Polynomials

Polynomial evaluation at any given point:

Suppose P(x)= x^2 + 2x + 3 and we want to calculate P(10) ?

>> p=[1 2 3];

>> polyval(p,10)

ans =123

Roots of polynomial:

Suppose we want to fine the roots of the previous polynomial:

>> roots(p)

ans =

-1.0000 + 1.4142i

-1.0000 - 1.4142i

Even though MATLAB is a numerical package, it has capabilities for handling polynomials. In

MATLAB, a polynomial is represented by a vector containing its coefficients in descending order.

For instance, the following polynomial

p(x) = x^2 – 3x + 5

is represented by the vector p = [1, -3, 5] and the polynomial

q(x) $= x^4 + 7x^2 - x$

is represented by q = [1, 0, 7, -1, 0]

MATLAB can interpret any vector of length n + 1 as an nth order polynomial. Thus, if your

polynomial is missing any coefficients, you must enter zeros in the appropriate place(s) in the

vector, as done above.

You can find the value of a polynomial using the polyval command. For example, to find the

value of the polynomial q above at x = –1, you type

» polyval(q,-1)

ans = 9

>> polyval(q,2)

ans = 42

Finding the roots of a polynomial is as easy as entering the following command.

» roots(q)

ans =

0

0.0712 + 2.6486i

0.0712 - 2.6486i

-0.1424

Note that MATLAB can handle complex numbers as well, with i=sqrt(-1). This is reflected

in the four roots above, two of which are complex.

Suppose you want to multiply two polynomials together. Their product is found by taking the

convolution of their coefficients. MATLAB's command conv will do this for you. For

example, if s(x) = x + 2 and t(x) = x^2 + 4x + 8 then

z(x) = s(x) t(x) = $x^3 + 6x^2 + 16x + 16$

In MATLAB, we type

» s = [1 2];

» t = [1 4 8];

» z = conv(s,t)

z = 1 6 16 16

MATLAB can obtain derivatives of polynomials very easily. The command polyder

takes as input the coefficient vector of a polynomial and returns the vector of coefficients for its

derivative. For example, with p(x) = $x^2 - 3x + 5$ as before

» polyder(p)

ans = 2 -3

For example, with d(x) = $2x^2 - 6x + 4$

>> d=[2 -6 4];

>> polyder(d)

ans = 4 -6

>> polyval(d,4)

ans =12