



# Weather and Dengue

- 1** An enquiry was triggered for our **team of researchers in NEA** to do an exploratory analysis to gain insights on Singapore's weather patterns and its relation to dengue infection numbers
  
- 2** Findings will be **presented to other teams and managers at NEA and other stakeholders** involved in the control of dengue infections and aim to better inform their understanding and their decision making during the implementation of these control

---

Ngan Han Kiong  
GA DSI-SG-42  
29 Feb 2024

# Table of contents

**01** Background and Problem statement

---

**02** Methodology

---

**03** Findings

---

**04** Conclusion and Recommendations





01

# Background and Problem statement

---

# Background



## Dengue infections up for seven straight weeks; NEA urges 'immediate action'



23 Jan 2024 08:49PM  
(Updated: 23 Jan 2024 09:06PM)



[Link to article](#)



An A... : iStock/lirton)

New: You can now listen to articles.



Listen to this article



3 min

This audio is generated by an AI tool.

SINGAPORE: More than 400 dengue infections were reported in the week ending Jan 20, marking the seventh consecutive week of increase, newly released data by the National Environment Agency (NEA) showed on Tuesday (Jan 23).

The 410 dengue cases reported last week was 15 more than in the previous seven

- Recent article on Channel News Asia highlighted that dengue infections is on the rise.
- In a 2022 article on Channel News Asia "[Rising temperatures could increase risk of new infectious diseases in Singapore: Experts](#)", it mentions how **rising temperatures due to climate change may increase the risk of infectious diseases** in Singapore, including dengue fever.
- Dengue fever cases have risen significantly in recent years, attributed partly to climate change and the expansion of mosquito habitats. There is a more dire need to address this rising numbers and determine the factors that affect dengue infections
- Study conducted by a group of Iranian researchers [Climate Change and Infectious Diseases: Evidence from Highly Vulnerable Countries](#) concludes that **temperature had a positive relationship with number of patients affected from infectious diseases**
- Another study by a group of Chinese researchers [The effect of temperature on dengue virus transmission by Aedes mosquitoes](#) concludes that the **optimum minimum temperature** for transmission of DENV is 14.8 °C and the **optimum maximum temperature** ranges from 32 to 33 °C.

### Related Topics

dengue    mosquitoes

National Environment Agency

# Problem Statement

**Examine the relationship between  
climate-related variables and the  
incidence of dengue cases**



# Datasets used

Weather-related datasets from data.gov.sg

<b>Monthly Total Rainfall</b>	Measure of monthly total rainfall from 1982 to 2022
<b>Monthly Number of Rain Days</b>	Measure of number of rainy days from 1982 to 2022
<b>Monthly Mean Surface Air Temperature</b>	Measure of monthly mean surface air temperature from 1982 to 2022
<b>Monthly Mean Sunshine Duration</b>	Measure of mean sunshine hours 1982 to 2022
<b>Monthly Mean Relative Humidity</b>	Measure of monthly mean relative humidity from 1982 to 2022

<b>Weekly Number of Dengue and Haemorrhagic Fever Infections</b>	Measure of the weekly number of dengue and haemorrhagic fever infections from 2014 to 2018
--	--

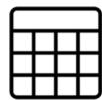


# Procedure and Methodology

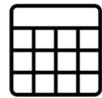
02



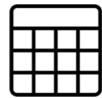
# Procedure and Methodology



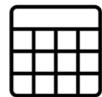
Number of Dengue Infections  
Weekly data from 2014 to 2018



Number of Dengue Infections  
Monthly data from 2014 to 2018



Surface Air Temperature  
Monthly data from 1982 to 2022



Total Rainfall  
Monthly data from 1982 to 2022



Other Climate Datasets  
Monthly data from 1982 to 2022



Combined Data  
Monthly data from 2014 to 2018

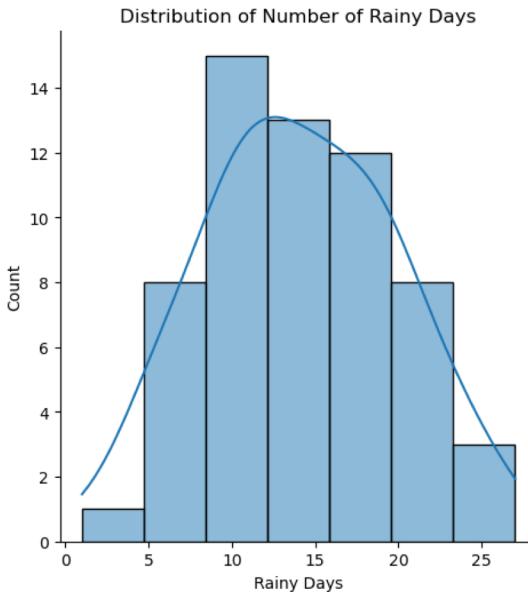
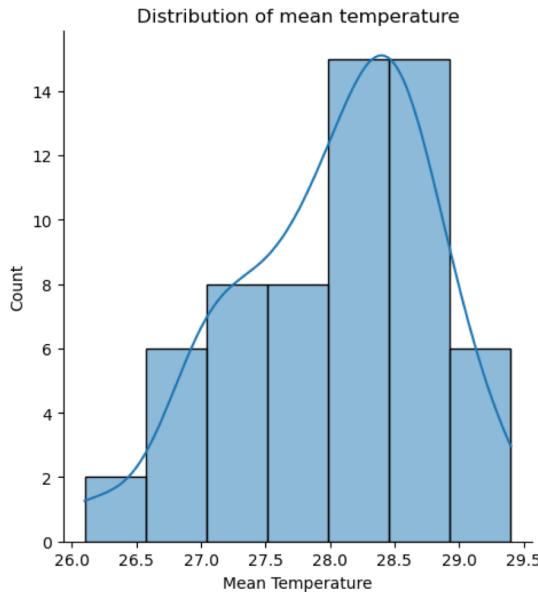
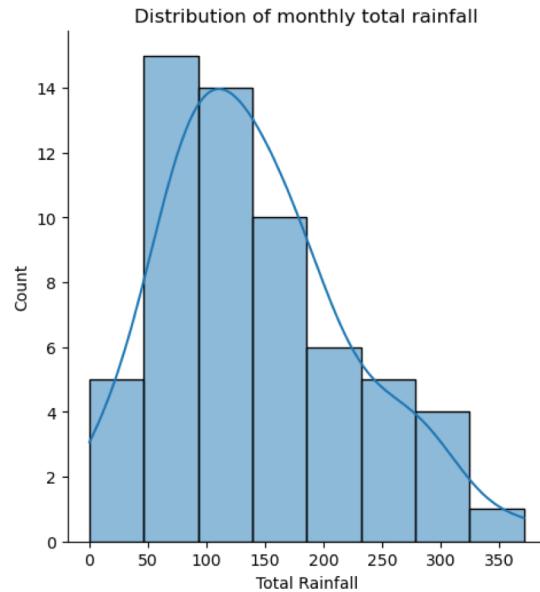
# 03 Findings

---



# Visualising the Variables

- Histograms for the Climate Variables (Monthly total rainfall, Mean temperature, Number of rainy days)
- Central tendency: symmetric or skewed, Modality: peaks, Outlier: isolated bars, Variability: width of the histogram



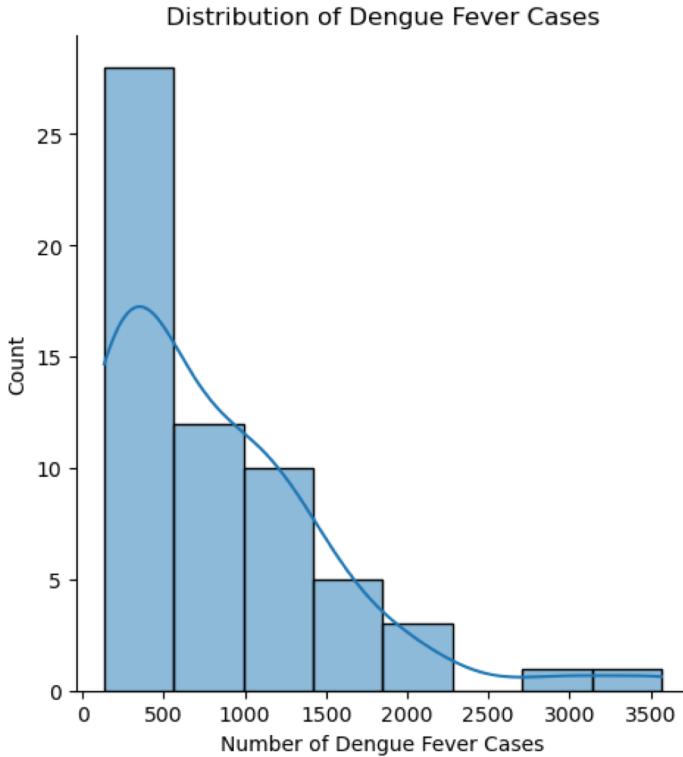
- **Positively skewed** distribution (with a greater concentration of data on the left)
- **Unimodal** with one peak
- **No outlier** with no isolated bar
- **Wide histogram** which may suggest wide spread around the mean

- **Negatively skewed** distribution (with a greater concentration of data on the right)
- **Bimodal** with two peaks
- **No outlier** with no isolated bar
- **Wide histogram** which may suggest wide spread around the mean

- **Symmetrical** distribution
- **Unimodal** with one peak
- **No outlier** with no isolated bar
- **Wide histogram** which may suggest wide spread around the mean

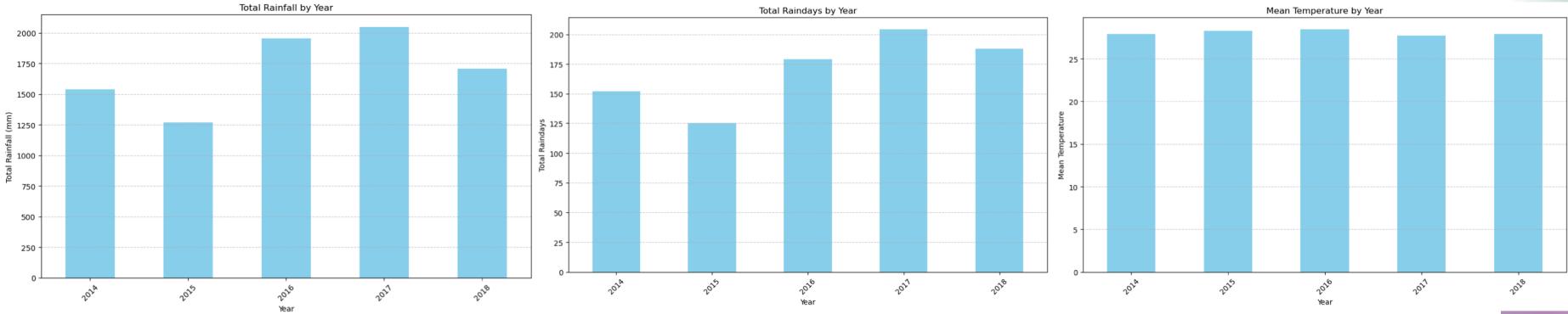
# Visualising the Variables

- Central tendency: symmetric or skewed, Modality: peaks, Outlier: isolated bars, Variability: width of the histogram

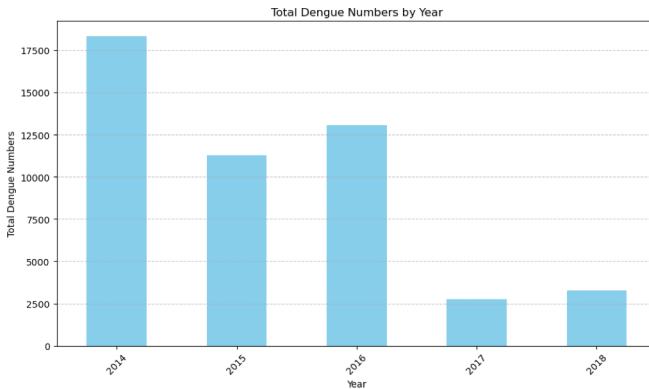


- Positively skewed** distribution (with a greater concentration of data on the left)
- Unimodal** with one peak
- Two outliers** with two isolated bar corresponds to the monthly dengue cases in Jan 2016 and Jul 2014
- Wide histogram** which may suggest wide spread around the mean

# Visualising the Variables

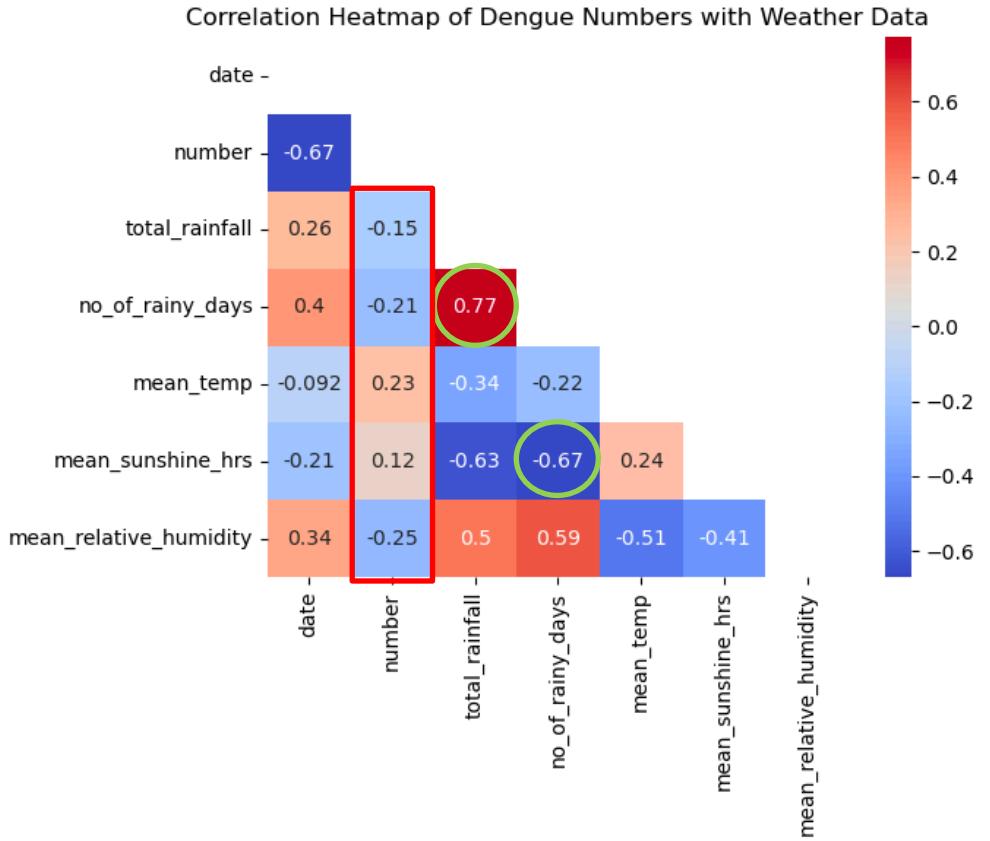


- The **trends year by year** in total rainfall, total raindays and mean temperature **are not pronounced** although for total rainfall and total raindays may show a general increase
- Long term trends beyond 2018 suggest that total rainfall, total raindays and the mean temperature could remain consistent.



- General **decrease in dengue infection numbers** from 2014 to 2018
- 2014 has the highest dengue infection numbers while 2017 has the lowest dengue infection numbers
- Long term trend beyond 2018 may suggest lower dengue infections
- Possible explanation for the decrease could be the herd immunity to the particular dengue serotype**

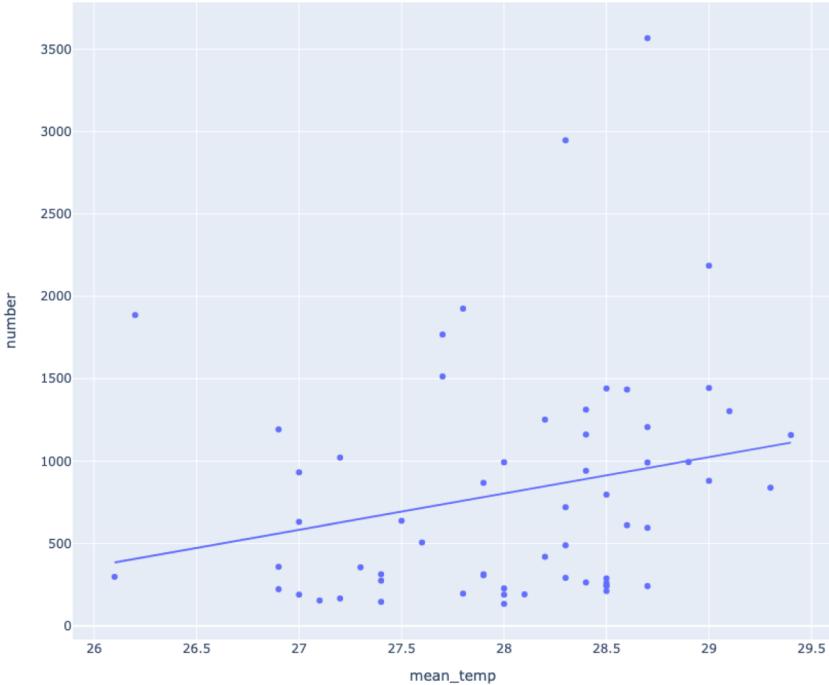
# Correlation Heatmap



- A **correlation heatmap** is a graphical representation of the correlation matrix, which illustrates the **pairwise correlations** between variables in a dataset.
- Highest **positive correlation** between number of rainy days and total rainfall
- Highest **negative correlation** between number of rainy days and mean sunshine hours
- Correlation of dengue infections numbers and the climate related variables are much lower ranging from **0.12 to 0.23** and **-0.15 to -0.25**.

# Relationship between mean temperature and dengue infection numbers

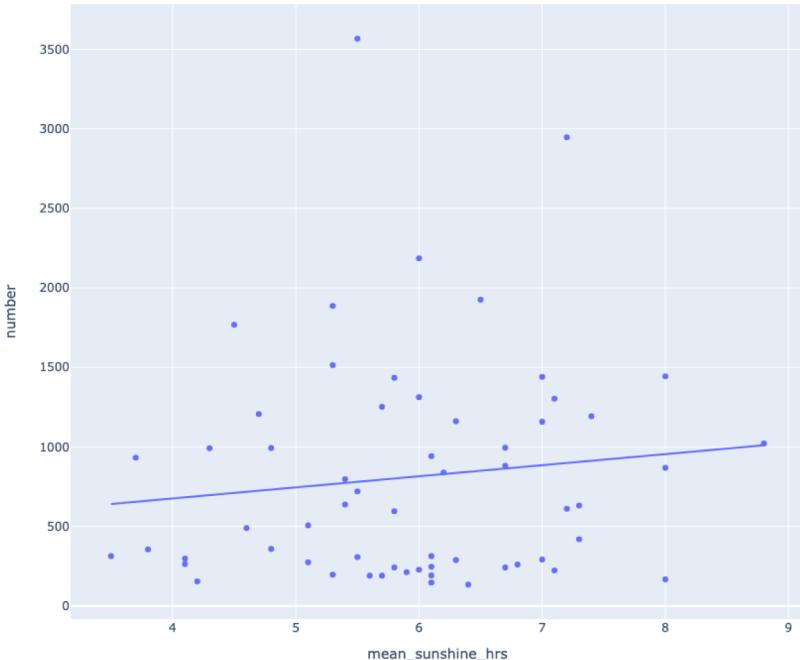
Relationship between Mean Temperature and Dengue Fever Cases



- A **scatterplot** with a linear best fit line is a graphical representation used to visualize the relationship between two continuous variables in a dataset.
  - Linear Best Fit Line: indicates the direction (slope) and strength (R-squared) of the relationship between the two variables.
- 
- We see a **weakly positive relationship** between the mean temperature and the number of dengue infections. The line of best fit has an  $R^2$  value of 0.054, and a coefficient of 220.
  - An increase in 1 degree Celsius in temperature will result an increase in the number of dengue cases on average by 220.
  - With the **small  $R^2$  value**, it indicates that mean temperature alone is not a strong predictor of the number of dengue cases, and there are likely other factors influencing the variability in dengue cases.

# Relationship between mean sun hours and dengue infection numbers

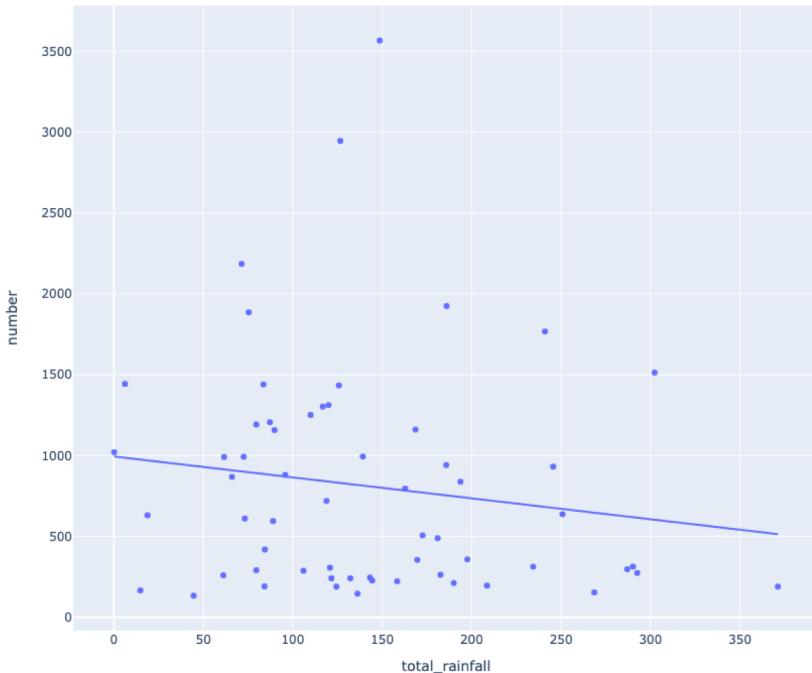
Relationship between Sun Hours and Dengue Fever Cases



- We see a **weakly positive relationship** between the mean sunshine hours and the number of dengue cases. The line of best fit has an  $R^2$  value of 0.0133, and a coefficient of 69.83.
- This means that an increase in 1 hour in sunshine will result an increase in the number of dengue cases on average by 70.
- With the **small  $R^2$  value**, it indicates that mean sunshine hours alone is not a strong predictor of the number of dengue infections, and there are likely other factors influencing the variability in dengue cases.

# Relationship between total rainfall and dengue infection numbers

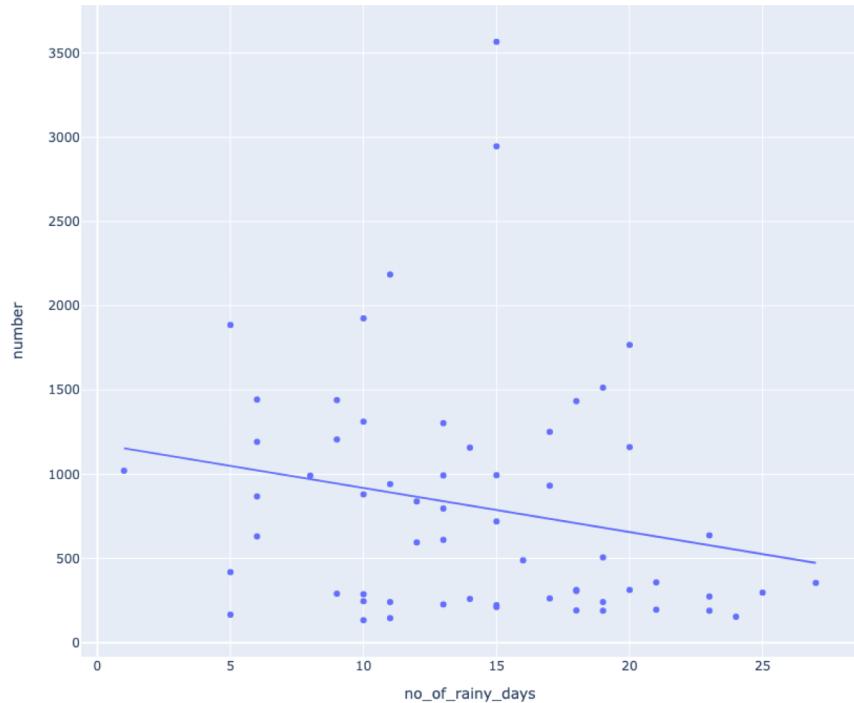
Relationship between Total Rainfall and Dengue Fever Cases



- We see a **weakly negative relationship** between the total rainfall and the number of dengue cases. The line of best fit has an  $R^2$  value of 0.0216, and a coefficient of 1.29.
- This means that an increase in 1 mm of total rainfall will result an increase in the number of dengue cases on average by 1.29.
- With the **small  $R^2$  value**, it indicates that total rainfall alone is not a strong predictor of the number of dengue infections, and there are likely other factors influencing the variability in dengue cases.

# Relationship between number of rainy days and dengue infection numbers

Relationship between Rainy Days and Dengue Fever Cases



- We see a **weakly negative relationship** between the number of rainy days and the number of dengue cases. The line of best fit has an  $R^2$  value of 0.0461, and a coefficient of 26.14.
- This means that an increase in 1 rainy day will result in an increase in the number of dengue cases on average by 26.
- With the **small  $R^2$  value**, it indicates that number of rainy days alone is not a strong predictor of the number of dengue cases, and there are likely other factors influencing the variability in dengue cases.



# Conclusion and Recommendations

---

04

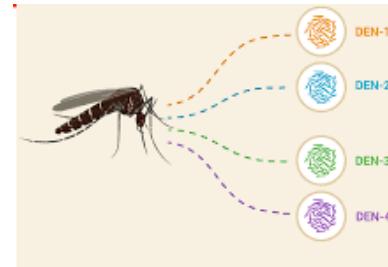


# Conclusions

- Due to the **weak positive correlation** between number of dengue cases and mean temperature, we can expect that there will be an increase in the number of dengue cases as temperature rises.
- With the current fluctuations of weather in the short term, coupled by the **continued global warming long term**, it is paramount for the government to ensure that these are taken into account when doing capacity planning in health resources both in the short and long run.
- Correlation between variables and the number of dengue cases can indicate a statistical association or relationship but **does not guarantee accurate prediction of dengue cases**.

# Recommendations

- Clean the data of outliers, and plot the graphs again to see if there's a stronger correlation between the mean temperature and the number of dengue cases, as well as an improved  $R^2$  value.
- Understand the relationship between temperature and number of dengue cases on a **more granular level**, by breaking down into different dengue clusters as well as different serotypes for these dengue cases.



- Build machine learning models to **predict possible future temperature fluctuations and trends**, and include these predictions in the planning of health resources for Singapore.