NBA_EDA

December 12, 2022

```
[ ]: import pandas as pd
     import numpy as np
     import matplotlib.pyplot as plt
     import matplotlib.patches as mpatches
     import seaborn as sns
```

```
[ ]: pd.set_option("display.max_columns", None)
```

##Games Data

```
[ ]: all_games = pd.read_csv("/content/drive/MyDrive/Machine Learning NBA /Final␣
      ↪Data/games_with_features.csv", index_col="id")
```

```
[ ]: all_games.head()
```

```
[ ]:              date  home_team_score  period  postseason  season status  \
     id
     47179  2019-01-30              126       4       False    2018  Final
     48751  2019-02-09              112       4       False    2018  Final
     48739  2019-02-08              117       4       False    2018  Final
     48740  2019-02-08              119       4       False    2018  Final
     48746  2019-02-08              102       4       False    2018  Final

            visitor_team_score  home_team.id home_team.abbreviation  \
     id
     47179                  94             2                    BOS
     48751                 123             2                    BOS
     48739                 110            23                    PHI
     48740                 106            30                    WAS
     48746                  96            26                    SAC

           home_team.conference home_team.division home_team.full_name  \
     id
     47179                 East           Atlantic      Boston Celtics
     48751                 East           Atlantic      Boston Celtics
     48739                 East           Atlantic  Philadelphia 76ers
     48740                 East          Southeast  Washington Wizards
     48746                 West            Pacific    Sacramento Kings
```

```
       visitor_team.id visitor_team.abbreviation visitor_team.conference  \
id
47179                4                       CHA                    East
48751               13                       LAC                    West
48739                8                       DEN                    West
48740                6                       CLE                    East
48746               16                       MIA                    East

      visitor_team.division visitor_team.full_name  winner  \
id
47179             Southeast      Charlotte Hornets       1
48751               Pacific            LA Clippers       0
48739             Northwest         Denver Nuggets       1
48740               Central    Cleveland Cavaliers       1
48746             Southeast             Miami Heat       1

       home_team_avg_score_historical  visitor_team_avg_score_historical  \
id
47179                           105.7                               98.4
48751                           105.7                              100.6
48739                           103.2                              104.2
48740                           103.4                               98.4
48746                           105.5                               96.1

      home_team_id_year visitor_team_id_year  home_team_avg_score  \
id
47179            2 2018               4 2018                112.8
48751            2 2018              13 2018                112.8
48739           23 2018               8 2018                117.9
48740           30 2018               6 2018                116.4
48746           26 2018              16 2018                114.9

       visitor_team_avg_score  home_avg_score_diff  visitor_avg_score_diff
id
47179                   108.3             3.620000               -3.831707
48751                   113.1             3.620000                0.581818
48739                   108.2             8.725532               -4.670213
48740                   103.8             7.429268               -8.419512
48746                   105.4             5.129268               -6.670732
```

```
[ ]: all_seasons = np.sort(all_games["season"].unique())
     all_seasons
```

```
[ ]: array([1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989,
            1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000,
            2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011,
       2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021])
```

###Percent of home team win

[ ]:
```
n_home_wins = all_games[all_games["home_team_score"].
 ↪gt(all_games["visitor_team_score"])].shape[0]  # number of games where home␣
 ↪team won
n_games = all_games.shape[0]  # number of games
home_win_pct = round(n_home_wins/n_games, 2)

print(n_home_wins, n_games, home_win_pct, sep="\n")
```

```
30529
49995
0.61
```

[ ]:
```
home_win_pcts = []
for season in all_seasons:
    season_games = all_games[all_games["season"].eq(season)]
    n_home_wins = season_games[season_games["home_team_score"].
 ↪gt(season_games["visitor_team_score"])].shape[0]  # number of games where␣
 ↪home team won
    n_games = season_games.shape[0]  # number of games
    home_win_pct = round(n_home_wins/n_games, 2) * 100
    home_win_pcts.append(home_win_pct)
    print(season, n_home_wins, n_games, home_win_pct)
```

```
1979 622 950 65.0
1980 612 995 62.0
1981 592 989 60.0
1982 612 986 62.0
1983 687 1022 67.0
1984 642 1011 64.0
1985 662 1010 66.0
1986 677 1014 67.0
1987 697 1023 68.0
1988 729 1087 67.0
1989 767 1179 65.0
1990 773 1175 66.0
1991 751 1180 64.0
1992 725 1183 61.0
1993 729 1184 62.0
1994 700 1178 59.0
1995 764 1257 61.0
1996 733 1261 57.99999999999999
1997 746 1252 60.0
1998 492 791 62.0
1999 775 1264 61.0
```

```
2000 752 1260 60.0
2001 744 1260 59.0
2002 800 1277 63.0
2003 789 1271 62.0
2004 791 1314 60.0
2005 802 1319 61.0
2006 778 1309 59.0
2007 803 1316 61.0
2008 805 1315 61.0
2009 786 1312 60.0
2010 797 1311 61.0
2011 637 1074 59.0
2012 806 1314 61.0
2013 764 1319 57.99999999999999
2014 755 1311 57.99999999999999
2015 782 1316 59.0
2016 763 1309 57.99999999999999
2017 770 1312 59.0
2018 774 1311 59.0
2019 623 1142 55.00000000000001
2020 311 558 56.00000000000001
2021 410 774 53.0
```

[ ]:

```
fontdict = {'weight' :'bold', 'size' :'16'

}
```

[ ]:

```
y = home_win_pcts * 100
print(y)
ax = plt.figure(figsize=(16,8))
ax  = sns.barplot(all_seasons, home_win_pcts, palette = 'inferno')
ax.bar_label(ax.containers[0], fmt='%.f%%')
ax.set_xticklabels(all_seasons, rotation = 45)
plt.savefig("/content/drive/MyDrive/Machine Learning NBA /Figures/Home Team Win␣
 ↪% by Year.png")
ax.set_xlabel("Year", fontdict = {'weight' : 'bold', 'size' : 13})
```

```
[65.0, 62.0, 60.0, 62.0, 67.0, 64.0, 66.0, 67.0, 68.0, 67.0, 65.0, 66.0, 64.0,
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57.99999999999999, 59.0, 57.99999999999999, 59.0, 59.0, 55.00000000000001,
56.00000000000001, 53.0]
```
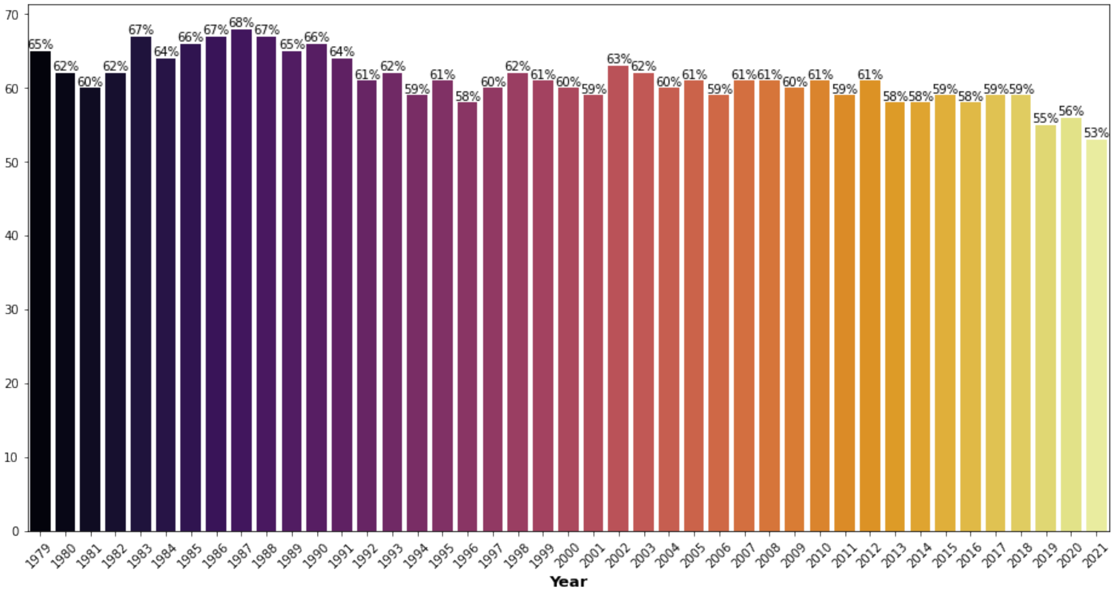

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning:
Pass the following variables as keyword args: x, y. From version 0.12, the only
valid positional argument will be `data`, and passing other arguments without an
explicit keyword will result in an error or misinterpretation.
  FutureWarning
```

```
[ ]: Text(0.5, 35.89770926787756, 'Year')
```



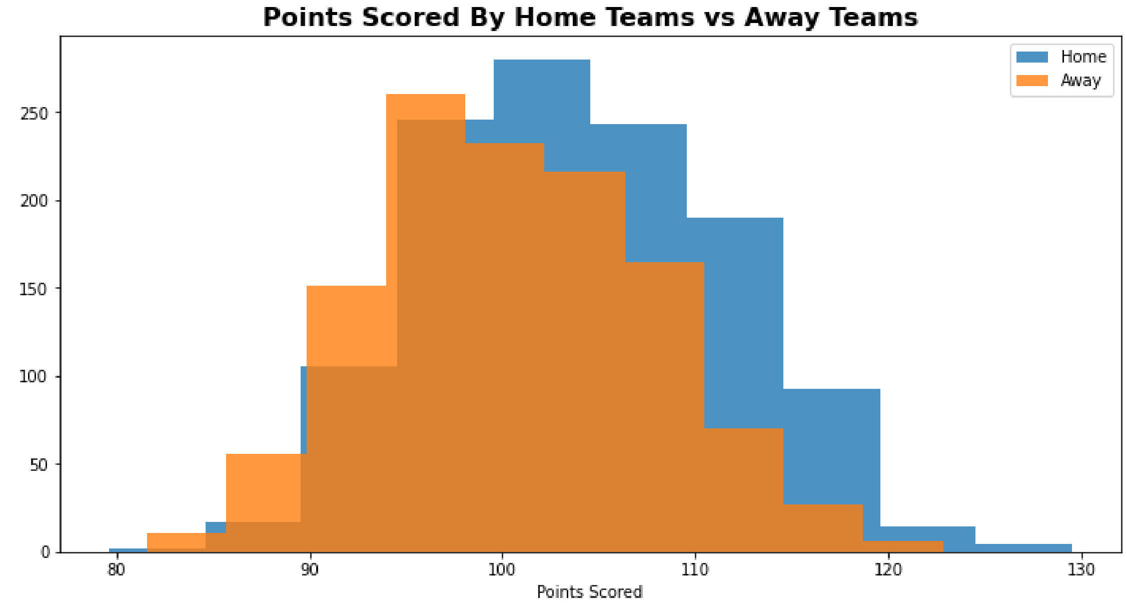
##Points scores when playing at home

[ ]:
```
home_avg = all_games[["home_team.full_name", "season", "home_team_avg_score"]].groupby(["home_team.full_name", "season"]).mean().values
```

[ ]:
```
visiting_avg = all_games[["visitor_team.full_name", "season", "visitor_team_avg_score"]].groupby(["visitor_team.full_name", "season"]).mean().values
```

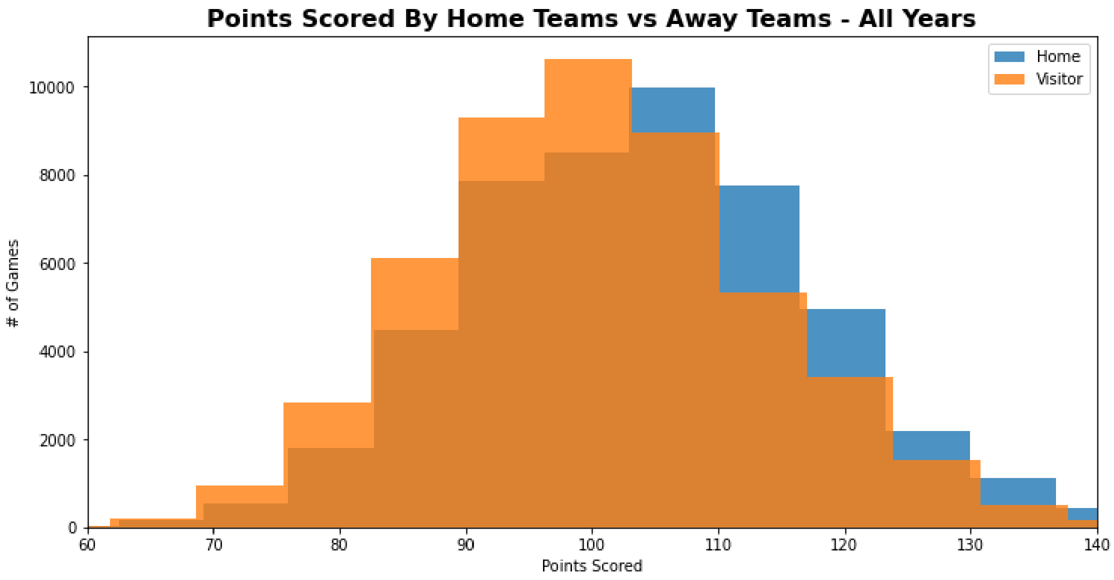
[ ]:
```
avg_score_by_team = all_games[["home_team.full_name", "season", "home_team_avg_score"]].groupby(["home_team.full_name", "season"]).mean()

avg_score_by_team.columns = ["avg_score_as_home"]

avg_score_by_team["avg_score_as_home"] = home_avg
avg_score_by_team["avg_score_as_visitor"] = visiting_avg
avg_score_by_team["avg_score_mean"] = (home_avg + visiting_avg) / 2
avg_score_by_team["avg_score_diff"] = (home_avg - visiting_avg)
avg_score_by_team.reset_index(inplace=True)
```

[ ]:
```
plt.figure(figsize=(12,6))
plt.hist(avg_score_by_team["avg_score_as_home"], alpha=0.8, label="Home", bins=10)
plt.hist(avg_score_by_team["avg_score_as_visitor"], alpha=0.8, label="Away", bins=10)
plt.title("Points Scored By Home Teams vs Away Teams", fontdict)
plt.xlabel("Points Scored")
plt.legend()
plt.savefig("/content/drive/MyDrive/Machine Learning NBA /Figures/Points Scored␣
  ↪By Home Teams vs Away Teams.png")
plt.show()
```



[ ]:

```
plt.figure(figsize=(12,6))
plt.hist(all_games["home_team_score"], alpha=0.8, label="Home", bins=20)
plt.hist(all_games["visitor_team_score"], alpha=0.8, label="Visitor", bins=20)
plt.xlim(60,140)
plt.title("Points Scored By Home Teams vs Away Teams - All Years", fontdict)
plt.xlabel("Points Scored")
plt.ylabel("# of Games")
plt.legend()
plt.savefig("/content/drive/MyDrive/Machine Learning NBA /Figures/Points Scored␣
  ↪By Home Teams vs Away Teams - All Years.png")
plt.show()
```



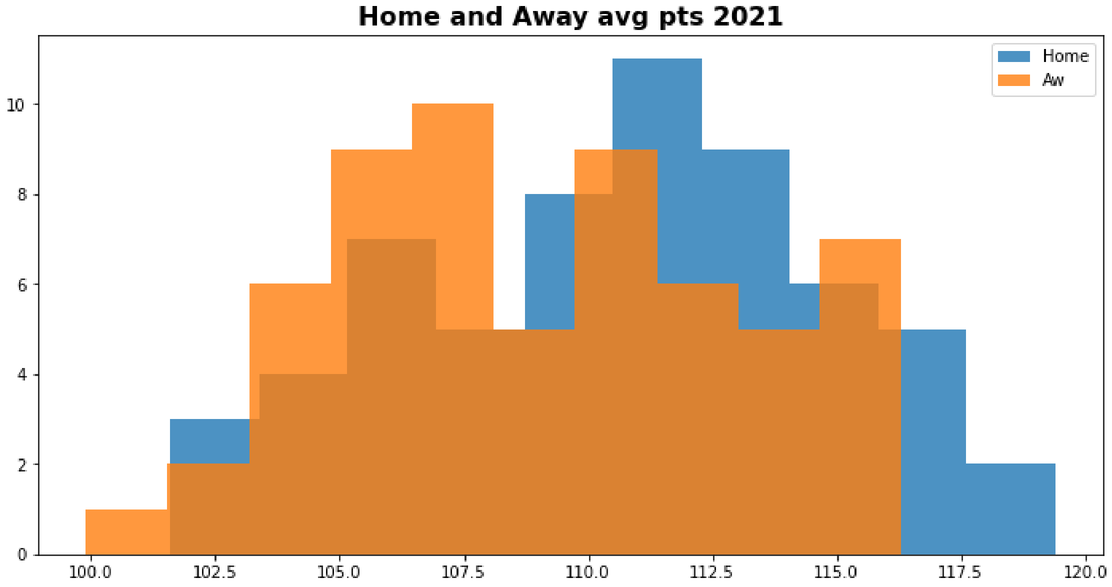
```
[ ]: avg_score_by_team[avg_score_by_team["avg_score_as_home"].gt(120)]
```

```
[ ]:         home_team.full_name  season  avg_score_as_home  avg_score_as_visitor  \
     253       Dallas Mavericks    1986              120.7                 112.6
     290         Denver Nuggets    1980              124.7                 118.9
     291         Denver Nuggets    1981              129.5                 122.8
     292         Denver Nuggets    1982              125.5                 119.9
     293         Denver Nuggets    1983              126.7                 120.6
     294         Denver Nuggets    1984              122.8                 117.8
     296         Denver Nuggets    1986              122.1                 110.8
     298         Denver Nuggets    1988              122.5                 113.2
     300         Denver Nuggets    1990              120.1                 119.6
     385    Golden State Warriors  1989              121.4                 111.2
     387    Golden State Warriors  1991              120.5                 116.7
     552      Los Angeles Lakers   1984              123.6                 115.7
     553      Los Angeles Lakers   1985              120.2                 113.7
     554      Los Angeles Lakers   1986              121.2                 115.0
     918            Phoenix Suns   1988              120.2                 116.9
     1038      San Antonio Spurs   1979              122.2                 115.5
     1042      San Antonio Spurs   1983              122.7                 117.7
     1192     Washington Wizards   2020              121.5                 112.0

          avg_score_mean  avg_score_diff
     253          116.65             8.1
     290          121.80             5.8
     291          126.15             6.7
     292          122.70             5.6
     293          123.65             6.1
```

```
294           120.30          5.0
296           116.45         11.3
298           117.85          9.3
300           119.85          0.5
385           116.30         10.2
387           118.60          3.8
552           119.65          7.9
553           116.95          6.5
554           118.10          6.2
918           118.55          3.3
1038          118.85          6.7
1042          120.20          5.0
1192          116.75          9.5
```

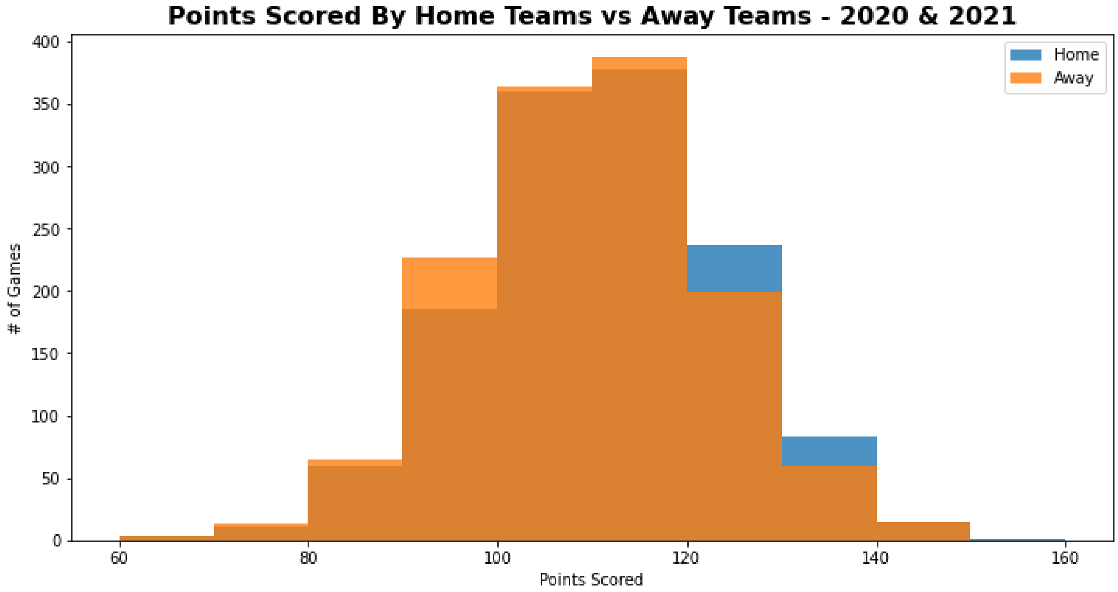
[ ]:

```
plt.figure(figsize=(12,6))
plt.hist(avg_score_by_team[avg_score_by_team["season"].
 ↪isin([2019,2021])]["avg_score_as_home"], alpha=0.8, label="Home")
plt.hist(avg_score_by_team[avg_score_by_team["season"].
 ↪isin([2019,2021])]["avg_score_as_visitor"], alpha=0.8, label="Aw")
plt.title("Home and Away avg pts 2021", fontdict)
plt.legend()
plt.savefig("/content/drive/MyDrive/Machine Learning NBA /Figures/Home and Away␣
 ↪avg pts 2021.png")
plt.show()
```



[ ]:

```
plt.figure(figsize=(12,6))
plt.hist(all_games[all_games["season"].isin([2020,2021])]["home_team_score"],␣
 ↪alpha=0.8, label="Home",
         bins=[60,70,80,90,100,110,120,130,140,150,160])
plt.hist(all_games[all_games["season"].
 ↪isin([2020,2021])]["visitor_team_score"], alpha=0.8, label="Away",
        bins=[60,70,80,90,100,110,120,130,140,150,160])
plt.title("Points Scored By Home Teams vs Away Teams - 2020 & 2021", fontdict)
plt.xlabel("Points Scored")
plt.ylabel("# of Games")
plt.legend()
plt.savefig("/content/drive/MyDrive/Machine Learning NBA /Points Scored By Home␣
 ↪Teams vs Away Teams - 2020 & 2021.png")
plt.show()
```

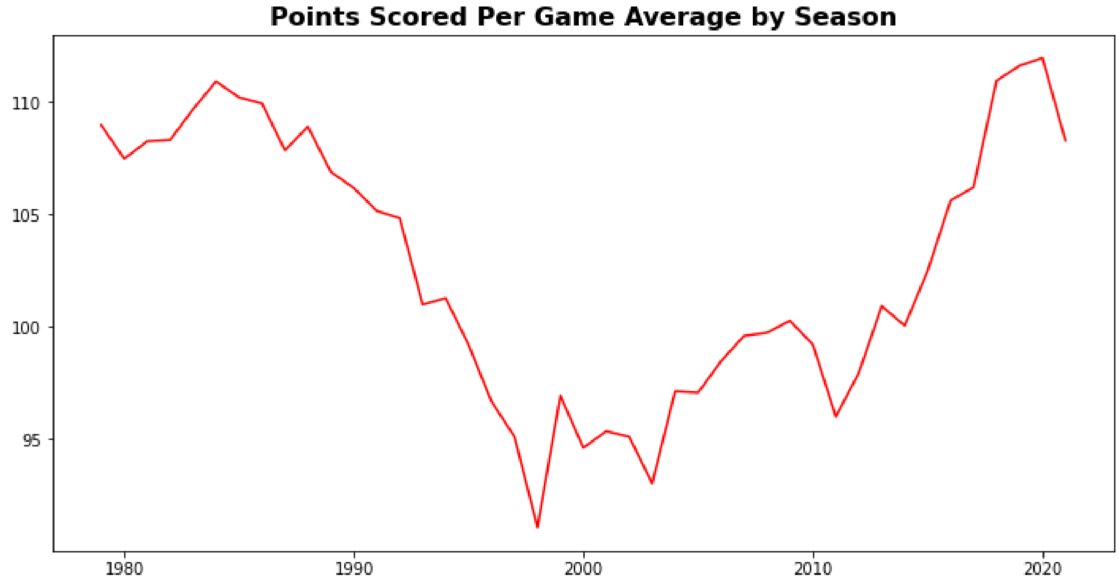


[ ]:
```
avg_score_by_team["avg_score_diff"].mean()
```

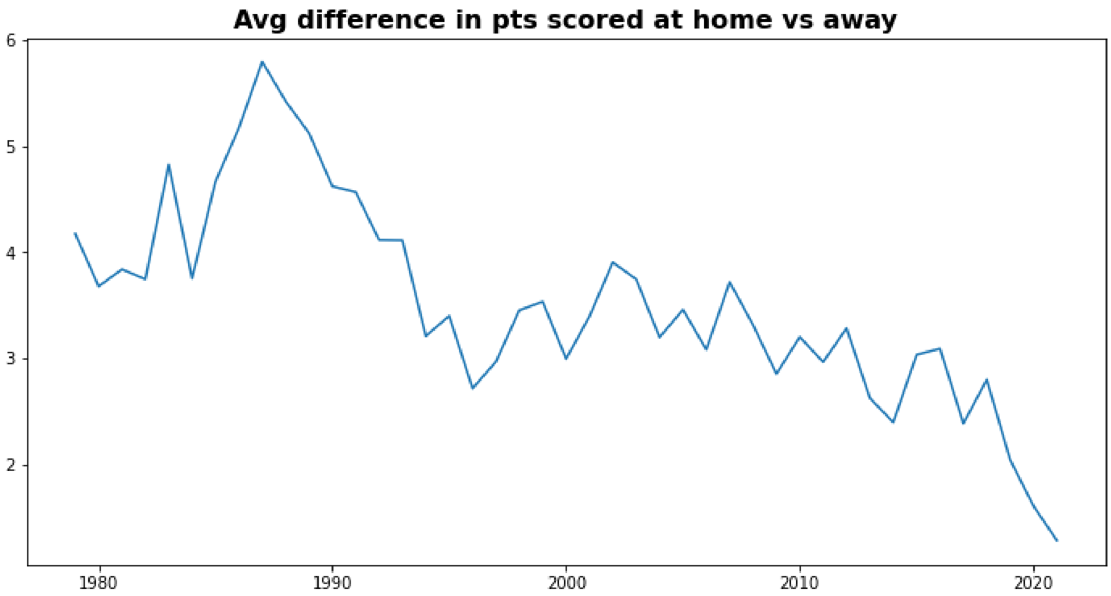
[ ]:
```
3.401926298157454
```

[ ]:
```
avg_score_by_season = all_games[["season", "home_team_avg_score",␣
 ↪"visitor_team_avg_score"]].groupby("season").mean()
avg_score_by_season["mean_avg_score"] =␣
 ↪(avg_score_by_season["home_team_avg_score"] +␣
 ↪avg_score_by_season["visitor_team_avg_score"]) / 2
avg_score_by_season["diff"] = avg_score_by_season["home_team_avg_score"] -␣
 ↪avg_score_by_season["visitor_team_avg_score"]
```

```
[ ]: plt.figure(figsize=(12,6))
     plt.title("Points Scored Per Game Average by Season", fontdict)
     plt.plot(avg_score_by_season.index, avg_score_by_season["mean_avg_score"],␣
      ↪color="red")
     plt.savefig("/content/drive/MyDrive/Machine Learning NBA /Points Scored Per␣
      ↪Game Average by Season.png")
     plt.show()
```



```
[ ]: plt.figure(figsize=(12,6))
     plt.plot(avg_score_by_season.index, avg_score_by_season["diff"])
     plt.title("Avg difference in pts scored at home vs away", fontdict)
     plt.savefig("/content/drive/MyDrive/Machine Learning NBA /Points Scored Per␣
      ↪Game Average by Season.png")
     plt.show()
```



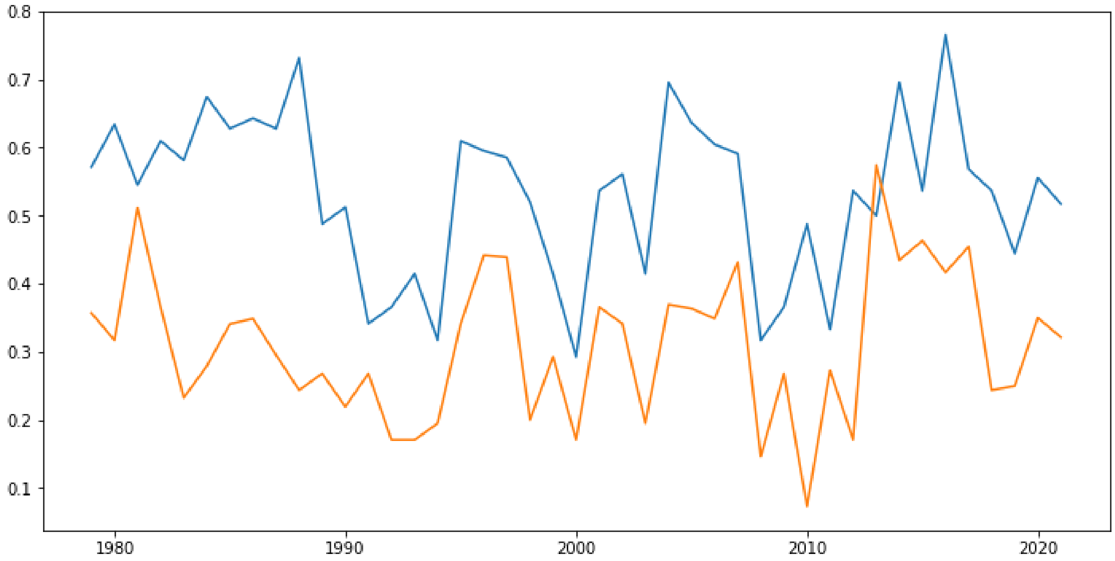
##Getting Washington Stats

```
[ ]: washington_home = all_games[all_games["home_team.full_name"].eq("Washington␣
       ↪Wizards")]
     washington_away = all_games[all_games["visitor_team.full_name"].eq("Washington␣
       ↪Wizards")]
     washington = pd.concat([washington_home, washington_away])
```

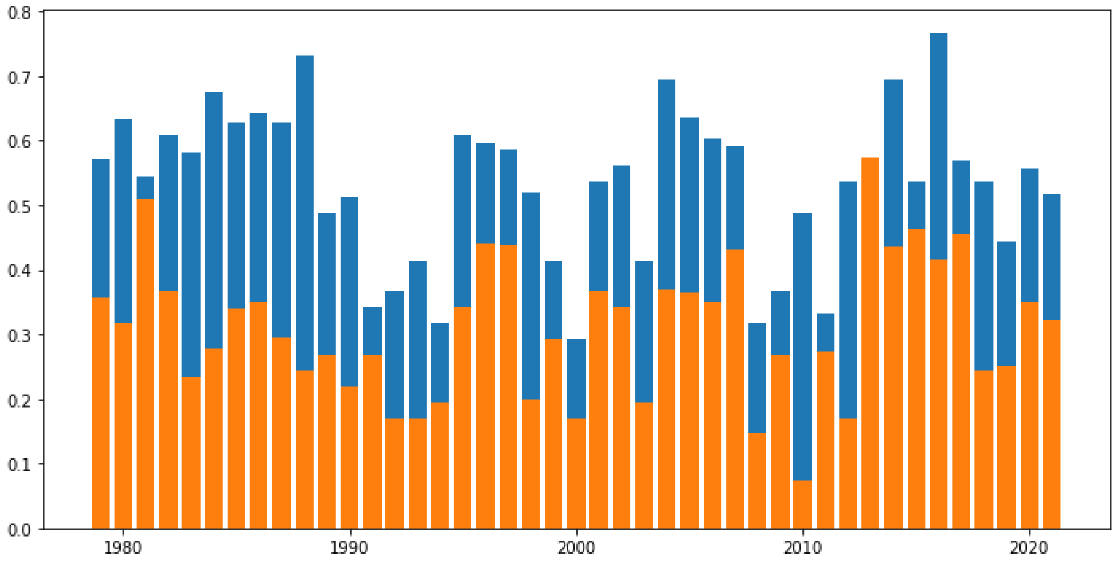
```
[ ]: washington_home_win_pct = washington_home[["season", "winner"]].
       ↪groupby("season").sum() / washington_home[["season", "winner"]].
       ↪groupby("season").count()
```

```
[ ]: washington_away_win_pct = 1 - washington_away[["season", "winner"]].
       ↪groupby("season").sum() / washington_away[["season", "winner"]].
       ↪groupby("season").count()
```

```
[ ]: plt.figure(figsize = (12,6))
     plt.plot(washington_home_win_pct)
     plt.plot(washington_away_win_pct)
     plt.savefig("/content/drive/MyDrive/Machine Learning NBA /Washington Game␣
       ↪Points.png")
     plt.show()
```



[ ]:
```
plt.figure(figsize = (12,6))
plt.bar(washington_home_win_pct.index, washington_home_win_pct.winner)
plt.bar(washington_away_win_pct.index, washington_away_win_pct.winner)
plt.show()
```



##Stats Data

[ ]:
```
stats = pd.read_csv("/content/drive/MyDrive/Machine Learning NBA /Final Data/
↪stats_feats.csv")
```

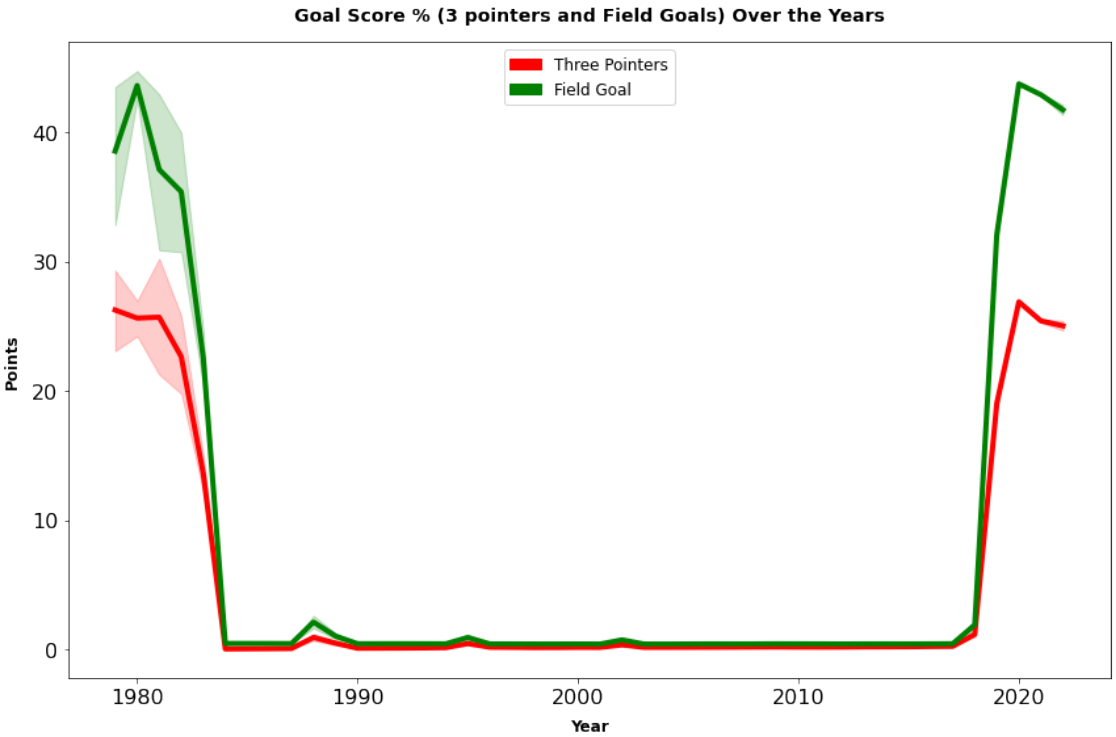
```
stats
```

```
[ ]:        game.id   game.date  game.season  winner  home_ast  home_blk  \
     0            1  2018-10-16         2018       1     23.40      5.35
     1            2  2018-10-16         2018       1     31.55      7.60
     2            3  2018-10-17         2018       0     21.35      5.15
     3            4  2018-10-17         2018       1     23.15      3.40
     4            5  2018-10-17         2018       1     22.55      4.25
     …        …         …          …     …       …       …
     46668   857658  2022-11-28         2022       0     25.85      4.40
     46669   857659  2022-11-28         2022       0     24.95      4.80
     46670   857660  2022-11-28         2022       0     22.90      6.00
     46671   857661  2022-11-28         2022       1     25.35      3.95
     46672   857662  2022-11-28         2022       1     29.55      3.05

            home_dreb  home_fg3_pct  home_fg3a  home_fg3m  home_fg_pct  home_fga  \
     0          36.05      0.283508      32.10      11.60     0.407498     85.30
     1          34.45      0.186014      27.60      11.35     0.511330     83.35
     2          35.85      0.211261      26.70       9.45     0.415333     87.05
     3          33.55      0.239457      28.45      11.50     0.431416     84.55
     4          33.20      0.291932      25.80      10.00     0.453450     84.70
     …          …           …        …        …          …       …
     46668      32.05     20.284341      33.80      12.50    32.655897     84.20
     46669      34.45     13.977462      39.25      14.65    28.952156     85.15
     46670      33.20     24.626431      33.05      10.85    42.398149     86.40
     46671      32.25     20.856653      32.15      10.60    42.469124     87.40
     46672      34.65     33.899859      37.75      14.35    45.480293     87.85

            home_fgm  home_ft_pct  home_fta  home_ftm  home_oreb  home_pf  \
     0         38.10     0.392525     21.45     16.35       8.80    20.20
     1         43.50     0.385137     20.15     16.35       8.60    18.85
     2         38.70     0.515664     27.40     21.25       9.75    17.05
     3         38.95     0.400628     20.05     14.95       9.30    17.85
     4         41.25     0.432828     20.20     15.30       9.40    18.80
     …         …          …       …       …        …      …
     46668     40.30    39.248915     25.65     20.35       6.95    19.10
     46669     41.65    29.378268     27.50     20.55      10.90    20.70
     46670     40.20    43.942857     22.15     16.05       9.90    19.20
     46671     43.05    44.212607     22.00     17.35      11.85    20.40
     46672     42.80    46.114460     21.25     17.05       8.75    19.65

            home_pts  home_reb  home_stl  home_turnover  away_ast  away_blk  \
     0        104.15     44.85      7.05          12.90     25.60      4.75
     1        114.70     43.05      7.65          15.25     22.55      5.60
     2        108.10     45.60      6.45          11.35     21.30      4.65
     3        104.35     42.85      7.90          13.30     21.60      4.10
     4        107.80     42.60      7.90          13.00     20.55      4.25
```

```
…         …       …       …            …       …       …
46668    113.45     39.00      7.15          13.65     27.15      3.40
46669    118.50     45.35      7.00          13.60     24.30      4.80
46670    107.30     43.10      7.85          12.45     24.15      5.25
46671    114.05     44.10      8.10          12.95     23.00      4.00
46672    117.00     43.40      6.80          11.85     22.50      4.00

       away_dreb  away_fg3_pct  away_fg3a  away_fg3m  away_fg_pct  away_fga  \
0          34.20      0.242414      29.45      10.85     0.451425     83.50
1          32.80      0.235524      31.20      11.20     0.406164     90.10
2          32.00      0.226351      25.30       8.60     0.398101     82.05
3          35.45      0.249849      31.60      10.25     0.425655     85.15
4          30.00      0.276580      25.85       9.40     0.433132     81.05
…          …           …        …        …          …       …
46668      32.40     23.005717      29.45      10.50    42.006387     88.85
46669      33.65     26.124760      31.30      11.75    44.094360     87.80
46670      33.80     26.426683      35.45      12.15    39.111668     88.60
46671      35.10     26.378944      36.95      12.50    38.601197     89.50
46672      32.00     28.075487      39.15      13.50    42.805649     87.50

       away_fgm  away_ft_pct  away_fta  away_ftm  away_oreb  away_pf  \
0         39.20     0.477155     24.25     18.20      11.10    21.15
1         41.50     0.353259     22.60     16.20      12.50    20.05
2         37.80     0.433145     23.85     18.70       9.50    21.55
3         37.45     0.506771     25.15     19.70       9.15    20.65
4         35.85     0.429151     20.30     16.55       9.60    23.85
…         …          …       …       …        …      …
46668     43.20    39.141589     19.15     15.50       9.50    22.40
46669     41.45    40.042889     20.40     16.50       8.60    19.00
46670     38.70    41.549211     23.35     17.60      11.75    20.00
46671     39.10    37.552899     20.45     15.00      10.70    18.95
46672     39.50    46.193101     25.35     18.45      10.50    20.15

       away_pts  away_reb  away_stl  away_turnover  diff_away_ast  \
0        107.45     45.30      8.00          15.55          -2.20
1        110.40     45.30      7.80          12.10           9.00
2        102.90     41.50      8.80          14.30           0.05
3        104.85     44.60      7.30          16.60           1.55
4         97.65     39.60      6.75          14.50           2.00
…         …       …       …            …            …
46668    112.40     41.90      7.95          13.05          -1.30
46669    111.15     42.25      6.65          12.20           0.65
46670    107.15     45.55      6.80          14.25          -1.25
46671    105.70     45.80      7.95          13.30           2.35
46672    110.95     42.50      7.65          15.40           7.05

       diff_away_blk  diff_away_dreb  diff_away_fg3_pct  diff_away_fg3a  \
0               0.60            1.85           0.041094            2.65
1               2.00            1.65          -0.049510           -3.60
2               0.50            3.85          -0.015089            1.40
3              -0.70           -1.90          -0.010392           -3.15
4               0.00            3.20           0.015352           -0.05
…              …             …                …             …
46668           1.00           -0.35          -2.721376            4.35
46669           0.00            0.80         -12.147298            7.95
46670           0.75           -0.60          -1.800252           -2.40
46671          -0.05           -2.85          -5.522291           -4.80
46672          -0.95            2.65           5.824371           -1.40

       diff_away_fg3m  diff_away_fg_pct  diff_away_fga  diff_away_fgm  \
0                0.75         -0.043927           1.80          -1.10
1                0.15          0.105166          -6.75           2.00
2                0.85          0.017233           5.00           0.90
3                1.25          0.005761          -0.60           1.50
4                0.60          0.020318           3.65           5.40
…               …               …            …            …
46668            2.00         -9.350490          -4.65          -2.90
46669            2.90        -15.142204          -2.65           0.20
46670           -1.30          3.286482          -2.20           1.50
46671           -1.90          3.867926          -2.10           3.95
46672            0.85          2.674644           0.35           3.30

       diff_away_ft_pct  diff_away_fta  diff_away_ftm  diff_away_oreb  \
0             -0.084629          -2.80          -1.85           -2.30
1              0.031878          -2.45           0.15           -3.90
2              0.082519           3.55           2.55            0.25
3             -0.106143          -5.10          -4.75            0.15
4              0.003677          -0.10          -1.25           -0.20
…                 …            …            …             …
46668          0.107326           6.50           4.85           -2.55
46669        -10.664621           7.10           4.05            2.30
46670          2.393646          -1.20          -1.55           -1.85
46671          6.659708           1.55           2.35            1.15
46672         -0.078641          -4.10          -1.40           -1.75

       diff_away_pf  diff_away_pts  diff_away_reb  diff_away_stl  \
0             -0.95          -3.30          -0.45          -0.95
1             -1.20           4.30          -2.25          -0.15
2             -4.50           5.20           4.10          -2.35
3             -2.80          -0.50          -1.75           0.60
4             -5.05          10.15           3.00           1.15
…             …            …            …            …
46668         -3.30           1.05          -2.90          -0.80
46669          1.70           7.35           3.10           0.35
```

```
46670         -0.80           0.15          -2.45           1.05
46671          1.45           8.35          -1.70           0.15
46672         -0.50           6.05           0.90          -0.85

       diff_away_turnover
0                   -2.65
1                    3.15
2                   -2.95
3                   -3.30
4                   -1.50
…                   …
46668                0.60
46669                1.40
46670               -1.80
46671               -0.35
46672               -3.55

[46673 rows x 58 columns]
```

```
[ ]: fig, ax = plt.subplots(figsize=(12, 8))
     sns.lineplot(data=stats, x='game.season', y='home_fg3_pct', ax=ax, color='r',␣
      ↪linewidth=4)
     sns.lineplot(data=stats, x='game.season', y='home_fg_pct', ax=ax, color='g',␣
      ↪linewidth=4)

     ax.set_title('Goal Score % (3 pointers and Field Goals) Over the Years',␣
      ↪fontsize=14, pad=16, fontweight='bold')
     ax.set_xlabel('Year', fontsize=12, labelpad=8, fontweight='bold')
     ax.set_ylabel('Points', fontsize=12, labelpad=8, fontweight='bold')

     red_patch = mpatches.Patch(color='r', label='Three Pointers')
     green_patch = mpatches.Patch(color='g', label='Field Goal')
     ax.legend(handles=[red_patch, green_patch], fontsize='large')

     plt.xticks(fontsize=16)
     plt.yticks(fontsize=16)
     plt.tight_layout()
```


Goal Score % (3 pointers and Field Goals) Over the Years
Three Pointers
Field Goal
Points
40
30
20
10
0
1980
1990
2000
2010
2020
Year