COGS 108 - Final Project

Overview

In this project, we investigated the correlation between having more free throws attempted and winning more games by the use of bar charts, tables and pie charts to visualize our data and T-test in order to analyze our data and check for correlations.

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Research Question

The question that we tackled and analyzed in this project is how much of an effect having more attempted free throws will have on winning games in the regular season.

Background and Prior Work

In today's modern NBA, James Harden is prolific for being a player that draws in more fouls than any other player in NBA history. Although James Harden is a super star athlete in his own right, many fans argue if his team wins only because of the amount of free throws he gets to shoot. Our question looks to dive into this by going into recent NBA seasons and analyzing each game though looking at the team that attempted more free throws and seeing if that team won or loss that game. Perhaps many people think that the more free throws mean the higher percentage the team winning rate, but the data we collect is not.

From our research, we found previous work that showed free throws are important and crucial to team success in volume rather than accuracy (attempted over made).

References
1) http://theseason.gc.com/basketball-free-throw-rate (http://theseason.gc.com/basketball-free-throw-rate)

Hypothesis

Our hypothesis for this question leads us to believe that more free throws attempted does lead to a higher % of won games because more free throw shots lead to more uncontested attempts which could naturally result in more points. Therefore we would have to expect the teams that make it to playoffs in Eastern and Western conference based on their regular season results and their seedings would have a correlation with their attempted free throws. In other words, since these teams had more wins, we would expect that they would have more attempted free throws than the league average and after finding meaningful values based on our analysis, we would look to see how much having more free throws impacted their winning rates.

Setup

In [3]:

```
# Import needed libraries and modules
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import patsy
import statsmodels.api as sm
import os
import scipy
from IPython.display import display_html
def display_side_by_side(*args):
   html_str=''
   for df in args:
       html_str+=df.to_html()
   display_html(html_str.replace('table','table style="display:inline"'),raw=Tru
e)
from IPython.core.display import HTML

def multi_table(table_list):
    ''' Acceps a list of IpyTable objects and returns a table which contains eac
h IpyTable in a cell
    '''
    return HTML(
        '<table><tr style="background-color:white;">' +
        ''.join(['<td>' + table._repr_html_() + '</td>' for table in table_list
]) +
        '</tr></table>'
    )
```

Datasets

Our dataset was obtained from https://www.kaggle.com/pablote/nba-enhanced-stats (https://www.kaggle.com/pablote/nba-enhanced-stats). This dataset is based on box score and standings statistics of the NBA teams from 2012-2018. The data that we chose is official box scores which contains every statistic in an NBA game. The size of the whole dataset is 44.3k rows x 119 column.These data points that we used are the number of games that were played each regular season game results and each team's rankings and free throws attempted in those games.

In [2]:

```
# Read in our file of data
df = pd.read_csv("2012-18_officialBoxScore.csv")
df.drop_duplicates( keep='first',inplace=True)
```

Data Cleaning and Pre-Processing

The first step taken was extracting the data necessary from this dataset since it was a huge and detailed dataset and not all the data that was presented in this dataset interested us. We broke up the data just to have the games played in every regular season, their dates, game results and each team's ranking and free throws attempted.

Afterwards, we broke the data frame to look at the teams that had more free throws attempted in their games and observed the outcome of the game in which the respective team had more attempted free throws.

Then, to go into more depth, we then extracted just the top 8 teams from each conference in the first and last season and compared their free throw attempts to the league average for that particular season.

In [3]:

```
# Break up data frame to just the dates, team result, team free throws
DateRsltFta = df

wins = DateRsltFta[DateRsltFta['teamRslt'] == 'Win']
loss = DateRsltFta[DateRsltFta['teamRslt'] == 'Loss']

# Break up dataframes for each season
mask1213 = (DateRsltFta['gmDate'] >= '2012-10-30') & (DateRsltFta['gmDate'] <=
'2013-04-17')
season1213 = DateRsltFta.loc[mask1213]

mask1314 = (DateRsltFta['gmDate'] >= '2013-10-29') & (DateRsltFta['gmDate'] <=
'2014-04-16')
season1314 = DateRsltFta.loc[mask1314]

mask1415 = (DateRsltFta['gmDate'] >= '2014-10-28') & (DateRsltFta['gmDate'] <=
'2015-04-15')
season1415 = DateRsltFta.loc[mask1415]

mask1516 = (DateRsltFta['gmDate'] >= '2015-10-27') & (DateRsltFta['gmDate'] <=
'2016-04-13')
season1516 = DateRsltFta.loc[mask1516]

mask1617 = (DateRsltFta['gmDate'] >= '2016-10-25') & (DateRsltFta['gmDate'] <=
'2017-04-12')
season1617 = DateRsltFta.loc[mask1617]

mask1718 = (DateRsltFta['gmDate'] >= '2017-10-17') & (DateRsltFta['gmDate'] <=
'2018-04-11')
season1718 = DateRsltFta.loc[mask1718]
```

Summing total wins and losses per season:

In [4]:

```
# Break up data frame to see which team shot more free throws

# Season 2012-2013
moreFTA1213 = season1213[season1213['teamFTA'] > season1213['opptFTA']]
moreFTA1213.drop_duplicates( keep='first',inplace=True)
sumMoreFTA1213Win = sum(moreFTA1213['teamRslt'] == 'Win')
sumMoreFTA1213Loss = sum(moreFTA1213['teamRslt'] == 'Loss')


moreFTA1213copy = moreFTA1213
moreFTA1213copy.teamRslt[moreFTA1213copy.teamRslt == 'Win'] = 1
moreFTA1213copy.teamRslt[moreFTA1213copy.teamRslt == 'Loss'] = 0


# Season 2013-2014
moreFTA1314 = season1314[season1314['teamFTA'] > season1314['opptFTA']]
moreFTA1314.drop_duplicates( keep='first',inplace=True)
sumMoreFTA1314Win = sum(moreFTA1314['teamRslt'] == 'Win')
sumMoreFTA1314Loss = sum(moreFTA1314['teamRslt'] == 'Loss')

# Season 2014-2015
moreFTA1415 = season1415[season1415['teamFTA'] > season1415['opptFTA']]
moreFTA1415.drop_duplicates( keep='first',inplace=True)
sumMoreFTA1415Win = sum(moreFTA1415['teamRslt'] == 'Win')
sumMoreFTA1415Loss = sum(moreFTA1415['teamRslt'] == 'Loss')

# Season 2015-2016
moreFTA1516 = season1516[season1516['teamFTA'] > season1516['opptFTA']]
moreFTA1516.drop_duplicates( keep='first',inplace=True)
sumMoreFTA1516Win = sum(moreFTA1516['teamRslt'] == 'Win')
sumMoreFTA1516Loss = sum(moreFTA1516['teamRslt'] == 'Loss')

# Season 2016-2017
moreFTA1617 = season1617[season1617['teamFTA'] > season1617['opptFTA']]
moreFTA1617.drop_duplicates( keep='first',inplace=True)
sumMoreFTA1617Win = sum(moreFTA1617['teamRslt'] == 'Win')
sumMoreFTA1617Loss = sum(moreFTA1617['teamRslt'] == 'Loss')

# Season 2017-2018
moreFTA1718 = season1718[season1718['teamFTA'] > season1718['opptFTA']]
moreFTA1718.drop_duplicates( keep='first',inplace=True)
sumMoreFTA1718Win = sum(moreFTA1718['teamRslt'] == 'Win')
sumMoreFTA1718Loss = sum(moreFTA1718['teamRslt'] == 'Loss')
```

```
C:\Users\zhaoy\Anaconda3\lib\site-packages\ipykernel_launcher.py:5:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  """
C:\Users\zhaoy\Anaconda3\lib\site-packages\ipykernel_launcher.py:11:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  # This is added back by InteractiveShellApp.init_path()
C:\Users\zhaoy\Anaconda3\lib\site-packages\pandas\core\generic.py:86
82: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  self._update_inplace(new_data)
C:\Users\zhaoy\Anaconda3\lib\site-packages\IPython\core\interactives
hell.py:3296: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  exec(code_obj, self.user_global_ns, self.user_ns)
C:\Users\zhaoy\Anaconda3\lib\site-packages\ipykernel_launcher.py:12:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
  if sys.path[0] == '':
C:\Users\zhaoy\Anaconda3\lib\site-packages\ipykernel_launcher.py:17:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
C:\Users\zhaoy\Anaconda3\lib\site-packages\ipykernel_launcher.py:23:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
C:\Users\zhaoy\Anaconda3\lib\site-packages\ipykernel_launcher.py:29:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
C:\Users\zhaoy\Anaconda3\lib\site-packages\ipykernel_launcher.py:35:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/panda
s-docs/stable/indexing.html#indexing-view-versus-copy
C:\Users\zhaoy\Anaconda3\lib\site-packages\ipykernel_launcher.py:41:
SettingWithCopyWarning:
```

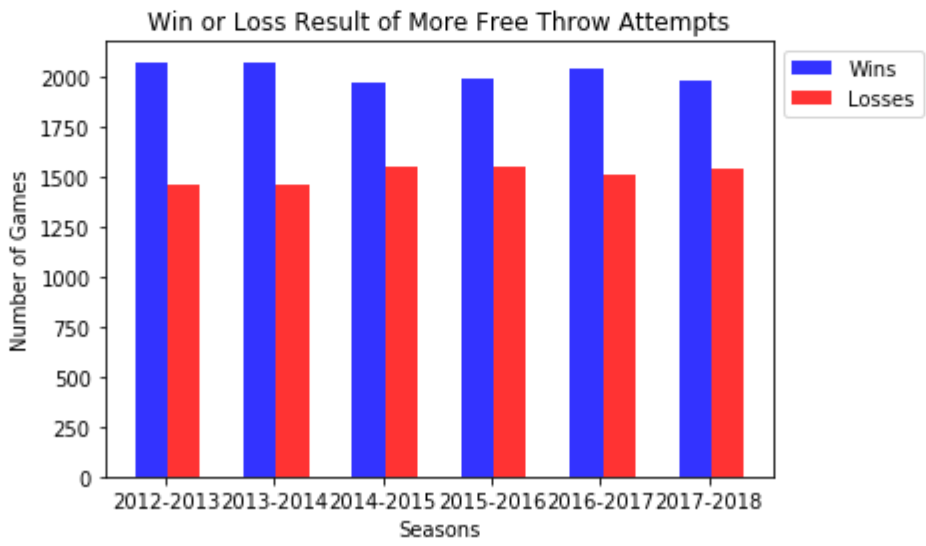
```
A value is trying to be set on a copy of a slice from a DataFrame

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

Data Analysis and Results

Graphing Wins vs. Losses when shooting more free throws than the opposing team (All seasons combined)

In [5]:

```
seasons = ['2012-2013', '2013-2014', '2014-2015', '2015-2016', '2016-2017', '201
7-2018']
wins = [sumMoreFTA1213Win, sumMoreFTA1314Win, sumMoreFTA1415Win, sumMoreFTA1516W
in, sumMoreFTA1617Win, sumMoreFTA1718Win]
losses = [sumMoreFTA1213Loss, sumMoreFTA1314Loss, sumMoreFTA1415Loss, sumMoreFTA
1516Loss, sumMoreFTA1617Loss, sumMoreFTA1718Loss]
# WinAndLossDf = pd.DataFrame(seasons,columns=['Seasons'])
# WinAndLossDf['Games Won'] = wins
# WinAndLossDf['Games Lost'] = losses
# WinAndLossDf.plot(x="Seasons", y=["Games Won", "Games Lost"],kind="bar", width
=.4).legend(bbox_to_anchor=(1, 1))

# create plt
fig, ax = plt.subplots()
index = np.arange(6)
bar_width = 0.3
opacity = 0.8

rects1 = plt.bar(index, wins, bar_width,
alpha=opacity,
color='b',
label='Wins')

rects2 = plt.bar(index + bar_width, losses, bar_width,
alpha=opacity,
color='r',
label='Losses')

plt.xlabel('Seasons')
plt.ylabel('Number of Games')
plt.title('Win or Loss Result of More Free Throw Attempts')
plt.xticks(index + bar_width-.17, seasons)
plt.legend()
plt.figure(figsize=(15,15))
# # plt.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.)
# plt.legend(bbox_to_anchor=(0., 1.02, 1., .102), loc=3,
#            ncol=2, mode="expand", borderaxespad=0.)
ax.legend(loc='best', bbox_to_anchor=(1,1))
plt.tight_layout()

plt.show()
```

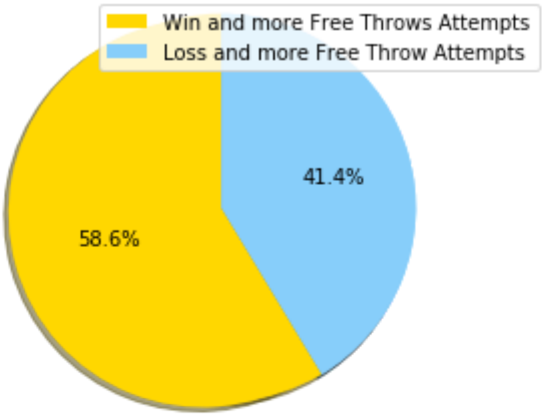



```
<Figure size 1080x1080 with 0 Axes>
```

Plot 1: This is a bar plot indicating the outcome of the games for the team with more free throws attempted in each season from 2012-2018. For instance in the 2012-2013 season, approximately 2025 games were won where the winning team had more free throw attempts. From the plot we can tell that more games were won each season when more free throws were attempted and therefore there is a higher chance of winning a single game when more free throws are made.

In [6]:

```
# For better visual, with a pie chart

labels = 'Win and more Free Throws Attempts', 'Loss and more Free Throw Attempt
s'
colors = ['gold', 'lightskyblue']
sizes = [sumMoreFTA1213Win, sumMoreFTA1213Loss]
explode = (0.1, 0)

patches,texts = plt.pie(sizes, colors=colors, shadow=True, startangle=90, explod
e=explode)
plt.legend(patches, labels, loc="best")
plt.pie(sizes, colors=colors, autopct='%1.1f%%', shadow=True, startangle=90)
plt.axis('equal')
plt.show()
```



Plot 2: In order to be able to better visualize the results, a pie chart is plotted in which the percentage of the games that were won and lost with more free throws attempted are shown. From the plot we can interpret that more free throws leads to a higher chance of winning a game since 58.6% of the games were won when more free shots were made.

In [7]:

```
# NBA Team Rankings 2012 - 2018

rank1 = pd.read_csv('12-13_Standing.csv')
rank1 = rank1.sort_values(by=['RANK'], ascending=True)

rank2 = pd.read_csv('13-14_Standing.csv')
rank2 = rank2.sort_values(by=['RANK'], ascending=True)

rank3 = pd.read_csv('14-15_Standing.csv')
rank3 = rank3.sort_values(by=['RANK'], ascending=True)

rank4 = pd.read_csv('15-16_Standing.csv')
rank4 = rank4.sort_values(by=['RANK'], ascending=True)

rank5 = pd.read_csv('16-17_Standing.csv')
rank5 = rank5.sort_values(by=['RANK'], ascending=True)

rank6 = pd.read_csv('17-18_Standing.csv')
rank6 = rank6.sort_values(by=['RANK'], ascending=True)
```

In [8]:

```
# Drop one of the duplicate column for each season

rank11 = rank1.drop(['RANKORD'], axis = 1)
rank22 = rank2.drop(['RANKORD'], axis = 1)
rank33 = rank3.drop(['RANKORD'], axis = 1)
rank44 = rank4.drop(['RANKORD'], axis = 1)
rank55 = rank5.drop(['RANKORD'], axis = 1)
rank66 = rank6.drop(['RANKORD'], axis = 1)
```

Playoff Team ranking for reference (Each season)

In [9]:

```
# display data table 2012 - 13, 2013 - 14
display_side_by_side(rank11, rank22)
```

	SEASON	TEAM	RANK	WIN	LOST
20	2012-13	OKC	1	60	22
15	2012-13	MIA	1	66	16
25	2012-13	SA	2	58	24
19	2012-13	NY	2	54	28
7	2012-13	DEN	3	57	25
11	2012-13	IND	3	49	32
14	2012-13	MEM	4	56	26
1	2012-13	BKN	4	49	33
12	2012-13	LAC	4	56	26
4	2012-13	CHI	5	45	37
0	2012-13	ATL	6	44	38
9	2012-13	GS	6	47	35
13	2012-13	LAL	7	45	37
2	2012-13	BOS	7	41	40
10	2012-13	HOU	7	45	37
16	2012-13	MIL	8	38	44
27	2012-13	TOR	9	34	48
28	2012-13	UTA	9	43	39
22	2012-13	PHI	9	34	48
6	2012-13	DAL	10	41	41
24	2012-13	POR	11	33	49
29	2012-13	WAS	11	29	53
8	2012-13	DET	11	29	53
17	2012-13	MIN	12	31	51
5	2012-13	CLE	13	24	58
26	2012-13	SAC	13	28	54
18	2012-13	NO	14	27	55
3	2012-13	CHA	14	21	61
23	2012-13	PHO	15	25	57
21	2012-13	ORL	15	20	62

	SEASON	TEAM	RANK	WIN	LOST
24	2013-14	SA	1	62	20
10	2013-14	IND	1	56	26
14	2013-14	MIA	2	54	28
19	2013-14	OKC	2	59	23
26	2013-14	TOR	3	48	34
3	2013-14	CHI	3	48	34
11	2013-14	LAC	3	57	25
23	2013-14	POR	4	54	28
9	2013-14	HOU	4	54	28
0	2013-14	BKN	5	44	38
28	2013-14	WAS	5	44	38
8	2013-14	GS	6	51	31
2	2013-14	CHA	7	43	39
13	2013-14	MEM	7	50	32
5	2013-14	DAL	8	49	33
18	2013-14	NY	9	37	45
22	2013-14	PHO	9	48	34
16	2013-14	MIN	10	40	42
4	2013-14	CLE	10	33	49
6	2013-14	DEN	11	36	46
7	2013-14	DET	11	29	53
17	2013-14	NO	12	34	48
1	2013-14	BOS	12	25	57
20	2013-14	ORL	13	23	59
25	2013-14	SAC	13	28	54
12	2013-14	LAL	14	27	55
21	2013-14	PHI	14	19	63
15	2013-14	MIL	15	15	67
27	2013-14	UTA	15	25	57

In [10]:

```
# display data table 2014 - 15, 2015 - 16
display_side_by_side(rank33, rank44)
```

	SEASON	TEAM	RANK	WIN	LOST
0	2014-15	ATL	1	60	22
9	2014-15	GS	1	67	15
12	2014-15	LAC	2	56	26
5	2014-15	CLE	2	53	29
10	2014-15	HOU	2	56	26
4	2014-15	CHI	3	50	32
27	2014-15	TOR	4	49	33
25	2014-15	SA	4	55	27
14	2014-15	MEM	4	55	27
29	2014-15	WAS	5	46	36
16	2014-15	MIL	6	41	41
24	2014-15	POR	6	51	31
6	2014-15	DAL	7	50	32
2	2014-15	BOS	7	40	42
11	2014-15	IND	8	38	44
1	2014-15	BKN	8	38	44
18	2014-15	NO	8	45	37
20	2014-15	OKC	8	45	37
15	2014-15	MIA	10	37	45
23	2014-15	PHO	10	39	43
3	2014-15	CHA	11	33	49
28	2014-15	UTA	11	38	44
7	2014-15	DEN	12	30	52
8	2014-15	DET	12	32	50
21	2014-15	ORL	13	25	57
26	2014-15	SAC	13	29	53
13	2014-15	LAL	14	21	61
22	2014-15	PHI	14	18	64
17	2014-15	MIN	15	16	66
19	2014-15	NY	15	17	65

	SEASON	TEAM	RANK	WIN	LOST
5	2015-16	CLE	1	57	25
9	2015-16	GS	1	73	9
27	2015-16	TOR	2	56	26
25	2015-16	SA	2	67	15
0	2015-16	ATL	3	48	34
2	2015-16	BOS	3	48	34
3	2015-16	CHA	3	48	34
20	2015-16	OKC	3	55	27
15	2015-16	MIA	3	48	34
12	2015-16	LAC	4	53	29
24	2015-16	POR	5	44	38
14	2015-16	MEM	6	42	40
6	2015-16	DAL	6	42	40
11	2015-16	IND	7	45	37
10	2015-16	HOU	8	41	41
8	2015-16	DET	8	44	38
28	2015-16	UTA	9	40	42
4	2015-16	CHI	9	42	40
26	2015-16	SAC	10	33	49
7	2015-16	DEN	10	33	49
29	2015-16	WAS	10	41	41
21	2015-16	ORL	11	35	47
18	2015-16	NO	12	30	52
16	2015-16	MIL	12	33	49
17	2015-16	MIN	13	29	53
19	2015-16	NY	13	32	50
23	2015-16	PHO	14	23	59
1	2015-16	BKN	14	21	61
22	2015-16	PHI	15	10	72
13	2015-16	LAL	15	17	65

In [11]:

```
# display data table 2016 - 17, 2017 - 18
display_side_by_side(rank55, rank66)
```

	SEASON	TEAM	RANK	WIN	LOST
2	2016-2017	BOS	1	53	29
9	2016-2017	GS	1	67	15
27	2016-2017	TOR	2	51	31
25	2016-2017	SA	2	61	21
5	2016-2017	CLE	2	51	31
10	2016-2017	HOU	3	55	27
29	2016-2017	WAS	4	49	33
28	2016-2017	UTA	4	51	31
12	2016-2017	LAC	4	51	31
0	2016-2017	ATL	5	43	39
11	2016-2017	IND	6	42	40
20	2016-2017	OKC	6	47	35
16	2016-2017	MIL	6	42	40
14	2016-2017	MEM	7	43	39
24	2016-2017	POR	8	41	41
4	2016-2017	CHI	8	41	41
15	2016-2017	MIA	8	41	41
7	2016-2017	DEN	9	40	42
18	2016-2017	NO	10	34	48
8	2016-2017	DET	10	37	45
6	2016-2017	DAL	11	33	49
3	2016-2017	CHA	11	36	46
26	2016-2017	SAC	12	32	50
19	2016-2017	NY	12	31	51
21	2016-2017	ORL	13	29	53
17	2016-2017	MIN	13	31	51
13	2016-2017	LAL	14	26	56
22	2016-2017	PHI	14	28	54
23	2016-2017	PHO	15	24	58
1	2016-2017	BKN	15	20	62

	SEASON	TEAM	RANK	WIN	LOST
27	2017-18	TOR	1	59	23
10	2017-18	HOU	1	65	17
2	2017-18	BOS	2	55	27
9	2017-18	GS	2	58	24
22	2017-18	PHI	3	52	30
24	2017-18	POR	3	49	33
20	2017-18	OKC	4	48	34
5	2017-18	CLE	4	50	32
18	2017-18	NO	4	48	34
28	2017-18	UTA	4	48	34
11	2017-18	IND	5	48	34
16	2017-18	MIL	6	44	38
15	2017-18	MIA	6	44	38
25	2017-18	SA	7	47	35
17	2017-18	MIN	7	47	35
29	2017-18	WAS	8	43	39
8	2017-18	DET	9	39	43
7	2017-18	DEN	9	46	36
3	2017-18	CHA	10	36	46
12	2017-18	LAC	10	42	40
19	2017-18	NY	11	29	53
13	2017-18	LAL	11	35	47
1	2017-18	BKN	12	28	54
26	2017-18	SAC	12	27	55
6	2017-18	DAL	13	24	58
4	2017-18	CHI	13	27	55
14	2017-18	MEM	14	22	60
21	2017-18	ORL	14	25	57
23	2017-18	PHO	15	21	61
0	2017-18	ATL	15	24	58

Calculating each season's league average free throws per game:

In [12]:

```
#League average free throw attempts

leagueAVG1213 = season1213['teamFTA'].sum() / len(season1213)

leagueAVG1314 = season1314['teamFTA'].sum() / len(season1314)

leagueAVG1415 = season1415['teamFTA'].sum() / len(season1415)

leagueAVG1516 = season1516['teamFTA'].sum() / len(season1516)

leagueAVG1617 = season1617['teamFTA'].sum() / len(season1617)

leagueAVG1718 = season1718['teamFTA'].sum() / len(season1718)
```

Calculating Average Free Throw Attempts for teams that made the playoffs (For simplication, we will only look at the Season 2012-2013 and 2017-2018):

In [13]:

```
#Season 12-13 teams making playoffs

# Eastern Conference

# Seed 1
MIA1213 = season1213[season1213['teamAbbr'] == 'MIA']
MIAFTA1213 = MIA1213['teamFTA'].sum() / len(MIA1213)
MIA1213DIFF = MIAFTA1213 - leagueAVG1213;

# Seed 2
NY1213 = season1213[season1213['teamAbbr'] == 'NY']
NYFTA1213 = NY1213['teamFTA'].sum() / len(NY1213)
NY1213DIFF = NYFTA1213 - leagueAVG1213;



# Seed 3
IND1213 = season1213[season1213['teamAbbr'] == 'IND']
INDFTA1213 = IND1213['teamFTA'].sum() / len(IND1213)
IND1213DIFF = INDFTA1213 - leagueAVG1213;

# Seed 4
BKN1213 = season1213[season1213['teamAbbr'] == 'BKN']
BKNFTA1213 = BKN1213['teamFTA'].sum() / len(BKN1213)
BKN1213DIFF = BKNFTA1213 - leagueAVG1213;

# Seed 5
CHI1213 = season1213[season1213['teamAbbr'] == 'CHI']
CHIFTA1213 = CHI1213['teamFTA'].sum() / len(CHI1213)
CHI1213DIFF = CHIFTA1213 - leagueAVG1213;

# Seed 6
ATL1213 = season1213[season1213['teamAbbr'] == 'ATL']
ATLFTA1213 = ATL1213['teamFTA'].sum() / len(ATL1213)
ATL1213DIFF = ATLFTA1213 - leagueAVG1213;

# Seed 7
BOS1213 = season1213[season1213['teamAbbr'] == 'BOS']
BOSFTA1213 = BOS1213['teamFTA'].sum() / len(BOS1213)
BOS1213DIFF = BOSFTA1213 - leagueAVG1213;

# Seed 8
MIL1213 = season1213[season1213['teamAbbr'] == 'MIL']
MILFTA1213 = MIL1213['teamFTA'].sum() / len(MIL1213)
MIL1213DIFF = MILFTA1213 - leagueAVG1213;

East1213Top8 = [MIAFTA1213, NYFTA1213, INDFTA1213, BKNFTA1213, CHIFTA1213, ATLFT
A1213, BOSFTA1213, MILFTA1213]
East1213Top8DIFF = [MIA1213DIFF, NY1213DIFF, IND1213DIFF, BKN1213DIFF, CHI1213DI
FF, ATL1213DIFF, BOS1213DIFF, MIL1213DIFF]


# Western Conference

# Seed 1
OKC1213 = season1213[season1213['teamAbbr'] == 'OKC']
OKCFTA1213 = OKC1213['teamFTA'].sum() / len(OKC1213)
OKC1213DIFF = OKCFTA1213 - leagueAVG1213;
```

```
# Seed 2
SA1213 = season1213[season1213['teamAbbr'] == 'SA']
SAFTA1213 = SA1213['teamFTA'].sum() / len(SA1213)
SA1213DIFF = SAFTA1213 - leagueAVG1213;

# Seed 3
DEN1213 = season1213[season1213['teamAbbr'] == 'DEN']
DENFTA1213 = DEN1213['teamFTA'].sum() / len(DEN1213)
DEN1213DIFF = DENFTA1213 - leagueAVG1213;

# Seed 4
LAC1213 = season1213[season1213['teamAbbr'] == 'LAC']
LACFTA1213 = LAC1213['teamFTA'].sum() / len(LAC1213)
LAC1213DIFF = LACFTA1213 - leagueAVG1213;

# Seed 5
MEM1213 = season1213[season1213['teamAbbr'] == 'MEM']
MEMFTA1213 = MEM1213['teamFTA'].sum() / len(MEM1213)
MEM1213DIFF = MEMFTA1213 - leagueAVG1213;

# Seed 6
GS1213 = season1213[season1213['teamAbbr'] == 'GS']
GSFTA1213 = GS1213['teamFTA'].sum() / len(GS1213)
GS1213DIFF = GSFTA1213 - leagueAVG1213;

# Seed 7
LAL1213 = season1213[season1213['teamAbbr'] == 'LAL']
LALFTA1213 = LAL1213['teamFTA'].sum() / len(LAL1213)
LAL1213DIFF = LALFTA1213 - leagueAVG1213;

# Seed 8
HOU1213 = season1213[season1213['teamAbbr'] == 'HOU']
HOUFTA1213 = HOU1213['teamFTA'].sum() / len(HOU1213)
HOU1213DIFF = HOUFTA1213 - leagueAVG1213;

West1213Top8 = [OKCFTA1213, SAFTA1213, DENFTA1213, LACFTA1213, MEMFTA1213, GSFTA
1213, LALFTA1213, HOUFTA1213]
West1213Top8DIFF = [OKC1213DIFF, SA1213DIFF, DEN1213DIFF, LAC1213DIFF, MEM1213DI
FF, GS1213DIFF, LAL1213DIFF, HOU1213DIFF]

leagueAVG1213Index = [leagueAVG1213, leagueAVG1213, leagueAVG1213, leagueAVG1213
, leagueAVG1213, leagueAVG1213, leagueAVG1213, leagueAVG1213]
```

In [14]:

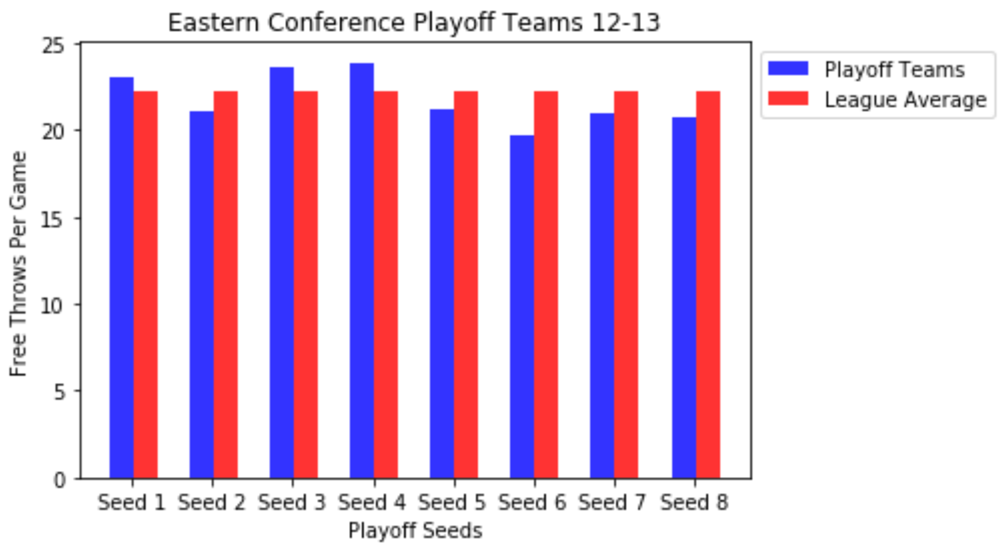
```
#Season 17-18 teams making playoffs

# Eastern Conference

# Seed 1
TOR1718 = season1718[season1718['teamAbbr'] == 'TOR']
TORFTA1718 = TOR1718['teamFTA'].sum() / len(TOR1718)
TOR1718DIFF = TORFTA1718 - leagueAVG1718;

# Seed 2
BOS1718 = season1718[season1718['teamAbbr'] == 'BOS']
BOSFTA1718 = BOS1718['teamFTA'].sum() / len(BOS1718)
BOS1718DIFF = BOSFTA1718 - leagueAVG1718;


# Seed 3
PHI1718 = season1718[season1718['teamAbbr'] == 'PHI']
PHIFTA1718 = PHI1718['teamFTA'].sum() / len(PHI1718)
PHI1718DIFF = PHIFTA1718 - leagueAVG1718;

# Seed 4
CLE1718 = season1718[season1718['teamAbbr'] == 'CLE']
CLEFTA1718 = CLE1718['teamFTA'].sum() / len(CLE1718)
CLE1718DIFF = CLEFTA1718 - leagueAVG1718;

# Seed 5
IND1718 = season1718[season1718['teamAbbr'] == 'IND']
INDFTA1718 = IND1213['teamFTA'].sum() / len(IND1718)
IND1718DIFF = INDFTA1718 - leagueAVG1718;

# Seed 6
MIA1718 = season1718[season1718['teamAbbr'] == 'MIA']
MIAFTA1718 = MIA1213['teamFTA'].sum() / len(MIA1718)
MIA1718DIFF = MIAFTA1718 - leagueAVG1718;

# Seed 7
MIL1718 = season1718[season1718['teamAbbr'] == 'MIL']
MILFTA1718 = MIL1213['teamFTA'].sum() / len(MIL1718)
MIL1718DIFF = MILFTA1718 - leagueAVG1718;

# Seed 8
WAS1718 = season1718[season1718['teamAbbr'] == 'WAS']
WASFTA1718 = WAS1718['teamFTA'].sum() / len(WAS1718)
WAS1718DIFF = WASFTA1718 - leagueAVG1718;

East1718Top8 = [TORFTA1718, BOSFTA1718, PHIFTA1718, CLEFTA1718, INDFTA1718, MIAF
TA1718, MILFTA1718, WASFTA1718]
East1718Top8DIFF = [TOR1718DIFF, BOS1718DIFF, PHI1718DIFF, CLE1718DIFF, IND1718D
IFF, MIA1718DIFF, MIL1718DIFF, WAS1718DIFF]

# Western Conference

# Seed 1
HOU1718 = season1718[season1718['teamAbbr'] == 'HOU']
HOUFTA1718 = HOU1718['teamFTA'].sum() / len(HOU1718)
HOU1718DIFF = HOUFTA1718 - leagueAVG1718;

# Seed 2
GS1718 = season1718[season1718['teamAbbr'] == 'GS']
```

```
GSFTA1718 = GS1718['teamFTA'].sum() / len(GS1718)
GS1718DIFF = GSFTA1718 - leagueAVG1718;

# Seed 3
POR1718 = season1718[season1718['teamAbbr'] == 'POR']
PORFTA1718 = POR1718['teamFTA'].sum() / len(POR1718)
POR1718DIFF = PORFTA1718 - leagueAVG1718;

# Seed 4
OKC1718 = season1718[season1718['teamAbbr'] == 'OKC']
OKCFTA1718 = OKC1718['teamFTA'].sum() / len(OKC1718)
OKC1718DIFF = OKCFTA1718 - leagueAVG1718;

# Seed 5
UTA1718 = season1718[season1718['teamAbbr'] == 'UTA']
UTAFTA1718 = UTA1718['teamFTA'].sum() / len(UTA1718)
UTA1718DIFF = UTAFTA1718 - leagueAVG1718;

# Seed 6
NO1718 = season1718[season1718['teamAbbr'] == 'NO']
NOFTA1718 = NO1718['teamFTA'].sum() / len(NO1718)
NO1718DIFF = NOFTA1718 - leagueAVG1718;

# Seed 7
SA1718 = season1718[season1718['teamAbbr'] == 'SA']
SAFTA1718 = SA1718['teamFTA'].sum() / len(SA1718)
SA1718DIFF = SAFTA1718 - leagueAVG1718;

# Seed 8
MIN1718 = season1718[season1718['teamAbbr'] == 'MIN']
MINFTA1718 = MIN1718['teamFTA'].sum() / len(MIN1718)
MIN1718DIFF = MINFTA1718 - leagueAVG1718;

West1718Top8 = [HOUFTA1718, GSFTA1718, PORFTA1718, OKCFTA1718, UTAFTA1718, NOFTA
1718, SAFTA1718, MINFTA1718]
West1718Top8DIFF = [HOU1718DIFF, GS1718DIFF, POR1718DIFF, OKC1718DIFF, UTA1718DI
FF, NO1718DIFF, SA1718DIFF, MIN1718DIFF]

leagueAVG1718Index = [leagueAVG1718, leagueAVG1718, leagueAVG1718, leagueAVG1718
, leagueAVG1718, leagueAVG1718, leagueAVG1718, leagueAVG1718]
```

Checking for correlation in free throws per game between teams making the playoffs and the league average of 2012-2013 and 2017-2018 season (Comparing averages and the differences):

In [15]:

```
playOffSeed = ['Seed 1', 'Seed 2', 'Seed 3', 'Seed 4', 'Seed 5', 'Seed 6', 'Seed
7', 'Seed 8']

# create plt
fig, ax = plt.subplots()
index = np.arange(8)
bar_width = 0.3
opacity = 0.8

rects1 = plt.bar(index, East1213Top8 , bar_width,
alpha=opacity,
color='b',
label='Playoff Teams')

rects2 = plt.bar(index + bar_width, leagueAVG1213Index, bar_width,
alpha=opacity,
color='r',
label='League Average')

plt.xlabel('Playoff Seeds')
plt.ylabel('Free Throws Per Game')
plt.title('Eastern Conference Playoff Teams 12-13')
plt.xticks(index + bar_width-.17, playOffSeed)
plt.legend()
plt.figure(figsize=(15,15))
ax.legend(loc='best', bbox_to_anchor=(1,1))
plt.tight_layout()

plt.show()
```

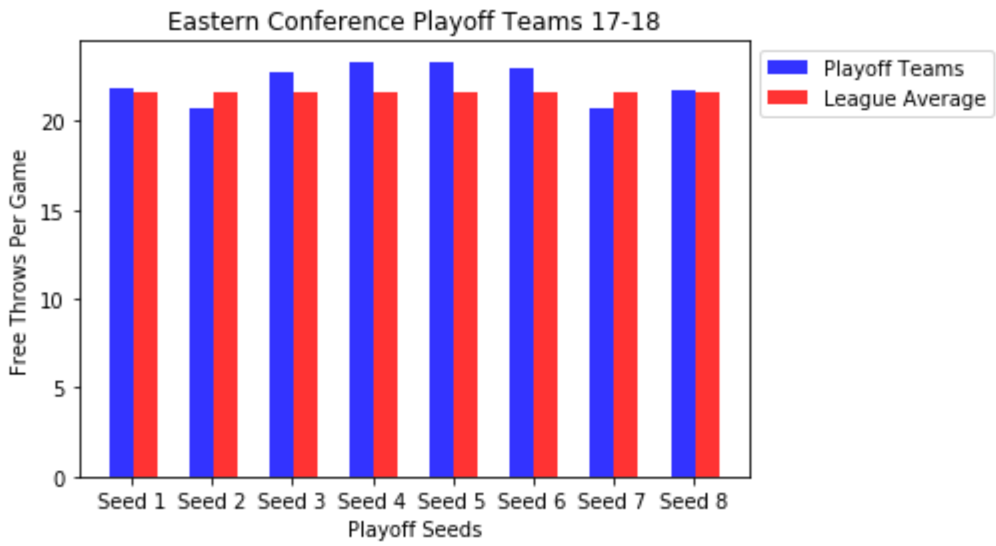



```
<Figure size 1080x1080 with 0 Axes>
```

Plot 3 above:

In [16]:

```
playOffSeed = ['Seed 1', 'Seed 2', 'Seed 3', 'Seed 4', 'Seed 5', 'Seed 6', 'Seed 7', 'Seed 8']

# create plt
fig, ax = plt.subplots()
index = np.arange(8)
bar_width = 0.3
opacity = 0.8

rects1 = plt.bar(index, East1718Top8 , bar_width,
alpha=opacity,
color='b',
label='Playoff Teams')

rects2 = plt.bar(index + bar_width, leagueAVG1718Index, bar_width,
alpha=opacity,
color='r',
label='League Average')

plt.xlabel('Playoff Seeds')
plt.ylabel('Free Throws Per Game')
plt.title('Eastern Conference Playoff Teams 17-18')
plt.xticks(index + bar_width-.17, playOffSeed)
plt.legend()
plt.figure(figsize=(15,15))
ax.legend(loc='best', bbox_to_anchor=(1,1))
plt.tight_layout()

plt.show()
```

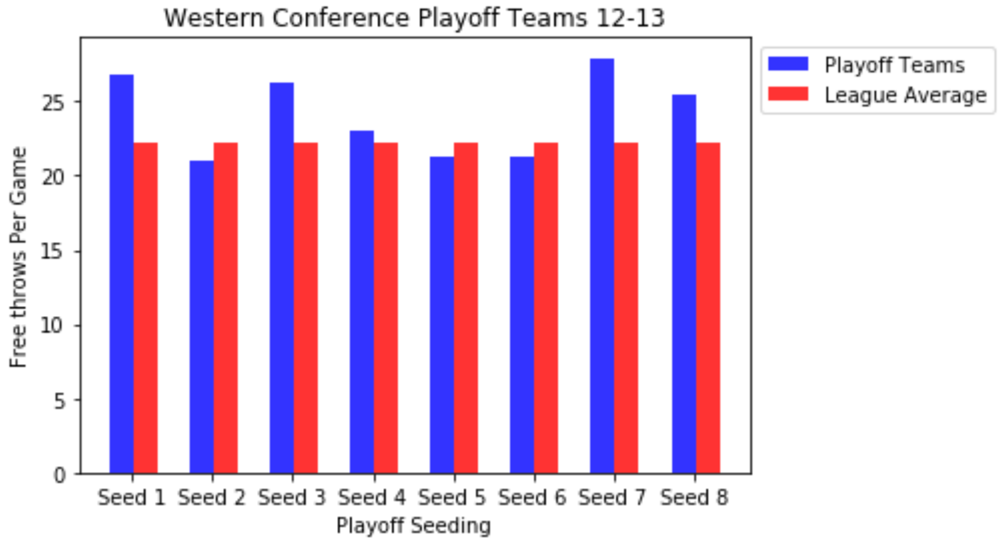



```
<Figure size 1080x1080 with 0 Axes>
```

Plot 3 & 4: These two bar graphs show the average of free throws made by each team that made it to Eastern Conference playoffs compared to the regular season average of free throws made in 2012-2013 in plot 3 and 2017-2018 in plot 4. From the plot we can see that not all the teams that made it to playoffs had above average free throws made even though these teams are the 8 teams with the highest rate of wins in that season.

In [17]:

```
fig, ax = plt.subplots()
index = np.arange(8)
bar_width = 0.3
opacity = 0.8

rects1 = plt.bar(index, West1213Top8 , bar_width,
alpha=opacity,
color='b',
label='Playoff Teams')

rects2 = plt.bar(index + bar_width, leagueAVG1213Index, bar_width,
alpha=opacity,
color='r',
label='League Average')

plt.xlabel('Playoff Seeding')
plt.ylabel('Free throws Per Game')
plt.title('Western Conference Playoff Teams 12-13')
plt.xticks(index + bar_width-.17, playOffSeed)
plt.legend()
plt.figure(figsize=(15,15))
ax.legend(loc='best', bbox_to_anchor=(1,1))
plt.tight_layout()

plt.show()
```

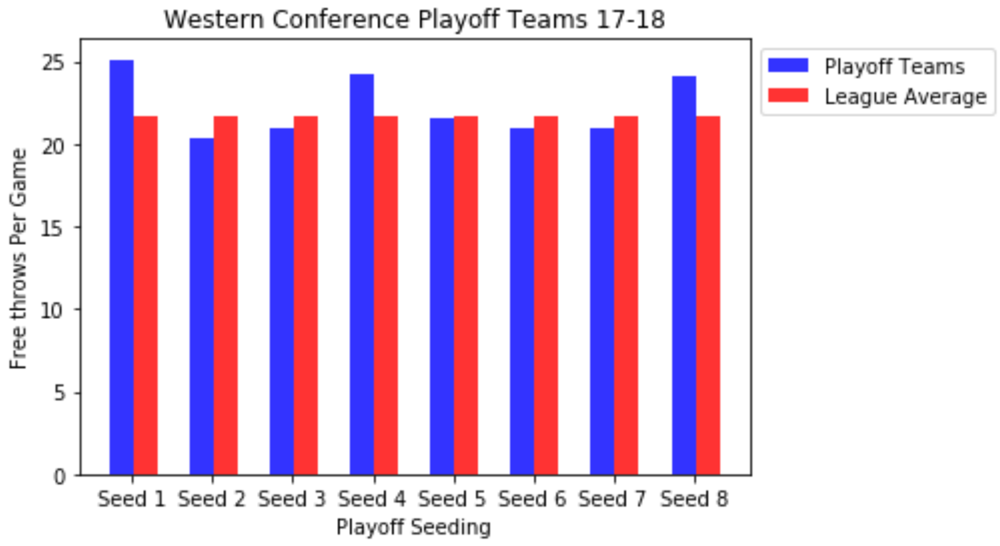



```
<Figure size 1080x1080 with 0 Axes>
```

Plot 5 above:

In [18]:

```
fig, ax = plt.subplots()
index = np.arange(8)
bar_width = 0.3
opacity = 0.8

rects1 = plt.bar(index, West1718Top8 , bar_width,
alpha=opacity,
color='b',
label='Playoff Teams')

rects2 = plt.bar(index + bar_width, leagueAVG1718Index, bar_width,
alpha=opacity,
color='r',
label='League Average')

plt.xlabel('Playoff Seeding')
plt.ylabel('Free throws Per Game')
plt.title('Western Conference Playoff Teams 17-18')
plt.xticks(index + bar_width-.17, playOffSeed)
plt.legend()
plt.figure(figsize=(15,15))
ax.legend(loc='best', bbox_to_anchor=(1,1))
plt.tight_layout()

plt.show()
```

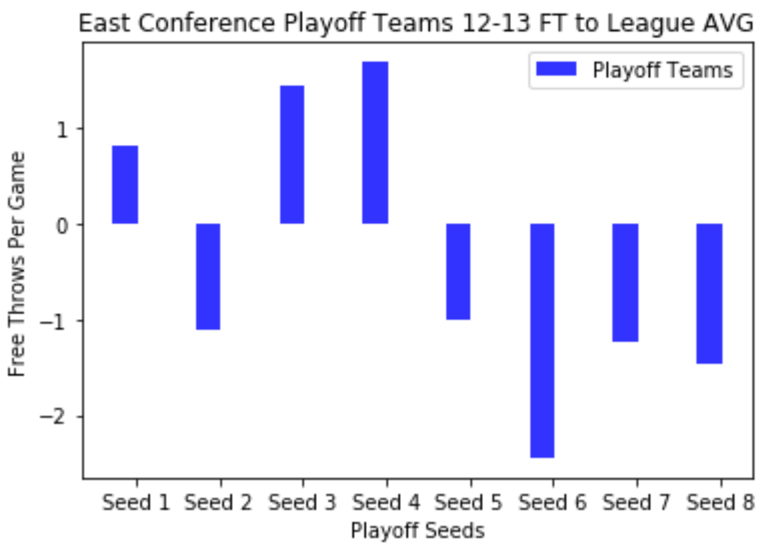



```
<Figure size 1080x1080 with 0 Axes>
```

Plot 5 & 6: These two bar graphs show the average of free throws made by each team that made it to Western Conference playoffs compared to the regular season average of free throws made in 2012-2013 in plot 3 and 2017-2018 in plot 4. From the plot we can see that not all the teams that made it to playoffs had above average free throws made even though these teams are the 8 teams with the highest rate of wins in that season.

In [19]:

```
playOffSeed = ['Seed 1', 'Seed 2', 'Seed 3', 'Seed 4', 'Seed 5', 'Seed 6', 'Seed
7', 'Seed 8']

# create plt
fig, ax = plt.subplots()
index = np.arange(8)
bar_width = 0.3
opacity = 0.8

rects1 = plt.bar(index, East1213Top8DIFF , bar_width,
alpha=opacity,
color='b',
label='Playoff Teams')

#rects2 = plt.bar(index + bar_width, leagueAVGIndex, bar_width,
# alpha=opacity,
# color='r',
# label='League Average')

plt.xlabel('Playoff Seeds')
plt.ylabel('Free Throws Per Game')
plt.title('East Conference Playoff Teams 12-13 FT to League AVG')
plt.xticks(index + bar_width-.17, playOffSeed)
plt.legend()
plt.figure(figsize=(15,15))
ax.legend(loc='best', bbox_to_anchor=(1,1))
plt.tight_layout()

plt.show()
```

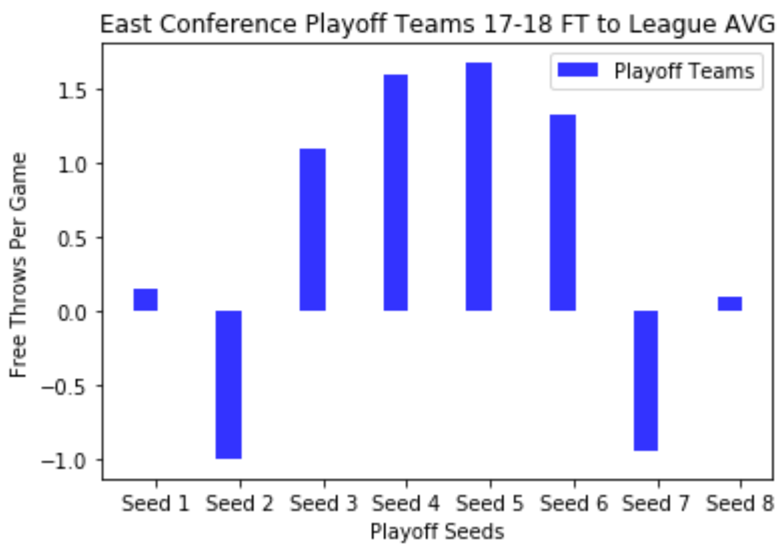



```
<Figure size 1080x1080 with 0 Axes>
```

Plot 7 above:

In [20]:

```
playOffSeed = ['Seed 1', 'Seed 2', 'Seed 3', 'Seed 4', 'Seed 5', 'Seed 6', 'Seed 7', 'Seed 8']

# create plt
fig, ax = plt.subplots()
index = np.arange(8)
bar_width = 0.3
opacity = 0.8

rects1 = plt.bar(index, East1718Top8DIFF , bar_width,
alpha=opacity,
color='b',
label='Playoff Teams')

#rects2 = plt.bar(index + bar_width, leagueAVGIndex, bar_width,
# alpha=opacity,
# color='r',
# label='League Average')

plt.xlabel('Playoff Seeds')
plt.ylabel('Free Throws Per Game')
plt.title('East Conference Playoff Teams 17-18 FT to League AVG')
plt.xticks(index + bar_width-.17, playOffSeed)
plt.legend()
plt.figure(figsize=(15,15))
ax.legend(loc='best', bbox_to_anchor=(1,1))
plt.tight_layout()

plt.show()
```

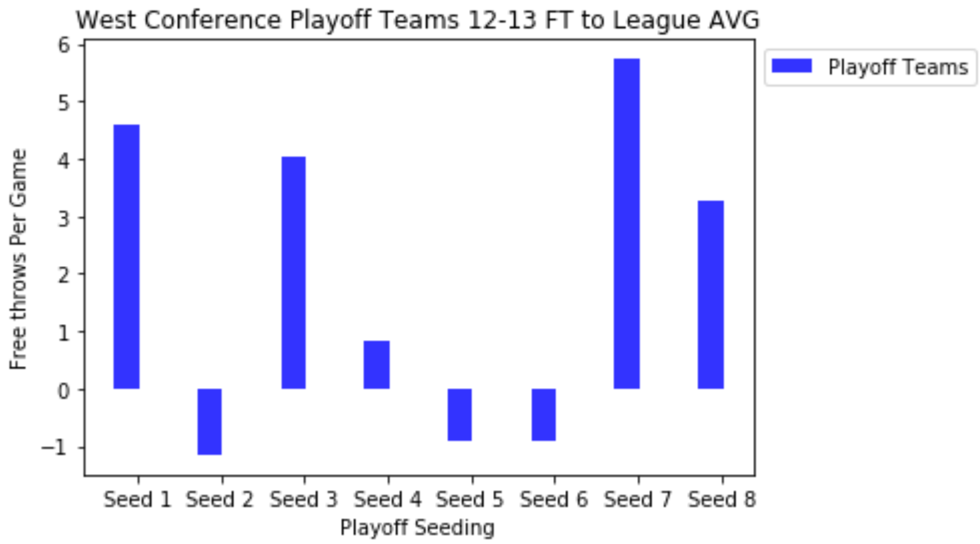



```
<Figure size 1080x1080 with 0 Axes>
```

Plot 7 & 8: These two bar graphs represent the same concept as plot 3 & 4. However, in order to be able to better visualize the results, the average of free throws made by each playoff team was subtracted by the league average hence explaining the negative values. The negative values indicates the Eastern Conference teams that made it to playoffs but were below average when it comes to free throws attempted.

In [21]:

```
fig, ax = plt.subplots()
index = np.arange(8)
bar_width = 0.3
opacity = 0.8

rects1 = plt.bar(index, West1213Top8DIFF , bar_width,
alpha=opacity,
color='b',
label='Playoff Teams')

# rects2 = plt.bar(index + bar_width, leagueAVGIndex, bar_width,
# alpha=opacity,
# color='r',
# label='League Average')

plt.xlabel('Playoff Seeding')
plt.ylabel('Free throws Per Game')
plt.title('West Conference Playoff Teams 12-13 FT to League AVG')
plt.xticks(index + bar_width-.17, playOffSeed)
plt.legend()
plt.figure(figsize=(15,15))
ax.legend(loc='best', bbox_to_anchor=(1,1))
plt.tight_layout()

plt.show()
```

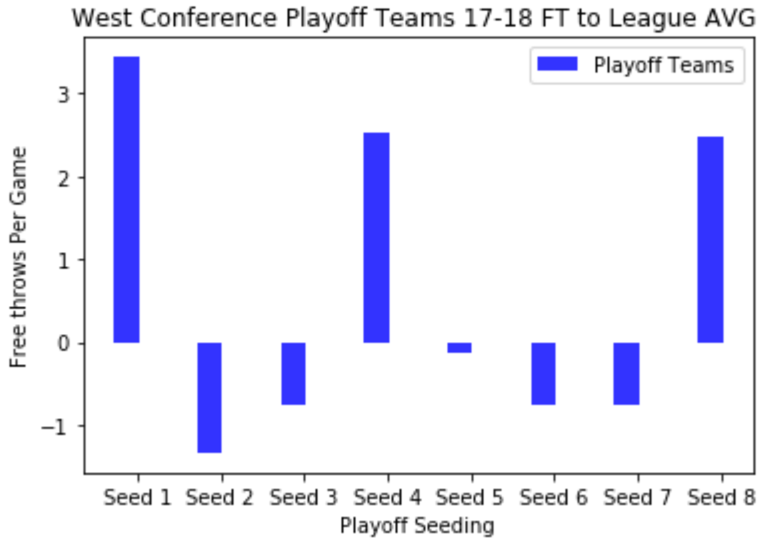


<Figure size 1080x1080 with 0 Axes>

Plot 9 above:

In [22]:

```
fig, ax = plt.subplots()
index = np.arange(8)
bar_width = 0.3
opacity = 0.8

rects1 = plt.bar(index, West1718Top8DIFF , bar_width,
alpha=opacity,
color='b',
label='Playoff Teams')

# rects2 = plt.bar(index + bar_width, leagueAVGIndex, bar_width,
# alpha=opacity,
# color='r',
# label='League Average')

plt.xlabel('Playoff Seeding')
plt.ylabel('Free throws Per Game')
plt.title('West Conference Playoff Teams 17-18 FT to League AVG ')
plt.xticks(index + bar_width-.17, playOffSeed)
plt.legend()
plt.figure(figsize=(15,15))
ax.legend(loc='best', bbox_to_anchor=(1,1))
plt.tight_layout()

plt.show()
```




```
<Figure size 1080x1080 with 0 Axes>
```

Plot 9 & 10: These two bar graphs represent the same concept as plot 5 & 6. However, in order to be able to better visualize the results, the average of free throws made by each playoff team was subtracted by the league average hence explaining the negative values. The negative values indicates the Western Conference teams that made it to playoffs but were below average when it comes to free throws attempted.

In [23]:

```
# 2012-2013 T-Test Data

East1213Stats = scipy.stats.ttest_1samp(East1213Top8, leagueAVG1213)
West1213Stats = scipy.stats.ttest_1samp(West1213Top8, leagueAVG1213)

dataEast1213 = [[East1213Stats[0], East1213Stats[1]/2]]
East1213_statTable = pd.DataFrame(dataEast1213, columns=['Test Statistic', 'p-va
lue'])

dataWest1213 = [[West1213Stats[0], West1213Stats[1]/2]]
West1213_statTable = pd.DataFrame(dataWest1213, columns=['Test Statistic', 'p-va
lue'])
```

In [24]:

```
# 2017-2018 T-Test Data

East1718Stats = scipy.stats.ttest_1samp(East1718Top8, leagueAVG1718)
West1718Stats = scipy.stats.ttest_1samp(West1718Top8, leagueAVG1718)

dataEast1718 = [[East1718Stats[0], East1718Stats[1]/2]]
East1718_statTable = pd.DataFrame(dataEast1718, columns=['Test Statistic', 'p-va
lue'])

dataWest1718 = [[West1718Stats[0], West1718Stats[1]/2]]
West1718_statTable = pd.DataFrame(dataWest1718, columns=['Test Statistic', 'p-va
lue'])
```

East Playoff Teams 12-13 T-Test Results:

In [25]:

```
East1213_statTable
```

Out[25]:

	Test Statistic	p-value
0	-0.759076	0.236294

East Playoff Teams 17-18 T-Test Results:

In [26]:

```
East1718_statTable
```

Out[26]:

	Test Statistic	p-value
0	1.314815	0.115004

West Playoff Teams 12-13 T-Test Results:

In [27]:

```
West1213_statTable
```

Out[27]:

	Test Statistic	p-value
0	1.961229	0.045328

West Playoff Teams 17-18 T-Test Results:

In [28]:

```
West1718_statTable
```

Out[28]:

	Test Statistic	p-value
0	0.876004	0.205039

T-test Explanation: We decided to go more in depth about whether there was a correlation between the league average free throw attempts and the average free throw attempts for making the playoffs(top 8) in the Eastern and Western Conferences for the first season of our data set(2012-2013) and the last season of our data set(2017-2018). We carried this out by running a one-sample T-Test on the league average free throw attempts per game and either the top 8 teams of the Western Conference or Eastern Conference in a respective season. After getting the p-value from doing the T-Test, we compare it to our alpha value of 0.05. We discovered that for the top 8 Eastern conference teams from the 2012-2013 and 2017-2018 season and the Western Conference playoff teams from the 2017-2018 season, there was no correlation between free throw attempts and making the playoffs as the p-values were all way above .05 (i.e .236, .115, .205). However, the test for the top 8 Western Conference teams of the 2012-2013 season was below .05 (0.04) but we see this as a coincidence.

Ethics and Privacy

In this project we were not violating any ethical codes because we are only analyzing basketball data that has been made public by the NBA. The dataset that was chosen is official box score statistics which is simply every piece of statistical data from an NBA game with no bias as it just records all pieces of data from the game. One unintended consequence that our findings could have is that the NBA teams could use this analysis in order to strategize when it comes to committing fouls and giving away free throws since we have proven that more free throw attempts does not correlate with more wins. “Intentionally fouling” strategy already exists where teams that are behind intentionally commit fouls by the end of the game as soon as the other team gains possession in the hopes that the opposition would miss their free throws and therefore we believe that taking steps to guard our findings is redundant.

Conclusion & Discussion

Our results indicate that there is a higher chance of winning a single game with more number of free throws attempted but there is no correlation between having more free throws leading into a higher win percentage during the regular season. It was shown that our hypothesis was partly inaccurate since we expected that playoff teams who have the most wins during the regular season to have more average free throws attempted compared to the league average since more free throws in a game results in a higher chance of winning that game but it was proven otherwise. In the seasons that we analyzed there were quite a few seeds that were below the league average of free throws in both conferences. Some limitations of our analysis was that we only went truly in depth on the first and last seasons of our data set to see the correlation between winning enough games to make the playoffs and the amount of free throw attempts per game.