

## The <random> library

C++ code has a modern library <random> that improves over the old C and C++ use of rand() found in <cstdlib>.

In the program that we saw in week 1 for calculating the probabilities when rolling two dice:

```
//The following program computes
//the probability for dice possibilities
#include <iostream>    //drops .h still available
#include <cstdlib>
#include <ctime>
using namespace std;
const int sides = 6; //replaces many sharp defines
inline int r_sides(){ return (rand() % sides + 1); }
int main(void)
{
    const int    n_dice = 2;
    srand(clock()); //why?
    cout << "\nEnter number of trials: ";
    int trials;
    cin >> trials; //compare to scanf
    int* outcomes = new int[n_dice * sides + 1];

    for (int j = 0; j < trials; ++j) {
        int roll = 0;
        for (int k = 1; k <= n_dice; ++k) {
            roll += r_sides();
        }
        outcomes[roll]++;
    }

    cout << "probability\n";
    for (int j = 2; j < n_dice * sides + 1; ++j)
        cout << "j = " << j << " p = "
            << static_cast<double>(outcomes[j])/trials
            << endl;
}
```

This is replaced by

```
//The following program computes
//the probability for dice possibilities
#include <iostream>
#include <random>
#include <ctime>
using namespace std;
const int sides = 6;
int main(void)
{
    const int    n_dice = 2;
    uniform_int_distribution<unsigned> u(1,6);
    default_random_engine e(time(0));

    cout << "\nEnter number of trials: ";
    int trials;
    cin >> trials; //compare to scanf
    int* outcomes = new int[n_dice * sides +1];

    for (int j = 0; j < trials; ++j) {
        int roll = 0;
        for (int k = 1; k <= n_dice; ++k) {
            roll += u(e);
        }
        outcomes[roll]++;
    }

    cout << "probability\n";
    for (int j = 2; j < n_dice * sides + 1; ++j)
        cout << "j = " << j << " p = "
            << static_cast<double>(outcomes[j])/trials
            << endl;
}
```

The library `<random>` has modern random number generator including a default random engine declaration as seen in this example. Popular engines included are

## Pseudo-random number engines (instantiations)

Particular instantiations of generator engines and adaptors:

### **default\_random\_engine**

Default random engine ([class](#) )

### **mt19937**

Mersenne Twister 19937 generator ([class](#) )

### **ranlux48**

Ranlux 48 generator ([class](#) )

### **knuth\_b**

Knuth-B generator ([class](#) )

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