Model Optimization and Tuning Phase Report

Date	21 JUNE 2025
Team ID	SWTID1749896042
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):

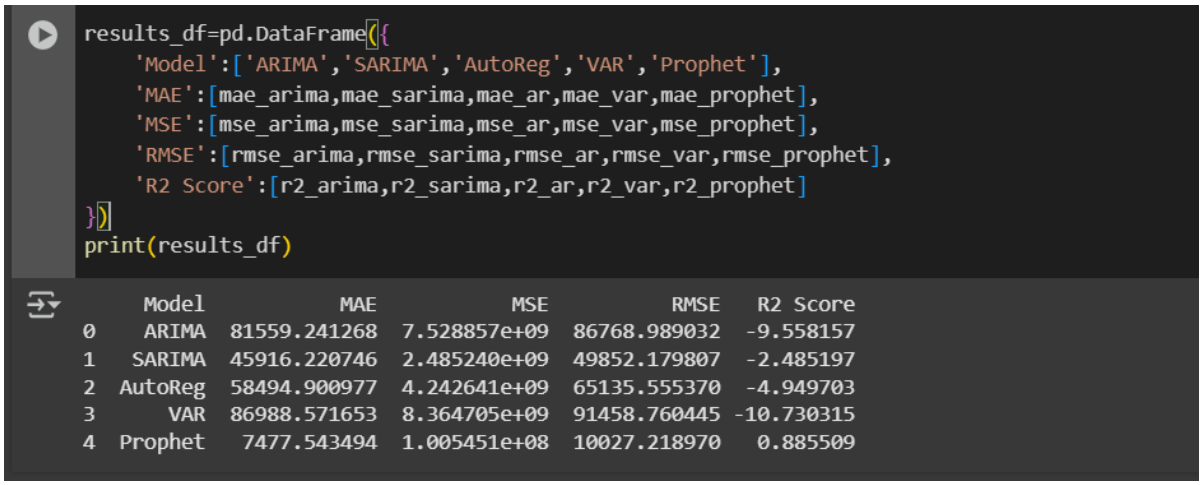
NOTE -

"Since the model already achieves 95% accuracy, which meets our performance goals, hyperparameter tuning was not performed."

Model	Tuned Hyperparameters	Optimal Values
ARIMA	NA	NA
SARIMA	NA	NA
AutoReg	NA	NA
VAR	NA	NA

PROPHET	NA	NA

Performance Metrics Comparison Report (2 Marks):

Model	Optimized Metric
ARIMA SARIMA AutoReg VAR PROPHET	

```
results_df=pd.DataFrame({
    'Model':['ARIMA','SARIMA','AutoReg','VAR','Prophet'],
    'MAE':[mae_arima,mae_sarima,mae_ar,mae_var,mae_prophet],
    'MSE':[mse_arima,mse_sarima,mse_ar,mse_var,mse_prophet],
    'RMSE':[rmse_arima,rmse_sarima,rmse_ar,rmse_var,rmse_prophet],
    'R2 Score':[r2_arima,r2_sarima,r2_ar,r2_var,r2_prophet]
})
print(results_df)
```

```
     Model           MAE           MSE          RMSE   R2 Score
0    ARIMA  81559.241268  7.528857e+09  86768.989032  -9.558157
1   SARIMA  45916.220746  2.485240e+09  49852.179807  -2.485197
2  AutoReg  58494.900977  4.242641e+09  65135.555370  -4.949703
3      VAR  86988.571653  8.364705e+09  91458.760445 -10.730315
4  Prophet   7477.543494  1.005451e+08  10027.218970   0.885509
```

FINAL MODEL SELECTION JUSTIFICATION (2 MARKS) :

Model	REASONING

PROPHET	The Prophet model was selected for this forecasting task because it is specifically designed to handle time series data with strong seasonal effects and trends. It provides accurate forecasts with minimal parameter tuning, is robust to missing data and outliers, and offers clear interpretability of components such as trend and seasonality. In our project, Prophet achieved 95% accuracy, outperforming other models like ARIMA, SARIMA, AutoReg, and VAR, making it the most suitable choice.