Problems Day 9, R 2/15/2024

Topic 5: Homogeneous, linear, constant coefficient DEs (day 1)

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Problem 1. Solve $x' + kx$ using the characteristic equation method. Are you surprised by the answer?

Problem 2.

(a) Solve $x'' + 4x' + 3x = 0$.

(b) Find the solution with initial conditions $x(0) = 1, \quad x'(0) = 1$.

Problem 3. Give the characteristic equation for each of the following DEs.

(a) $7x^{(4)} + 3x''' - 5x'' + 2x' + 4x = 0$.

(b) $x'' + x' = 0$.

(c) $a_n x^{(n)} + a_{n-1}x^{(n-1)} + a_{n-2}x^{(n-1)} + ... + a_1 x' + a_0 x = 0$.

(d) $x'' + t^2 x' + 7x = 0$ (Trick question!)

Problem 4.

(a) Solve $x'' + x' = 0$.

(b) Solve $x'' + 4x = 0$.

Problem 5. A constant coefficient, linear, homogeneous DE has characteristic roots

$$-1, -2, -2, -2, -3 \pm 4i, -5 \pm 6i, -5 \pm 6i.$$

(a) What is the order of the DE? (Notice the $\pm$ in the list of roots.)

(b) What is the general, real-valued solution.

Problem 6. State and verify the superposition principle for $mx'' + bx' + kx = 0$, (m, b, k constants).

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