Program 2: Acceptance-Rejection

Eric Wolfe
Dr. Mayer
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Source Code

Main.java

```java
/**
 * Created by Eric Wolfe on 10/7/17.
 */
public class Main {

    public static void main(String[] args){
        System.out.println("Starting experiments: ");
        System.out.println("Experiments 1");
        new Pi(100);
        System.out.println("Experiments 2");
        new Pi(1000);
        System.out.println("Experiments 3");
        new Pi(10000);
        System.out.println("Experiments 4 (Bonus)");
        new Pi(100000);
        System.out.println("Experiments 5 (Bonus)");
        new Pi(1000000);
        System.out.println("Finished tests");
    }
}
```

Pi.java

```java
/**
 * Created by Eric Wolfe on 10/7/17.
 */

import java.util.Random;

public class Pi {

    public Pi(int numberofPoints){
        run(numberofPoints);
```

```
    }

    private void run(int numberOfPoints){
        Random random = new Random();
        double result, numberOfSuccesses = 0.0;
        for(int i = 0; i < numberOfPoints; i++){
            double x = random.nextDouble();
            double y = random.nextDouble();
            result = calculateCircle(x, y);
            if (result <= 1.0){
                numberOfSuccesses++;
            }
        }
        printResults(numberOfSuccesses, numberOfPoints);
    }

    private void printResults(double result, int numberOfPoints){
        System.out.printf("The number of accepted points: %.0f\n", result);
        System.out.printf("Approximate value of pi: %.5f\n", 4*(result/
(double)numberOfPoints));
    }

    private double calculateCircle(double x, double y){
        x = x * x;
        y = y * y;
        return (x + y);
    }
}
```

Results

1st Run

```
Starting experiments:
Experiments 1
The number of accepted points: 83
Approximate value of pi: 3.32000
Experiments 2
The number of accepted points: 795
Approximate value of pi: 3.18000
Experiments 3
The number of accepted points: 7805
Approximate value of pi: 3.12200
Experiments 4 (Bonus)
The number of accepted points: 78453
Approximate value of pi: 3.13812
Experiments 5 (Bonus)
The number of accepted points: 785332
Approximate value of pi: 3.14133
Finished tests
```

2nd Run

```
Starting experiments:
Experiments 1
The number of accepted points: 78
Approximate value of pi: 3.12000
Experiments 2
The number of accepted points: 781
Approximate value of pi: 3.12400
Experiments 3
The number of accepted points: 7877
Approximate value of pi: 3.15080
Experiments 4 (Bonus)
The number of accepted points: 78560
Approximate value of pi: 3.14240
Experiments 5 (Bonus)
The number of accepted points: 785810
Approximate value of pi: 3.14324
Finished tests
```

3rd Run

```
Starting experiments:
Experiments 1
The number of accepted points: 78
Approximate value of pi: 3.12000
Experiments 2
The number of accepted points: 795
Approximate value of pi: 3.18000
Experiments 3
The number of accepted points: 7841
Approximate value of pi: 3.13640
Experiments 4 (Bonus)
The number of accepted points: 78567
Approximate value of pi: 3.14268
Experiments 5 (Bonus)
The number of accepted points: 785381
Approximate value of pi: 3.14152
Finished tests
```

Discussion

After running my program multiple times, I found that my approximate values for 10,000 point runs 2 and 3 were the closest to the correct pi value while the 1st run was a little bit more off. Next, I looked at the approximate values and how close they were for different number of points. At first glance, 10,000 points were a lot closer to π than 100 points. I decided to increase the number of points to 1,000,000 and found that the approximation was closer than just 10,000 points. The reason for this is because when you increase the sample amount, an additional decimal place is correct when compared to π's actual value. This is clearly seen when 1,000 test points are tested because each one of the approximate values have a 1 in the tenths place. After 1,000,000 points are

tested, the 4 is correct in the hundredths for each run.