In [ ]:
```
#Research Question:
#This project will examine Tyrese Maxey's three-point shooting performance t
#Using season and game-level statistics from Basketball-Reference, I will an
#compare performance over the years he had been in the league, and investiga
#efficiency varies against different teams.

#Going back to your research questions themselves, determine what type of st
#to answer each one.  Some examples could be ANOVA to determine if there are
#for prediction, time series analysis for forecasting, classification or clu

#Q1: Has Maxey's three-point percentage improved, declined, or remained cons
#Q2: Are there significant differences in Maxey's 3P% between seasons? ANOVA
#Q3: Does Maxey shoot more efficiently against some teams compared to others
```

In [1]:
```
import pandas as pd
import numpy as np
```

In [2]:
```
# The past 5 years of Maxey's league data
Year_20 = pd.read_excel('Maxey2020-21.xlsx')
Year_21 = pd.read_excel('Maxey2021-22.xlsx')
Year_22 = pd.read_excel('Maxey2022-23.xlsx')
Year_23 = pd.read_excel('Maxey2023-24.xlsx')
Year_24 = pd.read_excel('Maxey2024-25.xlsx')
```

In [4]:
```
# The amount of rows and columns in each data set.
print("Year 20:", Year_20.shape) #This was the Covid season and had less gam
print("Year 21:", Year_21.shape)
print("Year 22:", Year_22.shape)
print("Year 23:", Year_23.shape)
print("Year 24:", Year_24.shape)
```

```
Year 20: (73, 34)
Year 21: (83, 34)
Year 22: (83, 34)
Year 23: (83, 34)
Year 24: (83, 34)
```

In [5]:
```
#Come back and delete row 72 because it was the totals in the orginal data s
#rename 'Unnamed: 5' to 'Location' and update NaN to Home and '@' to Away

                        # Glossary ('*' = Needed for Project)
    #Rk -- Rank
    #Gcar -- Career Game Number for Player *
    #Gtm -- Season Game Number for Team *
    #GS -- Games Started *
    #MP -- Minutes Played *
```

```
    #FG -- Field Goals *
    #FGA -- Field Goal Attempts *
    #FG% -- Field Goal Percentage *
    #3P -- 3-Point Field Goals *
    #3PA -- 3-Point Field Goal Attempts *
    #3P% -- 3-Point Field Goal Percentage *
    #2P -- 2-Point Field Goals
    #2PA -- 2-Point Field Goal Attempts
    #2P% -- 2-Point Field Goal Percentage
    #eFG% -- Effective Field Goal Percentage (This statistic adjusts for the
    #FT -- Free Throws
    #FTA -- Free Throw Attempts
    #FT% -- Free Throw Percentage
    #ORB -- Offensive Rebounds
    #DRB -- Defensive Rebounds
    #TRB -- Total Rebounds
    #AST -- Assists ** Keeping to possibly explore whether higher assist opp
    #STL -- Steals
    #BLK -- Blocks
    #TOV -- Turnovers
    #PF -- Personal Fouls
    #PTS -- Points *
    #GmSc -- Game Score
    #+/- -- Plus-Minus

Year_20
```

Out[5]:

	Rk	Gcar	Gtm	Date	Team	Unnamed: 5	Opp	Result	GS	MP	...	DRB
0	1.0	1.0	1.0	2020-12-23	PHI	NaN	WAS	W, 113-107	NaN	10:51:00	...	2.0
1	2.0	2.0	2.0	2020-12-26	PHI	@	NYK	W, 109-89	NaN	08:49:00	...	1.0
2	3.0	3.0	3.0	2020-12-27	PHI	@	CLE	L, 94-118	NaN	21:40:00	...	0.0
3	4.0	4.0	4.0	2020-12-29	PHI	NaN	TOR	W, 100-93	NaN	08:01:00	...	0.0
4	5.0	5.0	5.0	2020-12-31	PHI	@	ORL	W, 116-92	NaN	21:00:00	...	2.0
...	...	...	...	...	...	...	...	...	...	...	...	...
68	58.0	58.0	69.0	2021-05-11	PHI	@	IND	L, 94-103	NaN	16:34:00	...	1.0
69	59.0	59.0	70.0	2021-05-13	PHI	@	MIA	L, 94-106	NaN	17:17:00	...	0.0
70	60.0	60.0	71.0	2021-05-14	PHI	NaN	ORL	W, 122-97	NaN	22:53:00	...	5.0
71	61.0	61.0	72.0	2021-05-16	PHI	NaN	ORL	W, 128-117	*	1 day, 10:52:00	...	7.0
72	NaN	NaN	NaN	NaT	NaN	NaN	NaN	41-20	8	940	...	93.0

73 rows × 34 columns

In [6]:
```
Year_20.dtypes

            #Data Types I need to change
#Change 'Team' to category
#Change 'Location' to Boolean
#Change 'Opp' category
#Change 'GS' to Boolean
```

Out[6]:
```
Rk                    float64
Gcar                  float64
Gtm                   float64
Date           datetime64[ns]
Team                   object
Unnamed: 5             object
Opp                    object
Result                 object
GS                     object
MP                     object
FG                    float64
FGA                   float64
FG%                   float64
3P                    float64
3PA                   float64
3P%                   float64
2P                    float64
2PA                   float64
2P%                   float64
eFG%                  float64
FT                    float64
FTA                   float64
FT%                   float64
ORB                   float64
DRB                   float64
TRB                   float64
AST                   float64
STL                   float64
BLK                   float64
TOV                   float64
PF                    float64
PTS                   float64
GmSc                  float64
+/-                   float64
dtype: object
```

In [7]:
```
   #Code to delete totals row and renaming 'Unnamed:5' to 'Location'
Year_20 = Year_20.rename(columns={'Unnamed: 5': 'Location'})
Year_20 = Year_20.drop(index=72)
Year_21 = Year_21.rename(columns={'Unnamed: 5': 'Location'})
Year_21 = Year_21.drop(index=82)
Year_22 = Year_22.rename(columns={'Unnamed: 5': 'Location'})
Year_22 = Year_22.drop(index=82)
Year_23 = Year_23.rename(columns={'Unnamed: 5': 'Location'})
Year_23 = Year_23.drop(index=82)
Year_24 = Year_24.rename(columns={'Unnamed: 5': 'Location'})
Year_24 = Year_24.drop(index=82)
Year_24
```

Out[7]:

	Rk	Gcar	Gtm	Date	Team	Location	Opp	Result	GS	MP	...	DF
0	1.0	267.0	1.0	2024-10-23	PHI	NaN	MIL	L, 109-124	*	1 day, 14:59:00	...	6
1	2.0	268.0	2.0	2024-10-25	PHI	@	TOR	L, 107-115	*	1 day, 16:54:00	...	2
2	3.0	269.0	3.0	2024-10-27	PHI	@	IND	W, 118-114 (OT)	*	1 day, 23:47:00	...	4
3	4.0	270.0	4.0	2024-10-30	PHI	NaN	DET	L, 95-105	*	1 day, 16:04:00	...	3
4	5.0	271.0	5.0	2024-11-02	PHI	NaN	MEM	L, 107-124	*	1 day, 13:28:00	...	2
...	...	...	...	...	...	...	...	...	...	...	...	
77	52.0	NaN	78.0	2025-04-05	PHI	NaN	MIN	L, 109-114	Inactive	NaN	...	Na
78	52.0	NaN	79.0	2025-04-07	PHI	@	MIA	L, 105-117	Inactive	NaN	...	Na
79	52.0	NaN	80.0	2025-04-09	PHI	@	WAS	W, 122-103	Did Not Dress	NaN	...	Na
80	52.0	NaN	81.0	2025-04-11	PHI	NaN	ATL	L, 110-124	Inactive	NaN	...	Na
81	52.0	NaN	82.0	2025-04-13	PHI	NaN	CHI	L, 102-122	Inactive	NaN	...	Na

82 rows × 34 columns

In [8]:
```
#new Data frames with only needed columns
Maxey20_21 = Year_20[['Date', 'Location', 'Opp', 'Result', 'GS', 'MP', 'FG',
Maxey21_22 = Year_21[['Date', 'Location', 'Opp', 'Result', 'GS', 'MP', 'FG',
Maxey22_23 = Year_22[['Date', 'Location', 'Opp', 'Result', 'GS', 'MP', 'FG',
Maxey23_24 = Year_23[['Date', 'Location', 'Opp', 'Result', 'GS', 'MP', 'FG',
Maxey24_25 = Year_24[['Date', 'Location', 'Opp', 'Result', 'GS', 'MP', 'FG',
Maxey20_21
```

Out[8]:

	Date	Location	Opp	Result	GS	MP	FG	FGA	FG%	3P	3PA	3P%
0	2020-12-23	NaN	WAS	W, 113-107	NaN	10:51:00	3.0	6.0	0.500	0.0	1.0	0.000
1	2020-12-26	@	NYK	W, 109-89	NaN	08:49:00	1.0	4.0	0.250	0.0	0.0	NaN
2	2020-12-27	@	CLE	L, 94-118	NaN	21:40:00	3.0	8.0	0.375	0.0	2.0	0.000
3	2020-12-29	NaN	TOR	W, 100-93	NaN	08:01:00	0.0	3.0	0.000	0.0	2.0	0.000
4	2020-12-31	@	ORL	W, 116-92	NaN	21:00:00	5.0	9.0	0.556	0.0	0.0	NaN
...	...	...	...	...	...	...	...	...	...	...	...	...
67	2021-05-08	NaN	DET	W, 118-104	*	1 day, 11:13:00	7.0	11.0	0.636	2.0	3.0	0.667
68	2021-05-11	@	IND	L, 94-103	NaN	16:34:00	4.0	9.0	0.444	0.0	1.0	0.000
69	2021-05-13	@	MIA	L, 94-106	NaN	17:17:00	3.0	8.0	0.375	0.0	2.0	0.000
70	2021-05-14	NaN	ORL	W, 122-97	NaN	22:53:00	3.0	9.0	0.333	0.0	1.0	0.000
71	2021-05-16	NaN	ORL	W, 128-117	*	1 day, 10:52:00	11.0	19.0	0.579	3.0	4.0	0.750

72 rows × 14 columns

In [10]:

In [9]:
```
    #Changing Location results to 'home' or 'away'
for df in [Maxey20_21, Maxey21_22, Maxey22_23, Maxey23_24, Maxey24_25]:
        df['Location'] = df['Location'].replace('@', 'Away').fillna('Home')
Maxey20_21
```

Out[9]:

	Date	Location	Opp	Result	GS	MP	FG	FGA	FG%	3P	3PA	3P%
0	2020-12-23	Home	WAS	W, 113-107	NaN	10:51:00	3.0	6.0	0.500	0.0	1.0	0.000
1	2020-12-26	Away	NYK	W, 109-89	NaN	08:49:00	1.0	4.0	0.250	0.0	0.0	NaN
2	2020-12-27	Away	CLE	L, 94-118	NaN	21:40:00	3.0	8.0	0.375	0.0	2.0	0.000
3	2020-12-29	Home	TOR	W, 100-93	NaN	08:01:00	0.0	3.0	0.000	0.0	2.0	0.000
4	2020-12-31	Away	ORL	W, 116-92	NaN	21:00:00	5.0	9.0	0.556	0.0	0.0	NaN
...	...	...	...	...	...	...	...	...	...	...	...	...
67	2021-05-08	Home	DET	W, 118-104	*	1 day, 11:13:00	7.0	11.0	0.636	2.0	3.0	0.667
68	2021-05-11	Away	IND	L, 94-103	NaN	16:34:00	4.0	9.0	0.444	0.0	1.0	0.000
69	2021-05-13	Away	MIA	L, 94-106	NaN	17:17:00	3.0	8.0	0.375	0.0	2.0	0.000
70	2021-05-14	Home	ORL	W, 122-97	NaN	22:53:00	3.0	9.0	0.333	0.0	1.0	0.000
71	2021-05-16	Home	ORL	W, 128-117	*	1 day, 10:52:00	11.0	19.0	0.579	3.0	4.0	0.750

72 rows × 14 columns

In [11]:
```
for df in [Maxey20_21, Maxey21_22, Maxey22_23, Maxey23_24, Maxey24_25]:
    df['GS'] = df['GS'].replace({'*': 1, 'Did Not Play': 0, 'Inactive': 0, '
    df['GS'] = df['GS'].fillna(0)
    df['GS'] = df['GS'].astype(int)

Maxey20_21
```

Out[11]:

	Date	Location	Opp	Result	GS	MP	FG	FGA	FG%	3P	3PA	3P%
0	2020-12-23	Home	WAS	W, 113-107	0	10:51:00	3.0	6.0	0.500	0.0	1.0	0.000
1	2020-12-26	Away	NYK	W, 109-89	0	08:49:00	1.0	4.0	0.250	0.0	0.0	NaN
2	2020-12-27	Away	CLE	L, 94-118	0	21:40:00	3.0	8.0	0.375	0.0	2.0	0.000
3	2020-12-29	Home	TOR	W, 100-93	0	08:01:00	0.0	3.0	0.000	0.0	2.0	0.000
4	2020-12-31	Away	ORL	W, 116-92	0	21:00:00	5.0	9.0	0.556	0.0	0.0	NaN
...	...	...	...	...	...	...	...	...	...	...	...	...
67	2021-05-08	Home	DET	W, 118-104	1	1 day, 11:13:00	7.0	11.0	0.636	2.0	3.0	0.667
68	2021-05-11	Away	IND	L, 94-103	0	16:34:00	4.0	9.0	0.444	0.0	1.0	0.000
69	2021-05-13	Away	MIA	L, 94-106	0	17:17:00	3.0	8.0	0.375	0.0	2.0	0.000
70	2021-05-14	Home	ORL	W, 122-97	0	22:53:00	3.0	9.0	0.333	0.0	1.0	0.000
71	2021-05-16	Home	ORL	W, 128-117	1	1 day, 10:52:00	11.0	19.0	0.579	3.0	4.0	0.750

72 rows × 14 columns

In [12]:
```
#Changing Data Types

# Year 1
Maxey20_21['Location'] = Maxey20_21['Location'].astype('category')
Maxey20_21['Opp'] = Maxey20_21['Opp'].astype('category')
Maxey20_21['GS'] = Maxey20_21['GS'].astype('boolean')
Maxey20_21['Result'] = Maxey20_21['Result'].astype('string')

# Year 2
Maxey21_22['Location'] = Maxey21_22['Location'].astype('category')
```

```
Maxey21_22['Opp'] = Maxey21_22['Opp'].astype('category')
Maxey21_22['GS'] = Maxey21_22['GS'].astype('boolean')
Maxey21_22['Result'] = Maxey21_22['Result'].astype('string')

# Year 3
Maxey22_23['Location'] = Maxey22_23['Location'].astype('category')
Maxey22_23['Opp'] = Maxey22_23['Opp'].astype('category')
Maxey22_23['GS'] = Maxey22_23['GS'].astype('boolean')
Maxey22_23['Result'] = Maxey22_23['Result'].astype('string')

# Year 4
Maxey23_24['Location'] = Maxey23_24['Location'].astype('category')
Maxey23_24['Opp'] = Maxey23_24['Opp'].astype('category')
Maxey23_24['GS'] = Maxey23_24['GS'].astype('boolean')
Maxey23_24['Result'] = Maxey23_24['Result'].astype('string')

# Year 5
Maxey24_25['Location'] = Maxey24_25['Location'].astype('category')
Maxey24_25['Opp'] = Maxey24_25['Opp'].astype('category')
Maxey24_25['GS'] = Maxey24_25['GS'].astype('boolean')
Maxey24_25['Result'] = Maxey24_25['Result'].astype('string')

Maxey24_25.dtypes
```

Out[12]:

```
Date          datetime64[ns]
Location            category
Opp                 category
Result       string[python]
GS                    boolean
MP                     object
FG                    float64
FGA                   float64
FG%                   float64
3P                    float64
3PA                   float64
3P%                   float64
AST                   float64
PTS                   float64
dtype: object
```

In [ ]:

```
#Project 3
```

In [13]:

```
Maxey20_21[['Win or Loss', 'Score']] = Maxey20_21['Result'].str.split(',', e
Maxey20_21[['Team_Score', 'Opponent_Score']] = Maxey20_21['Score'].str.split
Maxey20_21['Team_Score'] = pd.to_numeric(Maxey20_21['Team_Score'], errors='c
Maxey20_21['Opponent_Score'] = pd.to_numeric(Maxey20_21['Opponent_Score'], e

Maxey21_22[['Win or Loss', 'Score']] = Maxey21_22['Result'].str.split(',', e
Maxey21_22[['Team_Score', 'Opponent_Score']] = Maxey21_22['Score'].str.split
Maxey21_22['Team_Score'] = pd.to_numeric(Maxey21_22['Team_Score'], errors='c
```

```
Maxey21_22['Opponent_Score'] = pd.to_numeric(Maxey21_22['Opponent_Score'], e

Maxey22_23[['Win or Loss', 'Score']] = Maxey22_23['Result'].str.split(',', e
Maxey22_23[['Team_Score', 'Opponent_Score']] = Maxey22_23['Score'].str.split
Maxey22_23['Team_Score'] = pd.to_numeric(Maxey22_23['Team_Score'], errors='c
Maxey22_23['Opponent_Score'] = pd.to_numeric(Maxey22_23['Opponent_Score'], e

Maxey23_24[['Win or Loss', 'Score']] = Maxey23_24['Result'].str.split(',', e
Maxey23_24[['Team_Score', 'Opponent_Score']] = Maxey23_24['Score'].str.split
Maxey23_24['Team_Score'] = pd.to_numeric(Maxey23_24['Team_Score'], errors='c
Maxey23_24['Opponent_Score'] = pd.to_numeric(Maxey23_24['Opponent_Score'], e

Maxey24_25[['Win or Loss', 'Score']] = Maxey24_25['Result'].str.split(',', e
Maxey24_25[['Team_Score', 'Opponent_Score']] = Maxey24_25['Score'].str.split
Maxey24_25['Team_Score'] = pd.to_numeric(Maxey24_25['Team_Score'], errors='c
Maxey24_25['Opponent_Score'] = pd.to_numeric(Maxey24_25['Opponent_Score'], e

Maxey20_21
```

Out[13]:

	Date	Location	Opp	Result	GS	MP	FG	FGA	FG%	3P	3PA	3P%
0	2020-12-23	Home	WAS	W, 113-107	False	10:51:00	3.0	6.0	0.500	0.0	1.0	0.000
1	2020-12-26	Away	NYK	W, 109-89	False	08:49:00	1.0	4.0	0.250	0.0	0.0	NaN
2	2020-12-27	Away	CLE	L, 94-118	False	21:40:00	3.0	8.0	0.375	0.0	2.0	0.000
3	2020-12-29	Home	TOR	W, 100-93	False	08:01:00	0.0	3.0	0.000	0.0	2.0	0.000
4	2020-12-31	Away	ORL	W, 116-92	False	21:00:00	5.0	9.0	0.556	0.0	0.0	NaN
...	...	...	...	...	...	...	...	...	...	...	...	...
67	2021-05-08	Home	DET	W, 118-104	True	1 day, 11:13:00	7.0	11.0	0.636	2.0	3.0	0.667
68	2021-05-11	Away	IND	L, 94-103	False	16:34:00	4.0	9.0	0.444	0.0	1.0	0.000
69	2021-05-13	Away	MIA	L, 94-106	False	17:17:00	3.0	8.0	0.375	0.0	2.0	0.000
70	2021-05-14	Home	ORL	W, 122-97	False	22:53:00	3.0	9.0	0.333	0.0	1.0	0.000
71	2021-05-16	Home	ORL	W, 128-117	True	1 day, 10:52:00	11.0	19.0	0.579	3.0	4.0	0.750

72 rows × 18 columns

In [14]:
```
Maxey20_21['Win or Loss'] = Maxey20_21['Win or Loss'].astype('category')
Maxey21_22['Win or Loss'] = Maxey21_22['Win or Loss'].astype('category')
Maxey22_23['Win or Loss'] = Maxey22_23['Win or Loss'].astype('category')
Maxey23_24['Win or Loss'] = Maxey23_24['Win or Loss'].astype('category')
Maxey24_25['Win or Loss'] = Maxey24_25['Win or Loss'].astype('category')


Maxey24_25.dtypes
```

Out[14]:
```
Date              datetime64[ns]
Location                category
Opp                     category
Result            string[python]
GS                       boolean
MP                        object
FG                       float64
FGA                      float64
FG%                      float64
3P                       float64
3PA                      float64
3P%                      float64
AST                      float64
PTS                      float64
Win or Loss             category
Score             string[python]
Team_Score                 Int64
Opponent_Score             Int64
dtype: object
```

In [15]:
```
Maxey_0 = pd.concat([Maxey20_21, Maxey21_22, Maxey22_23, Maxey23_24, Maxey24
Maxey_0['Season'] = (['2020-21'] * len(Maxey20_21) + ['2021-22'] * len(Maxey
    + ['2022-23'] * len(Maxey22_23) + ['2023-24'] * len(Maxey23_24) + ['2024
Maxey_0['Season'] = Maxey_0['Season'].astype('category')
Maxey_0
```

Out[15]:

	Date	Location	Opp	Result	GS	MP	FG	FGA	FG%	3P	3PA	3P
0	2020-12-23	Home	WAS	W, 113-107	False	10:51:00	3.0	6.0	0.500	0.0	1.0	0
1	2020-12-26	Away	NYK	W, 109-89	False	08:49:00	1.0	4.0	0.250	0.0	0.0	Na
2	2020-12-27	Away	CLE	L, 94-118	False	21:40:00	3.0	8.0	0.375	0.0	2.0	0
3	2020-12-29	Home	TOR	W, 100-93	False	08:01:00	0.0	3.0	0.000	0.0	2.0	0
4	2020-12-31	Away	ORL	W, 116-92	False	21:00:00	5.0	9.0	0.556	0.0	0.0	Na
...	...	...	...	...	...	...	...	...	...	...	...	
395	2025-04-05	Home	MIN	L, 109-114	False	NaN	NaN	NaN	NaN	NaN	NaN	Na
396	2025-04-07	Away	MIA	L, 105-117	False	NaN	NaN	NaN	NaN	NaN	NaN	Na
397	2025-04-09	Away	WAS	W, 122-103	False	NaN	NaN	NaN	NaN	NaN	NaN	Na
398	2025-04-11	Home	ATL	L, 110-124	False	NaN	NaN	NaN	NaN	NaN	NaN	Na
399	2025-04-13	Home	CHI	L, 102-122	False	NaN	NaN	NaN	NaN	NaN	NaN	Na

400 rows × 19 columns

In [73]:
```
Maxey = Maxey_0[[ 'Date', 'Season', 'Location', 'Opp','Score','Win or Loss',
Maxey
```

Out[73]:

	Date	Season	Location	Opp	Score	Win or Loss	GS	3P	3PA	3P%	PTS	Team
0	2020-12-23	2020-21	Home	WAS	113-107	W	False	0.0	1.0	0.0	6.0	
1	2020-12-26	2020-21	Away	NYK	109-89	W	False	0.0	0.0	NaN	2.0	
2	2020-12-27	2020-21	Away	CLE	94-118	L	False	0.0	2.0	0.0	6.0	
3	2020-12-29	2020-21	Home	TOR	100-93	W	False	0.0	2.0	0.0	0.0	
4	2020-12-31	2020-21	Away	ORL	116-92	W	False	0.0	0.0	NaN	10.0	
...	...	...	...	...	...	...	...	...	...	...	...	...
395	2025-04-05	2024-25	Home	MIN	109-114	L	False	NaN	NaN	NaN	NaN	
396	2025-04-07	2024-25	Away	MIA	105-117	L	False	NaN	NaN	NaN	NaN	
397	2025-04-09	2024-25	Away	WAS	122-103	W	False	NaN	NaN	NaN	NaN	
398	2025-04-11	2024-25	Home	ATL	110-124	L	False	NaN	NaN	NaN	NaN	
399	2025-04-13	2024-25	Home	CHI	102-122	L	False	NaN	NaN	NaN	NaN	

400 rows × 13 columns

In [74]:
```
Maxey = Maxey.set_index(['Date'])
Maxey
```

Out[74]:

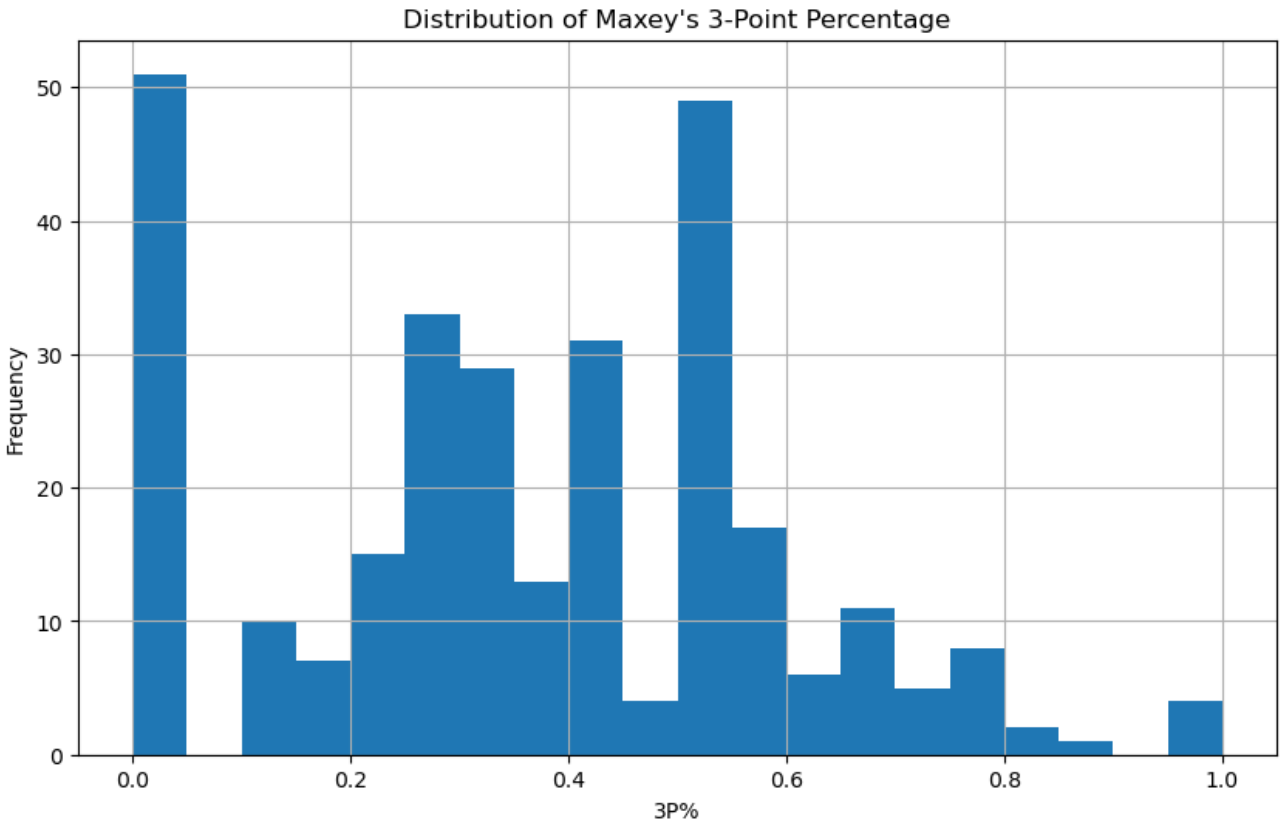
Date	Season	Location	Opp	Score	Win or Loss	GS	3P	3PA	3P%	PTS	Team_Scor
2020-12-23	2020-21	Home	WAS	113-107	W	False	0.0	1.0	0.0	6.0	11
2020-12-26	2020-21	Away	NYK	109-89	W	False	0.0	0.0	NaN	2.0	10
2020-12-27	2020-21	Away	CLE	94-118	L	False	0.0	2.0	0.0	6.0	9
2020-12-29	2020-21	Home	TOR	100-93	W	False	0.0	2.0	0.0	0.0	10
2020-12-31	2020-21	Away	ORL	116-92	W	False	0.0	0.0	NaN	10.0	11
...	...	...	...	...	...	...	...	...	...	...	
2025-04-05	2024-25	Home	MIN	109-114	L	False	NaN	NaN	NaN	NaN	10
2025-04-07	2024-25	Away	MIA	105-117	L	False	NaN	NaN	NaN	NaN	10
2025-04-09	2024-25	Away	WAS	122-103	W	False	NaN	NaN	NaN	NaN	12
2025-04-11	2024-25	Home	ATL	110-124	L	False	NaN	NaN	NaN	NaN	11
2025-04-13	2024-25	Home	CHI	102-122	L	False	NaN	NaN	NaN	NaN	10

400 rows × 12 columns

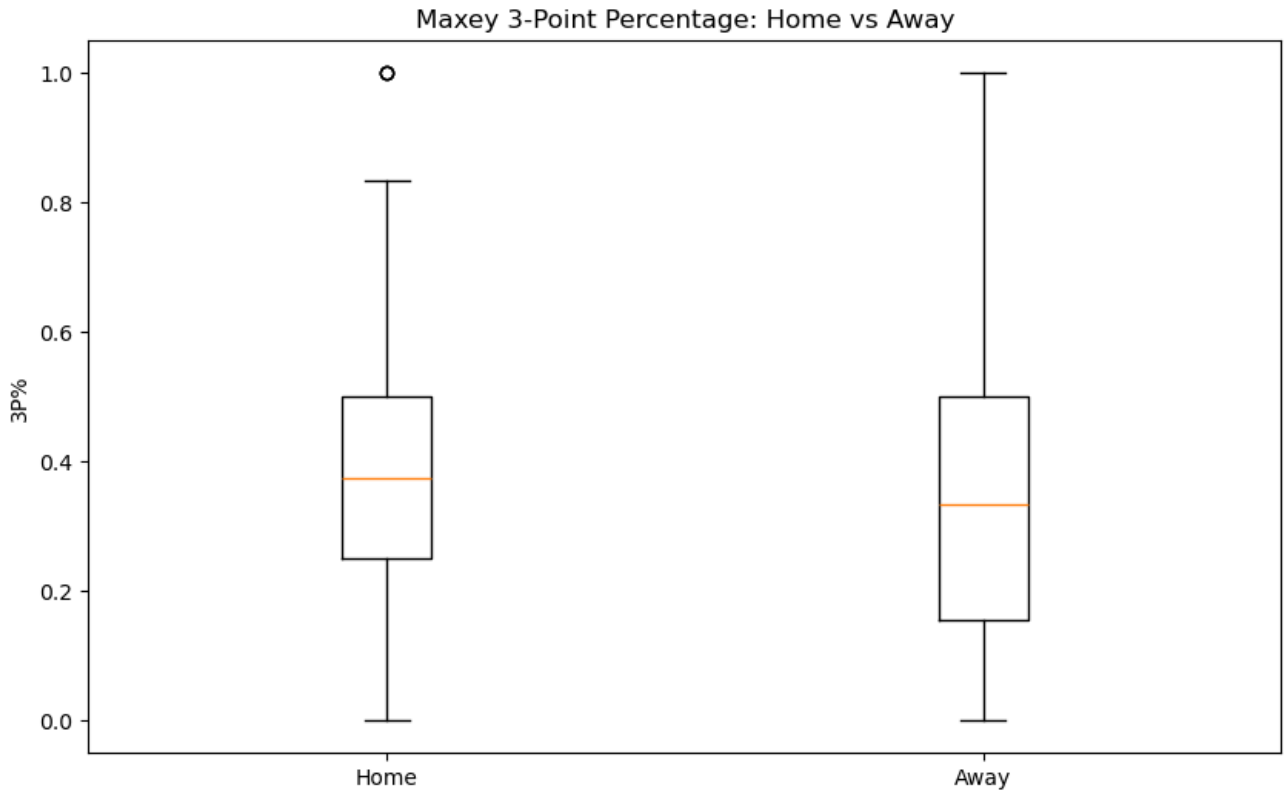
In [ ]:
```
#Project 4
```

In [75]:
```
#Histogram of 3-Point Percentage
import matplotlib.pyplot as plt
import seaborn as sns


plt.figure(figsize=(10,6))
Maxey['3P%'].hist(bins=20)
```

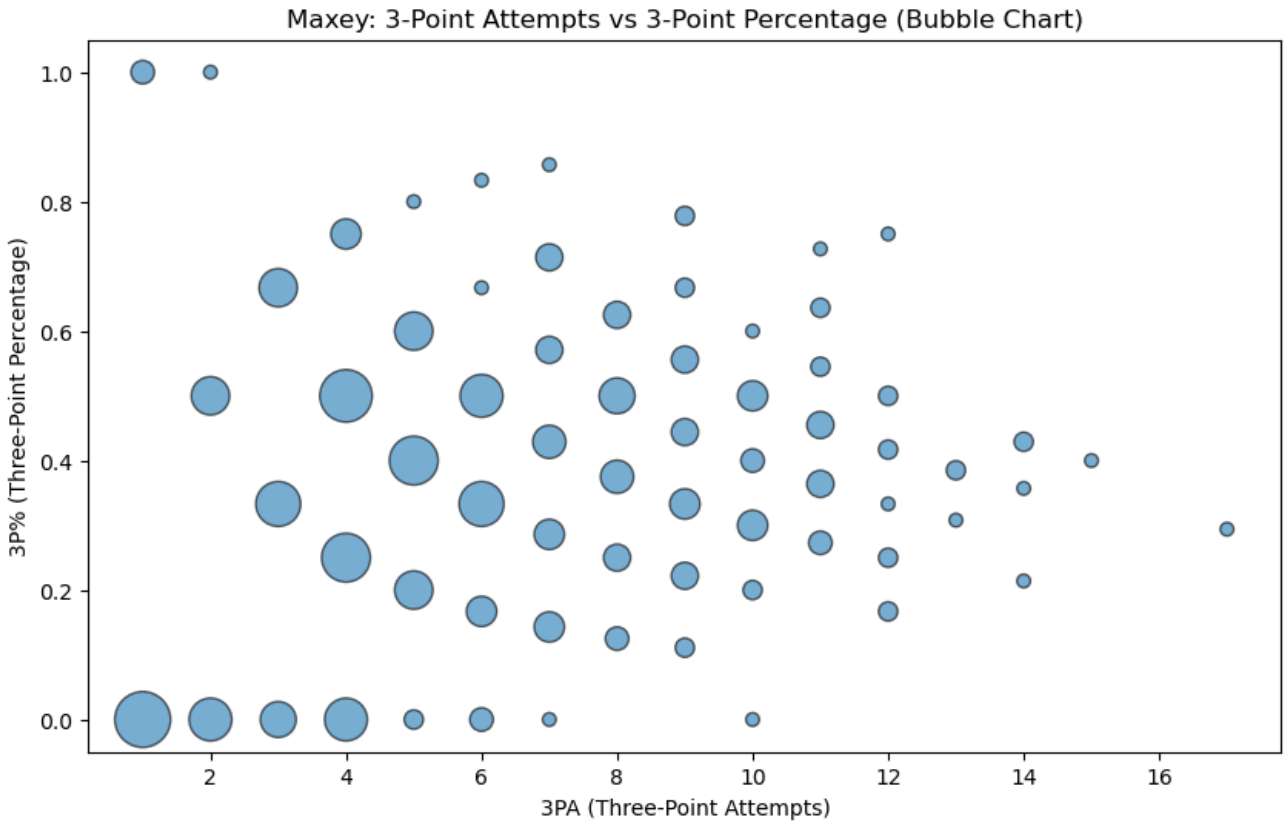
```
plt.title("Distribution of Maxey's 3-Point Percentage")
plt.xlabel("3P%")
plt.ylabel("Frequency")
plt.show()
```



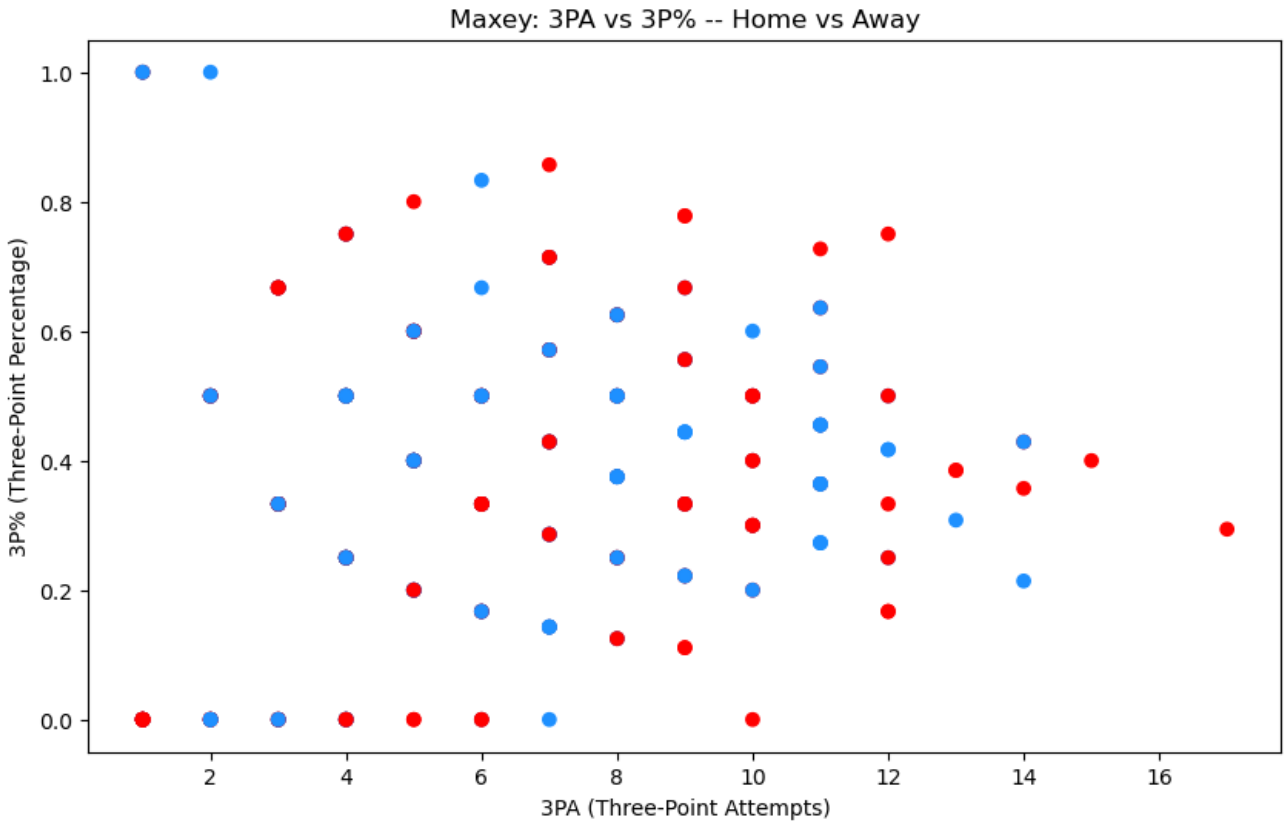
In [76]:
```
home_pct = Maxey.loc[(Maxey['Location'] == 'Home') & Maxey['3P%'].notna(), '
away_pct = Maxey.loc[(Maxey['Location'] == 'Away') & Maxey['3P%'].notna(), '

fig, ax = plt.subplots(figsize=(10,6))

ax.boxplot([home_pct, away_pct], tick_labels=['Home', 'Away'])

ax.set_title('Maxey 3-Point Percentage: Home vs Away')
ax.set_ylabel('3P%')

plt.show()

#Maxey shoots about the same on average no matter where he plays, but he's r
#The box for home games is tighter, which means his 3P% game to game doesn't
#Away games have a wider spread, so he's has some really good nights and som
```



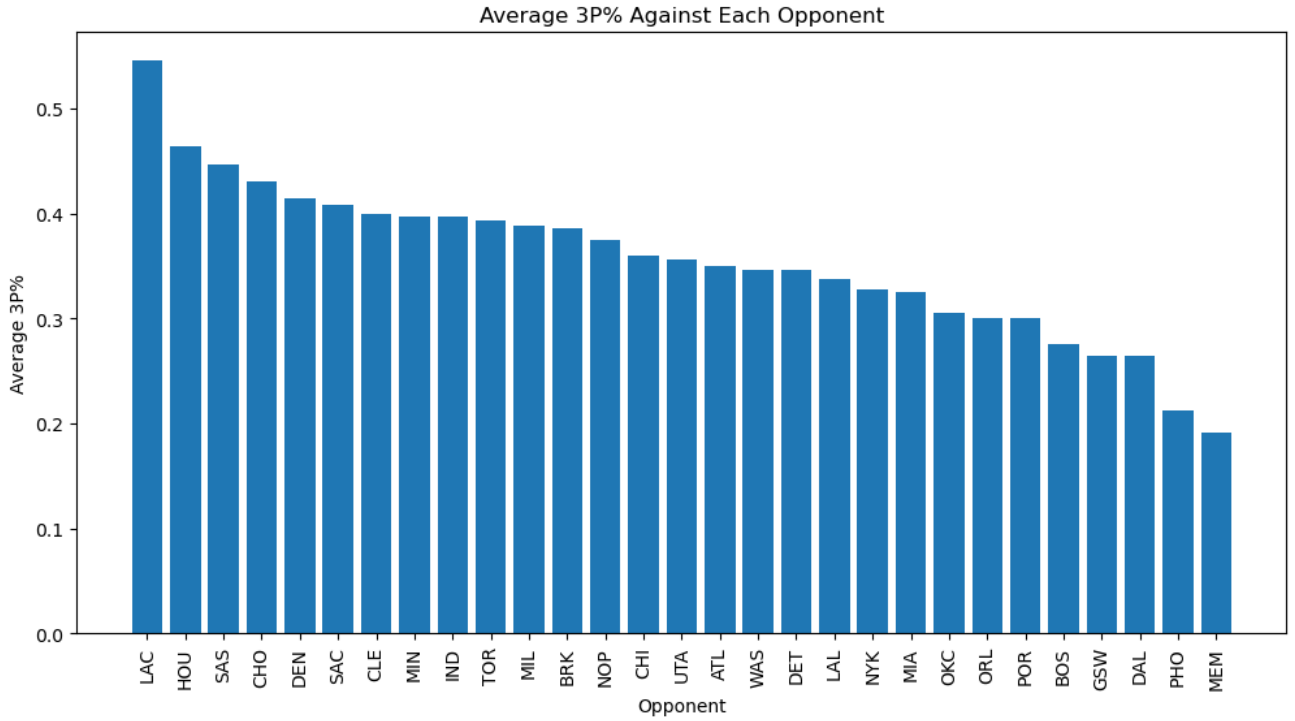
In [77]:
```
#  Bubble Chart for 3PA vs 3P%

bubble_data = Maxey[Maxey['3PA'] > 0].copy()

bubble_group = (
    bubble_data.groupby(['3PA', '3P%'])
    .size()
    .reset_index(name='count')
)

plt.figure(figsize=(10,6))

plt.scatter(
    bubble_group['3PA'],
    bubble_group['3P%'],
    s=bubble_group['count'] * 40,
    alpha=0.6,
    edgecolors='black'
)

plt.title("Maxey: 3-Point Attempts vs 3-Point Percentage (Bubble Chart)")
plt.xlabel("3PA (Three-Point Attempts)")
plt.ylabel("3P% (Three-Point Percentage)")

plt.show()
```



In [78]:
```
fig, ax = plt.subplots(figsize=(10,6))

color_map = {'Home': 'dodgerblue', 'Away': 'red'}
colors = Maxey['Location'].map(color_map)

ax.scatter(Maxey['3PA'], Maxey['3P%'], c=colors)

ax.set_title("Maxey: 3PA vs 3P% -- Home vs Away")
ax.set_xlabel("3PA (Three-Point Attempts)")
ax.set_ylabel("3P% (Three-Point Percentage)")


plt.show()

#no clear correlation between the amount of threes he takes and how many he
```

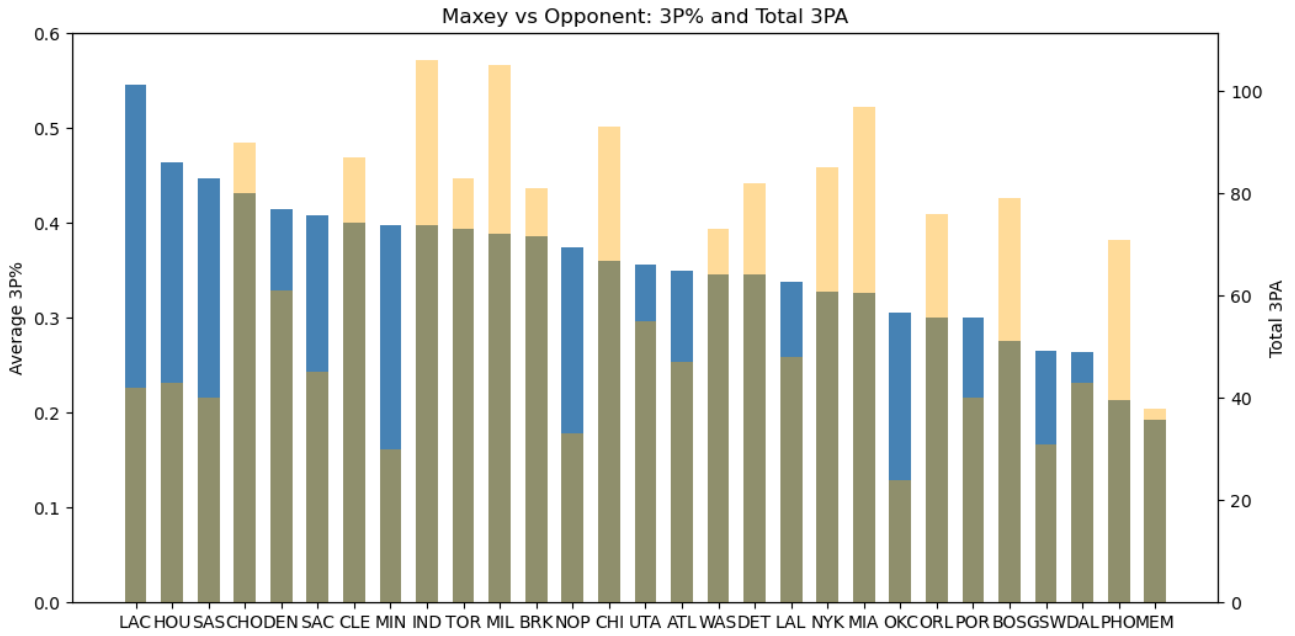


In [79]:
```
avg_vs_opp = Maxey.groupby('Opp', observed=False)['3P%'] \
                  .mean() \
                  .sort_values(ascending=False)

fig, ax = plt.subplots(figsize=(12, 6))
ax.bar(avg_vs_opp.index, avg_vs_opp.values)

ax.set_title("Average 3P% Against Each Opponent")
ax.set_xlabel("Opponent")
ax.set_ylabel("Average 3P%")

plt.xticks(rotation=90)
plt.show()
```



In [80]:
```
avg_vs_opp = Maxey.groupby('Opp', observed=False)['3P%'] \
                  .mean() \
                  .sort_values(ascending=False)

total_vs_opp = Maxey.groupby('Opp', observed=False)['3PA'] \
                    .sum() \
                    .reindex(avg_vs_opp.index)

fig, ax1 = plt.subplots(figsize=(12, 6))

bars1 = ax1.bar(avg_vs_opp.index,
                avg_vs_opp.values,
                width=0.6,
                color='steelblue',
                label='Average 3P%')

ax1.set_ylabel("Average 3P%")
ax1.set_ylim(0, 0.60)
ax1.set_title("Maxey vs Opponent: 3P% and Total 3PA")

ax2 = ax1.twinx()

bars2 = ax2.bar(avg_vs_opp.index,
                total_vs_opp.values,
                width=0.6,
                color='orange',
                alpha=0.4,
                label='Total 3PA')
```

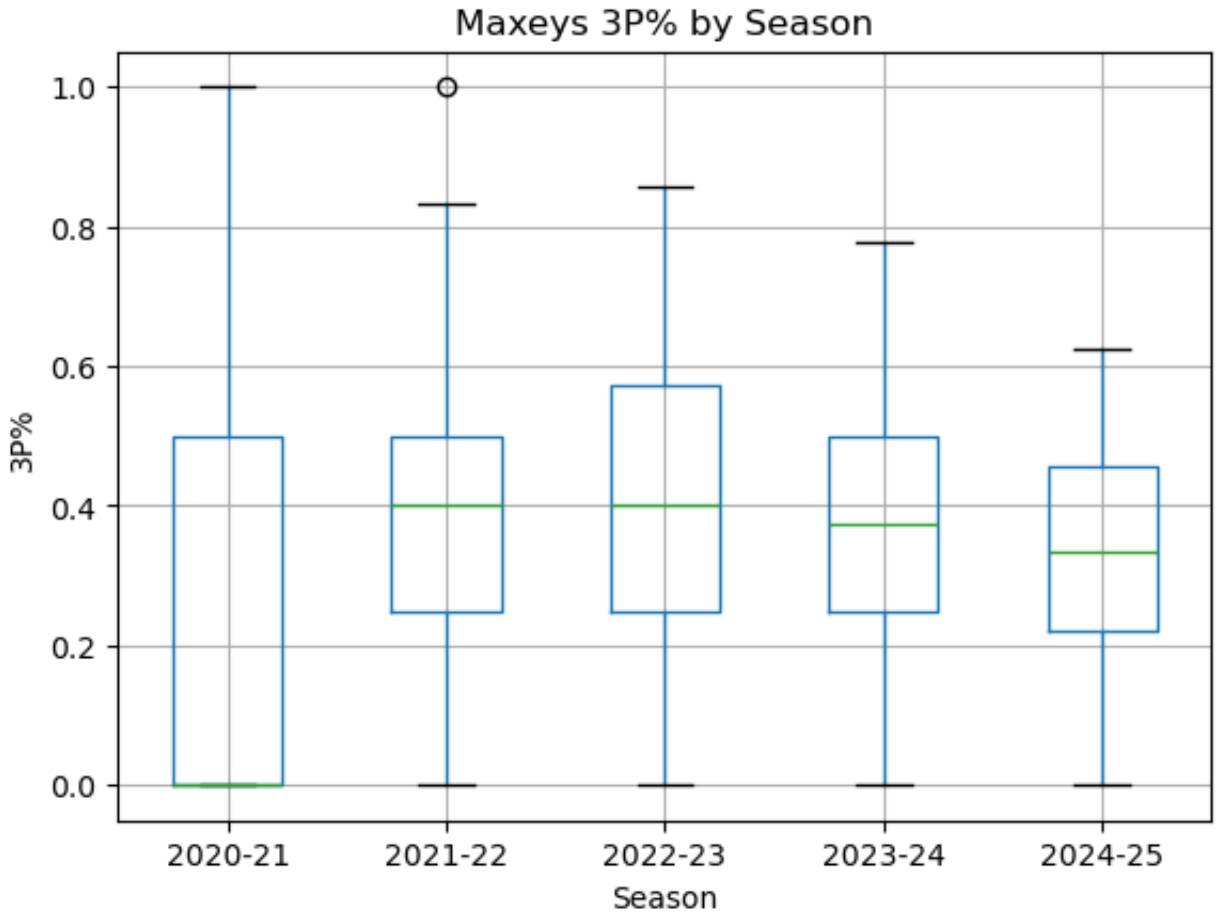
```
ax2.set_ylabel('Total 3PA')

plt.xticks(rotation=90)
plt.show()
```



In [108…

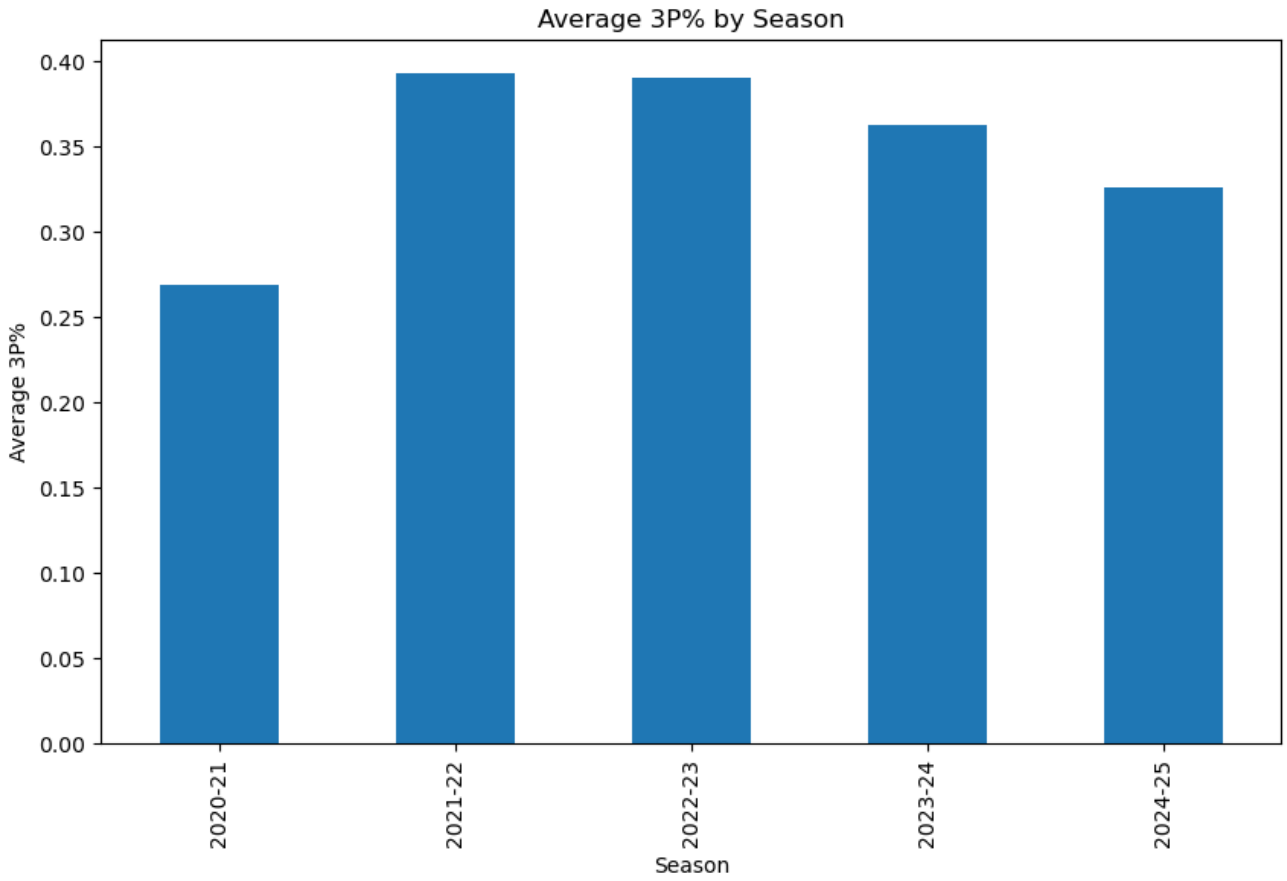
```
plt.figure(figsize=(10,6))

Maxey.boxplot(column='3P%', by='Season')
plt.title('Maxeys 3P% by Season')
plt.suptitle('')
plt.xlabel('Season')
plt.ylabel('3P%')

plt.show()
```

```
<Figure size 1000x600 with 0 Axes>
```



In [107…

```
season_avg = Maxey.groupby('Season', observed=True)['3P%'].mean()

plt.figure(figsize=(10,6))
season_avg.plot(kind='bar')

plt.title("Average 3P% by Season")
plt.xlabel("Season")
plt.ylabel("Average 3P%")

plt.show()
```



In [ ]:
```
#Project 5
```

In [83]:
```
games_per_season = Maxey.groupby('Season', observed=True).size()
print('Games played per season:')
print(games_per_season)
```

```
Games played per season:
Season
2020-21    72
2021-22    82
2022-23    82
2023-24    82
2024-25    82
dtype: int64
```

In [84]:
```
season_summary = Maxey.groupby('Season', observed=True).agg({
    '3P%': 'mean',
    '3PA': 'mean',
    'PTS': 'mean'
})
print(season_summary)
```

```
              3P%       3PA        PTS
Season
2020-21  0.268857  1.688525   8.000000
2021-22  0.392889  4.120000  17.480000
2022-23  0.389533  6.150000  20.300000
2023-24  0.361986  8.128571  25.942857
2024-25  0.325923  9.192308  26.326923
```

In [85]:
```
opp_avg = Maxey.groupby('Opp', observed=True)['3P%'].mean().sort_values(asce
print(opp_avg)
```

```
Opp
LAC    0.545444
HOU    0.464400
SAS    0.446667
CHO    0.431154
DEN    0.414444
SAC    0.408000
CLE    0.399786
MIN    0.397600
IND    0.397313
TOR    0.393923
MIL    0.388600
BRK    0.385750
NOP    0.375000
CHI    0.359600
UTA    0.356143
ATL    0.349700
WAS    0.346167
DET    0.346133
LAL    0.337500
NYK    0.327417
MIA    0.325857
OKC    0.305500
ORL    0.300769
POR    0.300625
BOS    0.275500
GSW    0.264875
DAL    0.264625
PHO    0.212700
MEM    0.192000
Name: 3P%, dtype: float64
```

In [86]:
```
pivot_home_away = Maxey.pivot_table(
    values='3P%',
    index='Season',
    columns='Location',
    aggfunc='mean',
    observed=True
)
```

```
print(pivot_home_away)

#maxey had a better 3p% away for the only time in 2022-23 season, for the mo
```

```
Location      Away      Home
Season
2020-21   0.188391  0.366263
2021-22   0.375083  0.410694
2022-23   0.434767  0.344300
2023-24   0.346088  0.377000
2024-25   0.319458  0.331464
```

In [87]:
```
pivot_winloss = Maxey.pivot_table(
    values='3PA',
    index='Season',
    columns='Win or Loss',
    aggfunc='count',
    observed=True
)

print(pivot_winloss)

#Amount of games maxey shot a 3 in each season:
#2020-21: 61 (Maxey did not play 30 of them)
#2021-22: 75
#2022-23: 60 (did not play 22 games that season - injured)
#2023-24: 70 (did not play 12 games that season - injured)
#2024-25: 52 (did not play 30 games that season - injured)
```

```
Win or Loss   L   W
Season
2020-21      20  41
2021-22      30  45
2022-23      21  39
2023-24      27  43
2024-25      32  20
```

In [88]:
```
Maxey_played = Maxey[Maxey['3PA'].notna()]

ct_home_away = pd.crosstab(Maxey_played['Location'],
                           Maxey_played['Win or Loss'])
print(ct_home_away)
#out of all the games in each season maxey shot a 3 in, this shows how many
```

```
Win or Loss   L   W
Location
Away         67  89
Home         63  99
```

In [89]:
```
ct_season_opp = pd.crosstab(Maxey['Season'], Maxey['Opp'])
```

```
print(ct_season_opp)

#shows how many games THE TEAM played against every team each season (idk if
```

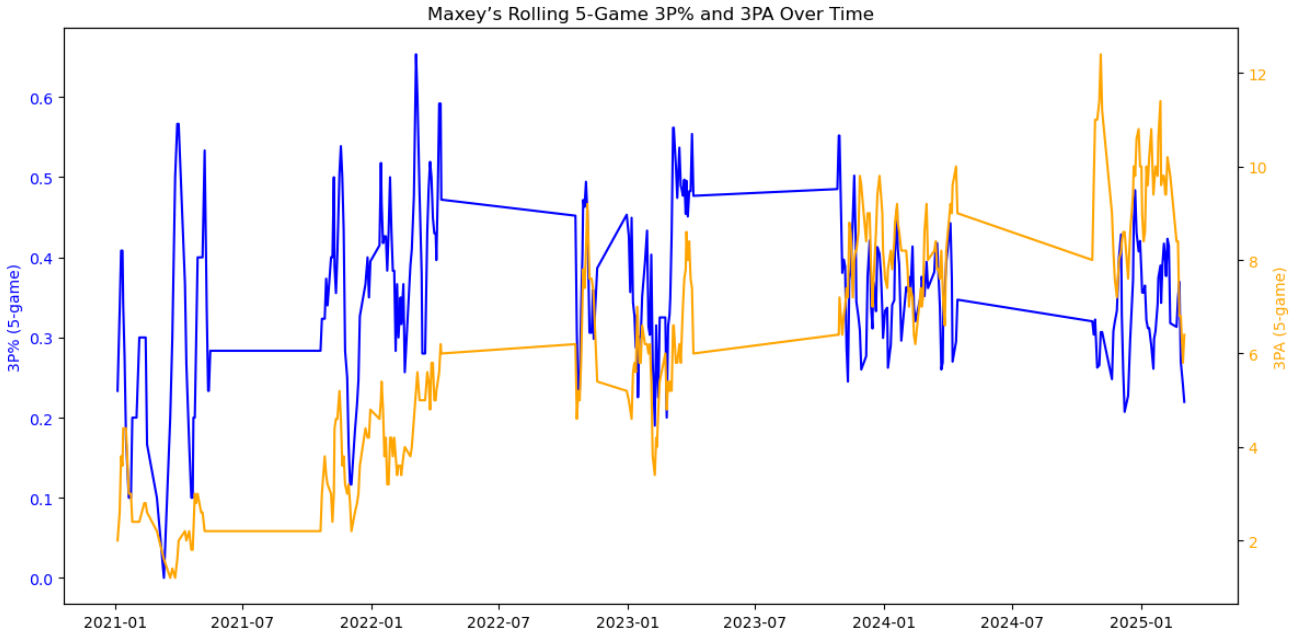
```
Opp      ATL  BOS  BRK  CHI  CHO  CLE  DAL  DEN  DET  GSW  ...  NYK  OKC  OR
L  \
Season                                                      ...
2020-21    3    3    3    3    3    3    2    2    3    2  ...    3    2
3
2021-22    3    4    4    4    4    4    2    2    4    2  ...    4    2
4
2022-23    4    4    4    4    3    3    2    2    3    2  ...    4    2
4
2023-24    4    4    4    3    4    4    2    2    4    2  ...    4    2
3
2024-25    3    4    4    4    4    3    2    2    3    2  ...    4    2
4

Opp      PHO  POR  SAC  SAS  TOR  UTA  WAS
Season
2020-21    2    2    2    2    3    2    3
2021-22    2    2    2    2    4    2    3
2022-23    2    2    2    2    4    2    4
2023-24    2    2    2    2    4    2    4
2024-25    2    2    2    2    4    2    3

[5 rows x 29 columns]
```

In [90]:
```
ct_season_opp = pd.crosstab(Maxey_played['Season'], Maxey_played['Opp'])

low_smpl_cols = ct_season_opp.columns[(ct_season_opp < 3).any(axis=0)]

ct_low = ct_season_opp[low_smpl_cols]
print(ct_low)

#Maxey has not played at least three games against each opponent in each sea
```

```
Opp      ATL  BRK  CHO  CLE  DAL  DEN  DET  GSW  HOU  LAC  ...  NYK  OKC  OR
L  \
Season                                                      ...
2020-21    3    2    3    3    2    2    3    2    2    2  ...    2    2
3
2021-22    3    3    3    4    2    2    4    2    0    2  ...    4    2
3
2022-23    2    2    1    2    2    2    2    1    1    1  ...    3    1
2
2023-24    3    3    4    4    2    1    3    1    2    2  ...    3    1
3
2024-25    0    3    3    2    1    2    3    2    1    2  ...    2    0
3

Opp      PHO  POR  SAC  SAS  TOR  UTA  WAS
Season
2020-21    2    2    1    1    1    1    3
2021-22    2    2    2    1    4    2    3
2022-23    2    2    1    2    3    2    3
2023-24    2    1    2    2    3    2    4
2024-25    2    2    2    1    2    1    1

[5 rows x 26 columns]
```

In [ ]:
```
#Project 6
```

In [92]:
```
ts = Maxey.copy()
ts = ts[(ts['3PA'] > 0) | (ts['3P%'] > 0)]
ts = ts.sort_index()

ts['3P%_roll5'] = ts['3P%'].rolling(5).mean()
ts['3PA_roll5'] = ts['3PA'].rolling(5).mean()

fig, ax1 = plt.subplots(figsize=(12, 6))

ax1.plot(ts.index, ts['3P%_roll5'], color='blue', label='Rolling 3P% (5-game
ax1.set_ylabel("3P% (5-game)", color='blue')
ax1.tick_params(axis='y', labelcolor='blue')

ax2 = ax1.twinx()
ax2.plot(ts.index, ts['3PA_roll5'], color='orange', label='Rolling 3PA (5-ga
ax2.set_ylabel("3PA (5-game)", color='orange')
ax2.tick_params(axis='y', labelcolor='orange')

plt.title("Maxey's Rolling 5-Game 3P% and 3PA Over Time")
plt.xticks(rotation=45)
plt.tight_layout()

plt.show()
```



In [93]:
```
conference_map = {
    "ATL":"East","BOS":"East","BKN":"East","CHA":"East","CHI":"East","CLE":"
    "DET":"East","IND":"East","MIA":"East","MIL":"East","NYK":"East","ORL":"
    "PHI":"East","TOR":"East","WAS":"East",

    "DAL":"West","DEN":"West","GSW":"West","HOU":"West","LAC":"West","LAL":"
    "MEM":"West","MIN":"West","NOP":"West","OKC":"West","PHO":"West","POR":"
    "SAC":"West","SAS":"West","UTA":"West"
}

Maxey["Conference"] = Maxey["Opp"].map(conference_map)

Maxey["Conference"].value_counts()
```

Out[93]:
```
Conference
East    213
West    150
Name: count, dtype: int64
```

In [94]:
```
from scipy.stats import f_oneway

cleaned = Maxey[Maxey['3PA'] > 0].copy()
cleaned = cleaned.dropna(subset=['3P%'])
```

In [95]:
```
#Q2: Are there significant differences in Maxey's 3P% between seasons? (yes)

groups_season = [
    cleaned[cleaned['Season'] == season]['3P%']
    for season in cleaned['Season'].unique()
]
```

```
f_stat, p_val = f_oneway(*groups_season)
print(f_stat, p_val)

#statistically signficant
```

```
2.5579176327530386 0.03893372646407128
```

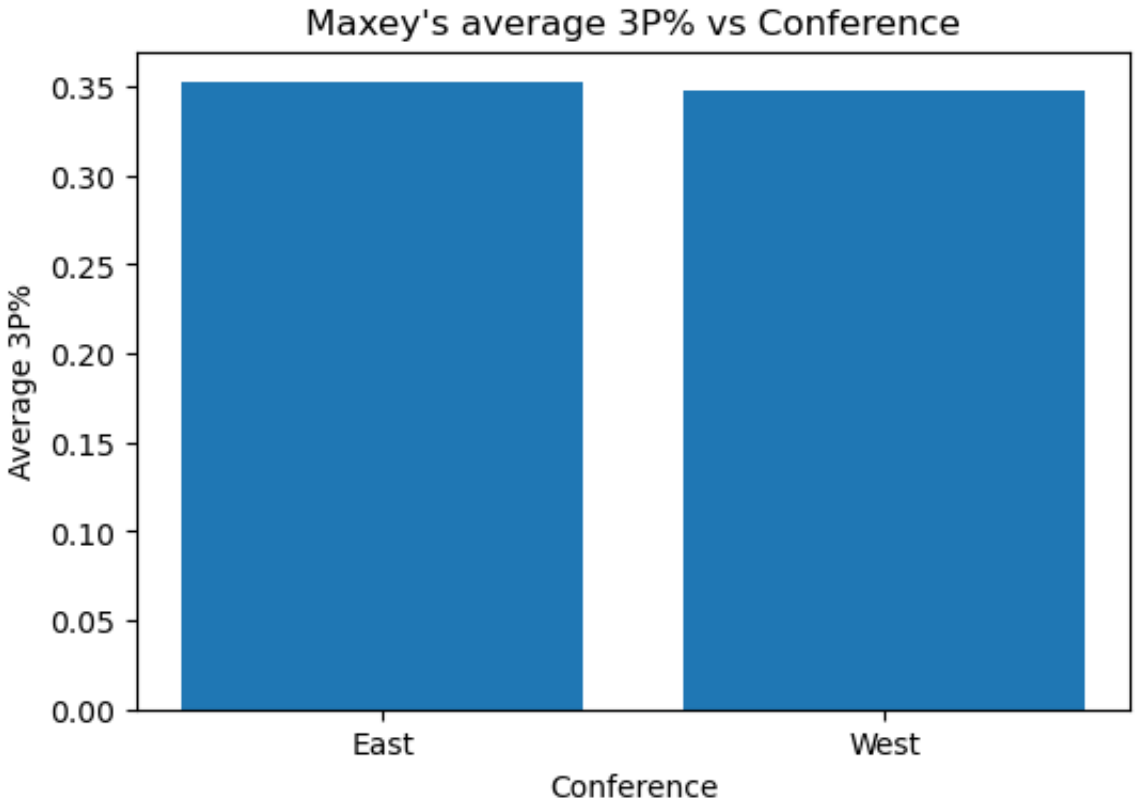
In [96]:
```
grand_mean = cleaned['3P%'].mean()

ss_between = sum(
    len(season_group) * (season_group.mean() - grand_mean)**2
    for season_group in groups_season
)
ss_total = np.sum((cleaned['3P%'] - grand_mean)**2)

effect = ss_between / ss_total
print("Effect size:", effect)

#only accounts for 3.4% of change in 3p% from season to season
```

```
Effect size: 0.03396611821385095
```

In [97]:
```
#Q3: Does Maxey shoot more efficiently against one conference vs another? (r

east = cleaned[cleaned['Conference'] == 'East']['3P%']
west = cleaned[cleaned['Conference'] == 'West']['3P%']

f_stat, p_val = f_oneway(east, west)
print(f_stat, p_val)

#statistically insignificant
```

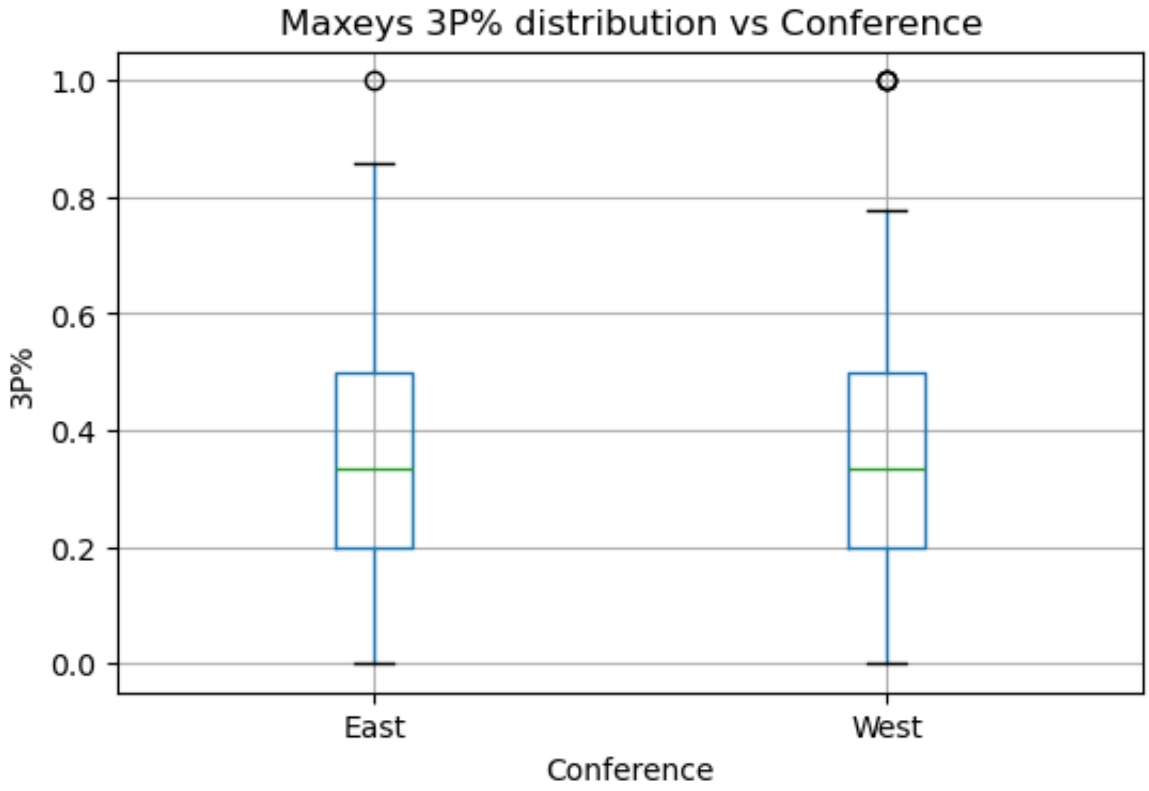
```
0.018372031999673036 0.8922835700300595
```

In [109…
```
con = (
    cleaned
    .groupby('Conference', observed=False)['3P%']
    .mean()
    .sort_index()
)

fig, ax = plt.subplots(figsize=(6, 4))
ax.bar(con.index, con.values)
ax.set_title('Maxey\'s average 3P% vs Conference')
ax.set_xlabel('Conference')
ax.set_ylabel('Average 3P%')
plt.show()
```



In [110…

```
fig, ax = plt.subplots(figsize=(6, 4))
cleaned.boxplot(column='3P%', by='Conference', ax=ax)
ax.set_title('Maxeys 3P% distribution vs Conference')
ax.set_xlabel('Conference')
ax.set_ylabel('3P%')
plt.suptitle('')
plt.show()
```



In [105…
```
#Q1: Has Maxey's three-point percentage improved, declined, or remained cons
```

In [106…
```
from statsmodels.tsa.api import ExponentialSmoothing

season_avg = (Maxey.groupby('Season', observed=False)['3P%'].mean().sort_inc

es_model = ExponentialSmoothing(season_avg,trend=None,seasonal=None).fit()
es_fitted = es_model.fittedvalues

fig, ax = plt.subplots(figsize=(8, 5))
ax.plot(season_avg.index, season_avg.values, marker='o', label='Actual seasc
ax.plot(season_avg.index, ses_fitted, linestyle='--', label='Fitted 3P%')
ax.set_title('Maxey season 3P% with Exponential Smoothing')
ax.set_xlabel('Season')
ax.set_ylabel('3P%')
ax.legend()
plt.show()
```

```
/opt/anaconda3/lib/python3.13/site-packages/statsmodels/tsa/base/tsa_model.py:559: UserWarning: Could not infer format, so each element will be parsed individually, falling back to `dateutil`. To ensure parsing is consistent and as-expected, please specify a format.
  _index = to_datetime(index)
/opt/anaconda3/lib/python3.13/site-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: An unsupported index was provided. As a result, forecasts cannot be generated. To use the model for forecasting, use one of the supported classes of index.
  self._init_dates(dates, freq)
```