Maths & Stats Pre-Sessional Tutorial

Topic: Regression Analysis and Derivatives

Exercise 1

A large consumer goods company has been studying the effect of advertising on total profits. As part of this study, data on advertising expenditures (X) and total sales (Y) were collected for a 5-month period and are as follows:

(x, y) : (10,100) (15,200) (7,80) (12,120) (14,150).

a) Plot the data.
b) Does the plot provide evidence that advertising has a positive effect on sales?
c) Knowing that Cov(x, y) = 140 and s $Cov\ (X,Y) = 140$ and $s_X^2 = 10.3$, compute the regression coefficients $\widehat{\beta_0}$ and $\widehat{\beta_1}$.

Exercise 2

Consider the following linear model estimated for an industrial sector:

$$\hat{y} = 10 + 5x_1 + 4x_2 - 2x_3$$

where: *y* is profit (in thousand $) for the firm, x_1 is the number of workers, x_2 is the average number of years of education of the firm's workforce, and x_3 is the number of competitors.

Compute $\hat{y}$ when $x_1 = 20,\ x_2 = 11\ and\ x_3 = 10$

Exercise 3

Consider the following regression of the percentage change in the Dow Jones index in a year on the percentage change in the index over the first 5 trading days of the year:

$$\hat{y} = 12.942 - 2.034x$$

n = 13, and the standard error of the slope is 1.378.

Test the significance of the slope parameter at 10% significance level.

Exercise 4

Derive the OLS estimator.

Exercise 5

Find the first derivative of the following functions:

a) $f(x) = x^2 + 3x + 1$

b) $f(x) = (2x - 3)^5$

c) $f(x) = 4x^3(2x - 1)$

Exercise 6

Are functions (a), (b) in Exercise 5 concave or convex? Why?

And is function $f(x) = \ln(3x)$ concave or convex?

Exercise 7

Find the stationary points of the following functions. Are they max or min?

a) $f(x) = x^2 + 3x + 1$

b) $f(x) = x^3 - 3x + 1$