Exercise 1

21.9.2021

#1 Decision trees

Arne Ivarsen works for a Norwegian oil drilling company and is faced a decision problem about a new prospective drilling site. He has three possibilities: (1) decide not to drill, (2) test the *structure* of the deposit first and then decide to drill or not to drill, and (3) to drill without testing.

Drilling costs 70000 NKr. The deposits of the prospective drilling sites are classified into three classes *rich, intermediate* and *dry*, based on the amount of oil in them. Ivarsen has estimated and computed that a rich deposit produces an amount of oil which is worth 270000 NKr, an intermediate deposit worth 120000 NKr and dry nothing (costs have not been accounted for).

To support his decision making, Ivarsen has collected information about previous 100 drilling sites. The table below includes the number of rich, intermediate and dry deposits per each structure (NS = *no structure* / OS = *open-type structure* / CS = *closed-type structure*).

	dry	intermediate	rich	Sum
NS	35	9	2	46
OS	12	16	6	34
CS	3	5	12	20
Sum	50	30	20	100

The test is not inerrable. The test reveals that the site has (1) *no structure* correctly with a probability of 80% (that is, if the site has no structure, the test confirms this with a probability of 80%), (2) an open-type structure correctly with a probability of 85% and (3) a closed-type structure correctly with a probability of 90%. If the test gives a wrong answer, both wrong answers have the same probability.

Ivarsen maximizes expected monetary value. Your task is to form a decision tree of the problem. Use the Excel sheet from the webpage of the course.

a) Compute the needed probabilities.
b) What is the expected value of sample information?
c) What is the maximum amount of money that Ivarsen should pay for the test?
d) Assume that the test costs 10000 Kr.
   a. How big a change in the drilling costs would change the decision recommendation?
   b. Examine also the effects caused by changes in the test's reliability.