Data Analysis of Singapore Weather Patterns to Identify Means to Optimise Households Energy Consumption by Town

Data Analyst of a vendor hired by Government

Who am I?

Government wishes to promote usage of energy efficiency across island.

They will run pilot projects for 3-5 towns in Singapore and needs some insights how to approach it.

Problem Statement

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

Analysing the **relationship** between Singapore weather and energy consumption across **town**, we can identify **opportunities** to promote more efficient practices and optimise energy usage.

Methodology

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

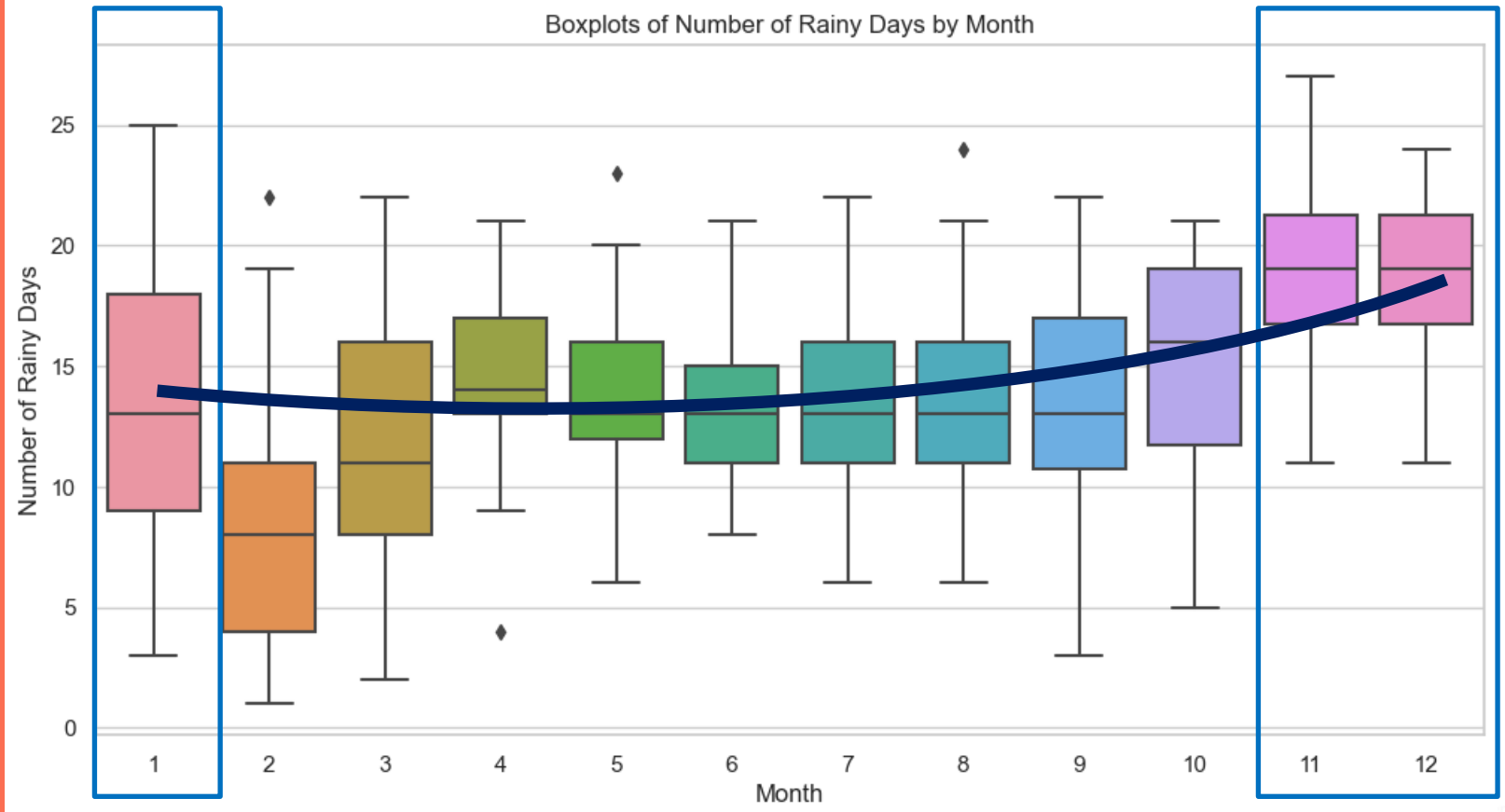
Step 2 : Relationship between various monthly weather data

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

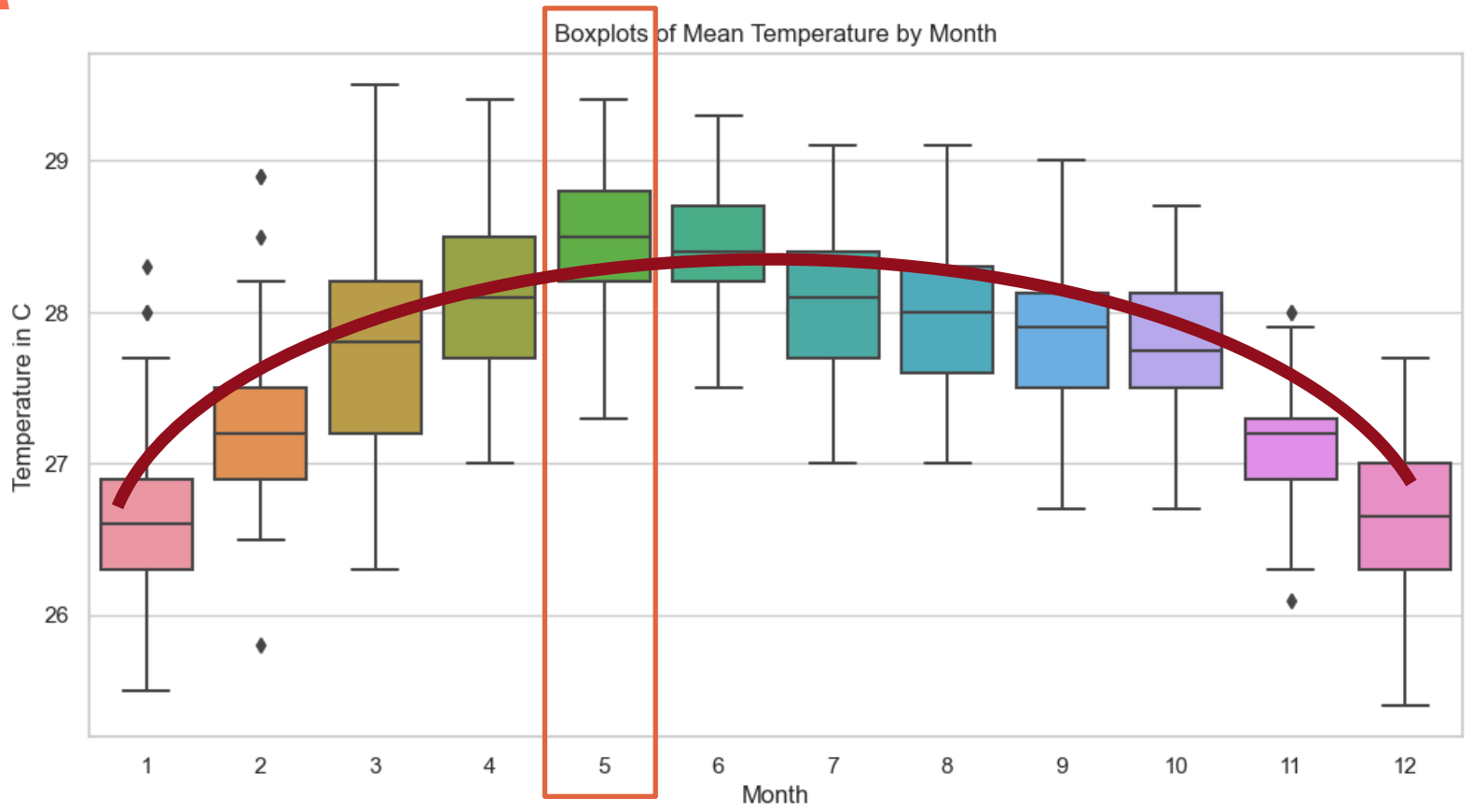
Step 4 : Relationship between average energy consumption across **town**

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

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).

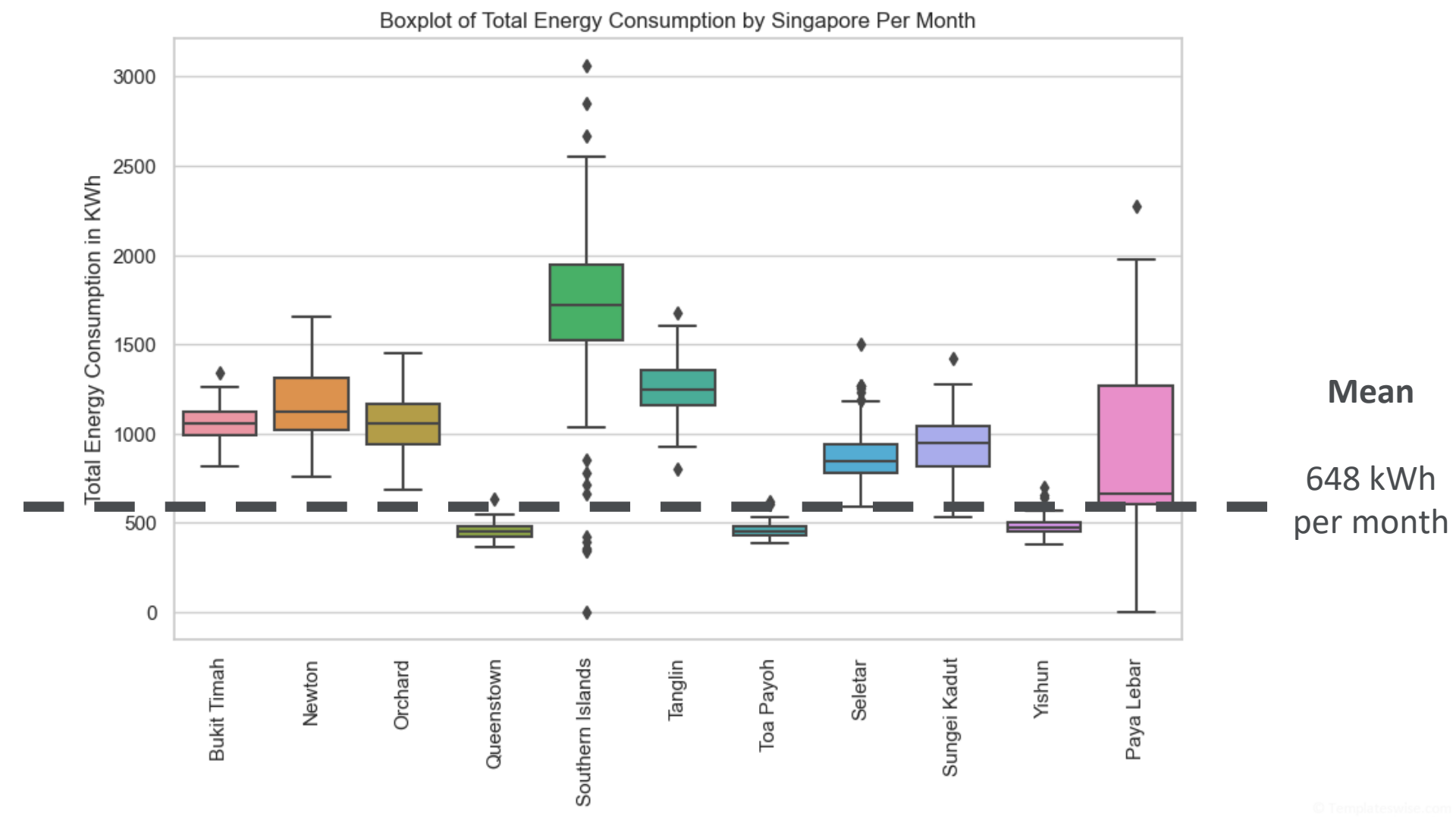
Major Source of Energy Consumption in Household

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
Total Energy Consumption in KWh
3000
2500
2000
1500
1000
500
0
Bukit Timah
Newton
Orchard
Queenstown
Southern Islands
Tanglin
Toa Payoh
Seletar
Sungei Kadut
Yishun
Paya Lebar
Mean
648 kWh
per month

Step 3: Energy Consumption Patterns

Energy / Area	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

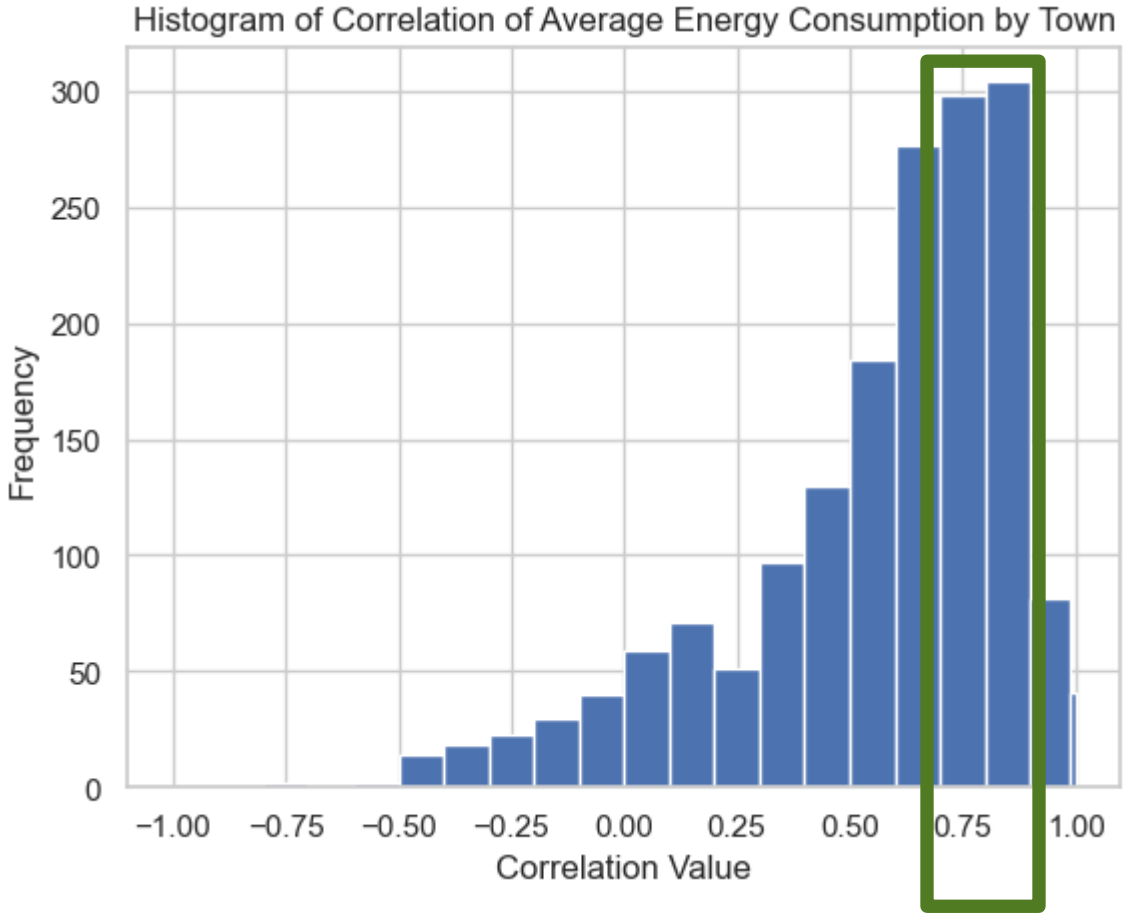
Area	Multiplier	Possible Reason and Potential Remedy
Bukit Timah	2x	Campaign that focus on Landed Properties
Newton	2x	
Orchard	2x	
Tanglin	1.5x	
Southern Island	1.4x	
Paya Lebar	3x	Campaign that focus on Landed Properties
Seletar	2x	
Sungei Kadut	1.5x	Campaign that focuses on Light Industrial Factories

- 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

Step 4: Relationship between average energy consumption across **town**

A good portions of correlation coefficients are strongly positively correlated (> 0.7) to each other.



Relationship between Energy Consumption across **town**

The energy consumption patterns across towns are **similar**.

Push for one **successful** campaign in a town

Expand our campaigns to all towns

How weather could potentially connect to energy consumption

Possibility 1

People stays at home more during rainy seasons

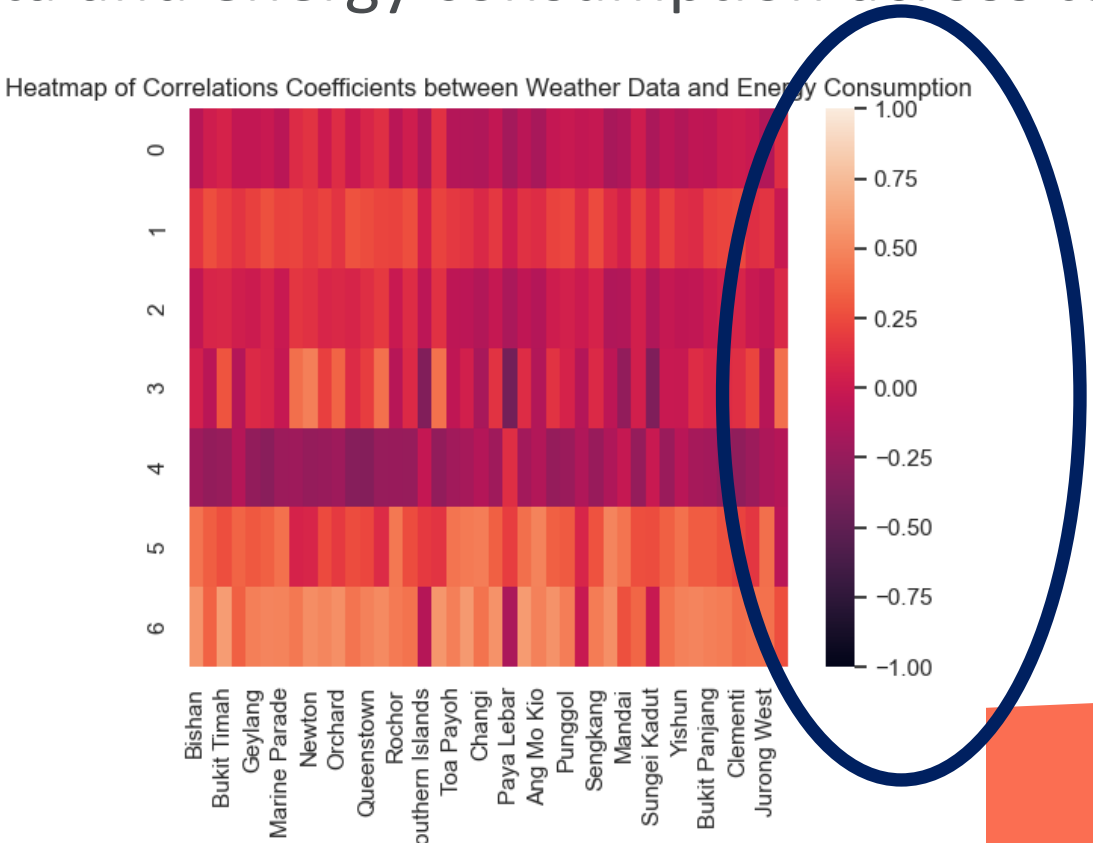
=> More household energy consumption

Possibility 2

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

⇒ More household energy consumption

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



Summary of Recommendations

(1) The recommended campaign from us will **not** be weather-dependent.

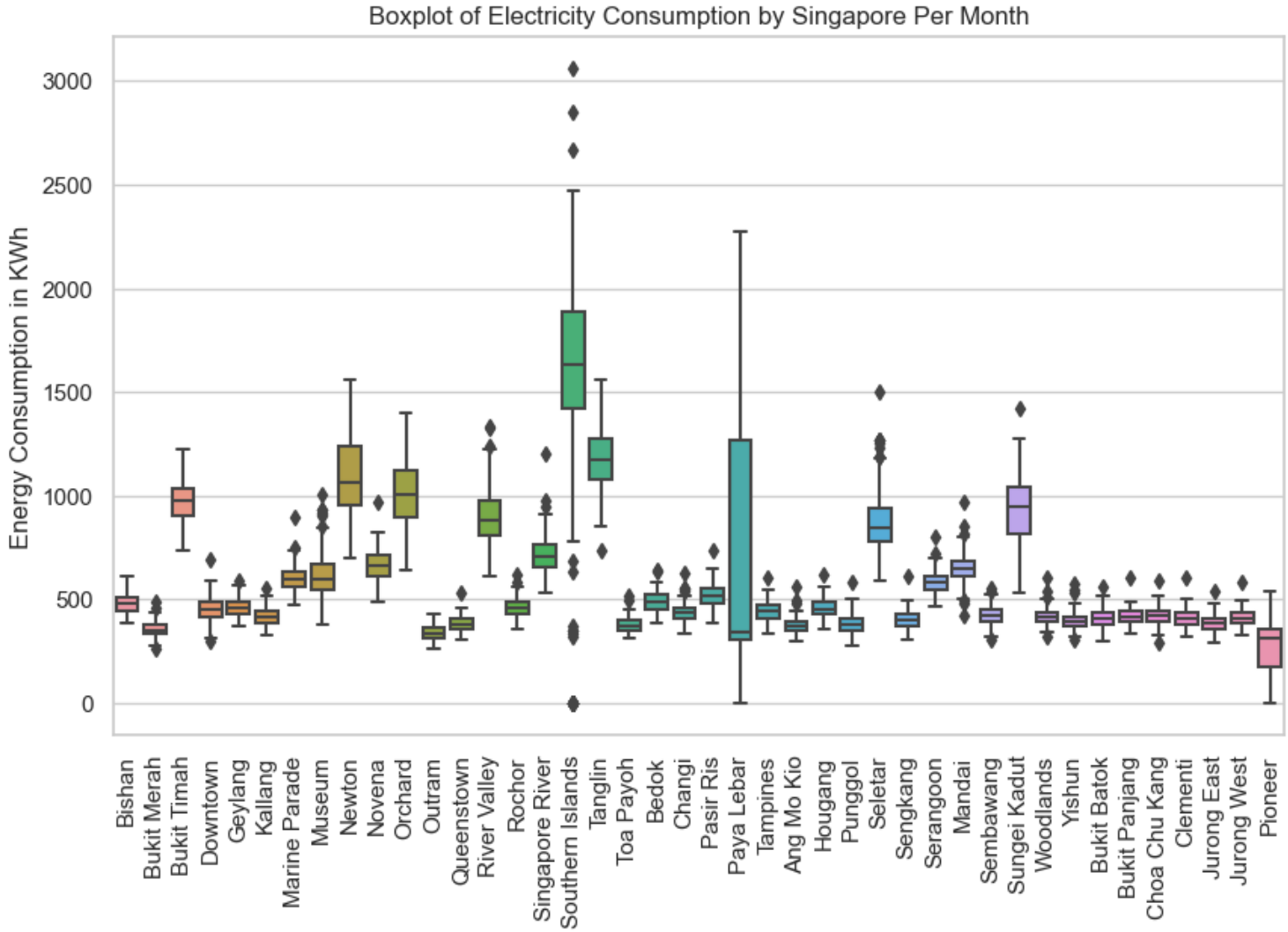
(2) Bukit Timah, Newton, Orchard, Tanglin and Southern Islands are

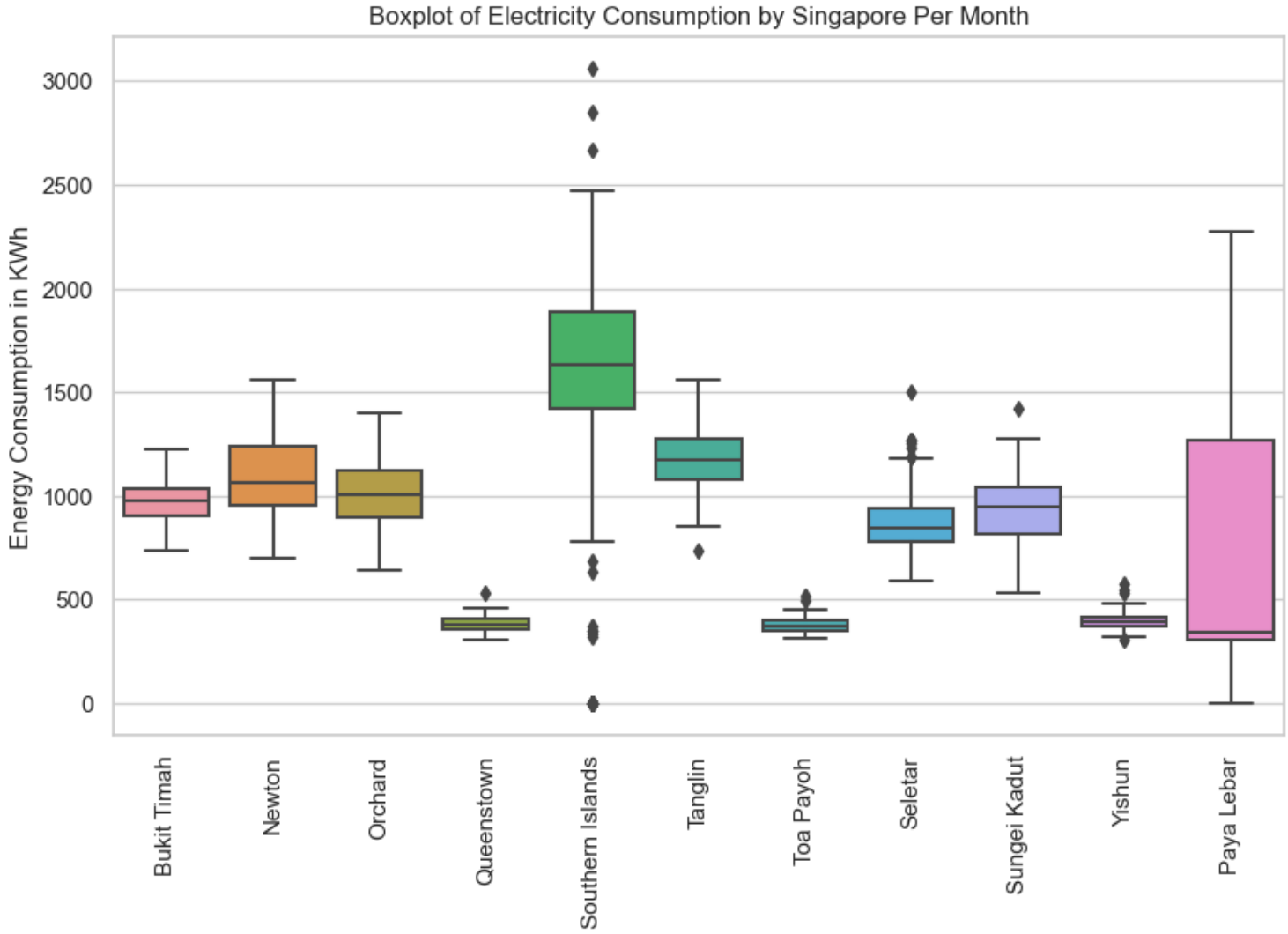
- **top** target audience for energy consumption campaign
- the campaign will be **electricity** consumption focused

(3) Any successful recommendations are expandable to all other towns due to the **high level of similiarity** between energy consumption patterns across areas.

Appendix

1. Boxplot of Monthly Electricity Consumption across **all** towns
2. Boxplot of Monthly Electricity Consumption across **selected** towns
3. Boxplot of Monthly Gas Consumption across **all** towns
4. Boxplot of Monthly Gas Consumption across **selected** towns
5. Boxplot of Monthly Total Energy Consumption
6. Table of Housing Type by Percentage
7. Boxplot of Total Rainfall by Month


Boxplot of Electricity Consumption by Singapore Per Month
Energy Consumption in KWh
3000
2500
2000
1500
1000
500
0
Bishan
Bukit Merah
Bukit Timah
Downtown
Geylang
Kallang
Marine Parade
Museum
Newton
Novena
Orchard
Outram
Queenstown
River Valley
Rochor
Singapore River
Southern Islands
Tanglin
Toa Payoh
Bedok
Changi
Pasir Ris
Paya Lebar
Tampines
Ang Mo Kio
Hougang
Punggol
Seletar
Sengkang
Serangoon
Mandai
Sembawang
Sungei Kadut
Woodlands
Yishun
Bukit Batok
Bukit Panjang
Choa Chu Kang
Clementi
Jurong East
Jurong West
Pioneer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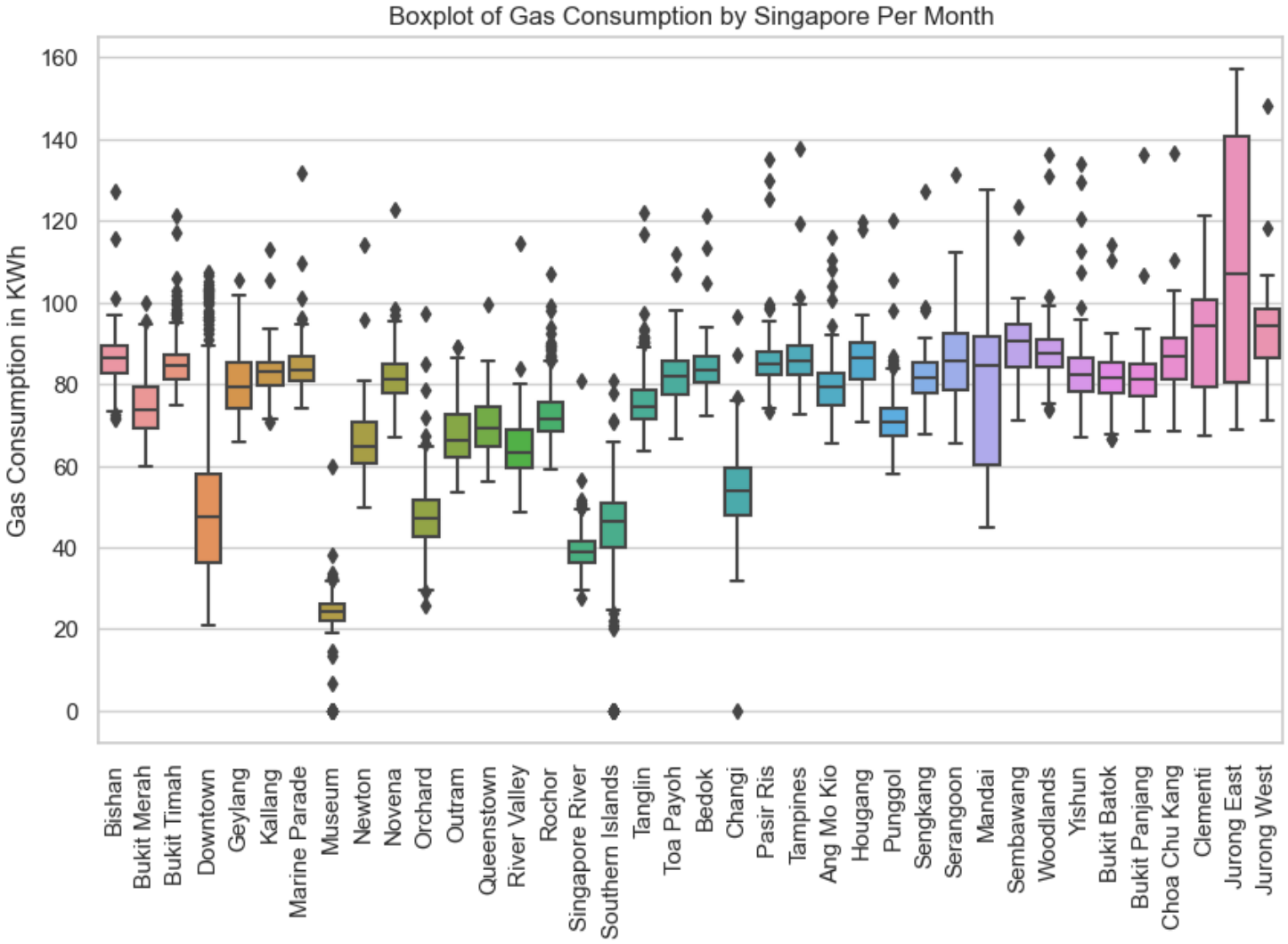
Boxplot of Gas Consumption by Singapore Per Month
Gas Consumption in KWh
160
140
120
100
80
60
40
20
0
Bishan
Bukit Merah
Bukit Timah
Downtown
Geylang
Kallang
Marine Parade
Museum
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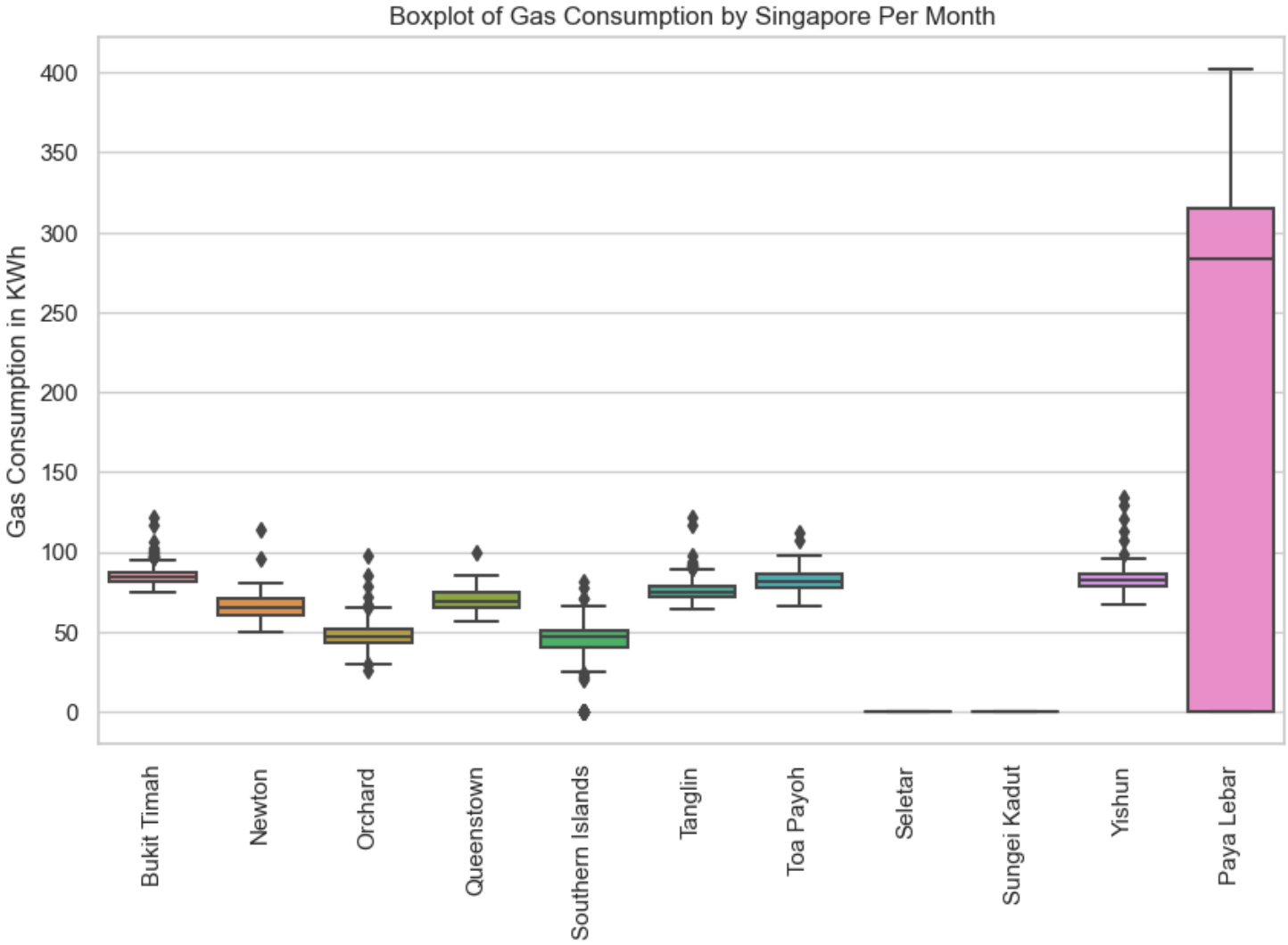
Jurong West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Gas Consumption in KWh
400
350
300
250
200
150
100
50
0
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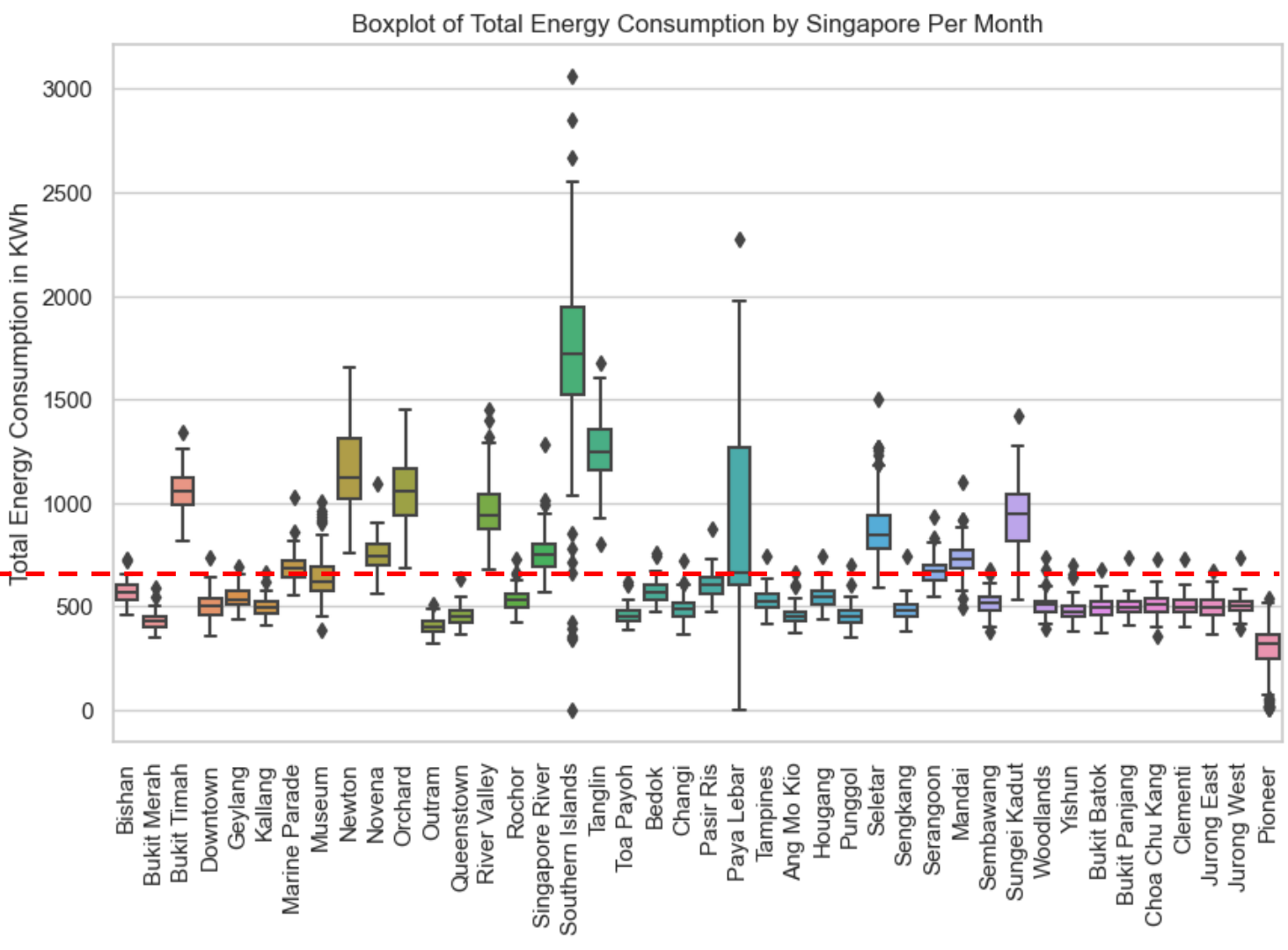

mean
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per month

Housing Type by Percentage

Items	Unit	Latest Period	Latest Data	% Change (Y-o-Y) 1/	Previous Period Data	% Change (Y-o-Y) 2/
Total HDB Dwellings	%	2022	77.9	na	78.3	na
HDB 1- & 2-Room Flats 7/	%	2022	6.7	na	6.6	na
HDB 3-Room Flats	%	2022	17.2	na	17.5	na
HDB 4-Room Flats	%	2022	31.4	na	31.5	na
HDB 5-Room & Executive Flats	%	2022	22.6	na	22.7	na
Condominiums & Other Apartments	%	2022	17.0	na	16.5	na
Landed Properties	%	2022	4.9	na	4.9	na

Dec is the wettest month.