HW1

February 21, 2025

Imports

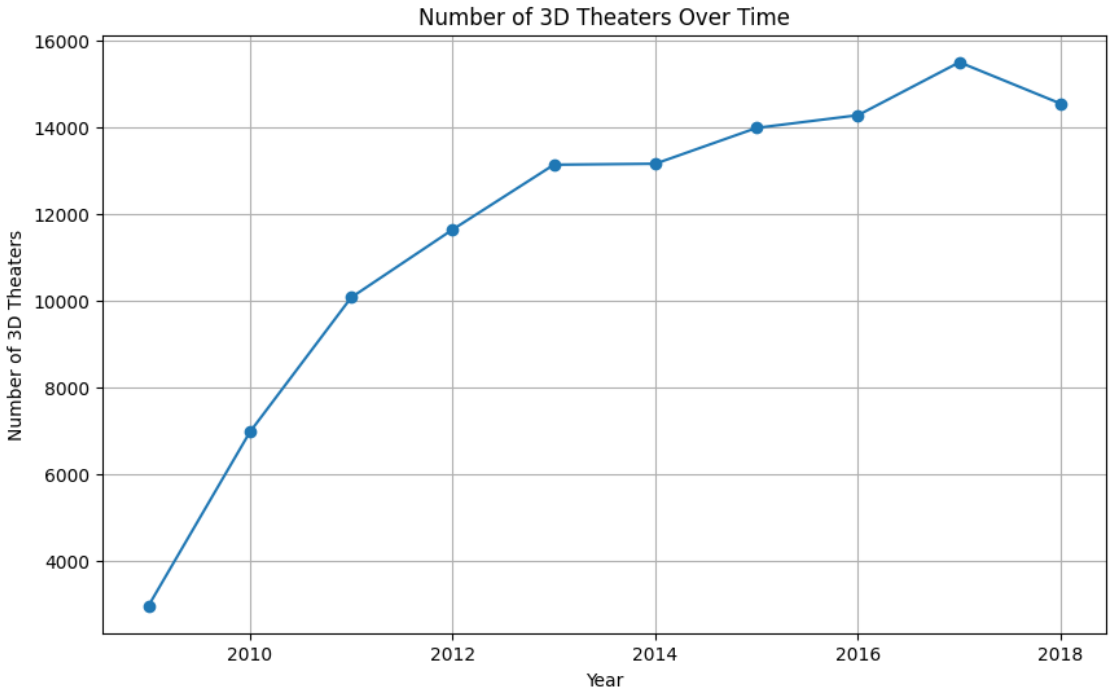
[11]:
```
import numpy as np
import pandas as pd
import scipy.optimize as opt
import matplotlib.pyplot as plt
```

[21]:
```
data = pd.read_excel('data/cinema_data.xlsx')

print(data)
```

```
   Year  Count
0  2009   2961
1  2010   6968
2  2011  10073
3  2012  11639
4  2013  13136
5  2014  13158
6  2015  13985
7  2016  14278
8  2017  15499
9  2018  14543
```

[13]:
```
plt.figure(figsize=(10, 6))
plt.plot(data['Year'], data['Count'], marker='o')
plt.title('Number of 3D Theaters Over Time')
plt.xlabel('Year')
plt.ylabel('Number of 3D Theaters')
plt.grid(True)
plt.show()
```



[14]:
```
def bass_model(t, p, q, M):
    """Bass Diffusion Model"""
    return (M * (p + q) ** 2 * np.exp(-(p + q) * t)) / (p + q * np.exp(-(p + q)␣
↪* t)) ** 2
```

[15]:
```
data['Year'] -= data['Year'].min()  # Normalize years to start from 0
```

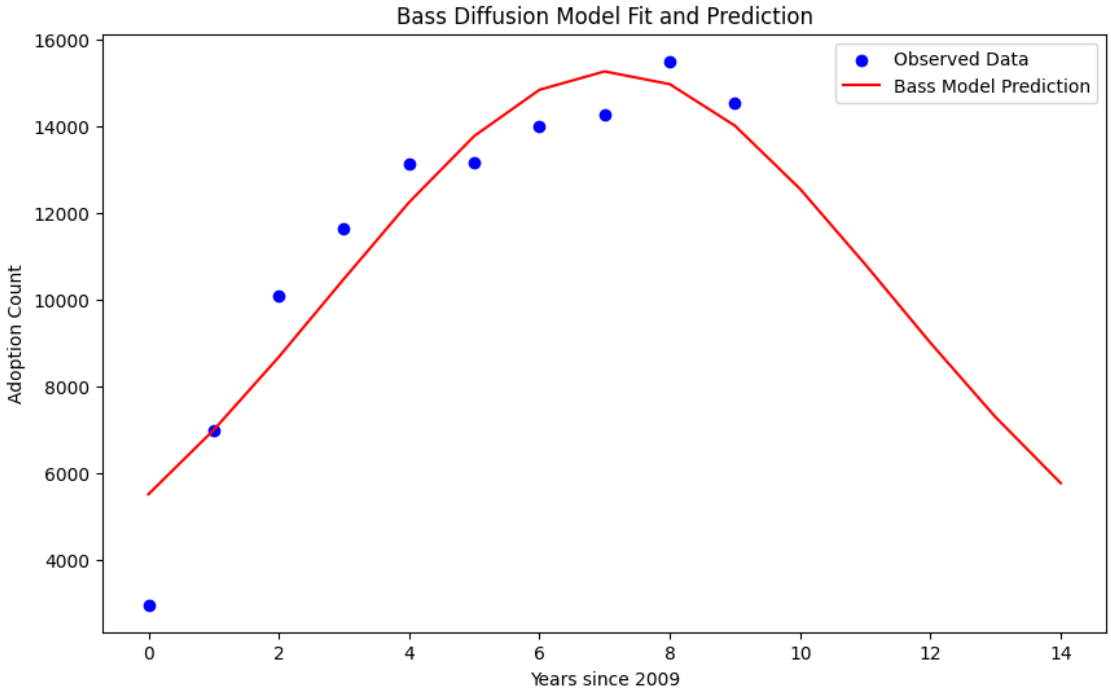
[16]:
```
params, _ = opt.curve_fit(bass_model, data['Year'], data['Count'], p0=[0.03, 0.
↪38, 16000])
p, q, M = params
print(f"Estimated Parameters: p={p:.4f}, q={q:.4f}, M={M:.2f}")
```

```
Estimated Parameters: p=0.0310, q=0.2783, M=5512.29
```

[17]:
```
years_future = np.arange(0, 15)
predicted = bass_model(years_future, p, q, M)
```

[20]:
```
plt.figure(figsize=(10, 6))
plt.scatter(data['Year'], data['Count'], label='Observed Data', color='blue')
plt.plot(years_future, predicted, label='Bass Model Prediction', color='red')
plt.xlabel('Years since 2009')
plt.ylabel('Adoption Count')
plt.legend()
plt.title('Bass Diffusion Model Fit and Prediction')
```

```
plt.show()
```


Bass Diffusion Model Fit and Prediction
Observed Data
Bass Model Prediction
Adoption Count
Years since 2009
16000
14000
12000
10000
8000
6000
4000
0
2
4
6
8
10
12
14