Analyzing the NYC Subway Dataset

Questions

Overview

This project consists of two parts. In Part 1 of the project, you should have completed the questions in Problem Sets 2, 3, 4, and 5 in the Introduction to Data Science course.

This document addresses part 2 of the project. Please use this document as a template and answer the following questions to explain your reasoning and conclusion behind your work in the problem sets. You will attach a document with your answers to these questions as part of your final project submission.

Section 0. References

Please include a list of references you have used for this project. Please be specific - for example, instead of including a general website such as stackoverflow.com, try to include a specific topic from Stackoverflow that you have found useful.

https://bespokeblog.wordpress.com/2011/07/11/basic-data-plotting-with-matplotlib-part-3-histograms/

http://pandas.pydata.org/pandas-docs/version/0.15.2/basics.html#iteration

http://blog.yhathq.com/posts/ggplot-for-python.html

http://pandas.pydata.org/pandas-docs/version/0.15.2/indexing.html

http://stackoverflow.com/questions/22391433/count-the-frequency-that-a-value-occurs-in-a-dataframe-column

Section 1. Statistical Test

1.1 **Which statistical test did you use to analyze the NYC subway data?**

Mann–Whitney U-test
Welch's t-test

Did you use a one-tail or a two-tail P value?
Two-tail p value

What is the null hypothesis?
The mean of rainy days and non-rainy days show no real differences in ridership.

What is your p-critical value?

0.05

1.2 **Why is this statistical test applicable to the dataset? In particular, consider the assumptions that the test is making about the distribution of ridership in the two samples.**
Our dataset are not equal sample size nor do they have the same variance.
Sample Size of Rainy Days = 44104
Variance Rainy = 5619401.454
Sample of Non-Rainy Days = 87847
Variance Non-Rainy = 5382422.911

Mann-Whitney U-test is applicable to the dataset because the dependent variable is either ordinal or continuous but not normally distributed. We can also use the Welch's t-test since we are comparing the means of two nonpaired groups.

1.3 **What results did you get from this statistical test? These should include the following numerical values: p-values, as well as the means for each of the two samples under test.**
Mann_Whitney U Test:
p-value = 0.024999912793489721 x 2 = 0.0499998255869794 = 4.99998255869794 %

Welch's t-test:
p-value = 0.2695064

rainy day means = 1105.446
non-rainy day means = 1090.279

1.4 **What is the significance and interpretation of these results?**
Using the results from the Mann-Whitney U-test, the p value is ~5% which is less than or equal to the p-critical value. This is telling us there is a significance difference in ridership when it rains compare to non-rainy days. We would reject the null hypothesis and accept the alternate hypothesis. The alternate hypothesis would be the mean of rainy days and non-rainy days does show a real differences in ridership. The result for Welch's t-test says to reject the null hypothesis and accept the alternate hypothesis too. The p-value for a two-tail is 0.2695064 which is less than our p-critical value of 0.05. The difference in mean of ridership between rainy and non-rainy day is ~15 riders. It may be small but it is statistically significance to matter.

Section 2. Linear Regression

2.1 **What approach did you use to compute the coefficients theta and produce prediction for ENTRIESn_hourly in your regression model:Gradient descent (as implemented in exercise 3.5) OLS using Statsmodels Or something different?**

gradient descent

2.2 **What features (input variables) did you use in your model? Did you use any dummy variables as part of your features?**
The features which I used were fog, maxtempi, and rain.
Yes, dummy variables were used. If you look at problem set 3.5, you will see what dummy variables were used:
dummy_units = pandas.get_dummies(dataframe['UNIT'], prefix='unit'

2.3 **Why did you select these features in your model? We are looking for specific reasons that lead you to believe that the selected features will contribute to the predictive power of your model. Your reasons might be based on intuition. For example, response for fog might be: "I decided to use fog because I thought that when it is very foggy outside people might decide to use the subway more often." Your reasons might also be based on data exploration and experimentation, for example: "I used feature X because as soon as I included it in my model, it drastically improved my R2 value."**

The temperature of the day, I feel, impacts people decision to walk to their destination (if it is within reason). If the mean temp of the day was low say below freezing, more people would want to get off of the street and ride a nice warm subway versus waiting for a cab.
Rain would deter people from being outside and force them to find a way to get to their destination without getting wet. This is where the subway comes into play. No standing out in the wet rain while waiting for a cub and plus it is a lot cheaper.

2.4 **What are the coefficients (or weights) of the non-dummy features in your linear regression model?**
fog = 5.11970917e+01
maxtempi = -4.85891106e+01
rain = -1.13910731e+01

2.5 **What is your model's R2 (coefficients of determination) value?**
0.425831938562

2.6 **What does this R2 value mean for the goodness of fit for your regression model? Do you think this linear model to predict ridership is appropriate for this dataset, given this R2 value?**
R2 value tells you how 'close' your data points are to the fitted regression line overall. It is the percentage of the response variable variation that is explained by a linear model. R2 will always be between 0 and 1. 0 indicates the model explains none of the variability of the response data while 1 indicates the model explains all of the variability of the response data around its mean. The higher the R2 the better our model fits the data.

I think this linear model to predict ridership is appropriate for this dataset. R2 value came in at

42.5% which is a reasonable value to predicting if people are riding the subway or not. The attempt to predict human behavior is very hard to do when compare with for example manufacturing process.

Section 3. Visualization

Please include two visualizations that show the relationships between two or more variables in the NYC subway data.

Remember to add appropriate titles and axes labels to your plots. Also, please add a short description below each figure commenting on the key insights depicted in the figure.

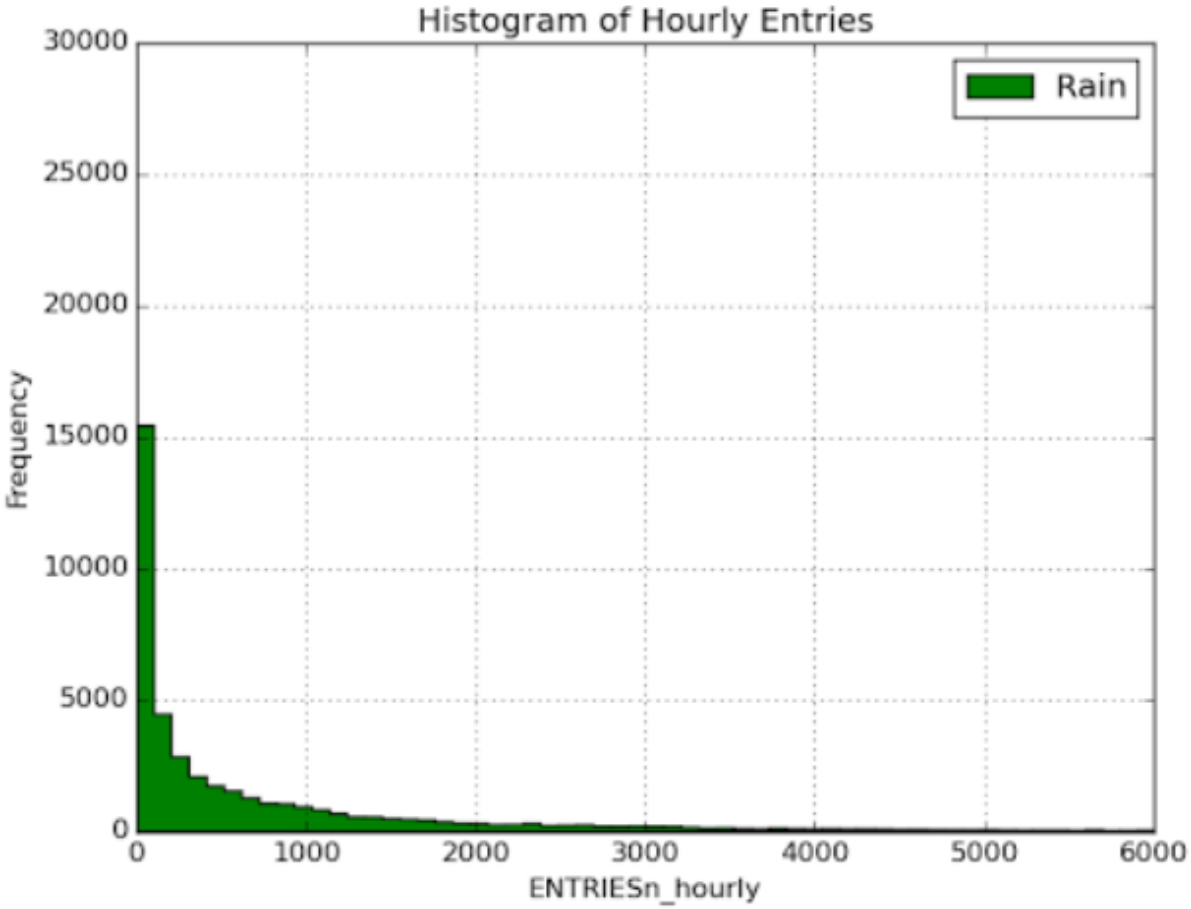
3.1 One visualization should contain two histograms: one of ENTRIESn_hourly for rainy days and one of ENTRIESn_hourly for non-rainy days.

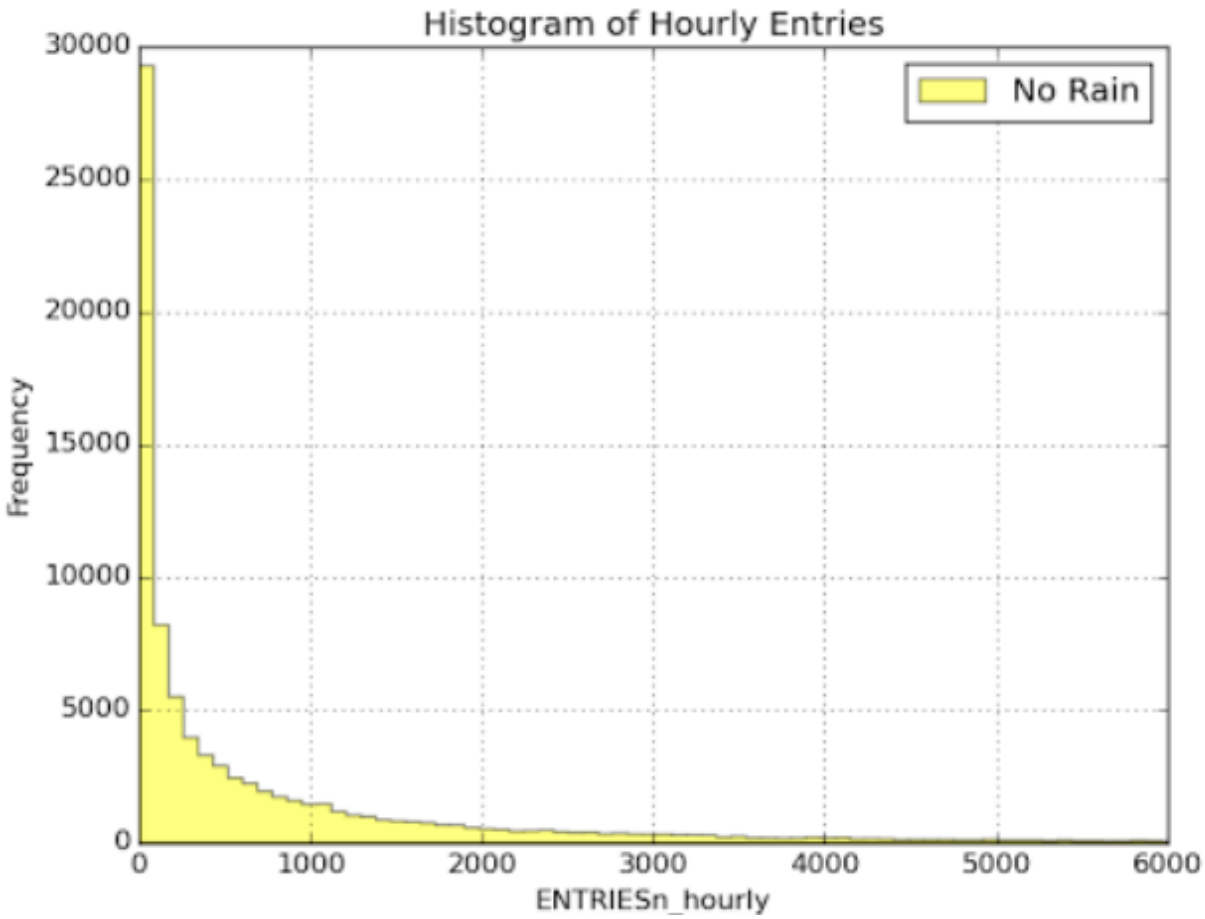
You can combine the two histograms in a single plot or you can use two separate plots.

If you decide to use to two separate plots for the two histograms, please ensure that the x-axis limits for both of the plots are identical. It is much easier to compare the two in that case.

For the histograms, you should have intervals representing the volume of ridership (value of ENTRIESn_hourly) on the x-axis and the frequency of occurrence on the y-axis. For example, each interval (along the x-axis), the height of the bar for this interval will represent the number of records (rows in our data) that have ENTRIESn_hourly that falls in this interval.

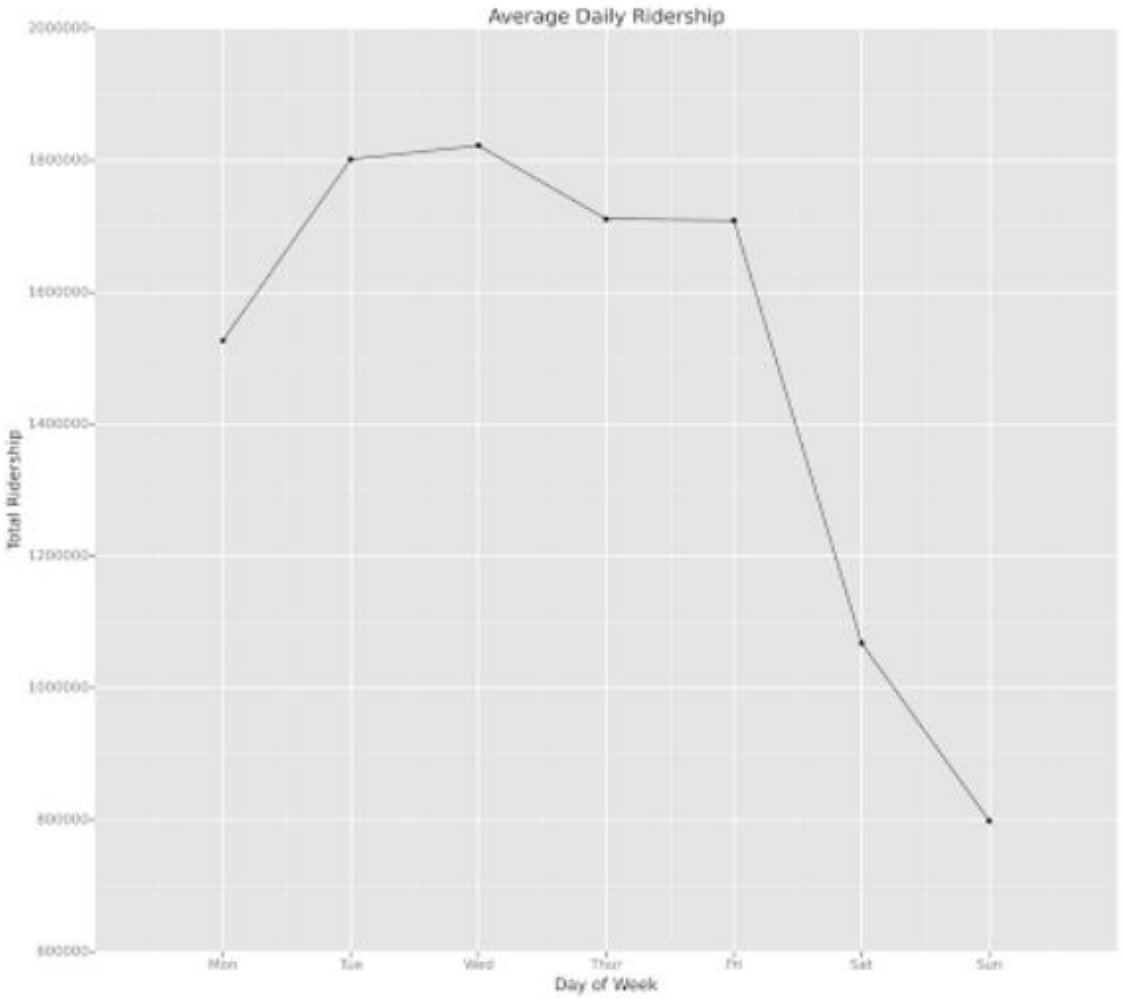
Remember to increase the number of bins in the histogram (by having larger number of bars). The default bin width is not sufficient to capture the variability in the two samples.


Histogram of Hourly Entries
Rain
Frequency
ENTRIESn_hourly
0
5000
10000
15000
20000
25000
30000
0
1000
2000
3000
4000
5000
6000



The histogram of hourly entries depicts the frequency of people riding the subway when it is raining and not raining. During non-rainy days, the level of frequency occurs a lot more than rainy days.

3.2 **One visualization can be more freeform**.



The graph above is displaying the daily average ridership for each day of the week. As you can see, more people tend to ride the subway in the mid part of the week peeking on Wednesday before you see a drop off heading into the weekend. The lowest average ridership is on Sunday.

Section 4. Conclusion

Please address the following questions in detail. Your answers should be 1-2 paragraphs long.

4.1 **From your analysis and interpretation of the data, do more people ride the NYC subway when it is raining or when it is not raining?**

More people ride the NYC subway when it is not raining. From the statistical tests results, there is a difference in terms of the mean of ridership. Results from both the Welch's T-test along with Mann

Whiney U Test, the p value was less than the p-critical value. Since the p value is less than the p critical value, one would reject the null hypothesis and accept the alternate hypothesis. The visualization shows a much higher frequency of riders during non-rainy days compare with rainy days.

4.2 **What analyses lead you to this conclusion? You should use results from both your statistical tests and your linear regression to support your analysis.**

The histogram shows a much higher volume of riders for non-rainy days. Each bar for the non-rainy days are higher when compare with rainy days. Just looking at each interval of bar, the non-rainy day is clearly higher until you get further down to about 3500 to 4000 range of the entries hourly axis. This tells you people are riding the subway more during non-rainy days. The results from the statistic tests of Welch's t-test and Mann Whitney U test says the mean between both rainy and non-rainy days are not equal. They are statistically significant.

From the linear regression model, the coefficients (weight) of the non-dummy features for rain had a negative value (rain = -1.13910731e+01). This implies that rain had a negative impact or must not be important in predicting ridership. What you want is a higher value as this tells us it is a greater contributor in predicting subway ridership.

Section 5. Reflection

Please address the following questions in detail. Your answers should be 1-2 paragraphs long.

5.1 **Please discuss potential shortcomings of the methods of your analysis, including: Dataset, Analysis, such as the linear regression model or statistical test.**

One might use a longer time frame of dataset to determine the answer for the question. Instead of 30 days increase the dataset to possibly 3 months which would capture the three wettest months for NYC historically. One would also see if any kind of special events that may occur during those days. Those couple of events might skew the results a bit. Another factor is the regular riders, those that ride the subway daily for their job. If it is possible, figure out how many monthly riders there are. These are the people who are going to ride the subway regardless of rain or shine.

As the data set becomes larger, Mann-Whitney U test becomes less effective. This reduces its effectiveness because the calculation becomes too long-winded, and it takes a very long time to complete. It also reduces the precision of the result, as with a bigger sample size there is more margin for error.

R2 cannot determine whether coefficient estimates and predictions are biased. So to combat it, one must assess the residual plots. R2 is just a sample/estimate and not the entire population.

5.2 (**Optional) Do you have any other insight about the dataset that you would like to share with us?**