Analysis of Finding Quadratic Regression Polynomial

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***Abstract*—In this project second degree polynomial is found from observation using quadratic regression method and this polynomial is used for one dimensional projectile motion simulation in Matlab.**

Keywords—quadratic regression, one dimensional projectile motion, simulation in Matlab, styling, insert (*key words****)***

I. Introduction

This document is a report of third assignment of my Modelling and Simulation course. Second degree polynomial is found using quadratic regression. Quadratic regression is finding the best fit equation for a set of data shaped like a parabola. Quadratic regression is a way to model a relationship between two sets of variables. Matlab is used for simulation environment. Also Matlab is used for find mathematical model.

II. Importance of the Regression Analysis

[1]Regression analysis is a set of statistical processes for estimating the relationships among variables. It includes many techniques for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables. Regression analysis is widely used for prediction and forecasting. Therefore, it is used in machine learning, business life, and a lot of different areas. In conclusion, usage of the regression analysis is controlling the independent variables.

III. Quadratic Regression Analysis

[2]In this study we have two sets of data. These data sets was used to find a second order polynomial. Least squares method was used to find this second order polynomial. "Least squares" means that the overall solution minimizes the sum of the squares of the residuals made in the results of every single equation. First data set which is x_i represents time in second and the other one is y_i represents height in meter. Let (1) is a second order polynomial. We can find coefficients of (1) solving (2).

$$y = ax^2 + bx + c \tag{1}$$

(2)

$$\begin{pmatrix} \sum x_i^2 y_i \\ \sum x_i^2 y_i \\ \sum y_i \end{pmatrix} \begin{pmatrix} \sum x_i^4 & \sum x_i^3 & \sum x_i^2 \\ \sum x_i^3 & \sum x_i^2 & \sum x_i \\ \sum x_i^2 & \sum x_i & n \end{pmatrix}^{-1} = \begin{pmatrix} a \\ b \\ c \end{pmatrix}$$

$x_{i,}$ represents individual values for each independent variable.

$y_{i,}$ represents individual values for each dependent variable.

n is number of pairs of data.

a, b, and c is coefficients of (1).

$$SSE = \sum (y_i - ax_i - bx_i - c)^2 \tag{3}$$

$$SST = \sum (y_i - \mu_y)^2 \tag{4}$$

$$R^2 = 1 - \frac{SSE}{SST} \tag{5}$$

μ_y is represents mean value of y.

[3]The relative predictive power of a quadratic model is denoted by R^2. The value of R^2 varies between 0 and 1. The closer the value is to 1, the more accurate the model is. In this project R^2 value is 0.99823, this value is very close to 1.

IV. Analysing Simulation

After finding the second order polynomial also we can find time elapsed until maximum height, maximum height, initial velocity, gravitational acceleration and initial velocity. In this project is used Matlab (Matrix Laboratory) for simulation and calculations.

$$t = \frac{-b}{2a} \tag{6}$$

We can express the value of time at maximum height using (6). Also we can express other values using (7) and (8).

$$v_f = v_i + at \tag{7}$$

$$\triangle x = \left(\frac{v_f + v_i}{2}\right)t \tag{8}$$

v_f represents the value of final velocity.

v_i represents the value of initial velocity.

a represents the value of gravitational acceleration.

t represents the value of time.

Δx represents the displacement.

We can simulation using these values and with the second order polynomial we found using (2). The simulation is shown on the (1).

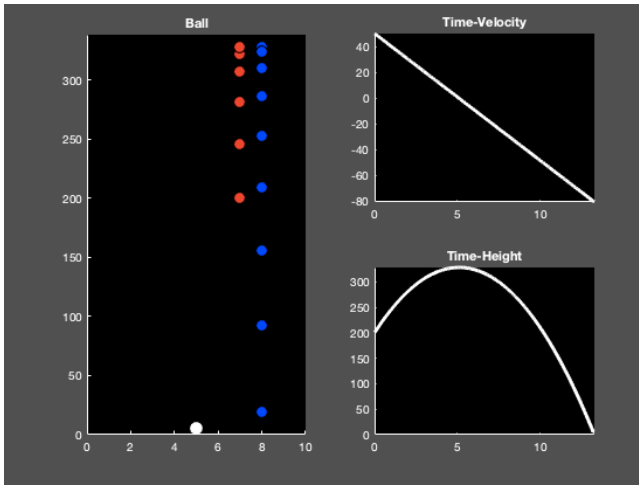

Figure 1

V. Conclusion

Regression analysis is controlling the independent variables. This method is used for finding the second order polynomial. After finding the polynomial we can simulation using this polynomial. Using 2 sets of data we can simulation and we can find polynomial.

References

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