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Objective

Understand the application of Regression in real world scenarios and implement the Linear Regression techniques taught as part of the module CSE 7402o, to solve the near real time use case from Civil Engineering Domain.

Real-world Scenarios

Study of Soil Properties

Collapsing buildings are a serious threat to structural engineers, building industry, government, estate developers, building consultants and other relevant stakeholders in the building industry, as well as landlords and tenants. High rising structures, especially, require a factor of safety with respect to different building materials, due to the unpredictability in the analysis of soil and its cost implication. Several scholars, in their work, have applied linear regression models with more than one independent variable as multiple linear regression and similarly, in their research they have pointed out that MLRA is a well-known method that depicts the relationship that exists between a set of dependent and independent variables using statistical approaches. Soil forms the basis of support for all engineering structures such as buildings, roadways, dams. Importantly many scholars have classified soil properties into three (3) – physical properties (example, colour, porosity, structure, texture); chemical properties (example PH, salinity, cation exchange capacity (CEC), organic matter, C: N ratio (carbon, nitrogen ratio) and mechanical properties such as bearing capacity, permeability, seepage, shear strength, lateral earth pressure etc. In depth efforts and techniques have been employed in the studies of soil properties.

Reference :

https://www.ajol.info/index.php/njt/article/download/164960/154456

Estimating Time of Completion of Construction Project

Productivity rates of construction trades are the basis for accurately estimating time and costs required to complete a project. Productivity could be defined as "the ratio of output of required quality to the inputs" for a specific production situation; in the construction industry, it is generally accepted as "work output per man-hours worked". Improved productivity helps contractors not only to be more efficient and profitable; knowing actual productivity levels also helps them to estimate accurately and be more competitive during bidding for projects.

In response to the industry needs, MLR has been used to conduct an accurate measurement of on-site construction productivity through developing regression models for predicting the productivity of finishing works for floors with marble.

Reference:

https://www.researchgate.net/publication/269791271_Using_Multivariable_Linear_Regression_Technique_for_Modeling_Productivity_Construction_in_Iraq

HOT | Domain: Civil Engineering

Background

The Compressive Strength of Concrete determines the quality of Concrete. This is generally determined by a standard crushing test on a concrete cylinder. This requires engineers to build small concrete cylinders with different combinations of raw materials and test these cylinders for strength variations with a change in each raw material. The recommended wait time for testing the cylinder is 28 days to ensure correct results. This consumes a lot of time and requires a lot of labour to prepare different prototypes and test them. Also, this method is prone to human error and one small mistake can cause the wait time to drastically increase.

One way of reducing the wait time and reducing the number of combinations to try is to make use of digital simulations, where we can provide information to the computer about what we know and the computer tries different combinations to predict the compressive strength. This way we can reduce the number of combinations we can try physically and reduce the amount of time for experimentation.

Problem Statement

Concrete is the most important material in civil engineering. The concrete compressive strength (CCS) is a function of age and ingredients. These ingredients include cement, blast furnace slag, fly ash, water, superplasticizer, coarse aggregate, and fine aggregate. In this use case, we will understand and find the relation between CCS and the independent features using statistical models and use the same for prediction.

Tasks: Perform the tasks as mentioned in the jupyter notebook and submit the file

Learning Outcomes

- Be able to explore Data
  - Be able to understand the data and target variable
  - Be able to observe relation between each feature and the target variable
- Be able to prepare and preprocess the data for modelling
- Be able to implement linear regression model(s) and how to improve model performances
- Be able to interpret the model and evaluate the model performance

Additional references

https://elitedatascience.com/feature-engineering
https://towardsdatascience.com/linear-regression-detailed-view-ea73175f6e86
https://www.cement.org/cement-concrete-applications/how-concrete-is-made