Q1:

a)

Since there is no dead end page,

And

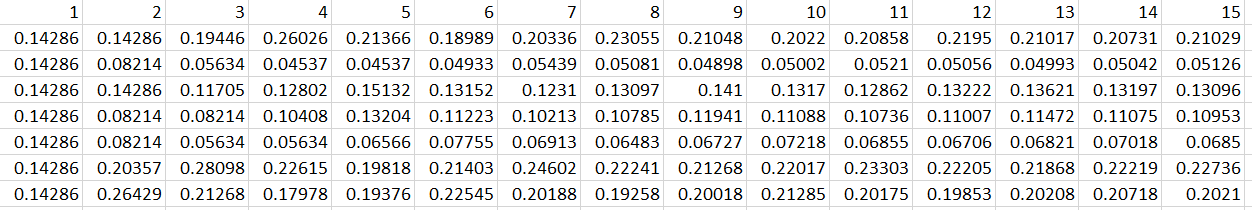
Finally

Is the google matrix.

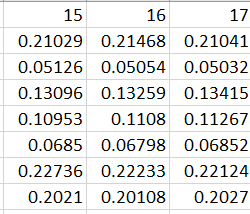
b)

after 15 iterations,

iterations as below:



c)



by watching the 15th and 16th column, in the first row, 0.210 does not equal to 0.215, therefore the Ranking vector does not match up to at least 3 significant digits. To reach 3 significant digits there should be around 24 iterations.

Q2:

Let matrix . As discussed in class, columns of sums to 1.

Since columns of also sum to 1, columns of sum to 1.

Hence for each column of M, as required.

As discussed in class, matrix is the probability matrix, replacing entries of zero columns with 1/R.

Hence for each entry of , ,

Then .

Since columns of sum to 1, each entry of is strictly greater than 0, then for any entry, the entry is equal to 1 minus all other entries in that column, which must be less than 1, .

Hence, we can conclude that Google matrix is a Markov matrix.

Q3:

Substitute gives

Then we can solve in time. Now we know .

Then solve in time. Now we know

Then solve in time. Now we know

And finally solve in time.

In total it took time.

Q4:

So , , .

Solve :

Let , then

Now solve for :

Q5:

a)

, , from the calculation steps we get

, , from the calculation steps we get

b) once we know the previous value, by the recurrence formula, we need constant time to compute the next. So the cost of computing LU decomposition is

c)

since in L and U matrices, each row only contains two non-zero entries. Therefore solving and require steps . Therefore solving requires time, we get the derivatives at all points in time. By now we know all the coordinates and derivatives at those points. Using formulas , , which take time for each interval, we can calculate the spline in time.