Concrete Strength; Group Seven

Determining the quality of concrete is a tedious task. When testing certain materials, a standard crushing test takes place where the strength of a concrete cylinder is examined for a period of twenty-eight days. This test shows engineers the effects of a compressive force on a different combination of raw materials over the twenty-eight-day period. The twenty-eight period is not the only lengthy aspect of this process. Each time the concrete is tested, the materials of the concrete are changed and tested for another twenty-eight days. A significant amount of time and effort is spent during each analysis in an attempt to discover the optimal assemblage of data. This also leaves a lot of room for error, leading to an increase of the overall experiment time. Therefore, a digital prediction of concrete strength is desired to shorten this process and allow the data to be understood more quickly and easily.

Constructing a simulation can reduce the amount of time and labor it takes to find the correct raw materials to reach the desired strength of concrete. This simulation will give us a number of options of raw materials to try out manually which will drastically shorten the process of testing the compressive strength. When providing a computer with all the known information, the computer will produce data much more rapidly than repeating the standard weight test manually. This is quite complicated due to the fact that a big majority of the data must be known before attempting to create a simulation that manufactures valid results. We must find the relationship between each of the raw materials and how each specific material affects the strength in order to compose software that will provide us with accurate predictions. These predictions can then be used to accurately model the strength of the entered mixture of materials.

As a group, we discussed the steps we will need to take in engineering a test to get the appropriate results as fast as possible. First, we familiarized ourselves with the concrete strength database. This database contains one thousand and thirty examples and nine attributes. Seven of the nine attributes represent the weight of the raw materials, one represents the age, and the last attribute, the output value, represents the overall compressive concrete strength of a certain concrete mixture. We will use the Pearson correlations to understand the relationship of the raw materials more in-depth. When looking at our database, we can see the relationship of each attribute, or input value, in regards to the compressive strength, or the output value. We can also see how each raw material affects one another. We will take note of strong positive and strong negative correlations as these help us recognize relationships. Then we will design scatter plots between Compressive strength and multiple different variables to be able to visualize the interactions of each variable.

With all this known information, and after becoming familiar with each correlation, we can begin constructing models. We will start by designing a linear regression model to get an image of the linear relationship between the featured variables and the desired output. We will use the variations found in the article “Concrete Compressive Strength Prediction using Machine Learning” to test our data. These are functions that lessen the intricacy of a linear regression model which helps us understand the image more efficiently. We use these to define the RMSE and the R2 of each predictor then with this information, create a bar graph. Looking at the bar graph, using predicted and true values, we can determine if linear regression, Lasso regression, or Ridge regression is the best fit for our featured variables. We will then use the predicted values on three different scatter plots (linear, lasso, and ridge regression) to identify visual differences between the three. Following that, we will use the Decision Tree and the Random Forest regressor to test the same variables giving us more diversity. Plotting these next to each other will help us understand which algorithm is the best fit.

Once we have discovered our best model, we will use this when determining the concrete strength of the five provided mixtures. We will test these mixtures on our constructed model and understand which raw materials produce the best outcome.

In order to accomplish the task of creating a predictive model for concrete analysis the roles are as follows:

**Jaron Z**: Lead code

**Esteban W**: Auxiliary code

**Berrilyn B**: Literary analysis

**Lydia B**: Literary editor, effort sheets

Works Cited

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