

Contents

Finding a zero of a continuous function from \mathbb{R}^m to \mathbb{R}^n .

① Linear systems: direct methods

- Given $A \in \mathbb{R}^{m \times m}$ and $b \in \mathbb{R}^m$, find $x \in \mathbb{R}^m$ such that $Ax = b$.
- Least-squares problems

② Nonlinear systems

- $x^5 = 4x + 2$ $\cos x = x$ $e^x = x + 2$ $\begin{cases} 3x = \sin(x+y) \\ 3y = \cos(x-y) \end{cases}$
- bisection method, fixed-point iteration, Newton's method, secant method

③ Linear systems: iterative methods

④ Curve fitting



interpolation
approximation

⑤ Numerical differentiation

Given $f: \mathbb{R} \rightarrow \mathbb{R}$ and $x \in \text{dom } f$, estimate $f'(x)$.

⑥ Numerical integration

Given $f: [a, b] \rightarrow \mathbb{R}$ continuous, estimate $\int_a^b f$.

⑦ Differential equations

- Initial-value problems (ODE with initial condition)
- Boundary-value problems (ODE or PDE with boundary conditions)