

# Modelling and Prediction of Athletic Readiness based on Sleep and Recovery Patterns

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**Team: Panchtron**

**Week number: 4**

## *A. Progress Summary*

### *1) Work Completed:*

- **Data Preprocessing & Imputation:** Applied multiple imputation techniques, including Mean, Median, Mode, KNN, Polynomial Interpolation, MICE, and Expectation Maximization (EM). Selected the most effective approach based on data consistency.
- **Feature Engineering & Selection:** Analyzed correlations between Sleep Score, Recovery Metrics (HRV, RHR), and RSI (Readiness Score). Extracted key features for model training.
- **Model Development & Evaluation:** Implemented Ridge Regression, Lasso, Random Forest, LightGBM, and XGBoost. **Ridge Regression performed best**, followed by LightGBM, based on MAE, RMSE, and  $R^2$  Score.
- **Presentation & Documentation:** Delivered a mid-semester presentation summarizing dataset insights, model results, and future steps.

### *2) Milestones achieved:*

- Successfully handled missing data with various imputation techniques and finalized the best approach.
- Built and evaluated predictive models, with Ridge Regression emerging as the best performer.
- Documented findings and provided structured progress updates.

## *B. Challenges & Resolutions*

### *1) Problems faced:*

- **Severe Data Imbalance:** RSI values were sparse, affecting predictions. Addressed through feature engineering and resampling techniques.
- **Variability in Imputation Results:** Different methods led to varied model performances. Resolved by comparing models trained on different imputed datasets.
- **Model Performance Differences:** Ridge Regression outperformed complex models like XGBoost. Focus shifted to optimizing Ridge and LightGBM.

### *C. Upcoming Tasks*

#### *1) Tasks Planned:*

- Fine-tuning hyperparameters for Ridge Regression and LightGBM.
- Implementing dataset augmentation techniques to improve imputation effectiveness.
- Enhancing feature selection through further analysis.