MATH 2121 **Mathematical Modeling and Simulation** **Spring 2024**

Problem Set 2

(Out Tue 01/30/2024, Due Tue 02/06/2024)

Submissions are to be done by emailing to the course instructor: all requested Matlab files, plus a single file (PDF preferred), called `yourfamilyname_pset2.pdf` that contains all requested explanations.

Problem 2

(a) Download the Matlab file `temple_abm_random_walkers.m` from the course website
`http://math.temple.edu/~seibold/teaching/2024_2121/`
Modify the code so that 10,000 random walk runs are conducted, and plot (using Matlab's `histogram`, or `hist`) the probability distribution of the position of the bottom agent after 100 random walk steps. Explain the shape of the obtained histogram (why is not symmetric? why is it not centered around 0?). Moreover, submit your new program under the filename `yourfamilyname_problem2a.m`

(b) Now modify the code from part (a) to describe the following random walk. Three agents, starting at positions -5, 0, and 5, walk without crossing each others' paths (i.e., any step that would cause crossing is rejected). In each step, each agent walks either up (i.e., its position is increased by 1) or down (i.e., its position is decreased by 1). The bottom agent and the top agent go up or down with probabilities 0.5. The middle agent does the same if it is exactly in between the other two agents. Otherwise, it walks with probability 0.6 towards the nearer of the other two agents. Produce a histogram (using at least 10,000 random walk runs) of the position of the middle agent after 100 steps. Explain the shape of the obtained histogram, and how it results from the laws of motion of the agents. Moreover, submit your new program under the filename `yourfamilyname_problem2b.m`

(c) Write a program of a single random walker that conducts the following law. In each step, it goes up or down with probability 0.5. The step size is 1 with probability 0.95, and 21 with probability 0.05. [This process can be interpreted as two modes of travel: train and airplane.] Plot the histograms (using at least 100,000 samples) of the walker's position after: 10 steps; 40 steps; and 160 steps. Explain the qualitative differences between these three histograms. Moreover, submit your new program under the filename `yourfamilyname_problem2c.m`