English Premier League (EPL) Pythagorean Predictor

In [1]:
```
# Importing Packages

import pandas as pd
import numpy as np
import statsmodels.formula.api as smf
import matplotlib.pyplot as plt
import seaborn as sns

# Custom
import warnings
warnings.filterwarnings('ignore')
%config InlineBackend.figure_formats = {'svg'} # makes everything svg by default
%matplotlib inline
```

In [2]:
```
# Read Data

dataset = pd.read_excel('../dm/EPL2017-18.xlsx')
print(dataset.columns.tolist())

display( dataset.head() )
```

```
['Date', 'HomeTeam', 'AwayTeam', 'FTHG', 'FTAG', 'FTR']
```

	Date	HomeTeam	AwayTeam	FTHG	FTAG	FTR
0	20170811	Arsenal	Leicester	4	3	H
1	20170812	Brighton	Man City	0	2	A
2	20170812	Chelsea	Burnley	2	3	A
3	20170812	Crystal Palace	Huddersfield	0	3	A
4	20170812	Everton	Stoke	1	0	H

In [3]:
```
# Cleanup
dataset['count'] = 1

dataset['hwinvalue'] = np.where( dataset['FTR']=='H',1, np.where(dataset['FTR']=='D',.5,0) )
dataset['awinvalue'] = np.where( dataset['FTR']=='A',1, np.where(dataset['FTR']=='D',.5,0) )

home1 = dataset[dataset.Date < 20180000].groupby(['HomeTeam'])['count','hwinvalue', 'FTHG','FTAG']\
    .sum().reset_index()
home1 = home1.rename(columns={'HomeTeam':'Team','count':'MPh','FTHG':'GFh', 'FTAG':'GAh'})

away1 = dataset[dataset.Date < 20180000].groupby(['AwayTeam'])['count','awinvalue', 'FTHG','FTAG']\
    .sum().reset_index()
away1 = away1.rename(columns={'AwayTeam':'Team','count':'MPa','FTHG':'GAa','FTAG':'GFa'})
# because my goals in away ground will be home goals against for the other team


home2 = dataset[dataset.Date > 20180000].groupby(['HomeTeam'])['count','hwinvalue', 'FTHG','FTAG']\
    .sum().reset_index()
home2 = home2.rename(columns={'HomeTeam':'Team','count':'MPh','FTHG':'GFh', 'FTAG':'GAh'})

away2 = dataset[dataset.Date > 20180000].groupby(['AwayTeam'])['count','awinvalue', 'FTHG','FTAG']\
    .sum().reset_index()
away2 = away2.rename(columns={'AwayTeam':'Team','count':'MPa','FTHG':'GAa','FTAG':'GFa'})
# because my goals in away ground will be home goals against for the other team

half1 = pd.merge(home1, away1, on="Team")
half2 = pd.merge(home2, away2, on="Team")
```

In [4]:
```
# Evaluations
halves = [half1, half2]

for half in halves:
    half["MP"] = half["MPh"] + half["MPa"]
    half["wValue"] = half["hwinvalue"] + half["awinvalue"]
    half["GF"] = half["GFh"] + half["GFa"]
    half["GA"] = half["GAh"] + half["GAa"]


half1["pyth1"] = (half1["GF"]**2) / (half1["GF"]**2 + half1["GA"]**2)
half1["wpc1"] = half1["wValue"]/half1["MP"]


half2["pyth2"] = (half2["GF"]**2) / (half2["GF"]**2 + half2["GA"]**2)
half2["wpc2"] = half2["wValue"]/half2["MP"]
```

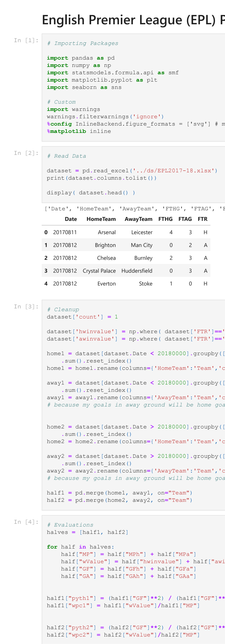
In [5]:
```
# Cleaned up Dataset
dropCols = ["MPh", "hwinvalue", "GFh", "GAh", "MPa", "awinvalue", "GFa", "GAa"]

for half in halves:
    display(
        half.drop(columns = dropCols).head()
    )
```

	Team	MP	wValue	GF	GA	pyth1	wpc1
0	Arsenal	21	13.5	38	26	0.681132	0.642857
1	Bournemouth	21	7.5	20	32	0.280899	0.357143
2	Brighton	21	8.5	15	25	0.264706	0.404762
3	Burnley	21	12.5	18	17	0.528548	0.595238
4	Chelsea	21	15.5	39	14	0.885847	0.738095

	Team	MP	wValue	GF	GA	pyth2	wpc2
0	Arsenal	17	8.5	36	25	0.674649	0.500000
1	Bournemouth	17	9.0	25	29	0.426330	0.529412
2	Brighton	17	7.0	19	29	0.300333	0.411765
3	Burnley	17	7.5	18	22	0.400990	0.441176
4	Chelsea	17	9.0	23	24	0.478733	0.529412

In [6]:
```
# using half 1 pyth as predictor for half 2 wpc
predictor = pd.merge(half1, half2, on = "Team")
```

In [7]:
```
# Plotting
sns.relplot(x="pyth1", y="wpc2", data = predictor)
plt.xlim(0, 1), plt.ylim(0, 1)
plt.show()
```



In [8]:
```
# Regression

regression = smf.ols(formula = 'wpc2 ~ pyth1', data=predictor).fit()
regression.summary()
```

Out[8]:

OLS Regression Results

Dep. Variable:	wpc2	**R-squared:**	0.633
Model:	OLS	**Adj. R-squared:**	0.613
Method:	Least Squares	**F-statistic:**	31.06
Date:	Wed, 26 Jan 2022	**Prob (F-statistic):**	2.73e-05
Time:	01:06:16	**Log-Likelihood:**	19.534
No. Observations:	20	**AIC:**	-35.07
Df Residuals:	18	**BIC:**	-33.08
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	0.2897	0.043	6.690	0.000	0.199	0.381
pyth1	0.4543	0.082	5.573	0.000	0.283	0.626

Omnibus:	4.877	**Durbin-Watson:**	2.048
Prob(Omnibus):	0.087	**Jarque-Bera (JB):**	1.521
Skew:	-0.033	**Prob(JB):**	0.467
Kurtosis:	1.650	**Cond. No.**	4.65

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

In [9]:
```
# correlation matrix

values = predictor[["Team', 'wpc1', 'wpc2', 'pyth1', 'pyth2']]
display( values.corr() )
```

	wpc1	wpc2	pyth1	pyth2
wpc1	1.000000	0.756573	0.968204	0.745832
wpc2	0.756573	1.000000	0.795693	0.955986
pyth1	0.968204	0.795693	1.000000	0.795331
pyth2	0.745832	0.955986	0.795331	1.000000

In [10]:
```
# Quiz Questions


print(
    "How many EPL games from this season were played in 2018?"
    + "\n" +
    str(dataset[dataset.Date > 20180000].shape[0])
)


print(
    "Which team scored the highest number of goals while playing at home in the first half of the season?"
    + "\n" +
    half1.sort_values("GFh", ascending=False).iloc[0][0]
)


print(
    "Which team conceded the highest number of goals while playing away in the first half of the season?"
    + "\n" +
    half1.sort_values("GAa", ascending=False).iloc[0][0]
)


half1['dev'] = abs(half1['wpc1'] - half1['pyth1'])
print(
    "Which of the following teams had the smallest difference between their win percentage and Pythagorean expe
)
display( half1.sort_values("dev", ascending=True).head() )
print("Mancity")
print(
    "Which of the following teams had the smallest difference between their win percentage and Pythagorean expe
)
display( half1.sort_values("dev", ascending=True).head() )
print("Leicester")


print(
    "Which of the following teams had the highest value for away wins (awinvalue) for in the first half of the
)
display( half1.sort_values("awinvalue", ascending=False).tail() )

half2['gap'] = abs(half2['hwinvalue'] - half2['awinvalue'])
print(
    "Which team had the largest gap between home points won (hwinvalue) and away points won (awinvalue) in the
    + "\n" +
    half2.sort_values("gap", ascending=False).iloc[0][0]
)


print(
    "What was the correlation between win percentage and the Pythagorean expectation in the first half of the
)
display(
    round(values.corr().iloc[0, 2], 3)
)


print(
    "What was the correlation between win percentage in the first half of the season and the second half of the
)
display(
    round(values.corr().iloc[0, 1], 3)
)


print(
    "What was the correlation between win percentage in the second half of the season and the Pythagorean expec
)
display(
    round(values.corr().iloc[1, 2], 3)
)
```

```
How many EPL games from this season were played in 2018?
173
Which team scored the highest number of goals while playing at home in the first half of the season?
Man City
Which team conceded the highest number of goals while playing away in the first half of the season?
Stoke
Which of the following teams had the smallest difference between their win percentage and Pythagorean expectati
on in the first half of the season?
```

	Team	MPh	hwinvalue	GFh	GAh	MPa	awinvalue	GAa	GFa	MP	wValue	GF	GA	pyth1	wpc1	dev
8	Leicester	10	5.0	13	14	11	5.0	18	18	21	10.0	31	32	0.484131	0.476190	0.007941
10	Man City	10	9.5	36	7	11	10.5	5	25	21	20.0	61	12	0.962743	0.952381	0.010362
17	Watford	11	4.5	14	23	10	4.5	14	16	21	9.0	30	37	0.396651	0.428571	0.031921
0	Arsenal	10	8.5	25	10	11	5.0	16	13	21	13.5	38	26	0.681132	0.642857	0.038275
12	Newcastle	11	4.0	9	13	10	3.0	17	10	21	7.0	19	30	0.286281	0.333333	0.047053

```
Mancity
Which of the following teams had the smallest difference between their win percentage and Pythagorean expectati
on in the first half of the season?
```

	Team	MPh	hwinvalue	GFh	GAh	MPa	awinvalue	GAa	GFa	MP	wValue	GF	GA	pyth1	wpc1	dev
8	Leicester	10	5.0	13	14	11	5.0	18	18	21	10.0	31	32	0.484131	0.476190	0.007941
10	Man City	10	9.5	36	7	11	10.5	5	25	21	20.0	61	12	0.962743	0.952381	0.010362
17	Watford	11	4.5	14	23	10	4.5	14	16	21	9.0	30	37	0.396651	0.428571	0.031921
0	Arsenal	10	8.5	25	10	11	5.0	16	13	21	13.5	38	26	0.681132	0.642857	0.038275
12	Newcastle	11	4.0	9	13	10	3.0	17	10	21	7.0	19	30	0.286281	0.333333	0.047053

```
Leicester
Which of the following teams had the highest value for away wins (awinvalue) for in the first half of the seaso
n?
```

	Team	MPh	hwinvalue	GFh	GAh	MPa	awinvalue	GAa	GFa	MP	wValue	GF	GA	pyth1	wpc1	dev
2	Brighton	10	5.5	10	12	11	3.0	13	5	21	8.5	15	25	0.264706	0.404762	0.140056
19	West Ham	9	4.0	10	14	11	3.0	24	12	20	7.0	22	38	0.251037	0.350000	0.098963
5	Crystal Palace	11	5.0	14	18	10	2.5	14	4	21	7.5	18	32	0.240356	0.357143	0.116787
14	Stoke	10	5.0	13	19	11	2.5	27	10	21	7.5	23	46	0.200000	0.357143	0.157143
18	West Brom	11	4.5	10	15	10	2.5	13	5	21	7.0	15	28	0.222993	0.333333	0.110340

```
Which team had the largest gap between home points won (hwinvalue) and away points won (awinvalue) in the secon
d half the season?
Arsenal
What was the correlation between win percentage and the Pythagorean expectation in the first half of the seaso
n?
0.968
What was the correlation between win percentage in the first half of the season and the second half of the seas
on?
0.757
What was the correlation between win percentage in the second half of the season and the Pythagorean expectatio
n in the first half of the season?
0.796
```