analysis_v1

December 25, 2024

0.1 Household energy consumption analysis

0.2 Setup

[4]:
```
import pandas as pd
import matplotlib.pyplot as plt

current_data_df = pd.read_csv("./data/household_data.csv", delimiter=";")
current_data_df["Month_Year"] = current_data_df["Month"].str[:3].str.
 ↪capitalize() + " " + current_data_df["Year"].astype(str).str[-2:]
current_data_df
```

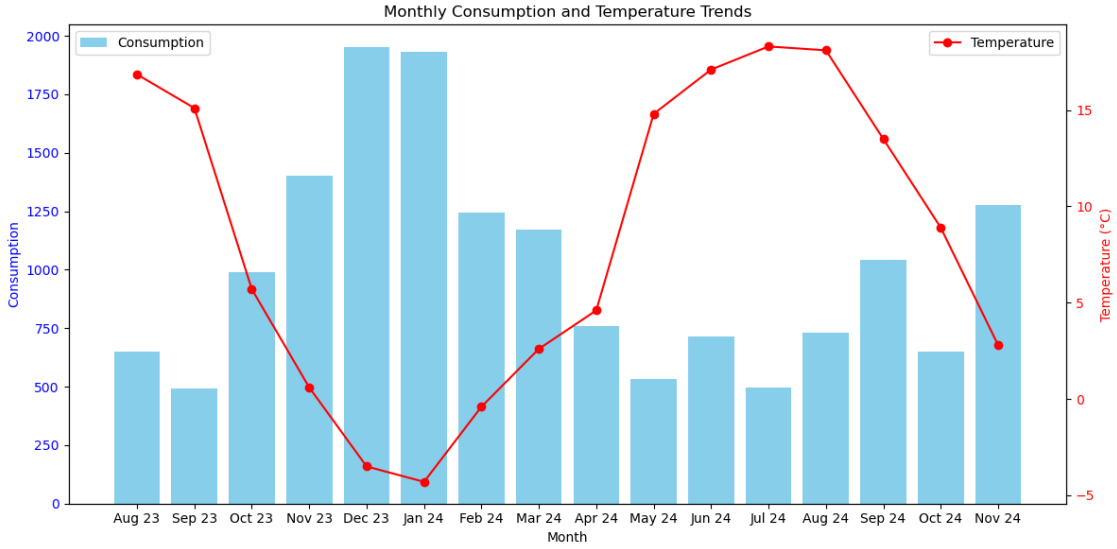
[4]:

	Year	Month	Consumption	Temperature	Invoice	Month_Year
0	2023	august	648	16.85	642.28	Aug 23
1	2023	september	493	15.10	861.06	Sep 23
2	2023	october	988	5.70	885.02	Oct 23
3	2023	november	1400	0.60	1593.23	Nov 23
4	2023	december	1950	-3.50	3033.28	Dec 23
5	2024	january	1931	-4.30	3990.47	Jan 24
6	2024	february	1245	-0.40	4586.01	Feb 24
7	2024	march	1171	2.60	2595.36	Mar 24
8	2024	april	759	4.60	2651.73	Apr 24
9	2024	may	531	14.80	1893.53	May 24
10	2024	june	713	17.10	1313.01	Jun 24
11	2024	july	495	18.30	1536.73	Jul 24
12	2024	august	730	18.10	1325.47	Aug 24
13	2024	september	1042	13.50	1520.58	Sep 24
14	2024	october	650	8.90	1961.90	Oct 24
15	2024	november	1278	2.80	1556.20	Nov 24

0.3 Current situation analysis

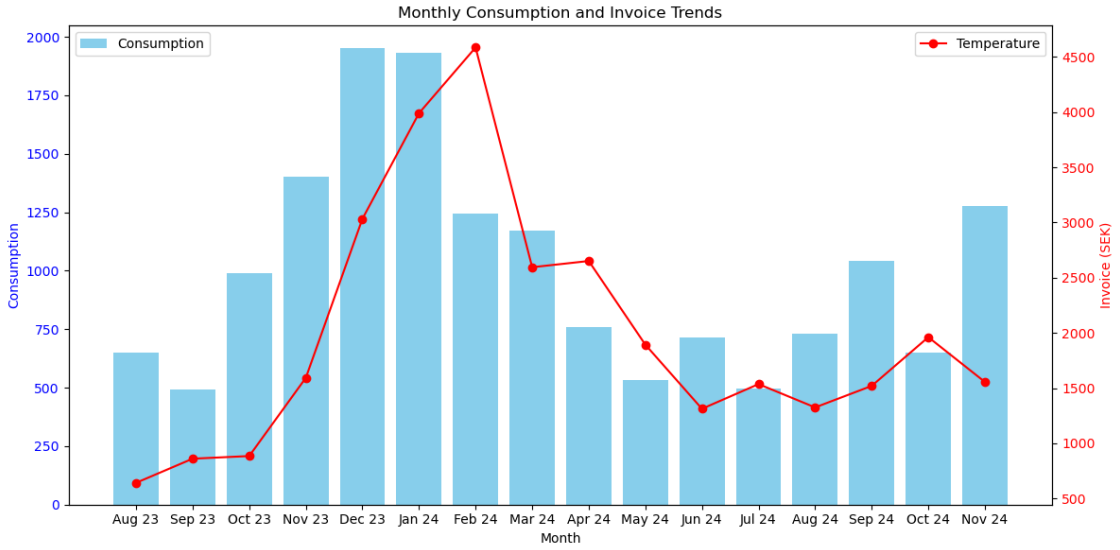
[5]:
```
fig, ax1 = plt.subplots(figsize=(12, 6))

ax1.bar(current_data_df["Month_Year"], current_data_df["Consumption"],␣
 ↪color="skyblue", label="Consumption")
ax1.set_ylabel("Consumption", color="blue")
ax1.set_xlabel("Month")
```

```
ax1.tick_params(axis="y", labelcolor="blue")

ax2 = ax1.twinx()
ax2.plot(current_data_df["Month_Year"], current_data_df["Temperature"],␣
 ↪color="red", marker="o", label="Temperature")
ax2.set_ylabel("Temperature (°C)", color="red")
ax2.tick_params(axis="y", labelcolor="red")

ax1.legend(loc="upper left")
ax2.legend(loc="upper right")

plt.title("Monthly Consumption and Temperature Trends")
plt.xticks(rotation=45, ha="right")
plt.tight_layout()
plt.show()
```



[6]:
```
fig, ax1 = plt.subplots(figsize=(12, 6))

ax1.bar(current_data_df["Month_Year"], current_data_df["Consumption"],␣
 ↪color="skyblue", label="Consumption")
ax1.set_ylabel("Consumption", color="blue")
ax1.set_xlabel("Month")
ax1.tick_params(axis="y", labelcolor="blue")

ax2 = ax1.twinx()
ax2.plot(current_data_df["Month_Year"], current_data_df["Invoice"],␣
 ↪color="red", marker="o", label="Temperature")
ax2.set_ylabel("Invoice (SEK)", color="red")
```

```
ax2.tick_params(axis="y", labelcolor="red")

ax1.legend(loc="upper left")
ax2.legend(loc="upper right")

plt.title("Monthly Consumption and Invoice Trends")
plt.xticks(rotation=45, ha="right")
plt.tight_layout()
plt.show()
```



0.3.1 Consumption, temperature and invoice

We observe that consumption increases as the temperature drops, which is expected during colder months when energy usage for heating typically rises. This pattern is further reflected in the invoice amounts, which also increase during months of higher consumption.

0.3.2 Cost per Unit of Consumption

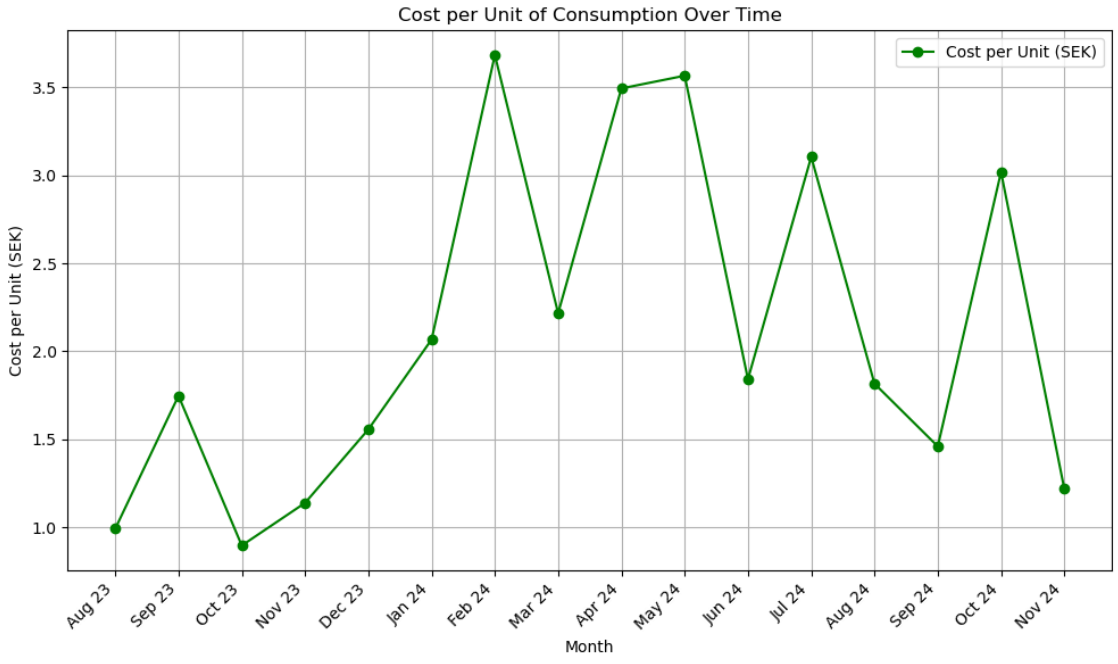
The Cost per Unit of Consumption provides a measure of how much is being paid per unit of energy consumed. This metric can help identify trends in energy pricing over time, including potential seasonal rate changes, discounts, or anomalies in billing.

Formula: The cost per unit, denoted as C , is calculated as:

$$C = \frac{I}{C_m}$$

Where: - I represents the total Invoice amount for the month. - C_m is the Consumption for the corresponding month.

[9]:
```
current_data_df["Cost_per_Unit"] = current_data_df["Invoice"] /␣
 ↪current_data_df["Consumption"]

fig, ax = plt.subplots(figsize=(10, 6))

ax.plot(
    current_data_df["Month_Year"],
    current_data_df["Cost_per_Unit"],
    marker="o",
    color="green",
    label="Cost per Unit (SEK)"
)
ax.set_title("Cost per Unit of Consumption Over Time")
ax.set_xlabel("Month")
ax.set_ylabel("Cost per Unit (SEK)")
ax.grid(True)
ax.legend()

plt.xticks(rotation=45, ha="right")
plt.tight_layout()
plt.show()
```



0.3.3 Cost per Unit Analysis: October and November

Analyzing the data for October 2023 vs. October 2024 and November 2023 vs. November 2024 reveals a concerning trend. - In October 2024, despite a significant reduction in energy consumption

compared to October 2023—thanks to the installation of a new energy-efficient heater—the invoice amount was higher. This indicates a substantial increase in energy prices, which outweighed the benefits of reduced consumption. - Similarly, in November 2024, consumption was lower than in November 2023, yet the invoice amount remained almost the same. This further supports the observation that energy rates have increased.

Key Takeaways: 1. Energy Price Increases: - The cost per unit of energy has risen significantly from 2023 to 2024. Even with improved energy efficiency and reduced consumption, the invoices for both months (October and November) reflect higher or equivalent costs compared to the previous year. 2. Negation of Savings: - The financial benefits of the energy-efficient heater, which reduced consumption in October and November 2024, were negated by higher energy prices. 3. Billing Practices: - Fixed costs, seasonal pricing, or surcharges applied by the energy provider may have further contributed to the higher invoices.