Problem 1

```
x_coord     :  [0.0, 0.25, 0.5, 0.75, 1.0]
Nodes       :  [(1, 0, 1), (2, 1, 2), (3, 2, 3), (4, 3, 4)]
Quad_point  :  [0.125, 0.375, 0.625, 0.875]
Quad_weight :  [0.25, 0.25, 0.25, 0.25]
```

Note the last two value of Nodes return the global index for Phi. Unknown is trivial and is equal to first element of each tuple in Nodes. x_coord is equispaced x point between 0,1. Quad_Point is Quadrature Point Calculated by MID-POINT formula. Quad Weight is the respective weight for Quadrature.

Problem 2

```
Value of basis function phi_2 at x : 0.125 is 0 and Derivative : 0
Value of basis function phi_2 at x : 0.375 is 0.5 and Derivative : -4.0
Value of basis function phi_2 at x : 0.5 is 1.0 and Derivative : 4.0
Value of basis function phi_2 at x : 0.675 is 0.2999999999999998 and Deriv
ative : 4.0
Value of basis function phi_2 at x : 0.8 is 0 and Derivative : 0
```

Problem 3

```
Mass Matrix
[[0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]]
```

Stiffness Matrix

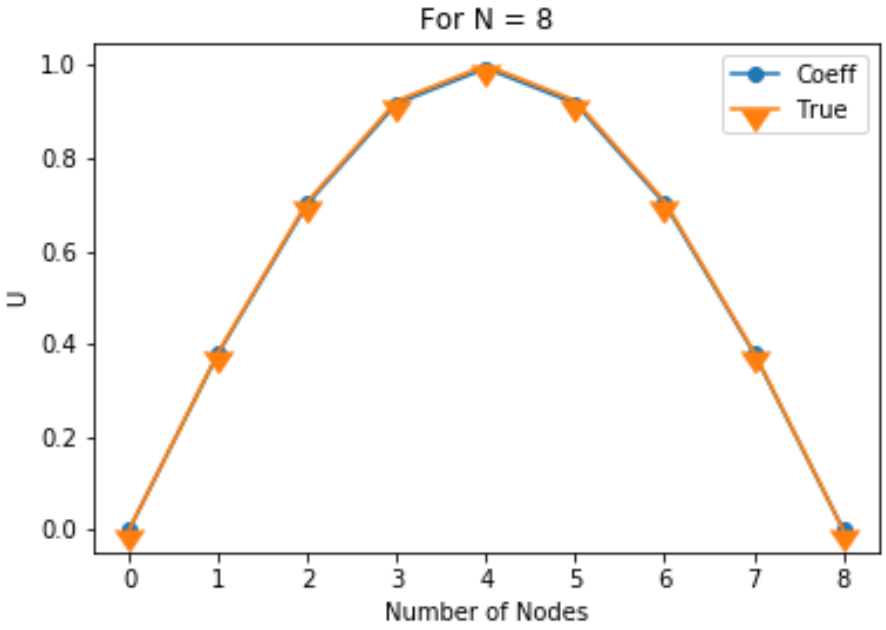
```
[[ 32. -16.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.]
 [-16.  32. -16.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.]
 [  0. -16.  32. -16.   0.   0.   0.   0.   0.   0.   0.   0.   0.
    0.]
 [  0.   0. -16.  32. -16.   0.   0.   0.   0.   0.   0.   0.   0.
    0.]
 [  0.   0.   0. -16.  32. -16.   0.   0.   0.   0.   0.   0.   0.
    0.]
 [  0.   0.   0.   0. -16.  32. -16.   0.   0.   0.   0.   0.   0.
    0.]
 [  0.   0.   0.   0.   0. -16.  32. -16.   0.   0.   0.   0.   0.
    0.]
 [  0.   0.   0.   0.   0.   0. -16.  32. -16.   0.   0.   0.   0.
    0.]
 [  0.   0.   0.   0.   0.   0.   0. -16.  32. -16.   0.   0.   0.
    0.]
 [  0.   0.   0.   0.   0.   0.   0.   0. -16.  32. -16.   0.   0.
    0.]
 [  0.   0.   0.   0.   0.   0.   0.   0.   0. -16.  32. -16.   0.
    0.]
 [  0.   0.   0.   0.   0.   0.   0.   0.   0.   0. -16.  32. -16.
    0.]
 [  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0. -16.  32.
   -16.]
 [  0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0. -16.
   32.]]
```

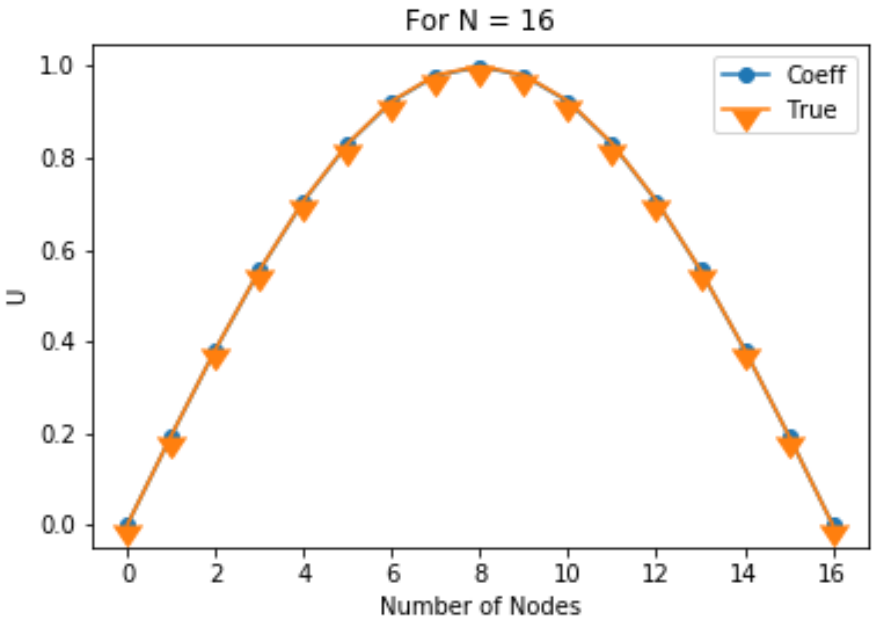
Matrix F

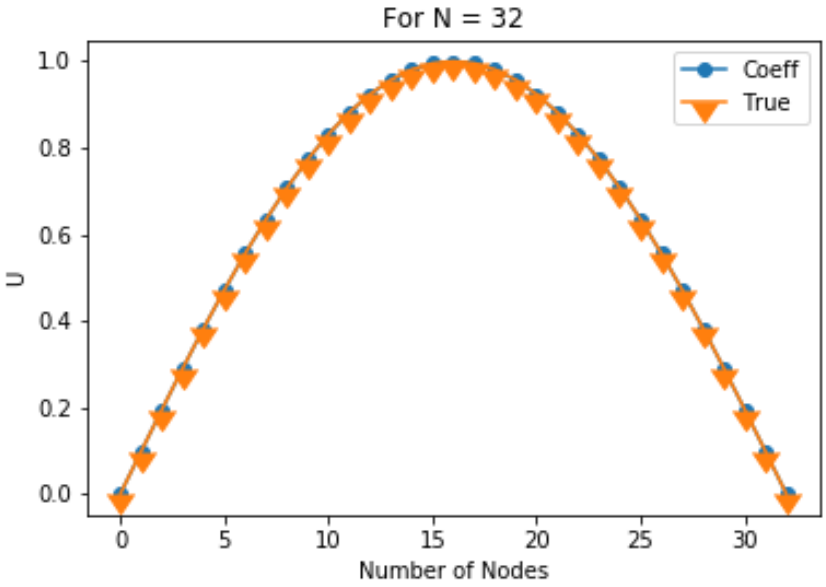
```
[[0.11976204]
 [0.23492169]
 [0.34105344]
 [0.43407869]
 [0.51042254]
 [0.56715114]
 [0.60208444]
 [0.61387997]
 [0.60208444]
 [0.56715114]
 [0.51042254]
 [0.43407869]
 [0.34105344]
 [0.23492169]
 [0.11976204]]
```

Problem 4

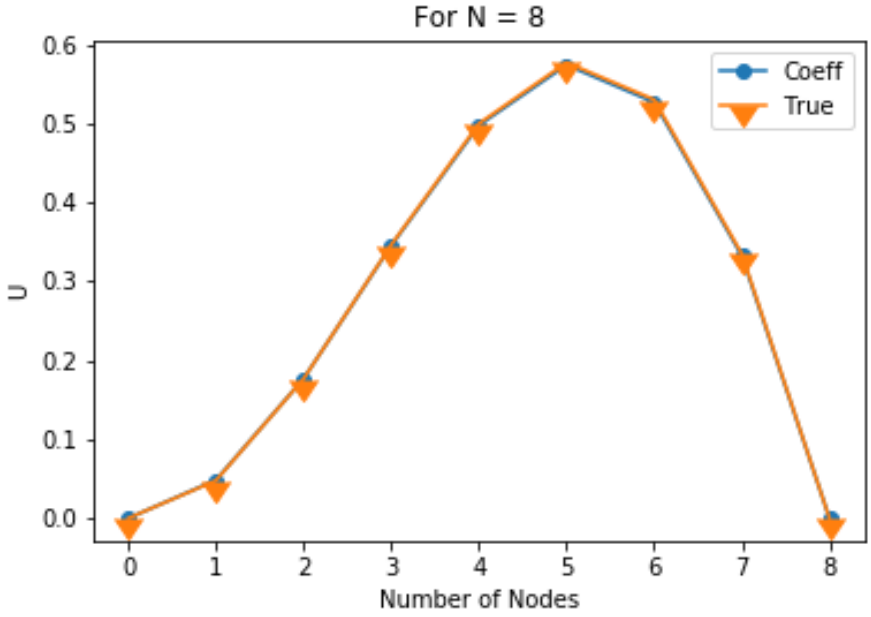
Part 1

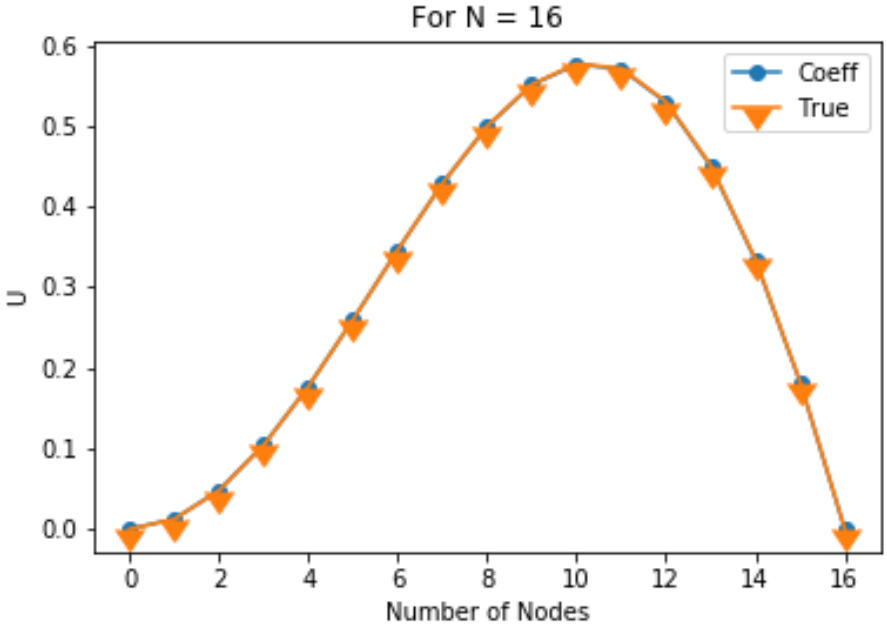


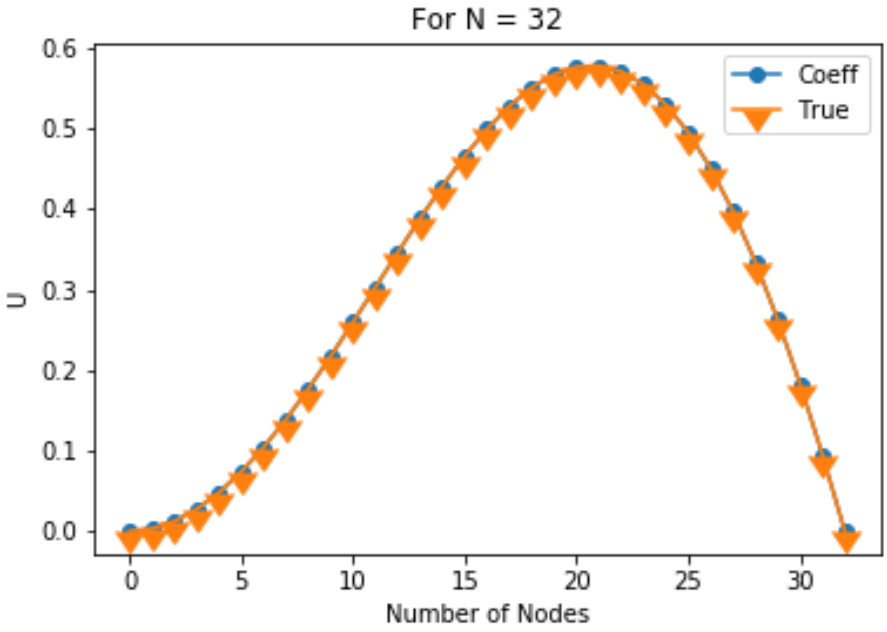



For N = 32
Coeff
True
U
Number of Nodes
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30

Part 2


For N = 8
Coeff
True
U
Number of Nodes
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
1
2
3
4
5
6
7
8


For N = 16
Coeff
True
U
Number of Nodes
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
2
4
6
8
10
12
14
16


For N = 32
Coeff
True
U
Number of Nodes
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
5
10
15
20
25
30