

# Harnessing Weather Patterns to Identify Means to Optimise Households Energy Consumption by Town

# Who am I?

- Data Analyst employed by a vendor hired by NEA to
- NEA needs to target 3-5 towns in Singapore that consumes the most amount of energy
- The final goal is to promote usage of energy efficiency across island

# Problem Statement

Weather can potentially impact energy consumption as usage patterns in response to weather conditions.

By analysing the **relationship** between rainy days and energy consumption, we can identify **opportunities** to promote more efficient practices and optimise energy usage.

# Methodology

**Step 1 :** Monthly weather **pattern** in Singapore

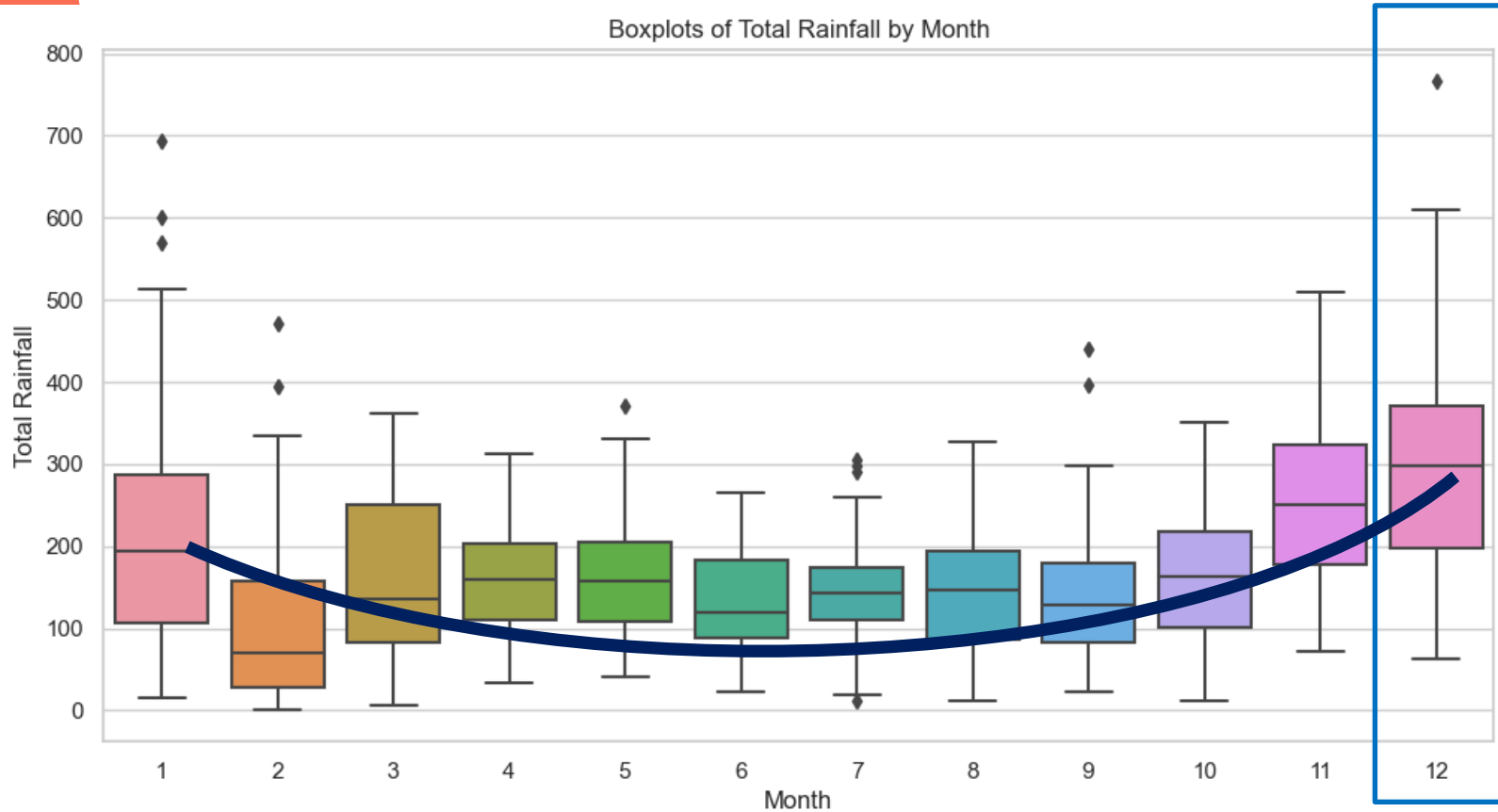
**Step 2 : Relationship** between various monthly weather data

**Step 3 :** Energy consumption **pattern** per month across **town** in Singapore

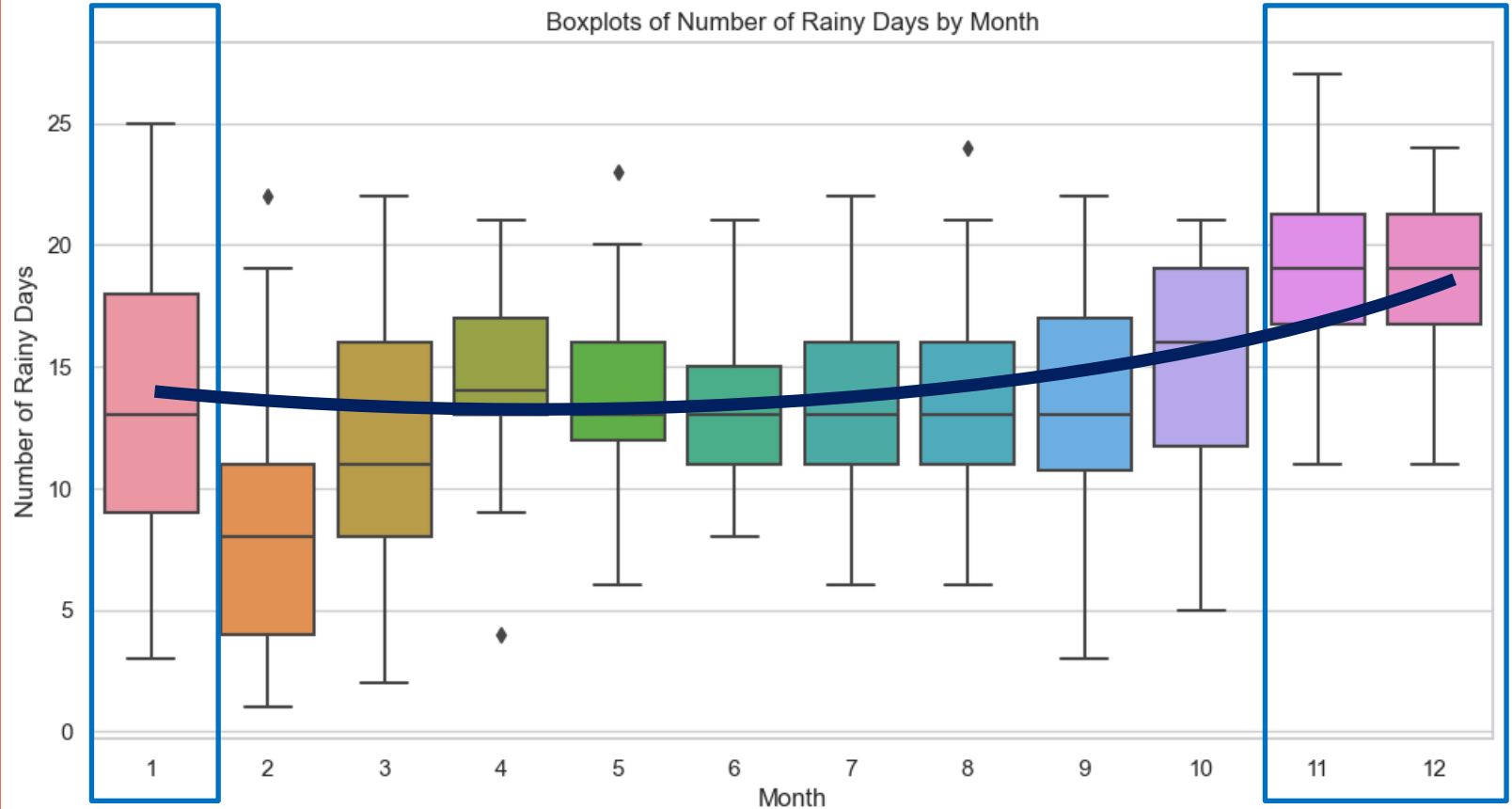
**Step 4 : Relationship** between various monthly weather data

**Step 5 : Relationship** between various monthly weather data and energy consumption across town

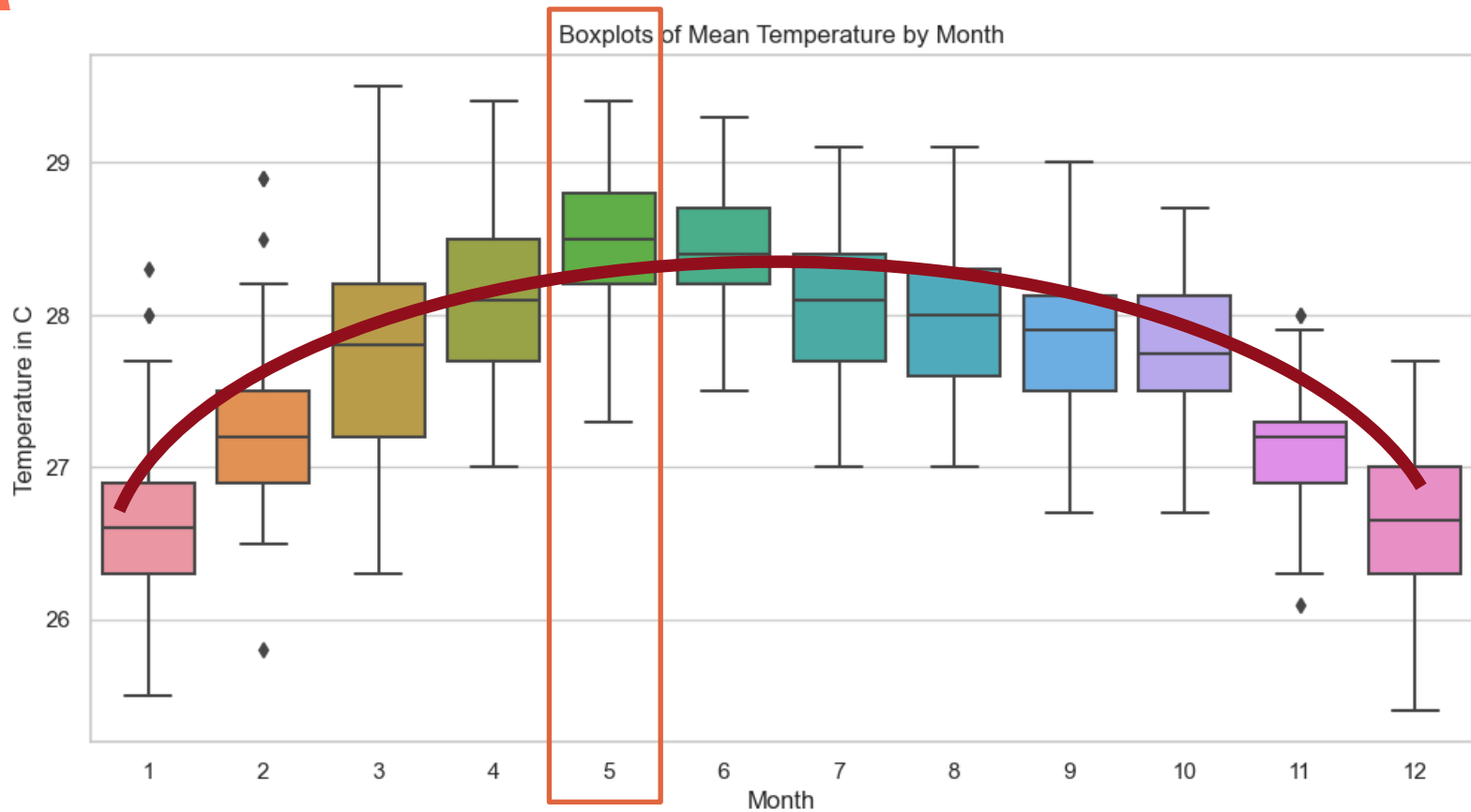
# Dec is the wettest month.



# Nov – Jan rains the most.



# May is the hottest in Singapore



## Step 2: Important Relationship between Weather Data

- (1) total rainfall in a month and maximum rainfall in a day have strong positive correlation ( $r = 0.81$ ).
- (2) total rainfall and mean temperature have very **mild (less than expected)** negative correlation ( $r = -0.51$ ).



# How weather could potentially connect to energy consumption

## **Possibility 1**

People stays at home more during rainy seasons

=> More household energy consumption

## **Possibility 2**

Air-conditioner / Water Heater are used more during hot seasons

⇒ More household energy consumption

# Major Source of Energy Consumption in Household



**5-ticks AC**  
200 to 250 kWh  
per month



**Refrigerator**  
6 kWh per  
wash/dry cycle

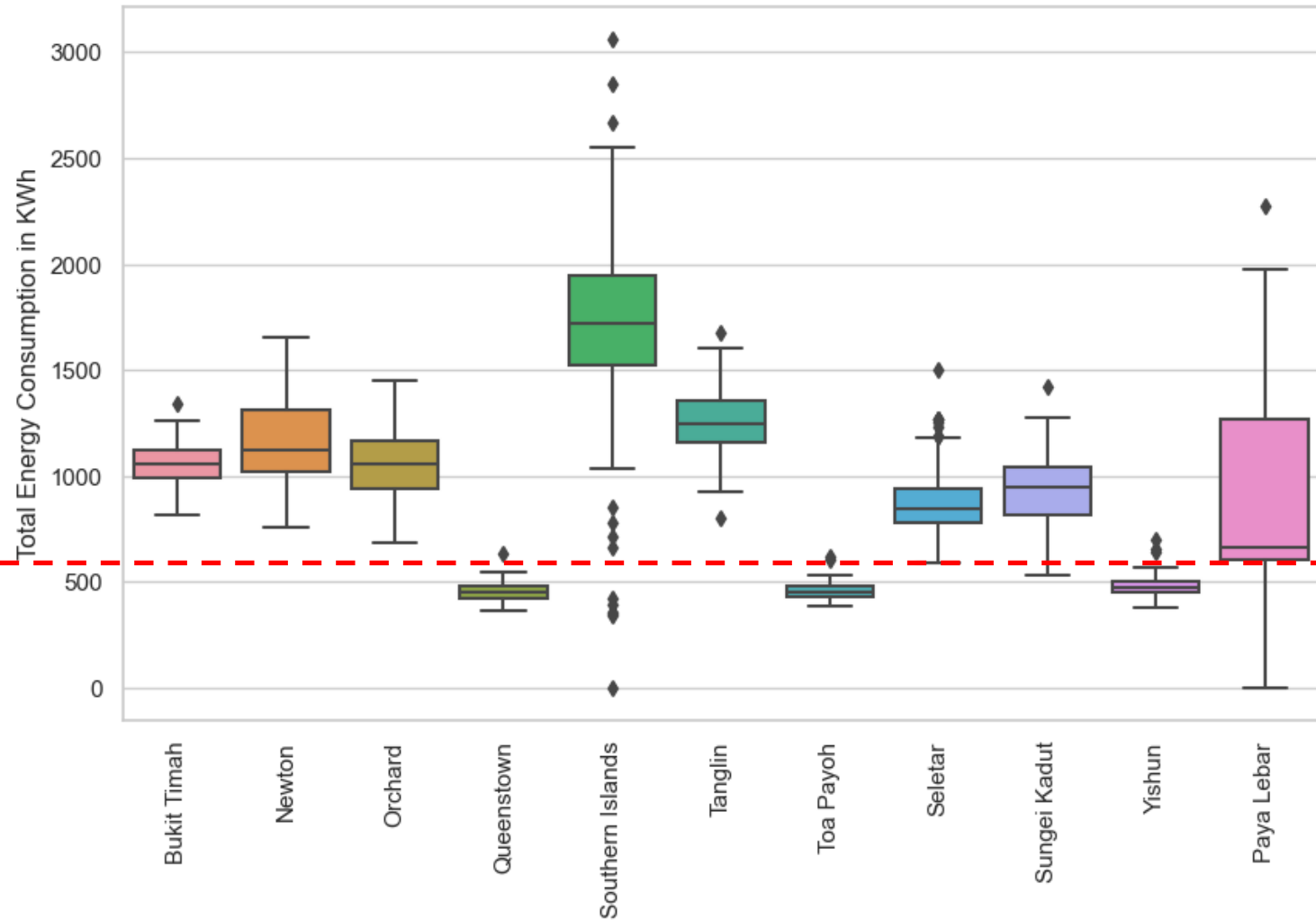


**Water Heater**  
60 to 80 kWh per  
month



**Washer/Dryer**  
6 kWh per  
wash/dry cycle

Boxplot of Total Energy Consumption by Singapore Per Month



mean  
648 kWh  
per month

# Step 3: Energy Consumption Patterns

| <div>Energy</div> <div>Area</div> | Average Household Consumption per Month (kwh) | Mean Household Consumption per Month (kWh) | Multiplier |
|-----------------------------------|---|--|------------|
| Bukit Timah                       | 1058  | 648  | 2x         |
| Newton                            | 1164  |  | 2x         |
| Orchard                           | 1063  |  | 2x         |
| Paya Lebar                        | 907   |  | 1.5x       |
| Seletar                           | 869   |  | 1.4x       |
| Southern Island                   | 1574  |  | 3x         |
| Tanglin                           | 1253  |  | 2x         |
| Sungei Kadut                      | 932   |  | 1.5x       |

# Opportunities

| Area            | Multiplier | Possible Reason       |
|-----------------|------------|-----------------------|
| Bukit Timah     | 2x         | Landed Properties     |
| Newton          | 2x         |                       |
| Orchard         | 2x         |                       |
| Tanglin         | 1.5x       |                       |
| Southern Island | 1.4x       |                       |
| Paya Lebar      | 3x         | Proximity to Airport  |
| Seletar         | 2x         |                       |
| Sungei Kadut    | 1.5x       | Light Industrial Area |

- The table below shows a collection of correlation coefficients ( $r$ ) between the variables below.
- For example, Energy Consumption in Bishan is 0.726245 correlated with Bukit Merah.

|               | Bishan   | Bukit Merah | Bukit Timah | Downtown | Geylang  | Kallang  | Marine Parade |
|---------------|----------|-------------|-------------|----------|----------|----------|---------------|
| Bishan        | 1.000000 | 0.726245    | 0.811978    | 0.613544 | 0.895236 | 0.914687 | 0.872386      |
| Bukit Merah   | 0.726245 | 1.000000    | 0.641676    | 0.638045 | 0.730314 | 0.827337 | 0.804182      |
| Bukit Timah   | 0.811978 | 0.641676    | 1.000000    | 0.529479 | 0.722889 | 0.776652 | 0.752140      |
| Downtown      | 0.613544 | 0.638045    | 0.529479    | 1.000000 | 0.457717 | 0.602136 | 0.635288      |
| Geylang       | 0.895236 | 0.730314    | 0.722889    | 0.457717 | 1.000000 | 0.946110 | 0.842965      |
| Kallang       | 0.914687 | 0.827337    | 0.776652    | 0.602136 | 0.946110 | 1.000000 | 0.890666      |
| Marine Parade | 0.872386 | 0.804182    | 0.752140    | 0.635288 | 0.842965 | 0.890666 | 1.000000      |

# Relationship between Energy Consumption across town

- (1) All the variables are closely related to one another.
- (2) Most of the numbers are strongly positively correlated ( $> 0.7$ ) to each other.

# Relationship between Energy Consumption across town





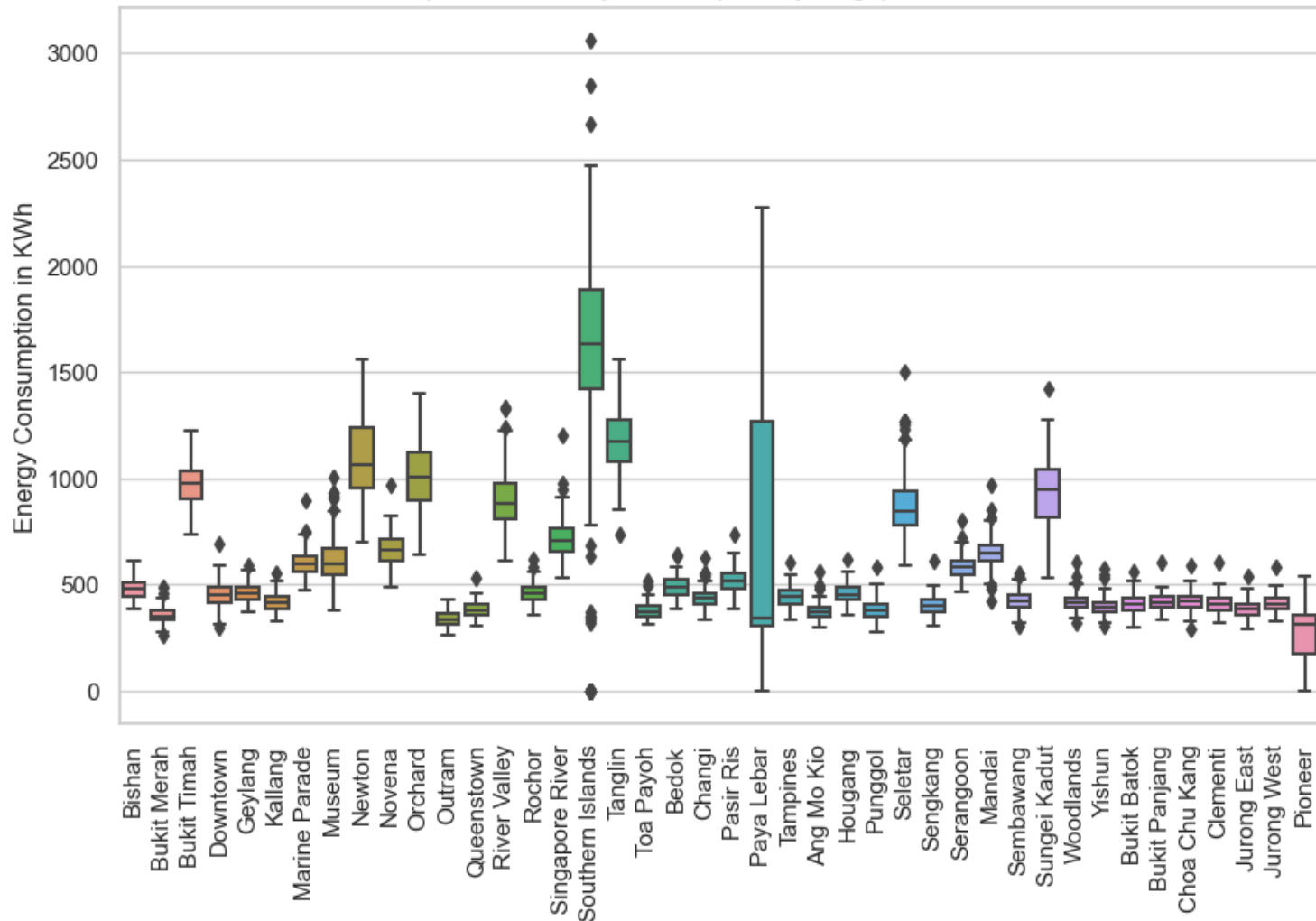
# Summary of Insights

- (1) The recommendations from us will **not** be weather-dependent.
- (2) Bukit Timah, Newton, Orchard, Tanglin and Southern Islands are
  - **top** target audience for energy consumption campaign
  - the campaign will be **electricity** consumption focused
- (3) If a energy conservation strategy works in this area, due to the **high** correlation between energy consumption patterns across areas, the campaign can expand to island-wide.

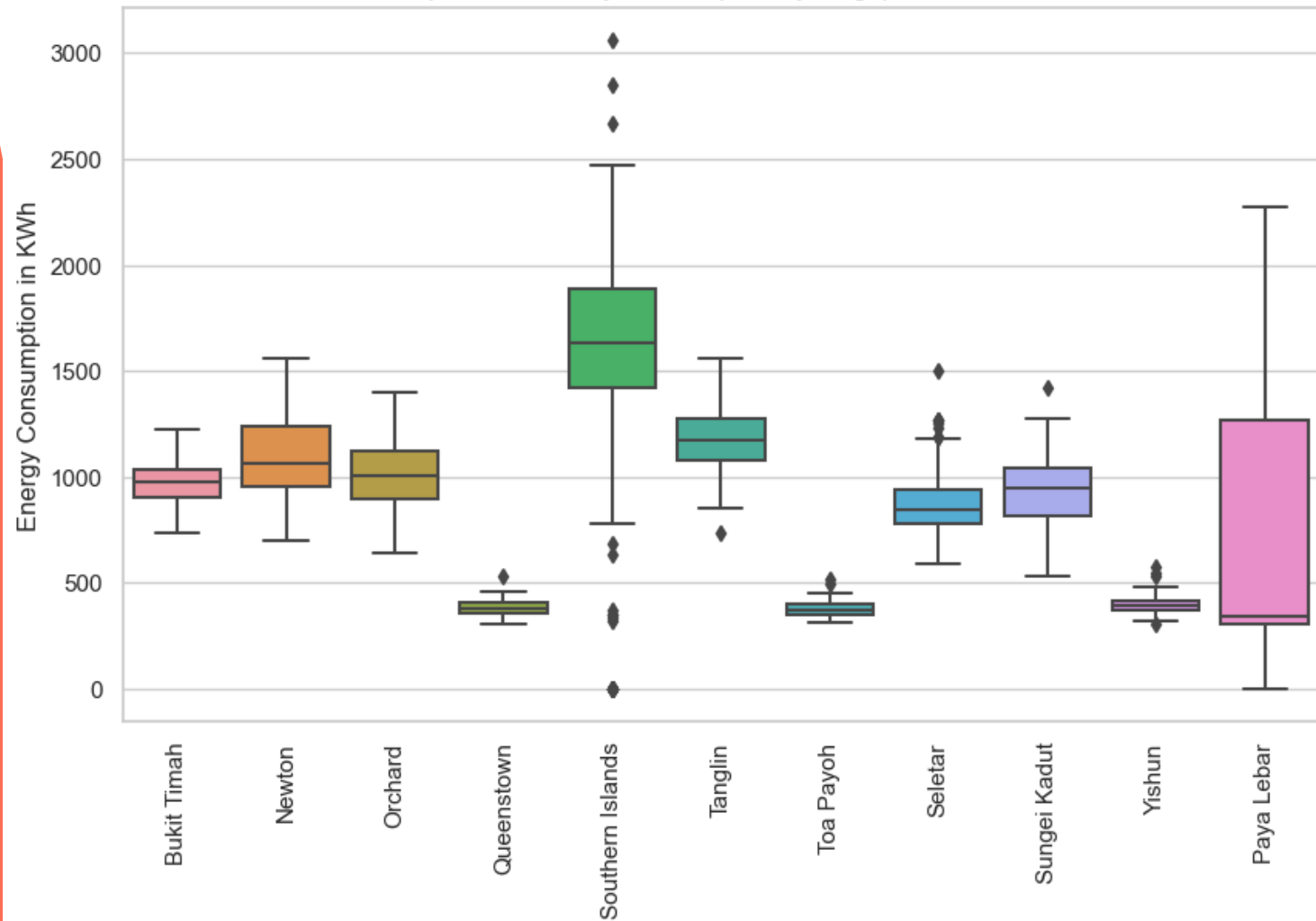
# Appendix

1. Boxplot of Monthly Gas Consumption
2. Boxplot of Monthly Electricity Consumption
3. Boxplot of Monthly Total Energy Consumption

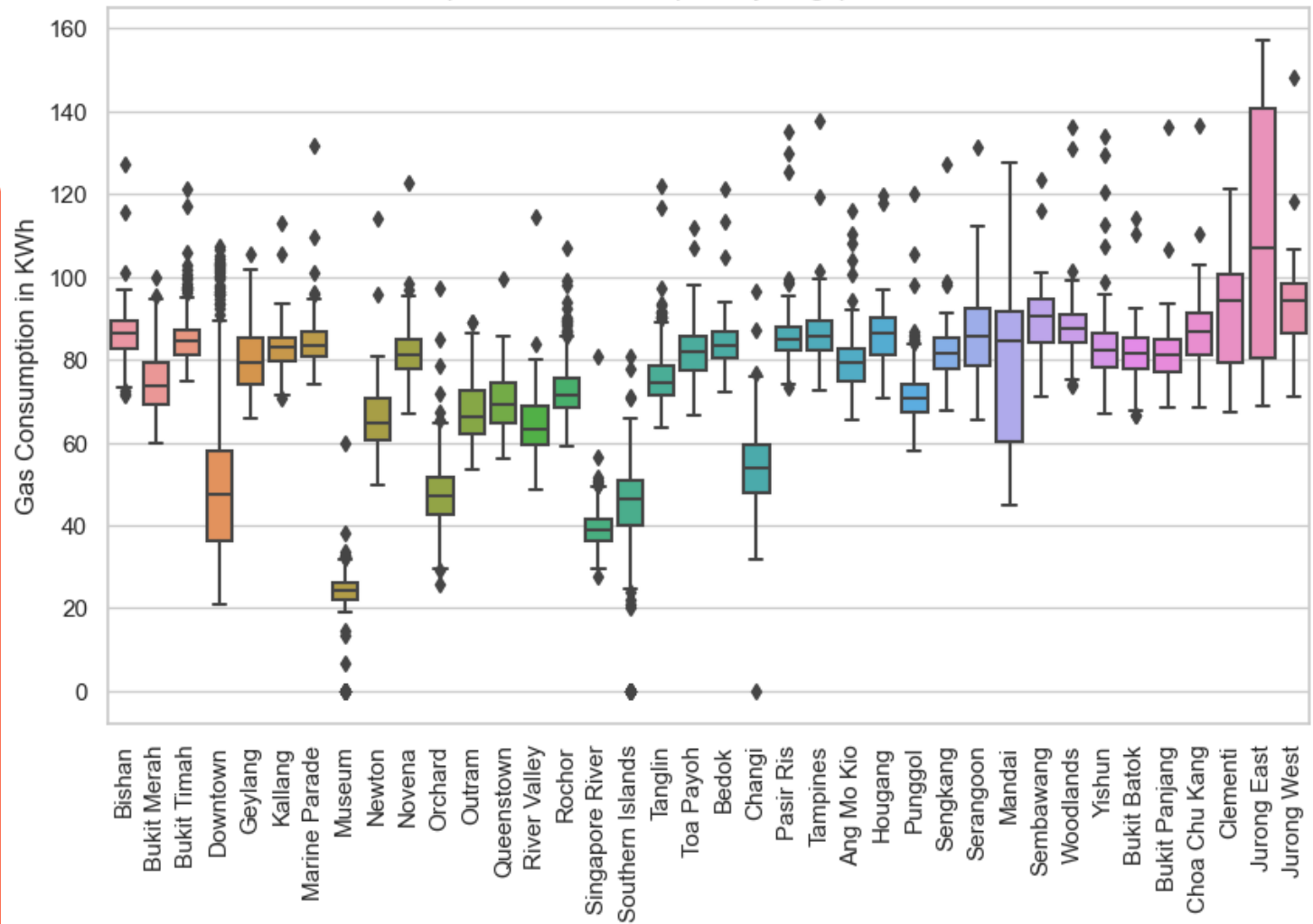
# Boxplot of Electricity Consumption by Singapore Per Month



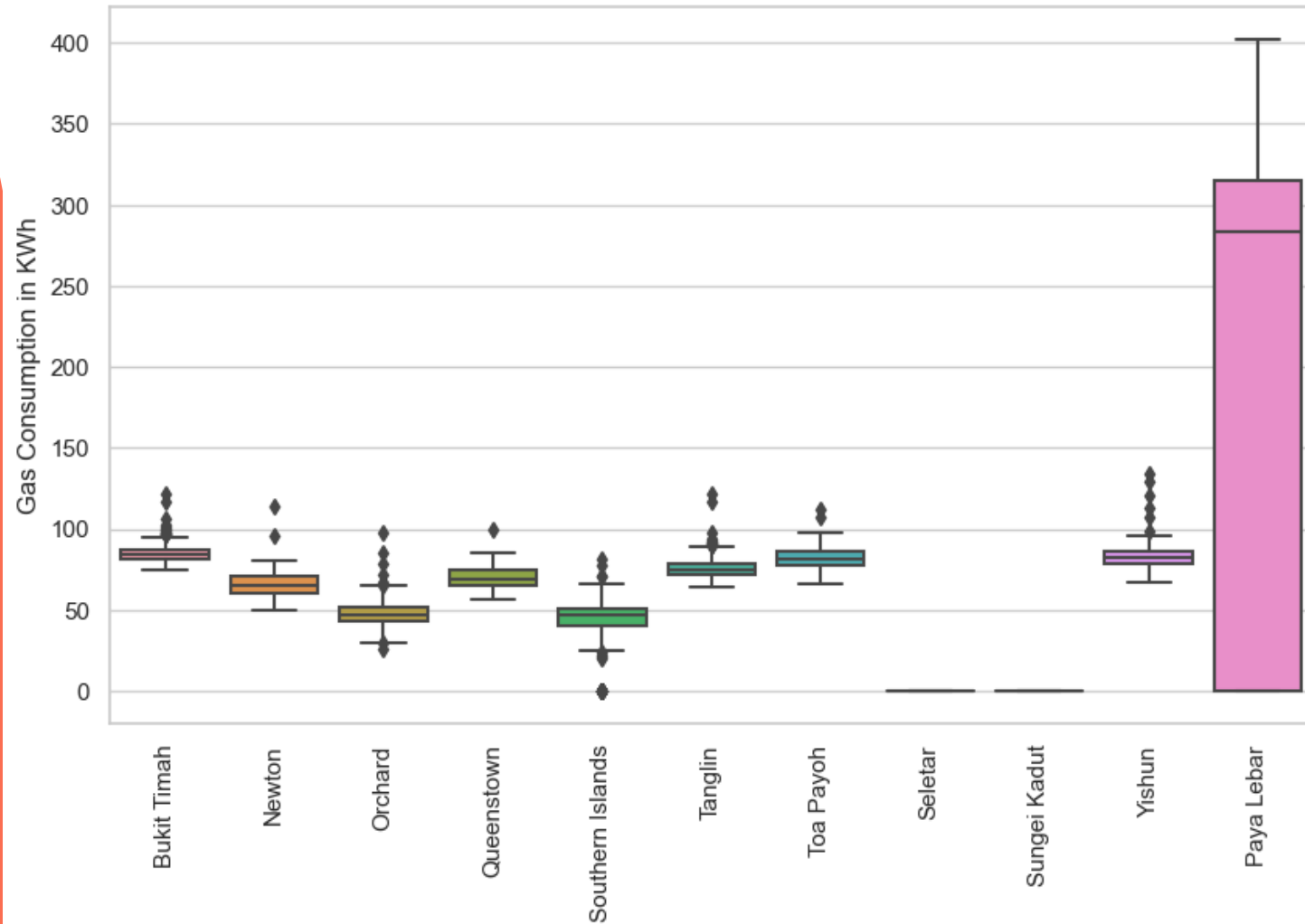
Boxplot of Electricity Consumption by Singapore Per Month



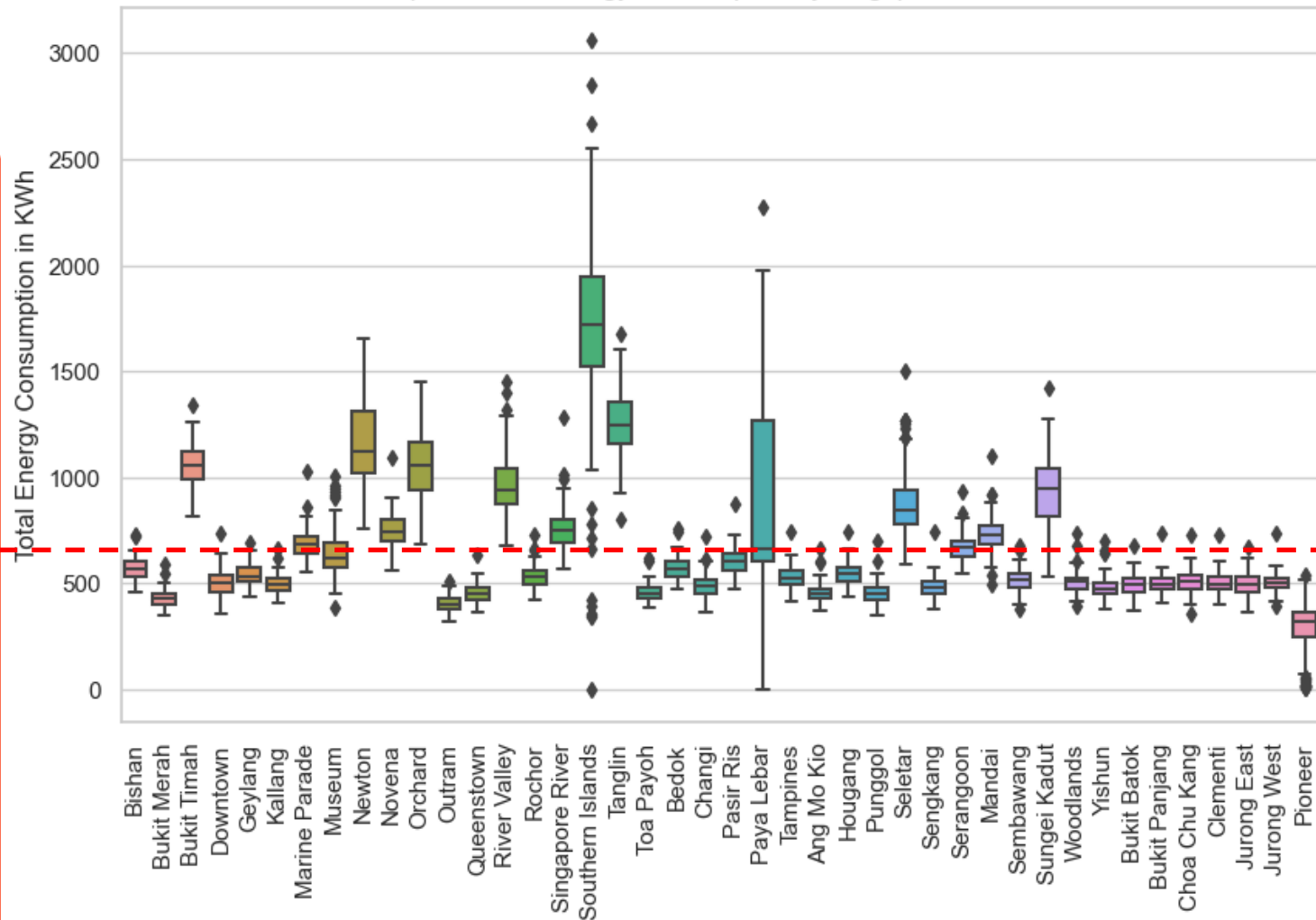
# Boxplot of Gas Consumption by Singapore Per Month



Boxplot of Gas Consumption by Singapore Per Month



# Boxplot of Total Energy Consumption by Singapore Per Month



mean  
648 kWh  
per month