Model Performance Comparison

Purpose.
Compare baseline and advanced models on the same test set (or via cross-validation) to select the best model for production. Comparison must include accuracy metrics, stability (variance), inference time, and model explainability.

Metrics used

- **Mean Squared Error (MSE)** — penalizes larger errors, lower is better.
- **Mean Absolute Error (MAE)** — average absolute difference, easier to interpret.
- **R^2 score** — proportion of variance explained (0 to 1, higher is better).

Linear Regression

```
[ ] from sklearn.linear_model import LinearRegression
    regressor = LinearRegression()
```

```
[ ] from sklearn.metrics import mean_squared_error,r2_score, mean_absolute_error

    regressor.fit(x_train, y_train)

    pred_test=regressor.predict(x_test)
    print("test_mse: ",mean_squared_error(y_test, pred_test))
    print("test_mae: ",mean_absolute_error(y_test, pred_test))
    print("R2_score: ",r2_score(y_test, pred_test))
```

```
test_mse:  0.879100826664016
test_mae:  0.1957826268679382
R2_score:  -27.99985070092153
```

Random Forest Model

```
[ ] from sklearn.ensemble import RandomForestRegressor
    model_rf= RandomForestRegressor(n_estimators= 200 , max_depth=5)
    model2= model_rf.fit(x_train, y_train)
```

```
pred_test2= model2.predict(x_test)
print("test_mse: ",mean_squared_error(y_test, pred_test2))
print("test_mae: ",mean_absolute_error(y_test, pred_test2))
print("R2_score: ",r2_score(y_test, pred_test2))
```

```
test_mse:  0.020629835668726747
test_mae:  0.0990796086456456
R2_score:  0.31946127653196765
```

XgboosT

```
[ ] import xgboost as xgb
    model_xgb = xgb.XGBRegressor(n_estimators=100, learning_rate=0.1, max_depth=5)
    model= model_xgb.fit(x_train, y_train)
```

```
[ ] pred_test3= model.predict(x_test)
    print("test_mse: ",mean_squared_error(y_test, pred_test3))
    print("test_mae: ",mean_absolute_error(y_test, pred_test3))
    print("R2_score: ",r2_score(y_test, pred_test3))
```

```
test_mse:  0.02021150707977389
test_mae:  0.09780533089943558
R2_score:  0.3332611345864712
```