Capstone Project 1

Distribution of doctors in France

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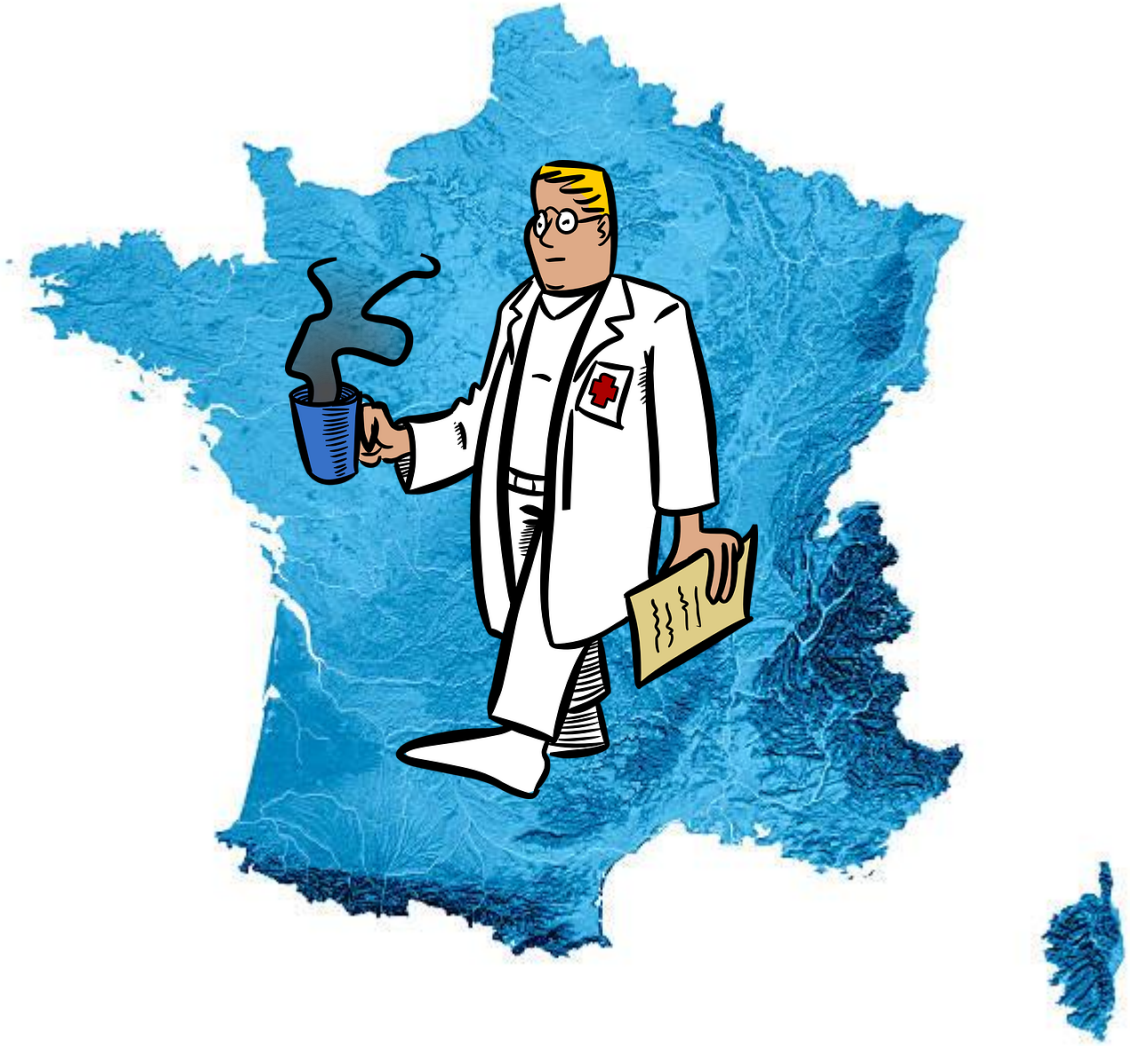
Problem Statement

- In France, the distribution of healthcare professional on the whole territory is problematic. People living in villages far from big cities complain about the lack of doctors and the very long delay to have a medical appointment.

- **The purpose of this project is to construct a model with machine learning to predict the distribution of healthcare professionals in France considering the location, the population of municipalities, the specialty of doctors….**

- This would allow us to learn about areas that lack healthcare professional to know where to locate potential future medical infrastructures and where future doctors should settle.



Datasets

❑ **First Dataset: Healthcare professional by zipcodes in France**

- Sex of doctors
- Specialisation of doctors

➔ **https://public.opendatasoft.com**

❑ **Second Dataset: Population by zipcodes in France**

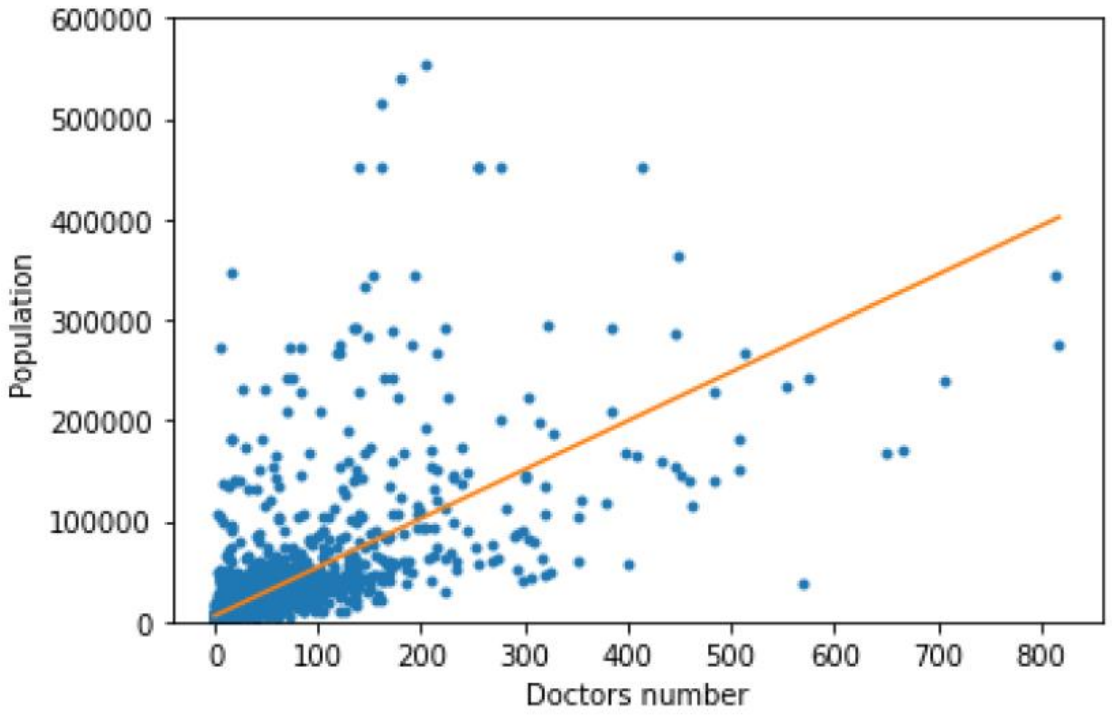
- Population
- Surface Area
- Latitudes
- Longitudes
- Regions

➔ **https://data.opendatasoft.com**

❑ **Two extra datasets:**

- Poverty rate by region in France
- Unemployment rate by region in France

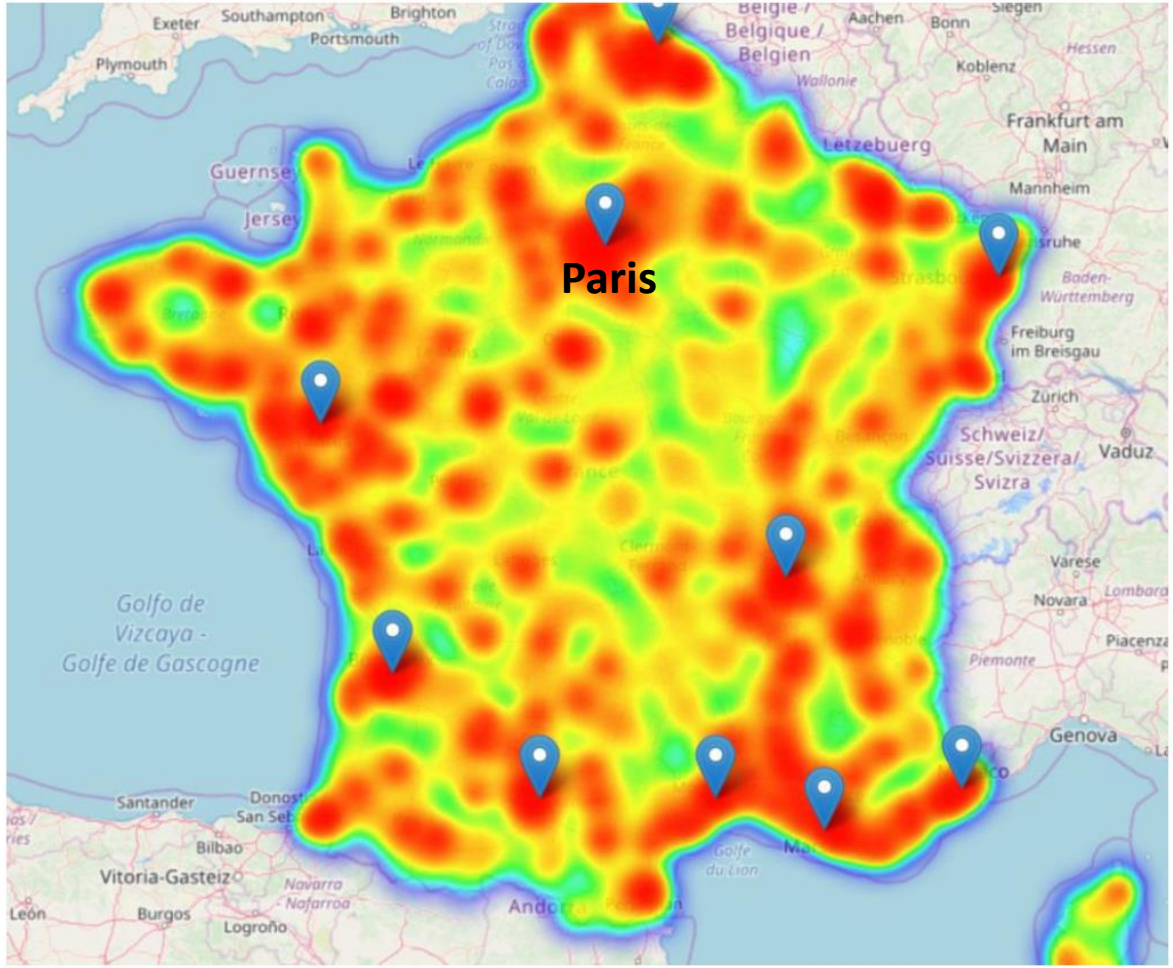
Relation between Population & Doctors Number



➔ Positive correlation between Population and Doctors Number. There is a higher Number of Doctors for the more populated territories.

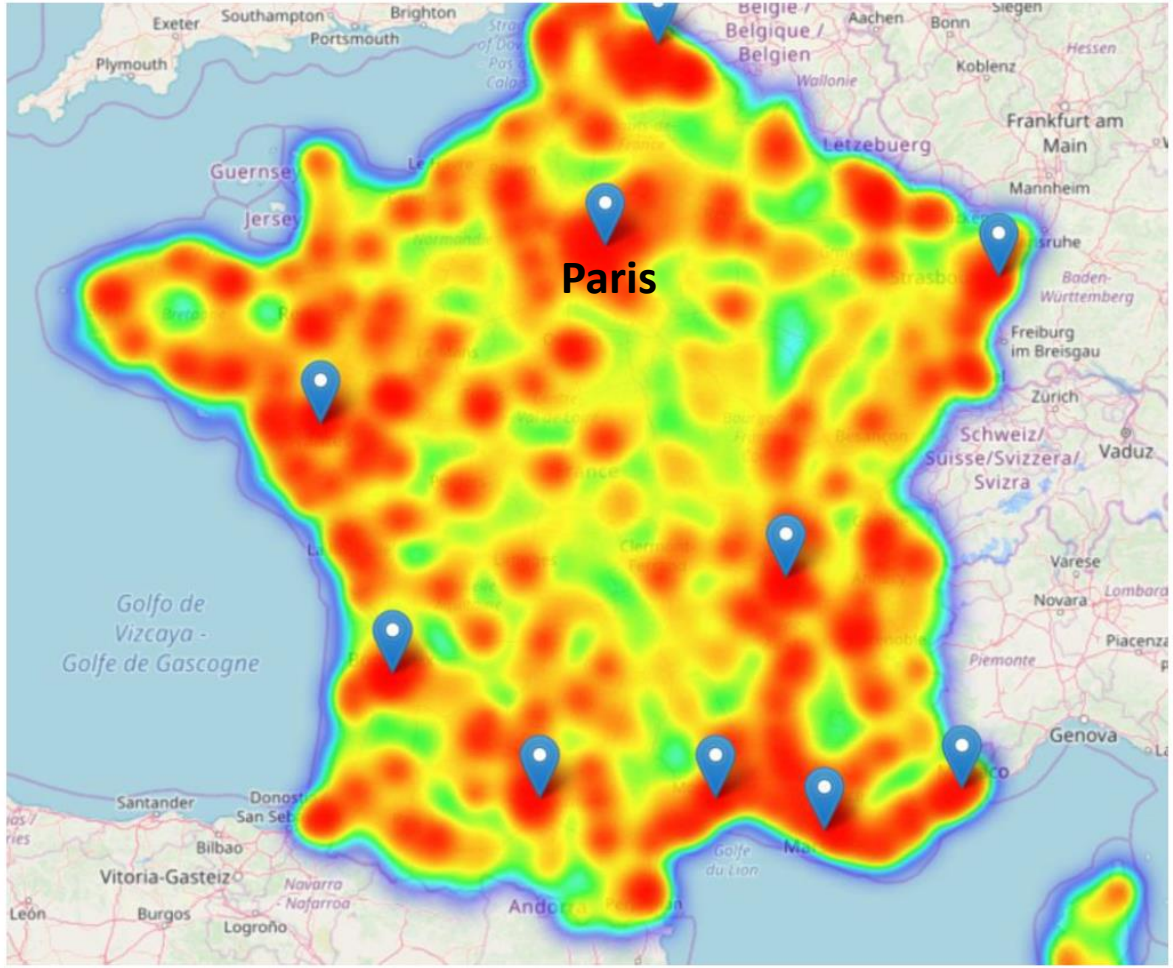
Heatmap Population

Density of the population of the France

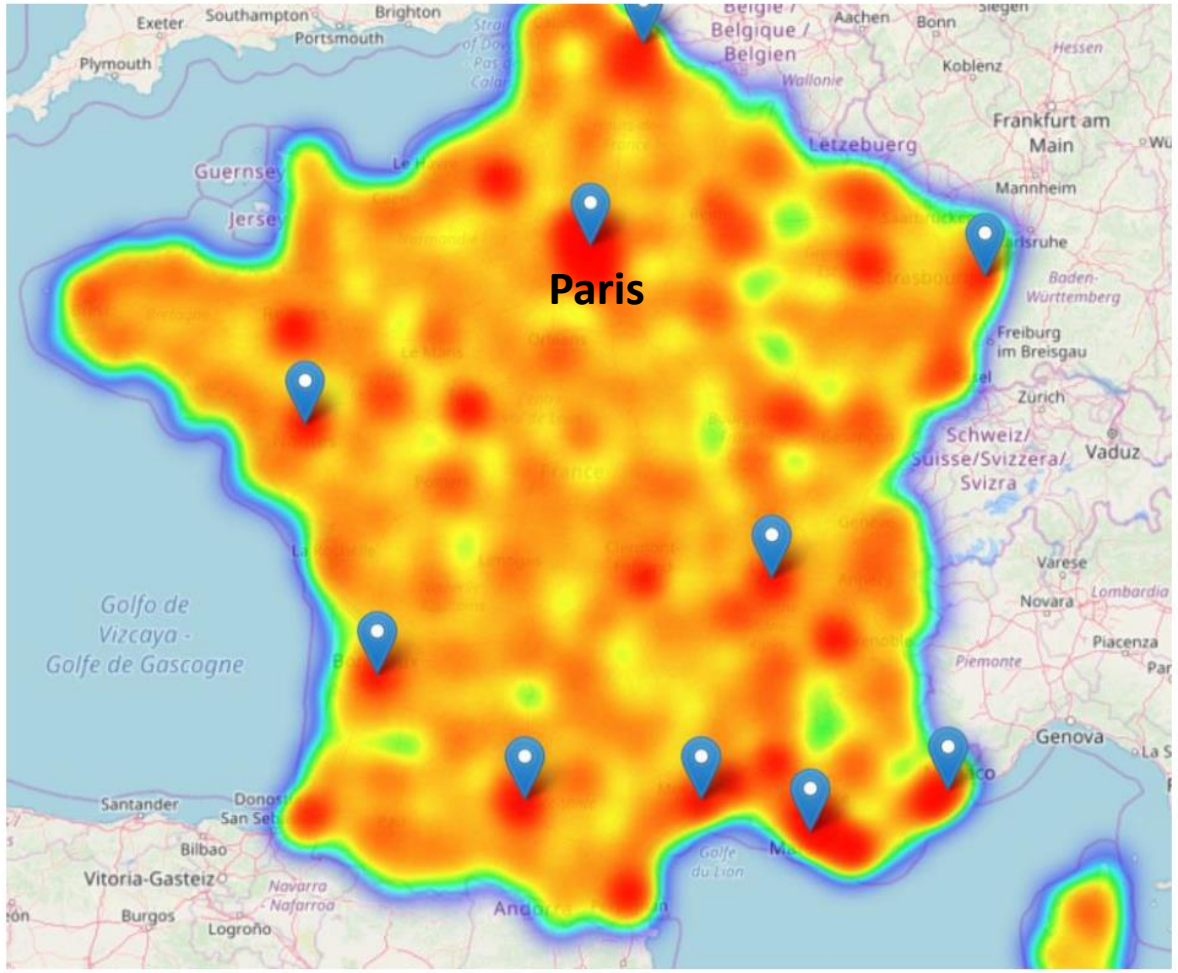


Heatmap Population vs. Doctors number

Density of the population of the France



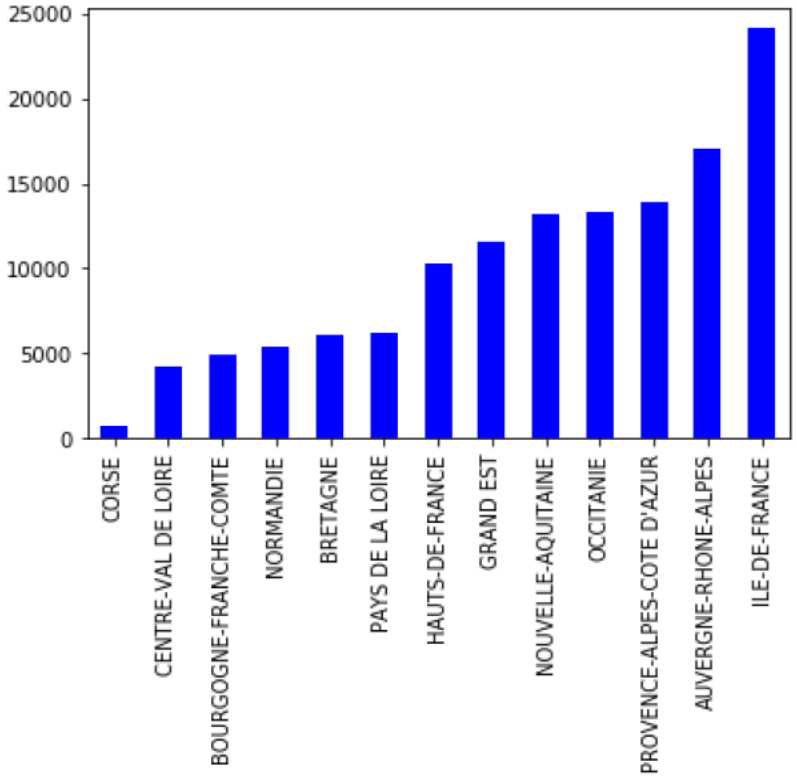
Density of the number of doctors in the France

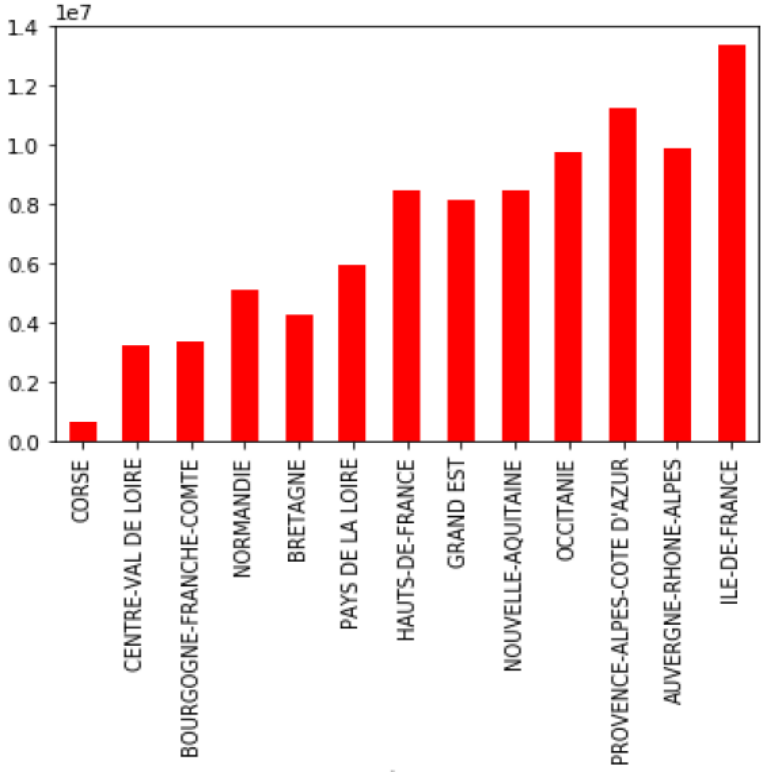


➔ There is a lot of doctors in more populated cities.

Population and Doctors number by Regions

Doctors number

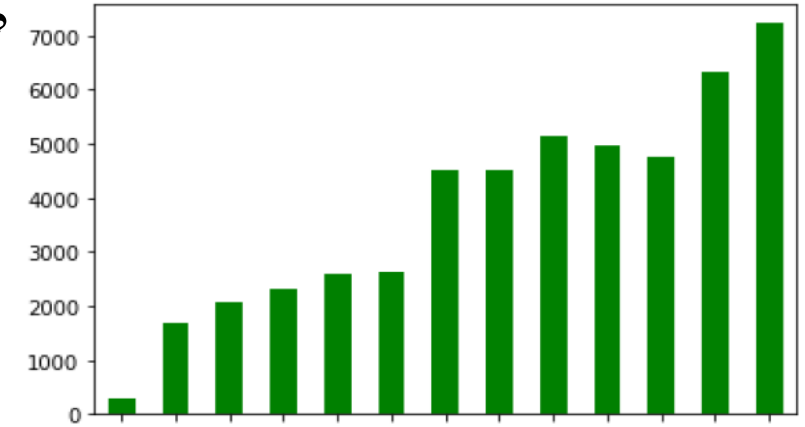


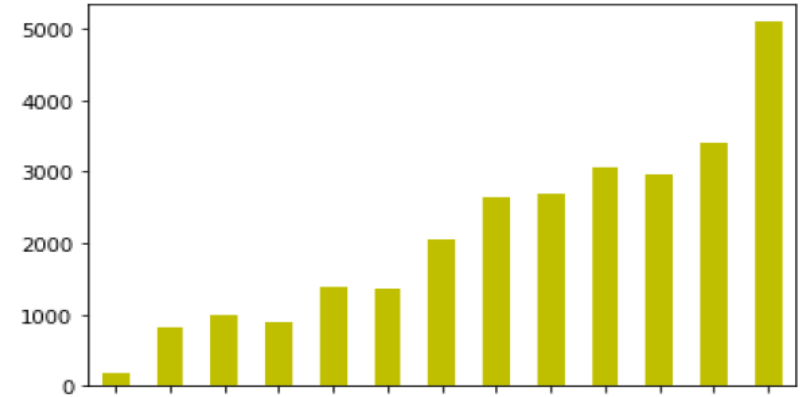


Population (x10e3)

➔ Similar distributions across French regions.

General practitioners number





Dental surgeons number

1st model: Predict the number of doctors per zip code

Linear Regression Model

$R^2 = 0.551$

Most significant features (p<0.001):

Features	+ / -	Coefficients
Surface Area	-	0.0004
Population	+	0.0007
General practitioner rate	-	0.99
Dental surgeon rate	-	0.96

Random Forest Regressor Model

R^2 training data = 0.93
R^2 test data = 0.78

Importance of features:

	importance
Population_Zipcode	0.633379
General_practitioner_rate	0.195719
SurfaceArea_Zipcode	0.047523
Longitude_from_Paris	0.041959
Dental_surgeon_rate	0.031124
Women_doctor_rate	0.018173
poverty_rate	0.014113
Latitude_from_Paris	0.010303
unemployment_rate	0.005956
North_South	0.001751

2nd model: Predict the population by General Practitioner by zip code

Linear Regression Model

$R^2 = 0.055$

Most significant features (p<0.001):

Features	+ / -	Coefficients
Surface Area	+	2.2
Latitude from Paris	+	5984.1
Male doctor rate	+	303.7

Random Forest Regressor Model

R^2 training data = 0.13
R^2 test data = 0.18

Importance of features:

	importance
SurfaceArea_Zipcode	0.407728
Latitude_from_Paris	0.240098
Women_doctor_rate	0.237319
Longitude_from_Paris	0.055437
poverty_rate	0.049127
unemployment_rate	0.008744
North_South	0.001545

Conclusion

1. Model to predict the number of doctors by zip code

➔ More doctors in the most populated cities

Is there the same ratio of general practitioner per habitant in both densely populated and less populated cities?

2. Model to predict the population by general practitioner by zip code.

➔ The model has an accuracy very weak, we cann't predict in which cities doctors have to settle in priority.
➔ We need more features that have an impact on our variable to predict.

Recommendation:

The futur general practitioners have to settle in priority in cities located in the south and east of Paris.