MA_HW_1 (1)

February 28, 2025

Exercise 1

Innovation: Figure 02 Source: https://time.com/7094914/figure-02/

Exercise 2 Historical Innovation: ASMIO by Honda

ASIMO (Advanced Step in Innovative Mobility) was a humanoid robot developed by Honda, first introduced in 2000. It was designed to assist humans in various tasks, showcasing advancements in robotics, AI, and automation. Similarly, Figure 02 is an advanced humanoid robot that builds upon previous robotic innovations, integrating AI-driven capabilities and enhanced mechanical dexterity for industrial and service applications.

I have chosen this historical data, because both ASIMO and Figure 02 share commonalities in their objectives: improving human-robot interactions, performing assistance-based tasks, and demonstrating robotic advancements. However, Figure 02 likely benefits from modern AI models and more sophisticated machine learning techniques, making it more adaptable and functional in industrial and commercial settings.

References:

https://global.honda/en/newsroom/news/2000/c001120b-eng.html https://spectrum.ieee.org/figure-new-humanoid-robot

Exercise 3

https://www.statista.com/statistics/264084/worldwide-sales-of-industrial-robots/ - Worldwide installations of industrial robots from 2004 to 2022

The dataset provides a historical basis to estimate the adoption rate of humanoid robots like ASIMO and extrapolate for Figure 02.

[21]:
```python
import numpy as np
import pandas as pd
import scipy.optimize as opt
import matplotlib.pyplot as plt

data = pd.read_excel('robots-worldwide-shipments.xlsx')
print(data)
```

```
   Year  Shipments
0  2004         97
1  2005        120
2  2006        112
```

```
3    2007         114
4    2008         113
5    2009          60
6    2010         121
7    2011         166
8    2012         159
9    2013         178
10   2014         221
11   2015         254
12   2016         304
13   2017         400
14   2018         423
15   2019         387
16   2020         390
17   2021         526
18   2022         553
```

[29]:

```
#Problem 4

def bass_model(t, p, q, M):
    return (M * (p + q) ** 2 * np.exp(-(p + q) * t)) / (p + q * np.exp(-(p + q)
 ↪* t)) ** 2

data['Year'] -= data['Year'].min()

params, _ = opt.curve_fit(bass_model, data['Year'], data['Shipments'], 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=0.0022, q=0.1321, M=66.79
```

[41]:

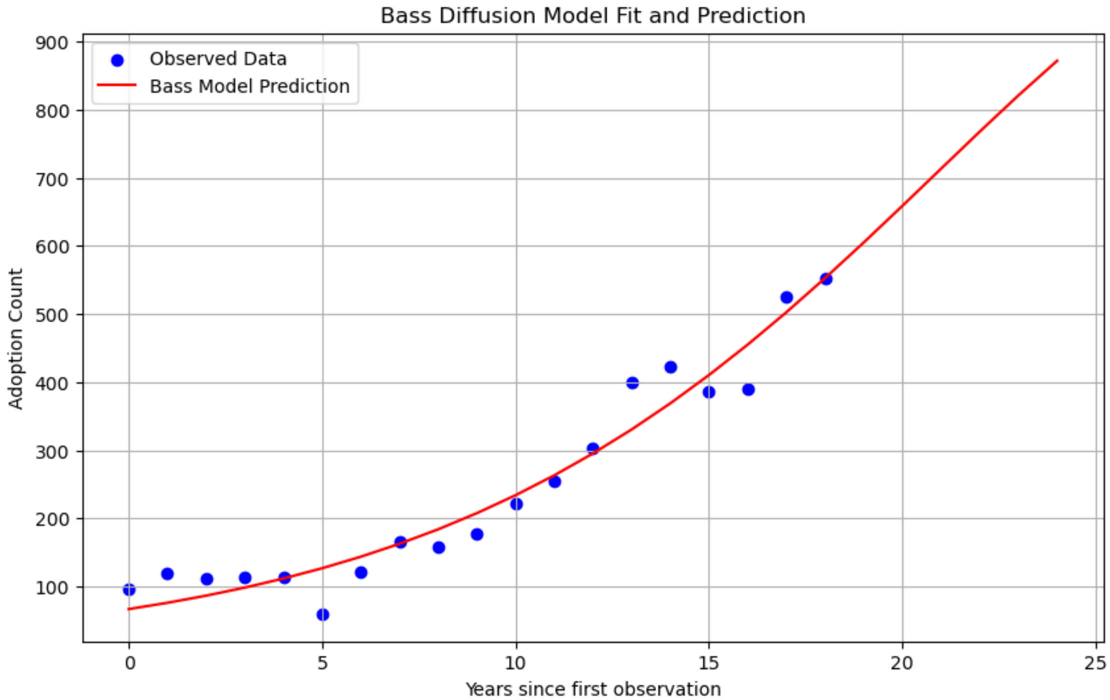
```
#Problem 5

years = data['Year'].values
shipments = data['Shipments'].values

future_years = np.arange(0, 25)
future_adoption = bass_model(future_years, p, q, M)

plt.figure(figsize=(10, 6))
plt.scatter(years - years.min(), shipments, label='Observed Data', color='blue')
plt.plot(future_years, future_adoption, label='Bass Model Prediction',
 ↪color='red')
plt.xlabel('Years since first observation')
plt.ylabel('Adoption Count')
plt.legend()
```

```
plt.title('Bass Diffusion Model Fit and Prediction')
plt.grid()
plt.show()
```



6) Scope Decision: Global

The diffusion of Figure 02 should be analyzed on a global scale, because industrial automation is a worldwide trend. Companies like BMW (already testing Figure 02) and industries in China, Japan, the U.S., and Germany are driving robotics adoption. Since Figure AI is likely targeting an international market, a global analysis provides a more accurate prediction of adoption. If a country-specific study is needed, the U.S. or China would be the best choices due to their leadership in robotics and automation.

[45]:
```
#Problem 7

years = np.arange(0, 25)
cumulative_adopters = bass_model(years, p, q, M)
new_adopters = np.diff(cumulative_adopters, prepend=0)

results_df = pd.DataFrame({
    'Year': np.arange(2023, 2023 + len(new_adopters)),
    'New Adopters': new_adopters.astype(int)
})

print(results_df)
```

	Year	New Adopters
0	2023	66
1	2024	9
2	2025	10
3	2026	11
4	2027	13
5	2028	15
6	2029	16
7	2030	18
8	2031	21
9	2032	23
10	2033	26
11	2034	29
12	2035	32
13	2036	35
14	2037	38
15	2038	41
16	2039	44
17	2040	47
18	2041	50
19	2042	52
20	2043	53
21	2044	54
22	2045	54
23	2046	53
24	2047	50