

Generating Random Numbers

Linear Congruential Method

Games, simulators, screen savers, and many other types of applications make use of random numbers. A widely used method for generating random numbers is called the *Linear Congruential Method*. This method uses a formula to generate a sequence of numbers. Although the numbers in the sequence vary and for most applications can be considered random, the sequence will at some point repeat. Therefore, random numbers in a computer application are referred to as *pseudorandom* (like random).

pseudorandom

Math class

Java includes the `Math` class in the `java.lang` package for generating random numbers. This class includes the `random()` method, which uses the Linear Congruential Method:

Class `Math` (`java.lang.Math`)

Methods

`random()` returns the next random double between 0 (inclusive) and 1.0.

The `RandomNumberDemo` class below uses the `random()` method to display five numbers between 0 and 1.0:

```
import java.lang.Math;

public class RandomNumberDemo {

    public static void main(String[] args) {
        System.out.println("First number: " + Math.random());
        System.out.println("Second number: " + Math.random());
        System.out.println("Third number: " + Math.random());
        System.out.println("Fourth number: " + Math.random());
        System.out.println("Fifth number: " + Math.random());
    }
}
```

`RandomNumberDemo` produces output similar to the following:

```
First number: 0.9331210845045746
Second number: 0.044809094051135645
Third number: 0.7513628840022181
Fourth number: 0.8422982570759002
Fifth number: 0.4831409546072769
```

random numbers in a range

To generate a random number in a range the following formula is used:

$$(\text{highNum} - \text{lowNum} + 1) * \text{Math.random()} + \text{lowNum}$$

For example, the `RandomNumberDemo2` class generates five numbers between 5 and 10:

```

import java.lang.Math;

public class RandomNumberDemo2 {

    public static void main(String[] args) {
        System.out.println("First number: " +
            (6 * Math.random() + 5));
        System.out.println("Second number: " +
            (6 * Math.random() + 5));
        System.out.println("Third number: " +
            (6 * Math.random() + 5));
        System.out.println("Fourth number: " +
            (6 * Math.random() + 5));
        System.out.println("Fifth number: " +
            (6 * Math.random() + 5));
    }
}

```

RandomNumberDemo2 produces output similar to the following:

```

First number: 5.868880551519611
Second number: 7.162322990090601
Third number: 8.245540484524573
Fourth number: 7.173467294487763
Fifth number: 10.737238643872553

```

random integers

Numbers generated by `random()` have a decimal portion. Casting can be used to produce random integers (whole numbers). Casting a `double` to an `int` truncates the decimal portion of the number. For example, the `RandomIntDemo` class generates an integer between 5 and 10:

TIP Use rounding along with casting to produce an integer that is either 0 or 1 in an expression similar to:
`(int)(Math.random()+0.5)`

```

import java.lang.Math;

public class RandomIntDemo {

    public static void main(String[] args) {
        System.out.println("Number: " +
            (int)(6 * Math.random() + 5));
    }
}

```

RandomIntDemo produces output similar to the following:

```

Number: 7

```