Team project

Alex, Goajun, Sergey, Bastien

Introduction

We have performed analysis of electricity data provided by the French Distribution Network (RTE)

Analysis

1. Background on electricity in France
2. Evolution of energy mix
3. Correlation studies

Source Open data: https://www.data.gouv.fr/fr/datasets/electricite-consommation-production-co2-et-echanges/

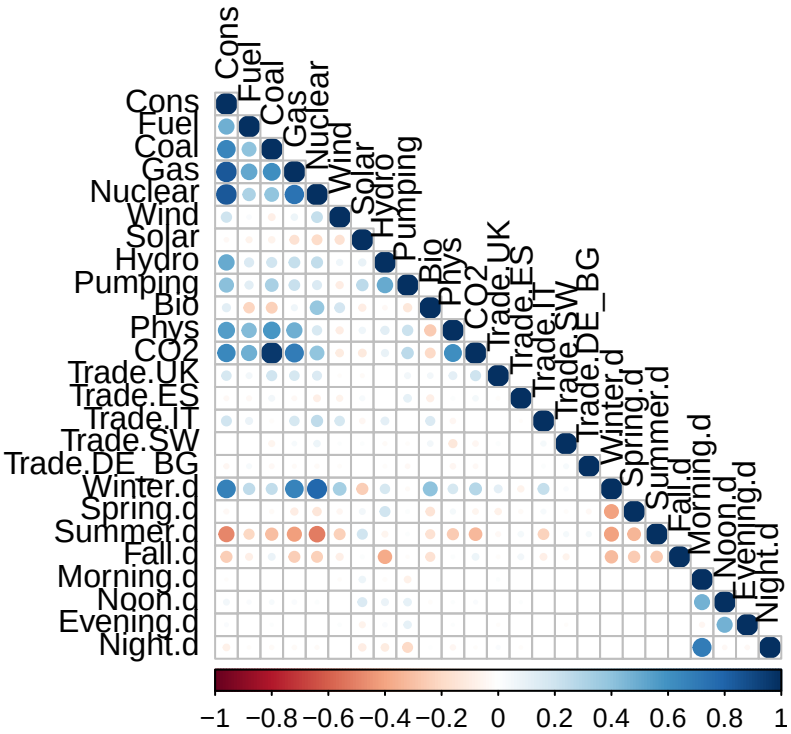
Part 1 - Analysys of French Energy System.

The purpose of the current analysis is to interpret French Energy System data uploaded from ... The raw data contains the following information about French Energy System for every 30 minute during the period from ... untill ...: 1. Total consumption of energy (demand) in MW (megawatts); 2. Generation mix that meets the demand. The generators are grouped according to the nature of energy producing units and fuel used; 3. Net export data that describes energy flows of French Energy System and energy systems of other companies 4. CO2 emission data recorded aggregately for all energy generators.

Given the nature of the data the analysis will focuse on the following issues: 1. Understanding of correlations between consumption, generation mix, CO2 emissions, net export, time of the day and season. 2. If correlation is traced and can be explained the next step is to use linear regression models to describe the relationship between dependent and independent variables.

Part 2 - Correlation matrix analysis

We used R programming language tools to construct correlation matrix for the parameters selected from the raw dataset. For better visualisation we used "Corrplot" package, that can let us trace dependencies in a convenient way. We decided to exclude from analysis the correlation coefficients that are not significant under p = 0,05. Such cells are left blank in the following diagramm:



The exact correlation coefficients betwenn selected parameters are given in the followng matrix:

As we can see from the table and diagramm above there are correlations between following variables: 1. Consumption and generation mix; 2. Consumption and the season of the year; 3. CO2 emissions and fuel-fired generators (primarily Coal and Gas); 4. Solar energy generation and the season; 5. Wind energy generation and the season.

The correlation between consumption and generation mix seems obvious since power stations produce electricity according to the current demand load in the system. We decided not to construct the model for this relationship since similar analysis is provided in the energy mix table. Instead, we decided to futher investigate relationships from point 2 to 5.

Regression of consumption vc the season of the year To find the relationship between consumption of the energy and the season we assumed that Intercept will represent consumption in Fall and used other seasons are either 1 or 0. The results of regression are the following:

$$Consumption = 4.7916 \times 10^4 + -3457 * Summer + 6055 * Spring + 1.8877 \times 10^4 * Winter$$

Regression of CO2 emissions vc fuel-fired generators (primarily Coal and Gas) To understand relationship between CO2 emissions and energy generated from different sources (generation mix) we ran the following regression:

$$CO2_emission = 0.0076902 * Fuel + 0.0148562 * Coal + 5.651 \times 10^{-4} * Gas + 4.885 \times 10^{-4} * Nuclear$$

summary(Regression.CO2)

Regression of Solar energy generation vc the season To find the relationship between solar energy generation and the season we assumed that Intercept will represent generation in Fall and used other seasons are either 1 or 0. The results of regression are the following:

$$Solar_generation = 571 + 235 * Summer + 46 * Spring + -315 * Winter$$

Regression of Wind energy generation vc the season To find the relationship between wind energy generation and the season we assumed that Intercept will represent generation in Fall and used other seasons are either 1 or 0. The results of regression are the following:

$$Wind_generation = 1555 + -277 * Summer + 163 * Spring + 891 * Winter$$

Conclusion

We have become more familiar with R by using the set of data. We have confirmed seveal of our assumptions by querying the set of data including: - the balance of the energy over the period under study - the evolution of the mix of energy over the period under study - various sets of correlation