Tutorial

Prof. A Agrawal
IIT Bombay

Problem 1

- The calibration data of a pressure transducer is given in the table below. Find out (i) The equation for the line of best fit, (ii) If the transducer reads 25.35 mV, find the value of pressure.

Pressure (kPa)	Output voltage (mV) – with increasing pressure	Output voltage (mV) – with decreasing pressure
0	0.25	0.20
10	10.56	10.60
20	21.65	21.75
30	32.21	32.65
40	43.75	43.98
50	52.30	52.73

Least-squares calibration curve

- The equation for straight line is given as

  $q_o = m\, q_i + b$

  where q_i: input quantity; q_o: output quantity
- For calculating m and b, use the following equations (where N is the total number of data points):

$$m = \frac{N\sum q_i q_o - (\sum q_i)(\sum q_o)}{N\sum q_i^2 - (\sum q_i)^2}$$

$$b = \frac{(\sum q_o)(\sum q_i^2) - (\sum q_i)(\sum q_i q_o)}{N\sum q_i^2 - (\sum q_i)^2}$$

Standard deviation

Standard deviation in q_o, q_i, m, b are given as

$$s_{qo}^2 = \frac{1}{N-2}\sum (mq_i + b - q_0)^2$$

$$s_{qi}^2 = \frac{s_{qo}^2}{m^2}$$

$$s_m^2 = \frac{N s_{qo}^2}{N\sum q_i^2 - (\sum q_i)^2}$$

$$s_b^2 = \frac{s_{qo}^2 \sum q_i^2}{N\sum q_i^2 - (\sum q_i)^2}$$

Problem 2

- The average power transmission by a rotating shaft is given as: W = (2 pi) RFL/t

  where R is revolutions of shaft in time t, is F force, L is length of torque arm.
- Given, R = 1202 +/1 rev

  F = 45 +/- 0.18 N

  L = 0.397 +/- 0.00127 m

  t = 60 +/- 0.5 s

  Find the value and uncertainty in power.