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Homework 1

BME 7410

Submitted by,

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2.12 Power-law prediction of animal metabolism:

Let,

Mass of the animal = **m**;

Metabolism rete = **M**;

Here,

M= f(m) and according to the power-law,

$$M = b*m^a$$

Or, $\log(M) = \log(b*m^a)$;

Or, $\log(M) = \log(b) + a*\log(m)$;

Or, $\log(M) = a*\log(m) + k$; where $k = \log(b)$

Again, for normal equation, **B = A*c**, let,

$$B = \begin{bmatrix} \log(M1) \\ . \\ . \\ \log(M5) \end{bmatrix} \text{ of size } (5*1);$$

$$A = \begin{bmatrix} \log(m1) & 1 \\ . & . \\ . & . \\ \log(m5) & 1 \end{bmatrix} \text{ of size } (5*2);$$

$$c = \begin{bmatrix} c1 \\ c2 \end{bmatrix} \text{ of size } (2*1);$$

Here, we know that,

$$A^T*A*c = A^T*B;$$

Hence, $c = (A^T*A)^{-1}* A^T*B$

Corresponding Matlab script:

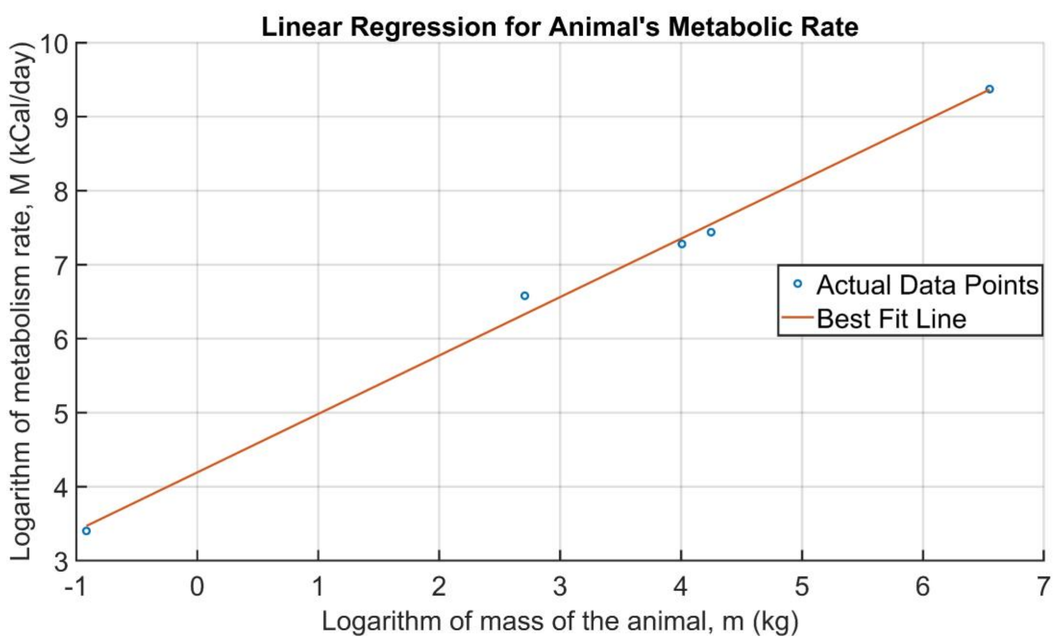
```
%%% loading the data
Mass = [700 70 55 15 0.4];
Metabolism = [11760 1700 1450 720 30];

%%% taking the logarithm of each element
log_Mass = log(Mass);
log_Metabolism = log(Metabolism);

%%% creating the metrices for linear regression
A = [log_Mass; ones(1,5)]';
B = log_Metabolism';

%%% calculating the co-efficients of best fit line
c = inv(A'*A)*A'*B;

%%% plotting the results
plot(log_Mass, log_Metabolism, 'o', log_Mass, (A*c)');
grid
box off
```

Calculated values for c:

0.789745516058414

4.19237727443467

Figure:



2.14 Transformation of non-linear equations:

For the second order irreversible reaction;

$$\mathbf{A + A \xrightarrow{k_2} A_2}$$

Let, $\boldsymbol{C_A}$ = concentration of A after time t;

$\boldsymbol{C_{A0}}$ = initial concentration of A;

$$\frac{\boldsymbol{C_A}}{\boldsymbol{C_{A0}}} = \frac{\mathbf{1}}{\mathbf{1} + \boldsymbol{k_2 C_{A0} t}}$$

Or, $\frac{\boldsymbol{C_{A0}}}{\boldsymbol{C_A}} = \mathbf{1} + \boldsymbol{k_2 C_{A0} t}$

Or, $\frac{\mathbf{1}}{\boldsymbol{C_A}} = \frac{\mathbf{1}+\boldsymbol{k_2 C_{A0} t}}{\boldsymbol{C_{A0}}}$

Or, $\frac{\mathbf{1}}{\boldsymbol{C_A}} = \frac{\mathbf{1}}{\boldsymbol{C_{A0}}} + \boldsymbol{k_2 t}$

Or, **y = c + m*x** --(1)

where, **y =** $\frac{\mathbf{1}}{\boldsymbol{C_A}}$**;**

c = $\frac{\mathbf{1}}{\boldsymbol{C_{A0}}}$;

m = $\boldsymbol{k_2}$

Here, Equation (1) explains a linear relationship between reactant concentration and time.

A probable figure of the equation (1),