# Balls'n Bins

The *Balls'n Bins*-problem deals with the experiment of randomly distributing a number of balls into an equal number of bins and trying to figure out how many balls there should be room for in each bin in order to avoid overflow with very high probability.

Implement and test the *Balls & Bins* problem and answer the following questions.

1. The essential problem here is to determine the how many balls a bin must be able to contain in order to, with a very high probability, prevent overflow. What would be a good estimate for the maximum number of balls in a bin if 10,007 balls are randomly distributed in 10,007 bins? You may wish to calculate an average and a maximum value over several experiments.
2. Repeat the experiment for 32,749 balls and bins and compare the results of the two experiments.
3. Solve also the above problems using *the power of two choices* principle, that is: pick two bins randomly and place the ball in the bin with the fewest balls.
4. Weiss suggests that with the 'ordinary' B&B experiment the maximum number of balls in a single bin is expected to be $\Theta(\log N / \log \log N)$ and $\Theta(\log \log N)$ for power of two choices. Can your experiments confirm this?
5. Theorem 5.2 suggests that if N balls are placed into $M = N^2$ bins, the probability that no bin has more that one ball is less than 0.5. Make experiments that confirm or reject this theorem.

Be aware that generating random numbers can be a bit tricky in C++ 😊