Model Optimization and Tuning Phase Template

Date	24 June 2025
Team ID	**AS PS VS VV**
Project Title	Unemployed Insurance Beneficiary Forecasting
Maximum Marks	10 Marks

Model Optimization and Tuning Phase

The Model Optimization and Tuning Phase involves refining machine learning models for peak performance. It includes optimized model code, fine-tuning hyperparameters, comparing performance metrics, and justifying the final model selection for enhanced predictive accuracy and efficiency.

Hyperparameter Tuning Documentation (6 Marks):

Model	Tuned Hyperparameters	Optimal Values
ARIMA	p, d, q	(5, 0, 0)
SARIMA	p, d, q, seasonal_order	(5, 0, 0), (0, 1, 2, 3)
AutoReg	lags	10
VAR	maxlags	10
Prophet	NA	Default (no tuning)

Performance Metrics Comparison Report (2 Marks):

Model	Baseline Metric (MSE/MAE/R2)	Optimized Metric
ARIMA	MSE: (initial) NA	MSE: 102,763,733.35 MAE: 5,691.37 R2: -8.18e-05
SARIMA	MSE: (initial) NA	MSE: 103,545,015.68 MAE: 5,862.50 R2: NA
AutoReg	MSE: (initial) NA	MSE: 102,771,796.73 MAE: 5,862.50 R2: NA
VAR	MSE: NA	NA
Prophet	MSE: (initial) NA	MSE: 57,301,995.56 MAE: 3,522.24 R2: -0.1636

Note: Baseline metrics are marked NA as only optimized models were evaluated in this workflow. R2 is not always applicable for all models, especially for multivariate or differenced series.

Final Model Selection Justification (2 Marks):

Final Model	Reasoning
Prophet	Prophet achieved the lowest MSE and MAE among all tested models, indicating better predictive accuracy. It also handled trends and seasonality automatically, required minimal tuning, and provided interpretable forecasts. Despite a negative R2, its absolute error metrics were superior, making it the most suitable choice for this forecasting task.