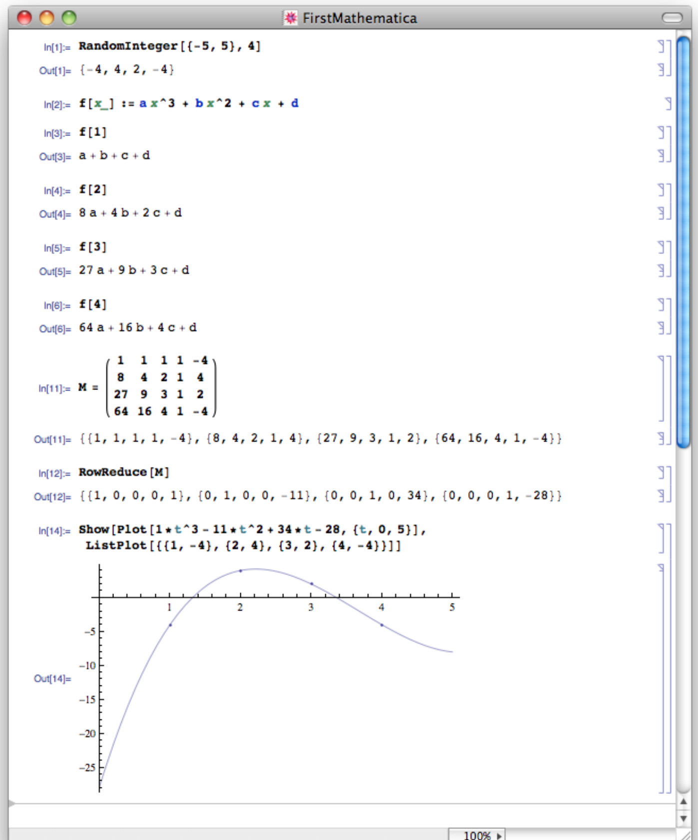
Custom Polynomials Mathematica Lab **Elementary Linear Algebra**

In this lab we will use the RowReduce command to find custom polynomials that behave nicely at integer data values. You can get the file shown on the right from the Desire2Learn course site so that you will have working versions of each Mathematica command involved. You will turn in a single file with Parts I, II and III answered. Use text formatting (Format > Style > Text) to add explanations where needed. Once you have completed the Mathematica notebook, choose File > Save As and select pdf as your file type. Submit your final pdf file in Desire2Learn using the Dropbox feature by the due date.

Part I. Building a cubic polynomial that goes through four randomly generated points.

1. The first line gives you your personal y values to work with. Everyone will use x values from $\{1, 2, 3, 4\}$ paired with their random y values.
2. The definition of the matrix is easy to do if you (a) don't mind lots of brackets or (b) use the Basic Math Assistant palette.
3. The last line that shows your function along with your custom data set is essentially your self-check that your answer is correct.
4. Pay attention to your data values! If you re-execute the first line of this notebook, you will get new random y values and the rest of your work will have to be updated.



Part II. Make a conjecture about what will happen to the row reduced M if the original set of four points fall on a line. In the same Mathematica notebook, give one specific example of linear data and show you are right about M.

Part III. Building a polynomial with prescribed roots and critical points.

It is well-known that every quadratic polynomial has a critical value halfway between its two zeros. (A *critical value* is a value of x where the derivative is 0. A *zero* is a value of x that makes the function value 0.) Use linear algebra to figure out what must be special about a cubic polynomial

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f[x_] := a x^3 + b x^2 + c x + d
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if it has to have zeros at $x = 1$ and $x = 3$ and a critical point at $x = 2$. Your explanation should be in the form above, where you give the relevant equations, the matrix M, and the row reduced form as part of a well-formed argument.

BONUS! Consider the quadratic polynomial

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f[x_] := a x^2 + b x + c
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Show that if r and s are zeros of f, then f mush have a critical point at the halfway point, $x = \frac{r+s}{2}$. Your explanation does not need to involve linear algebra. Presentation and good writing count! (Do this problem on separate paper.)