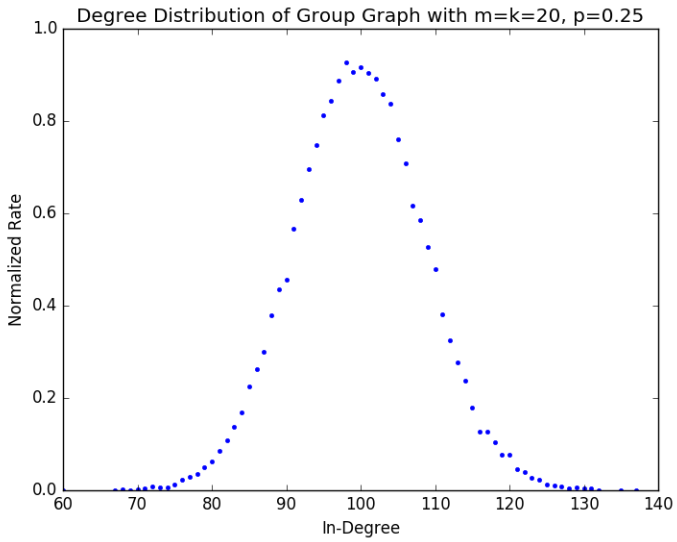
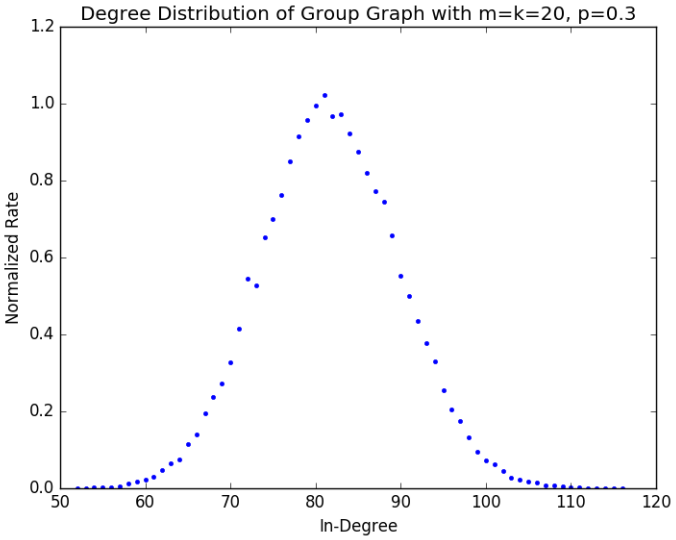
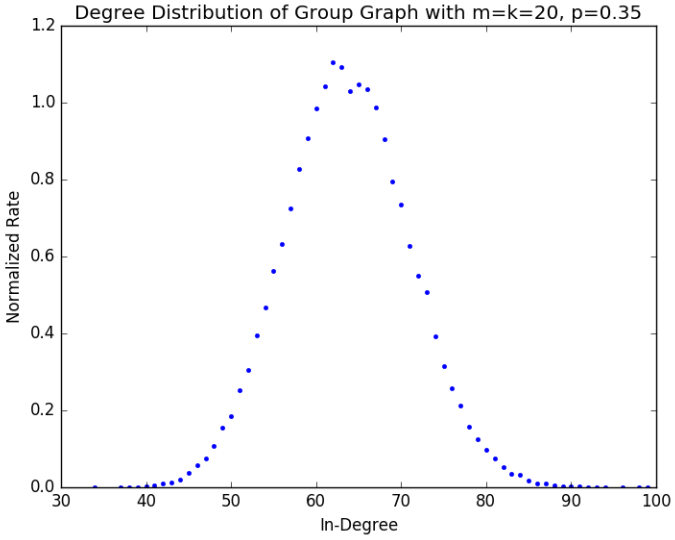
[redacted] Network Analysis Assignment

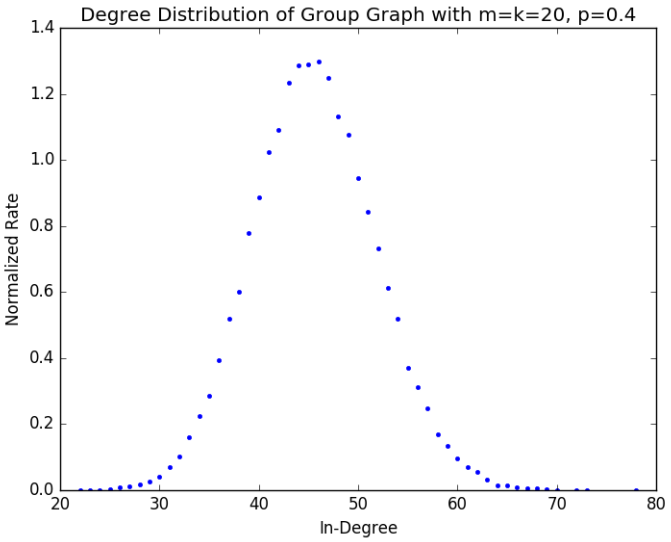
Question 1

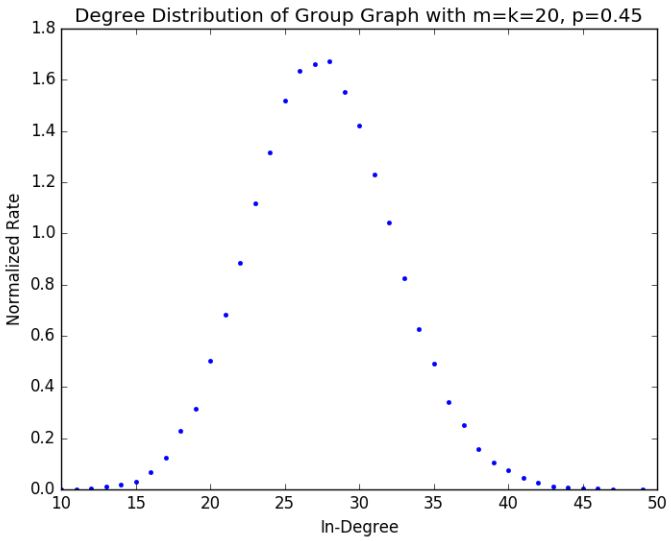
The below plots illustrate the degree distribution of group graphs for p + q = 0.5, p > q. To investigate the relationship, a group graph with 400 vertices (20 groups of 20 vertices) was constructed 100 times for each set of values for p and q, and the degree distribution averaged.

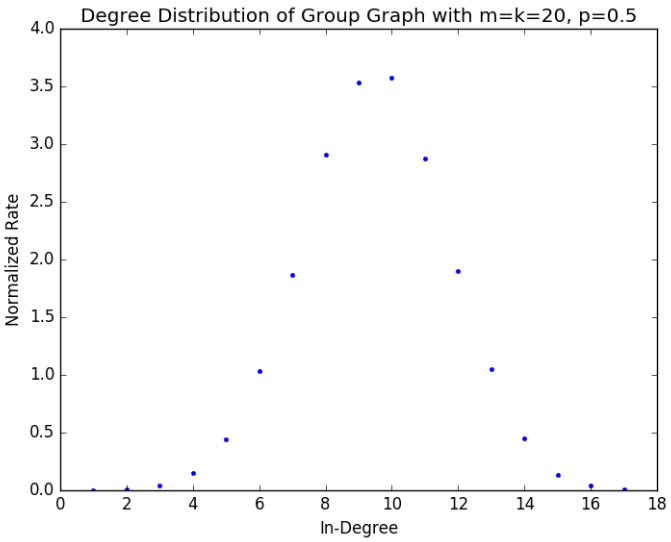






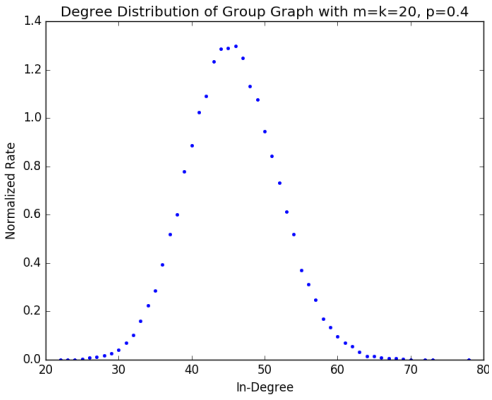


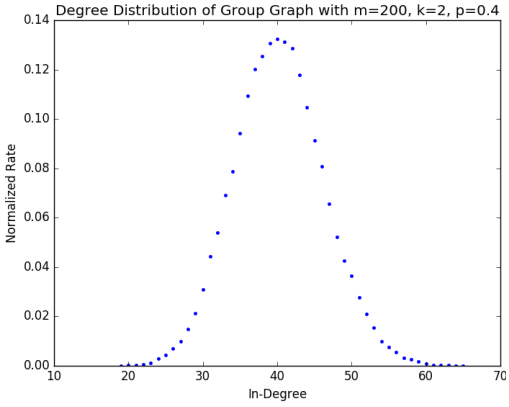


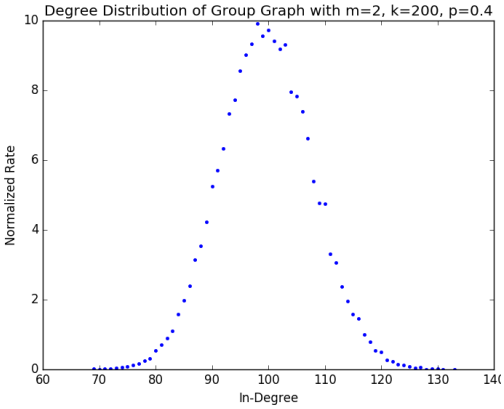


From the above illustrations, we can see that, for all combinations of p and q, a similar degree distribution is obtained i.e. the shapes of the plots are very similar. We can also observe that, in each distribution, the degrees of each vertex do not differ greatly from the average vertex degree in that graph. For example, in the first graph (m=k=20, p=0.25) the average degree is around 100, and the other degree values range from approximately 70-130, so there is little variation in vertex degree.

To validate that this degree distribution is true for group graphs in general, and not just the above case, we test with m=200, k=2 and m=2, k=200 with a fixed p of 0.4. The plots below illustrate the results for the different m, k combinations.

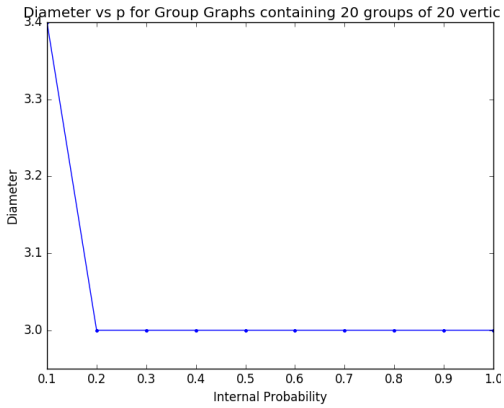


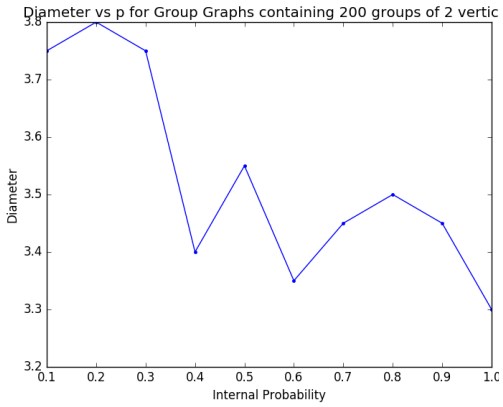


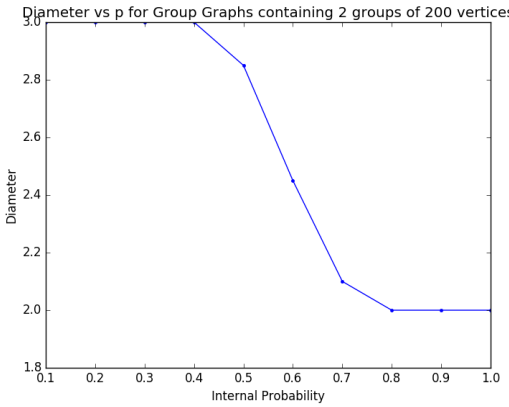


We can see that an almost identical degree distribution can be found in all of the graphs, they just have different values. Therefore, we can assume that this degree distribution holds for group graphs in general.

The following plots illustrate the relationship between the diameter of a group graphs and p (for fixed q). In each case, q was set to be 0.05 and, for each m, k pair, 20 graphs were produced for each value of p, and their diameter averaged. It has been established in the previous part of this question that the degree distribution of group graphs in independent of the m, k pair, however, multiple m, k pairs were used here for completeness.







We can see from the illustrations that the relationship between diameter and p is rather insignificant. As p increases, there tends to be a very minor decrease in the diameter, however this decrease is not noticeable enough for the relationship to be interesting.