

Selected Solutions for Exercises in
Numerical Methods with MATLAB:
Implementations and Applications

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Chapter 4
Organizing and Debugging
MATLAB Programs

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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

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

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 arbitrary 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.