**Problem 2: Experiment with Linear Regression**

Linear Regression is an approach which is used to model the relationship between a scalar dependent variable (y) and one or more independent variable(s) (X).

In this problem, we implemented the Linear Regression function, in which we learned the weight vector (w) using the training data matrix (X) and the corresponding labels (y).

The below squared loss function was minimized and used for learning the weights:



The weights were obtained by:



|  |  |  |
| --- | --- | --- |
| **Data Type (Training / Testing)** | **Intercept Present?** | **RMSE Values** |
| Training | Yes | 46.76708559 |
| Training | No | 138.20074835 |
| Testing | Yes | 60.89203717 |
| Testing | No | 326.76499438 |

*Table 1*

The Root Mean Squared Error (RMSE) calculated for the two cases are tabulated as above (Table 1).

RMSE is similar to Standard Deviation .In regression, it calculates the deviation of the actual y-values from the regression line.

From the above table, we can see that that the RMSE calculated with the intercept, for both training and testing, is lesser than without the intercept. Hence, the OLE with the intercept is better than without intercept, for both training and testing data. This is as expected since if without intercept, the hypothesis line must pass through the origin point, allowing the line to only rotate. Only when an intercept is introduced does it give the line freedom to rotate as well as translate. Hence, the learnt hypothesis is closer to the actual concept, which leads to lesser errors when using an intercept.

Hence, errors are lesser when we use intercepts.