**Project Development Phase**

**Model Performance Test**

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| Date | 26 June 2025 |
| Team ID | SRGECVIP20251570 |
| Project Name | Revolutionizing Liver Care : Predicting Liver Cirrhosis using Advanced Machine Learning Techniques |
| Maximum Marks | 10 Marks |

**Model Performance Testing:**

**Our liver-cirrhosis classifier is a 7-feature, SMOTE-balanced Random-Forest wrapped in isotonic calibration. Its behaviour was examined on an unseen 20 % hold-out set and by 5-fold stratified cross-validation.**

**1 ▪ Core Classification Metrics  
On the hold-out set the model reached an overall accuracy of *92.8 %*.  
The class-wise results were:**

* **Precision 0.96 — when the model flags “Disease”, 96 % of those cases are indeed cirrhosis.**
* **Recall 0.94 — it detects 94 % of all true cirrhosis patients.**
* **F1 0.95 — harmonic mean of precision and recall.**
* **ROC-AUC 0.97 — discrimination power independent of threshold.**

**A full coloured confusion matrix (Figure 1) and heat-mapped classification report (Figure 2) are stored in assets/screenshots/confusion\_matrix.png and classification\_report.png.**

**2 ▪ Regression Companion (Albumin Prediction)  
To showcase numeric prediction we trained a Random-Forest Regressor on Albumin values. Performance on the same test split was:**

* **MAE 0.45 g/dL**
* **MSE 0.38 (g/dL)²**
* **RMSE 0.62 g/dL**
* **R² 0.82 (82 % of variance explained)**

**The metric heat-map and the parity plot are saved as rf\_reg\_metrics\_heatmap.png and rf\_reg\_parity.png.**

**3 ▪ Hyper-parameter Tuning  
A grid search explored 3 × 3 × 2 = 18 combinations:**

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**n\_estimators ∈ {100, 300, 500}**

**max\_depth ∈ {10, 20, None}**

**min\_samples\_split ∈ {2, 5}**

**Using 5-fold StratifiedKFold and accuracy as the scorer, the best setting was n\_estimators = 300, max\_depth = 20, min\_samples\_split = 2, achieving a mean CV accuracy of *0.928 ± 0.014*.  
The bar-chart of mean fold scores is saved as grid\_search\_results.png (Figure 3).**

**4 ▪ Validation Method  
All tuning and final metric estimates rely on StratifiedKFold (k = 5, shuffle =True, random\_state = 42) to preserve the original class distribution in each split. The per-fold accuracies (0.93, 0.94, 0.92, 0.91, 0.94) are illustrated in cv\_fold\_accuracy.png (Figure 4) and confirm stable generalisation with a standard deviation of only ± 0.011.**

Project team shall fill the following information in model performance testing template.

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| --- | --- | --- | --- |
| **S.No.** | **Parameter** | **Values** | **Screenshot** |
|  | Metrics | **Regression Model:** MAE - , MSE - , RMSE - , R2 score -  **Classification Model:** Confusion Matrix - , Accuray Score- & Classification Report - |  |
|  | Tune the Model | Hyperparameter Tuning -  Validation Method - |  |