# Tutorial 0 : Modelisation

Operations research, 3rd semester.

2024

*This tutorial gives you some practical applications of operations research and, this way, is an introduction to what operations research is. For each of the following exercises, the subject is a problem written in natural language. You have to rewrite it in a mathematical way using all the tools you know such that a computer can solve the problem. Some of the problems lack information. In that case, you have to think of what is missing, to make assumptions and, sometimes, simplify the real to focus on the problem you are asked to solve. Note that you do not have to solve the problem : you do have to give the inputs and the outputs of the problem, not how the latter are computed from the former. Note also that there could be multiple possible answers but some of them may be more easily defended. You can use any tool you know : graph, system of equations and/or inequations, set, list, boolean formulas, ...*

## 1 Easy modelisations

*Each of the following exercises are easy : no information is missing and the adequate tool is almost obvious.*

**Exercise 1 — *Risk evaluation***

How many links may fail until two users of a telecommunication network, whoever they are, cannot communicate anymore ?

**Exercise 2 — *Let's play***

Solve a sudoku.

**Exercise 3 — *Let's be fair-play***

Could you give me the five best olympics countries ?

**Exercise 4 — *Bier and crackers***

How many channels should I watch or record in order to see every sporting event I would like to see ?

## 2 Intermediate modelisations

*The following problems are harder. Try not to forget any important element before modelising.*

**Exercise 5 — *Which way ?***

Where and how do we have to put road signs in order to direct people to the main cities ?

**Exercise 6 — *Are we late ?***

How to decide if a set of tasks of a project may be finished on time and satisfying resource constraints.

**Exercise 7 — *News***

Where to put law enforcement agents in order to ensure the safety of a crowd ?

**Exercise 8 — *TMNT !***

How to maximize the number of parts of a pizza by cutting it $n$ times ?

**Exercise 9 — *Genetic sequencing***

How to rebuild a complete DNA from a set of fragments ?

# 3 Hard modelisations

*Each of the following problems gives you too few information. A proper way to modelise them would be to ask questions to experts (those who could almost solve the problem by hand). However, currently, your teacher is the only person you can rely on.*

**Exercise 10 — *Chemistry problem***

What is the 3D form of a molecule ?

**Exercise 11 — *Public transport***

In a city where you have an idea of the visitor numbers thoughout the year, could you adapt the public transport ?

**Exercise 12 — *In outer space !***

Will the rocket explode tomorrow ?