Regression.

$$y = c_0 + c_1 x_1 + \cdots + c_n x_n + \epsilon$$

where, ϵ is a random error with a mean of 0.

$$y_i = c_0 + c_1 x_{1i} + \epsilon_i \quad , \quad i = 1, \ldots k.$$

$\Rightarrow$ given $(x_{1i}, y_i) \rightarrow \epsilon_i$ is the error.

To minimize the error, a method of least squares is used.

The sum of the squares of error is

$$L = \sum_{i=1}^{k} \epsilon_i^2 = \sum_{i=1}^{k} (y_i - c_0 - c_1 x_{1i})^2$$

Value of $\hat{c}_0$ & $\hat{c}_1$ is calculated by taking the partial derivative with respect to coefficients & then equating it to 0.

Approaches in classification (Regression)

1. Division : Data devided into region based on class.
2. Prediction : Formulas are generated to predict the output class value.

1 I Two classes : (a) Short
(b) Medium

$$y = c_0 + \epsilon.$$

$$L = \sum_{i=1}^{12} \epsilon_i^2 = \sum_{i=1}^{12} (y_i - c_0)^2 = \sum_{i=1}^{12} (y_i^2 + c_0^2 - 2y_i c_0)$$

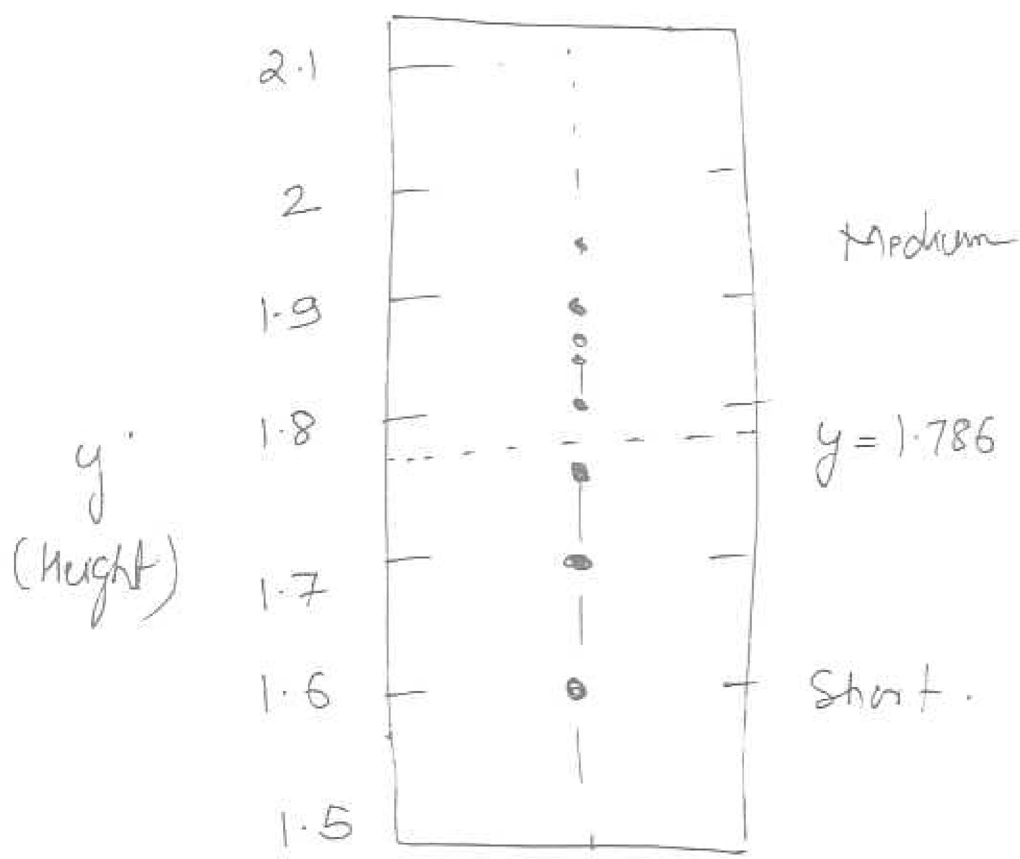
$$\frac{\delta L}{\delta c_0} = \sum_{i=1}^{12} 2c_0 - \sum_{i=1}^{12} 2y_i = 0$$

$$c_0 = \frac{\sum_{i=1}^{12} y_i}{12}$$

$$y_i = \{1.6, 1.9, 1.88, 1.7, 1.95, 1.6, 1.7, 1.8, 1.95, 1.9, 1.8, 1.75\}$$

$$C_0 = \frac{21.43}{12}$$

$$C_0 = 1.78583$$



Division.

(2) Prediction:

Short class → 0

Medium class → 1.

Dataset: {(1.6, 0), (1.9, 1), (1.88, 1), (1.7, 0),
(1.85, 1), (1.6, 0), (1.7, 0), (1.8, 1),
(1.95, 1), (1.9, 1), (1.8, 1), (1.75, 1)}

$$y = c_0 + c_1 x_1 + \epsilon$$

$$L = \sum_{i=1}^{12} \epsilon_i^2 = \sum_{i=1}^{12} (y_i - c_0 - c_1 x_{1i})^2$$

$$\frac{\partial L}{\partial c_0} = -2\sum_{i=1}^{12} y_i + \sum_{i=1}^{12} 2c_0 + \sum_{i=1}^{12} 2c_1 x_{1i} = 0$$

$$c_0 = \frac{\sum y_i - \sum c_1 x_{1i}}{12} \quad \text{--- (1)}$$

$$\frac{\partial L}{\partial C_1} = 2\sum (y_i - c_0 - c_1 x_{1i})(-x_{1i}) = 0$$

$$c_1 = \frac{\sum (x_{1i} y_i) - \frac{\sum x_{1i} \sum y_i}{12}}{\sum (x_{1i})^2 - \frac{\left(\sum x_{1i}\right)^2}{12}}$$

$$\sum x_{1i} = 21.43$$

$$\sum y_i = 8$$

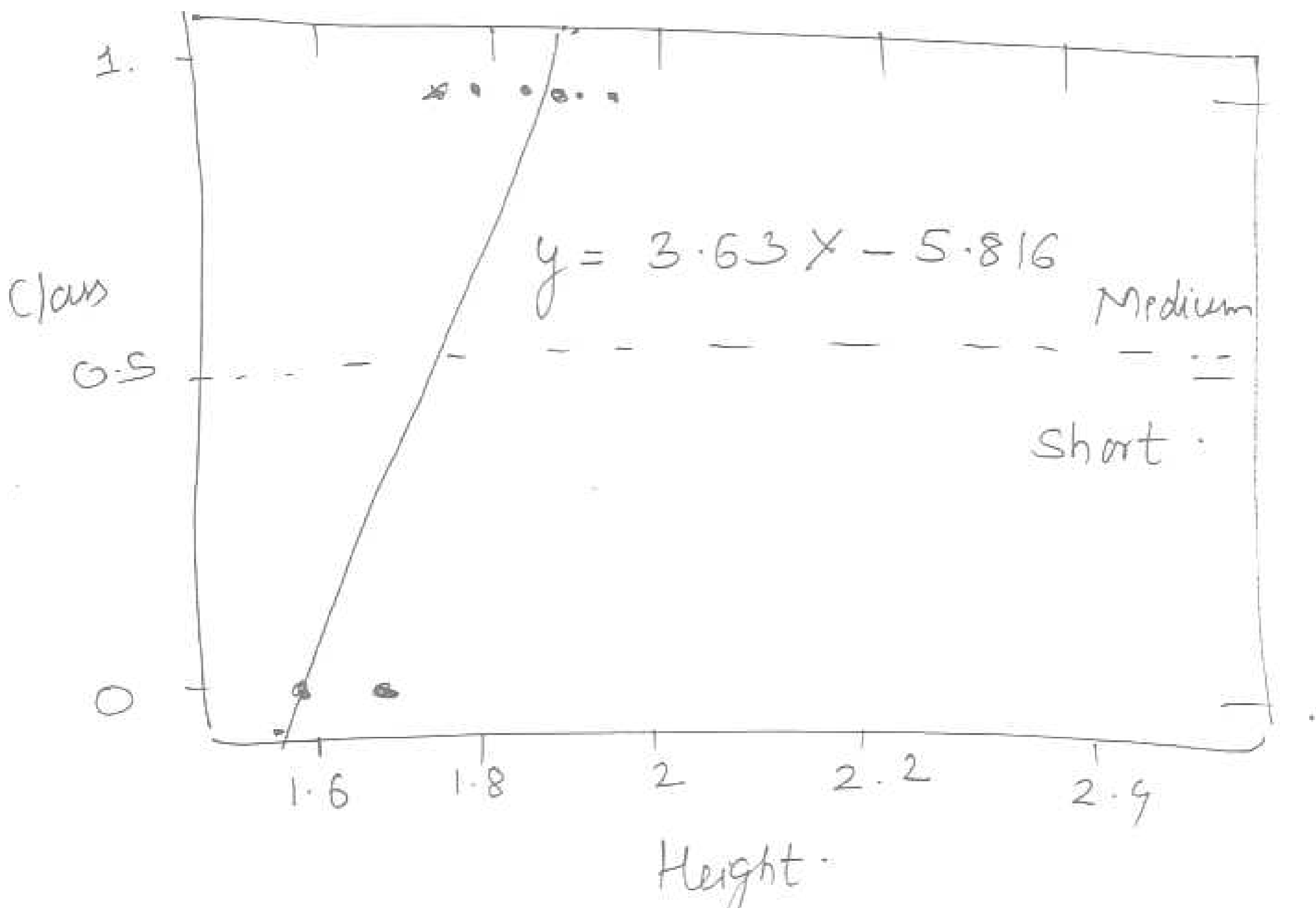
$$\sum (x_{1i} y_i) = 14.83$$

$$\sum (x_{1i}^2) = 38.42$$

$$\Rightarrow \quad c_0 = -5.816$$

$$c_1 = 3.63$$

$$y = -5.816 + 3.63x_1$$



Prediction.