

# Analyzing the NYC Subway Dataset

Data Analyst Nanodegree – Intro to Data Science

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## Section 0. References

- “Interpreting results: Mann-Whitney test”
  - [http://www.graphpad.com/guides/prism/6/statistics/index.htm?how\\_the\\_mann-whitney\\_test\\_works.htm](http://www.graphpad.com/guides/prism/6/statistics/index.htm?how_the_mann-whitney_test_works.htm)
- “Coefficient of Determination”
  - [http://stattrek.com/statistics/dictionary.aspx?definition=coefficient\\_of\\_determination](http://stattrek.com/statistics/dictionary.aspx?definition=coefficient_of_determination)
- “Points, as for a scatterplot”
  - [http://docs.ggplot2.org/0.9.3/geom\\_point.html](http://docs.ggplot2.org/0.9.3/geom_point.html)
- “Working with DataFrames”
  - <http://www.gregreda.com/2013/10/26/working-with-pandas-dataframes/>

## Section 1. Statistical Test

1.1 Which statistical test did you use to analyze the NYC subway data? Did you use a one-tail or a two-tail P value? What is the null hypothesis? What is your p-critical value?

I used the Mann-Whitney U test to analyze the NYC subway data. Since it is not known which data set has a higher / lower mean, I used a two-tail P value. The null hypothesis for this test is that rain has no correlation to subway rides, and the p-critical value is 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.

I performed a histogram plot of the hourly ridership data with rain vs. without rain. Through this graph I determined the data was non-normal. The Mann-Whitney U test is appropriate when analyzing data that is not normally distributed.

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.

Mean with rain: 1105.45  
Mean without rain: 1090.28  
U-value: 1924409167  
P-value: 0.025

1.4 What is the significance and interpretation of these results?

The generated P value above is smaller than the significant value, p-critical (0.05), with a sampling error probability of 2.5%. This allows us to reject the null hypothesis and conclude that hourly subway ridership is different when raining vs. when not raining.

## 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

2.2 What features (input variables) did you use in your model? Did you use any dummy variables as part of your features?

I used rain, precipitation, mean temperature, and hour as input variables. I used UNIT as a dummy variable

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.

I used the above input variables based on my own experience riding the NYC subway. I suspected that poor weather conditions and time of day would have a linear effect on ridership.

2.4 What are the coefficients (or weights) of the non-dummy features in your linear regression model?

4.63382098e+02

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

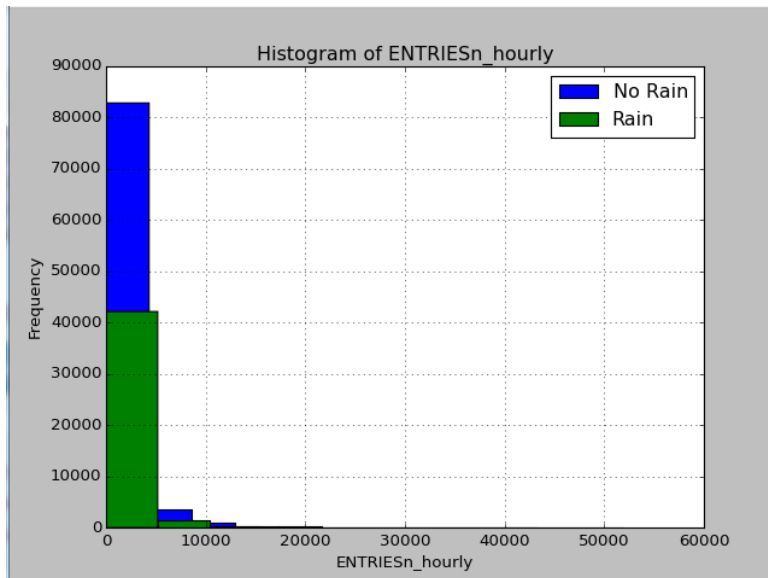
0.463968815042

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?

Given that the R2 value indicates how well data fit a statistical model. I do not believe my model is appropriate as it only explains 46.3% of the variation.

## Section 3. Visualization

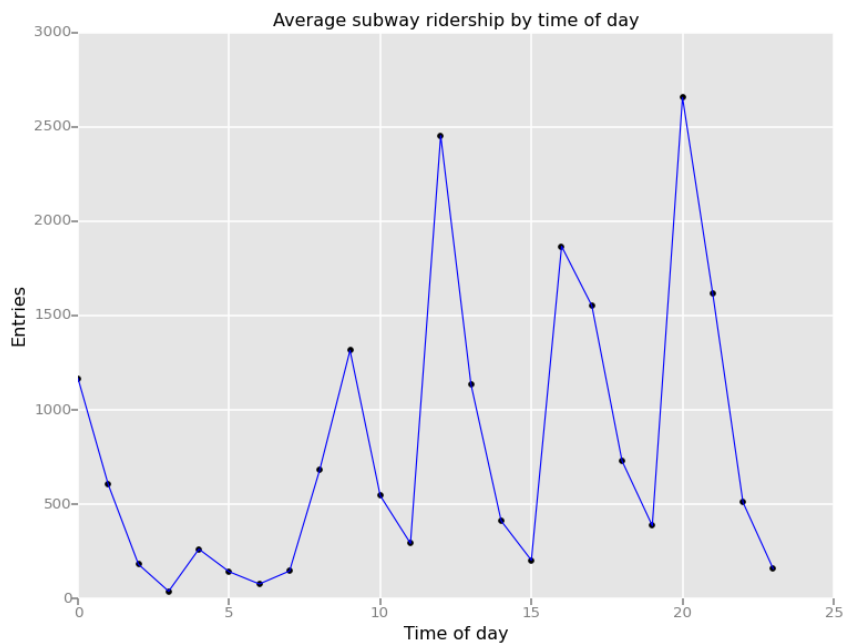
1.1 One visualization should contain two histograms: one of `ENTRIESn_hourly` for rainy days and one of `ENTRIESn_hourly` for non-rainy days.



The above image represents a histogram plot of hourly subway entries with & without rain. From the plot we can determine the following:

- Both data sets are not normally distributed
- The number of data points for days without rain is greater than data points with rain

1.2 One visualization can be more freeform. You should feel free to implement something that we discussed in class (e.g., scatter plots, line plots) or attempt to implement something more advanced if you'd like.



The above image represents the average subway entries per time of day. We can see from the above image that ridership increases in the afternoon and evening. It's unsurprising that ridership is low between 2–7am as most people would be asleep. However, I expected ridership peaks at 7-8am and 5-6pm which indicates the typical start and end of the work day. Surprisingly we see peaks at 1pm and 4pm. To further analyze this data for trends we should increase our input variables to include weather, days of the week, holiday schedule, and demographics.

## Section 4. Conclusion

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

I can say with a high level of certainty that ridership of the NYC subway increases when raining vs. when not raining. I have come to this conclusion based on tests performed in section 1 (Mann-Whitney U) & section 2 (Linear Regression).

The Mann-Whitney U test allowed us to reject our null hypothesis based on our P value (0.025) being lower than the P-critical value (0.05). The Linear Regression testing showed an increase in the R<sup>2</sup> value when using weather as input variables. However, it is important to note through my testing that we can see a greater impact on NYC subway ridership based on time of day vs. weather.

## Section 5. Reflection

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 area of concern when analyzing the turnstile data was the number of entries vs. exits. From the dataset we can see ~19% less subway exits than entries. This leads me to question the accuracy of the dataset and the mechanism used to capture the data.

The use of the Mann-Whitney U test to disprove our null hypothesis was the best approach given that the data was non-normal. However, this test doesn't take into account some units being more active despite weather conditions (i.e. special events, tourism, etc...).