You have an Excel file with the following column names:

- No

- X1 transaction date

- X2 house age

- X3 distance to the nearest MRT station

- X4 number of convenience stores

- X5 latitude

- X6 longitude

- Y house price of unit area

Problem Set: Scaling & Linear Regression

Part 1: Data Preprocessing

1. Load the Excel dataset into a pandas DataFrame. Handle any missing values and perform data exploration to understand the characteristics of the dataset.

2. Extract the feature columns (X1 to X6) and the target column (Y). Split the dataset into features (X) and target (y). (70% training & 30% testing ratio).

3. Standardize the feature columns (X1 to X6) using Z-score scaling. Implement the scaling process manually (without using libraries like `scikit-learn`).

Part 2: Linear Regression

4. Implement a simple linear regression model using the scaled features (X1 to X6) to predict the house price (Y). You can use gradient descent for optimization. Calculate the regression coefficients (intercept and slope) and write down the regression equation.

5. Evaluate the model's performance using metrics such as Mean Squared Error (MSE) and R-squared. Interpret the R-squared value in the context of this regression.

Part 3: Feature Scaling Comparison

6. Train another linear regression model without scaling the features. Compare the performance of this model with the scaled model from Part 2 in terms of convergence speed and prediction accuracy.

Part 4: Visualization and Analysis

7. Create scatter plots to visualize the relationship between each feature (X1 to X6) and the target variable (Y). Discuss the patterns you observe in the plots.

8. Visualize the predicted house prices from the scaled model against the actual house prices. Interpret the results and discuss any discrepancies.

Part 5: Advanced Problem (Optional)

9. Implement Min-Max scaling for the feature columns (X1 to X6) manually (without using libraries). Train a linear regression model using the Min-Max scaled features and compare its performance with the Z-score scaled and unscaled models.

Write a summary of your findings and insights from the analysis. Discuss the impact of feature scaling on the linear regression model's performance and interpretation of coefficients.