A variable can be defined as either a number or a string made up of the same digits. For example, as shown below, x is defined to be the number 536, and y is defined to be a string made up of the digits 536.

```
>> x=536

x =
   536

>> y='536'

y =
536
>>
```

The two variables are not the same even though they appear identical on the screen. Note that the characters 536 in the line below the x= are indented, while the characters 536 in the line below the y= are not indented. The variable x can be used in mathematical expressions, whereas the variable y cannot.

2.11 PROBLEMS

1. Create a row vector that has the following elements: 8, $10/4$, 12×1.4, 51, $\tan 85°$, $\sqrt{26}$, and 0.15.

2. Create a row vector that has the following elements: $\sqrt{15} \times 10^3$, $\dfrac{25}{14 - 6^2}$, $\ln 35/0.4^3$, $\dfrac{\sin 65°}{\cos 80°}$, 129, and $\cos^2(\pi/20)$.

3. Create a column vector that has the following elements: 25.5, $\dfrac{(14 \tan 58°)}{(2.1^2 + 11)}$, $6!$, 2.7^4, 0.0375, and $\pi/5$.

4. Create a column vector that has the following elements: $\dfrac{32}{3.2^2}$, $\sin^2 35°$, 6.1, $\ln 29^2$, 0.00552, $\ln^2 29$, and 133.

5. Define the variables $x = 0.85$, $y = 12.5$, and then use them to create a column vector that has the following elements: y, y^x, $\ln(y/x)$, $x \times y$, and $x + y$.

6. Define the variables $a = 3.5$, $b = -6.4$, and then use them to create a row vector that has the following elements: a, a^2, a/b, $a \cdot b$, and $\sqrt{a}$.

7. Create a row vector in which the first element is 1 and the last element is 43, with an increment of 6 between the elements (1, 7, 13, … , 43).

8. Create a row vector with 11 equally spaced elements in which the first element is 96 and the last element is 2.

9. Create a column vector in which the first element is 26, the elements decrease with increments of –3.6, and the last element is –10. (A column vector can be created by the transpose of a row vector.)

10. Create a column vector with 9 equally spaced elements in which the first element is –34 and the last element is –7. (A column vector can be created by the transpose of a row vector.)

11. Using the colon symbol, create a row vector (assign it to a variable named `Fives`) with five elements that are all 5.

12. Using the `linspace` command, create a row vector (assign it to a variable named `Nines`) with nine elements that are all 9.

13. Use a single command to create a row vector (assign it to a variable named `a`) with 6 elements such that the last element is 4.7 and the rest of the elements are 0s. Do not type the vector elements explicitly.

14. Use a single command to create a row vector (assign it to a variable named `b`) with 8 elements such that the last three element are 3.8 and the rest of the elements are 0s. Do not type the vector elements explicitly.

15. Use a single command to create a row vector (assign it to a variable named `b`) with 11 elements such that

```
b =
  0     2     4     6     8    10    12     9     6     3     0
```

Do not type the vector explicitly.

16. Create two row vectors: `a=2:3:17` and `b=3:4:15`. Then, by only using the name of the vectors (`a` and `b`), create a row vector `c` that is made from the elements of `a` followed by the elements of `b`.

17. Create two column vectors: `a=[2:3:17]'` and `b=[3:4:15]'`. Then, by only using the name of the vectors (`a` and `b`), create a column vector `c` that is made from the elements of `a` followed by the elements of `b`.

18. Create a vector (name it `vtA`) that has 10 elements of which the first is 8, the increment is 7, and the last element is 71. Then, assign elements of `vtA` to a new vector (call it `vtB`) such that `vtB` has 7 elements. The first 4 elements are the first 4 elements of the vector `vtA`, and the last 3 are the last 3 elements of the vector `vtA`. Do not type the elements of `vtA` vector explicitly.

19. Create a vector (name it `vctC`) that has 12 elements of which the first is 5, the increment is 4 and the last element is 49. Then, by assigning elements of `vctC` to new vectors, create the following two vectors:
    (*a*) A vector (name it `Codd`) that contains all the elements with odd index of `vctC`; i.e., `Codd = 5 13 21 ... 45`.
    (*b*) A vector (name it `Ceven`) that contains all the elements with even index of `vct`; i.e., `Ceven = 9 17 25 ... 49`.
    In both parts use vectors of odd and even numbers for the index of `Codd` and `Ceven`, respectively. Do not type the elements of the vectors explicitly.

20. Create a vector (name it `vctD`) that has 9 elements of which the first is 0, the increment is 3 and the last element is 27. Then create a vector (name it `vctDop`) that consist of the elements of `vctD` in reverse order. Do it by assigning elements of `vctD` to `vctDop`. (Do not type the elements of `vctDop` vector explicitly.)

21. Create the following matrix by using vector notation for creating vectors with constant spacing and/or the `linspace` command. Do not type individual elements explicitly.

$$A = \begin{bmatrix} 130 & 110 & 90 & 70 & 50 & 30 & 10 \\ 1 & 2.8333 & 4.6667 & 6.5 & 8.3333 & 10.1667 & 12 \\ 12 & 22 & 32 & 42 & 52 & 62 & 72 \end{bmatrix}$$

22. Create the following matrix by using vector notation for creating vectors with the `linspace` command. Do not type individual elements explicitly.

$$B = \begin{bmatrix} 5 & 2 & 3 \\ 5 & 2 & 3 \\ 5 & 2 & 3 \\ 5 & 2 & 3 \end{bmatrix}$$

23. Create the following matrix by typing one command. Do not type individual elements explicitly.

$$C = \begin{bmatrix} 7 & 7 & 7 & 7 & 7 \\ 7 & 7 & 7 & 7 & 7 \end{bmatrix}$$

24. Create the following matrix by typing one command. Do not type individual elements explicitly.

$$D = \begin{bmatrix} 0 & 0 & 0 & 0 & 8 \\ 0 & 0 & 0 & 0 & 7 \\ 0 & 0 & 0 & 0 & 6 \end{bmatrix}$$

25. Create the following matrix by typing one command. Do not type individual elements explicitly.

$$E = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 5 & 4 & 3 \\ 0 & 0 & 2 & 1 & 0 \end{bmatrix}$$

26. Create the following matrix by typing one command. Do not type individual elements explicitly.

$$F = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 10 & 20 \\ 0 & 0 & 2 & 8 & 26 \\ 0 & 0 & 3 & 6 & 32 \end{bmatrix}$$

27. Create three row vectors:

$a = [3\ -1\ 5\ 11\ -4\ 2]$, $b = [7\ -9\ 2\ 13\ 1\ -2]$, $c = [-2\ 4\ -7\ 8\ 0\ 9]$

(*a*) Use the three vectors in a MATLAB command to create a 3×6 matrix in which the rows are the vectors *a*, *b*, *c*, and *c*.

(*b*) Use the three vectors in a MATLAB command to create a 6×3 matrix in which the columns are the vectors *b*, *c*, and *a*.

28. Create three row vectors:

$a = [3\ -1\ 5\ 11\ -4\ 2]$, $b = [7\ -9\ 2\ 13\ 1\ -2]$, $c = [-2\ 4\ -7\ 8\ 0\ 9]$

(*a*) Use the three vectors in a MATLAB command to create a 3×4 matrix such that the first, second, and third rows consist of the last four elements of the vectors *a*, *b*, and *c*, respectively.

(*b*) Use the three vectors in a MATLAB command to create a 3×3 matrix such that the first, second, and third columns consist of the first three elements of the vectors *a*, *b*, and *c*, respectively.

29. Create two row vectors:

$a = [3\ 9\ -0.5\ 3.6\ 1.5\ -0.8\ 4]$, $b = [12\ -0.8\ 6\ 2\ 5\ 3\ -7.4]$

(*a*) Use the two vectors in a MATLAB command to create a 3×4 matrix such that the first row consists of elements 3 through 6 of vector *a*, the

second row consists of elements 4 through 7 of vector *a*, and the third row consists of elements 2 through 5 of vector *b*.

(*b*) Use the two vectors in a MATLAB command to create a 6×2 matrix such that the first column consists of elements 2 through 7 of vector *a*, and the second column consists of elements 1 through 3 and 5 through 7 of vector *b*.

30. By hand (pencil and paper) write what will be displayed if the following commands are executed by MATLAB. Check your answers by executing the commands with MATLAB. (Parts (*b*), (*c*), (*d*), and (*e*) use the vector that was defined in part (*a*).)

(*a*) `a=1:4:17` (*b*) `b=[a(1:3) a]` (*c*) `c=[a;a]'`

(*d*) `d=[a' a']'` (*e*) `e=[[a; a; a; a; a] a']`

31. The following vector is defined in MATLAB:

$$v = \begin{bmatrix} 6 & 11 & -4 & 5 & 8 & 1 & -0.2 & -7 & 19 & 5 \end{bmatrix}$$

By hand (pencil and paper) write what will be displayed if the following commands are executed by MATLAB. Check your answers by executing the commands with MATLAB.

(*a*) `a=v(3:8)` (*b*) `b=v([1,3,2:7,4,6])` (*c*) `c=v([9,1,5,4])'`

32. The following vector is defined in MATLAB:

$$v = \begin{bmatrix} 6 & 11 & -4 & 5 & 8 & 1 & -0.2 & -7 & 19 & 5 \end{bmatrix}$$

By hand (pencil and paper) write what will be displayed if the following commands are executed by MATLAB. Check your answers by executing the commands with MATLAB.

(*a*) `a=[v([1:3 7:-1:5]);v([10,1,4:6,2])]`

(*b*) `b=[v([9,2:4,1])' v([5 3 10 2 7])' v([10:-2:4,10])']`

33. Create the following matrix *A*.

$$A = \begin{bmatrix} 36 & 34 & 32 & 30 & 28 & 26 \\ 24 & 22 & 20 & 18 & 16 & 14 \\ 12 & 10 & 8 & 6 & 4 & 2 \end{bmatrix}$$

By writing one command and using the colon to address range of elements (do not type individual elements explicitly), use the matrix *A* to:

(*a*) Create a six-element row vector named `ha` that contains the elements of the second row of *A*.

(*b*) Create a three-element column vector named `hb` that contains the elements of the sixth column of *A*.

(*c*) Create a five-element row vector named `hc` that contains the first two elements of the third row of *A* and the last three element of the first row of *A*.

34. Create the following vector A.

$$A = [1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 10\ 11\ 12\ 13\ 14\ 15\ 16\ 17\ 18]$$

Then using the MATLAB's built-in `reshape` function create the following matrix B from the vector A:

$$B = \begin{bmatrix} 1 & 4 & 7 & 10 & 13 & 16 \\ 2 & 5 & 8 & 11 & 14 & 17 \\ 3 & 6 & 9 & 12 & 15 & 18 \end{bmatrix}$$

By writing one command and using the colon to address range of elements (do not type individual elements explicitly), use the matrix B to:

(a) Create a nine-element column vector named `Ba` that contains the elements of the first, third, and fifth columns of B.
(b) Create a seven-element row vector named `Bb` that contains elements 2 through 5 of the second row of B and the elements of the third column of B.
(c) Create a six-element row vector named `Bc` that contains elements 3 through 5 of the first row, and elements 2 through 4 of the third row of B.

35. Create the following vector C.

$$C = [1.5\ 2\ 2.5\ 3\ 3.5\ 4\ 4.5\ 5\ 9.6\ 9.1\ 8.6\ 8.1\ 7.6\ 7.1\ 6.6\ 6.1]$$

Then use MATLAB's built-in `reshape` function and the transpose operation to create the following matrix D from the vector C:

$$D = \begin{bmatrix} 1.5 & 2 & 2.5 & 3 \\ 3.5 & 4 & 4.5 & 5 \\ 9.6 & 9.1 & 8.6 & 8.1 \\ 7.6 & 7.1 & 6.6 & 6.1 \end{bmatrix}$$

By writing one command and using the colon to address a range of elements (do not type individual elements explicitly), use the matrix D to:

(a) Create a eight-element column vector named `Da` that contains the elements of the first and third rows of D.
(b) Create an eight-element raw vector named `Db` that contains the elements of the second and the fourth columns of D.
(c) Create a eight-element row vector named `Dc` that contains the first two elements of the first row, the last three elements of the second column, and the first three elements of the fourth row of D.

36. Create the following matrix E:

$$E = \begin{bmatrix} 0 & 5 & 5 & 5 & 5 & 5 \\ 0.1 & 0.3 & 0.5 & 0.7 & 0.7 & 0.9 \\ 12 & 9 & 6 & 3 & 0 & -3 \\ 6 & 7 & 8 & 9 & 10 & 11 \end{bmatrix}$$

(a) Create a 2×3 matrix F from the second and third rows, and the third

through the fifth columns of matrix E.

(*b*) Create a 4×4 matrix G from all rows and the third through sixth columns of matrix E.

37. Create the following matrix H:

$$H = \begin{bmatrix} 1.25 & 1.5 & 1.75 & 2 & 2.25 & 2.5 & 2.75 \\ 1 & 2 & 3 & 1 & 2 & 3 & 4 \\ 45 & 40 & 35 & 30 & 25 & 20 & 15 \end{bmatrix}$$

(*a*) Create a 2×5 matrix G such that its first row includes the first three elements and the last two elements of the first row of H, and the second row of G includes the last five elements of the third row of H.

(*b*) Create a 4×3 matrix K such that the first, second, third, and fourth rows are the second, third, fifth and seventh columns of matrix H.

38. The following matrix is defined in MATLAB:

$$M = \begin{bmatrix} 1 & 4 & 7 & 10 & 13 & 16 \\ 2 & 5 & 8 & 11 & 14 & 17 \\ 3 & 6 & 9 & 12 & 15 & 18 \end{bmatrix}$$

By hand (pencil and paper) write what will be displayed if the following commands are executed by MATLAB. Check your answers by executing the commands with MATLAB.

a) `A=M([1,3],[1,5,6])`

b) `B=M(:,[4,4:6])`

c) `C=M([1,2],:)`

d) `D=M([2,3],[2,3])`

39. The following matrix is defined in MATLAB:

$$N = \begin{bmatrix} 2 & 10 & 18 & 29 & 41 \\ 4 & 12 & 20 & 32 & 44 \\ 6 & 14 & 23 & 35 & 47 \\ 8 & 16 & 26 & 38 & 50 \end{bmatrix}$$

By hand (pencil and paper) write what will be displayed if the following commands are executed by MATLAB. Check your answers by executing the commands with MATLAB.

(*a*) `A=[N(1,1:4)',N(2,2:5)']`

(*b*) `B=[N(:,3)' N(3,:)]`

(*c*) `C(3:4,5:6)=N(2:3,4:5)`

40. By hand (pencil and paper) write what will be displayed if the following commands are executed by MATLAB. Check your answers by executing the commands with MATLAB.

```
v=1:2:23
M=reshape(v,3,4)
M(2,:)=[]
M(:,3)=[]
N=ones(size(M))
```

41. Using the `zeros`, `ones`, and `eye` commands, create the following arrays by typing one command:

(*a*) $\begin{bmatrix} 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 \end{bmatrix}$ (*b*) $\begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 \end{bmatrix}$ (*c*) $\begin{bmatrix} 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$

42. Using the `zeros`, `ones`, and `eye` commands create the following arrays by typing one command:

(*a*) $\begin{bmatrix} 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix}$ (*b*) $\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$ (*c*) $\begin{bmatrix} 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$

43. Use the `eye`, `ones`, and `zeros` commands to create the following arrays:

$$A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \quad C = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

Using the variables `A`, `B`, and `C`, write a command that creates the following matrix `D`:

$$D = \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 0 & 1 \end{bmatrix}$$

44. Create a 2×3 matrix A in which all the elements are 1. Then reassign A to itself (several times) such that A will become:

$$A = \begin{bmatrix} 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 \end{bmatrix}$$