# Assignment 1 - Dragos Pop

The first step in resolving the distribution of the match lengths was to implement Linear congruential generator in the provided template. This was done using the formula $z_{i+1}=(a·z_i+c) \% m$, returning the result or the normalized result depending on the range of the random variable needed (from 0 to m, and from 0 to 1 respective).

For an LCG to be efficient, its period should large and this is directly influenced by m, as the period can never be larger than m. It is also advised that m and c have no common factor, except 1, and each prime number that is a factor of m is also a factor of (a-1). Combining the previous mentioned, resulted that m should be a large multiple of 2, a to be a multiple of 4 + 1, and c to be odd. Consequently, I picked m equals 2^46, a equals 25214903917 and c 13, a popular option for the LCG parameters (according to https://en.wikipedia.org/wiki/Linear_congruential_generator) which complies with the above as well . For the value of the seed, I chose a random number (1346) because it does not affect the generator in a destructive way.

Secondly, it follows determining the empirical distribution of the game lengths. This included parsing the given file into an array and calling the function *EmpiricalDist* with the sorted array as the parameter. Then, the chart was sketched using *EmpiricalChart.*

Empirical CDF of the game lengths

The next step addressed simulating a match. According to the assignment description, a match is composed from 5 to 9 games and ends when one of the two players wins 5 games. To establish the result of one game, a random number from 0 to 1 was generated and its value compared with the 50% winning probability in order to predict the winner. Subsequently, another random number was generated and plugged in the inverse of the found empirical distribution to simulate the size of that game. This algorithm is repeated as long as one of the players wins 5 games, adding each game duration to the total match interval.
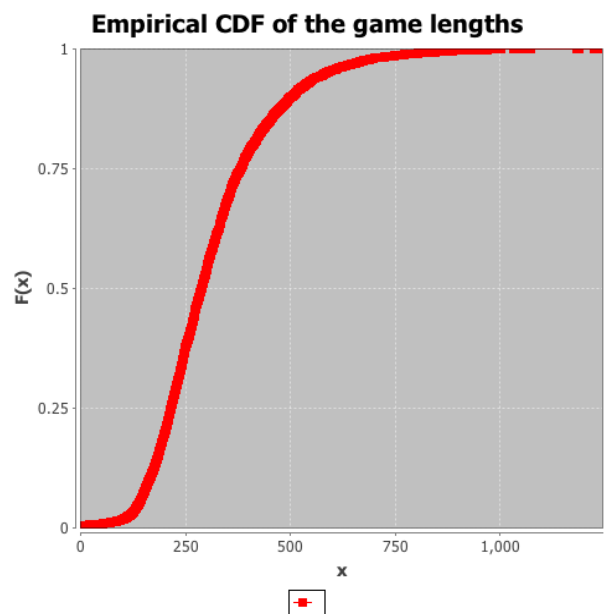
Lastly, 5000 of matches were simulated and their length added to the *Tally*, with the purpose of determining the distribution of the match durations. The observations showed that on average, a match lasts approximate 2 371.