**Roots of a Cubic Equation Using a Constraint with Solver**

Suppose we have to find a root for the equation:

x3 - 1.993x2 - 0.0835x - 0.0006825=0.

Let us further suppose that the problem that gave rise to this equation tells us that the value of xwe are interested in is greater than 1.00. Set up a worksheet, name the four coefficients (p, q, r, and s) put their values in cells B4:B7. Put the only formula is in E4:

=p\*D4A3+q\*D4^2+r\*D4+s

Call up Solver as before. We wish E4 to get a value of 0 by changing D4 to some value greater than 1. To add the constraint, click on the *Add* button in the *Subject to the Constraints* area to bring up the *Add Constraint* dialog box. In the *Cell Reference* box type D4. Change the operator to ">=", and type" 1" in the Constraint box. Click the *OK* button. The Solver dialog box now contains the constraint.

Click the *Solve* button. Solver finds an acceptable result. My values are D4 = 1.94999 and E4 = -8.3E-07.

Change the constraint to find the other two values. One of them is negative so the constraint D4 <= 0 will be appropriate. The other lies between 0 and 1. With a starting value 0 it may find it with no constraints. If the starting value is, say 2, two constraints will help: D4 >= 0 and D4 <= 1.

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| Finding a  | positive root |  | of a cubic | equation |
|  |  |  |  |  |
| Coefficients |  |  | Roots | Function |
| p | 1 |  | 0 | -0.0006825 |
| q | -1.993 |  |  |  |
| r | -0.0835 |  |  |  |
| s | -0.0006825 |  |  |  |
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| Finding a  | positive root |   | of a cubic  | equation  |
|   |   |   |   |   |
| Coefficients |   |   | Roots | Function |
| p | 1 |   | 0.1 | -0.0279625 |
| q | -1.993 |   |   |   |
| r | -0.0835 |   |   |   |
| s | -0.0006825 |   |   |   |
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D4>= -1 and D4 <=1

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| --- | --- | --- | --- | --- |
| Finding a positive | root  |   | of a cubic  | equation  |
|   |   |   |   |   |
| Coefficients |   |   | Roots | Function |
| p | 1 |   | -0.01116646 | 3.8549E-10 |
| q | -1.993 |   |   |   |
| r | -0.0835 |   |   |   |
| s | -0.0006825 |   |   |   |
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