

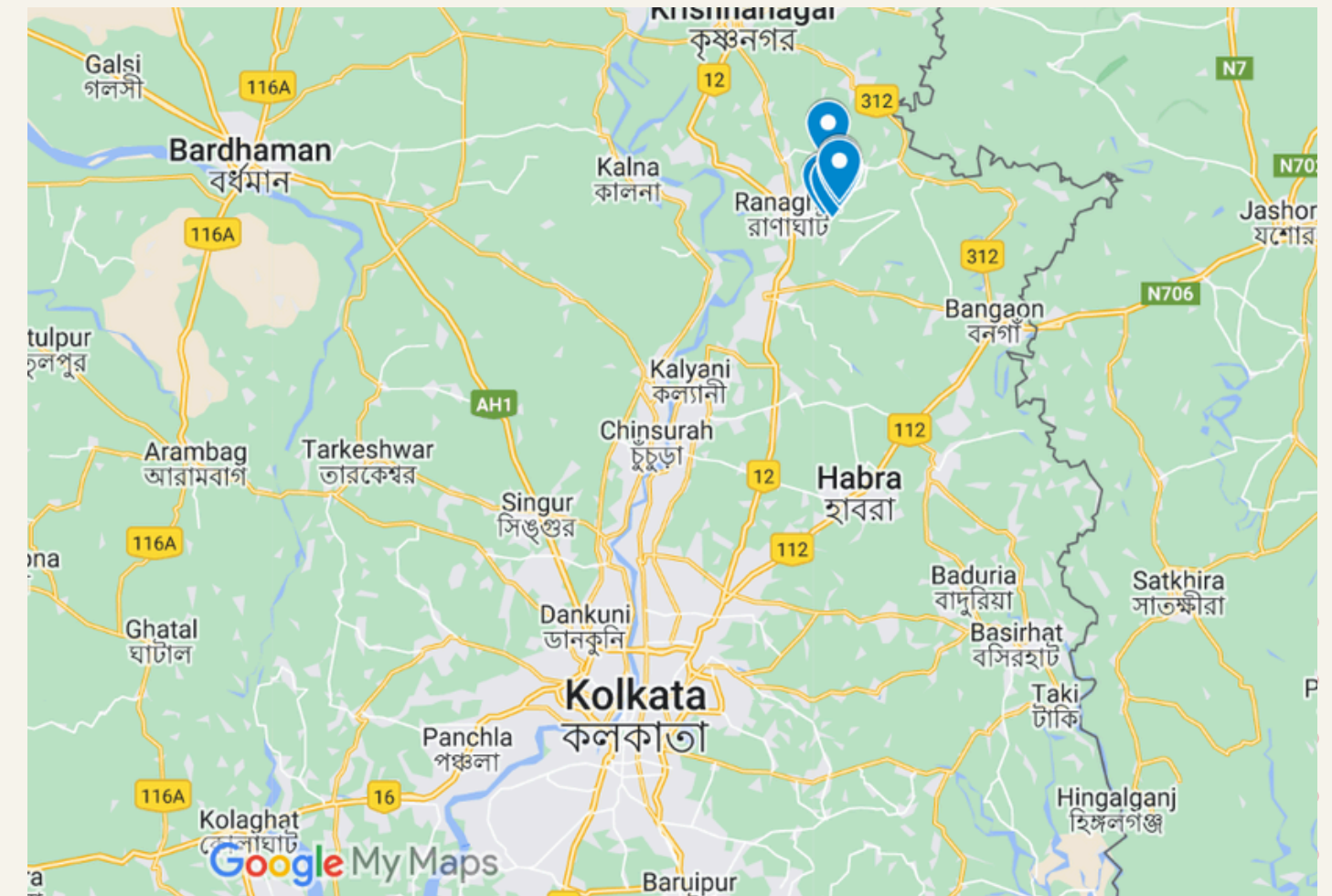
ENERGY AUDIT OF NADIA DISTRICT, WEST BENGAL

Course Project: CE6001

Fundamentals of Urban Science and Engineering

INTRODUCTION

We have chosen Nadia District, West Bengal as our primary area for the analysis. We had obtained 14 datapoints for electricity consumption from different houses in the district. All houses were independent houses.



BASIC OVERVIEW OF THE DISTRICT

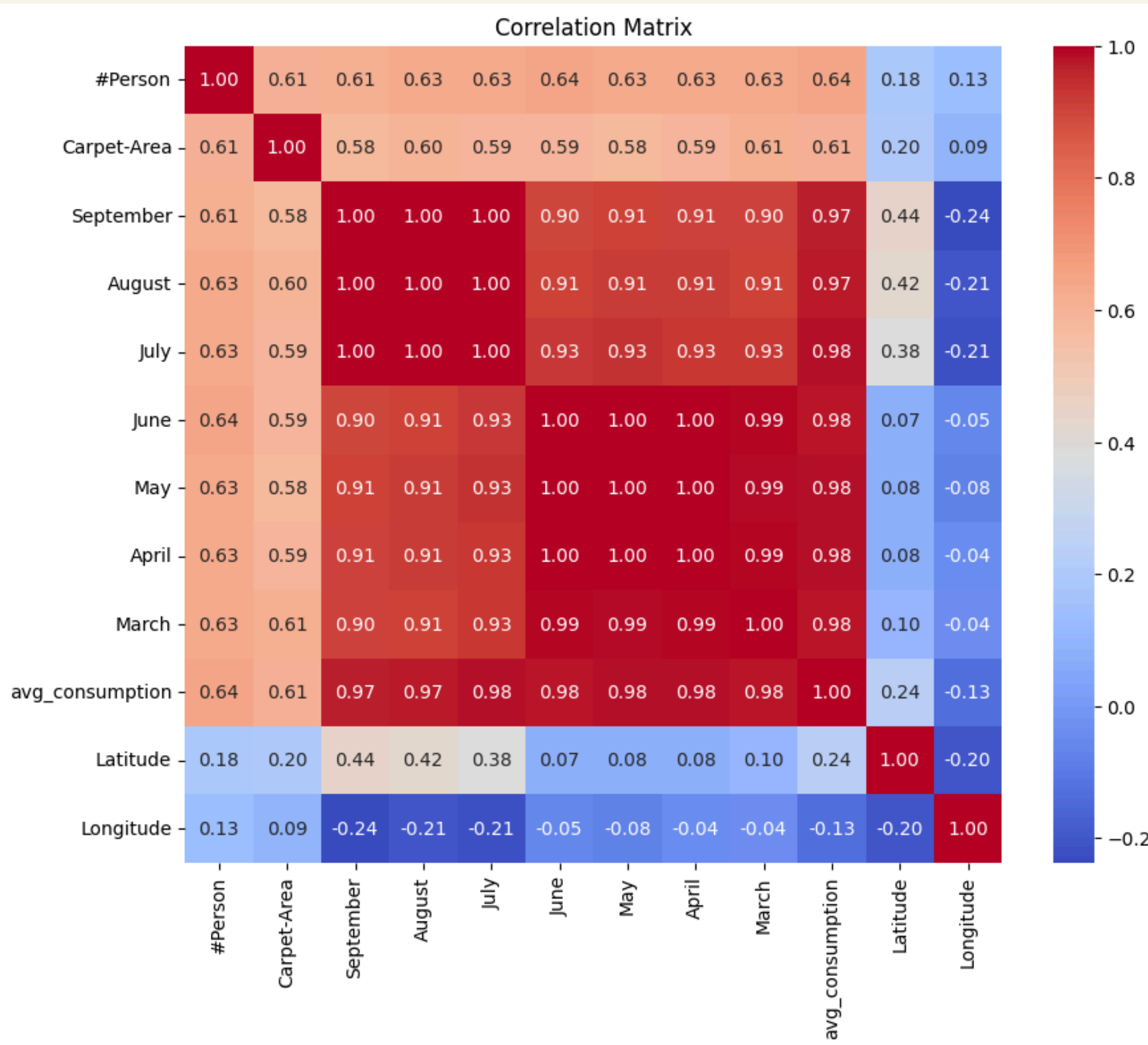
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- **Nadia** is a district in southern West Bengal, known for its rich cultural heritage, fertile plains, and significant agricultural output.
- **Location:** Bordered by Bangladesh to the east, Nadia is about 100 km north of Kolkata.
- **Climate:** Humid subtropical, with hot summers, mild winters, and heavy monsoon rains.
- **Topography:** Flat terrain, with major rivers like the Bhagirathi and Jalangi, and fertile alluvial soil.
- **Economy:** Dominated by agriculture (rice and jute), cottage industries (clay art, silk), and growing educational hubs like Kalyani.
- **Transport:** Well-connected by rail and road, with access to Kolkata's airport.
- **Population:** 5.5 million, predominantly Bengali-speaking.
- **Challenges:** Flood-Prone areas and uneven rural infrastructure development.



DATA ANALYSIS

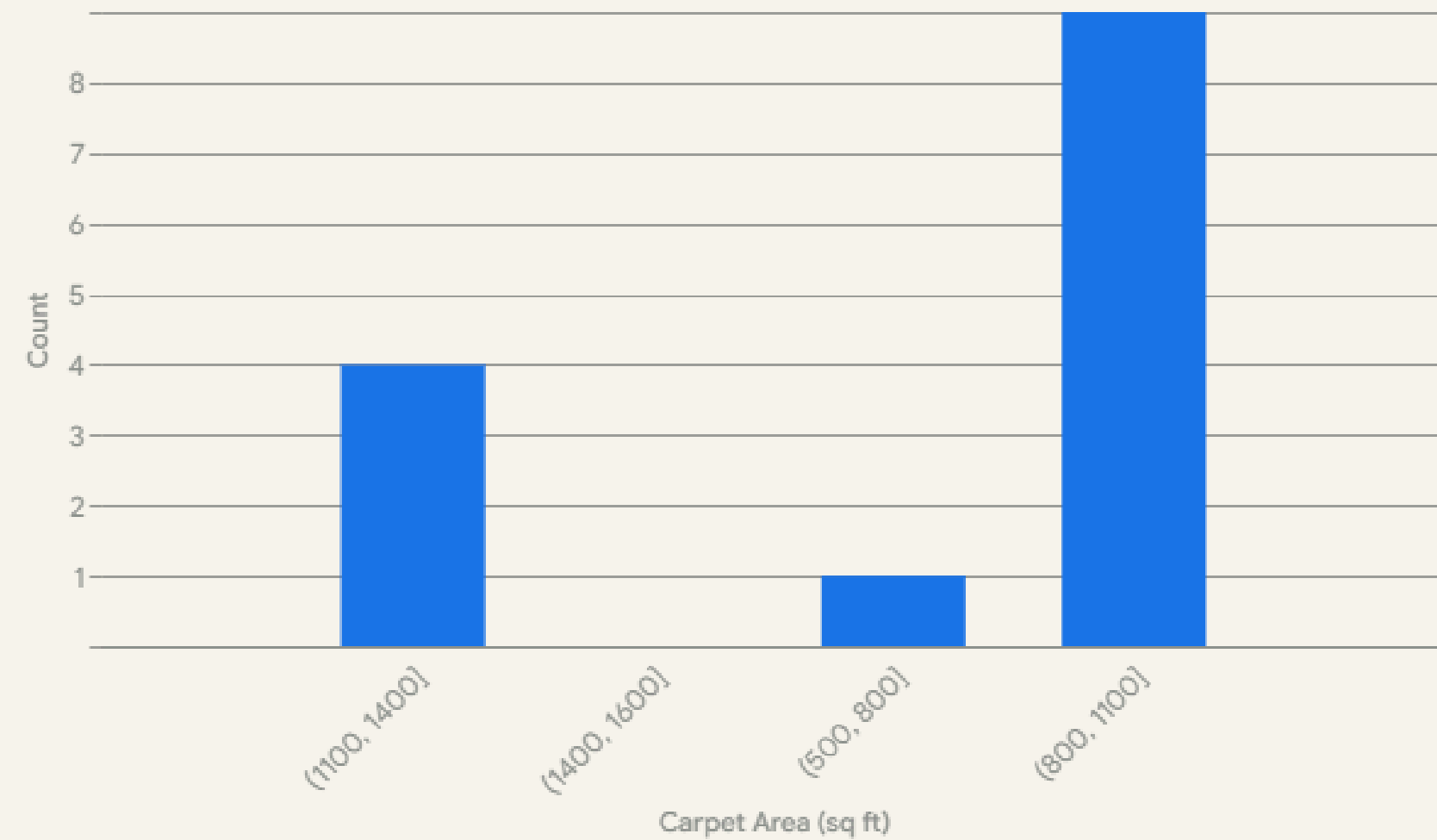
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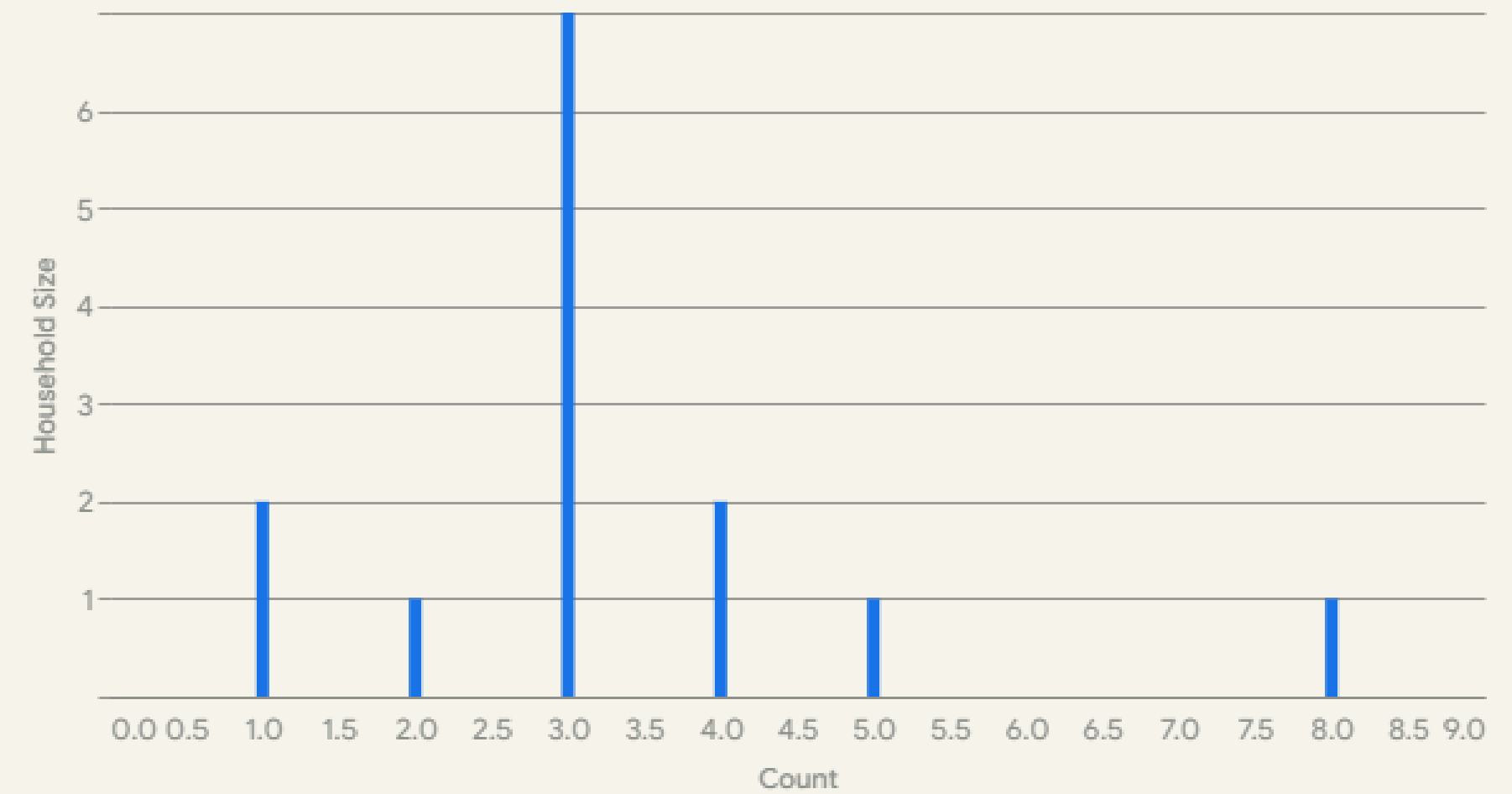
- Larger homes and more residents = higher electricity use.
- Peak consumption in warmer months (likely due to cooling needs).
- Consistent usage patterns throughout the year.
- Location has minimal impact on consumption.

DATA ANALYSIS

Carpet Area Distribution

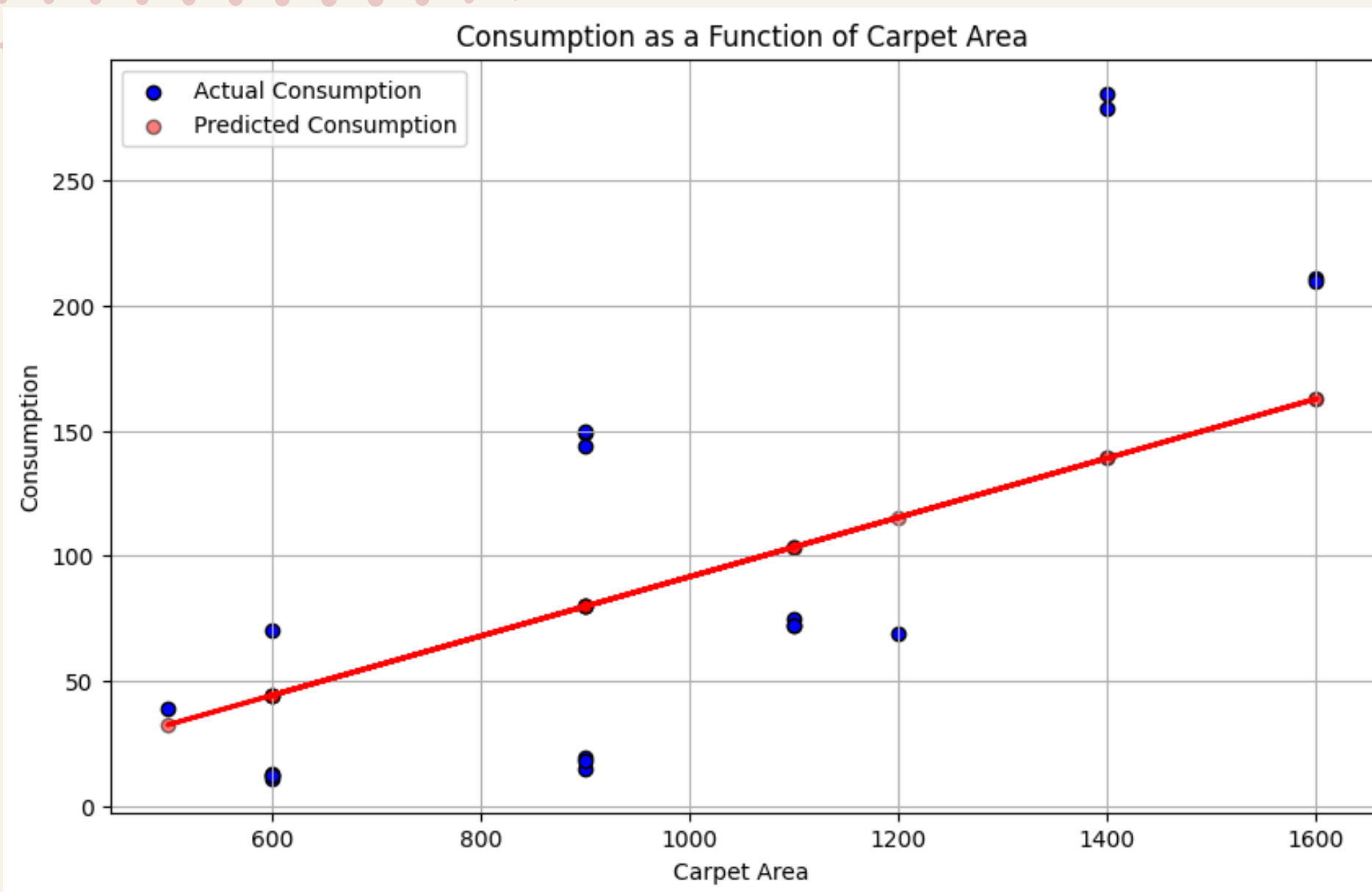


Household Size Distribution



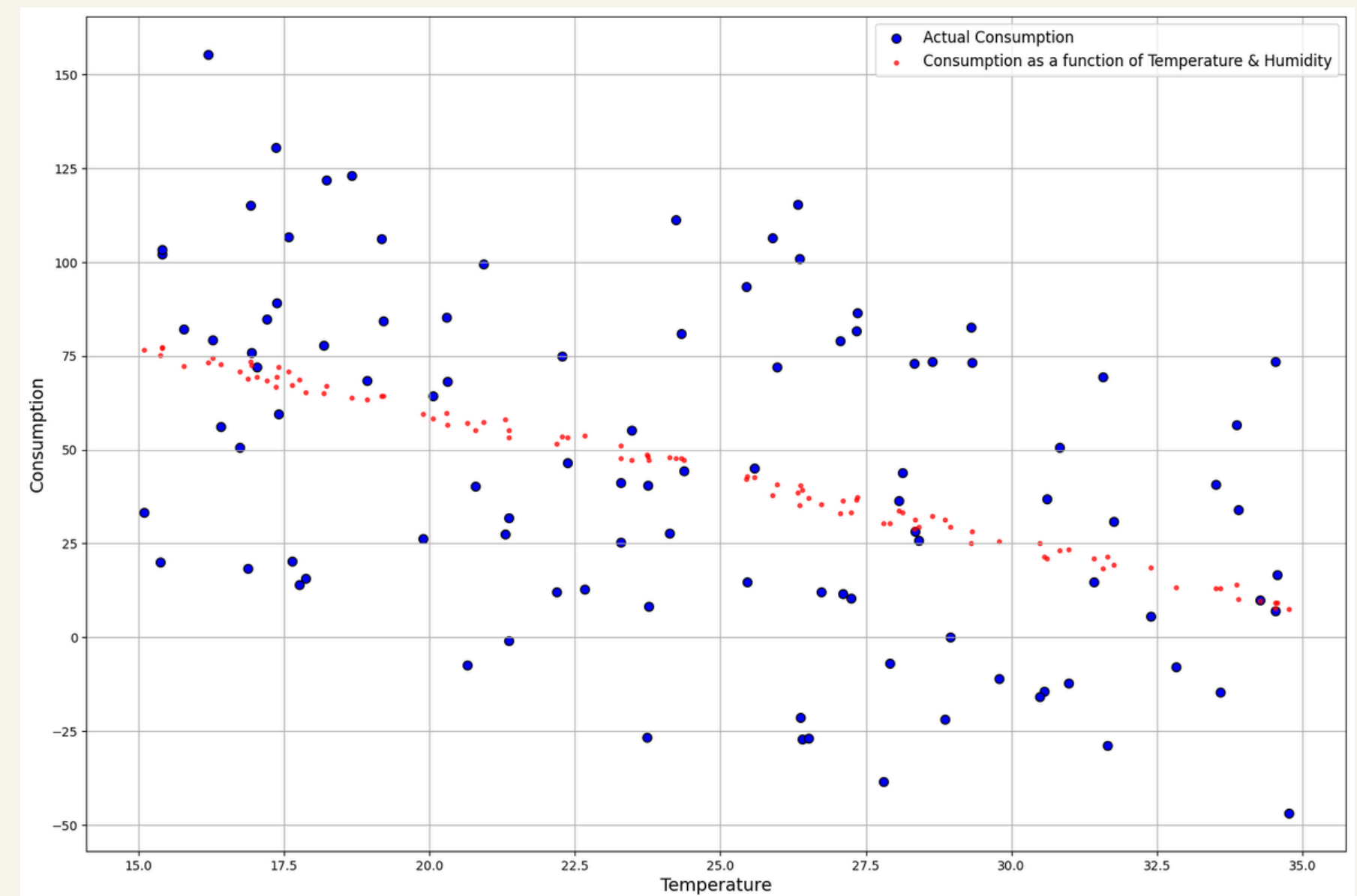
DATA ANALYSIS

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R²: 0.484

$$\text{Consumption} = 0.119 * \text{Carpet Area} + -27.019$$

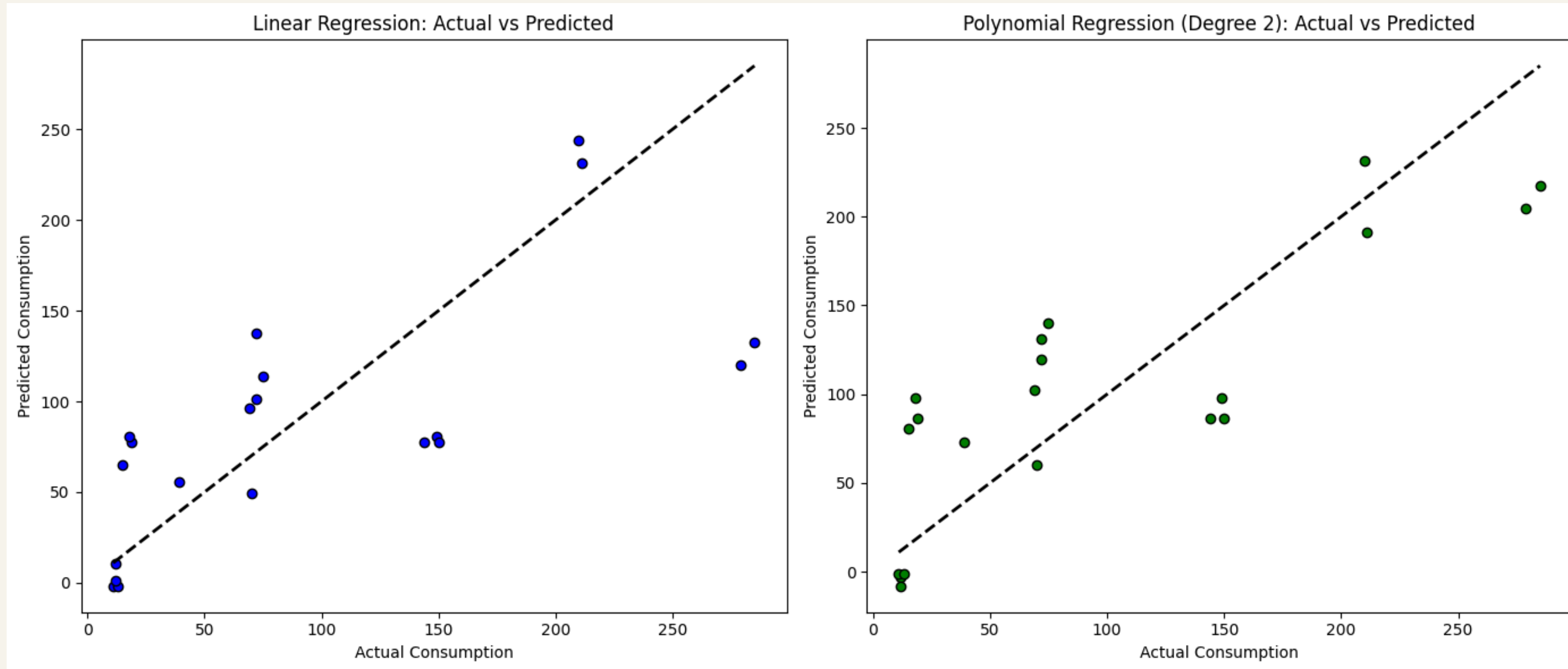


R²: 0.209

$$\text{Consumption} = 137.240 + -3.494 * \text{Temperature} + -0.143 * \text{Humidity}$$

DATA ANALYSIS

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Linear Regression Equation:

Consumption = 44.316 + -3.167 * Temperature + 0.063 * Carpet-Area + 23.841 * #Person

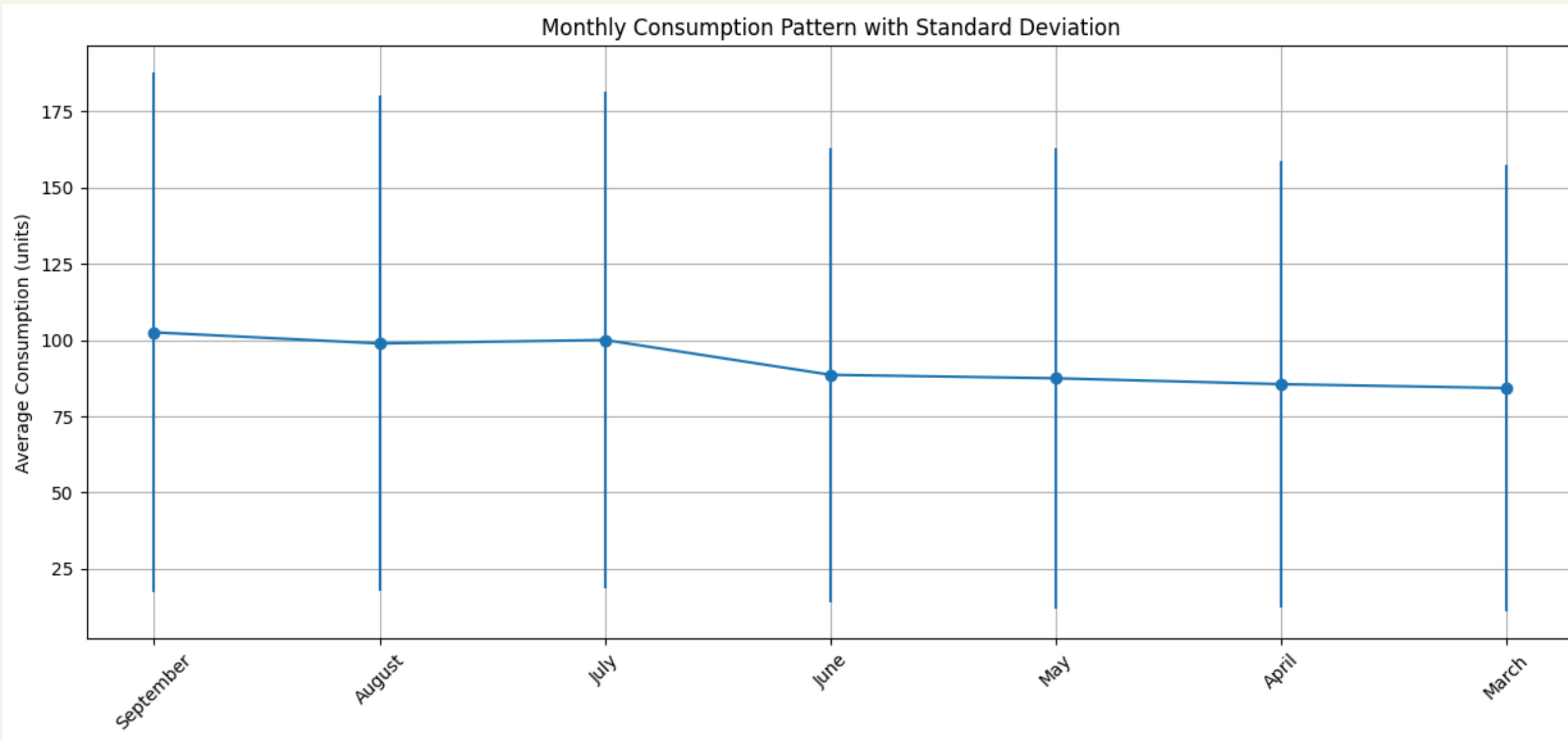
Polynomial Regression Equation:

Consumption = 2264.830 -132.169 * Temperature - 0.467 * Carpet-Area + 55.693 * #Person + 2.107 * Temperature^2 - 0.003 * Temperature Carpet-Area - 0.535 * Temperature #Person - 0.000 * Carpet-Area^2 + 0.206 * Carpet-Area #Person - 31.917 * #Person^2

Linear Regression **R²: 0.471**

Polynomial Regression **R²: 0.683**

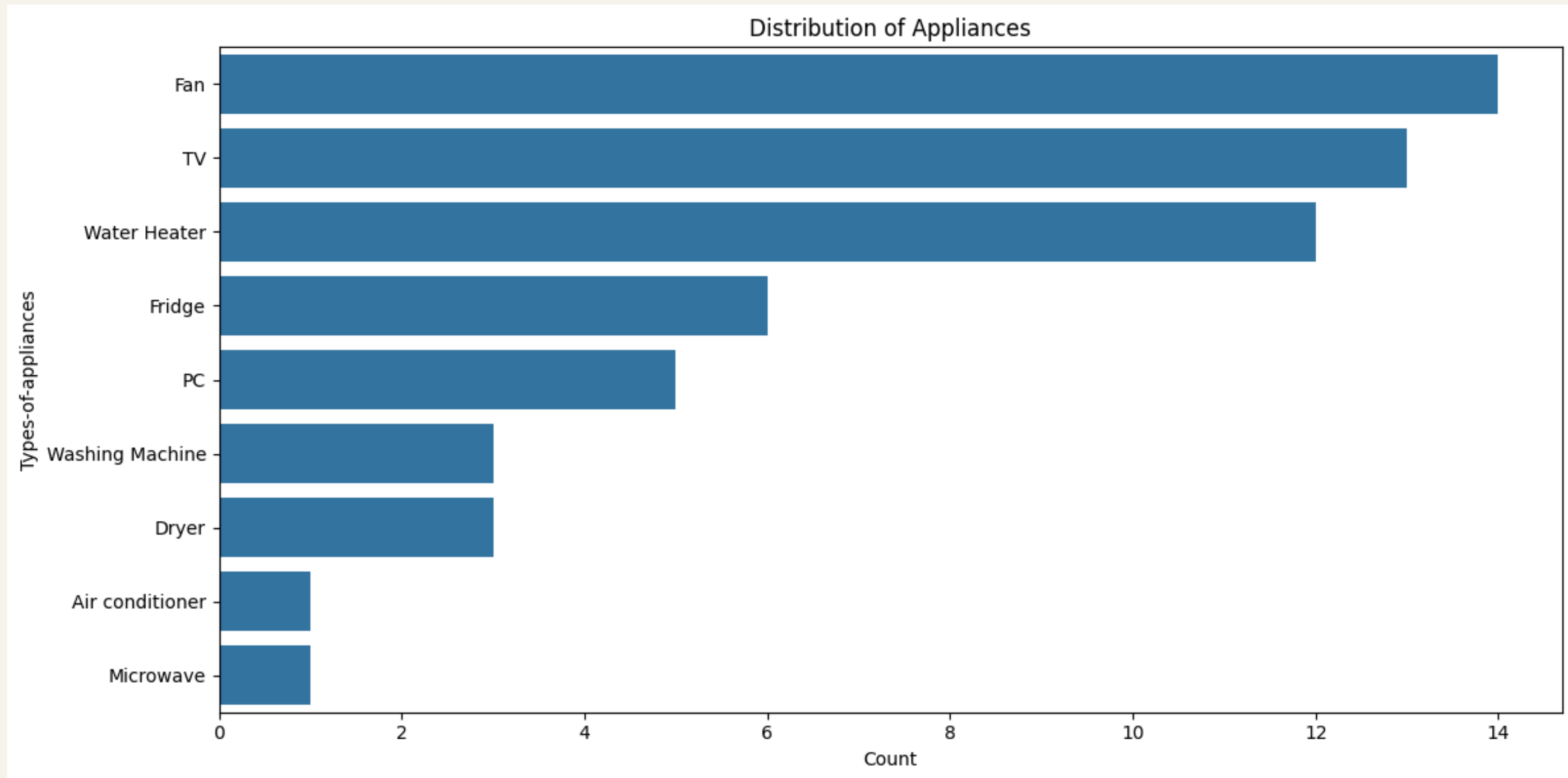
DATA ANALYSIS



Month-to-month average consumption changes

- March to April: 1.29 units (1.5%)
- April to May: 1.93 units (2.3%)
- May to June: 1.14 units (1.3%)
- June to July: 11.43 units (12.9%)
- July to August: -1.14 units (-1.1%)
- Aug to Sept. : 3.64 units (3.7%)

DATA ANALYSIS



DATA ANALYSIS

- Average consumption per person: 24.67 units
- Average area per person: 318.69 sq ft
- Most common household size: 3 persons
- Percentage of homes with AC: 7.1%
- Average consumption by AC homes: 123.14 units
- Average consumption by non-AC homes: 90.08 units
- Total number of homes: 14
- Average consumption: 92.44 units
- Median consumption: 72.86 units
- Maximum consumption: 282.00 units
- Minimum consumption: 11.71 units
- Average consumption per square foot: 0.090 units

DATA ANALYSIS

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Efficiency Metrics

- avg_consumption_per_sqft: 0.093
- avg_consumption_per_person: 26.411
- avg_consumption_per_appliance: 22.313

Correlations

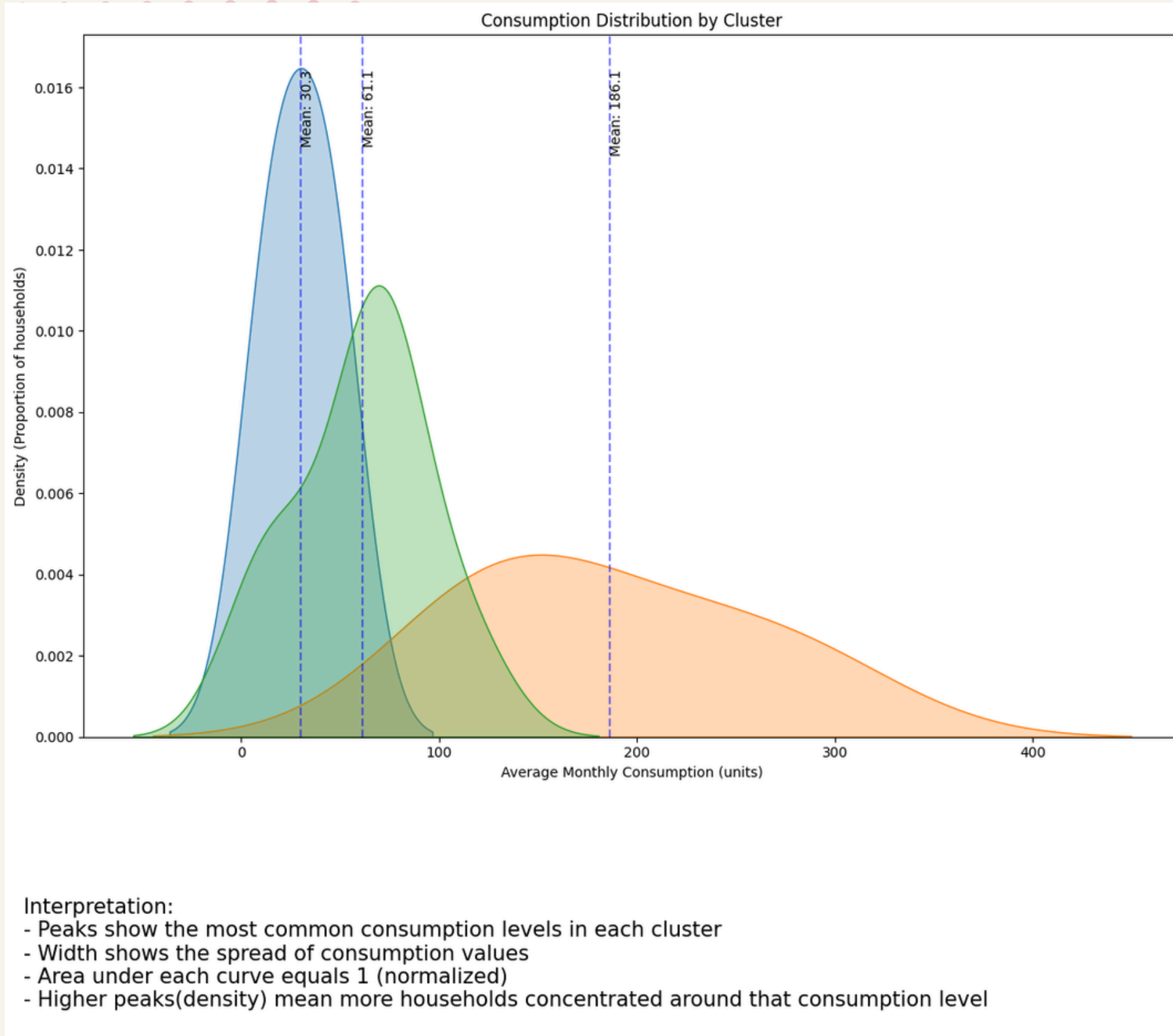
- area_vs_consumption: 0.606
- persons_vs_consumption: 0.642
- appliances_vs_consumption: 0.693

Most Efficient Households

Household ID	Avg Consumption	Consumption Per Person	Appliance Count
8	16.14	5.38	2
3	17.14	8.57	3
12	11.71	11.71	4

DATA ANALYSIS

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We found out 3 Clusters
in which all
the households could be
clubbed

Cluster 1:

Number of households: 4
Average consumption: 186.1 units
Min consumption: 123.1 units
Max consumption: 282.0 units
Typical characteristics:
Avg appliances: 6.0
Avg household size: 4.8 persons
Avg carpet area: 1250.0 sq ft

Cluster 0:

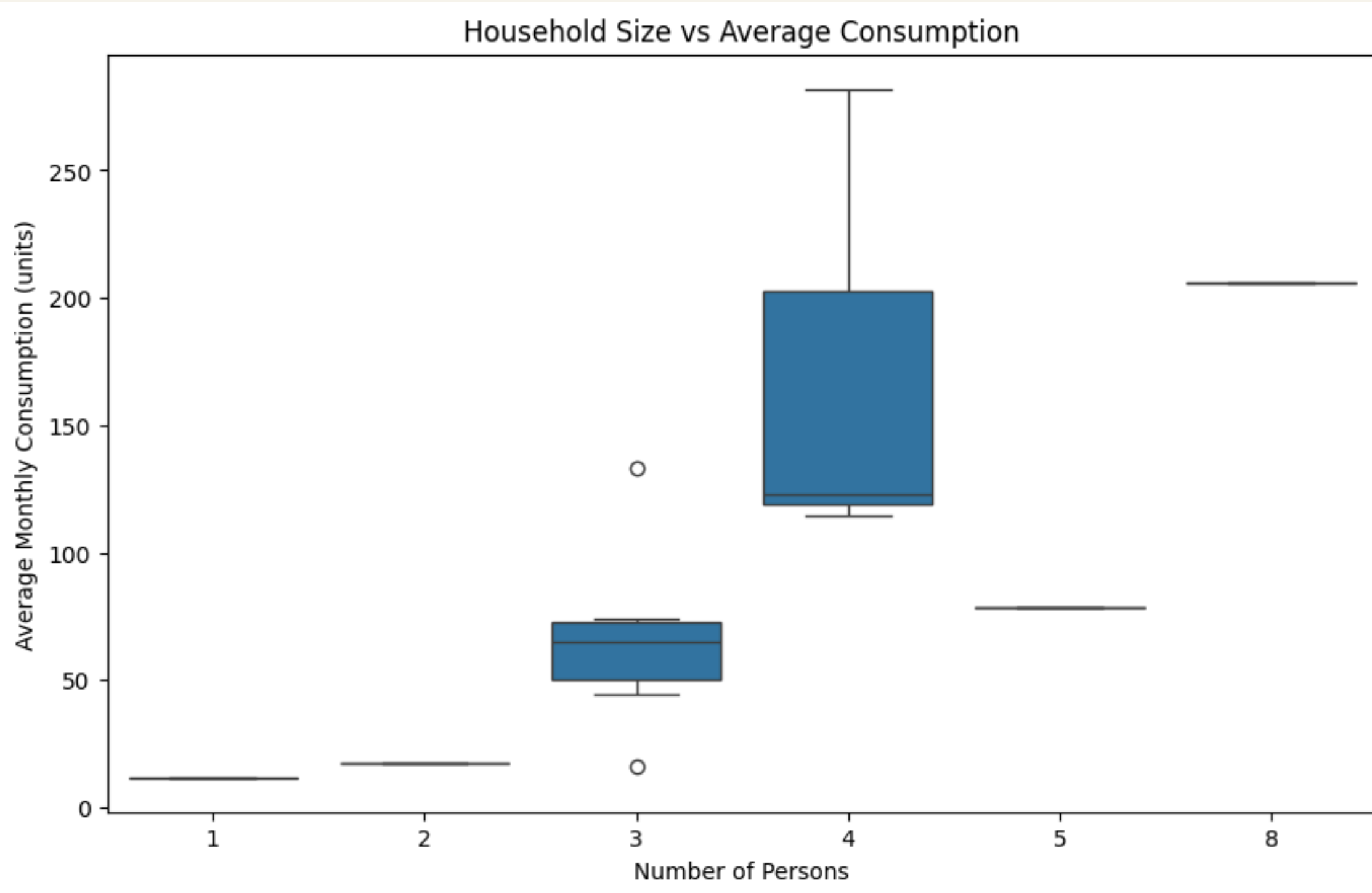
Number of households: 8
Average consumption: 61.1 units
Min consumption: 11.7 units
Max consumption: 114.4 units
Typical characteristics:
Avg appliances: 3.8
Avg household size: 3.0 persons
Avg carpet area: 912.5 sq ft

Cluster 2:

Number of households: 2
Average consumption: 30.3 units
Min consumption: 16.1 units
Max consumption: 44.4 units
Typical characteristics:
Avg appliances: 2.0
Avg household size: 3.0 persons
Avg carpet area: 800.0 sq ft

DATA ANALYSIS

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- **Household size and consumption have a moderate positive correlation, meaning larger households tend to consume more.** (This is supported by the correlation coefficient of 0.642 and the general upward trend in the boxplot)
- **Outliers exist, consumption variability increases with household size.** (Notice how the boxes and whiskers become larger for households with 3 or more people)

OVERVIEW

West Bengal State Electricity Distribution Company Ltd. (WBSEDCL), a government owned company is the primary supplier of electricity in West Bengal

1

Subsidized Tariffs

- Lower tariffs for economically weaker households and rural areas.
- Progressive slabs ensure affordability for low-income groups.

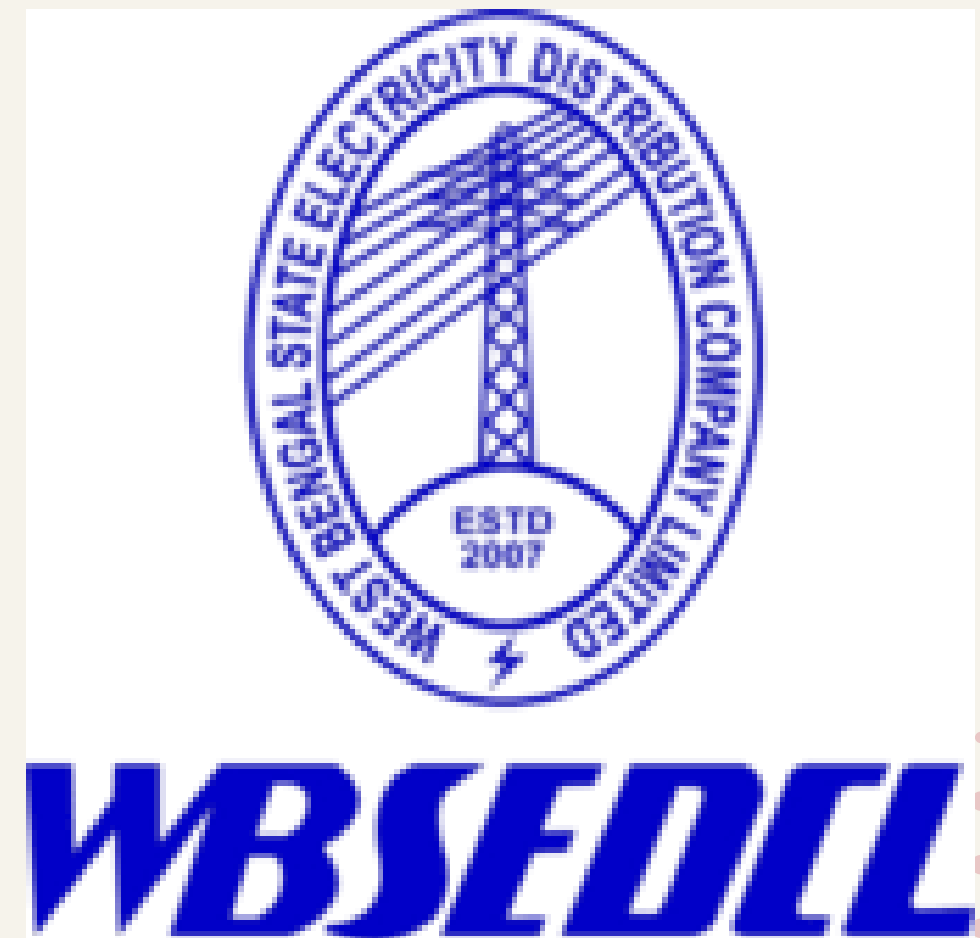
Current Tariff Rates (as of 2024)

Domestic Tariff (per unit):

- 0-100 units: ₹4.89 per unit
- 101-300 units: ₹5.40 per unit
- Above 300 units: ₹6.41 per unit

Fixed Monthly Charges:

- ₹30 for single-phase connections
- ₹75 for three-phase connections



2

Hasir Alo Scheme

- This scheme intends to provide free or reduced-cost electricity for marginalized and low-income households.
- Targeted support to ensure essential energy access.

3

Renewable Energy Initiatives

- Subsidies as high as 40% of the benchmark cost for household solar panel installation, especially in remote areas.
- Encourages sustainable practices and reduces grid dependency.

4

Renewable Energy Projects

- The Purulia Pumped Storage Project (900 MW) is operational; further projects are in planning to increase energy storage capacity.
- Emphasis on solar PV for agricultural uses, including solar-powered irrigation pumps.

5

Challenges with Existing Infrastructure

- Many coal plants are outdated, with over 38% of the capacity being over 20 years old.
- Planned decommissioning of aging plants and investments in clean energy infrastructure aim to reduce emissions and pollution

STRATEGIES

● Expanding Subsidy Program

Extending subsidies to low-income and rural households by lowering eligibility restrictions for greater affordability and energy access.

● Promote Renewable Energy

Encouraging solar panel installations with subsidies, easier approvals, and partnerships to lower costs and boost adoption.

● Public Awareness Campaigns

Educating citizens on energy-saving practices and subsidies via local outreach and digital platforms to boost participation.

● Research & Development

Investing in research for affordable energy solutions and efficient appliances to support state energy goals.

FUTURE OUTLOOK

- As can be seen from the analysis, the electricity consumption does not vary much across the months and many households don't use appliances like AC and microwaves. With the use of this appliances expected to increase in the coming future, the government should focus on building more renewable energy sources.
- The government is actively working on the rural electrification in the district. The West Bengal Renewable Energy Development Agency (WBREDA) is working on a 10 MW solar project at Bhajanghat and a 1 MW solar project at Ganga Sagar.

THANK YOU

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