

Rational Roots

Polynomial equations with real coefficients can have three types of roots: rational, irrational, complex. The Rational Root Theorem

Suppose that a polynomial equation with integral coefficients has the root h/k , where h and k are relatively prime integers. Then h must be a factor of the constant term of the polynomial and k must be a factor of the leading coefficient.

To find rational roots:

- 1) List all \pm factors of the constant (h) and the leading coefficient (k).
 - 2) List all possibilities of rational roots: $\pm h/k$.
 - 3) Use Descartes's rule of signs to figure out how many positive, negative, and complex roots there might be. Eliminate some of the possible roots if possible.
 - 4) Put the remaining possible roots in order from smallest to largest.
 - 5) Choose a possible rational root that falls in the middle of the pack. Test it using synthetic division. If you get a remainder of 0, it's a root! Find the depressed equation, and look for roots of the depressed equation.
 - 6) After doing synthetic division with a positive divisor, if a number is not a root, but you get all positives, then the number is too high (upper bound). Disregard all higher possibilities and look lower.
 - 7) After doing synthetic division with a negative divisor, if a number is not a root, but the signs of the answer are alternating positive and negative, then the number is too low (lower bound). Disregard all lower numbers and try higher.
 - 8) If you test several possible rational roots, nothing works, you find the upper and lower bounds but no roots, then the roots are irrational. There are no rational roots.
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