

# Introduction to Scientific Computing

## Lecture 10

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### 1 Random numbers

In daily life, random numbers appear all the time. For example when you roll a dice. For a computer, random numbers are difficult to generate because computers are inherently predictable (which is in general a good thing). Thus, coming up with a good random number generator can be tricky. In fact we will call it a *pseudo* random number generator because the numbers are not truly random.

All generators start from a seed value. If you start the generator from the same seed value multiple times, you always get the same answer (because computers are predictable).

Let us first define what we mean by a good random number generator:

- We want long periods for all initial seeds
- Uniformity of distribution for large numbers of generated numbers
- Uncorrelated successive values

Python comes with many random number generators. For example in the `random` package which we can use to generate a random number between 0 and 1:

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```
import random
random.seed(1)
random.random()
```

---

Every time you execute these commands, you will get the same. Note that when you remove the seed line, then python tries to pick a smart seed by itself. This might depend on the time, the current number jobs running on your computer, etc. This gives the illusion that the first number you get is truly random, however, it's not!

Why would we ever care about the details of whether a random number is truly random or predictable. There are many reasons:

- Suppose you are playing a computer game against the computer. You don't want to be able to predict the computer's next move.
- Random numbers are crucial when it comes to cryptography. All your banking information, snapchat messages, etc rely on random numbers!
- Many numerical algorithms require random numbers. We will talk about some of those. For such an algorithm to work well, we need to have *good* random numbers.

We will not discuss algorithms for random number generators in this course. But you should be aware of the issues that they might have (reproducible results, correlations, etc).