

Common Confusion 10

'polyfit' vs. 'polyval'

Matthew Woodring

Students tend to get confused on the difference between the 'polyfit' and 'polyval' functions. They also tend to get confused on the connection between these functions.

The 'polyfit' function is used to find the coefficients of a polynomial that best fit a set of data. Typically, you will have a set of 'X' data and 'Y' data and are asked to find the best fitting polynomial of the 'N'th degree. In this class, 'N' will usually be under '5'.

To use polyfit, you need a set of 'X' and 'Y' data and a 'N' degree. For example, if you had the set of 'X' and 'Y' data and a 'N' value below:

`'X = [1, 2, 3, 4, 5, 6, 7, 8, 9]'` and `'Y = [2, 6, 3, 7, 8, 9, 9, 3, 4]'` and `'N = 3'`

Using the 'polyfit' function would tell MATLAB to find the coefficients of the third-degree polynomial that best fits the given 'X' and 'Y' data. MATLAB would return a vector of numbers corresponding to the best fit polynomial given 'X', 'Y', and 'N':

`'P = [-0.0396, 0.2720, 0.9306, 1.3016]'`

Which would correspond to the function:

`'-0.0396X3 + 0.2720X2 + 0.9306X + 1.3016'`

The 'polyfit' function is used just to match a polynomial of a certain degree to a set of 'X' and 'Y' data. A vector containing the coefficients of this polynomial is returned.

In this class, you are often not given the 'N' value. You are usually asked to figure this out on your own. This can be accomplished by visualizing the given data with the 'plot' function and using that to determine the value of 'N'.

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The 'polyval' function is used to evaluate a given polynomial at a set of points. For example, if you had the polynomial:

$$P(X) = 5X^2 + 3X + 4$$

You could represent this as the vector:

$$P = [5, 3, 4]$$

MATLAB automatically recognizes the amount of elements stored in the vector 'P' and uses this to create the polynomial it evaluates. So, using 'P' in the context of the 'polyval' function, will result in MATLAB evaluating the appropriate polynomial at a set of points. If you had the set of points below:

$$X = [3, 2, 1]$$

You could evaluate the polynomial 'P(X)' above by typing:

$$\text{answer} = \text{polyval}(P, X)$$

This will store the resulting values of 'P(X)' in the variable 'answer'. Since 'X' had three elements in it, there will also be three elements in 'answer' since 'P', which corresponds to 'P(X)', was evaluated at three points.

Some functions similar to 'polyval' are 'polyder', which takes the derivative of a polynomial, and 'polyint', which takes the integral of a polynomial. We are unlikely to use these in this course, but they could be useful in future courses.

In this course, you usually use the 'polyfit' function first and then the 'polyval' function. You are typically given a set of 'X' and 'Y' data and are asked to match it to a polynomial, but are not given the 'N' value. It is up to you to determine this 'N' value by using the 'plot' function. Then, after you get the coefficients of the best-fitting polynomial, you use the 'polyval' function to evaluate it at a set of points.