Department od Economics, Management and Quantitative Methods

Università degli Studi di Milano

Data science and economics

Statistical Learning Project

Price prediction models for New York City Airbnb

Supervised Learning Report

Author:

Andrea Ierardi

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Abstract

The aim of the project is to analyse the data from the "New York City Airbnb Open Data" from the Kaggle website.
In particular, we focus on the developing of predictive model to forecast the house' prices using Supervised Learning algorithms:

- Decision Tree
- Random Forest
- Ranger Random Forest
- Linear Regression
- Neural Newtworks (?)

A crucial part of the project was to the tuning and finding of the hyperparameters of the different models in order to get the best fit.

2

Goal

The goal is developing different models in order to predict the price of a house in New York.

3

Discussion

3.1 Dataset

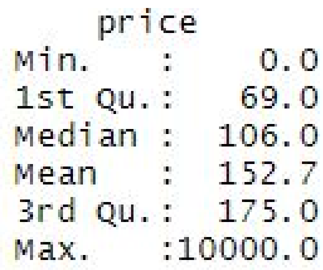
The dataset used in this project is one of a Kaggle competiotion and is called the New York City Airbnb Open Data. It contains 48.000 data points for each different column. The dataset has different columns:

- id
- **name**: name of the listing
- **host_id**
- **host_name**
- **neighbourhood_group**: location
- **neighbourhood**: area
- **latitude**: coordinates
- **longitude**: coordinates
- **room_type**: space type
- **price**: in dollars
- **minimum_nights**: amount of nights minimum
- **number_of_reviews**: number of reviews
- **last_review**: latest review
- **reviews_per_month**: number of reviews per month

- **calculated_host_listings_count**: amount of listing per host

- **availability_365**: number of days when listing is available for booking

We select just 5 of this feature from the dataset since we denotes them as the most important for the price of a house: latitude, longitude, room type, neighbourhood and the price itself to compare the prediction during the tests.



```
     price
Min.    :    0.0
1st Qu.:   69.0
Median :  106.0
Mean   :  152.7
3rd Qu.:  175.0
Max.   :10000.0
```

Figure 1: Price summary

From the Figure 1 is possible to see that there are some outliers in the dataset that can not be removed, since we have to take in account that could be present luxury houses. In fact, no outlier was removed from the dataset. Also, there were no null and missing value apart from the reviews_per_month column that we do not take in account in the project.

3.2 Data Pre-processing

The dataset has more or less 48.000 data points for each column, so an important part of this work was the pre-processing since it is large. Since the dataset is very large, running the different methods is time consuming. Scaling the numerical data is a key point to get better performance during the fitting process of the model. We starting scaling numerical data from -1 to 1, using pre installed R functions while for the categorical data we identify each label with a different integer number.
The categorical features from the selected are: neighbourhood and room type.
The numerical features are: latitude, longitude and price.

3.3 Decision Tree

Decision tree are one of the most used model in the Machine Learning world since are very familiar to human users and can be easily plotted.

3.4 Random Forest

Random Forest is an ensemble method which use a combination of decision tree to get the prediction.

3.4.1 Ranger Random Forest

Ranger Random Forest is a computationally light model which results are very close the classical Random Forest.

3.5 Linear Regression

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Results

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Conclusion

From the result the method with the most higher accuracy is the Random Forest method... while the worst are ....
Moreover, Random Forest method is also the worst in term of computation time for the tuning part since it takes for a configuration with 4 core, more or less 1 hour to tune the parameters.

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Appendix

7

Tabelle e grafici

Here a few examples of tables and graphs.

7.1 Tabelle

Codice	*CdL*	*Lotto*	$T_{setup/lotto}$	$T_{lav/pezzo}$	$T_{proc/pezzo}$	*Quantità*	T_{tot}
100	4	250	25	0,5	0,6	1	0,6
111	2	250	20	2	2,08	1	2,08
111	3	250	15	1,5	1,56	1	1,56
112	2	250	20	2,5	2,58	1	2,58
112	3	250	15	2	2,06	1	2,06
113	3	500	15	1	1,03	2	2,06
120	1	50	30	2	2,6	0,1	0,26
121	1	25	30	3	4,2	0,1	0,42
121	1	25	30	2,5	3,7	0,1	0,37

7.1.1 Altra tabella

7.2 Grafici

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Altro

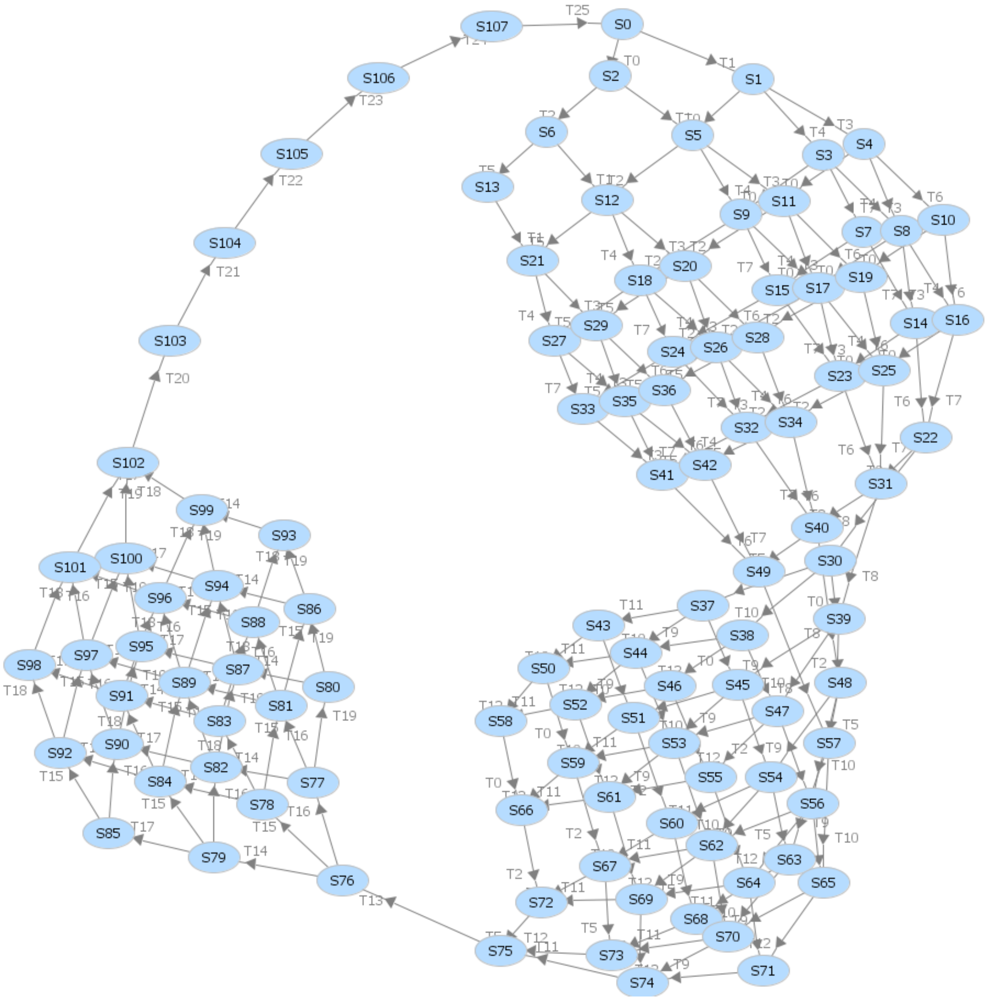

Figure 2: Didascalia.

8.1 Footnote

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[1] I created a footnote.

References

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