Math 324 A1(Due 5/2/2018, 11:55 pm) Name: Yuehongxiao Ma

Kafai

1. Generate 1000 samples of size 40000 random numbers from U(-2, 10). For each of these 1000 samples calculate the mean.
2. Find the simulated probability that the mean is between 3.99 and 4.1 inclusive.
3. Find the mean of the means.
4. Find the standard deviation of the means.
5. Draw the histogram of the means.
6. Generate 1000 samples of size 40000 random numbers from the Pareto Distribution (see below). For each of these 1000 samples calculate the mean.
7. Find the simulated probability that the mean is between 30 and 33 exclusive.
8. Find the simulated mean of the means.
9. Find the simulated standard deviation of the means.
10. Draw the histogram of the means.

**Note:**

* + **Use this cover page with your name(s) typed – At most two students**
  + **Use comments in your programs**
  + **Each source and output must be clearly marked with the question number**
  + **Circle the answers**

**How to generate Pareto Distribution variates:**

**Generate y which is a U(0,1) number.**

**Find the Pareto number by x = 1 / (1-y)^0.25**

**Code:**

import java.lang.Math;

import java.text.DecimalFormat;

/\*Sample class for Question 1 \*/

class sample {

double randNummean;//mean of the Question 1 sample

double randNumSize;

public sample() {

}

public sample(double \_randNumSize) {

randNumSize = \_randNumSize;

}

public double getSampleMean() {

/\* Question1:Generate 1 sample 4000 random numbers from U(-2,10)\*/

double sumRandNum = 0.00;

for (int i = 0; i < (int) randNumSize; i++) {

double rand = Math.random();

double randTest = rand \* (10.0 - (-2.0)) + (-2.0);

sumRandNum += randTest;

}

/\*Calculate 1 sample mean\*/

randNummean = sumRandNum / randNumSize;

return randNummean;

}

}

/\*Sample class for Question 2 \*/

class PDSample {

double randNummean;//mean of the Question 2 sample

double randNumSize;

public PDSample() {

}

public PDSample(double \_randNumSize) {

randNumSize = \_randNumSize;

}

public double getSampleMean() {

/\*Question2: Generate 1 sample 4000 random numbers from U(0,1)\*/

double sumRandNum = 0.00;

for (int i = 0; i < (int) randNumSize; i++) {

double y = Math.random();

double x = Math.pow((1 - y), -0.25);

sumRandNum += x;

}

/\*Calculate 1 sample mean\*/

randNummean = sumRandNum / randNumSize;

return randNummean;

}

}

public class Assignment1 {

/\*\*

\* @param args the command line arguments

\*/

public static void main(String[] args) {

/\*limit the digits of decimal numbers\*/

DecimalFormat df = new DecimalFormat("0.0000");

/\*Question 1 variables\*/

double sampleSize = 1000.00;//1000 samples

double randNumSize = 40000.00;//40000 random numbers

double sumOfSampleMean = 0.00;

double simuProbCouter = 0.00;

/\*Generate 1000 samples\*/

sample[] samples = new sample[(int) sampleSize];

for (int i = 0; i < sampleSize; i++) {

samples[i] = new sample(randNumSize);

/\*Question 1: Get the mean of the sample\*/

samples[i].getSampleMean();

sumOfSampleMean += samples[i].randNummean;

/\*Question 1: Check if the mean is between 3.99 and 4.1 inclusive\*/

if ((samples[i].randNummean >= 3.99) && (samples[i].randNummean <= 4.1)) {

simuProbCouter += 1.00;

}

}

/\*Question1.A.Simulated Probability\*/

double simuProb = simuProbCouter / sampleSize;

/\*Question1.B.The mean of the means\*/

double meanOfMean = sumOfSampleMean / sampleSize;

/\*Question1.C.Standard deviation of the means\*/

double sumOfxu2 = 0.00;

for (int i = 0; i < sampleSize; i++) {

double temp = (samples[i].randNummean - meanOfMean);

(sumOfxu2) += temp \* temp;

}

double SD = Math.sqrt((sumOfxu2 / sampleSize));

System.out.println("Question#1");

System.out.println("1.A. the simulated probability that the mean is between 3.99 and 4.1 inclusive: " + simuProb);

System.out.println("1.B. The mean of the means: " + meanOfMean);

System.out.println("1.C. the standard deviation of the means: " + SD);

/\*Question1.D Histogram\*/

double upper = meanOfMean + (4.0 \* SD);

double lower = meanOfMean - (4.0 \* SD);

System.out.println("1.D. Histogram: ");

for (double i = lower; i < upper; i += 0.005) {

System.out.print(df.format(i) + ": ");

for (int j = 0; j < samples.length; j++) {

int counter = 0;

if ((samples[j].randNummean >= i) && (samples[j].randNummean < (i + 0.005))) {

System.out.print("\*");

}

}

System.out.println();

}

System.out.println();

/\*Question 2 variables\*/

double PDsampleSize = 1000.00;//1000 samples

double PDrandNumSize = 40000.00;//40000 random numbers

double PDsumOfSampleMean = 0.00;

double PDsimuProbCouter = 0.00;

PDSample[] PDsamples = new PDSample[(int) PDsampleSize];

/\*Question 2: Generate 1000 samples\*/

for (int i = 0; i < PDsampleSize; i++) {

PDsamples[i] = new PDSample(PDrandNumSize);

/\*Question 2: Get the mean of the sample\*/

PDsamples[i].getSampleMean();

PDsumOfSampleMean += PDsamples[i].randNummean;

/\*Question 2: Check if the mean is between between 30 and 33 exclusive\*/

if ((PDsamples[i].randNummean > 30.00) && (PDsamples[i].randNummean < 33.00)) {

PDsimuProbCouter += 1.00;

}

}

/\*Question 2.A. Simulated Probability\*/

double PDsimuProb = PDsimuProbCouter / PDsampleSize;

/\*Question 2.B.The mean of the means\*/

double PDmeanOfMean = PDsumOfSampleMean / PDsampleSize;

/\*Question 2.C.Standard deviation of the means\*/

double PDsumOfxu2 = 0.00;

for (int i = 0; i < PDsampleSize; i++) {

double temp = (PDsamples[i].randNummean - PDmeanOfMean);

(PDsumOfxu2) += temp \* temp;

}

double PD\_SD = Math.sqrt((PDsumOfxu2 / PDsampleSize));

System.out.println("Question#2");

System.out.println("2.A. the simulated probability that the mean is between 30 and 33 exclusive: " + PDsimuProb);

System.out.println("2.B. the simulated mean of the means: " + PDmeanOfMean);

System.out.println("2.C. the simulated standard deviation of the means: " + PD\_SD);

/\*Question2.D Histogram\*/

double PDupper = PDmeanOfMean+(4\*PD\_SD);

double PDlower = PDmeanOfMean-(4\*PD\_SD);

System.out.println("2.D. Histogram: ");

for (double i = PDlower; i < PDupper; i += 0.0005) {

System.out.print(df.format(i) + ": ");

for (int j = 0; j < PDsamples.length; j++) {

if ((PDsamples[j].randNummean >= i) && (PDsamples[j].randNummean < (i + 0.0005))) {

System.out.print("\*");

}

}

System.out.println();

}

}

}

Output:

Question#1

1.A. the simulated probability that the mean is between 3.99 and 4.1 inclusive: 0.718

1.B. The mean of the means: 4.000660410313553

1.C. the standard deviation of the means: 0.016891021204809356

1.D. Histogram:

3.9331:

3.9381: \*

3.9431:

3.9481: \*\*

3.9531: \*\*\*

3.9581: \*\*\*\*\*\*\*

3.9631: \*\*\*\*\*\*\*\*\*\*

3.9681: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

3.9731: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

3.9781: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

3.9831: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

3.9881: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

3.9931: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

3.9981: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

4.0031: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

4.0081: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

4.0131: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

4.0181: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

4.0231: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

4.0281: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

4.0331: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

4.0381: \*\*\*\*\*

4.0431: \*

4.0481: \*

4.0531:

4.0581: \*\*

4.0631:

4.0681:

Question#2

2.A. the simulated probability that the mean is between 30 and 33 exclusive: 0.0

2.B. the simulated mean of the means: 1.3334251728570758

2.C. the simulated standard deviation of the means: 0.002375519674288151

2.D. Histogram:

1.3239:

1.3244:

1.3249:

1.3254:

1.3259:

1.3264: \*

1.3269: \*\*\*

1.3274: \*\*\*\*\*

1.3279: \*\*\*\*\*\*\*

1.3284: \*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3289: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3294: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3299: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3304: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3309: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3314: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3319: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3324: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3329: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3334: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3339: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3344: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3349: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3354: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3359: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3364: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3369: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3374: \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

1.3379: \*\*\*\*\*\*\*\*\*\*\*\*

1.3384: \*\*\*

1.3389: \*\*\*\*\*\*

1.3394: \*

1.3399: \*\*\*\*

1.3404: \*\*

1.3409:

1.3414: \*

1.3419:

1.3424:

1.3429: