

# STAT 3008 Applied Regression Analysis

## Tutorial 4.

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OCT 7&8&10 2013

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# 1 Remaining parts of Tuto3

## 2 Homework1 solution

### 3 An example(12-13 Midterm)

14. (30 marks) A certain metal discolours when exposed to air. To protect the metal against discoloration, it is coated with a chemical. In an experiment, coatings of varying thickness,  $x$  mm, of the chemical were applied to standard samples of the metal, and the times,  $t$  hours, for the metal to discolour were noted. The results are as shown.

$x$	1.8	3.0	4.0	5.7	7.2	8.4	10.3
$t$	3.4	5.9	7.0	8.7	9.5	10.4	11.1

- i) (4 marks) A researcher suggests that the theoretical relationship between  $t$  and  $x$  should be of the form

$$\exp(t) = Ax^B,$$

where  $A$  and  $B$  are constants. Show that this relationship may be expressed in the form

$$t = a + b \log x,$$

where  $a$  and  $b$  are functions of  $A$  and  $B$  respectively, which you should identify.

(1.)

$$\begin{aligned} \exp(t) &= Ax^B \\ t &= \log(Ax^B) = \log A + B \log x \dots (2\text{pt}) \\ t &= a + b \log x \\ a &= \log A; \quad b = B \dots (2\text{pt}) \end{aligned}$$

- ii) (10 marks) The researcher found that

$$\sum \log x = 11.2476, \quad \sum t = 56, \quad \sum (\log x)^2 = 20.3687, \quad \sum t \log x = 100.101,$$

Use these results to calculate the least squares regression line of  $t$  on  $\log x$ . Plot this line and the data on a scatter diagram with values of  $\log x$  on the horizontal axis. Is this fitting appropriate?

(2.)

$$\begin{aligned} t &= a + b \log x \\ \hat{b} &= \frac{\sum t \log x - n \bar{t} \bar{\log x}}{\sum (\log x)^2 - n \bar{\log x}^2} \dots (2\text{pt}) \\ \hat{b} &= 4.4074 \dots (1\text{pt}) \\ \hat{a} &= \bar{t} - \bar{\log x} \hat{b} \dots (2\text{pt}) \\ \hat{a} &= 0.9181 \dots (1\text{pt}) \end{aligned}$$