Chapter 2
Vectors and Matrices
Part 1
Matrix (plural – Matrices)

- Store a set of values of the same type
  - *element* - value stored

- Looks like a table: it has both rows and columns

- **dimensions** - matrix with *m* rows and *n* columns is called *m* x *n*
  - e.g. 2 x 3 matrix:

<table>
<thead>
<tr>
<th>9</th>
<th>6</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

- **array** - refer generically to a matrix or a vector
Vectors and Scalars

- **vector** - one of the dimensions is 1
  - **row** vector with n elements is $1 \times n$, e.g. $1 \times 4$:
    
    \[
    \begin{array}{cccc}
    5 & 88 & 3 & 11 \\
    \end{array}
    \]

- **column** vector with m elements is $m \times 1$, e.g. $3 \times 1$:

    \[
    \begin{array}{c}
    3 \\
    7 \\
    4 \\
    \end{array}
    \]

- **scalar** - $1 \times 1$ (a single value)

    \[
    \begin{array}{c}
    5 \\
    \end{array}
    \]
Row Vectors

- **1 x n** vector

- Direct method: values in [ ] separated by commas or spaces

```
>> v = [ 1 2 3 4 ]
v =
 1 2 3 4
>> v = [1,2,3,4]
v =
 1 2 3 4
```

- Colon operator: iterates through values first:step:last
  - e.g. 5:3:14 ---> [ 5 8 11 14 ]
  - Default step is 1 e.g. 2:4 ---> [ 2 3 4 ]
  - Reverse e.g. 4:-1:1 ---> [ 4 3 2 1 ]
linspace

- **linspace** – function creates linearly spaced vector

  \[
  \text{linspace}(x, y, n) - n \text{ values in inclusive range from } x \text{ to } y
  \]

- e.g. \text{linspace}(4, 7, 3) vector with 3 values including 4 and 7

  \[
  \rightarrow [4 \quad 5.5 \quad 7]
  \]
Concatenation

- Create vectors by joining together existing vectors, or adding elements to existing vectors.

```matlab
>> v = 2:5;
>> x = [33 11 2];
>> w = [v x]

w =
    2 3 4 5 33 11 2

>> newv = [v 44]

newv =
    2 3 4 5 44
```
Elements

• **index (subscript)** - each element number:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>33</td>
<td>11</td>
<td>-6</td>
<td>2</td>
</tr>
</tbody>
</table>

vec(4) - 4\textsuperscript{th} element of a vector vec above

• **index vector** - subset of vector using indices

vec( [2 4] ) - refers to 2\textsuperscript{nd} and 4\textsuperscript{th} elements of vec

vec( [1:3] ) - refers to first 3 elements

• Change value of element

vec(3) = 22
• \( m \times 1 \) vector

• Direct method: values in \([\ ]\) separated by \textit{semicolons}

\[
>> v = [4; 7; 2]
\]

\[
v =
4
7
2
\]

• \textbf{Transpose row}

\[
>> r = 1:3;
\]

\[
>> \text{vec} = r
\]

\[
\text{vec} =
2
3
4
\]

\textit{vec(2)} - \(2^{\text{nd}}\) element of a vector \textit{vec} above
Matrix Variables

- $m \times n$

$$\text{mat} = \begin{bmatrix} 1 & 3 & 6 & 11 & -2 \end{bmatrix}$$

- Separate rows with semicolons
- Separate within rows with blanks or commas
- Use any method to create a row vector. e.g. :

**ALWAYS same number of values in every row!!**
Functions (built-in) to create matrices

- **rand(m)** creates $m \times m$ matrix of random reals
- **rand(m,n)** creates $m \times n$ matrix of random reals
- **zeros(m)** creates $m \times m$ matrix of all zeros
- **zeros(m,n)** creates $m \times n$ matrix of all zeros
- **ones(m)** creates $m \times m$ matrix of all ones
- **ones(m,n)** creates $m \times n$ matrix of all ones