Occupancy Detection

MT7038

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Data

The occupancy status of a room was observed for a few days. Snapshots of the features below were taken every minute.

- Features - Numerical
  - Temperature
  - CO2
  - Humidity
  - HumidityRatio
  - Light
- Labels - Binary
  - Occupancy
    - Occupied
    - Unoccupied

Data

The occupancy status of a room was observed for a few days. Snapshots of the features below were taken every minute.

- Features
  - Temperature
  - CO2
  - Humidity
  - HumidityRatio
  - ~~Light~~
- Response
  - Occupancy
    - Occupied
    - Unoccupied

Light is excluded as the best classifier would otherwise become *Are the lights on?*

Brief Exploration

- Unbalanced data set
  - Many more unoccupied data points than occupied

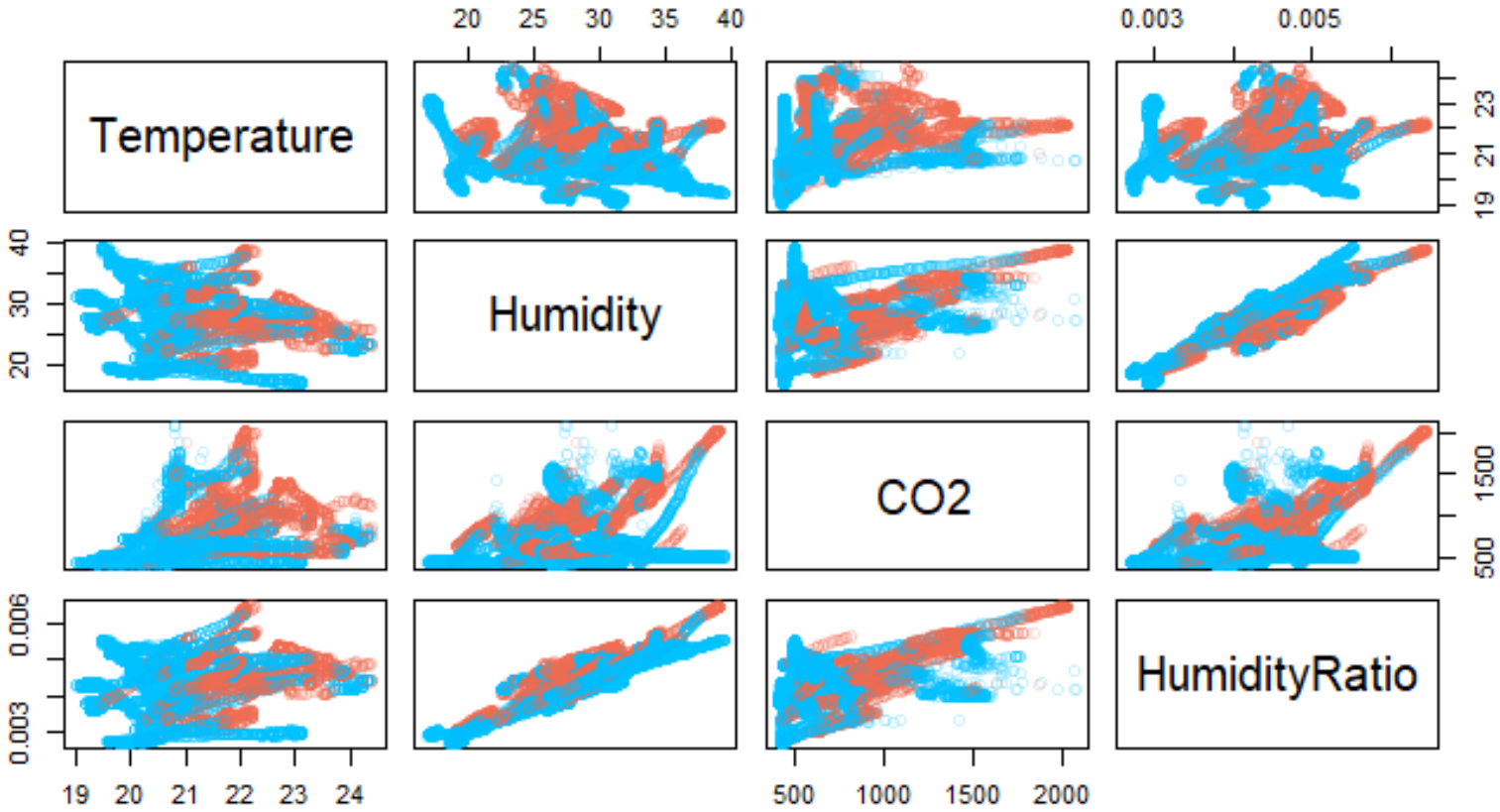


Figure: Pairplots of Features

- Non-linearity?

Brief Exploration

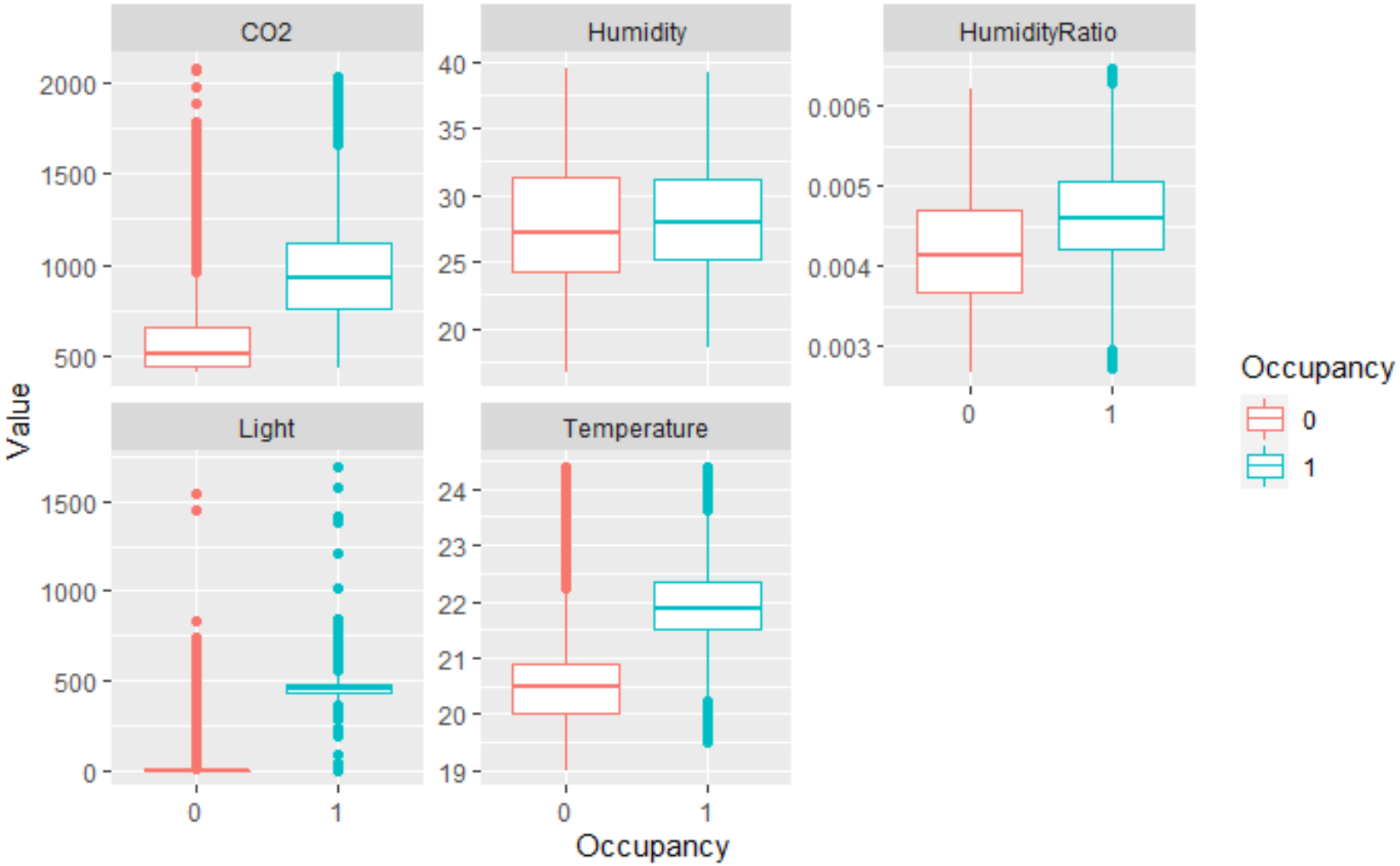


Figure: Boxplots of Features: Standardized and unstandardize

Methodology

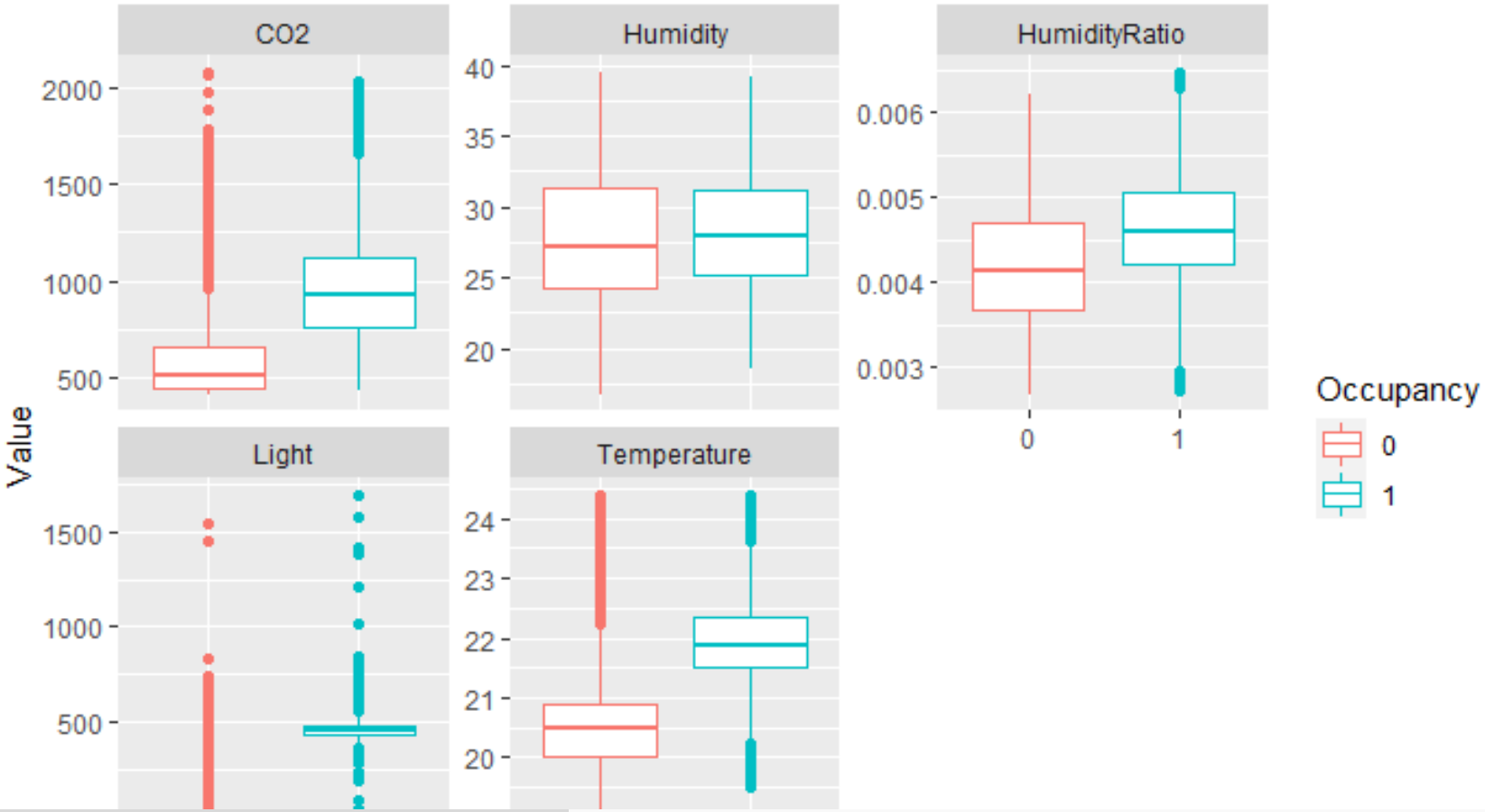
- SVM
  - Linear, Radial & Polynomial
- KNN
  - Regular & Weighted
- Decision Trees
  - Single Tree, Bagging, Boosting

Methodology

SVM

Why? ▷ Good for non-linear classification problems.

How? ▷ Using the package **e1071** and the function **svm**
▷ Linear, polynomial and radial kernels
▷ Coarse-to-fine parameter search



Methodology

KNN

Why?
- Good for non-linear classification problems
- Good with large training data sets
- Good if data is not noisy

How?
- Regular KNN using the package **class** and the function **knn**
- Weighted KNN using the package **kknn** and the function **kknn**
  - Epanechnikov kernel

Methodology

KNN - Regular

After a coarse search for a good value of k we noted that the best classifier was a 1-NN which further indicates that the data is not very noisy at all. The 1-NN achieved a testing accuracy of 93%.

A possible improvement is to use a weighted KNN where we put more emphasis on training points closer to the point which we want to predict than those further away.

Methodology

KNN - Weighted

In order to weight our data points we use the kernel distance from the point we want to predict to the k nearest neighbours. The choice of kernel is of course important but in our case all the available kernels in the function **kknn** generated approximatley the same results. As such we resorted to the Epanechnikov kernel as it is one we've encountered before.

When search for a good value of k in this case we found that the best validation accuracy was obtained for $k = 25$ which seems a bit more stable than using a 1-NN. This was also reflected in the testing accuracy which turned out to be 97.5%.

Methodology

Decision Trees

Why? ▷ WHY???
▷ WHY MORE?

How? ▷ HOW BAG/BOOST?
▷ HOW MORE?

Methodology

Decision Trees - Single

Methodology

Decision Trees - Bagging

Methodology

Decision Trees - Boosting

Discussion