Literature research

The initial phase of our final project involved crafting a literature report before delving into the computational aspects of data analysis, with a focus on understanding the intricacies of concrete mixing. Our exploration illuminated the significance of the incoming data and its role in this process. As articulated by Laskar (2011), the primary objective of a mix design method is to derive concrete ingredient proportions that enable the formulation of an initial trial batch, aiming for specific strength, long-term qualities, and performance. Leveraging digital simulations for predictive analysis proves invaluable in expediting the identification of optimal concrete mixtures. This undertaking, coupled with our research, equips us with insights into the individual influences of each component in the mix and underscores the utility of employing coded data models to ascertain the ideal combination.

To make good concrete, you need to make sure all the ingredients are just right. First, we test the physical properties of these ingredients, like cement, age, water, and others. This testing forms the basis for deciding how to mix the concrete. In our project, we're looking at data for things like cement, water, and more. We'll organize this data into a table to figure out the best way to mix them for the job.

Making sure the concrete is strong is super important. We check its strength by doing a test called compressive strength, which tells us how much pressure it can handle before breaking. In our project, we're using data to figure out how strong our concrete mixes are. A good concrete strength is usually between 17 to 28 MPa. So, from our data predictions, we'll know which mixes are strong enough for building things and which ones might not hold up well under pressure.

In the traditional method of predicting strength, a data model is highly valued for its role in selecting the finest materials and showcasing both the quality of these materials and the skill in their assembly (Badole, 2021). The data we obtain comes from a standard crushing test performed on a concrete cylinder, assessing its strength over a 28-day period. Various predictive models are available to identify the most suitable fit for the modeled data. Our study aims to pinpoint the optimal result from our data, offering the most accurate prediction of concrete strength for construction purposes.

Considering everything, figuring out how to mix concrete and determining its strength can be simplified using coding and digital simulations. Having accurate data with the best fits is crucial to ensure the concrete is strong and forms a solid foundation for construction. It involves considering the physical properties of each component and assessing compressive strength to ensure durability. By the end of our project, we will have gained insights into the significance of concrete mixing, the role of compressive strength, and identified the data model that provides the best results.

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Exploratory data analysis

Examine the concrete database and enhance the readability by restructuring the column headings. Next, determine the most suitable model structure and fitting model for our database. Choose from model structures like linear, power law, and quadratic, and consider data fitting tools such as ordinary least squares, lasso regression, and random forests. The key consideration in implementing these models is to add more parameters, given the presence of multiple variables that require comparison to identify the best predictor in the subsequent section.

Model building

We had different ways to figure out which concrete is the strongest for our project. A/B testing was an option, but it only lets us compare two things, and we wanted to check more than that. Hypothesis testing could have worked because it's good for looking at different sets of data, but it seemed a bit complicated for what we had. We also thought about Intercal Estaminets, but it didn't match up well with our data.

So, we decided on the Linear Regression model. It's like a math tool that tries to draw a straight line between our input stuff (like types of concrete) and what we want to find out (which one is the strongest). It turned out to be a good choice because we could put in new info, and the model helped us figure out which concrete is the strongest. It worked out well, and we got the answers we needed!

Interim report

Our project collaboration between Cameron Golden and me, Anan Shaik, was a deliberate division of tasks based on our strengths and expertise. Given Cameron's extensive coding experience, he took charge of the coding aspect, contributing 70% of the effort, while I took on the remaining 30%, assisting in finalizing the coding work. Recognizing the importance of comprehensive research, I dedicated myself to the research component, supporting Cameron in building the model. This included handling interim and literary research.

Our task allocation was thoughtfully considered to maximize efficiency on this challenging project. Cameron's proficiency in coding made him the ideal lead for that aspect, allowing me to manage other critical aspects, such as creating the video and handling the project submission. Each task was strategically assigned based on our individual strengths and comfort zones.

Thanks to our meticulous planning and collaborative effort, we successfully completed all tasks within the stipulated time frame. This ensured the seamless execution of our project and its timely delivery.

Thank you for watching :)