

Use the direct solution format for all questions on this assignment. Refer to the lecture slides on data reduction for pump performance measurement.

Use the data  $(t_i, v_i)$  below with for questions 1 to 4. Combine your answers into a word-processing document. Print that document and the Excel sheet used to perform the computations. Attached your spreadsheet, word-processing document and your solution to problem 5 into a single (stapled) document.

- Use Excel to create a scatter plot of following data of velocity versus time.

$t$ (s)	10	25	33	42	52	59	67	74
$v$ (m/s)	22	52	72	90	100	102	105	94

Add a straight line curve fit (trendline) to the plot created in step 1. Display the equation of the line fit on the plot. What is the  $R^2$  value of the line fit?

- Create a second plot of the data set, and add a quadratic polynomial curve fit to the data. . Display the equation of the line fit on the plot. What is the  $R^2$  value of the line fit?
- In your Excel sheet, compute the terms below. (Substitute  $t \rightarrow x$  and  $v \rightarrow y$ )
  - $\sum x_i$
  - $\sum y_i$
  - $\sum x_i y_i$
  - $\sum x_i \sum y_i$
  - $(\sum x_i)^2$
  - $\sum x_i^2$
- Using the values from problem 3, above, compute the slope ( $m$ ) and intercept ( $b$ ) of the least squares line fit and substitute  $m$  and  $b$  by their values in the equation  $\hat{y} = mx + b$ . In other words, extend your data table so that it has columns for  $x_i$ ,  $y_i$ , and  $\hat{y}_i$ . Compute the value of  $R^2$  from the data in your table.
- Given the following raw data from a pump measurement

Height of exit tube above reservoir	$h = 75$ cm
Mass of water collected	$\Delta m = 350$ g
Time during mass collection	$\Delta t = 24$ s
Motor voltage	$V_m = 11.98$ V
Motor current	$I_m = 0.42$ A

- a. Using the symbols in the preceding table, write down the formulas (using symbols, not numbers!) for computing the volumetric flow rate in L/min and the efficiency of the pump. Define symbols for any additional data (e.g. physical constants) necessary to complete the calculations.
- b. Substitute the numerical values from the table into the equations from part (a) to obtain values for the flow rate and the efficiency.