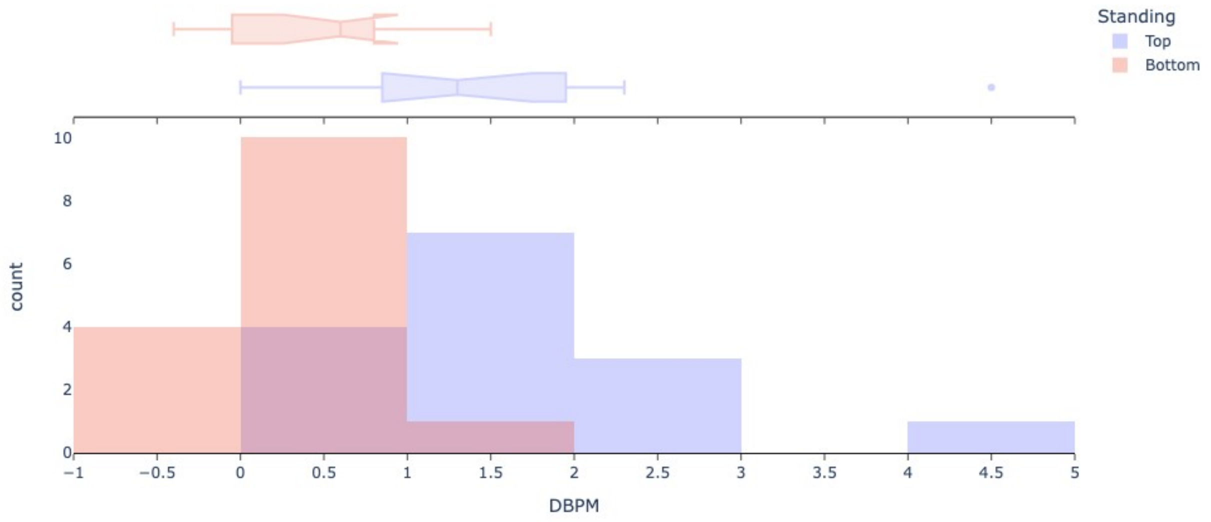
```
# t test for advanced stats at alpha level of 0.05
included=['PER', 'TS%', '3PAr', 'FTr', 'ORB%', 'DRB%',
       'TRB%', 'AST%', 'STL%', 'BLK%', 'TOV%', 'USG%', 'OWS', 'DWS',
'WS',
       'WS/48', 'OBPM', 'DBPM', 'BPM', 'VORP']
result=[]
import scipy.stats as stats
for i in included:
    bfg=ad_center2[ad_center2['Standing']=='Bottom'][i]
    tfg=ad_center2[ad_center2['Standing']=='Top'][i]
    result.append(stats.ttest_ind(a=bfg, b=tfg,equal_var=True).pvalue)
alpha=0.05
decision=[]
for i in result:
    if i < alpha:
        decision.append('Reject')
    else:
        decision.append('Accept')
final=pd.DataFrame(data={'Metrics':included,'P-
Value':result,'Decision':decision})
final[final['Decision']=='Reject'].sort_values(by='P-Value')
```

```
   Metrics   P-Value Decision
13     DWS  0.000052   Reject
14      WS  0.000405   Reject
17    DBPM  0.002217   Reject
15   WS/48  0.005564   Reject
12     OWS  0.009219   Reject
19    VORP  0.019704   Reject
18     BPM  0.033730   Reject
```

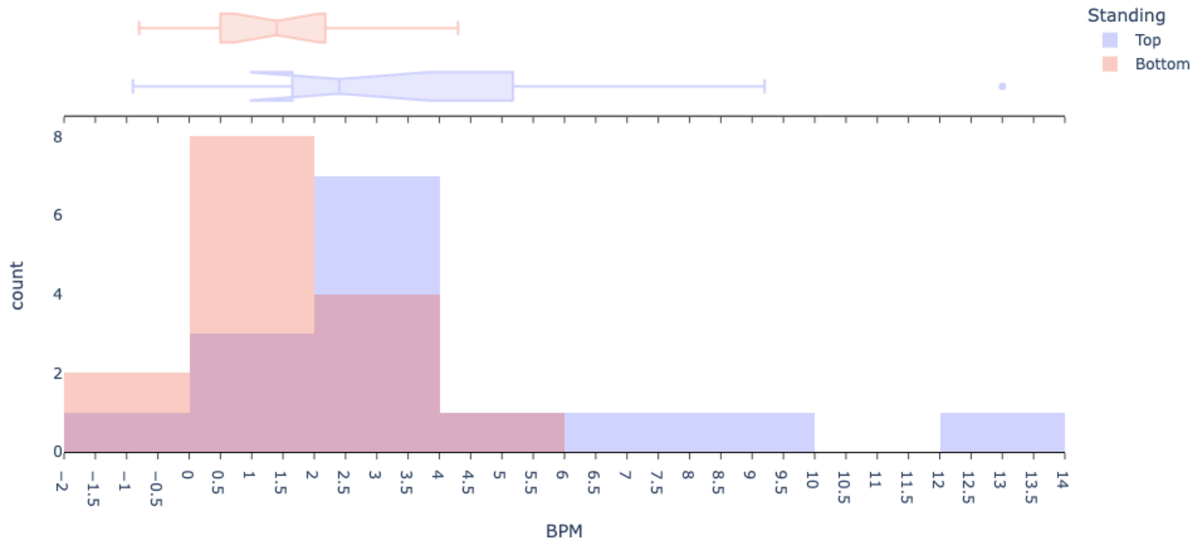
```
fig = px.histogram(ad_center2, x='2P', color='Standing',
                   marginal="box", height=500, width=1000) # or
violin, rug
fig.update_traces(opacity=0.3)
fig.update_layout(barmode='overlay',plot_bgcolor='rgba(0, 0, 0, 0)')
fig.update_xaxes(dtick=0.5,ticks='outside',showline=True,linecolor='bl
ack',mirror=False)
fig.show()

fig = px.histogram(ad_center2, x='VORP', color='Standing',
                   marginal="box", height=500, width=1000) # or
violin, rug
fig.update_traces(opacity=0.3)
fig.update_layout(barmode='overlay',plot_bgcolor='rgba(0, 0, 0, 0)')
fig.update_xaxes(dtick=0.5,ticks='outside',showline=True,linecolor='bl
ack',mirror=False)
fig.show()
```



```
fig = px.histogram(ad_center2, x='DBPM', color='Standing',
                   marginal="box", height=500, width=1000) # or
violin, rug
fig.update_traces(opacity=0.3)
fig.update_layout(barmode='overlay',plot_bgcolor='rgba(0, 0, 0, 0)')
fig.update_xaxes(dtick=0.5,ticks='outside',showline=True,linecolor='bl
ack',mirror=False)
fig.show()
```



```
fig = px.histogram(ad_center2, x='BPM', color='Standing',
                   marginal="box", height=500, width=1000) # or
violin, rug
fig.update_traces(opacity=0.3)
fig.update_layout(barmode='overlay',plot_bgcolor='rgba(0, 0, 0, 0)')
fig.update_xaxes(dtick=0.5,ticks='outside',showline=True,linecolor='bl
ack',mirror=False)
fig.show()
```



Winning stats

- 2pt

- DBPM
- VORP
- BPM

## Making Weighted Scores for Each Center Based on Stats of Interest

```
# making one big dataframe with regular and advanced stats
full_center = pd.merge(ad_center2, center2, on='Rk')
full_center.head()
```

```
   index  Rk              Player_x Pos_x  Age_x Tm_x  G_x  MP_x   PER  
TS%  \
0      2   3           Bam Adebayo     C     25  MIA   75  2598  20.1  
0.592   
1      7   8         Jarrett Allen     C     24  CLE   68  2220  19.9  
0.670   
2     16  17         Deandre Ayton     C     24  PHO   67  2035  19.9  
0.617   
3     83  81          Clint Capela     C     28  ATL   65  1730  22.1  
0.656   
4     86  84  Wendell Carter Jr.     C     23  ORL   57  1690  17.3  
0.621   

    3PAr    FTr  ORB%  DRB%  TRB%  AST%  STL%  BLK%  TOV%  USG%  
Unnamed: 19  \
0  0.011  0.361   8.0  23.6  15.5  15.9   1.7   2.4  12.7  25.2  
NaN   
1  0.016  0.353  11.7  23.6  17.7   7.5   1.2   3.5  11.4  16.4  
NaN   
2  0.027  0.225   9.2  27.5  18.1   9.2   0.9   2.3  11.0  22.9  
NaN   
3  0.002  0.244  16.1  29.4  22.7   4.7   1.2   3.9   8.3  15.7  
NaN   
4  0.367  0.318   8.0  25.3  16.6  12.0   0.9   1.9  13.2  20.5  
NaN   

   OWS  DWS   WS  WS/48  Unnamed: 24  OBPM  DBPM  BPM  VORP  \
0  3.6  3.8  7.4  0.137          NaN   0.8   0.8  1.5   2.3   
1  5.5  4.0  9.5  0.205          NaN   1.3   1.0  2.4   2.4   
2  3.3  3.0  6.2  0.147          NaN   0.9   0.0  0.9   1.5   
3  4.9  2.4  7.2  0.201          NaN   2.3  -0.1  2.2   1.8   
4  2.6  2.0  4.6  0.130          NaN   0.9   0.1  1.0   1.3   

  Player-additional_x Standing_x          Player_y Pos_y  Age_y Tm_y  
G_y  \
0           adebaba01        Top       Bam Adebayo     C     25  MIA  
75   
1           allenja01        Top     Jarrett Allen     C     24  CLE  
```

```
68
2         aytonde01       Top       Deandre Ayton     C     24  PHO
67
3         capelca01    Bottom        Clint Capela     C     28  ATL
65
4         cartewe01    Bottom  Wendell Carter Jr.     C     23  ORL
57

   GS  MP_y   FG   FGA    FG%  3P  3PA    3P%   2P   2PA    2P%   eFG%
FT  \
0  75  2598  602  1114  0.540   1   12  0.083  601  1102  0.545  0.541
324
1  68  2220  403   626  0.644   1   10  0.100  402   616  0.653  0.645
162
2  67  2035  522   887  0.589   7   24  0.292  515   863  0.597  0.592
152
3  63  1730  350   536  0.653   0    1  0.000  350   535  0.654  0.653
79
4  54  1690  322   613  0.525  80  225  0.356  242   388  0.624  0.591
144

   FTA    FT%  ORB  DRB  TRB  AST  STL  BLK  TOV   PF   PTS  \
0  402  0.806  184  504  688  240   88   61  187  208  1529
1  221  0.733  221  445  666  113   54   84   93  153   969
2  200  0.760  172  495  667  115   37   53  120  190  1203
3  131  0.603  258  459  717   58   45   79   54  139   779
4  195  0.738  120  377  497  132   30   33  106  159   868

  Player-additional_y Standing_y
0           adebaba01        Top
1           allenja01        Top
2           aytonde01        Top
3           capelca01     Bottom
4           cartewe01     Bottom

# Removing null or duplicate columns
full_center = full_center.drop(columns=['index','Unnamed:
19','Unnamed: 24','Player-additional_x','Player_y',

'Pos_y','Age_y','Tm_y','G_y','MP_y','Player-additional_y'])
full_center.head()


   Rk           Player_x Pos_x  Age_x Tm_x  G_x  MP_x   PER    TS%
3PAr  \
0   3        Bam Adebayo     C     25  MIA   75  2598  20.1  0.592
0.011
1   8      Jarrett Allen     C     24  CLE   68  2220  19.9  0.670
0.016
2  17      Deandre Ayton     C     24  PHO   67  2035  19.9  0.617
```

```
0.027
3  81         Clint Capela      C      28  ATL   65  1730  22.1  0.656
0.002
4  84  Wendell Carter Jr.      C      23  ORL   57  1690  17.3  0.621
0.367

     FTr  ORB%  DRB%  TRB%  AST%  STL%  BLK%  TOV%  USG%  OWS  DWS
WS  \
0  0.361   8.0  23.6  15.5  15.9   1.7   2.4  12.7  25.2  3.6  3.8
7.4
1  0.353  11.7  23.6  17.7   7.5   1.2   3.5  11.4  16.4  5.5  4.0
9.5
2  0.225   9.2  27.5  18.1   9.2   0.9   2.3  11.0  22.9  3.3  3.0
6.2
3  0.244  16.1  29.4  22.7   4.7   1.2   3.9   8.3  15.7  4.9  2.4
7.2
4  0.318   8.0  25.3  16.6  12.0   0.9   1.9  13.2  20.5  2.6  2.0
4.6

   WS/48  OBPM  DBPM  BPM  VORP Standing_x  GS   FG   FGA    FG%  3P
3PA  \
0  0.137   0.8   0.8  1.5   2.3        Top  75  602  1114  0.540   1
12
1  0.205   1.3   1.0  2.4   2.4        Top  68  403   626  0.644   1
10
2  0.147   0.9   0.0  0.9   1.5        Top  67  522   887  0.589   7
24
3  0.201   2.3  -0.1  2.2   1.8     Bottom  63  350   536  0.653   0
1
4  0.130   0.9   0.1  1.0   1.3     Bottom  54  322   613  0.525  80
225

     3P%   2P   2PA    2P%   eFG%   FT  FTA    FT%  ORB  DRB  TRB  AST
STL  \
0  0.083  601  1102  0.545  0.541  324  402  0.806  184  504  688  240
88
1  0.100  402   616  0.653  0.645  162  221  0.733  221  445  666  113
54
2  0.292  515   863  0.597  0.592  152  200  0.760  172  495  667  115
37
3  0.000  350   535  0.654  0.653   79  131  0.603  258  459  717   58
45
4  0.356  242   388  0.624  0.591  144  195  0.738  120  377  497  132
30

   BLK  TOV   PF   PTS Standing_y
0   61  187  208  1529        Top
1   84   93  153   969        Top
2   53  120  190  1203        Top
```

```
3   79   54  139   779      Bottom
4   33  106  159   868      Bottom
```

```python
# Creating new columns for normalized scores for each significant stat
# Creating a column with the sum of all normalized stat lines
weights={'2P':0.25,'DBPM':0.25,'BPM':0.25,'VORP':0.25}

for stat in weights.keys():
    max_val = full_center[stat].max()
    full_center.loc[:, stat+'_norm']=full_center[stat]/max_val

full_center.loc[:,'Weighted_Score']=sum([full_center[stat+'_norm']*wei
ght for stat, weight in weights.items()])

ranked_c=full_center.sort_values('Weighted_Score',ascending=False)

print(ranked_c[['Player_x','Weighted_Score']].head(30))
```

```
              Player_x  Weighted_Score
14        Nikola Jokić        0.972432
8          Joel Embiid        0.736519
23    Domantas Sabonis        0.571141
6        Anthony Davis        0.526742
5          Nic Claxton        0.420568
0          Bam Adebayo        0.365595
27      Nikola Vučević        0.361479
13   Jaren Jackson Jr.        0.346793
22  Kristaps Porziņģis        0.346789
1        Jarrett Allen        0.321704
17          Brook Lopez        0.312406
15      Walker Kessler        0.310922
20       Mason Plumlee        0.284608
21         Jakob Poeltl        0.281864
24      Alperen Şengün        0.262866
16        Kevon Looney        0.260815
12          Al Horford        0.260273
2        Deandre Ayton        0.254408
25        Myles Turner        0.249943
11         Rudy Gobert        0.228075
3         Clint Capela        0.220064
18      Onyeka Okongwu        0.214963
10      Daniel Gafford        0.195794
28      Christian Wood        0.171374
19        Kelly Olynyk        0.161647
4   Wendell Carter Jr.        0.153108
9         Drew Eubanks        0.152823
26   Jonas Valančiūnas        0.146891
29          Ivica Zubac        0.133961
7          Jalen Duren        0.074030
```

## Choosing optimal players for new team based on weight and salary

```
# importing player salary and formatting columns
salary=pd.read_csv('Nba Player Salaries.csv')
salary=salary.rename(columns={'Player
Name':'Player','2022/2023':'Salary'})
salary=salary.drop(columns=['Player
Id','2023/2024','2024/2025','2024/2025.1'])
salary.head()
```

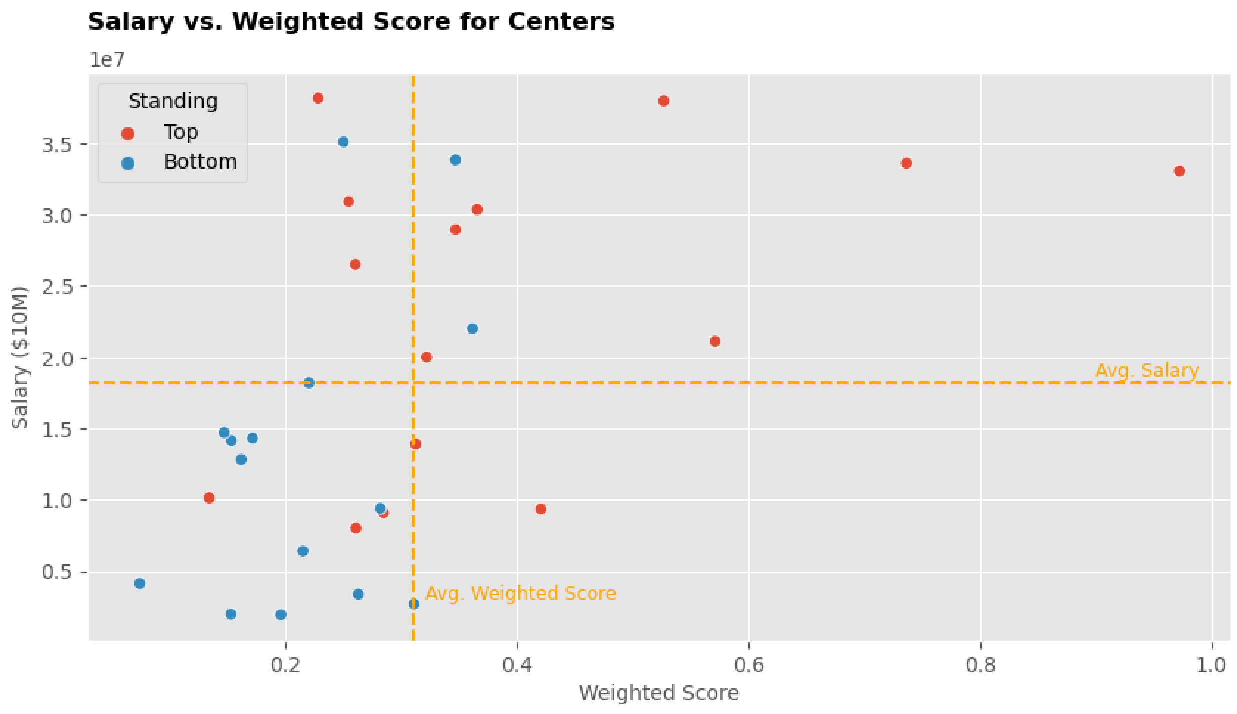
```
              Player           Salary
0      Stephen Curry  $48,070,014.00
1          John Wall  $47,345,760.00
2  Russell Westbrook  $47,080,179.00
3       LeBron James  $44,474,988.00
4       Kevin Durant  $44,119,845.00
```

```
ranked_c=ranked_c.rename(columns={'Player_x':'Player'})

# merging full data frame with centers ranked by weighted score with
their salaries
ranked_c2=pd.merge(ranked_c,salary,on='Player',how='left')
ranked_c2.head(3)
```

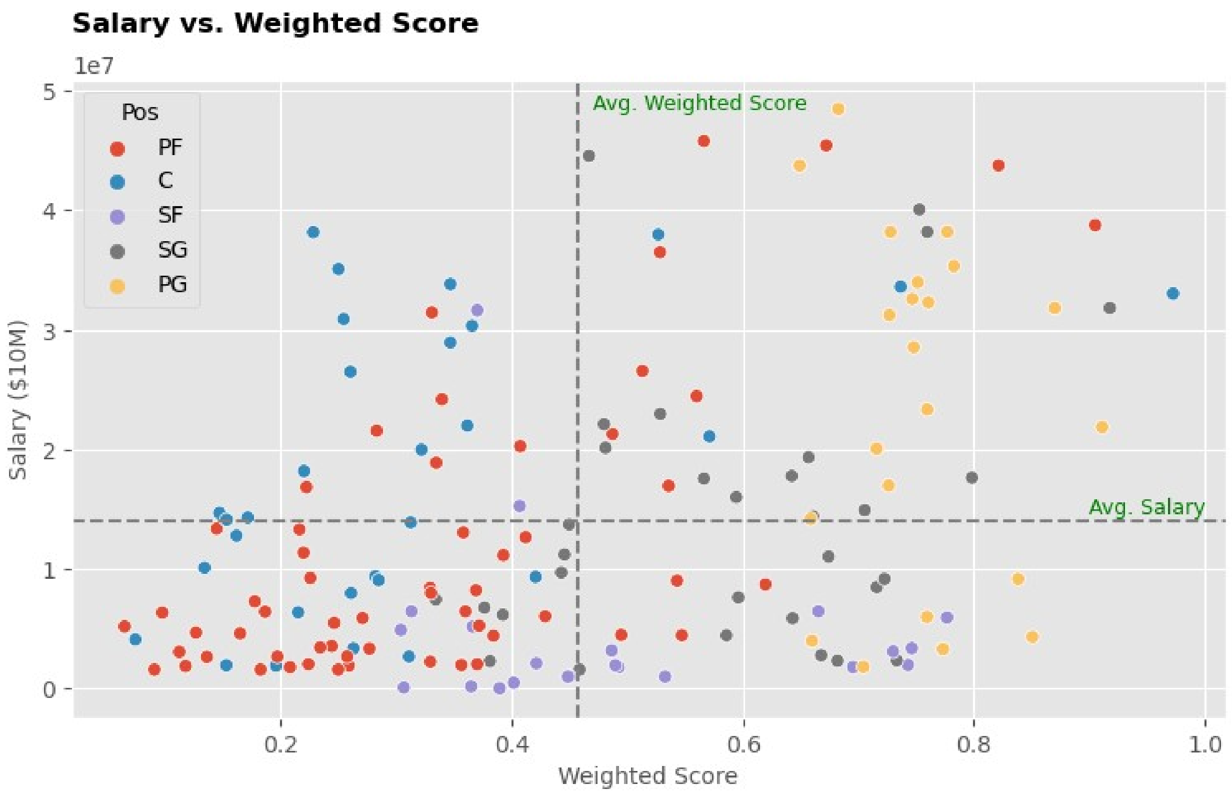
```
    Rk            Player Pos_x  Age_x Tm_x  G_x  MP_x   PER    TS%  
3PAr  \
0  249      Nikola Jokić     C     27  DEN   69  2323  31.5  0.701  
0.146
1  143       Joel Embiid     C     28  PHI   66  2284  31.4  0.655  
0.151
2  428  Domantas Sabonis     C     26  SAC   79  2736  23.5  0.668  
0.088

     FTr  ORB%  DRB%  TRB%  AST%  STL%  BLK%  TOV%  USG%   OWS  DWS  
WS  \
0  0.406   8.5  31.3  20.2  46.6   1.8   1.8  17.0  27.2  11.2  3.8  
14.9
1  0.581   5.9  28.3  17.3  22.9   1.4   4.6  11.9  37.0   8.4  3.9  
12.3
2  0.467  10.6  30.0  20.3  30.4   1.1   1.2  16.9  21.3   9.6  3.0  
12.6

   WS/48  OBPM  DBPM   BPM  VORP Standing_x  GS   FG   FGA    FG%  3P  
3PA  \
0  0.308   8.5   4.5  13.0   8.8        Top  69  646  1022  0.632  57  
149
1  0.259   6.8   2.3   9.2   6.4        Top  66  728  1328  0.548  66  
200
2  0.221   4.1   1.8   5.8   5.4        Top  79  577   938  0.615  31
```

```
83

     3P%   2P   2PA    2P%   eFG%   FT  FTA    FT%  ORB  DRB  TRB  AST
STL  \
0  0.383  589   873  0.675  0.660  341  415  0.822  167  650  817  678
87
1  0.330  662  1128  0.587  0.573  661  771  0.857  113  557  670  274
66
2  0.373  546   855  0.639  0.632  325  438  0.742  251  722  973  573
65

   BLK  TOV   PF   PTS Standing_y   2P_norm  DBPM_norm  BPM_norm
VORP_norm  \
0   47  247  174  1690        Top  0.889728   1.000000  1.000000
1.000000
1  112  226  205  2183        Top  1.000000   0.511111  0.707692
0.727273
2   39  230  279  1510        Top  0.824773   0.400000  0.446154
0.613636

   Weighted_Score          Salary
0        0.972432  $33,047,803.00
1        0.736519  $33,616,770.00
2        0.571141  $21,100,000.00

ranked_c2=ranked_c2.rename(columns={'Pos_x':'Pos','Tm_x':'Tm'})

# Manually adding in missing salary
ranked_c2.loc[8,'Salary']='$33,833,400.00'

# Removing dollar signs in salary
for i in range(len(ranked_c2)):
    ranked_c2.loc[i,'Salary']=ranked_c2.loc[i,'Salary'].strip('$')

# Removing decimal and following zeroes from salary
for i in range(len(ranked_c2)):
    ranked_c2.loc[i,'Salary']=ranked_c2.loc[i,'Salary'][:-3]

# removing commas from salary
for i in range(len(ranked_c2)):

ranked_c2.loc[i,'Salary']=ranked_c2.loc[i,'Salary'].replace(',','')

# making salary column integer
for i in range(len(ranked_c2)):
    ranked_c2.loc[i,'Salary']=int(ranked_c2.loc[i,'Salary'])

ranked_c2=ranked_c2.rename(columns={'Standing_x':'Standing'})

# Scatterplot depicting player salary vs weighted score
fig=sns.scatterplot(data = ranked_c2,
                x = 'Weighted_Score',
                y = 'Salary',
                hue = 'Standing')

plt.title("Salary vs. Weighted Score for Centers",
          loc= 'left',
          fontsize = 12,
          fontweight = 'bold',
          pad = 10)

plt.ylabel("Salary ($10M)", fontsize = 10)

plt.xlabel("Weighted Score", fontsize = 10)

avg_salary = ranked_c2['Salary'].mean()
avg_score = ranked_c2['Weighted_Score'].mean()

plt.axvline(x = avg_score, color = 'orange', linestyle = '--')
plt.axhline(y = avg_salary, color = 'orange', linestyle = '--')

plt.annotate("Avg. Salary",
             (0.9,18700000),
             color = "orange",
             fontsize = 9)

plt.annotate("Avg. Weighted Score",
             (0.32,3000000),
             color = "orange",
             fontsize = 9)
```

```
Text(0.32, 3000000, 'Avg. Weighted Score')
```



```python
# exporting center ranking for optimization
ranked_c4=ranked_c2[['Player','Tm','Pos','Weighted_Score','Salary']]
ranked_c4.head()
ranked_c4.to_csv('centers_final_list.csv')

# Scatterplot depicting player salary vs weighted score
full=pd.read_csv('full.csv')
fig=sns.scatterplot(data = full,
                x = 'Weighted_Score',
                y = 'Salary',
                hue = 'Pos')

plt.title("Salary vs. Weighted Score",
          loc= 'left',
          fontsize = 12,
          fontweight = 'bold',
          pad = 10)

plt.ylabel("Salary ($10M)", fontsize = 10)

plt.xlabel("Weighted Score", fontsize = 10)

avg_salary = full['Salary'].mean()
avg_score = full['Weighted_Score'].mean()

plt.axvline(x = avg_score, color = 'grey', linestyle = '--')
plt.axhline(y = avg_salary, color = 'grey', linestyle = '--')
plt.annotate("Avg. Salary",
             (0.9,14700000),
             color = "green",
             fontsize = 9)

plt.annotate("Avg. Weighted Score",
             (0.47,48400000),
             color = "green",
             fontsize = 9)

plt.rcParams["figure.figsize"] = (9,5)
```


Salary vs. Weighted Score
1e7
Salary ($10M)
Weighted Score
Pos
PF
C
SF
SG
PG
Avg. Weighted Score
Avg. Salary