DS3001_HW1_Q2

February 11, 2021

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from scipy.stats import norm
import math
```

[2]:
```
df = pd.read_csv('soccer17.csv')
```

[3]:
```
df['All_Goals'] = df.FTHG + df.FTAG
df['H1_Goals'] = df.HTHG + df.HTAG
df['H2_Goals'] = df['All_Goals'] - df['H1_Goals']
X = np.linspace(0, 10)
```

1 2a

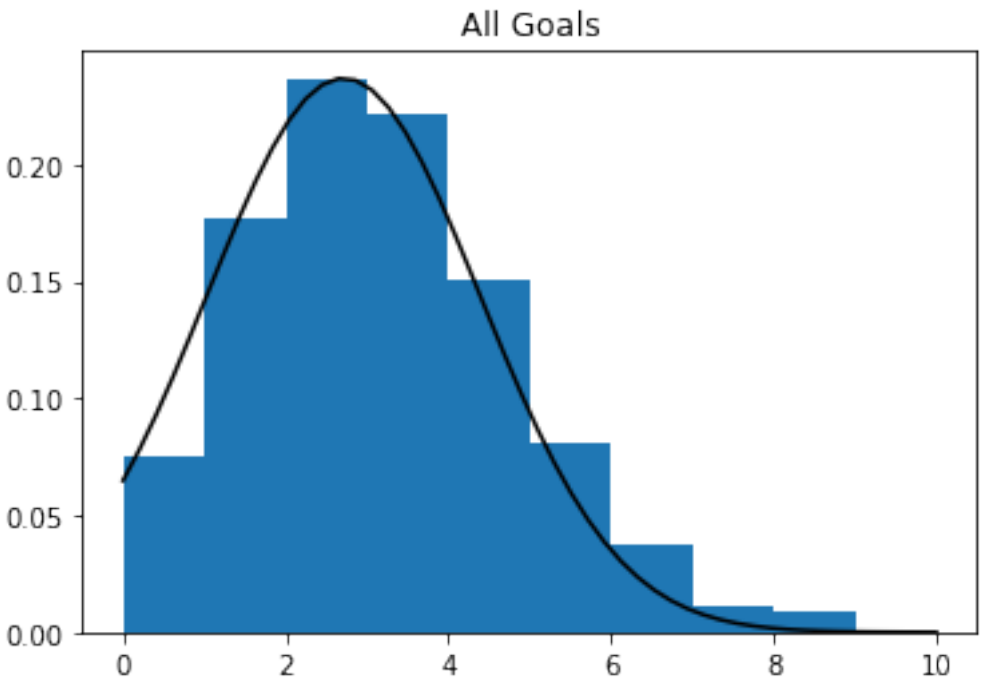
1.1 i. Model Selection

$A_1, ..., A_{7304} \overset{iid}{\sim} \mathcal{N}(\mu_A, \sigma_A^2)$ where A_i represents all goals scored in a single game i

1.2 ii. Histogram

[4]:
```
mu, sigma = norm.fit(df['All_Goals'])
plt.hist(df['All_Goals'], bins=np.arange(0, 10), density=True)
plt.plot(X, norm.pdf(X, mu, sigma), color='black')
plt.title('All Goals')
```

[4]:
```
Text(0.5, 1.0, 'All Goals')
```



2 2b

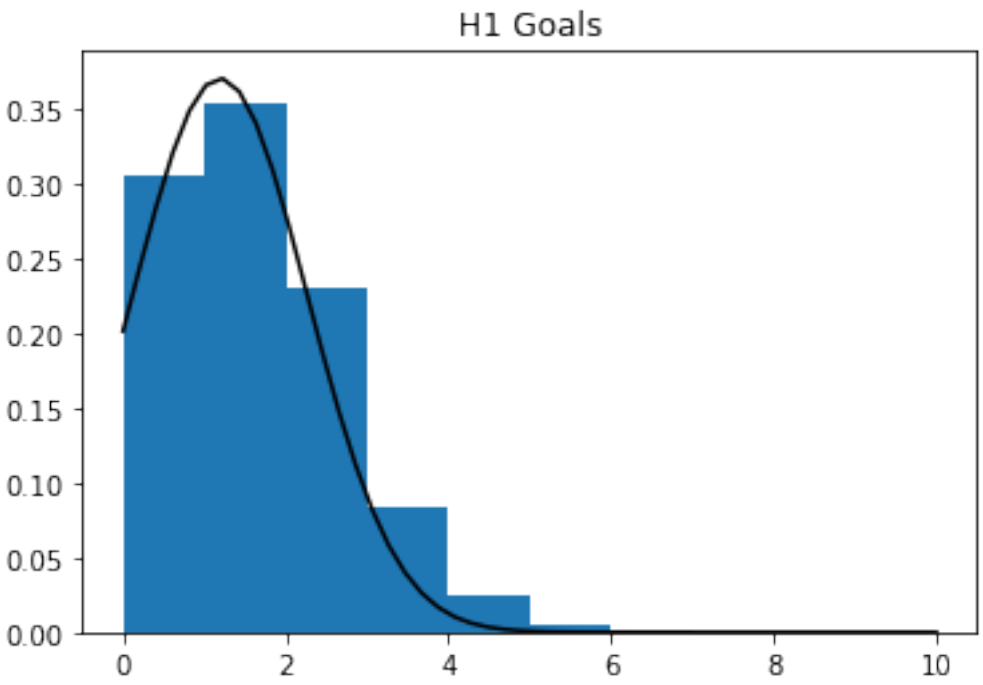
2.1 i. Model Selection

$H_1, ..., H_{7304} \overset{iid}{\sim} \mathcal{N}(\mu_H, \sigma_H^2)$ where H_i represents all first half goals scored in a single game i

2.2 ii. Histogram

[5]:
```
mu, sigma = norm.fit(df['H1_Goals'])
plt.hist(df['H1_Goals'], bins=np.arange(0, 10), density=True)
plt.plot(X, norm.pdf(X, mu, sigma), color='black' )
plt.title('H1 Goals')
```

[5]:
```
Text(0.5, 1.0, 'H1 Goals')
```



3 2c

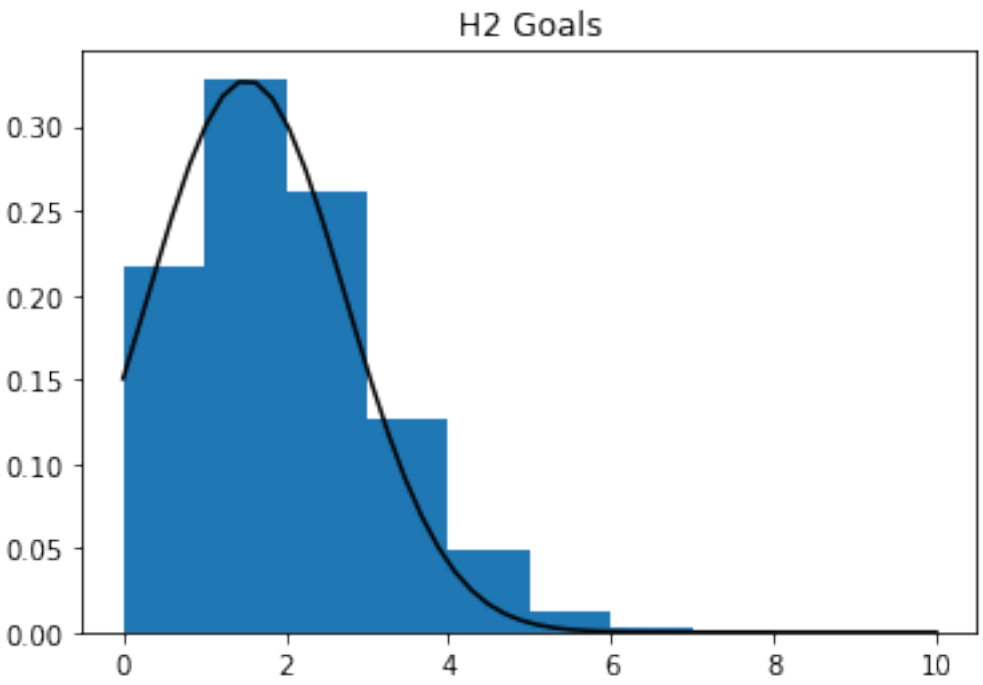
3.1 i. Model Selection

$I_1, ..., I_{7304} \overset{iid}{\sim} \mathcal{N}(\mu_I, \sigma_I^2)$ where I_i represents all second half goals scored in a single game i

3.2 ii. Histogram

[6]:
```
mu, sigma = norm.fit(df['H2_Goals'])
plt.hist(df.H2_Goals, bins=np.arange(0, 10), density=True)
plt.plot(X, norm.pdf(X, mu, sigma), color='black')
plt.title('H2 Goals')
```

[6]:
```
Text(0.5, 1.0, 'H2 Goals')
```



4 2d

[7]:
```
df2 = pd.DataFrame()
df2['Num_Games'] = df.groupby('Div').count()['All_Goals']
df2['Avg_Goals'] = df.groupby('Div').mean()['All_Goals']

df2.reset_index().sort_values(by='Avg_Goals', ascending=False)
```

[7]:

	Div	Num_Games	Avg_Goals
0	Bundesliga	1224	2.811275
2	La_Liga	1520	2.759211
4	Serie_A	1520	2.725658
1	EPL	1520	2.686184
3	Ligue_1	1520	2.588158

5 2e

[8]:
```
epsilon = 0.04
df4 = df.loc[df.All_Goals == 4]
fgg = df4.loc[(np.abs(df4.pH - df4.pA) < epsilon)]
```

[9]:
```
prob_draw =  math.factorial(4)/(math.factorial(2) * math.factorial(2)) * (0.
↪5)**2 * (0.5)**2
exp_draws = len(fgg) * prob_draw
draws = len(fgg.loc[fgg.FTHG == fgg.FTAG])
sigma = np.sqrt(0.375*0.625*len(fgg))

t = (draws-exp_draws)/sigma
p = 1 - norm.cdf(t)
print('p-value = {}'.format(p))
```

```
p-value = 0.007348710885011767
```

Our null hypothesis states that there is no "comeback tendency" within the dataset provided

Using an epsilon of $\epsilon = 0.04$, we were able to obtain a statistically significant p-value meaning that we reject the null hypothesis. This means that there is empirical evidence that suggests that a "comeback tendency" exists.