Part 2 - ModelFit

September 2, 2020

0.0.1 Intro

In this notebook, I go a step further with the data and feed it into a win probability model based on Brownian Motion.

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

pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', None)
```

[2]:
```
from nba_win_probability import dataloader, transformations, plotting,␣
↪win_probability
```

[3]:
```
df = dataloader.load_season("2018")
transformed_df = transformations.transform_data_for_analysis(df)
transformed_df = transformed_df[['GAME_ID', 'PLAYER1_TEAM_ABBREVIATION',␣
↪'PLAYER2_TEAM_ABBREVIATION',  'PERIOD', 'SCORE', 'SCOREMARGIN', 'SEASON',␣
↪'QUARTER_TS', 'TIME_ELAPSED', 'MINUTE', 'SCORE_BY_MINUTE']]
transformed_df.head(5)
```

[3]:
```
    GAME_ID PLAYER1_TEAM_ABBREVIATION PLAYER2_TEAM_ABBREVIATION  PERIOD  \
0  21800001                      BOS                      PHI       1
1  21800001                      PHI                      PHI       1
2  21800001                      BOS                      BOS       1
3  21800001                      PHI                      BOS       1
4  21800001                      BOS                      BOS       1

   SCORE  SCOREMARGIN SEASON  QUARTER_TS  TIME_ELAPSED  MINUTE  \
0    NaN          0.0   2018    0.000000      0.000000     0.0
1  2 - 0         -2.0   2018    1.083333      1.083333     1.0
2  2 - 2          0.0   2018    2.683333      2.683333     2.0
3  6 - 4         -2.0   2018    3.750000      3.750000     3.0
4  8 - 7         -1.0   2018    4.566667      4.566667     4.0

   SCORE_BY_MINUTE
```

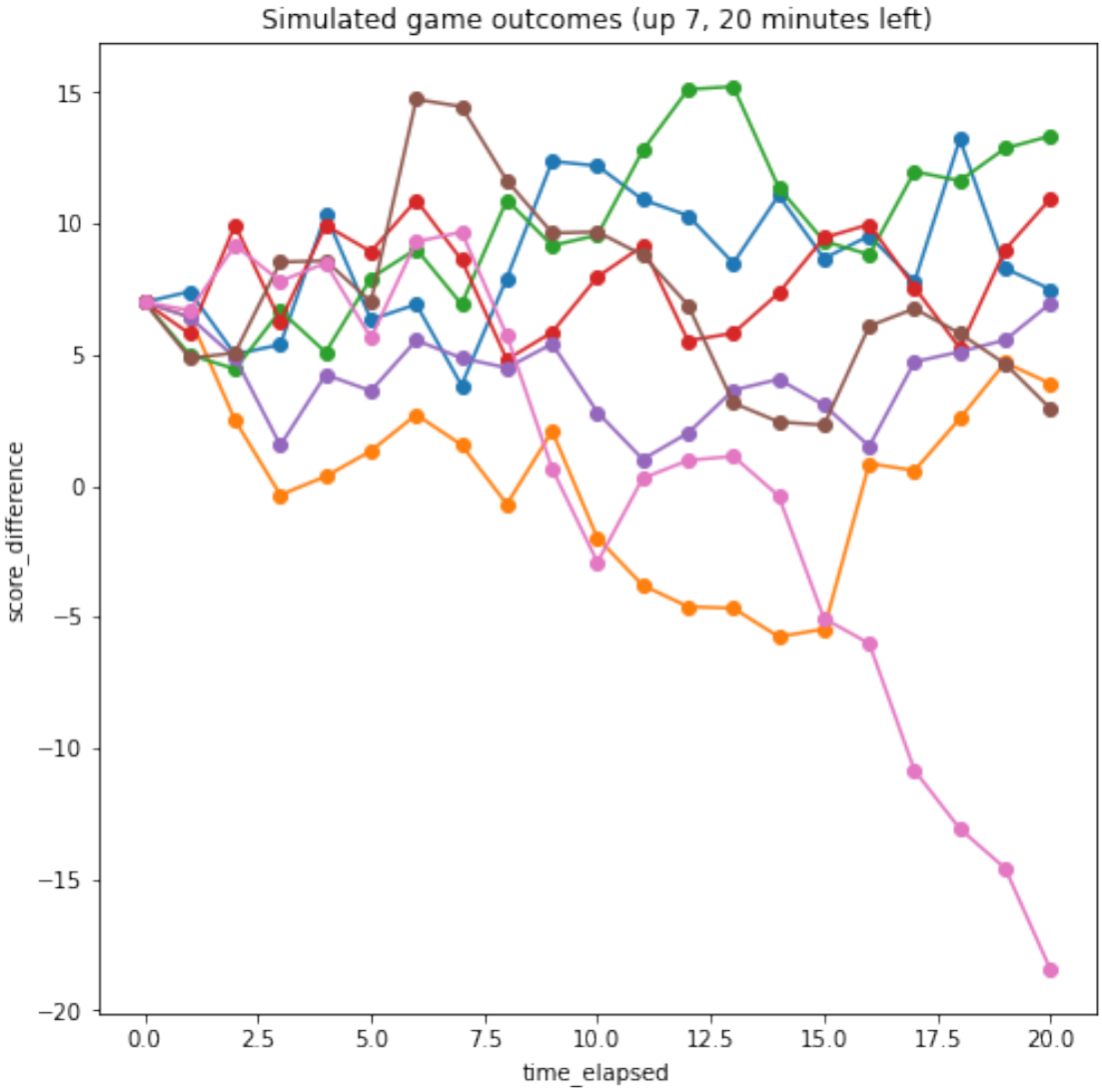
```
0              0.0
1             -2.0
2              2.0
3             -2.0
4              1.0
```

[4]:
```
# Use the minute-by-minute scoring as the parameter for the simulation model
scores_by_minute = transformed_df['SCORE_BY_MINUTE']
bwp = win_probability.BrownianWinProbabilitySimulation(scores_by_minute,␣
↪seed=808)
```

[5]:
```
# Estimate the win probability with a 7 pt. lead and 20 minutes remaining.
score_diff = 7
time_remaining = 20
outcome = bwp.estimate_home_win_probability(score_diff, time_remaining,␣
↪num_simulations=7)
print(outcome.estimated_win_probability)
```

```
0.8571428571428571
```

[6]:
```
replications = outcome.replications
plt.figure(figsize=(8, 8))
plt.title('Simulated game outcomes (up 7, 20 minutes left)')
plt.xlabel('time_elapsed')
plt.ylabel('score_difference')
for rep in replications:
    plt.plot([*range(0, len(rep), 1)], rep, '-o')
```



The plot above shows a series of simulated outcomes for a game where the home team is up by 7 with 20 minutes left.

[7]:
```
times_remaining = [35, 25, 15, 5]
score_differences = list(range(-20, 21))
data = []

for time_remaining in times_remaining:
    for score_diff in score_differences:
        for i in range(5):
            estimate = bwp.estimate_home_win_probability(score_diff,␣
↪time_remaining, 1000).estimated_win_probability
            data.append({'PROBA': estimate, 'TIME_REMAINING': time_remaining,␣
↪'SCOREMARGIN': score_diff})
```

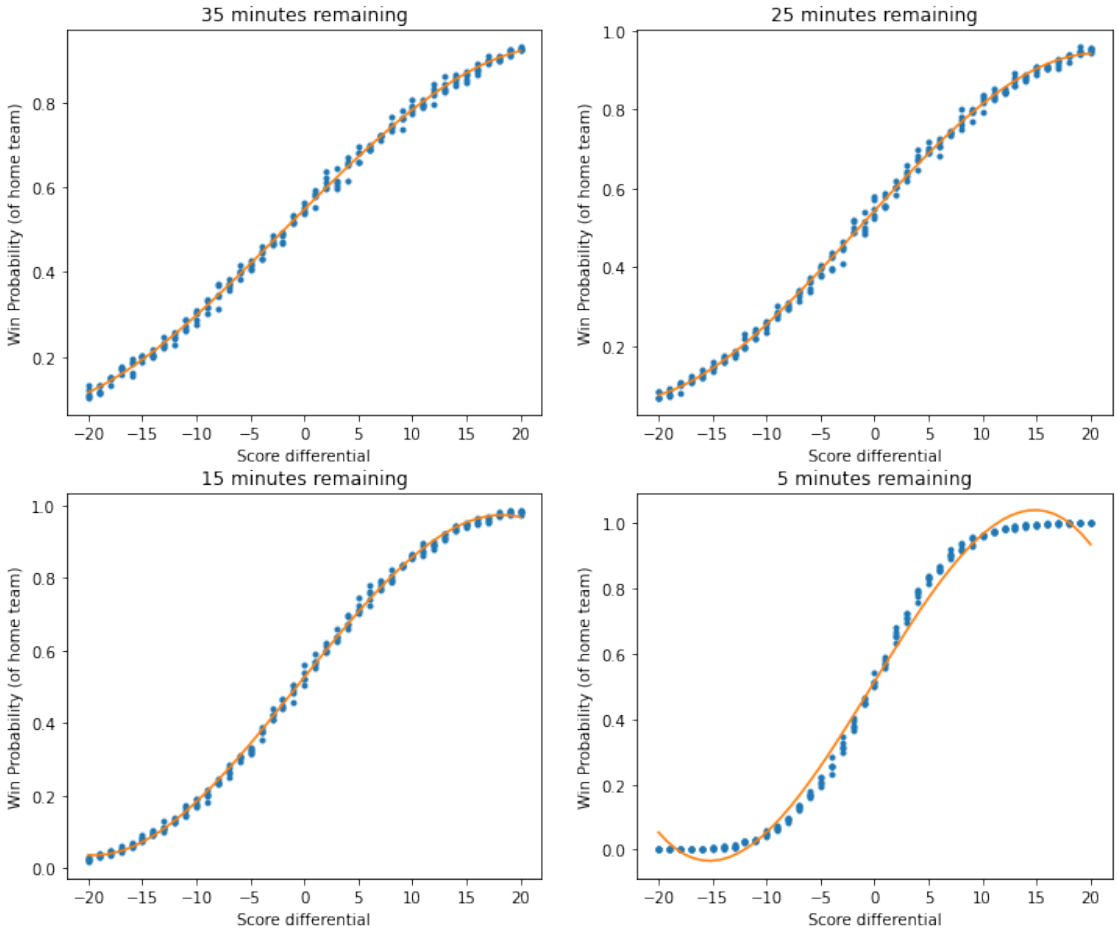
```
df = pd.DataFrame(data)
```

[8]:
```
figs, axs = plt.subplots(2, 2, figsize=(12, 10))
plot_map = {35: axs[0, 0], 25: axs[0, 1], 15: axs[1, 0], 5: axs[1, 1]}
for i in times_remaining:
    d = df[df['TIME_REMAINING'] == i]
    x = d['SCOREMARGIN']
    y = d['PROBA']

    p = np.poly1d(np.polyfit(x, y, 3))
    t = np.linspace(-20, 20)

    plot_map[i].plot(x, y, '.')
    plot_map[i].plot(t, p(t), '-')
    plot_map[i].set_title(f"{i} minutes remaining")

for ax in axs.flat:
    ax.set(xlabel='Score differential', ylabel='Win Probability (of home team)')
```



This plot displays how score differential impacts win probability at different points in the game.