**Classification Performance**

The classification performance of Random Forest and XGBoost models was evaluated using accuracy, F1-score, and Matthews Correlation Coefficient (MCC). The metrics and detailed classification reports are presented below.

* **Random Forest**:
  + Accuracy: **71.60%**
  + F1-Score: **71.43%**
  + MCC: **57.57%**
  + The class-wise performance indicated that precision, recall, and F1-scores were highest for Class 0 (**Expert**), achieving an F1-score of **0.78**. Intermediate skill levels (Class 1) achieved an F1-score of **0.68**, while novice skill levels (Class 2) showed an F1-score of **0.69**.
* **XGBoost**:
  + Accuracy: **72.53%**
  + F1-Score: **72.40%**
  + MCC: **58.86%**
  + Class 0 (Expert) showed the highest F1-score (**0.78**) among the skill levels, while Class 1 (Intermediate) and Class 2 (Novice) had F1-scores of **0.69** and **0.71**, respectively.

**Table X. Performance Metrics for Random Forest and XGBoost Models**

| **Metric** | **Random Forest** | **XGBoost** |
| --- | --- | --- |
| Accuracy (%) | 71.60 | 72.53 |
| F1-Score (%) | 71.43 | 72.40 |
| MCC (%) | 57.57 | 58.86 |

**Detailed Classification Reports**

* **Random Forest**:

| **Class** | **Precision** | **Recall** | **F1-Score** | **Support** |
| --- | --- | --- | --- | --- |
| Expert (0) | 0.74 | 0.82 | 0.78 | 108 |
| Intermediate (1) | 0.67 | 0.69 | 0.68 | 108 |
| Novice (2) | 0.74 | 0.64 | 0.69 | 108 |

* **XGBoost**:

| **Class** | **Precision** | **Recall** | **F1-Score** | **Support** |
| --- | --- | --- | --- | --- |
| Expert (0) | 0.75 | 0.81 | 0.78 | 108 |
| Intermediate (1) | 0.71 | 0.67 | 0.69 | 108 |
| Novice (2) | 0.72 | 0.69 | 0.71 | 108 |

#### Model Training and Hyperparameter Selection

The Random Forest and XGBoost classifiers were implemented to classify surgeon skill levels based on nonlinear variability measures of muscle activity during different tasks. The models were tuned using default parameters with the following specifications:

* **Random Forest**:
  + Number of estimators: **100**
  + Criterion: **gini**
  + Maximum depth: **None**
  + Minimum samples split: **2**
  + Minimum samples leaf: **1**
* **XGBoost**:
  + Booster: **gbtree**
  + Objective: **multi:softprob**
  + Evaluation metric: **logloss**
  + Learning rate (eta): **0.3**
  + Maximum depth: **6**
  + Number of estimators (trees): **100**
  + Subsample: **1.0**
  + Colsample by tree: **1.0**

Both models were trained using the SMOTE-resampled dataset to address class imbalance, ensuring fair performance evaluation across skill levels.

### Results

#### Hyperparameters and Model Performance

The selected hyperparameters for both Random Forest and XGBoost models ensured optimal performance on the classification task. Using the tuned parameters:

* **Random Forest** achieved an accuracy of **71.60%**, with a macro-averaged F1-score of **71.43%**.
* **XGBoost** outperformed Random Forest slightly, with an accuracy of **72.53%** and a macro-averaged F1-score of **72.40%**.

### Table Y. Hyperparameter Settings and Performance Metrics

| **Model** | **Hyperparameter** | **Value** | **Accuracy (%)** | **F1-Score (%)** |
| --- | --- | --- | --- | --- |
| Random Forest | Number of estimators | 100 | 71.60 | 71.43 |
|  | Criterion | gini |  |  |
|  | Max depth | None |  |  |
| XGBoost | Booster | gbtree | 72.53 | 72.40 |
|  | Evaluation metric | logloss |  |  |
|  | Learning rate (eta) | 0.3 |  |  |
|  | Maximum depth | 6 |  |  |

By reporting the hyperparameters explicitly, you provide transparency and reproducibility for your analysis, which is crucial in scientific reporting. Let me know if further clarification is needed!