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"""
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"""
import numpy as np
import matplotlib.pyplot as plt

def fB(B):
    n = len(B)
    b=0;
    for i in range(n):
        if(B[i] == 1):
            b = b + np.power(2,i)
    return b

#Z = constant, B = Matrix, alpha = noise
def PZgivenB(Z, B, alpha):
    ret = [(np.power(alpha, np.abs(Z-fB(B[i])))) * (1-alpha)/(1+alpha) for i in range(len(B))];
    return ret

#calculate the estimate for B i_val given sample size and B i's.
def calc(B, PZ_B, i_val):
    rows = len(B)
    sumPZ_B = np.zeros(shape=(rows, 1))
    sumPZ_Bq = np.zeros(shape=(rows, 1))
    sumPZ_B[0] = PZ_B[0];
    sumPZ_Bq[0] = B[0][i_val]*PZ_B[0]

    for i in range (1, rows):
        sumPZ_B[i] = PZ_B[i] + sumPZ_B[i-1]
        sumPZ_Bq[i] = (B[i][i_val]*PZ_B[i]) + sumPZ_Bq[i-1]

    result= np.array([sumPZ_Bq[i]/sumPZ_B[i] for i in range(rows)]).flatten()
    return result

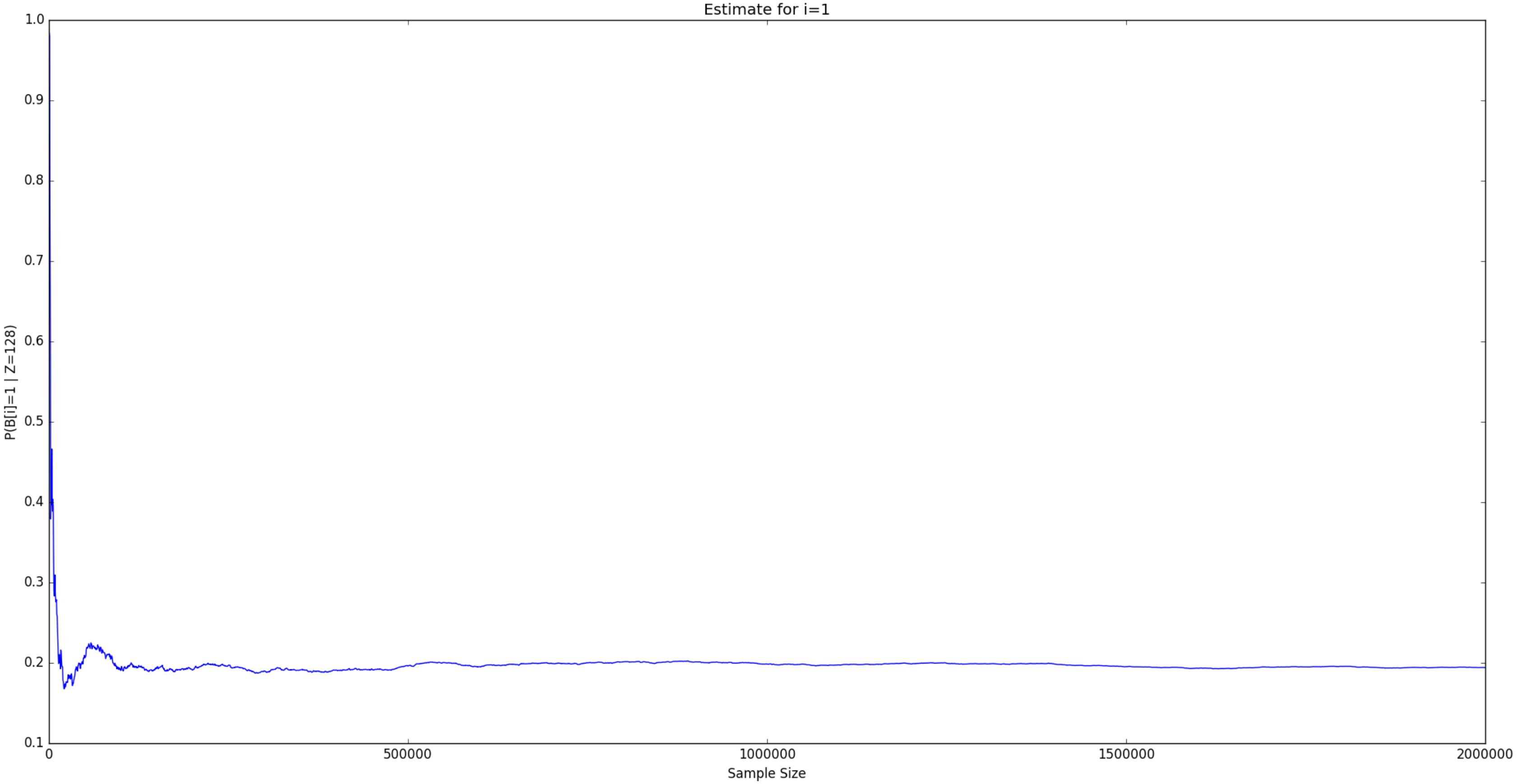
def plotDict(d, Z, title):
    lists = sorted(d.items()) # sorted by key, return a list of tuples
    x, y = zip(*lists) # unpack a list of pairs into two tuples
    plt.plot(x,y)
    plt.ylabel('P(B[i]=1 | Z=' + str(Z) +')')
    plt.xlabel('Sample Size')
    plt.title(title);
    plt.show()

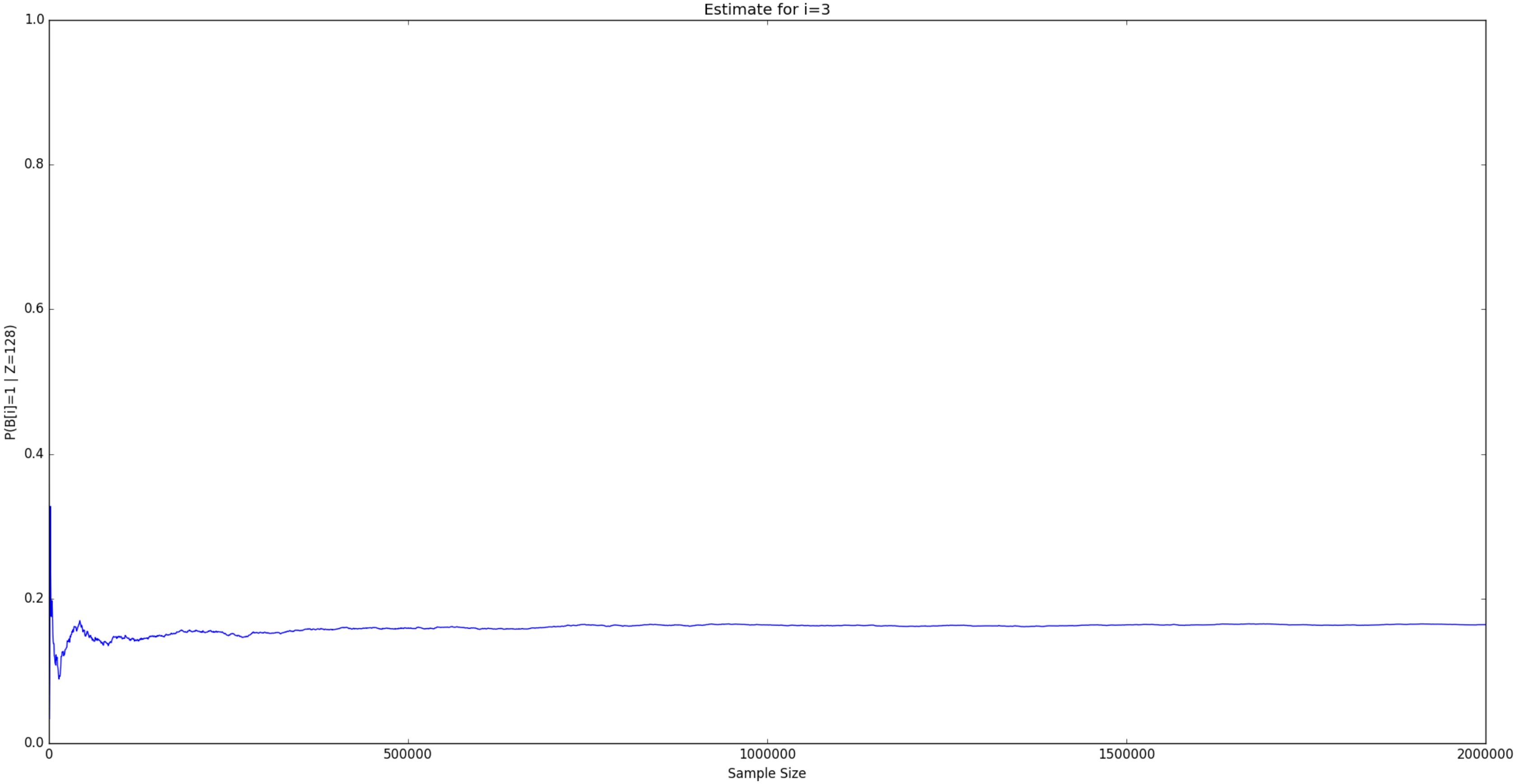
#generate big random observation data and iteratively add them to sample data.
def run(rows, Z_val, i_val, bits_val, alpha, begin_rows, increment, epsilon):
    sample_B = np.random.randint(2, size=(rows, bits_val))
    PZ_B = np.array(PZgivenB(Z_val, sample_B, alpha))
    result = calc(sample_B, PZ_B, i_val)

    curRows = begin_rows
    PB_Z = dict()
    delta=1000

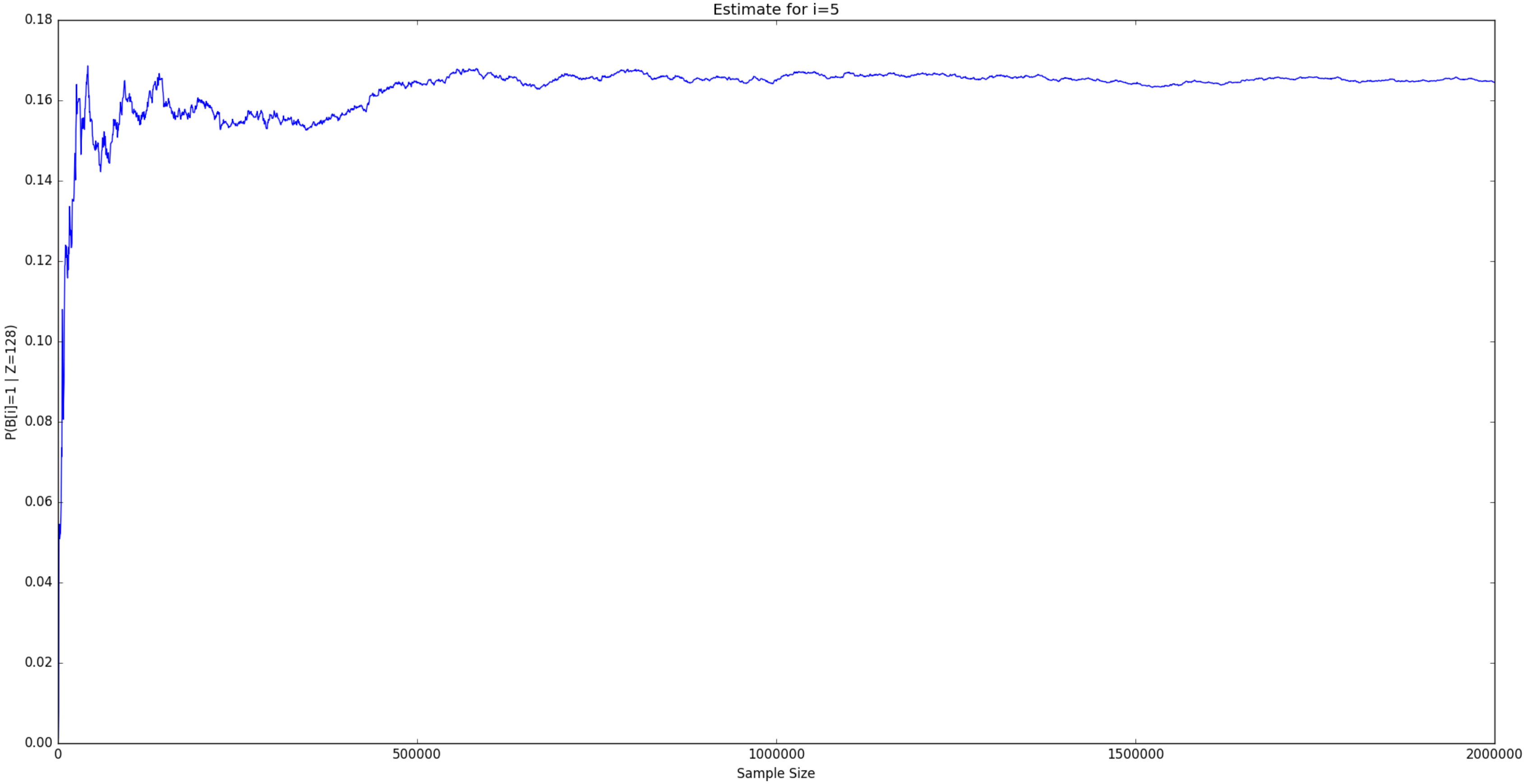
    while (curRows < rows and delta > epsilon):
        PB_Z[curRows] = result[curRows]
        curRows = curRows + increment
    plotDict(PB_Z, Z_val ,title='Estimate for i='+ str(i_val))

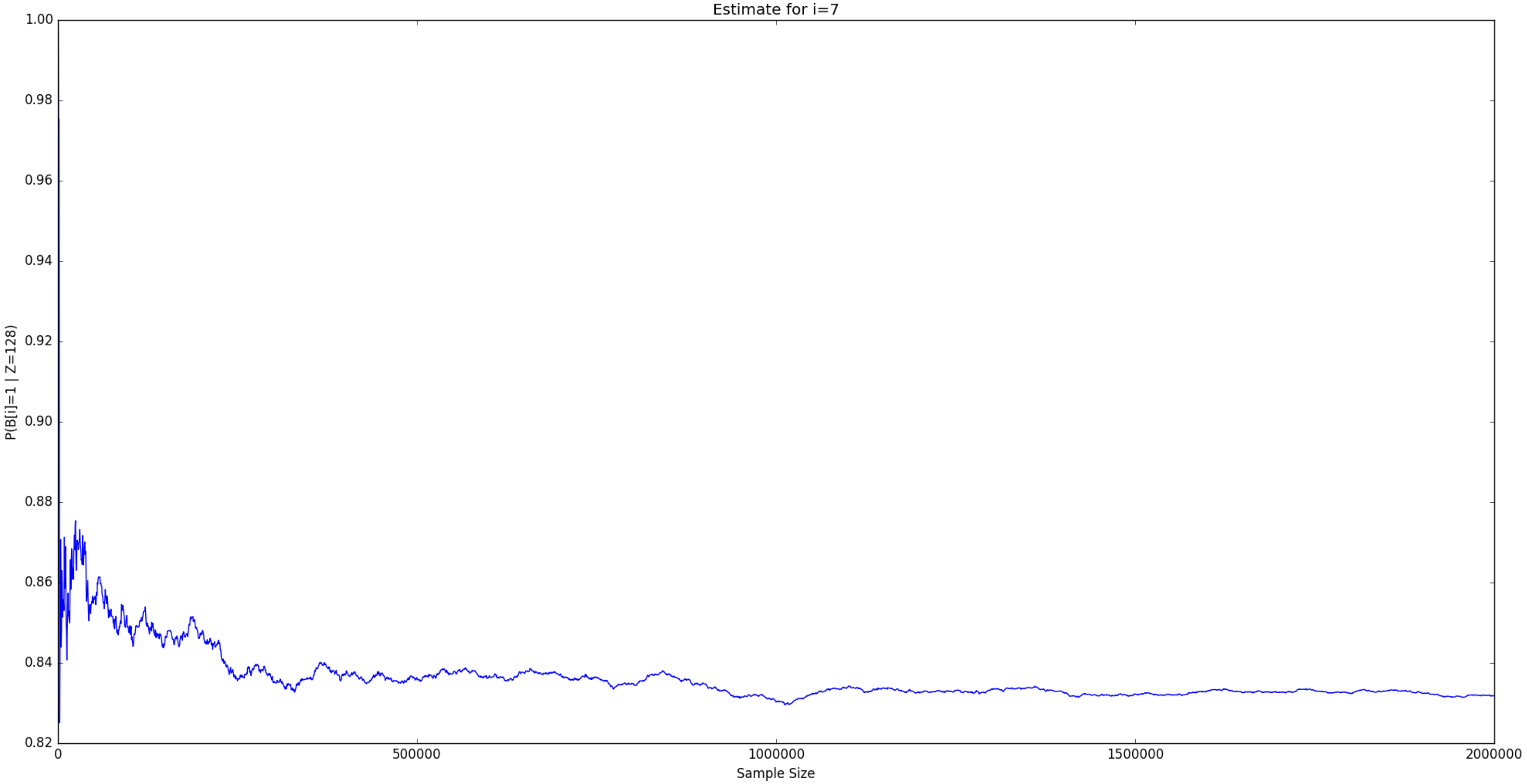
#all indexes are zero reference. So from the Assignment question, if i_val is 2, put 1 here.
run(rows=2000000,Z_val=128, i_val=6,bits_val=10,alpha=0.2, begin_rows=0, increment = 500, epsilon = 0.000)
```

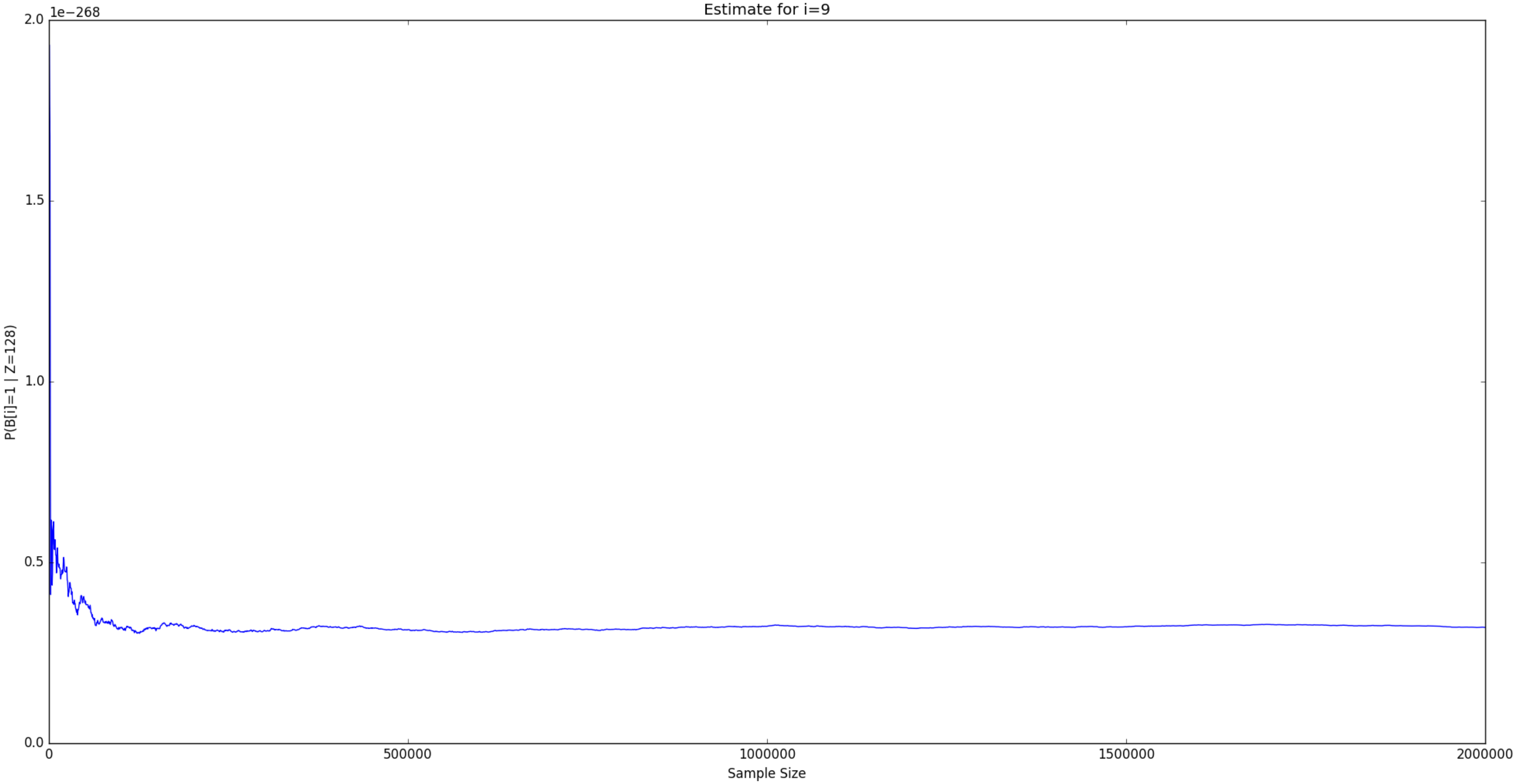

Estimate for i=1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
P(B[i]=1 | Z=128)
0
500000
1000000
1500000
2000000
Sample Size



Estimate for i=3
P(B[i]=1 | Z=128)
1.0
0.8
0.6
0.4
0.2
0.0
0
500000
1000000
1500000
2000000
Sample Size


Estimate for i=5
P(B[i]=1 | Z=128)
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
500000
1000000
1500000
2000000
Sample Size


Estimate for i=7
P(B[i]=1 | Z=128)
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.84
0.82
0
500000
1000000
1500000
2000000
Sample Size


Estimate for i=9
1e−268
2.0
1.5
1.0
0.5
0.0
P(B[i]=1 | Z=128)
0
500000
1000000
1500000
2000000
Sample Size