Solution for 2020 Xtern Work Sample Assessment: Data Science Work Assessment

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Assumptions

The solution to the assessment was drawn based on the following assumptions:
- According to the city regulations, scooters can not be charged while the vehicle carrying them is in motion. This means that the mega charging bus needs to be stationary while charging scooters.
- Charging time to go from one power level to the next is constant and lasts 1 hour.
- Going from one level to the next drain 1 unit of power from the mega charging bus main power.
- The mega charging bus main power has a capacity of 50,000 units of power.
- The mega charging bus main power is fully charged at the beginning.
- The mega bus can hold up to 10,000 scooters.

Why Excel

Microsoft Excel was used in this problem as an exploratory data science tool for the following reasons:
1. The data set is not massive. It contains only 25,668 records which can be handled by Excel with short delay on the visualization part.
2. My initial plan was to brush on R or Python and use either one to solve the problem. However, I fell short on time and decided to use what I'm more comfortable with, Excel!

Data Exploration

Knowing the data set was the first step that I did. The file containing the data was converted from *csv* to *xlsx* in order to utilize Excel power. After finishing the conversion, the data was converted into a *table* in order to deal with it easily. The conversion was done by selecting all the data and then pressing *ctrl-T* (on Windows) and then clicking OK on the dialog box that appeared (see the Screenshot below).
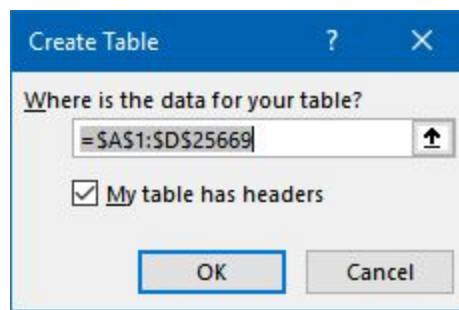
After creating the table, the following data in the table below was collected for each variable.

Variable	Type	# of Values	# Missing	Min	Max	Avg
scooter_id	String	25,668	0	0	25,667	N/A
xcoordinate	Float	25,668	0	–0.300061531	1.369517496	0.491567346
ycoordinate	Float	25,668	0	–0.2901196054	1.357176427	0.437083354
power_level	Categorical	25,668	0	0	5	N/A

Excel **PivotTable** and **PivotChart** have been used to compute the count for each category of the power_level variable. The resulted are shown numerically and visually below.

power_level	Count
0	4388
1	4248
2	4245
3	4160
4	4284
5	4343

Count of scooter_id

Number of Scooters with Different Power Levels
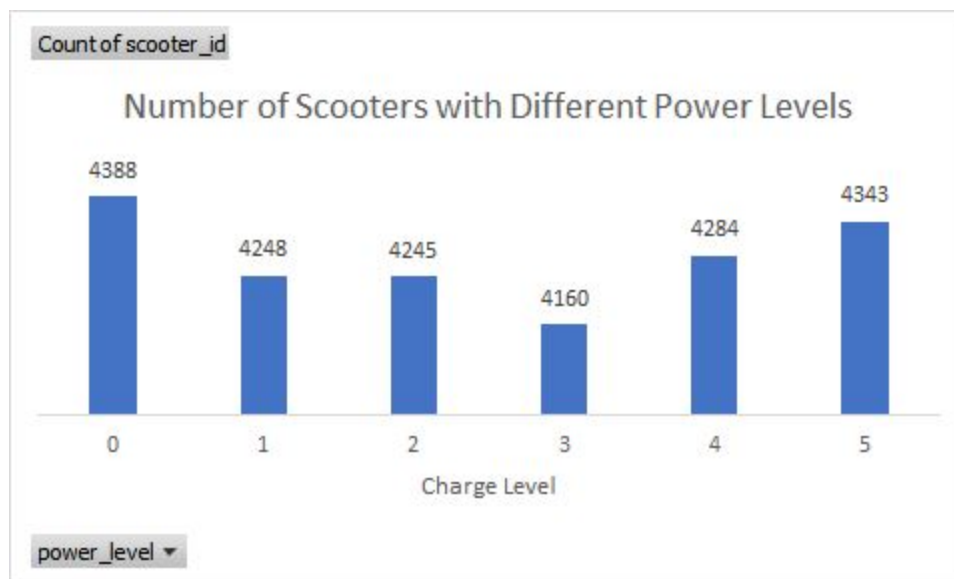
power_level ▾

The data were then separated into different sheets based on the power level. This resulted in 6 new Excel sheets as shown below:

| Data-Charge0 | Data-Charge1 | Data-Charge2 | Data-Charge3 | Data-Charge4 | Data-Charge5 |

Scatter plot for all the scooters was first generated, then a separate scatter plot for the scooter under each power level were generated. The plots are shown below.
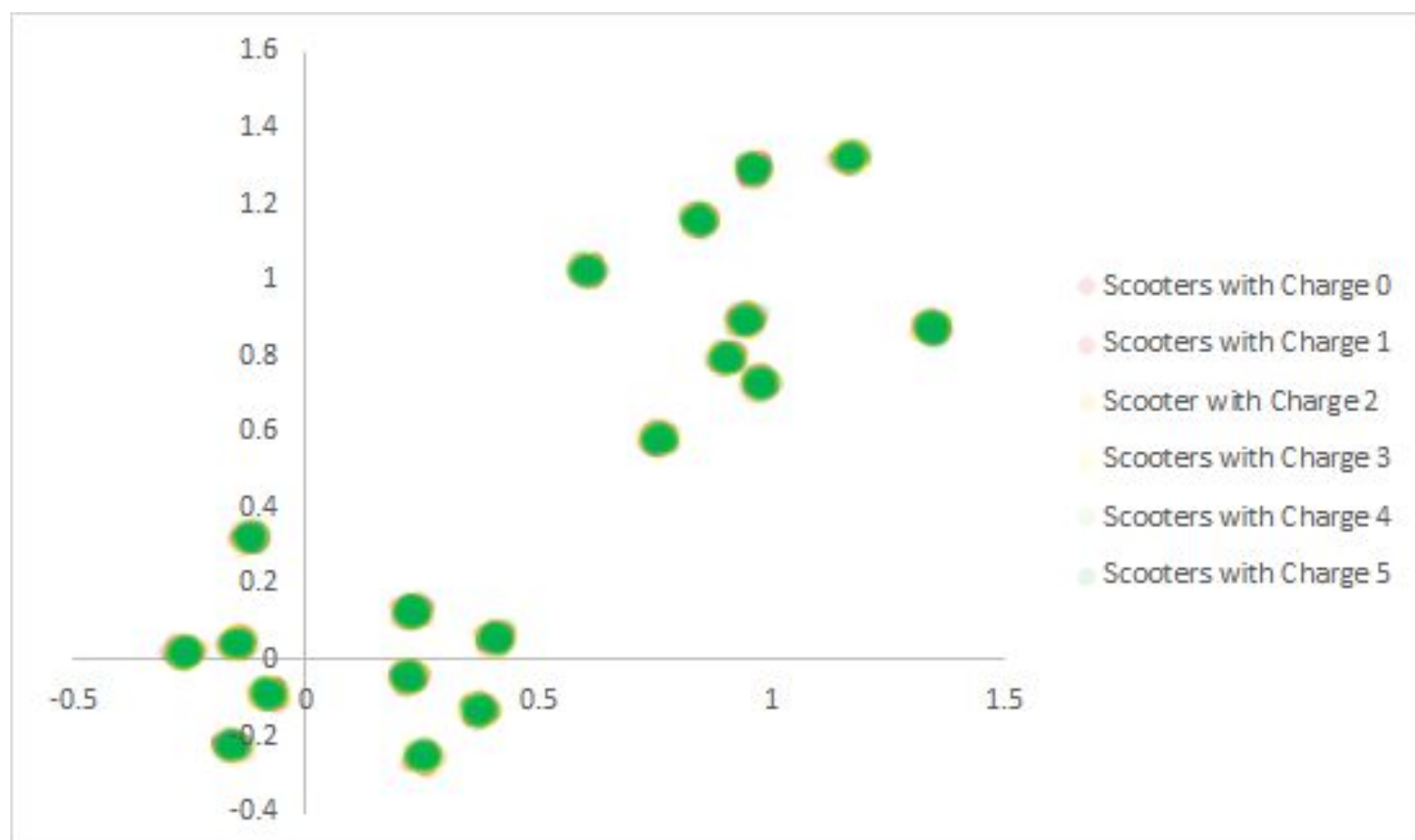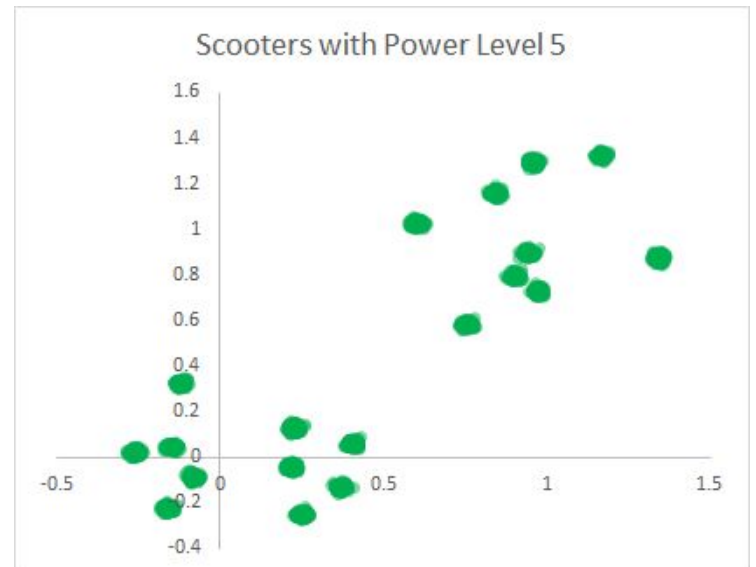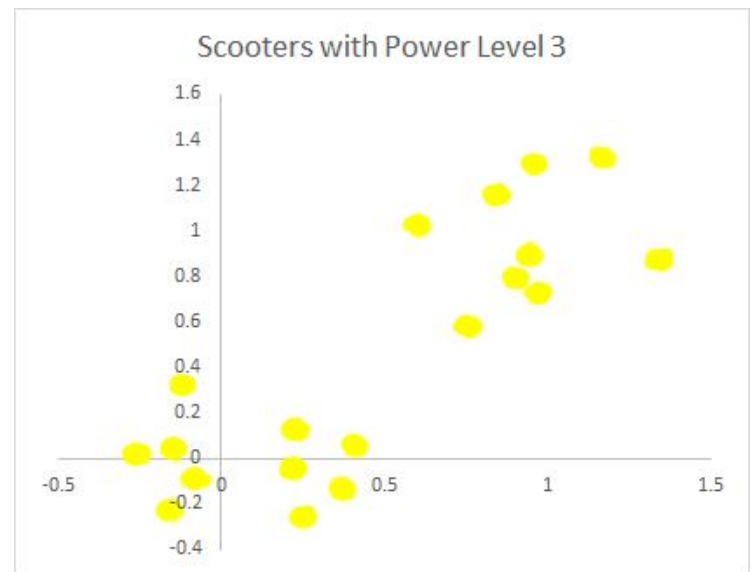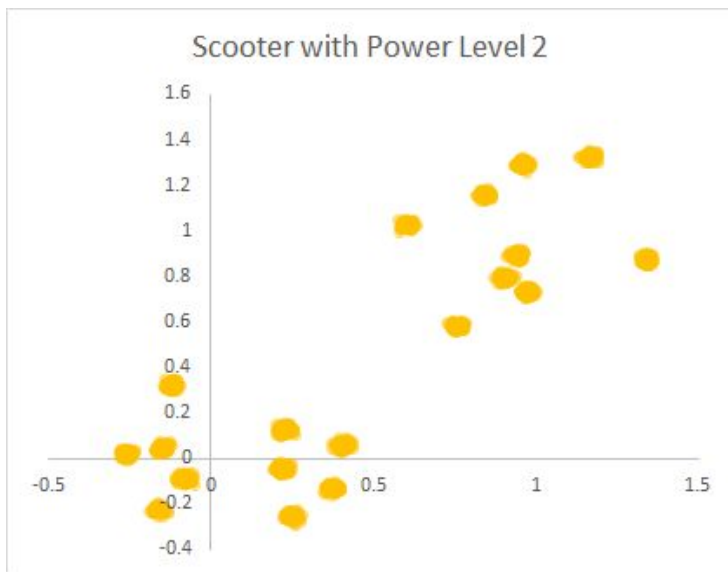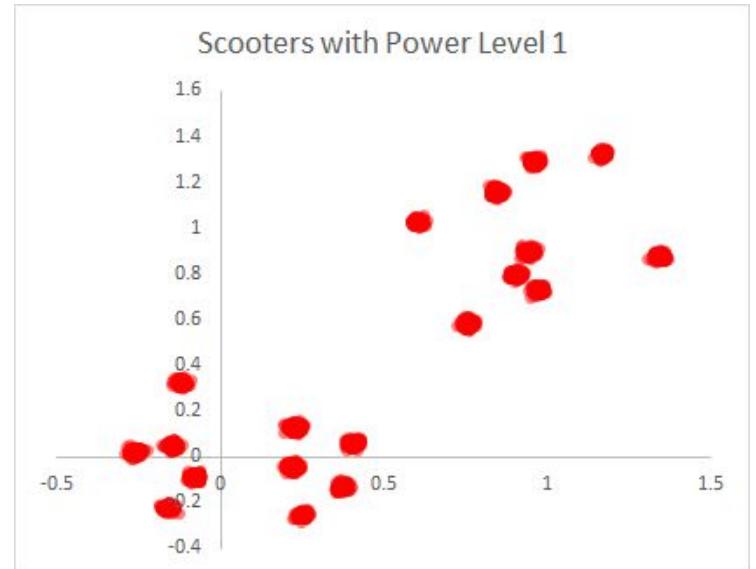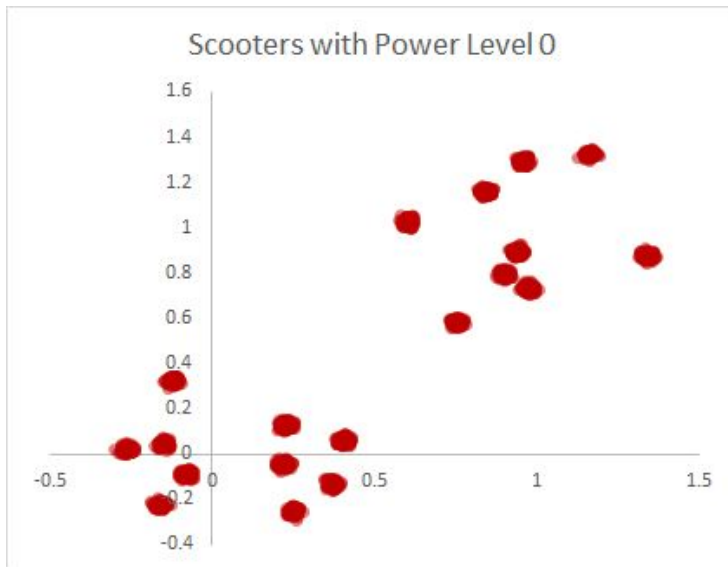
The transparency of the color of the markers (data points) were set to 90% in order to get an idea of the concentration of the scooters on the plot; the darker the color the more concentration of scooters exists.

Most Popular Scooter Locations

The scatter plots show that the scooters are concentrated in 19 different sites. The sites can be divided into 3 regions as follows:

- the *north-east region* centered around (1,1) and contains 9 sites,
- the *middle region* centered around (0.25,0) and contains 5 sites, and
- the *west region* centered around (-0.25,0) and contains 5 sites.

It can be estimated from the plots that the number of scooters in each of the 19 sites are almost the same given that the size of the collection of points is roughly the same and the color is almost the same intensity.

Operation Time Cost & Most Efficient Scooter Charging Strategy

The farthest point that the mega charging bus will reach is located at (-0.300061531,0.023457169). Hence, the distance from the charging station located at (20.19,20.19) to the farthest point is 28.75 miles. This means that the bus will need 34.5[1] minutes to reach the farthest point. Hence, we will assume that any trip that the mega bus do will last 34.5 minute on each way.

Since the bus can hold up to 10,000 scooters, on the first trip, the bus will pick

- all the scooters with power level zero (there are 4,388, remaining that the bus can hold: 5,612),
- all the scooters with power level one (there are 4,248, remaining that the bus can hold: 1,364),
- 71[2] scooters with power level two from each site

On the second trip, the bus will pick:

- all the remaining scooters with power level two (there are 2,895, remaining that the bus can hold: 7,105)
- all the scooters with power level three (there are 4,160, remaining that bus can hold: 2,945)
- 155 scooters with power level four from each site

On the third and last trip, the bus will pick

- all the remaining scooters with power level four (there are 1,339)

Hence the total operation time will be:

Operation	Estimated Time Required (in hours)
Round 1	
Travel time from charging station to site	0.575
Travel time from sites to charging station	0.575
Charging scooters	5.000

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[1] 28.75 miles / (50 miles / hour) = 0.575 hour * 60 minutes/hour = 34.5 minutes.
[2] 72 scooters need to be picked from one of the sites so that the total number of scooters is 10,000.

Round 2

Travel time from charging station to site	0.575
Travel time from sites to charging station	0.575
Charging scooters	3.000

Round 3

Travel time from charging station to site	0.575
Travel time from sites to charging station	0.575
Charging scooters	1
Travel time from charging station to site	0.575
Total	13.025

This means that in order to charge all the scooters to power level five, around **13 hours and 1.5 minutes** are needed in total.