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16/ENG06/062
Mechanical Engineering
ENG 382

Given $d = \alpha B^t$ ---①

Comparing eqn ① to $y = mx + c$ i.e Converting it into a linear equation

$$\log d = \log \alpha + t \log B$$

$$y = a_0 + a_1 x$$

Therefore $a_0 = \log \alpha$

$a_1 = \log B$

$x = t$

$y = \log d$

$Y = \log d$	$t = x$	XY	don	X^2	Y^2
1) 0.301029996	0	0	0	0	0.0906905
2) 0.698970004	1	0.698970004	1	1	0.488559067
3) 1.278753601	2	2.557507202	2	4	1.635210772
4) 1.698970004	3	5.096910013	3	9	2.886499076
5) 2.178976947	4	8.715907789	4	16	4.747940537
6) 2.672097858	5	13.36048929	5	25	7.140106962
7) 3.156851909	6	18.94111141	6	36	9.965713925
8) 3.654369091	7	25.58058364	7	49	13.35441345
9) 4.111800007	8	32.8944006	8	64	16.9068993
10) 4.614165911	9	41.5269532	9	81	21.28997336
11) 5.045405135	10	50.45405135	10	100	25.45611297

$\Sigma Y = 29.41133046$

$\Sigma x = 55$

$\Sigma XY = 199.8268839$

$\Sigma X^2 = 385$

$\Sigma Y^2 = 103.9620485$

$\Sigma Y = a_0 N + a_1 \Sigma X$

$29.41133046 = a_0(11) + a_1(55) \quad ---(i)$

$\Sigma XY = a_0 \Sigma X_1 + a_1 \Sigma X^2$

$199.8268839 = a_0(55) + a_1(385) \quad --- (ii)$

Combining eqn (i) and (ii)

$29.41133046 = 11a_0 + 55a_1$

$199.8268839 = 55a_0 + 385a_1$

$$a_0 = \begin{vmatrix} 29.41133046 & 55 \\ 199.8268839 & 385 \end{vmatrix} \Big/ \begin{vmatrix} 11 & 55 \\ 55 & 385 \end{vmatrix}$$

$$a_0 = \frac{[29.41133046][385] - [55][199.8268839]}{[11 \times 385] - [55 \times 55]} = 0.27511$$

$$a_1 = \begin{vmatrix} 11 & 29.41133046 \\ 55 & 199.8268835 \end{vmatrix} \Big/ \begin{vmatrix} 11 & 55 \\ 55 & 385 \end{vmatrix}$$

$$a_1 = \frac{[11 \times 199.8268835] - [29.41133046 \times 55]}{[11 \times 385] - [55 \times 55]}$$

$a_1 = 0.47973$

$a_0 = \log\alpha$ $\quad\quad$ $a_1 = \log B$

$0.27511 = \log\alpha$ $\quad\quad$ $0.47973 = \log\beta$

$\alpha = 1.8841$ $\quad\quad$ $\beta = 3.0181$

$\alpha = 1.8841$

$B = 3.0181$

Correlation Coefficient

$$R = \frac{N\Sigma XY - [\Sigma X][\Sigma Y]}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2]}}$$

$$R = \frac{[11 \times 199.8268839] - [55 \times 29.411330 46]}{\sqrt{(11 \times 385 - 55^2) \times (11 \times 103.960488)] - [29.411330 46]^2]}}$$

$R = 0.9998448312$

$R^2 = [0.9998448312]^2 = 0.9996896864$

For manual method

$R = 0.9998$

$R^2 = 0.9997$

From excel

$R = 0.9998448323576 3$

$R^2 = 0.9996896887922 57$

D

From the values of correlation coefficient obtained manually above. It can be seen that the correlation coefficient ranges between 0.8-1 ie 0.9998. Therefore the variables Log d and t correlate effectively.