Selected Solutions for Exercises in

Numerical Methods with MATLAB: Implementations and Applications

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Chapter 4

Organizing and Debugging MATLAB Programs

The latest version of this PDF file, along with other supplemental material for the book, can be found at `www.prenhall.com/recktenwald`.

4.2 Use stepwise refinement to describe all of the steps necessary to compute the average and standard deviation of the elements in a vector x. Implement these tasks in an m-file, and test your solution. Do not use the built-in `mean` and `std` functions. Rather, develop your solution from the equations for the average and standard deviation of a finite sample.

Partial Solution: Given an n-element vector x, the formulas for computing the mean $\bar{x}$ and variance σ^2 are

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad \sigma^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

The standard deviation is σ.

The tasks necessary for computing $\bar{x}$ and σ are

(a) Read the data into x (or accept x as input to a function)

(b) Determine n, the length of the data set

(c) Compute $\bar{x}$ and σ using the formulas given above

(d) Display the results (or return them to the calling function)

The implementation can be tested with (at least) the following cases

- Data set with $n = 1$. Is there an error trap for σ?
- Data set with $n = 2$. Then $\bar{x} = (x_1 + x_2)/2$, $\sigma = (x_2 - x_1)^2/2$.
- Data set of arbitray length with all $x_i = K$, where K is a constant. Then $\bar{x} = K$ and $\sigma = 0$.

Implementation of the code for computing $\bar{x}$ and σ is complicated in the case where n is large. For large n

- The available memory (RAM) may not be large enough to hold all the data at once.
- Computation of $\bar{x}$ and σ may cause overflow errors.
- Computation of both $\bar{x}$ and σ will suffer loss of significance if the sums are computed as written.