Computing Assignment 2

a)

Result

The number of iterations needed so that its stopping criterion is smaller than the tolerance (10^{-3}) is 227, 457, and 502 for dimension of the square matrix of 20, 40, and 80 respectively.

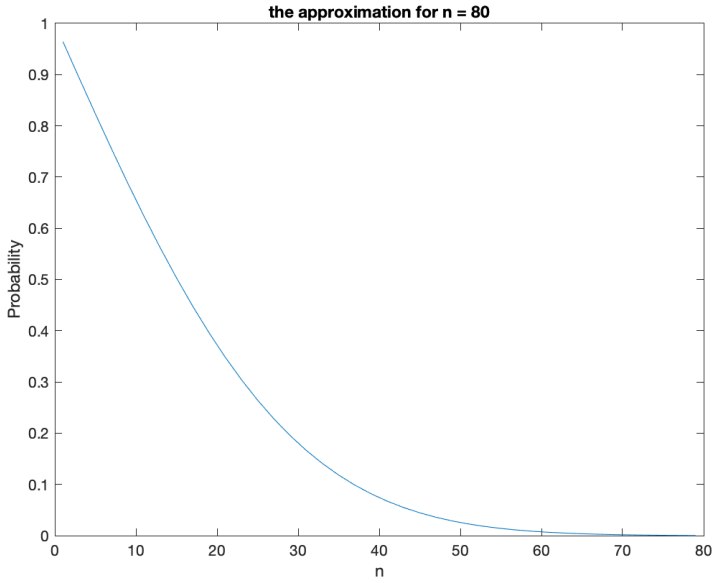

Figure 1

n	# Iteration
20	227
40	457
80	502

Figure 1 indicates a plot of approximation when n = 80.

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b) Algorithm for part(b) is pretty much similar to the part(a); however, only difference is that I have to compute exact solution of the system using backslash-operator [\]. The relative error is to measure accuracy between the exact solution and the x computed in part(a) by using inf-norm. I could get the number of iterations required where its relative error is smaller than a certain tolerance, 10^{-3} for each different dimension matrix A.

Result

The number of iterations needed so that its stopping criterion is smaller than the tolerance (10^{-3}) is 526, 2100, and 8388 for dimension of the square matrix of 20, 40, and 80 respectively.

n	# Iteration
20	526
40	2100
80	8388

The mathematical relationship between the n and the number of iterations required where its error is less than the tolerance is **$f(n) = 1.3n^2$** where f(n) is the number of the iterations. I could fit this by using least squared polynomial (polyfit function). Thus, the number of iterations will be required more as n gets larger.

c) The numbers of iterations in part(a) and part(b) do not agree. It is because they are having different stopping criterion; (a) is to compare relative error against the previous iteration of the approximation while (b) is to compare relative error against the exact solution. The number of iterations required in part(b) is way larger than (a). It is because, in part (b), it is determined by the relative error between the current iteration of the approximate solution and the exact solution. As the system is starting with an initial iteration where p(0) is a vector with all 0s, it would take longer to get to the exact solution from the initial iteration, compared to the approximation on the previous iteration.