

## Examples of Programs Using Random Numbers

Portions of this handout by Eric Roberts

```
/*
 * File: RollDice.java
 * -----
 * This program simulates rolling some number of dice until
 * the maximal value on the all the dice is rolled.
 */

import acm.program.*;
import acm.util.*;

public class RollDice extends ConsoleProgram {

    /* Number of sides on each die */
    private static final int NUM_SIDES = 6;

    public void run() {
        int numDice = readInt("Number of dice: ");
        int maxRoll = numDice * NUM_SIDES;
        int numRolls = 0;
        while (true) {
            int roll = rollDice(numDice);
            numRolls++;
            if (roll == maxRoll) break;
            println("Rolled " + roll);
        }
        println("Rolled " + maxRoll + " after " + numRolls + " rolls");
    }

    /* Returns the total of rolling numDice dice */
    private int rollDice(int numDice) {
        int total = 0;
        for (int i = 0; i < numDice; i++) {
            total += rgen.nextInt(1, NUM_SIDES);
        }
        return total;
    }

    /* Private instance variables */
    private RandomGenerator rgen = RandomGenerator.getInstance();
}

```

```
/*
 * File: ColorChangingSquare.java
 * -----
 * This program puts up a square in the center of the window
 * and randomly changes its color every second.
 */

import acm.graphics.*;
import acm.program.*;
import acm.util.*;

public class ColorChangingSquare extends GraphicsProgram {

    /* Size of the square in pixels */
    private static final int SQUARE_SIZE = 100;

    /* Pause time in milliseconds */
    private static final int PAUSE_TIME = 1000;

    public void run() {
        GRect square = new GRect(SQUARE_SIZE, SQUARE_SIZE);
        square.setFilled(true);
        add(square, (getWidth() - SQUARE_SIZE) / 2,
                (getHeight() - SQUARE_SIZE) / 2);

        /* Note: we meant to have this infinite loop */
        while (true) {
            square.setColor(rgen.nextColor());
            pause(PAUSE_TIME);
        }
    }

    /* Private instance variables */
    private RandomGenerator rgen = RandomGenerator.getInstance();
}

```

```
/*
 * File: PiApproximation.java
 * -----
 * This program computes an approximation to pi by simulating
 * a dart board, as described in Chapter 6, Programming Exercise 3
 * of "The Art and Science of Java". The general technique
 * is called Monte Carlo integration.
 */

import acm.program.*;
import acm.util.*;

public class PiApproximation extends ConsoleProgram {

    /* Number of darts to throw. */
    private static final int NDARTS = 10000;

    public void run() {
        int inside = 0;
        for (int i = 0; i < NDARTS; i++) {
            double x = rgen.nextDouble(-1.0, +1.0);
            double y = rgen.nextDouble(-1.0, +1.0);

            /* Consider circle of radius = 1, centered at (0, 0) */
            if (((x * x) + (y * y)) < 1.0) {
                inside++;
            }
        }

        /*
         * Note: area of circle =  $\text{PI} * r * r = \text{PI} * 1 * 1 = \text{PI}$ 
         * area of square = side * side =  $2 * 2 = 4$ 
         * So,  $\text{PI}/4$  is the fraction of darts landing in circle:
         * darts in circle =  $\text{NDARTS} * \text{PI}/4$ 
         *  $\text{PI} = (4 * \text{darts in circle})/\text{NDARTS}$ 
         */
        double pi = (4.0 * inside) / NDARTS;
        println("Pi is approximately " + pi);
    }

    /* Private instance variables */
    private RandomGenerator rgen = RandomGenerator.getInstance();
}

```