CVEN 302-501
Computer Applications in Engineering and Construction
Homework #7 Matrix Linear Regression and Interpolation

Date distributed : 11.2.2005
Date due : 11.14.2005 at 5:00 pm

Return your solution either in class or in my mail box (WERC Rm. 235H) by the date shown above. Please show all your work and follow the rules outlined in the course syllabus.

1 Linear Least-squares Regression

Use matrix least squares as presented in class to solve Problem 12.16 on page 220 in Chapra (2005). Write down your definition of the parameter vector $\theta$ and the values in your $A$ matrix and $f$ vector, and hand them in with your assignment. Use Matlab to compute the parameter values, and enclose a copy of the commands you typed in Matlab. Use your results to report the values of $\mu$ and $n$ in the problem.

2 Advanced Linear Least-squares Regression

Not all equations we want to fit to data can be found in curve-fitting packages, but many of the equations may still be appropriate for linear least-squares regression.

Use matrix least squares to solve Problem 13.10 on page 234 in Chapra (2005). As in the previous problem, write down all your matrices and vectors by hand (and turn them in) and then compute the regression using Matlab. Turn in a copy of your Matlab session with your assignment and report the values of $A$, $B$ and $C$ that solve the problem.

3 Interpolation

During a laboratory experiment, a student measures the wave heights of a solitary wave at different locations and summarizes the data in Table 1. Use interpolation to estimate the wave heights at intermediate points as follows:
Table 1: Wave heights measured for a solitary wave at $t = 10$ s.

<table>
<thead>
<tr>
<th>Location $x$ [m]</th>
<th>Height $\zeta$ [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>36.8</td>
<td>0.05</td>
</tr>
<tr>
<td>40.7</td>
<td>0.22</td>
</tr>
<tr>
<td>42.3</td>
<td>0.37</td>
</tr>
<tr>
<td>44.2</td>
<td>0.38</td>
</tr>
<tr>
<td>46.0</td>
<td>0.17</td>
</tr>
<tr>
<td>51.6</td>
<td>0.02</td>
</tr>
</tbody>
</table>

1. Use a second order Newton divided difference polynomial to estimate $\zeta$ at $x = 43$ m. Use the three data points from Table 1 that are most appropriate for interpolating a point at $x = 43$ m.

2. Use a third-order Lagrange interpolating polynomial to estimate $\zeta$ at $x = 43$ m. Use the four data points from Table 1 that are most appropriate for interpolating a point at $x = 43$ m.

3. Based on your third-order estimate in part 2, what is the approximate relative error of your second-order estimate in part 1?

4 **Inverse Interpolation and Root-Finding Review**