

IP Course Homework

Due Tues. Jan. 31

1. Let $\mathbf{H} = (h_{ij}) = (1/(i+j-1))$ denote the $n \times n$ Hilbert matrix. and set $b_i = \sum h_{ij}$, $j = 1:n$, for each i , so that $\mathbf{H}\mathbf{x} = \mathbf{b}$ has the exact solution $\mathbf{x} = \mathbf{e}^t = (1, \dots, 1)$. Solve $\mathbf{H}\mathbf{x} = \mathbf{b}$ by each of the following methods for a computed solution \mathbf{x}_C . Take $n = 6, 10, 14$ and 16 and record in each case (See doc norm in Matlab):

$$(1) \mathbf{r} = \mathbf{b} - \mathbf{H}\mathbf{x}_C \text{ and } \|\mathbf{r}\|_2 / \|\mathbf{b}\|_2$$

$$(2) \|\mathbf{x} - \mathbf{x}_C\|_2 / \|\mathbf{x}\|_2$$

(a) $\mathbf{x}_{\text{inv}} = \text{inv}(\mathbf{H}) * \mathbf{b}$ (See doc inv in MATLAB).

(b) $\mathbf{x}_{\text{slash}} = \mathbf{H} \backslash \mathbf{b}$ (See doc slash in MATLAB).

(c) Use the svd of \mathbf{H} to solve for \mathbf{x} , and call it \mathbf{x}_{svd} . (See >> doc svd in MATLAB).

Also calculate the 2 condition number for each \mathbf{H} . (See >> doc cond in MATLAB).

Look up and summarize how $\mathbf{x} = \mathbf{H} \backslash \mathbf{b}$ computes \mathbf{x} in Matlab. Use the doc command.

Interpret and explain the results of your computations in terms of accuracy and numerical efficiency in a one page summary. **What did you learn from this problem?**

Be sure to turn in your code and output, in format long. Don't turn in the Hilbert matrices. Use the diary command, and edit your file.

2. Practice with Matlab graphing. You should prepare a short write-up, something like a small "user's guide", discussing and illustrating the following Matlab commands:

plot, axes, axis, hold, legend, line, LineWidth, loglog, plot3, plotyy, semilogx, semilogy, subplot, title, xlabel, xlim, ylabel, ylim.

Illustrate all these Matlab graphics commands with nontrivial examples.

Again, use the doc command in Matlab.