

Problem Set 3 - Part 2 (Cohort Problems)

Acknowledgements: weather data is taken from weather.gov.sg

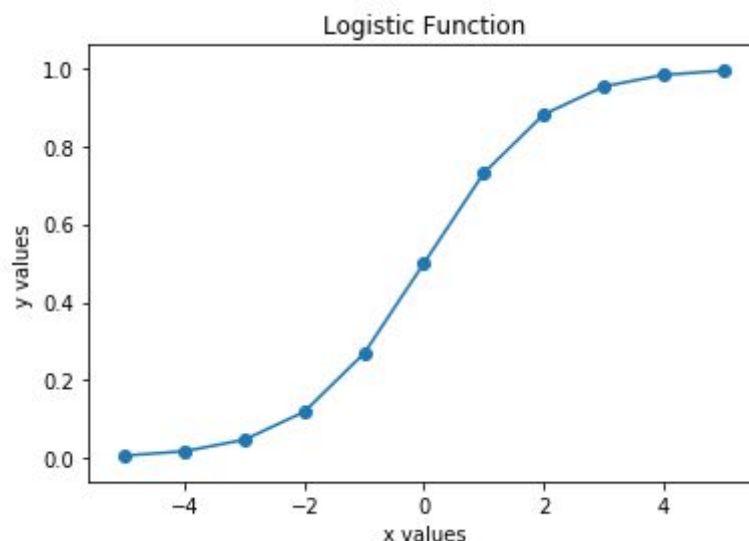
We will not grade your code for this problem set i.e. there will be no checkoffs or vocareum submission. Instead, after working through these problems, please complete the Week 3 Quiz on eDimension.

Problem 1 - Line Plot and Scatter Plot

The logistic function is given by

$$f(x) = \frac{e^x}{e^x + 1} = \frac{1}{1 + e^{-x}}$$

Produce the following plot that shows the points for this function for integer values of x from -5 to 5 inclusive. The resulting plot should look like this.



There are two ways you can do this plot.

- Method 1. Both the `plt.plot()` and `plt.scatter()` statements are used.
- Method 2. Only the `plt.plot()` statement is used, and markers are specified. Read the documentation for details.

Problem 2 - Weather Data

The daily rainfall data for Changi in Nov 2018 is given below. The numbers are in terms of mm of rain.

```
daily_total_rainfall = [ 0.2, 7.8, 0.4, 3.4, 0.4, 3.8, 12, 5.4, 1.6,  
0, 0.8, 12.4, 2.4, 2, 4.6, 0.8, 18.4, 7.4, 20.6, 4, 13.2, 2, 4, 0,  
4.8, 14.4, 9.6, 0, 5.6, 7.6]
```

You may download the starter code from eDimension if you encounter problems copying and pasting.

In this problem, there are four tasks:

1. Plot a histogram with five bins.
2. Plot a histogram with bin boundaries at 0, 4, 8, 12, 16, 20, 24.
Please refer to the matplotlib documentation on how to specify the bin boundaries.
3. Plot a boxplot of the data.
Satisfy yourself that you can read the approximate value of the median from the boxplot.
4. Plot a bar plot showing the number of rainy days vs the number of dry days.
For this question, we shall define dry days as days with rainfall of 0, and rainy days as otherwise.

Provide your answers to the following questions in eDimension.

1. From the histogram, how many days had $4 \text{ mm} \leq \text{rainfall} < 8 \text{ mm}$?
2. From the boxplot, how many days had particularly high rainfall? We call such points “outliers”.
3. From the bar plot, how many dry days were there in Nov 2018?

Homework Problems

Problem 1 - Sine Wave

The function $y = 2 \sin(3t)$ has an amplitude of 2 units.

It also has three cycles within a period of 2π .

Generate a line plot for this function that shows three cycles in a period of 2π .

Use 50 t -coordinates per cycle that are equally-spaced.

No markers are needed.

Hint:

- Generate a list of t -coordinates that meet the requirements.
- Then, for each t -coordinate, calculate the corresponding y -coordinate and store the result in a list. Then you are ready to plot the sine wave.

Problem 2 - Temperature data

The mean daily temperature for Jan 2018 is given below.

```
mean_temperature = [ 24.8, 25.5, 26.5, 26.1, 26, 26.8, 26.9, 26.4, 27.2,  
24.5, 23.9, 23.1, 23, 23.4, 25.2, 26.2, 27.2, 27.2, 26.9, 26.4, 27.2,  
27.5, 26.8, 26.7, 26.6, 26.4, 27.1, 26.3, 27.7, 26.9, 27.3]
```

You may download the starter code from eDimension if you encounter problems copying and pasting.

Make suitable plots to answer the following questions:

1. What is the approximate value of the median mean daily temperature in Jan 2018?
2. How many days in Jan 2018 had temperatures between 27 °C and 28 °C?

Exercises

For these exercises, no sample plots will be provided.
You are free to decide how you want to display the results.

Random Walk 1

The following pseudo-code implements a random walk with no constraints.

Decide n , the number of iterations
The zeroth element of list x is 0
The zeroth element of list y is 0

For n iterations

- Generate two random numbers, $xrand$ and $yrand$. These random numbers lie between -0.5 and 0.5
- Take the last element of x , add $xrand$ to it and append the result to list x
- Take the last element of y , add $yrand$ to it and append the result to list y

Plot the result of your random walk as a scatter plot.

Random Walk 2

Given the following x and y coordinates, generate a random walk that begins and ends at (0,0) and passes through each point exactly once. This random walk need not be the shortest path through the points. Show your result on a plot.

```
x1 = [0, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5]
y1 = [0, -2.0, 2.5, -1.0, 1.0, 3.0, 2.0]
```

You may find the following hints useful:

The following code generates all permutations of 1, 2, 3 and stores the result in a list.

```
import itertools
my_permutations = list( itertools.permutations([1,2,3]) )
```

The following code selects a random entry from a list.

```
import random
a = random.choice( [1,2,3] )
```