ESC103F Engineering Mathematics and Computation: Lab #2

An experimenter believes that the electrical conductivity (y) of cotton fibre depends on the humidity (ξ) and that over the range of humidity of interest, an approximately linear relationship, obscured by experimental error, will exist. It is common to transform linearly a variable such as humidity to coded form:

$$x = (\xi - \xi_0) / S$$

where ξ_0 is a convenient reference humidity and S is a scale factor. The linear model relating the independent variable x to the dependent variable y may then be written as:

$$y = a + bx$$

The data collected by the experimenter is as follows:

Humidity percent (ξ)	20	30	40	50
Observed electrical conductivity	8	23	28	34

You are asked to code the humidity as follows:

$$x = (\xi - 35) / 5$$

Write a live script in MATLAB to do the following:

a. Fit the linear model $y = a + bx$ based on the coded humidity and plot the fitted model along with the four points on a single figure. On the x-axis, plot the coded humidity and on the y-axis plot the electrical conductivity.
b. Fit a quadratic model to this same set of data of the form $y = a + bx + cx^2$ and plot this model fit on the same figure as part a) using a different line type.
c. Given that there are four data points, you can also curve fit the data with a cubic model of the form $y = a + bx + cx^2 + dx^3$. Plot this model fit on the same figure as part a) and b) using a different line type. Be sure to include a legend and label your axes.

Comment on which model fit is best in terms of its use/value for (i) interpolation and (ii) extrapolation. Interpolation refers to using the model to predict values for the electrical conductivity (y) using values for the coded humidity (x) that fall <u>within</u> the data set ($20 \leq \xi \leq 50$). Extrapolation refers to using the model to predict values for the electrical conductivity (y) using values for the coded humidity (x) that fall <u>outside</u> the data set ($\xi \leq 20$ or $\xi \geq 50$).