

Introduction to Simulation

Assignment 9: DTMCs

We want to build a simple model of the economy. We therefore assume, that there are only three main market conditions.

- bull market (increasing investor confidence)
- bear market (transition from high investor optimism to widespread investor fear and pessimism)
- recession (widespread investor fear and pessimism)

We further assume that in any given week, one of these states is prevalent. As the market is very volatile, the situation in the current week only depends on the market situation prevalent last week. Therefore, we can assume a discrete-time Markov chain (DTMC) can represent the dynamics of the economy.

We have data for the 150 weeks from last year, how often one of the market situations was succeeded by any of the other. (e.g. how often a bull market was followed by a recession).

market in week n	market in week n+1	number		
bull market	bull market	15		
bull market	bear market	10		
bull market	recession	25		
bear market	bull market	30		
bear market	bear market	5		
bear market	recession	15		
recession	bull market	5		
recession	bear market	35		
recession	recession	10		

a) Modelling

Sketch the discrete-time Markov chain (DTMC) that can be deduced from this statistic.

b) Transient Solution

Assume that the current week is a bull week. Using the above model, **compute** the probability that two weeks from now we will also have a bull market.

c) Hidden Markov Models

Assume that the market situation has a direct influence on the type of car having the highest sales in a given week. The probability that sports cars are sold most is 0.5 in a bull market week, 0.3 in a bear market week and 0.1 in a recession week.

Assuming that the current week is a recession week, **compute** the probability that in the following week, sports cars will have the highest sales.