Homework 4 Problem 4

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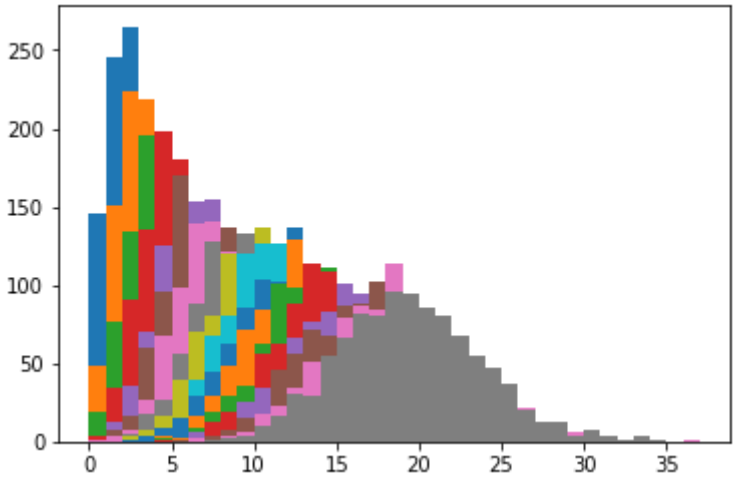
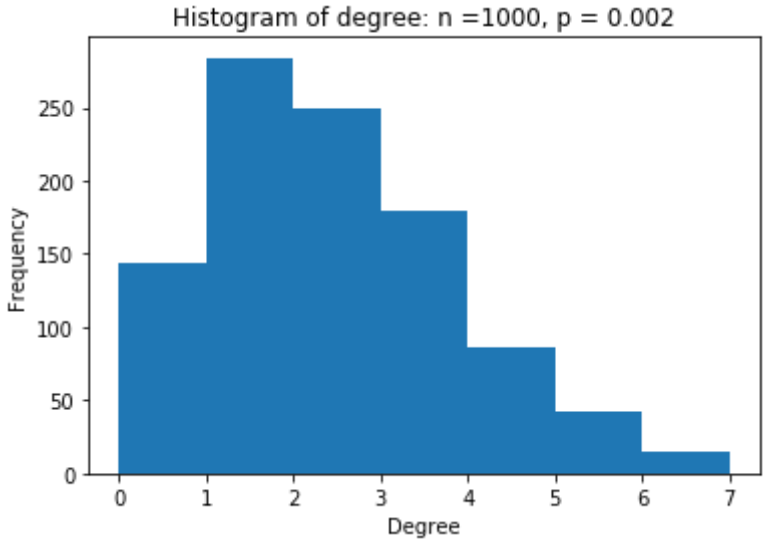
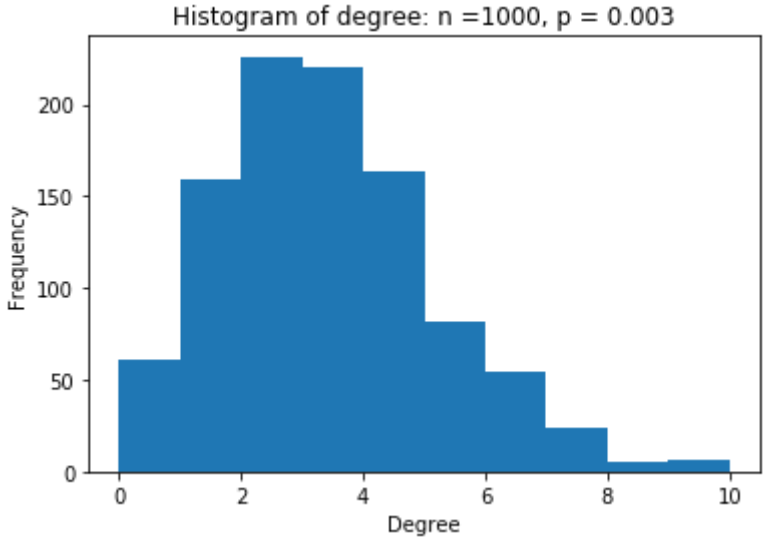
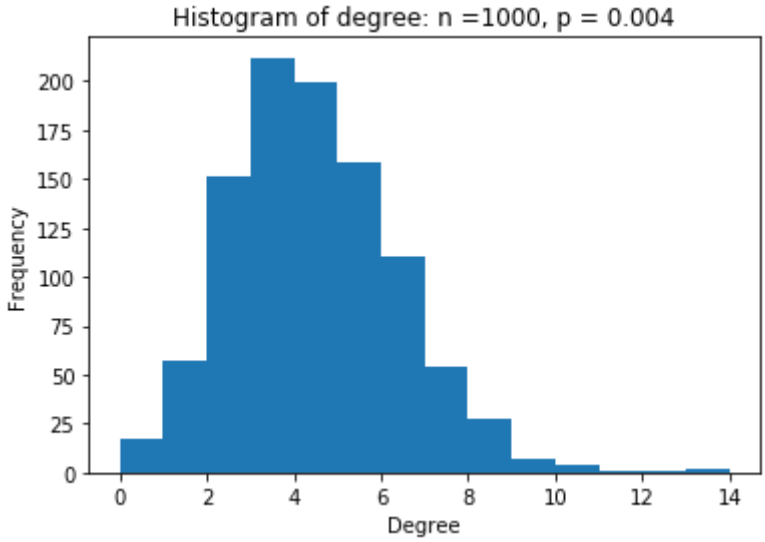
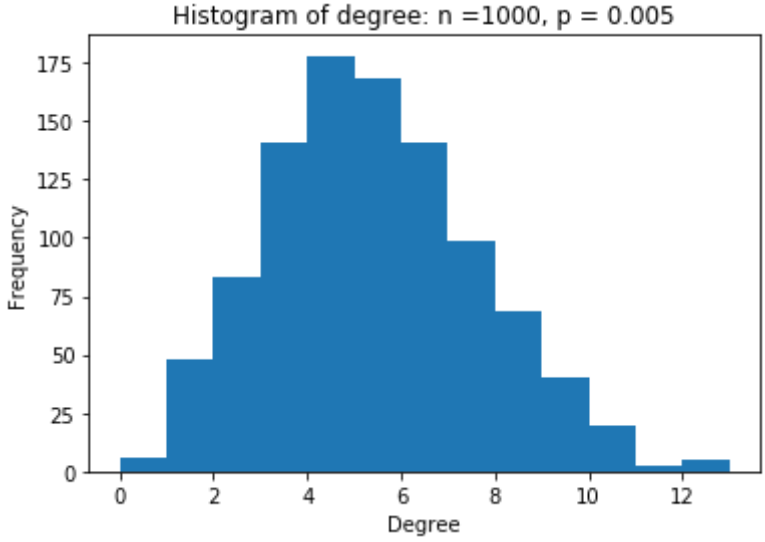
```
import random
import matplotlib.pyplot as plt
import numpy as np


class Graph:

    def __init__(self, n, p):
        self.n = n
        self.p = p
        m = n * (n - 1) * p // 2
        self.nodes = dict()
        self.edges = list()
        self.degree = [0 for i in range(n)]

    def get_random_graph(self):
        for i in range(self.n -1):
            for j in range(i+1, self.n):
                if random.random() < self.p:
                    self.add_edge(i, j)

    def add_edge(self, i, j):
        self.degree[i] += 1
        self.degree[j] += 1


if __name__ == "__main__":
    for i in range(2,20):
        g = Graph(1000, i/1000)
        g.get_random_graph()
        plt.hist(np.array(g.degree), bins=range(min(g.degree), max(g.degree) +
1, 1))
    plt.show()

    for i in range(2,21):
        g = Graph(1000, i/1000)
        g.get_random_graph()
        plt.hist(np.array(g.degree), bins=range(min(g.degree), max(g.degree) +
1, 1))
        plt.title(r'Histogram of degree: n =1000, p = %.3f' %(i/1000))
        plt.xlabel('Degree')
        plt.ylabel('Frequency')
        plt.show()
```

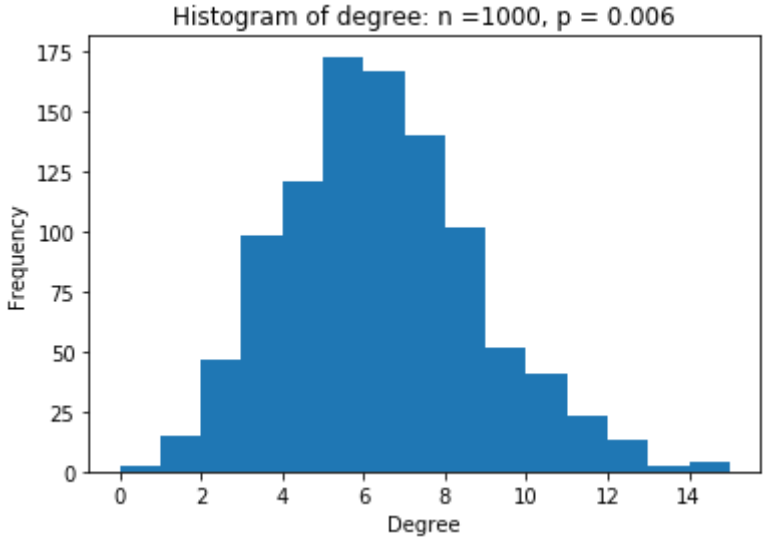

250
200
150
100
50
0
0
5
10
15
20
25
30
35

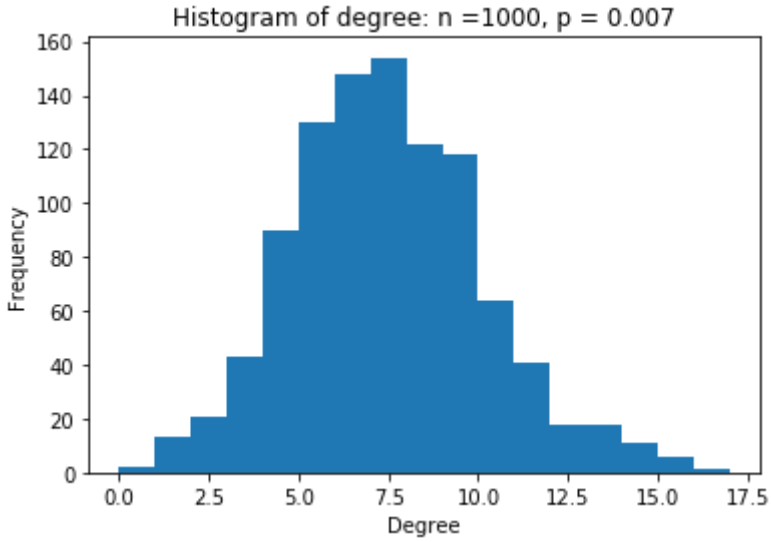

Histogram of degree: n =1000, p = 0.002
Frequency
250
200
150
100
50
0
0
1
2
3
4
5
6
7
Degree

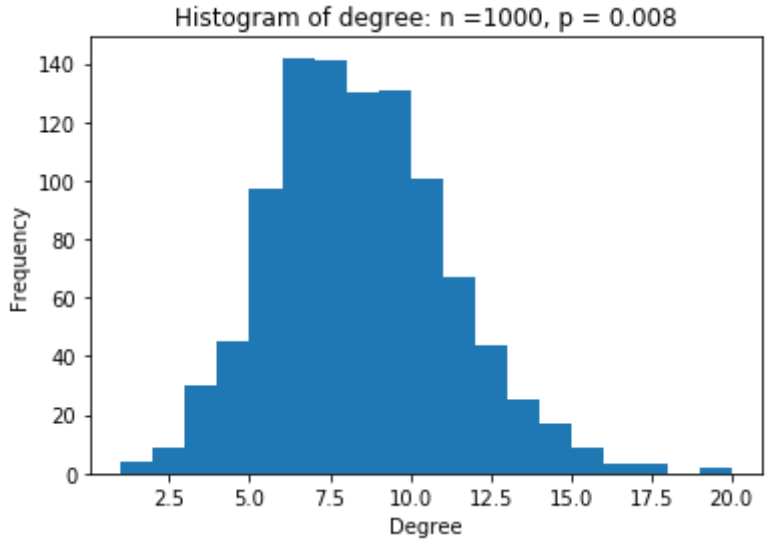

Histogram of degree: n =1000, p = 0.003
Frequency
200
150
100
50
0
0
2
4
6
8
10
Degree

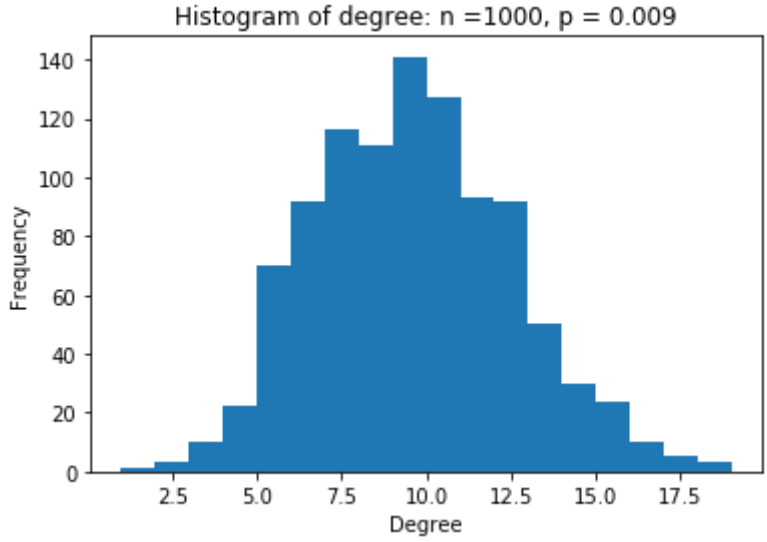

Histogram of degree: n =1000, p = 0.004
Frequency
Degree
0
25
50
75
100
125
150
175
200
0
2
4
6
8
10
12
14

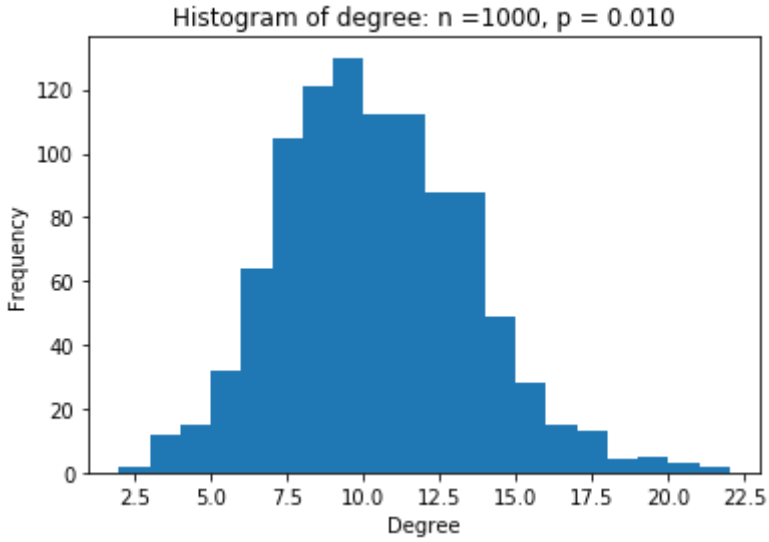

Histogram of degree: n =1000, p = 0.005
Frequency
Degree
0
25
50
75
100
125
150
175
0
2
4
6
8
10
12

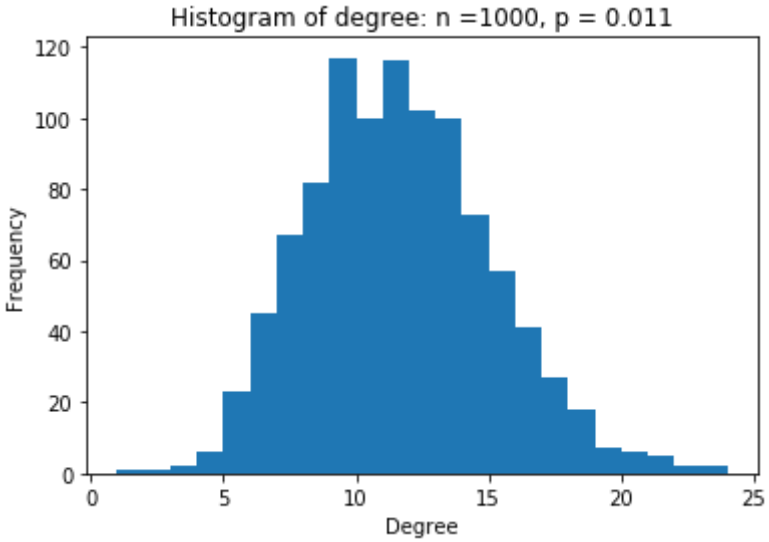

Histogram of degree: n =1000, p = 0.006
Frequency
Degree
0
25
50
75
100
125
150
175
0
2
4
6
8
10
12
14

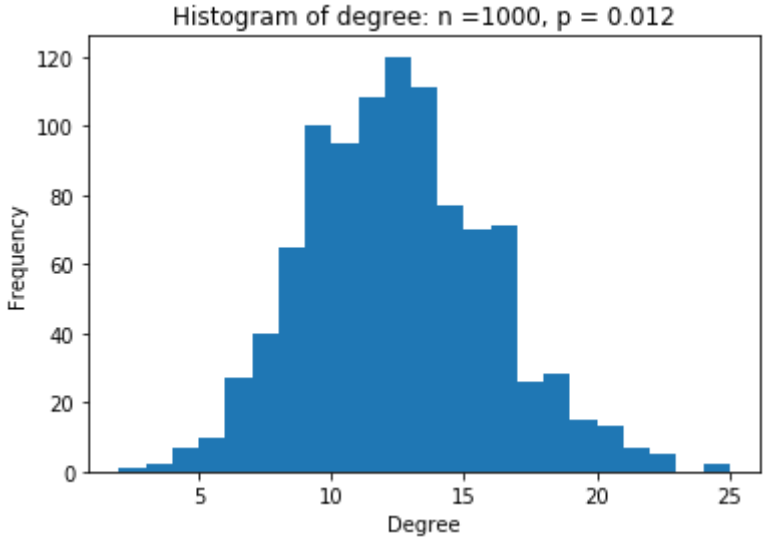

Histogram of degree: n =1000, p = 0.007
Frequency
Degree
0
20
40
60
80
100
120
140
160
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5

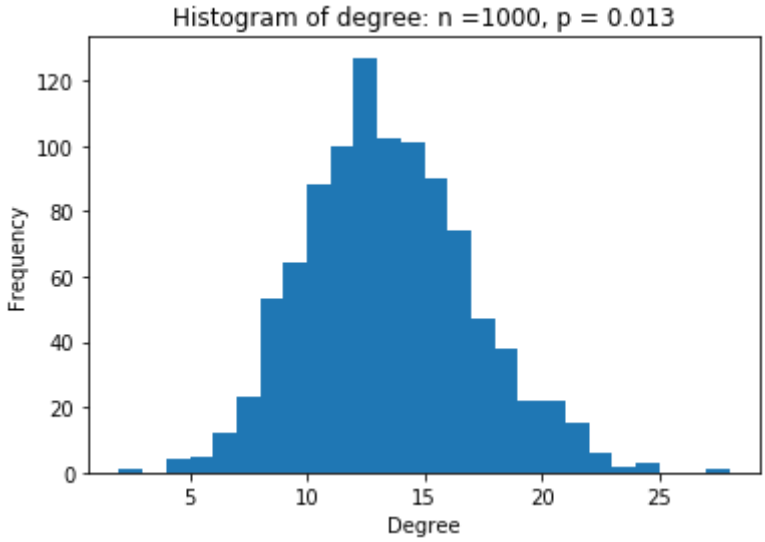

Histogram of degree: n =1000, p = 0.008
Frequency
Degree
0
20
40
60
80
100
120
140
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0

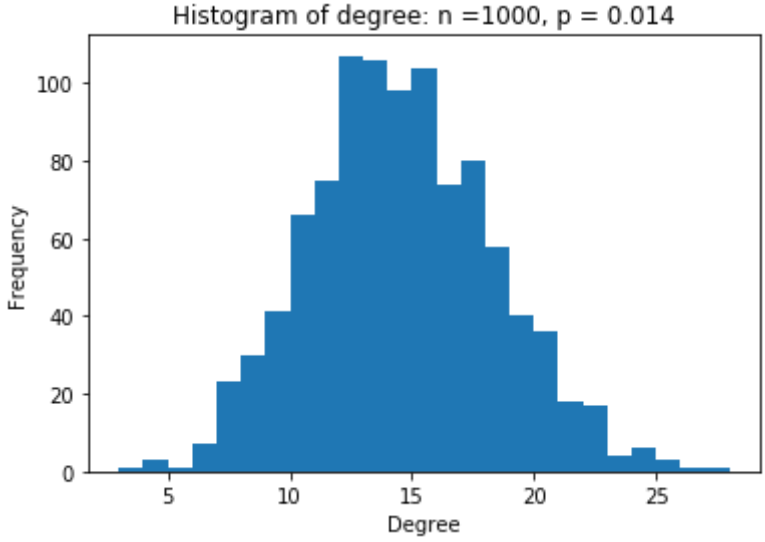

Histogram of degree: n =1000, p = 0.009
Frequency
Degree
0
20
40
60
80
100
120
140
2.5
5.0
7.5
10.0
12.5
15.0
17.5

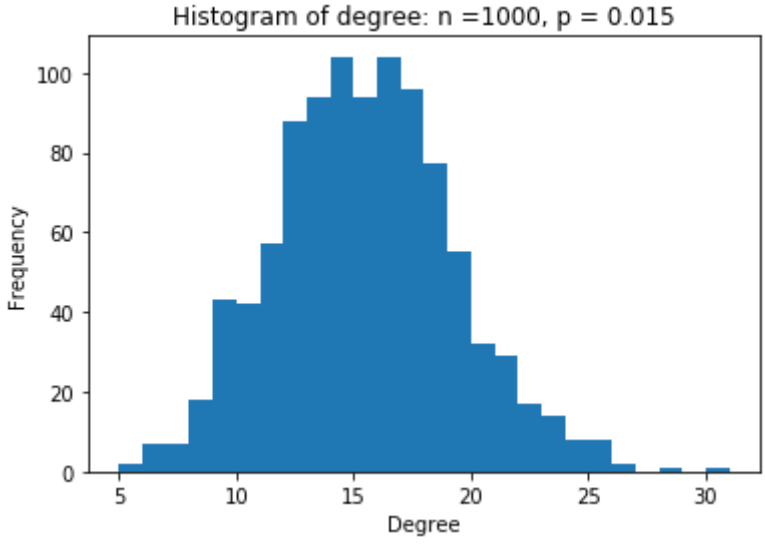

Histogram of degree: n =1000, p = 0.010
Frequency
Degree
0
20
40
60
80
100
120
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5

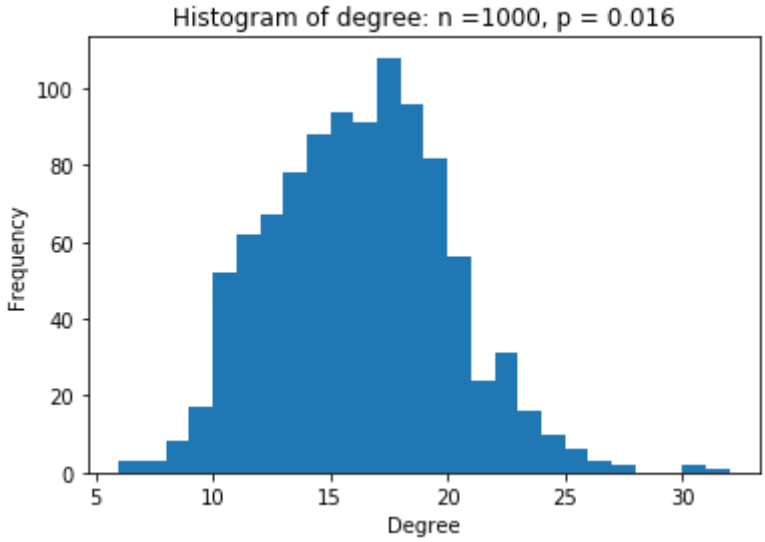

Histogram of degree: n =1000, p = 0.011
Frequency
Degree
0
20
40
60
80
100
120
0
5
10
15
20
25

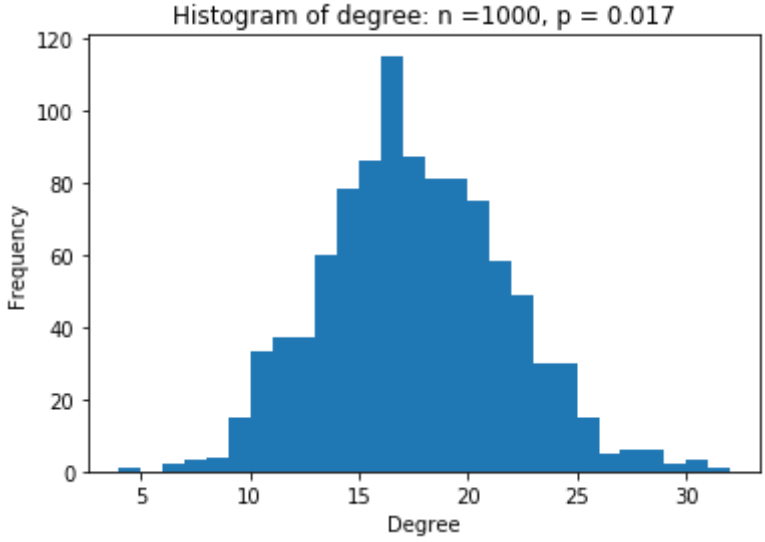

Histogram of degree: n =1000, p = 0.012
Frequency
Degree
0
20
40
60
80
100
120
5
10
15
20
25

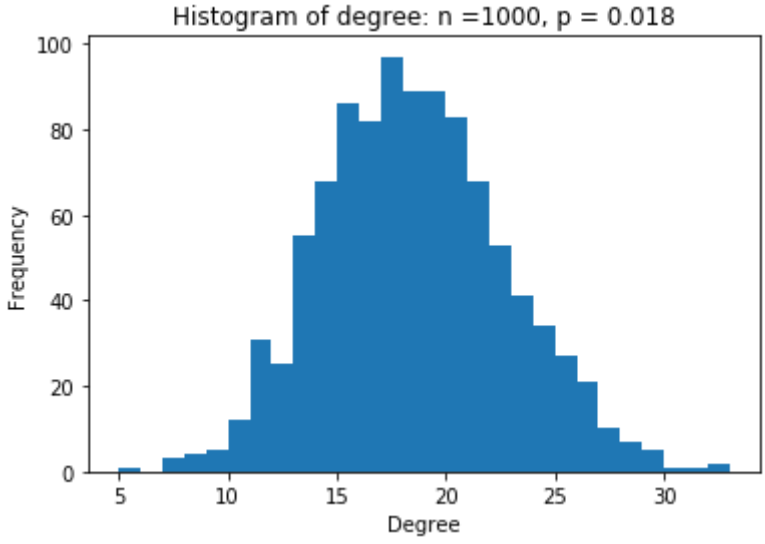

Histogram of degree: n =1000, p = 0.013
Frequency
Degree
0
20
40
60
80
100
120
5
10
15
20
25


Histogram of degree: n =1000, p = 0.014
Frequency
Degree
0
20
40
60
80
100
5
10
15
20
25


Histogram of degree: n =1000, p = 0.015
Frequency
Degree
0
20
40
60
80
100
5
10
15
20
25
30


Histogram of degree: n =1000, p = 0.016
Frequency
Degree
0
20
40
60
80
100
5
10
15
20
25
30


Histogram of degree: n =1000, p = 0.017
Frequency
Degree
0
20
40
60
80
100
120
5
10
15
20
25
30


Histogram of degree: n =1000, p = 0.018
Frequency
Degree
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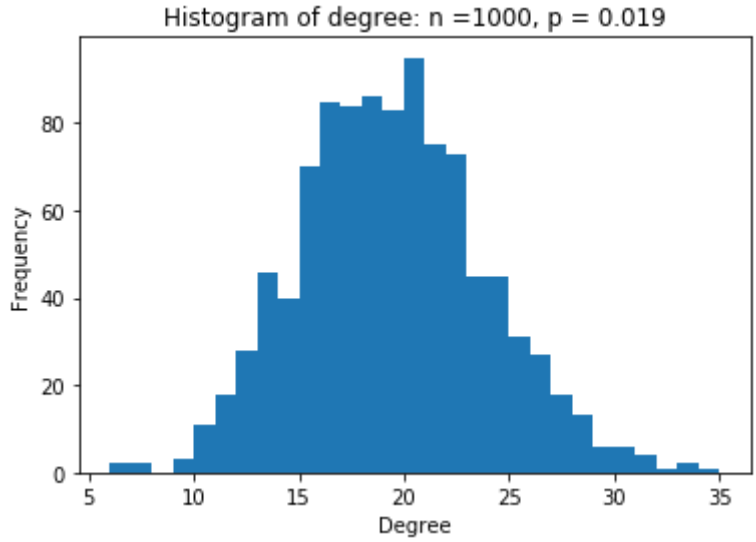
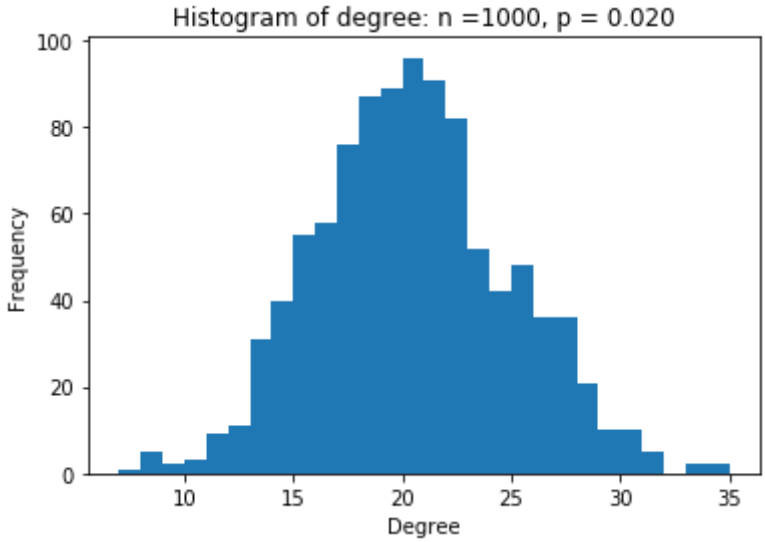
60
80
100
5
10
15
20
25
30





As the p increasing, the distribution of degree further skew to the right.

The distribution follows a approximate normal distribution.