

Solving Cubic Equations

חפש

חיפוש מותאם אישית של

If you thought the Quadratic Formula was complicated, the method for solving Cubic Equations is even more complex. We will use the example from the Cubic Equation Calculator:

$$2x^3 - 4x^2 - 22x + 24 = 0$$

Cubic equations have to be solved in several steps. First we define a variable 'f':

$$f = \frac{(3c/a) - (b^2/a^2)}{3}$$

"Plugging in" the numbers from the above equation, we get:

$$f = ((3 * -22/2) - (16/4)) / 3 = -12.333333...$$

Next we define 'g':

$$g = \frac{(2b^3/a^3) - (9bc/a^2) + (27d/a)}{27}$$

From this point on, you are expected to "plug in" the numbers:

$$g = 4.07407407407407....$$

Then we define 'h':

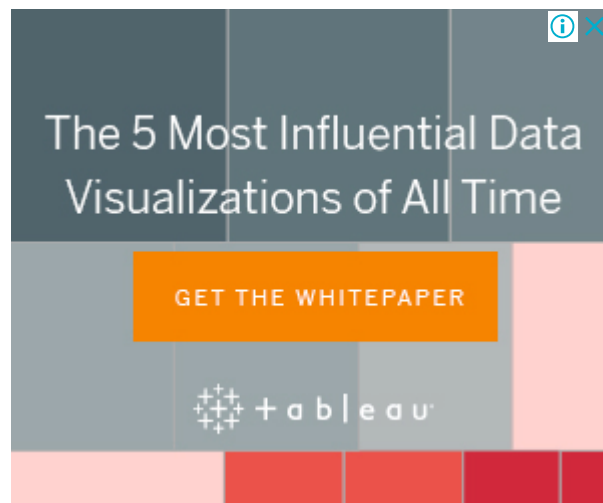
$$h = (g^2/4) + (f^3/27)$$

$$h = -65.333333...$$

If $h > 0$, there is only 1 real root and is solved by another method. (SCROLL down for this method)

For the special case where $f=0$, $g=0$ and $h = 0$, all 3 roots are real and equal. (SCROLL to the bottom for this method)

When $h \leq 0$, as is the case here, all 3 roots are real and we proceed as follows:



ALL 3 Roots Are Real

$$i = ((g^2/4) - h)^{1/2}$$

$$i = 8.33563754151978...$$

$$j = (i)^{1/3}$$

$$j = 2.0275875100994063...$$

NOTE: The following trigonometric calculations are in radians

$$k = \text{arc cosine } (- (g / 2i))$$

$$k = 1.817673356517739...$$

$$L = j * -1$$

$$L = -2.0275875100994...$$

$$M = \text{cosine } (k/3)$$

$$M = 0.8219949365268...$$

$$N = (\text{Square Root of } 3) * \text{sine } (k/3)$$

$$N = 0.9863939238321...$$

$$P = (b/3a) * -1$$

$$P = 0.66666666666666...$$

$$x_1 = 2j * \text{cosine}(k/3) - (b/3a)$$

$$x_1 = 4$$

$$x_2 = L * (M + N) + P$$

$$x_2 = -3$$

$$x_3 = L * (M - N) + P$$

$$x_3 = 1$$

$$\begin{aligned}
 x^2 + xy &= 20 \\
 y^2 + xy &= 30 \\
 xy &=?
 \end{aligned}$$



BRILLIANT

GET STARTED

When Only 1 Root Is Real

$$3x^3 - 10x^2 + 14x + 27 = 0$$

$$f = \frac{(3c/a) - (b^2/a^2)}{3}$$

$$f = .962962962962962...$$

$$g = \frac{(2b^3/a^3) - (9bc/a^2) + (27d/a)}{27}$$

$$g = 11.441700960219478...$$

$$h = (g^2/4) + (f^3/27)$$

$$h = 32.761202560585275...$$

$$R = -(g/2) + (h)^{1/2}$$

$$R = .002889779596782...$$

$$S = (R)^{1/3}$$

$$S = .142436591824886...$$

$$T = -(g/2) - (h)^{1/2}$$

$$T = -11.4445907398163...$$

$$U = (T)^{1/3}$$

$$U = -2.25354770293599...$$

$$X_1 = (S + U) - (b/3a)$$

$$X_1 = -1$$

$$X_2 = -(S + U)/2 - (b/3a) + i*(S-U)*(3)^{1/2}/2$$

$$X_2 = 2.16666666666... + i*2.07498326633146$$

$$X_3 = -(S + U)/2 - (b/3a) - i*(S-U)*(3)^{1/2}/2$$

$$X_3 = 2.16666666666... - i*2.07498326633146$$

When All 3 Roots Are Real and Equal

$$x^3 + 6x^2 + 12x + 8 = 0$$

$$f = \frac{(3c/a) - (b^2/a^2)}{3}$$

$$f = ((3*12/1) - (36/1)) / 3$$

$$f = 0$$

$$g = \frac{(2b^3/a^3) - (9bc/a^2) + (27d/a)}{27}$$

$$g = ((2*216/1) - (9*6*12/1) + (27*8/1)) / 27$$

$$g = (432 - 648 + 216) / 27$$

$$g = 0$$

$$h = (g^2/4) + (f^3/27)$$

$$h=0$$

$$x_1 = x_2 = x_3 = (d/a)^{1/3} * -1$$

$$x_1 = x_2 = x_3 = (8/1)^{1/3} * -1$$

$$x_1 = x_2 = x_3 = -2$$

**RETURN TO CUBIC EQUATION
CALCULATOR**

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