Random Forest is an ‘ensemble’ model that fits based on majority voting from numerous decision trees which corrects for overfitting. As Random Forest is a non-parametric algorithm, it requires little data preparation beforehand. Variables can be ranked according to importance based on Gini index, though how a variable affects final output is less interpretable than logistic regression.

The first iteration of training the Random Forest Classifier yielded 88.3% overall Accuracy, but a low Sensitivity of 27.96%, meaning it could correctly predict fewer than one-third of the cases where death occurred. We hypothesized that the low sensitivity might be due to an imbalance within the dataset (deaths occurred in <5% of all cases), and that undersampling the majority class (no death) or oversampling the minority class (death) might increase accuracy.

Using the **caret** package, the Random Forest model was trained additionally using the following sampling techniques: down (simple random undersampling an equivalent number of cases where patients did not die), ROSE (Random Over-Sampling Examples), and SMOTE (Synthetic Minority Oversampling Technique). The results are shown below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | original | down | ROSE | SMOTE |
| Accuracy | 88.29% | 81.10% | 91.39% | 84.06% |
| Specificity | 96.70% | 79.16% | 90.33% | 84.99% |
| Sensitivity | 27.96% | 83.05% | 92.45% | 82.82% |
| Bal. Accuracy | 77.02% | 62.33% | 91.39% | 83.90% |

The different sampling methods to balance the data all resulted in an increase in sensitivity as hoped, though overall accuracy fell for down-sampling and SMOTE, due to a decrease in detecting true negative cases. However, the ROSE method greatly increased sensitivity while preserving specificity, thus leading to a higher overall accuracy and much higher balanced accuracy.