## The prediction method for second order linear differential equations

Consider the differential equation

$$y'' + py' + qy = \mathrm{e}^{ax}(P_1(x)\cos(bx) + P_2(x)\sin(bx)).$$

where $p, q, a, b \in \mathbb{R}$ and $P_1$, $P_2$ are given polynomials.

If $a + bi$ is not a root of characteristic equation, then we predict PSNE in the form

$$y(x) = \mathrm{e}^{ax}(Q_1(x)\cos(bx) + Q_2(x)\sin(bx)),$$

where $Q_1$ and $Q_2$ are some polynomials such that $\deg Q_1 = \deg Q_2 = \max\{\deg P_1, \deg P_2\}$.

If $a + bi$ is a $p$-multiple root of characteristic equation, then we predict PSNE in the form

$$y(x) = x^p\mathrm{e}^{ax}(Q_1(x)\cos(bx) + Q_2(x)\sin(bx)),$$

where $Q_1$ and $Q_2$ are some polynomials such that $\deg Q_1 = \deg Q_2 = \max\{\deg P_1, \deg P_2\}$.

## The prediction method for recurrence equations

Consider the recurrence equation

$$ax_{n+2} + bx_{n+1} + cx_n = P_k(n) \cdot d^n,$$

where $a, b, c, d \in \mathbb{R}$ and $P_k$ is a polynomial of degree $k$.

If $d$ is not a root of characteristic equation, then we predict PSNE in the form

$$x_n = Q_k(n) \cdot d^n,$$

where $Q_k$ is a polynomial such that $\deg Q_k = k$.

If $d$ is a $p$-multiple root of characteristic equation, then we predict PSNE in the form

$$x_n = n^p \cdot Q_k(n) \cdot d^n,$$

where $Q_k$ is a polynomial such that $\deg Q_k = k$.