MTH 4600 Challenge Problem
Spring 2023

Simple Problem: An urn has 100 marbles in it; 50 are green and 50 are red (and you know this). Suppose we play the following game. You extract one marble at a time from the urn (without replacement). Each time you extract a green marble, I pay you \$1. Each time you extract a red marble, you pay me \$1. You can quit playing the game whenever you want. For example, if the first marble you choose is green, you can walk away from the game with your \$1. What is the expected value of this game to you? I have included code `Simple.cpp` that solves this problem. (Answer: 3.658141.)

Challenge Problem: In this version of the game, the urn again has 100 marbles with some green and the others red. However, the urn's composition is determined randomly in advance of play with each of the 101 possibilities

$$0 \text{ green - } 100 \text{ red}, \quad 1 \text{ green - } 99 \text{ red}, \quad \cdots \quad , \quad 99 \text{ green - } 1 \text{ red}, \quad 100 \text{ green - } 0 \text{ red}$$

equally likely. As in the first game, you know this fact. To be clear, you know how the composition of the urn is randomly selected, but you don't know the composition itself. Play proceeds as in the first game. What is the expected value of this game to you?

Hint: When there are 20 marbles with all 21 possibilities equally likely, the value of the game is 3.824359.

The first homework group to email to me the correct numerical answer to 6 decimal places and accompanying code (submitted after I confirm the result) will be excused from working a future homework project of their choice; you will be awarded 10 points for that project. Limit of 3 attempts per group.