Lab # 4 – A more realistic population growth

Population growth – Object-oriented programming and C++

In this lab you will propose a discrete event simulation of the growth of a rabbit population in the absence of predators. This supposes that we take into account the birth and death of rabbits. A female can give birth approximatively every month. Female give 4 to 8 liters per year, but there is more chance to have 5,6 or 7 litters. For each litter you have 3 to 6 baby rabbits. A random drawing can determine if such baby rabbits are males or females; the natural probability being approximatively around 50%. Unfortunately, in some countries this probability has been changed for humans since girls have been killed (before or after birth) when the society preferred males (for instance more than 100 million women missing in a big country which is a drama). Sexual maturity is reached between 5 to 8 months after the birth of baby rabbits. We can also simulate the probability of death according to the rabbit age, this can be given by proposing simple rules about survival. For adults (rabbits at sexual maturity), the survival rate is 50%, for little rabbits it is only 20%. When a rabbit reaches 11 years old, its survival rate is diminished by 10% every year, reaching 0% at 15 years old (meaning death at 15 years old). This model is more realistic than a Fibonnaci growth, it can be simulated with the input parameters and probability laws that you will decide (such choices are part of your modeling activity). You can find more realistic values using the Internet or Wikipaedia depending on the rabbit species.

Make your implementation choices (use C++ classes, but remain simple in your design). Use and adapt random variates that you have learned in previous labs (propose histograms that could match the observed or given data. Complete missing data with choices as realistic as possible. Select an appropriate time step and propose a set of results that will enable the study of the population growth.

You can decide to simulate for a few years and observe the number of rabbits you have, the growth will be fast for we do not have predators. This simulation can require non negligible computing time. Remember that what you obtain after a simulation just the result of a single stochastic experiment. The stochastic variability can be high. You should run at least 10 replications (experiments) with independent random streams) and then propose a confidence interval at 95% (similarly to what you did for the stochastic computing of PI). Prepare a complete written report which will be assessed.