Task 1: Data Evaluation and Regression Model Analysis

The purpose of this task is to present the results of a data evaluation and regression model analysis. The analysis was conducted to identify the relationship between input variables and output values and to determine the most appropriate regression models for predicting the outputs.

First, a sensitivity analysis was conducted using a correlation plot. The plot showed that input_1 had a weak negative correlation with output_2 and a moderate positive correlation with output_1. Input_2 had a weak correlation with both output_1 and output_2, while input_3 had a strong correlation with both outputs.

Next, histograms were used to assess the distribution of the two outputs. Output_1 had a normal distribution, while output_2 did not and contained outliers. Based on these findings, it was determined that output_1 was suitable for building a regression model, while output_2 was not.

During data preparation, extreme values and missing or invalid data points were checked and handled appropriately. Normalizing or standardizing the data was also recommended to improve the performance of the regression model.

Two regression models, linear and support vector, were built to predict the two outputs. The models were evaluated using MSE and R-squared scores. For output_1, the linear regression model had an MSE of 3915.67 and an R-squared score of -29.91, while the support vector regression model had an MSE of 0.002 and an R-squared score of 0.99. For output_2, the linear regression model had an MSE of 1073.69 and an R-squared score of 0.66, while the support vector regression model had an MSE of 2222.94 and an R-squared score of -16.55.

Based on the evaluation metrics, I concluded that the support vector regression model was better suited for predicting output_1, while the linear regression model was better suited for predicting output_2.

In conclusion, the data evaluation and regression model analysis provided valuable insights into the influence of individual inputs on the result values and helped in selecting appropriate regression models for predicting the two outputs.

Task 2: Mathematical Optimization of an Objective Function

The objective of this report is to present the results of an optimization of an objective function using the Nelder-Mead optimization algorithm.

The Nelder-Mead algorithm was chosen as it is suitable for problems that do not have an explicit gradient function. The optimization was started at the point (0, 0), which is the centre of the range of validity of x and y.

A 2D visualization of the objective function in x, y - space was created using the "matplotlib" library. The visualization showed the contours of the objective function and the optimized point. The colour of the contours represented the magnitude of the objective function.

Observations from the visualization showed that the objective function had a global minimum at the point (3.0, 2.0), which was very close to the optimized point. The visualization also revealed several local minima, but the global minimum was the lowest point on the entire contour plot.

In conclusion, the Nelder-Mead optimization algorithm was used to minimize the objective function, and the optimization was started at the point (0, 0). A 2D visualization of the objective function in x, y - space was created, and observations were made based on the visualization. The global minimum of the objective function was found to be at the point (3.0, 2.0).