Simple Linear Regression Analysis

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Abstract

In this report, I will reproduce the main results displayed in section 3.1 *Simple Linear Regression* (chapter3) of the book **An introduction to Statistical Learning.** descirbed below :

- Figure 3.1 (page 62) Scatterplot with fitted regression line (the vertical distances of each point to the line are optional).
- Table 3.1 (page 68) Summary of regression coefficients.
- Table 3.2 (page 69) Quality indices RSE, R square, and F-statistic.

Introduction

The goal of this homework is to reproduce the results of Explanatory Data Analysis on TV advertising budget and Sales and see if there is a assoication between them. If so, using linear regression we will see how they are correlated and how accurate model that can be used to predict sales based on the TV advertising budgets.

Data

Data set consists of the Sales(in thousand of units) of a certain products in 200 different markets, and the advertising budgets of 3 differnet media: TV, Radio, and Newspaper (4 variabales and 200 observations.) Since we are focusing on the TV and Sales, first we need to extract the data and applying the simple linear regression.

Methodology

I will apply a simple linear regression model to see the linear relationship between TV advertising budgets and the Sales:

$$Sales = \beta_0 + \beta_1 TV$$

To estimate the coefficients β_0 and β_1 we fit a regression model via the least squares criterion (Best Linear Prediction method).

Results

The regression coefficients are discribed below in a table:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	7.0326	0.4578	15.3603	0.0000
tv	0.0475	0.0027	17.6676	0.0000

Table 1: Information about Regression Coefficients

- Under the null hyopthesis, p-value of intercept is significant to reject the null. The estimate of the intercept is 7.0325935 with sd of 0.4578429
- Under the null hyopthesis, p-value of slope is significant to reject the null. The estimate of the slope is 0.4578429 with sd of 0.0026906

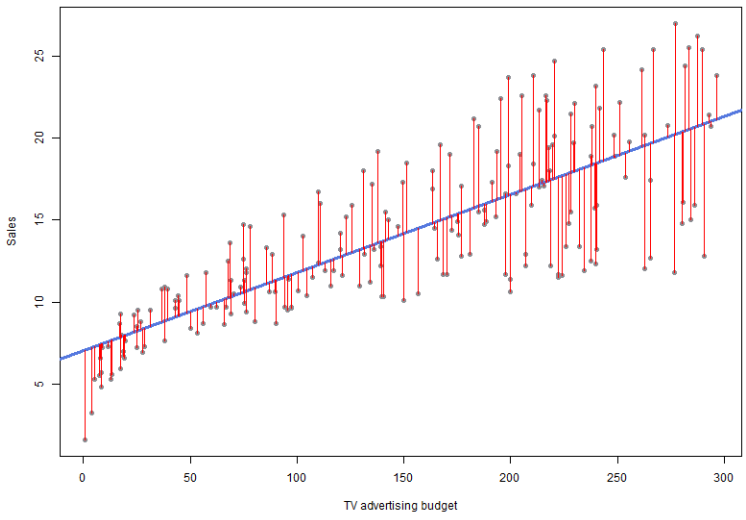
Quality indices RSE, R square, and F-statistic are given in the table below:

	Quantity	Value
1	R2	0.6119
2	RSE	3.2587
3	F-stat	312.1450

Table 2: Regression Quality Indices

- R sqaure is the percent of variation that can be explained by the regression equation. It means that about 61.1875051 precent of variations in sales can be explained by the regression equation.
- Residual Standard Error refers the estimated standard error of residuals. It measures the distance between the data point and the regression equation. Here, RSE is 3.2586564 on 198 degrees of freedom.
- In simple linear regression, null hypothesis of F-test is 'slope equals to zero.' Here, F-statistics is 312.1449944 which is significant to reject the null.

Figure 1: Scatterplot with fitted regression line



Conclusions

- According to the Table 2, F-statistics indicates to reject the null hypothesis, $H_0 : \beta_1 = 0$. Therefore, there is a linear relationship between `TV advertising budgets` and `Sales`.
- It is the same result when we test with the correlation coefficient presented in Table1.

- In the plot, it seems that there are slightly more variations at both ends. However, the data shows pretty good linear relationship between TV advertising and the Sales.
- 1000 standard unit increase in TV advertising, increases 47 standard units in sales
- Thus, it is safe to conclude that there is a linear relationship between them.