CA03 – Decision Tree Models

**Part 3: Performance Evaluation**

The final Logistic Regression model included the following parameters:

LogisticRegression(C=0.01, penalty='l2', solver='liblinear')

**Confusion Matrix**

A confusion matrix evaluates model performance by comparing true positive and negative outcomes again false positive and negative outcomes.

A picture containing graphical user interface

Description automatically generated

In this case, the model made the following predictions:

* True Positives: 15
* False Positives: 4
* True Negatives: 4
* False Negatives: 2

Based on the confusion matrix, the model is acceptable as it predicted 15 out of 17 total positive outcomes correctly. As the objective is to detect heart disease, the ability to correctly classify positive outcomes is more important than predicting negative outcomes.

**Classification Report**

A classification report returned the following results:

Table

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The model returned an Accuracy score of 0.76, meaning that it is able to accurately predict 76% of the outcomes. While the score is acceptable, a higher score is preferred as the detection of Cardiovascular Disease requires the most accurate results.

The report returned a Precision score of 0.7895. Using the positive cases as an example, Precision measure the ratio of true positive predictions to the sum of total positive predictions, regardless of whether they are true or false. Here, the model correctly classified 78.95% of all positive outcomes, meaning that there were some false positives. However, the ability to predict false positives is not as important as patients with false positive outcomes ultimately do not face any risks of Cardiovascular Disease.

The model’s Recall score is 0.8824, which is relatively high. Using the positive cases as an example, Recall represents the ratio of true positive predictions to the total number of positive outcomes. Here, the model correctly classified 88.24% of all true positive outcomes, meaning that there were only very few false negatives. In this case, the Recall score is more important than the Precision score; as explained earlier when analyzing the confusion matrix, the model’s ability to classify positive outcomes is crucial as its purpose is to identify the risks of Cardiovascular Disease, which can be life-threatening. Identifying too many false positives is not as harmful as predicting too many false negatives; thus, the Recall score is more important in this case.

Lastly, the F-1 score measures the balance between Precision and Recall. A threshold that is too low will lead to too many false positives, while a threshold that is too high will lead to too many false negatives. To obtain the most accurate results, the F-1 score should be as close to 1 as possible. In this case, the classification report returned a F-1 score of 0.8333, indicating a good balance between Precision and Recall.

**Sensitivity**

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The model has a higher Sensitivity score, meaning that it is better at predicting positive outcomes compared to making negative predictions. This is ideal in this case as the objective is to identify as many high-risk patients as possible.

**ROC and AUC**

The ROC curve measures sensitivity against specificity. The following plot was returned:

**Chart, line chart

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The AUC score represents the probability that a model can distinguish between positive and negative outcomes. Ideally, AUC = 1; in this case, it is about 0.6912. Although this score is not ideal, it is still acceptable as it is above 0.5.

**Conclusion**

This Logistic Regression model is of acceptable quality with an accuracy score of 0.76. When analyzing the Classification Report, it becomes evident that the model has a strong ability to correctly identify true outcomes when compared to all outcomes of one class, meaning that it is not only able to detect true negatives, but also true positives. A high Sensitivity score of 0.88 asserts that the model is better at predicting positive outcomes rather than negative outcomes. The ability to correctly predict positive outcomes is crucial when detecting high-risk patients for Cardiovascular Disease.

The ROC’s AUC score was rather low at 0.69, meaning that the model may not be able to precisely distinguish between positive and negative outcomes. A solution to this problem is to change the model’s threshold value, which can range between 0 and 1 and affects the AUC score.

Cardiovascular Disease detection requires models of exceptionally high quality. However, the model’s returned accuracy score and AUC score are merely acceptable. Thus, a different type of predictive model should be chosen to further increase the model’s performance scores.