

TD – Monday, October 23, 2023

Choices under uncertainty

The following exercises should be submitted on Monday, October 23.

**Exercise.** A safety agency is thinking of establishing a criterion under which an area prone to flooding should be evacuated. The probability of flooding is 1%. There are four possible outcomes:

- (A) No evacuation is necessary, and none is performed.
- (B) An evacuation is performed that is unnecessary.
- (C) An evacuation is performed that is necessary.
- (D) No evacuation is performed, and a flood causes a disaster.

Suppose that the agency is indifferent between the sure outcome B and the lottery of A with probability  $p$  and D with probability  $1 - p$ , and between the sure outcome C and the lottery of A with probability  $q$  and D with probability  $1 - q$ . Suppose also that it strictly prefers A to D and that  $p \in ]0, 1[$  and  $q \in ]0, 1[$ .

Assume that the conditions of the expected utility theorem are satisfied.

1. Construct a utility function of the expected utility form for the agency.
2. Consider two different policy criteria:

*Criterion 1:* This criterion will result in an evacuation in 90% of the cases in which flooding will occur and an unnecessary evacuation in 10% of the cases in which no flooding occurs.

*Criterion 2:* This criterion is more conservative. It results in an evacuation in 95% of the cases in which flooding will occur and an unnecessary evacuation in 5% of the cases in which no flooding occurs.

First, derive the probability distributions over the four outcomes under these two criteria. Then, by using the utility function in item 1. above, determine which criterion the agency should prefer.