**CHAPTER FOUR**

**RESULTS AND DISCUSSION**

This chapter describes the performance of 2 different ensemble models using precision, recall, accuracy, also the model fitting time and prediction time.

4.1 Model metrics results interpretation and comparison

Using a custom-built grid search CV to search best parameters to fit into the model to achieve best results and checking the fit and prediction time of both models to see which is faster at fitting and which is faster at predicting which will be very important when considering the choice of models in the business context.

Results trade off in business context

Predict time of x vs y – can this cause a bottle neck in the process

0.795% Precision signifies that the sentiments the model identified as positive were actually positive, 79.5% of the time,

0.80 recall signifies that out of the actual positive results, the model was able to detect 80%

0.90 Accuracy signifies out of the all the predictions made by the model, 90% were correct while 10% were incorrect.

Making sure the model is not overfitting

Custom grid search CV – Random Forest model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No of estimators** | **Max depth** | **Precision** | **Recall** | **Accuracy** |
| Est: 10 | Depth: 10 | Precision: 0.795 | Recall: 0.709 | Accuracy: 0.709 |
| Est: 10 | Depth: 20 | Precision: 0.889 | Recall: 0.866 | Accuracy: 0.866 |
| Est: 10 | Depth: 30 | Precision: 0.884 | Recall: 0.857 | Accuracy: 0.857 |
| Est: 10 | Depth: None | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 50 | Depth: 10 | Precision: 0.887 | Recall: 0.882 | Accuracy: 0.882 |
| Est: 50 | Depth: 20 | Precision: 0.897 | Recall: 0.88 | Accuracy: 0.88 |
| Est: 50 | Depth: 30 | Precision: 0.894 | Recall: 0.891 | Accuracy: 0.891 |
| Est: 50 | Depth: None | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 100 | Depth: 10 | Precision: 0.878 | Recall: 0.871 | Accuracy: 0.871 |
| Est: 100 | Depth: 20 | Precision: 0.901 | Recall: 0.885 | Accuracy: 0.885 |
| Est: 100 | Depth: 30 | Precision: 0.927 | Recall: 0.927 | Accuracy: 0.927 |
| Est: 100 | Depth: None | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |

Custom grid search CV – Gradient boosting model

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Estimators** | **Max depth** | **Learning rate** | **Precision** | **Recall** | **Accuracy** |
| Est: 100 | Depth: 3 | LR: 0.1 | Precision: 0.957 | Recall: 0.955 | Accuracy: 0.955 |
| Est: 50 | Depth: 7 | LR: 0.1 | Precision: 0.951 | Recall: 0.95 | Accuracy: 0.95 |
| Est: 150 | Depth: 3 | LR: 0.1 | Precision: 0.951 | Recall: 0.95 | Accuracy: 0.95 |
| Est: 150 | Depth: 15 | LR: 0.01 | Precision: 0.947 | Recall: 0.947 | Accuracy: 0.947 |
| Est: 50 | Depth: 3 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 50 | Depth: 7 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 50 | Depth: 11 | LR: 0.1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 50 | Depth: 11 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 50 | Depth: 15 | LR: 0.1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 50 | Depth: 15 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 100 | Depth: 3 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 100 | Depth: 7 | LR: 0.1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 100 | Depth: 7 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 100 | Depth: 11 | LR: 0.1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 100 | Depth: 11 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 100 | Depth: 15 | LR: 0.1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 100 | Depth: 15 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 150 | Depth: 3 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 150 | Depth: 7 | LR: 0.1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 150 | Depth: 7 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 150 | Depth: 11 | LR: 0.1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 150 | Depth: 11 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 150 | Depth: 15 | LR: 0.1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 150 | Depth: 15 | LR: 1 | Precision: 0.943 | Recall: 0.938 | Accuracy: 0.938 |
| Est: 150 | Depth: 11 | LR: 0.01 | Precision: 0.919 | Recall: 0.919 | Accuracy: 0.919 |
| Est: 100 | Depth: 15 | LR: 0.01 | Precision: 0.909 | Recall: 0.908 | Accuracy: 0.908 |
| Est: 50 | Depth: 3 | LR: 0.1 | Precision: 0.902 | Recall: 0.899 | Accuracy: 0.899 |
| Est: 100 | Depth: 11 | LR: 0.01 | Precision: 0.877 | Recall: 0.868 | Accuracy: 0.868 |
| Est: 150 | Depth: 7 | LR: 0.01 | Precision: 0.877 | Recall: 0.868 | Accuracy: 0.868 |
| Est: 50 | Depth: 15 | LR: 0.01 | Precision: 0.834 | Recall: 0.807 | Accuracy: 0.807 |
| Est: 100 | Depth: 7 | LR: 0.01 | Precision: 0.834 | Recall: 0.807 | Accuracy: 0.807 |
| Est: 50 | Depth: 11 | LR: 0.01 | Precision: 0.813 | Recall: 0.77 | Accuracy: 0.77 |
| Est: 100 | Depth: 3 | LR: 0.01 | Precision: 0.795 | Recall: 0.664 | Accuracy: 0.664 |
| Est: 150 | Depth: 3 | LR: 0.01 | Precision: 0.769 | Recall: 0.706 | Accuracy: 0.706 |
| Est: 50 | Depth: 3 | LR: 0.01 | Precision: 0.765 | Recall: 0.557 | Accuracy: 0.557 |
| Est: 50 | Depth: 7 | LR: 0.01 | Precision: 0.749 | Recall: 0.672 | Accuracy: 0.672 |