DEVELOPMENT OF A MACHINE LEARNING MODEL FOR ACCURATE PREDICTION OF EQUIVALENT CIRCULATING DENSITY USING REAL-TIME DRILLING DATA

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INTRODUCTION

The Equivalent Circulating Density is one of the crucial parameters in the drilling operation. The current method to determine either costs hundreds of thousands of dollars or not accurate and have discrepancies, which necessitate the need for this project.

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AIMS & OBJECTIVES

This project aims to develop a Machine Learning model that accurately predicts Equivalent Circulating Density with high accuracy in real-time for drilling.

Objectives:

1) To select the surface drilling parameters that influence the ECD
2) To determine the best ML algorithm for predicting the ECD using statistical tools
3) To optimize & apply an ML model for ECD prediction on unseen data

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METHODOLOGY

1) Data Collecting
2) Data Preprocessing
3) Model Creation
4) Model Training
5) Model Hyperparameter Tuning
6) Model Testing
7) Model Comparison & Analysis

Data was collected from the Volve field in Norway (open source) and was used to train 18 different models. These models used different algorithms to find the best-performing algorithm. 9927 data points from Well 1 were used in the first stage to train, validate, and test different models. To evaluate the model, the developed model was tested on unseen data from other Wells.

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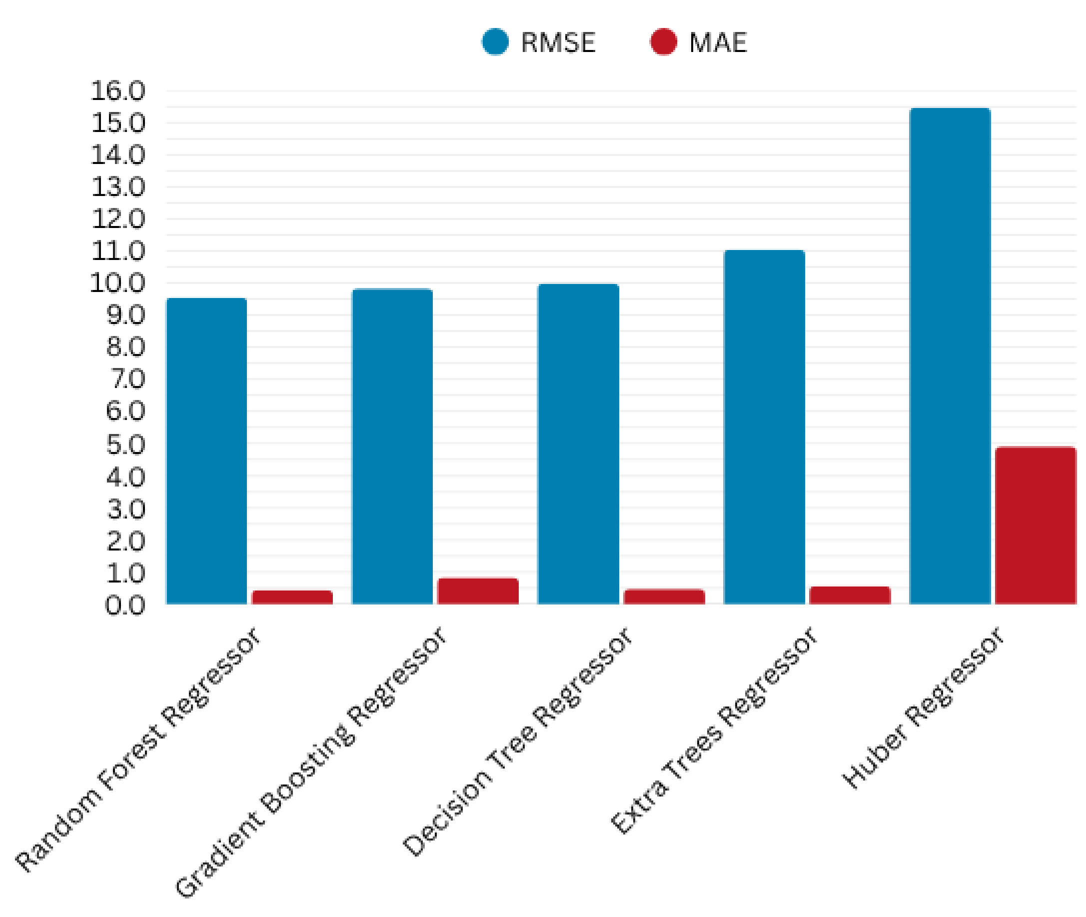
RESULTS & DISCUSSION

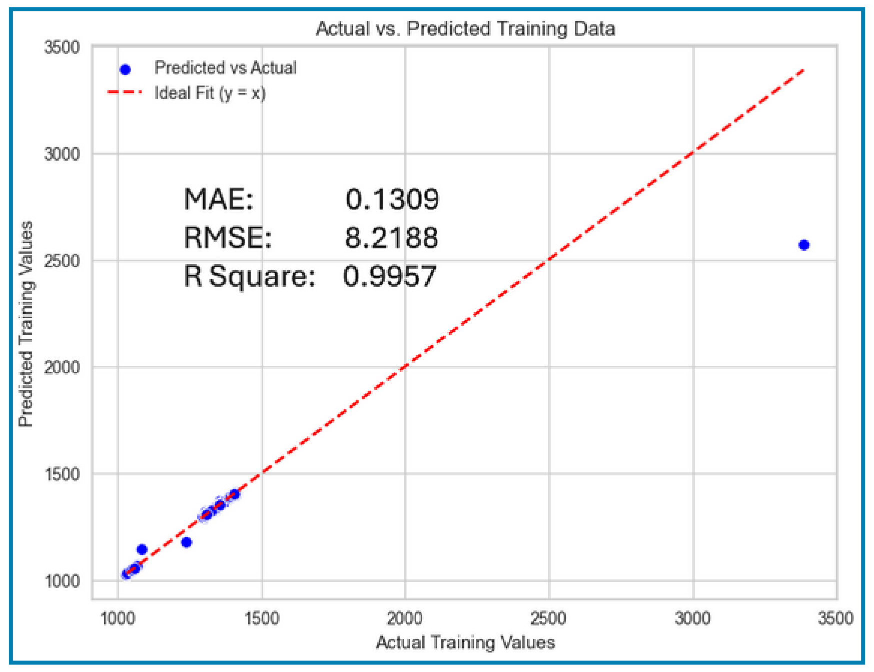
The following chart shows the RMSE and MAE training results of the best 5 algorithms, where the best-performing model is Random Forest Regressor as shown:



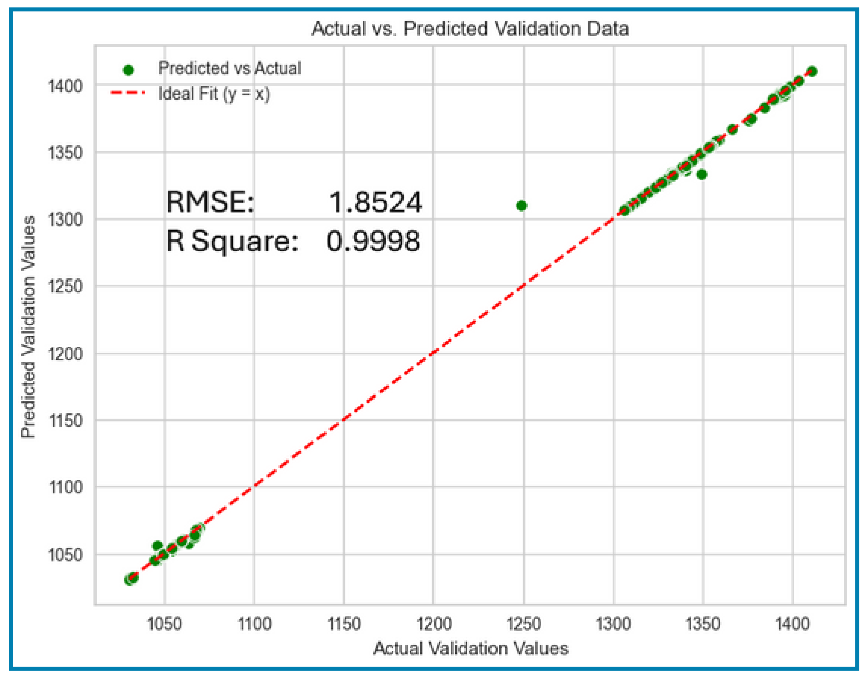
Initial results of the training phase of the 3 best-performing algorithms' accuracy are as follows:

Random Forest Regressor RMSE	9.5445
Random Forest Regressor R Square	0.9736
Gradient Boosting Regressor RMSE	9.8373
Gradient Boosting Regressor R Square	0.9736
Decision Tree Regressor RMSE	9.9848
Decision Tree Regressor R Square	0.9733

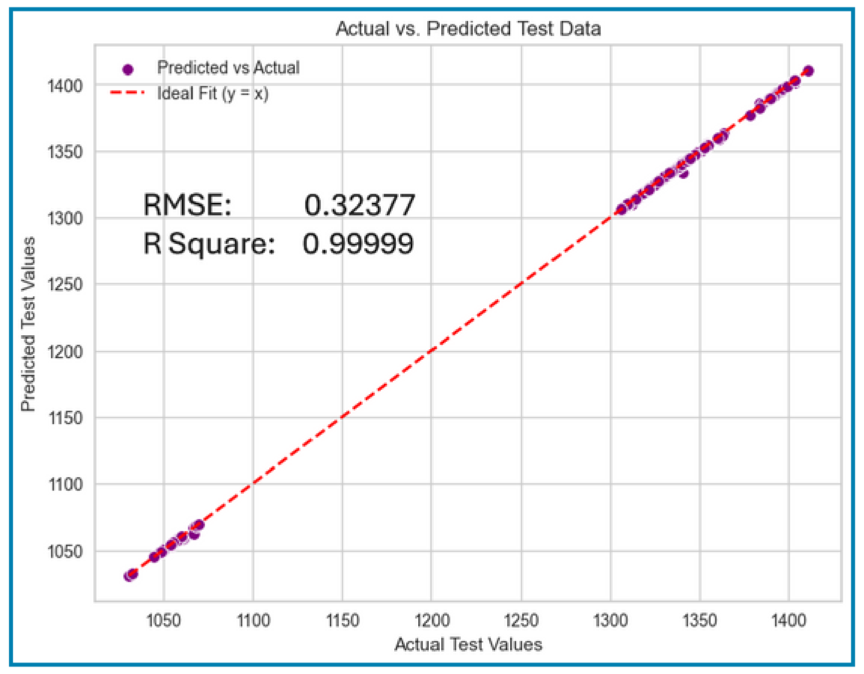
The following graph shows the accuracy of the Random Forest Regressor algorithm in the training phase:



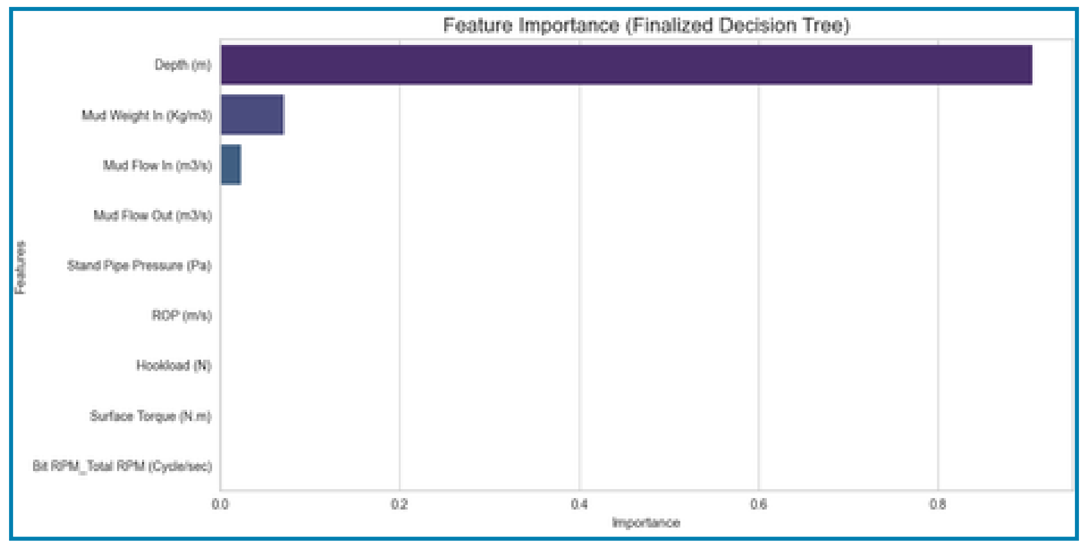
The following graph shows the accuracy of the Random Forest Regressor algorithm in the validation phase:



The following graph shows the accuracy of the Random Forest Regressor algorithm in the testing phase:



The following graph shows each variable importance and effectiveness to the Equivalence Circulating Density:



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CONCLUSION

The process was conducted by collecting and preprocessing the data. Afterwards, the ML model was developed. In the next step, the three best-performing were outlined on the basis of RMSE and R Square.

Among the three, Random Forest Regressor performed well with RMSE (9.5445) and R^2 (0.9736). While the second-best-performing ML model was Gradient Boosting Regressor, and Decision Tree Regressor stood in third position.

The best algorithm was furthermore tested by two unseen data from well 15/9-F-1 A and well 15/9-F-1 B, where the maximum percentage error was determined to be 12% for the first well and 6% for the second well.

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