

Fuzzy Reasoning

A brief report

This document is aimed to report the graphs that lead our decisions during the creation of the Mamdani fuzzy membership functions and rules. The document is divided in two parts: the first one will report scatters and histograms of the hour dataset, while the second part reports results from the day dataset.

1. Hour Data

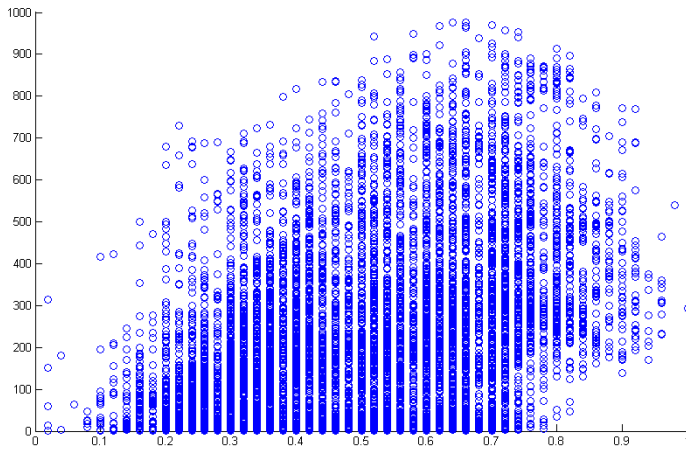


Figure 1.1 - Temperature

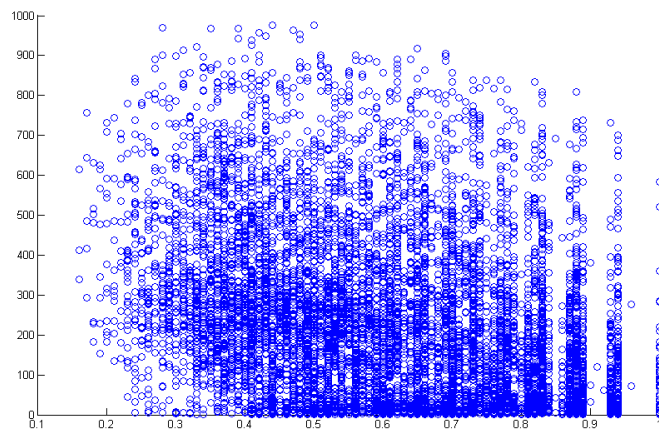


Figure 1.2 - Humidity

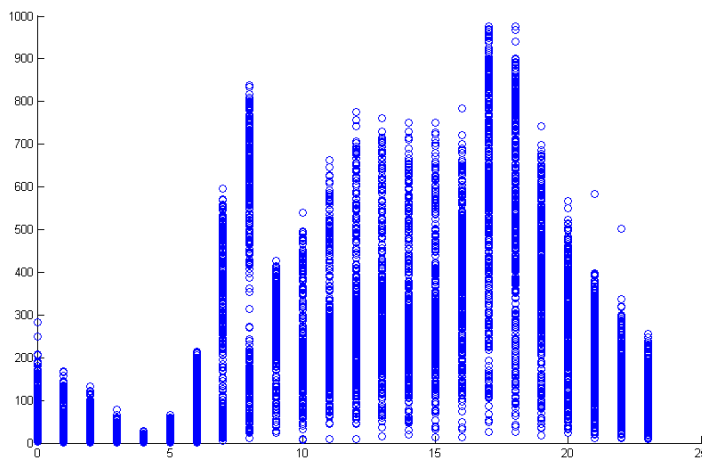


Figure 1.3 - Hour

Considerations

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The scatterplots helped the decision process by first providing a right insight of the distribution of the data in relation to the overall count, and then by inspiring some possible correlations between the features.

As Figure 1.1 shows the temperature is strongly correlated to the count, in fact the overall flux will be low on average when it's cold outside. Whereas the same reasoning couldn't be made on the humidity.

Figure 1.3 on the other hand describes the hourly change in the number of rented bikes. Obviously the count will be lower during the night, but what draw our attention were the peaks around 8-9 am and 6 pm.

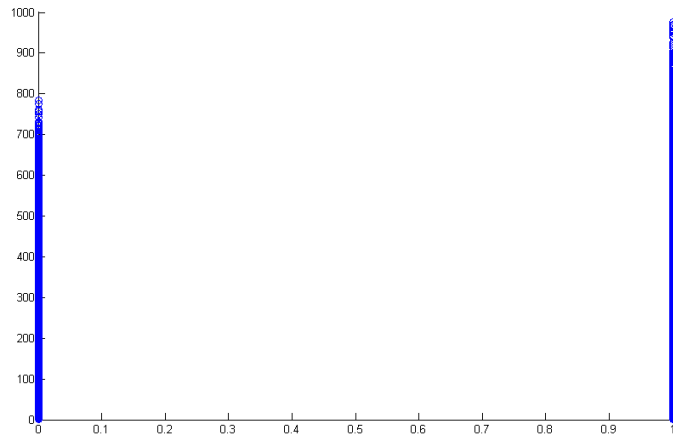


Figure 1.4 - Working day

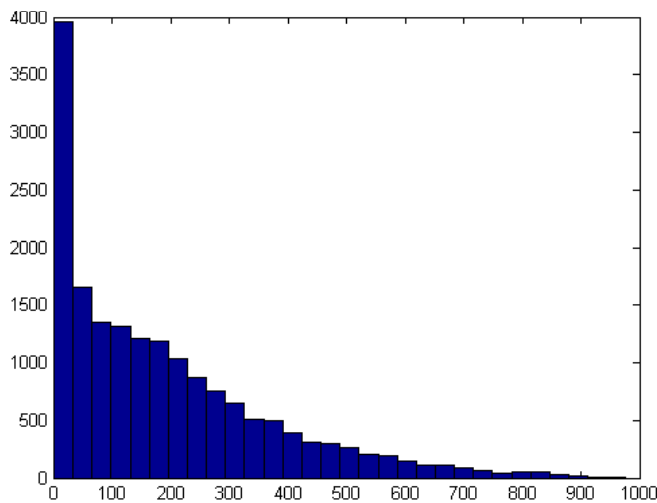


Figure 1.5 - Flux distribution

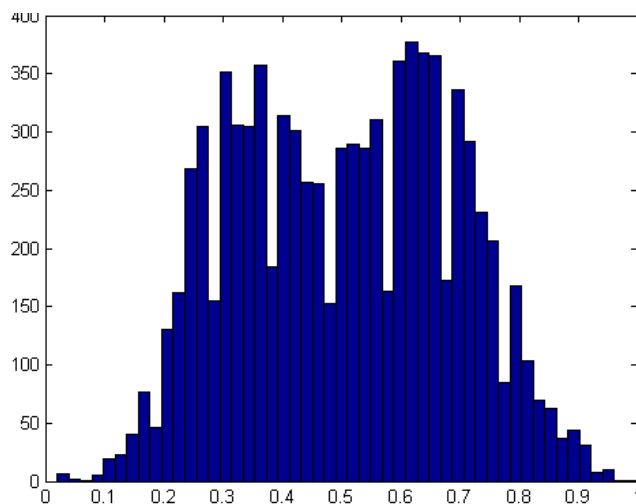


Figure 1.6 - Temperature distribution

Those two peaks may be representative of some sort of hidden behavior.

When seen together with Figure 1.4 those peaks may be accounted to the influence that the work factor has on the system. To further inspect this idea we decided to divide the hour membership function on whether the hour was belonging to the average working turn (from about 7am to 7pm) or not. Figures 1.7-8-9 and 10 in the following page further foster our idea while giving and insight about our reasoning.

The histograms in figures 1.5 and 1.6 on the other hand helped in the process of defining the membership functions, since they show how the data is distributed across the dataset.

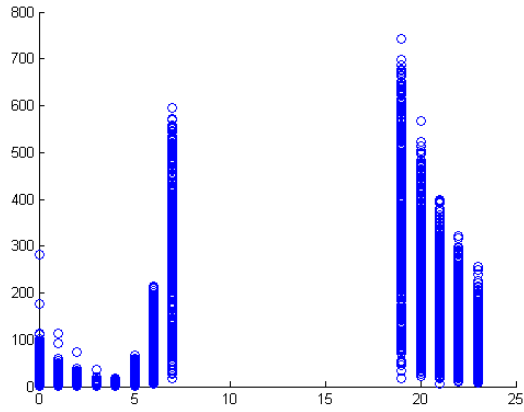


Figure 1.7 - WorkingDay & NonWorkingHour

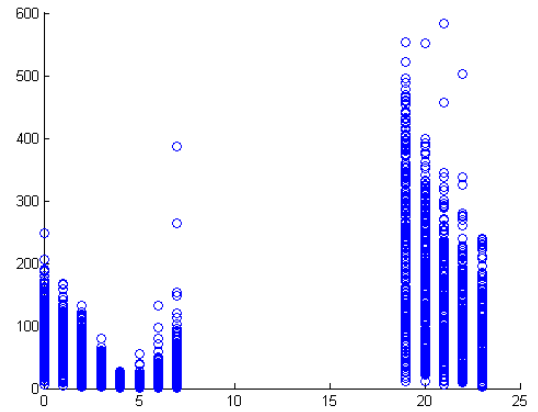


Figure 1.8 - NonWorkingDay & NonWorkingHour

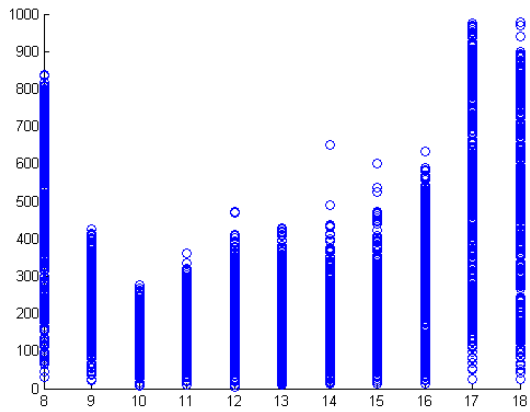


Figure 1.9 - WorkingDay & WorkingHour

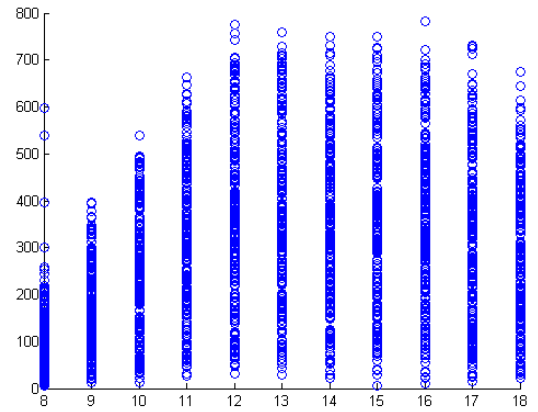


Figure 1.10 - NonWorkingDay & WorkingHour

2. Day Data

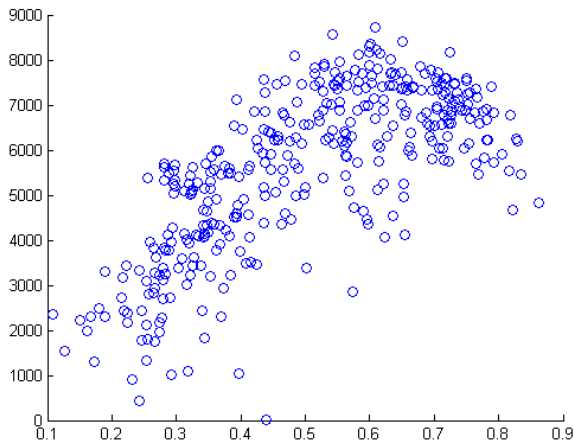


Figure 2.1 - Temperature

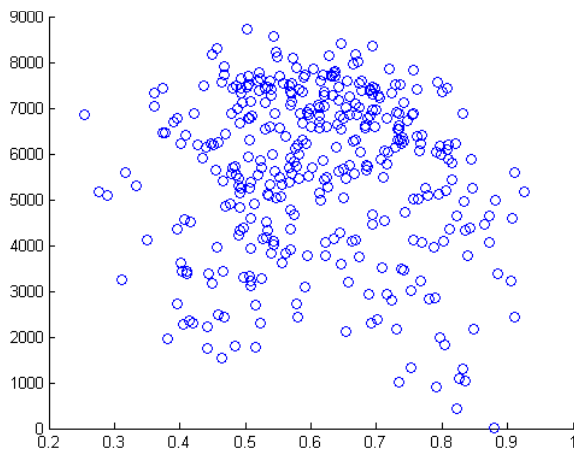


Figure 2.2 - Humidity

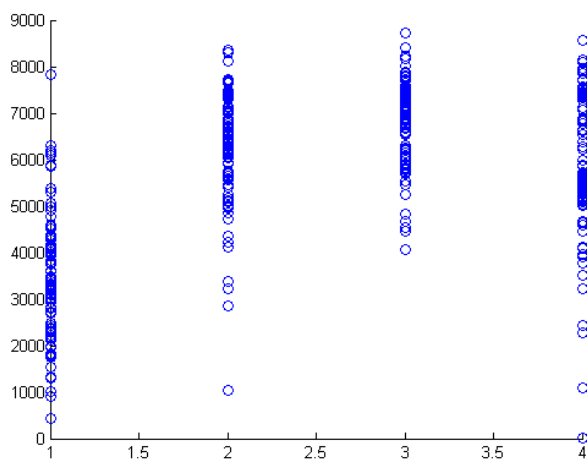


Figure 2.3 - Season

Considerations

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For the day dataset the same kind of analysis was carried out.

Figure 2.1 shows the temperature in relation to the total count of bikes. The empty spaces show that there is clearly some correlation with the number of bikes. This phenomenon lead our choices in the definition of the membership function and the model rules.

For what concerns the humidity the scatterplot in Figure 2.2 illustrates a slight concentration of the measures in the top-middle section of the plot. This aggregation endorses the creation of the membership functions, while it doesn't tell much for the rules.

The season is also a compelling feature for the definition of the rules. Figure 2.3 shows

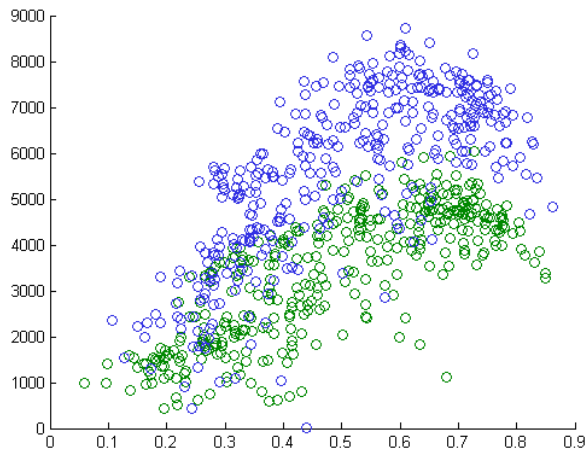


Figure 2.4 - Two years temperature

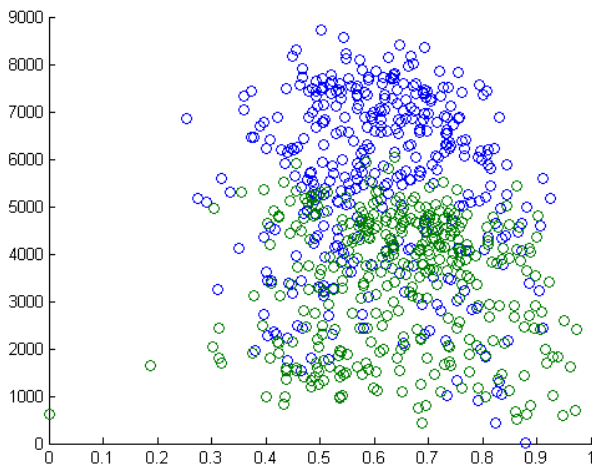


Figure 1.5 - Two years humidity

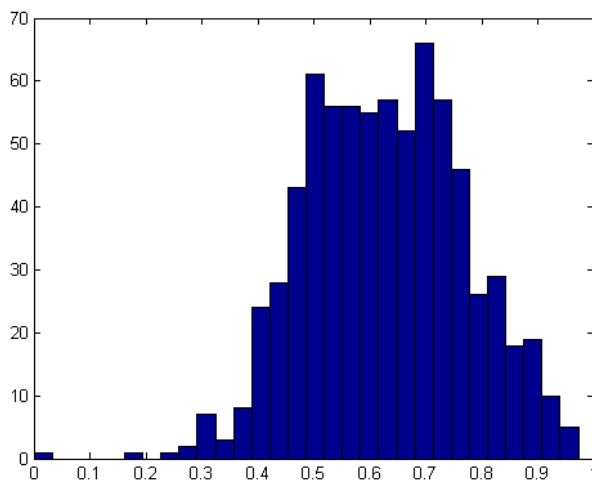


Figure 2.6 - Humidity distribution

a remarkable trend with respect to the change of season. Indeed, this feature was eventually chosen for the rule definition. For what concerns the definition of a membership function it is represented as 4 singletons, although also the month could be used to represent the seasons.

To help in the decision process all of the previous plots represent the trends in the course of just one year but, as Figure 2.4 and 2.5 show, the tendency persists among the two years and, hopefully, will continue also in the future.

Finally, since the scatterplot in Figure 2.2 was not enough to define the right membership for the humidity, the histogram in Figure 2.6 aided the membership definition process.