EXAMPLES OF MATRIX BUILDING COMMANDS

Suppose I wish to construct the matrix

$$\begin{bmatrix} 1 & 2 & 0 & 0 & 0 & 0 & 1 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 2 & 0 & 0 & 0 & 2 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 2 & 0 & 0 & 3 & -1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 4 & -1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 5 & -1 \\ 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 6 \end{bmatrix}$$

I can break this down into 3 submatrices with particular symmetry:

A

$$\begin{bmatrix} 1 & 2 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 2 \end{bmatrix}$$

B

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

C

$$\begin{bmatrix} 1 & -1 & 0 & 0 & 0 & 0 \\ 0 & 2 & -1 & 0 & 0 & 0 \\ 0 & 0 & 3 & -1 & 0 & 0 \\ 0 & 0 & 0 & 4 & -1 & 0 \\ 0 & 0 & 0 & 0 & 5 & -1 \\ 0 & 0 & 0 & 0 & 0 & 6 \end{bmatrix}$$

To construct A, use the kron command which pastes a matrix onto the nonzero values of a template matrix.

```
m1 = eye(3)    <- 3x3 identity template
m2 = [1 2]     <- matrix to copy
A = kron(m1, m2)
```

The matrix B is constructed similarly with template [1 1] and copy matrix eye(3):

```
m1 = [1 1]
m2 = eye(3)
B = kron(m1, m2)
```

The C matrix can be created with the spdiags command which inserts vectors as diagonals in a matrix.

```
V1 = (1:6)'
V2 = -ones(6,1)
K1 = 0
K2 = 1
C = spdiags([V1 V2], [K1 K2], 6, 6)
C = full(C)
```

V1, V2: vectors containing the diagonal elements

K1, K2: corresponding diagonal placement (0 → main diagonal, 1 → upper off diagonal)

[V1 V2]: vectors as columns in a matrix

[K1 K2]: vector of placement locations

6, 6: size of result

Now put the pieces together:

```
M = [[A; B] C]
```

Some other useful commands:

```
a = zeros(m,n)   % ← m x n matrix of zeros
b = inf(m,n)     % ← m x n matrix of inf's
c = repmat('I', 1, 13)   % ← string of 13 I's
d = repmat([1 2], 3, 4)  % ← matrix [1 2] repeated in 3 rows and 4 columns
```

$$\begin{bmatrix} 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 \\ 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 \\ 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 \end{bmatrix}$$

Suppose I wish to build the following matrix

$$M = \begin{bmatrix} 1 & 0 & 0 & 6 & 0 \\ 0 & 3 & 0 & 0 & 8 \\ 0 & 0 & 5 & 0 & 0 \\ 2 & 0 & 0 & 7 & 0 \\ 0 & 4 & 0 & 0 & 9 \end{bmatrix}$$

Here are different ways to achieve this:

```
T = [(1:9); zeros(2,9)]
T = T(:)
T(end-1:end) = []
M = reshape(T,5,5)
```

```
T = spdiags(ones(5,3),[-3 0 3],5,5)
T(T>0) = 1:9
M = full(T)
```

```
R = 1:1/3:9
mask = (R ~= round(R))
R(mask) = 0
M = reshape(R,5,5)
```