

Which formula to be used to calculate the roots of a given polynomial?

- When b is negative and if we use formula 1.2 to calculate x_1 , we can have cancellation of nearly equal numbers in the denominator which will cause large relative error by dividing with a very small number. Should use formula 1.1 in this situation.
- When b is negative, using original formula for x_2 will cause the cancellation of nearly equal number if b^2 is much greater than $4ac$. If that's the case then use alternate formula to calculate x_2 .
- When b is positive and if we use alternate quadratic formula for x_2 we can get a large relative error due to the subtraction of nearly two equal numbers if b^2 is much greater than $4ac$ and then dividing by that tiny number. Use formula 1.1 in this situation.
- When b is positive and we have a cancellation error in the numerator, using alternate formula for x_1 will result in a small relative error.

The relative error helps finding a better approximation. Errors differ by rounding to different significant digits.

NOTE: To round the digits to four significant numbers, I have used a built-in `round(num, digits, type)` function of MATLAB. It doesn't do an exact rounding but rounds to first four decimal places. (Eg. 0.005432 is rounded to 0.0054). The results are based on this kind of rounding.

Observations:

	X1	Absolute Error	Relative Error	X2	Absolute Error	Relative Error
a)	1.9030	6.5352×10^{-4}	3.4353×10^{-4}	0.7430	4.0483×10^{-4}	5.4456×10^{-4}
b)	-0.0784	8.7938×10^{-6}	1.1215×10^{-4}	-4.0600	3.8027×10^{-4}	9.3672×10^{-5}
c)	1.2230	1.2977×10^{-4}	1.0612×10^{-4}	-2.2230	1.2977×10^{-4}	5.8380×10^{-5}
d)	6.2350	0.0018	2.8206×10^{-4}	-0.3208	1.2063×10^{-4}	3.7617×10^{-4}

- a) Using original and the alternate quadratic formulas result in the same values for x_1 and x_2
- b) Using alternate quadratic formula to calculate x_1 gives a smaller relative error than using actual quadratic formula because b^2 (169) is much greater than $4ac$ (12.5664) which results in subtraction of nearly equal numbers. For x_2 the quadratic formula (1.1) gives smaller relative error.
- c) Using original and the alternate quadratic formulas result in the same values for x_1 and x_2
- d) Using original formula for x_1 results in a small relative error. For x_2 since b is negative and b^2 is much greater than $4ac$ it will cause a cancellation in the numerator and cause a large relative error.

The MATLAB code has been broken down into several functions to aid in calculating the roots and errors in the above table which includes rounding, calculating exact and approximate roots (four significant digits), and calculating absolute and relative errors.